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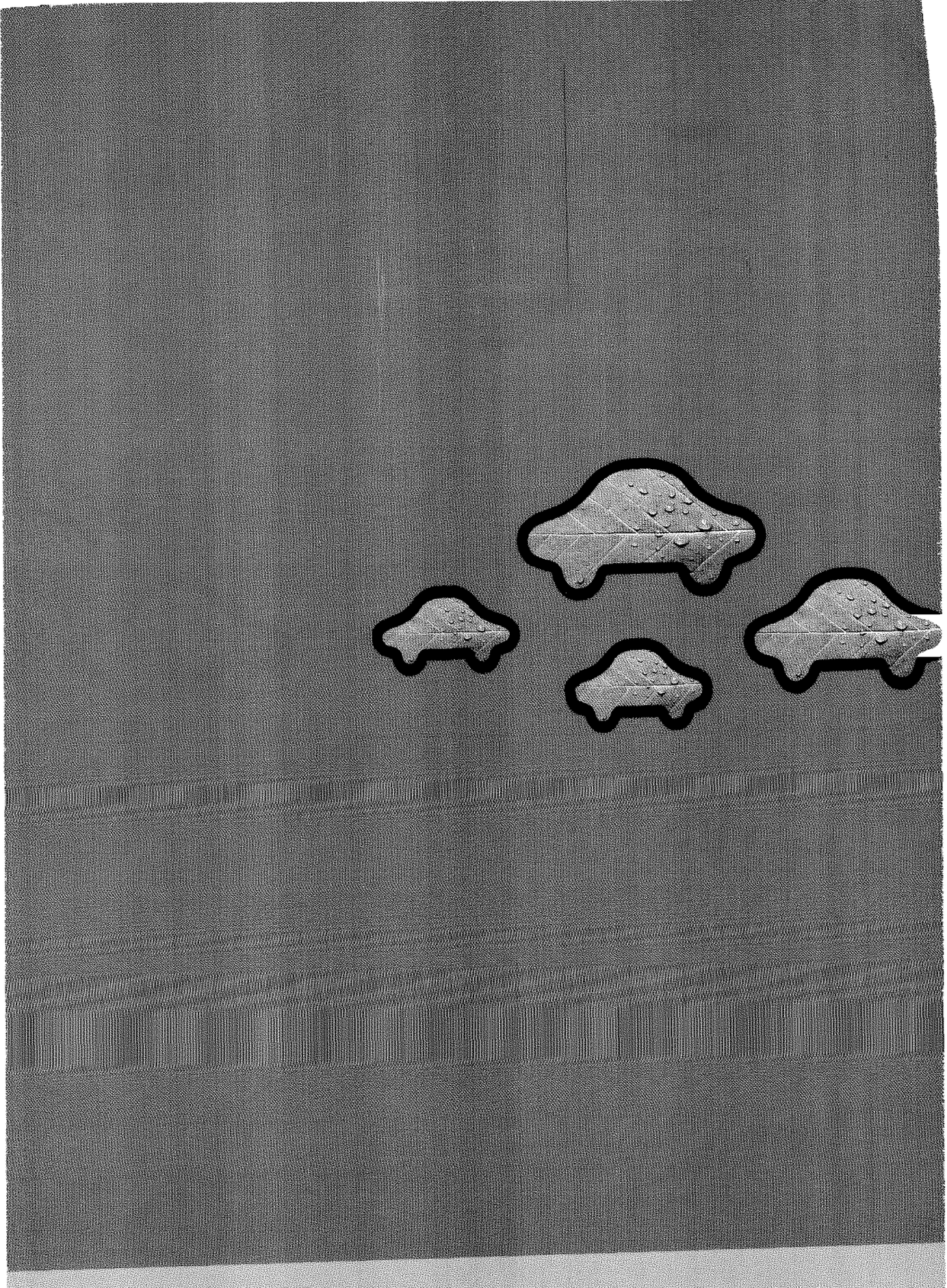

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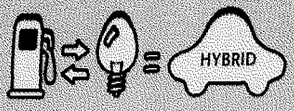

