**VIII ISHS SYMPOSIUM ON PROCESSING TOMATO**

DEVELOPING AN ENVIRONMENTAL MANAGEMENT SYSTEMS FRAMEWORK FOR PROCESSING TOMATOES

# Literature Review of Sustainable Agriculture to June 2001: Part B - Practical Considerations (An Australian Perspective)

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## Abstract:

***Literature dealing with the subject of the practical pursuit of sustainable agriculture is reviewed and the state of research and development into the achievement of sustainable land use systems is presented. It was found that major challenges in the areas of research methodology and a coordinated and balanced investment of effort into the components of sustainable agriculture, have yet to be addressed. The ISHS processing tomato industry publications over the years 1990-1998 are surveyed for evidence of sustainable agriculture awareness and research and the findings are discussed. A set of conclusions and a recommendation is presented.***

## INTRODUCTION

In January 2000 Unilever Australasia began a unique research initiative to identify the environmental impacts of growing processing tomatoes in Australia. As the first step in designing and implementing this Sustainable Agricultural Project (SAP), a literature review was made of the current thinking about sustainability and some of the approaches being applied in rural industries today. ***This paper is a précis of some of the practical issues associated with sustainable agriculture as presented in a formal (150 page) literature review report submitted to Unilever Australasia and Horticulture Australia Ltd, the research partnership that funded SAP. McMaster et al 2002 describes some of the theoretical issues.***

Associated with this review was an effort to determine the work in progress on environmental indicators by Australian agencies, governments, institutes, and organizations with particular reference to field monitoring at a farm level.

## MATERIALS & METHODS

The literature survey was undertaken by using the University of Adelaide library catalogue and a search of known internet web sites which embrace sustainability issues; a total of 325 references, 55.7% of which were published in the period 1998-2001, were examined, copied and evaluated and reported, supported by 35 figures and 17 tables of information. The distribution of the *number-of-papers-found* by *date-of-publication* was heavily skewed and reflected the historically recent development of- but growing interest in- research and development (R&D) into the subject of sustainable agriculture. Literature on "Sustainability" spanned a diverse array of agricultural industries and embraced several professional disciplines ranging from the bio-physical sciences, to Economics, to social sciences, to Energy and Engineering. The review concluded at the end of May 2000.

## RESULTS

Given both a recognition of the importance of using natural resources in a sustainable way and a commitment to doing so in practice, the challenge remains on how best to implement this commitment to achieve the desired result. Most policy makers at government level accept the principle of sustainability and the same is true of many of the progressive multinational companies who realise that the natural resources upon which they depend for raw product are finite in nature. Two case studies in question are those of the Australian Commonwealth Government and Unilever Australasia.

*An Australian Perspective*

The Australian Commonwealth commitment to the sustainable use of natural resources has been expressed through the efforts of various government instrumentalities including the Standing Committee of Agriculture and Resource Management (SCARM), which has categorised regional and national indicators of sustainable agriculture into four areas:

- Profitability
- Land & Water quality to sustain production
- Managerial skills
- Off-site environmental impacts (SCARM report1993)

An increasing public interest in the environment and the country's use of its natural resources led to the Standing Committee on Agriculture and Resource Management (SCARM) and its predecessor, the Standing Committee on Agriculture (SCA), initiating four sequential projects associated with the development of indicators to monitor the sustainability of agriculture in Australia (Baker J. and Sims H. 2000). In the first study (SCA, 1991) sustainable agriculture was defined as: *"the use of farming practices and systems which maintain or enhance: the economic viability of agriculture production; the natural resource base; and other ecosystems which are influenced by agricultural activities"*

The committee developed five guiding principles to assess the level of sustainability achieved by the agriculture sector:

- Farm productivity is sustained or enhanced over the long term
- Adverse impacts on the natural resource base of agricultural and associated ecosystems are ameliorated, minimised or avoided
- Residues resulting from the use of chemicals in agriculture are minimised
- The net social benefit derived from agriculture is maximised
- Farming systems are sufficiently flexible to manage risks associated with the vagaries of climate and markets.