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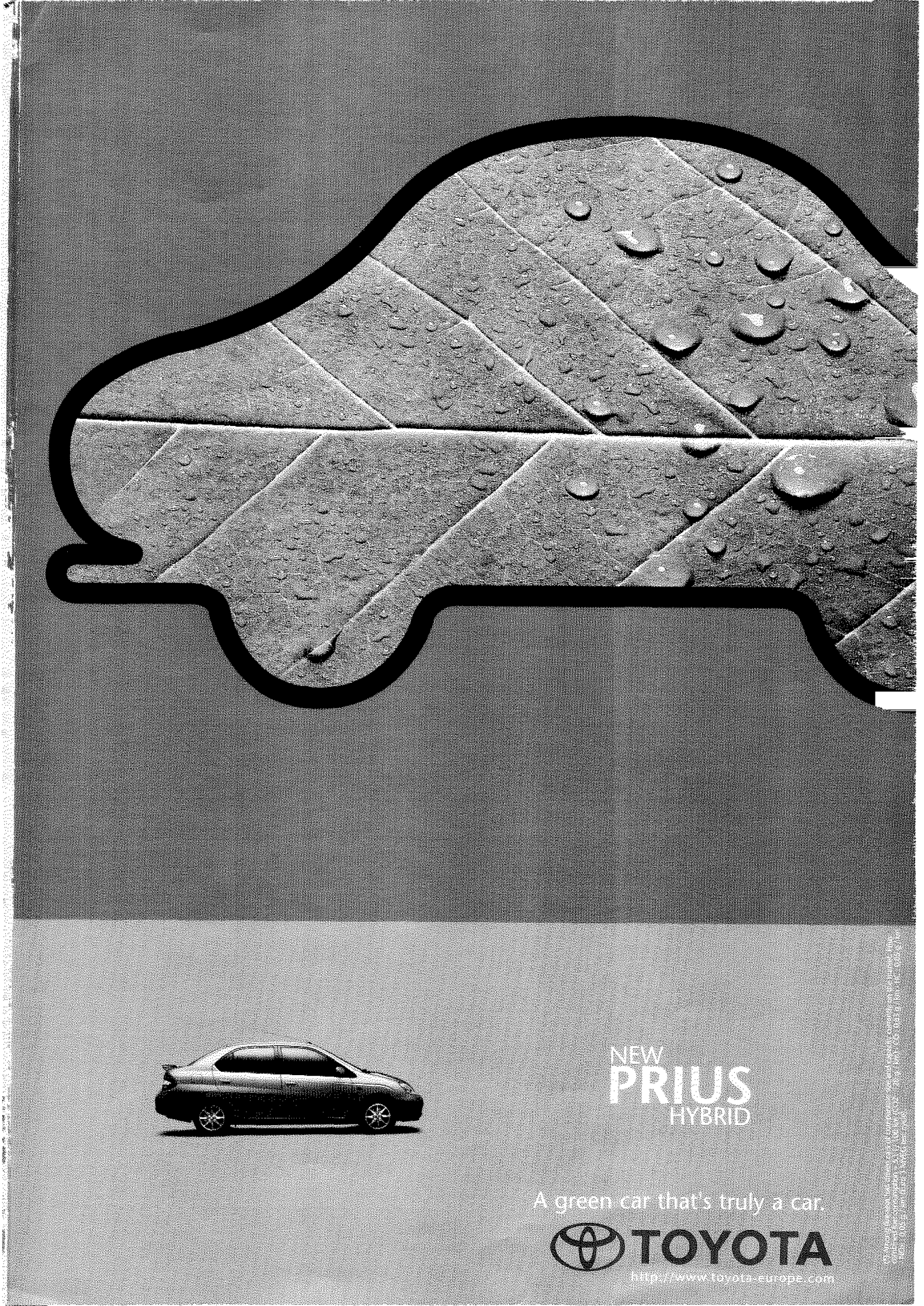
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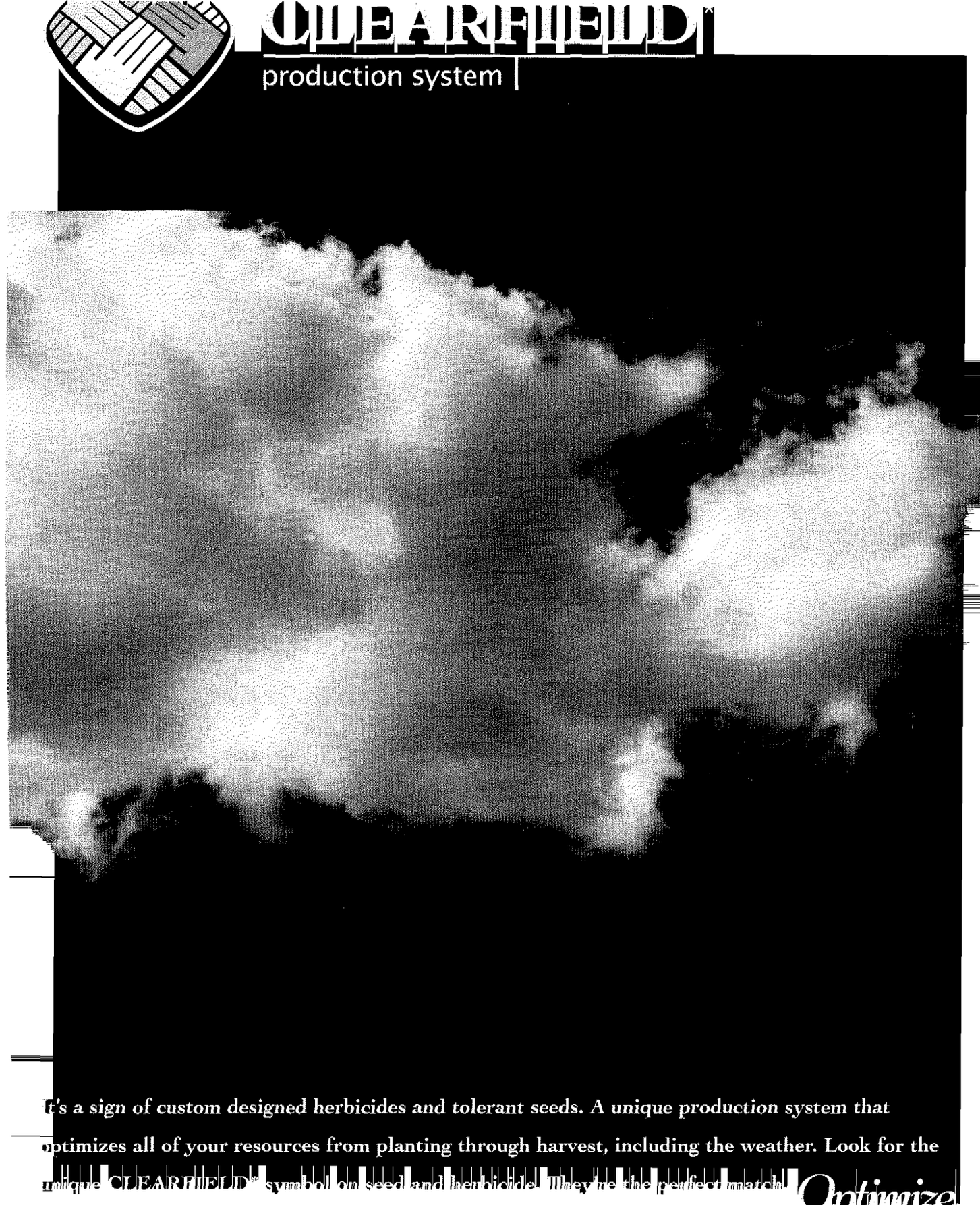

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CONTENTS

Introduction

Welcome to the third edition of Sustainable Development International. After the resounding success of edition 2, technical, strategic and commercial information continues to flow through this edition to facilitate the decision-making processes for major groups. Transport has been defined as a section within the journal as we continue to educate the readership by providing showcases for strategies and technologies for local-global Agenda 21 implementation.

Linking business, labour and civil society organisations together is an essential aim and integral to the development of the journal. Sustainable Development International believes that the commercial companies profiled in the journal are essential in contributing to solving problems in a sustainable manner. Businesses are solution providers to the question of implementation and vital in the development of a global coalition.

Edition 4 will primarily focus on Energy and Transport, the core themes for CSD 9 and Sustain 2001, where the journal will be present. In addition to this we will include articles discussing climate change and all aspects for the decision-making process. We will expand the editorial to incorporate an enhanced overview of all the issues pertaining to sustainable development.

We have also re-launched our web site. Daily news stories appear on the home page and case studies along with previous articles can now be found sectionalised under each topic heading. With the ever advancing globalisation of the Internet, it is not only the printed journal that reaches the key decision makers. The continued growth of the web enables users to access specific resource areas and research information required for solutions into sustainable development. For more information about the web site please view http://www.sustainabledevelopmentinternational.com

In conjunction with SDI we publish two sister journals, Integrated Coastal Zone Management and Sustainable Travel and Tourism. Through all three journals ICG Publishing is exploring a wider perspective and presenting a more expansive and instrumental roadmap to what is being developed and discussed at Earth Summit 2002.

I would like to thank all of the authors who have contributed to SDI for the very high standard of articles. I would also like to thank UNED for their contribution and advice on the journal and the database contacts. I hope that you find the journal both educational and enjoyable and if you would like to contribute to the next edition or have any comments, whether good or bad, please contact me on the e-mail address below.

Anna Pink
Editor
apink@icgpublishing.com
Sandra Clout
Divisional Manager

SUSTAINABLE DEVELOPMENT INTERNATIONAL

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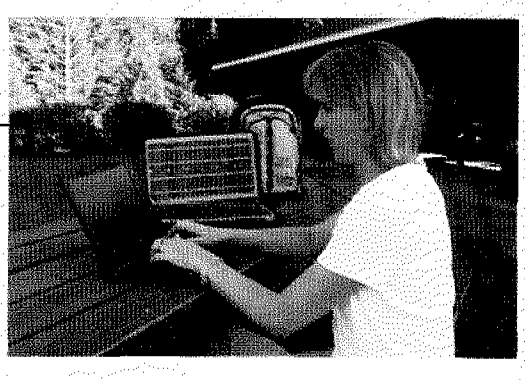

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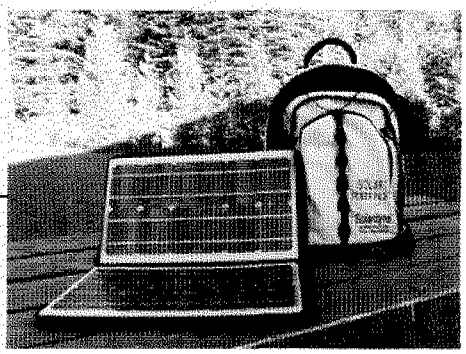