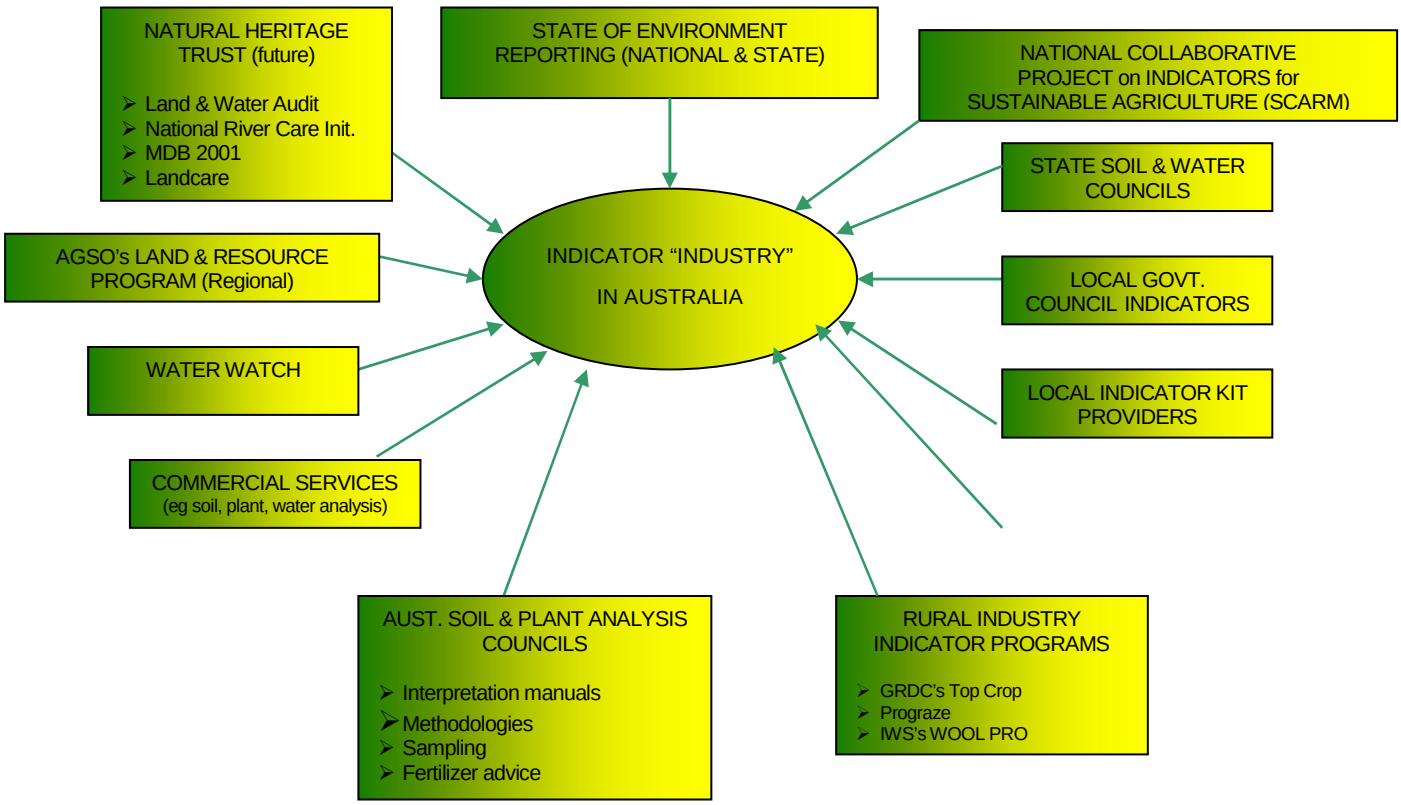


**Figure 1: The Sustainability Industry in Australia**

Over several years the widening commitment to sustainability has led to a proliferation of agencies, groups and programs, which contribute to that end (Figure 1). One of the most innovative developments has been the

undertaking of a National Land and Water Resource Audit (NLWRA) by SCARM to provide a nationwide assessment of Australia's land, vegetation and water resources now and in the future. The NLWRA aims to develop partnerships between States and Territories in the areas of data management, Capacity for Change, Ecosystem Health, Rangelands Monitoring, Agricultural-Productivity and Sustainability, Water Availability, Dryland Salinity and Vegetation (National Land and Water resources Report - Australia, 2000). The mission of the NLWRA is to provide a nationwide assessment of Australia's land, vegetation and water resources to support sustainable development now and in the future (National Land and Water resources Audit, Commonwealth of Australia 1998). The audit should meet natural resource management needs in the following areas:

- Policy assessment and development
- Investment decisions;
- Evaluation of program and policy performance; and
- Direct resource management, particularly by government.