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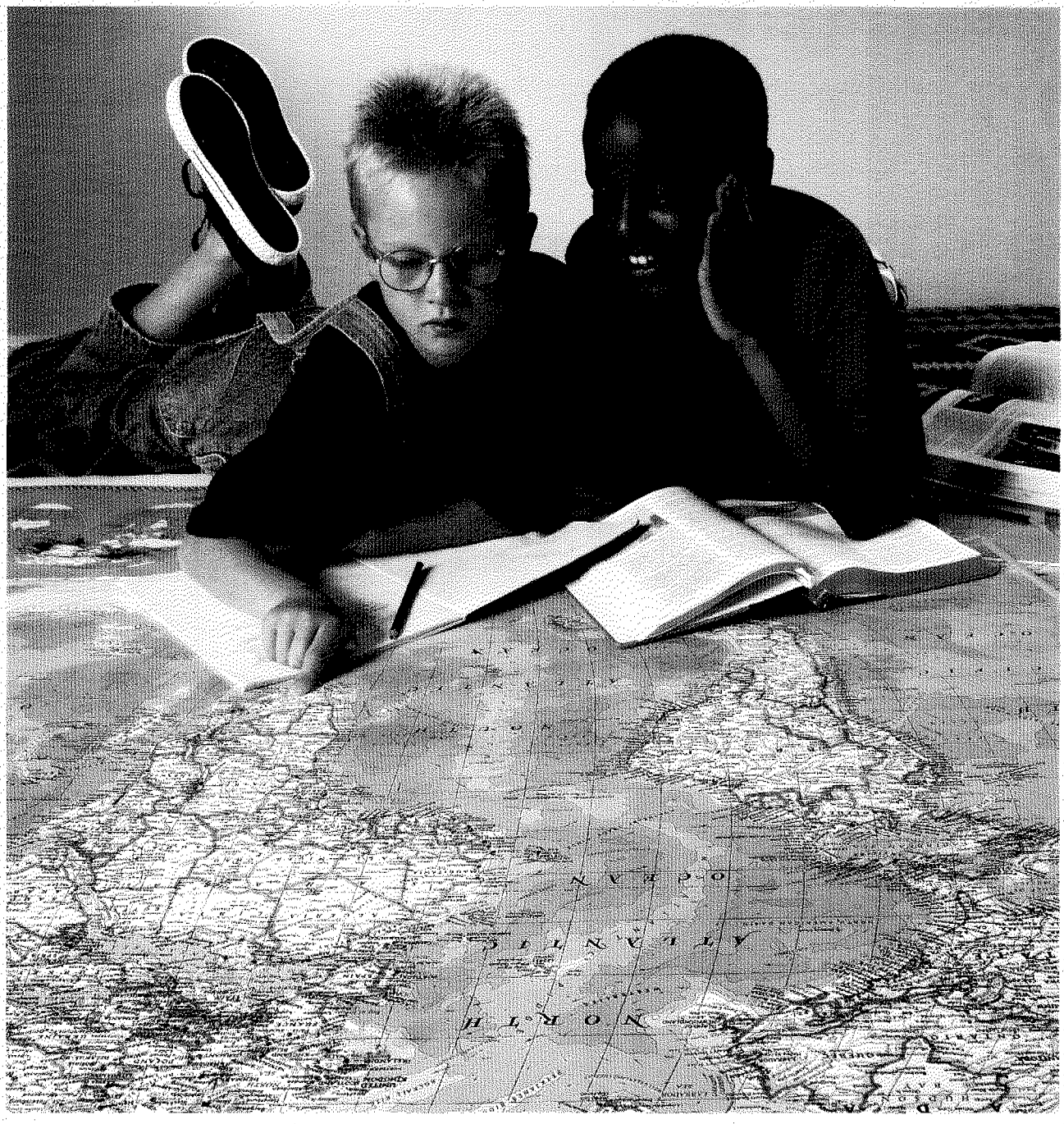

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An Invitation to the Global Compact

THE SECRETARY-GENERAL
THE UN GLOBAL COMPACT

New York, 26 July 2000

Together, we are making a bit of history.

Never before have so many global leaders from the worlds of business, labour and civil society come together at the United Nations to forge a new coalition in support of universal values.

I proposed the Global Compact as one step towards reaching those goals. The Compact is based on nine key principles drawn from the Universal Declaration of Human Rights, the International Labour Organisation's fundamental principles on rights at work, and the Rio Principles on environment and development.

I applaud the corporate leaders who signal that they are ready to embrace the Compact, and translate its principles into corporate practice, demonstrating leadership and exercising responsibility that come with the role they play in the global economy.

I also applaud the leaders of labour and civil society organisations in our partnership. Your participation does not mean that you have abandoned the particular cause you were set up to champion. But it means that you have decided to place that cause in a broader context, because it is more likely to flourish in a freer, more prosperous world.

Some may say that business should stick to business, and leave wider concerns to government. Certainly it is true that neither corporations nor voluntary groups can take over the indispensable role of the State.

Indeed, Governments have given us the principles that we are endeavouring to turn into concrete practices – in each instance after lengthy and sometimes difficult negotiations.

But we cannot wait for governments to do it all. Globalisation operates on Internet time. And you, in business, labour and civil society organisations, have skills and resources that are vital in helping to build a more robust global community.

Our business partners have agreed that they will do three things:

- They will become public advocates for the Compact in their corporate mission statements, annual reports and similar venues.
- At least once a year they will post on our website specific examples of progress they have made, or lessons they have learned, in putting the principles into practice in their own corporate domains.
- And they will join with the United Nations in partnership projects, either at the policy level – for instance, a dialogue on the role of corporations in zones of conflict – or at the operational level, such as helping African or South Asian villagers link up to the Internet, or strengthening small and medium-sized firms in developing countries.

The result is that we have a new global coalition, linking together enlightened leaders from business, labour, and civil society organisations.

Firstly, I hope we can send out a clarion call for others to join us. We need to gain a critical mass among leading companies, and in their supply chains, so that the Compact can truly be called Global.

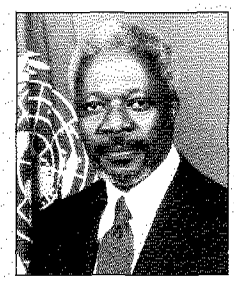
- Business leaders can persuade their peers to follow suit.
- Business associations can inform their members.
- Labour unions can mobilise the workforce – for after all, companies are not composed only of their executives.
- And civil society organisations can campaign publicly – as only they know how! – to create the dynamic context in which our objectives will flourish.

Secondly, I hope we can establish the Compact itself as a forum for dialogue between the three partners – devising common solutions to common problems.

Thirdly, and most important, we must decide on priorities, and devise mechanisms for translating our good intentions into actions that make a real difference to people's lives.

There is no shortage of good ideas about what to do. The real challenge is getting it done. Rest assured that I personally intend to remain fully engaged. And I am ready to establish a Global Compact Office, to co-ordinate the support you will get from different partners within the United Nations system. Journals and internet sites like SDI provide valuable information in the form of case studies that illustrate, through the partnerships between business/industry, labour and civil society organisations, the implementation of sustainable solutions. May these provide inspiration for further projects.

Kofi A. Annan
Secretary General for the United Nations



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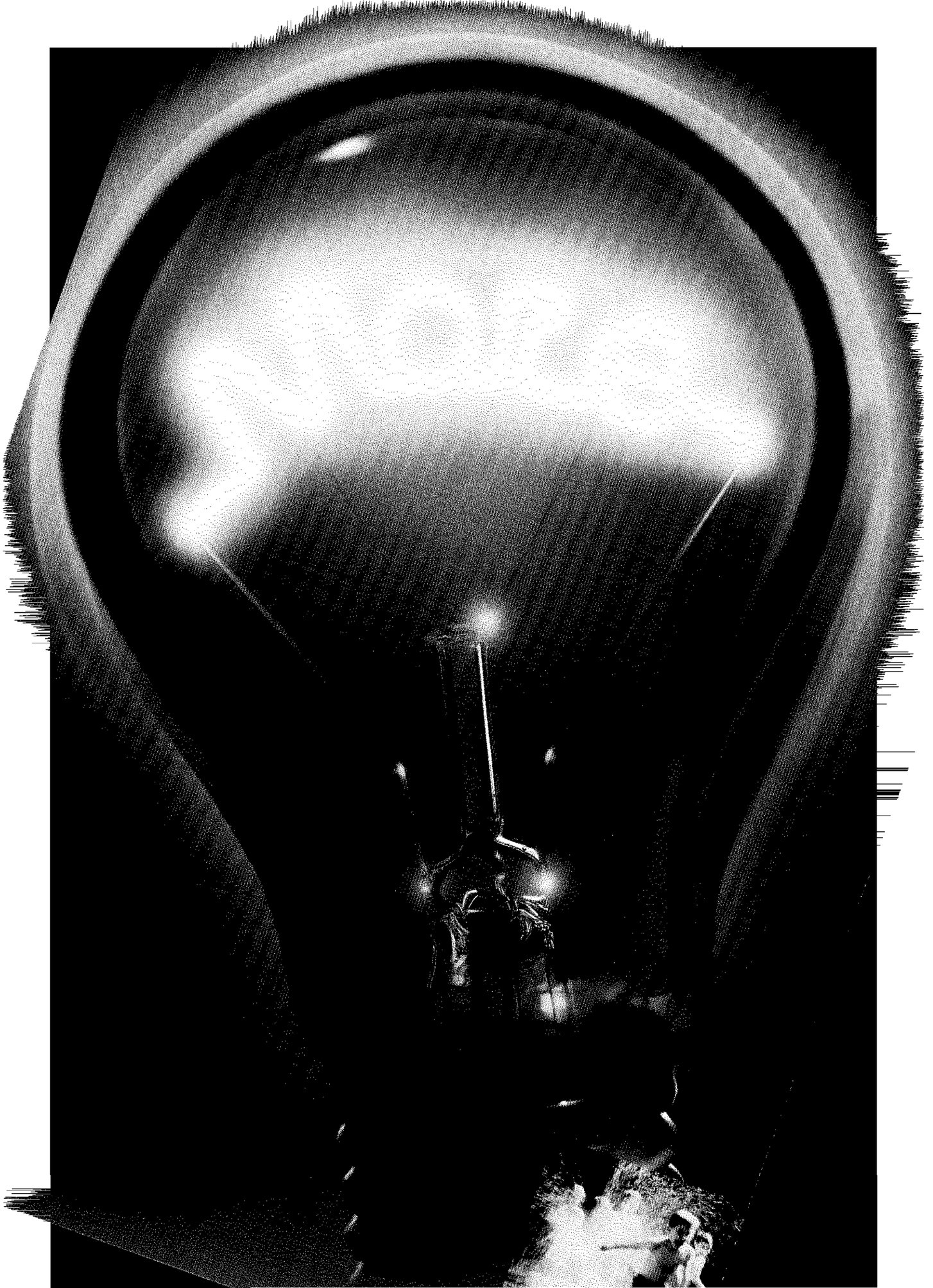

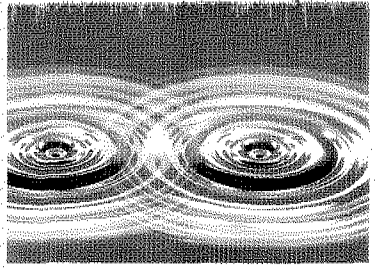

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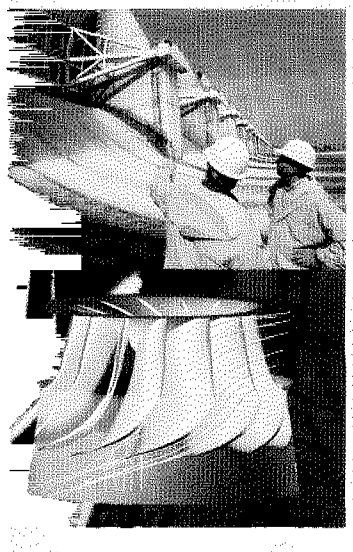