The intricate and interconnected complexities of the socio-economic and ecological systems affected by land-use activities is becoming increasingly clear (Hamblin A. 1998; Winpenny J.T. 1995) and illustrates that the challenge to achieve sustainable land use systems is one that requires an interdisciplinary "systems" approach. The leadership provided by SCARM is now filtering down to other levels of government (Duncombe-Wall D. et. al. 1999).

The Standing Committee of Agriculture in Australia has outlined the following principles (goals) of sustainable agriculture (RIRDC [Australia] 1997):

- Farm productivity is enhanced over the long term
- Adverse effects on the natural resource base and associated ecosystems are ameliorated, minimised or avoided
- Residues resulting from the use of chemicals in agriculture are minimised and
- Farming systems are sufficiently flexible to manage risks associated with the vagaries of climate and markets.

One of the key questions is whether or not it is possible to measure if agriculture is sustainable, and if so, how? The response has been to monitor one or more environmental variables (indicators), which reflect an aspect of the environment of concern to the investigator

*What is an indicator?*

In simple terms they are indicative measures or "indicators" which provide objective information to help decision-makers and they may include social, bio-physical (environmental) and economic measures.

Environmental indicators help track changes in the environment by selecting key measures that provide useful information about the whole system. Using indicators it is possible to evaluate the fundamental condition of the environment without having to capture the full complexity of the system (ANZECC [Australia] 2000). Indicators are based on the best scientific understanding currently available so that changes in these simple measures can be related to more complete environmental trends. When a time series data for an indicator show a trend, then there is a need for some interpretation of the trend and its implications. Therefore an indicator must be backed by a sound theoretical framework so that accurate interpretations can be made.

Alexandra et al (Alexandra J. et. al. 1998) use the acronym S.M.A.R.T. when choosing an indicator, which stands for **S**imple, **M**easurable, **A**chievable, **R**elevant and **T**imely; they then classify some 17 qualities desired in an indicator under the headings of the acronym.

*Evaluating Indicator Values*

In themselves, indicators give no indication of the condition or trend of an environment. They must be compared with predetermined reference values before a judgement can be made on the condition or the trend in the environment. Walker & Reuter (Walker J and Reuter D.J., 1996) point out that three types of reference values may be used to evaluate the indicators values:

- Historical levels (pre-farming disturbance)

- Desired levels (set by catchment care groups)
- Potential levels and threshold levels (set by biophysical constraints, or from tables compiled from research measurement).

Generally the last type would be the most rigorous reference value set since they are based on detailed measurement. Unfortunately this type of evaluation is often ruled out because the information relating to potential levels and threshold values is not available – then the second type of evaluation, which compares indicator values with desired levels, is used. The determination (setting) of "threshold" values for environmental indicators is an important R&D exercise in its' own right, and literature suggests this has yet to be addressed - it is an exercise that requires a clear consensus and accepted convention if there is to be a collective building of information about the sustainability of environmental management. It may be argued that thresholds need to be set at a farm-site level first and then only in the context of a holistic approach to that local environment.

*Unilever and Sustainable Food Production Systems*

As a global food company, Unilever's commitment to sustainable agriculture is motivated by the fact that agriculture provides two thirds of its raw materials and agriculture is under increasing environmental pressures world wide. (*Unilever Sustainable Agricultural Reference Manual*, 2000).

Since the mid-1990's, Unilever has been consulting with experts and engaging with suppliers, customers, consumers and business partners around the world to find a sustainable way forward for agriculture. This has led to the development of the Unilever Sustainable Agriculture initiative.

Unilever supports the view that Sustainable Development requires alignment of economic growth, environment protection and social progress. After taking a worldwide consultation they have arrived at the following definition of Sustainable agriculture :

*Sustainable agriculture is productive, competitive and efficient while at the same time protecting and improving the natural environment and conditions of the local communities.*

Unilever's approach to sustainable development is to support the following principles:

- Producing crops with high yield and nutritional quality to meet existing and future needs, while keeping resource inputs as low as possible.
- Ensuring that any adverse effects on soil fertility, water and air quality and biodiversity from agricultural activities are minimised and positive contributions are made where possible.
- Optimising the use of renewable resources while minimising the use of non-renewable resources.
- Sustainable agriculture should enable local communities to protect and improve their well-being and environments.