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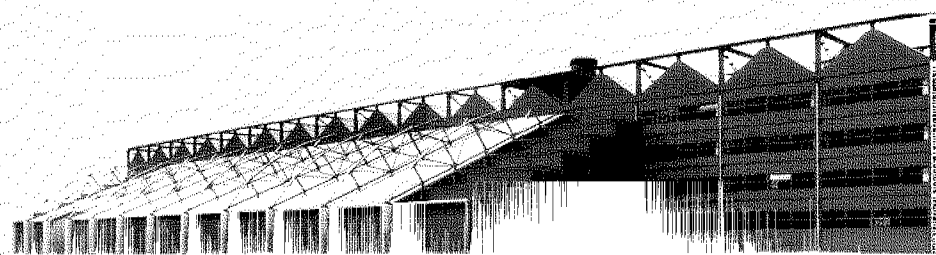
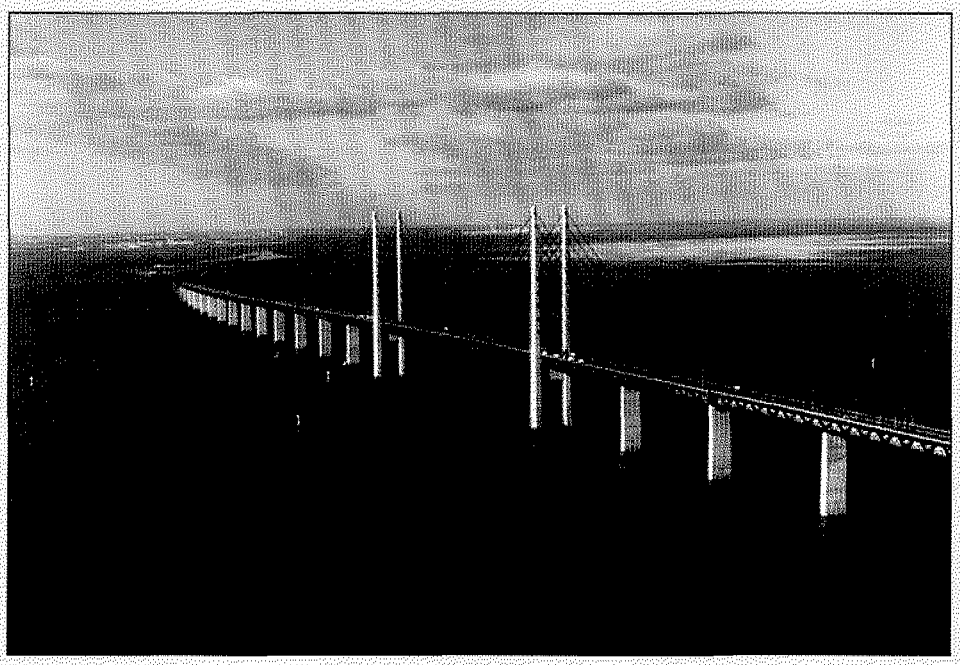


SECTION 1

GLOBAL ISSUES



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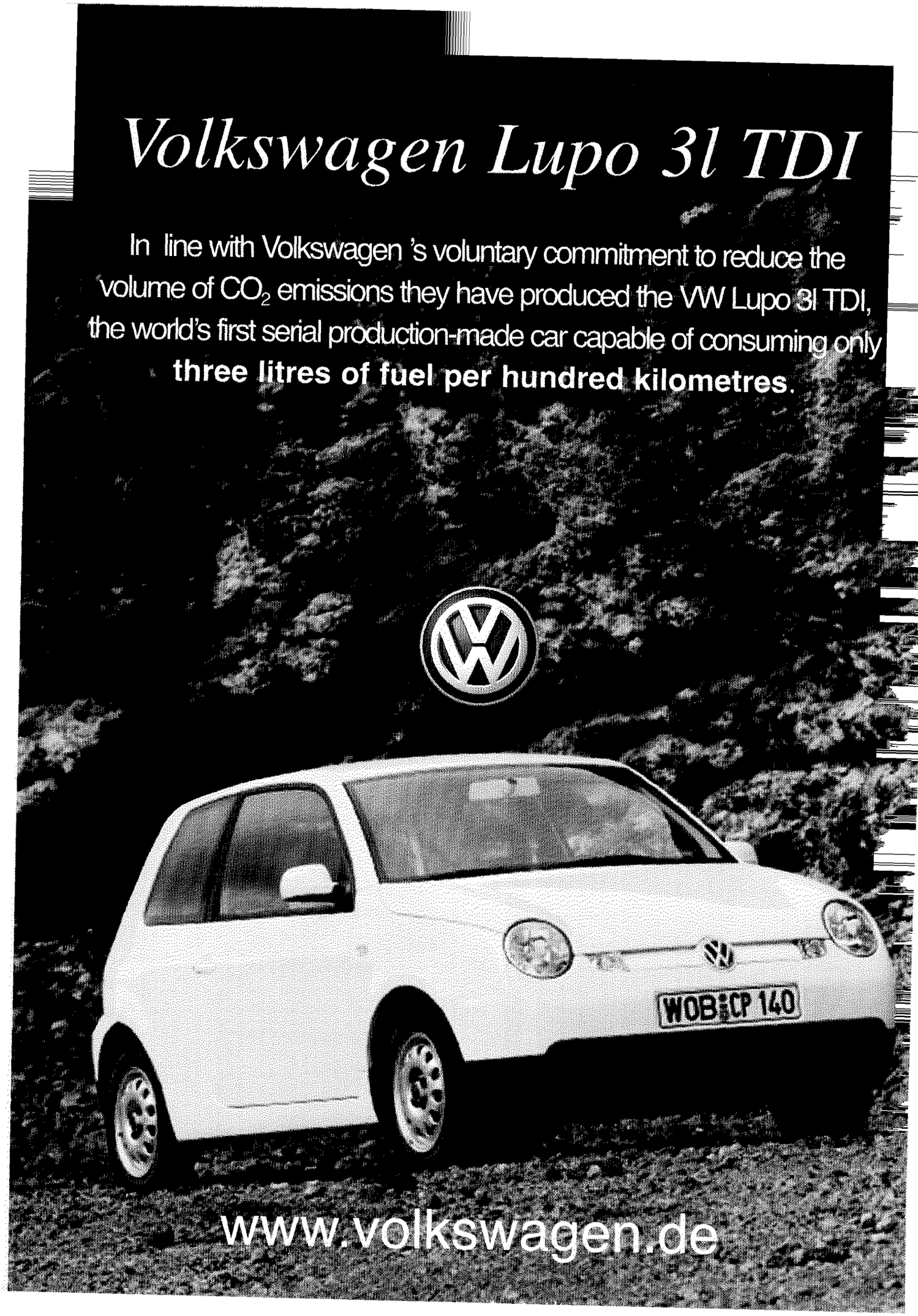

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Helping Boards Change Course

John Elkington, Virginia Terry & Peter Zollinger,[1] *SustainAbility, London & New York,*

Abstract

As the 20th century drew to an end, sustainable development (SD) began to 'come in from the cold'. A concept once dismissed as semi-seditious by many business leaders was increasingly recognised as a core challenge for governments and for globalising capitalism. As a result, the coming years will see a growing focus on the roles of chief executive officers (CEOs), chief financial officers (CFOs), boards and the financial markets they try to satisfy in the sustainability transition. But is the SD community paying enough attention to these trends? We think not. This short paper spotlights the evolving triple bottom line (TBL) agenda for corporations and their boards, and considers how the SD community can help ease the process for business leaders.

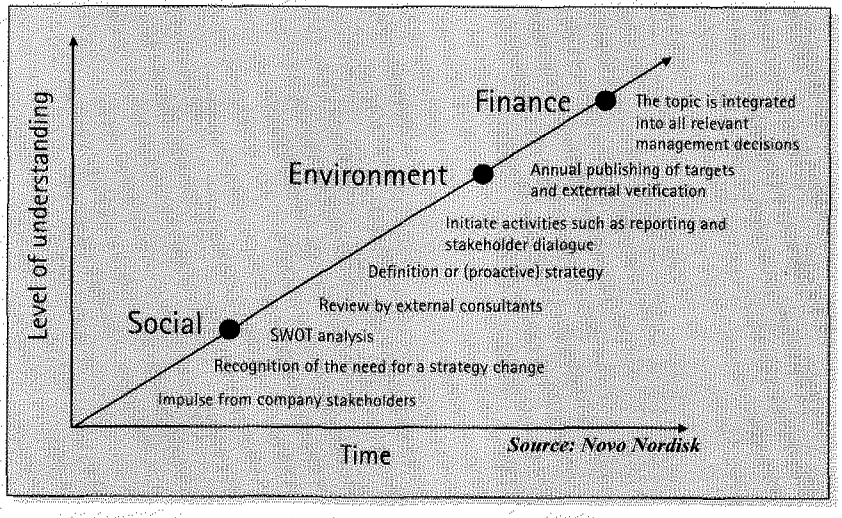

Figure 1
The road to triple bottom line accounting

INTRODUCTION

In the simplest terms, the triple bottom line (TBL) agenda focuses corporations not just on the economic value they add, but also on the environmental and social value they add – or destroy.[2] Work undertaken by SustainAbility for the United Nations Environment Programme (UNEP) suggests that board-level awareness is growing, with 28% of CEO forewords to corporate environmental reports in a recent international survey mentioning SD and 11% of the CEOs beginning to address the TBL agenda.[3]

That said, what follows is less an academic paper than a manifesto. It accepts the analysis of pessimistic observers like David Korten, who argue that corporations are better placed to take over the world than they are to run it sustainably once in control.[4] But it also underscores the growing – and necessary – convergence between the SD and corporate governance agendas, raising a number of research questions that must be tackled in the first decade of the 21st century. It calls for business leaders to join the push for improved systems of global governance. And it ends by sketching out some related research areas for the next 2–3 years.

WHAT'S THE LINK WITH CORPORATE GOVERNANCE?

Figure 1 shows one perspective, from Lise Kingo of Denmark's Novo Nordisk A/S, on where the TBL agenda is in a company that has been a leader in developing accountability, auditing and reporting practices in this field. The process often starts, as it did with Novo Nordisk in the late 1980s, with an external shock to the system, following which each element of the TBL agenda evolves towards board-level scrutiny and management.

In the past, there has been much discussion about whether successful corporate transformations are driven 'top down' or 'bottom up'. It is a central assumption in

1. The authors are members of the SustainAbility core team, based in London and New York (web-site: www.sustainability.co.uk). John Elkington is Chairman, Virginia Terry a Director (currently setting up SustainAbility Inc's New York offices', and Peter Zollinger a Director heads the TRIMARAN programme, on corporate governance.
2. John Elkington, *Cannibals With Forks: The Triple Bottom Line of 21st Century Business*, Capstone Publishing, Oxford, UK, 1997; New Society Press, British Columbia, Canada, and Connecticut, USA, 1998.
3. SustainAbility for UNEP, *The CEO Agenda: Can Business Leaders Satisfy the Triple Bottom Line?*, Engaging Stakeholders 1998.
4. David Korten, *When Corporations Rule the World*, Berrett-Koehler Publishers and Kumarian Press, 1995.

our work that transformation in any area, in any company, is not a case of either/or but of both/and.