Unilever intends to propose, discuss and agree to a set of indicators for Sustainable agriculture, with a range of relevant stakeholders, to measure and improve performance of agricultural systems in order to continuously add greater value to the partners and businesses in their supply chains and brands. They will support and stimulate general agreement on application of superior practises through partnerships and/or independent certification of supply chains. This will be embedded in their general efforts towards free market place pricing for all inputs and outputs. In this way they will deliver against their stated purpose*: to add continuously to the quality of life of their (our) consumers.*

As a result of research to date, Unilever has identified 10 Indicator clusters which collectively embrace the different components of a holistic approach to Sustainable Agriculture; the sustainable agriculture clusters (Unilever Ltd. 2000) are: (1) Soil fertility/health (2) Soil loss (3) Nutrients (4) Pest management (5) Biodiversity (6) Product value (7) Energy (8) Water (9) Social/human capital (10) Local economy. In themselves, the ten Unilever clusters of sustainability indicators appear to provide a pragmatic sectoring of the environmental issues to collectively offer a holistic framework to monitor the state of the environment for agriculturally based food producers and processors.

*Qualifying Remarks*

At the outset this review sought to identify the scientific conventions for measuring sustainability indicators and variables at the farm site level of investigation so that those same conventions could be applied to the Australian Sustainability Project for processing tomatoes in Northern Victoria and Southern New South Wales. The intent was to ensure that the methodology of monitoring environmental indices in processing tomato crops complied with existing protocols and so the integrity of data would be sound and found acceptable within the R&D "industry". Unfortunately while literature showed that almost every environmental variable that could be measured has been measured where the bio-physical aspects of agriculturally based food production systems are concerned, such measurements are mainly the result of various independent and usually uncoordinated investigations of discrete aspects of an environmental system, rather than an attempt to understand the system as a whole.

What the literature review did show is that conventions for selecting and measuring sustainability indicators do not exist in any formal sense within the R&D or scientific community either in Australia or elsewhere. Moreover, literature reports that a plethora of environmental indices have been investigated within each indicator cluster nominated by Unilever and neither variable subsets within a cluster group nor methods for measuring them are subject to any convention for research purposes; there is no evidence of a consensus on how to measure environmental indicators at a farm-site level as part of a holistic investigation of the farm environment.

Within Australia, conventions & interests seem to vary between states and most of the interest in Sustainable Agriculture is still at a regional and policy level – what might be described a "Top-Down" approach; while this is both reasonable & understandable, given the embryonic stage of development of the whole concept of sustainability and its application to environmental management, it has not been helpful to the immediate needs of this Sustainable Processing Tomato Project – which might be described as a "Bottom-up" or "Grass Roots" approach.

It will also be appreciated by the reader that while each cluster addresses an aspect of the environmental challenge for sustainable land use and the growing of processing tomatoes, there are active interrelationships within- and between-each cluster and its constituent indicators (Stirzaker R. 1996; Stirzaker R.J. 1997; Martens D.A. 1992; Jackson L.E. 1990;,Emmerson W.W.et.al 1994; Gianinazzi S. [Ed.] 1994; Greenland D.J.[ Ed.] 1994; Olson R. et.al [Ed. ] 1995; Stirzaker R.J.1997; Rural Research 1995/96).

When considering some of the detail of cluster indicators, it is helpful to remember that the notion of "sustainable levels" can be applied to each cluster group of indicators where environment management is concerned. e.g., when considering plant nutrients, the goal for sustainable management must be to develop and apply optimum management practices that supply appropriate amounts of all essential nutrients at the optimum time to produce, say, processing tomatoes, while balancing inputs with outputs so that excess accumulations are not transferred to non-target locations such as surface or groundwater resources or are wasteful of natural and economic resources within the farming enterprise (Hatfield J.L. [Ed. ], 1994).

*Sustainability and the Processing Tomato Industry*

In order to assess the state of awareness of sustainable agriculture within the processing tomato industry, an informal survey of research papers presented at recent international symposia ISHS symposia (1990-1998) on tomato processing was made to provide insight into the technical concerns and priorities of the industry. The Papers were classified according to the way their subject matter related to the 10 Indicator Clusters identified by Unilever (a paper may relate to several clusters) and showed significant gaps in the R&D spectrum where sustainability issues were concerned.

Within the context of this discussion about sustainable land use systems, some general comments on the basis of the above survey and the content of papers presented in previous ISHS symposia are as follows:

- In terms of crop management - crop growth, general tomato physiology and agronomy is well understood and conforms to general principles established for other vegetable crops. The sustainability of conventional yield and fruit quality "targets" does not seem to be considered,
- The lack of papers addressing the issues of soil fertility/Health and soil loss suggests an ignorance of the challenge of finding a sustainable production system for processing tomatoes and conversely the environmental problems inherent in current management and cropping systems,

- Nutrition - the sole focus of nutrition is apparently yield and fruit quality. Environmental side effects of nutrient programs such as nutrient balances, do not seem to be considered,
- Pest Management - there seems to be a disproportionate lack of papers in this section given it's importance to the environment and the safety of the (processed) food product. The only paper which directly touched on sustainability occurred in this section,
- Biodiversity - the absence of papers addressing this component of sustainability suggests an ignorance within the general industry about sustainability issues,
- Fruit Quality – fruit quality is considered in isolation of its' sustainability or the environment issues impacted by quality-driven production practices,
- Energy - the notion of energy efficiency as an evaluation tool or a consideration in the input mix embraced by processing tomato culture may not be understood. The influence of the energy sources used in tomato production upon the environment is not currently an agenda item for the industry at an international level,
- Water Management - the influence of irrigation upon cropping and fruit quality is well understood and accepted although groundwater impacts do not seem to be considered. The large number of reports in this section is possibly a reflection of the economic power of this management tool upon grower economic returns and profitability,
- Social/Human Capital - the "people-factor" of non-sustainability appears yet to formally register with industry membership. Is the market place a starting point to stimulate attention to this component of the sustainability "equation"?
- Local Economy - the cost of environment degradation (non-sustainability) is yet to be understood by the industry internationally. The tomato processors may be best placed to have a leadership role in the quest for sustainability since the problems come to focus in their value-adding role.

## CONCLUSIONS

A survey of literature on the subject of sustainability showed that:

- Because of the interwoven complexity and inter-dependence of the environment internationally, a coordinated approach to achieving the sustainable use of natural resources is needed across geo-political boundaries; within Australia, national entities such as Standing Committee of Agriculture and Resource Management (SCARM) and the Commonwealth Scientific and Industrial Research Organization (CSIRO) and the Commonwealth government department known as Environment Australia, are well placed to coordinate sustainability research and have begun to do so, and,
- Most of the current effort into sustainability addresses the bio-physical aspects of the environment - probably because of the presence of a pre-established infrastructure for that purpose which has traditionally focussed on primary production (agriculture) in Australia and elsewhere, and the relative ease with which this dimension of environmental sustainability may be examined.

An informal survey of research papers presented at recent international symposia on tomato processing was made to provide insight into the technical concerns and priorities of the industry and indicated:

- The technical concerns and priorities of the tomato processing industry are traditionally in the areas of (in descending order R&D investment as indicated by the number of papers presented) fruit quality, water management, general crop management and nutrition,
- Current industry awareness of sustainability issues is historically limited as reflected in the absence of papers in the subject areas of Biodiversity, Energy, Soil fertility/health, and Soil Loss,
- R&D in the tomato processing industry appears to be production- and fruit quality- driven, since most effort seems to be devoted to those issues which have a direct effect upon either yield or fruit quality; the sustainability of the commonly accepted commercial yield- and quality- "targets" envisioned or pursued by industry has yet to be questioned or considered,
- Formal conventions for measuring the different biophysical aspects of the tomato-processing environment have yet to be agreed upon and a diversity of methodologies are in use.

In the context of sustainable tomato processing production, the classification of the number International symposia papers according to the Unilever sustainability cluster groups suggests an imbalance in the focus of research. If it is assumed that the current balance in research is directed to assist growers on the basis of the price incentives processors offer to growers (eg, if prices are paid on the total soluble solids/hectare), then a change in the price incentives offered to growers might result in a change in the focus of research. The challenge might then be to find incentives for processors to pay growers according to pre-set sustainability criteria (eg. prices are "weighted" for, say, pesticide residue levels in fruit, environmental damage avoidance etc).

## RECOMMENDATIONS

As a consequence of the findings of this review it is recommended that the Tomato Processing industry be invited to convene a working party of key stakeholders to address the challenge of sustainability-education, environmental audit protocols, and market incentive options for growing fresh product more sustainably.

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