So why are CEOs and the boards of major corporations getting involved with the SD agenda? Surely the 'CEO agenda' is focused on more important things, like top management organisation, corporate portfolio strategy, corporate finance, mergers and acquisitions, shareholder relations, corporate governance, government relations and risk management?[5] The answer, of course, is that TBL concerns and priorities are now cutting across all of these areas of top management interest and responsibility.

Yet it is clear from our work with UNEP that most CEOs and other business leaders, even in 'switched-on' corporations, are not yet properly addressing even the dimension of environmental value added, let alone the wider social and ethical dimensions.[6] There is an urgent need for further evolution in accounting methods to embrace all three dimensions of the TBL agenda for business and markets.[7]

Table 1. TBL Agenda Moves from Factory Fence to Boardroom

70s	70s to 80s	Late 80s	Late 80s
PR managers	Environment managers	Marketers	CEOs
Lawyers		Product designers	Board members
	Planners	New product development specialists	CFOs
	Project managers		Investor relations specialists
	Process designers		Strategists

Source: SustainAbility

During a stakeholder dialogue session in Brussels organised by SustainAbility for Monsanto some years back, the conversation kept turning to the issue of corporate governance. At the end the day, startled, one Monsanto executive asked: 'What's corporate governance got to do with environmentalists?' Our answer is summed up in what follows, but it was reinforced a few weeks after the question was asked – when *The Wall Street Journal* announced that Monsanto, like ICI, Hoechst and a number of other major chemical corporations before it, had decided to break up its business into separate chemicals and life sciences corporations.

We are still at the stage where business leaders and their companies see SD as an option, rather than a necessary condition of market success. Where companies adopt SD policies and strategies, such initiatives remain highly vulnerable to changes at the top. When Dutch bank Rabobank International dedicated its centenary conference in 1998 to sustainability, for example, much of the drive came from Herman Wijffels, then the chairman of Rabobank Nederland.[8] Not long after, he left the company and it will be interesting to see how the new management respond to the same threats and opportunities. History shows that the enthusiasms of the last CEO or chairman tend to be rejected by the new, although Rabobank has so far stuck with the SD agenda.

Indeed, it is clear that a growing proportion of corporate sustainability issues revolve not just around process and product design but also around the design of corporations and their value chains, of 'business ecosystems' and, ultimately, of markets. Experience suggests that the best way to ensure that a given corporation fully addresses the TBL agenda is to build the relevant requirements into its corporate DNA from the very outset – and into the parameters of the markets it seeks to serve.

FROM FACTORY FENCE TO BOARDROOM

Clearly, we are still a long way from reaching this objective, but considerable progress has been made in recent decades. The centre of gravity of the sustainable business debate is in the process of shifting from public relations to competitive advantage and corporate governance – and, in the process, from factory fence to the boardroom (Table 1).

Traditionally, corporate governance has focused on the ways in which organisations, particularly limited companies and corporations, are managed, and on the nature of the accountability of managers to owners. The 1990s, however, saw a steady expansion of the agenda, from the 'exclusive' forms of corporate governance (largely focused on shareholders and financial markets) to more 'inclusive' forms, based on extensive stakeholder dialogue.

The UK has recently emerged as something of a laboratory of new forms of corporate governance. Among recent inquiries in the UK alone have been those resulting in the Cadbury, Greenbury, Hampel and 'Tomorrow's Company' reports. The financial markets and many traditionally-minded executives will probably continue to resist the expansion of the corporate governance agenda to cover wider stakeholder accountabilities, but this expansion now seems not only necessary but also inevitable.

Individual CEOs or top executives often play a critical role in the awakening of their own corporations to emerging TBL responsibilities and imperatives. But what happens when they move on? At the moment, the answer is that things can sometimes begin to unravel. The recent experience of the SD activities at Canada's Ontario Hydro after the departure of chairman Maurice Strong showed just how vulnerable such programmes can be to top management changes. There is a growing need to institutionalise and 'mainstream' the relevant priorities, systems and methodologies in such corporations.

The role of boards in this process will be fundamentally important. Longer term, however, the markets will increasingly require sound TBL performance. As a result, the role of CEOs and boards will switch from steering debates about whether to act at all to increasingly intense involvement in efforts to develop sustainable competitive advantage.

One of the implications of these issues becoming more important to corporate governance is that we will

5. Brian N. Dickie, *The CEO Agenda, Strategy and Business*, Issue 1, Fall 1995.
6. SustainAbility for UNEP, *The CEO Agenda: Can Business Satisfy the Triple Bottom Line?*, SustainAbility, with The Prince of Wales Business Leaders Forum and the UK Association of Chartered Certified Accountants, London, UK, 1998.
7. Among accountancy bodies focusing on this area in the UK are the Association of Chartered Certified Accountants (ACCA) and the Institute for Chartered Accountants (ICA).
8. Rabobank International, *Sustainability: Choices and Challenges for Future Development*, Rabobank International Amsterdam, 1998.

increasingly see chief financial officers (CFOs) becoming involved in this area. As Price Waterhouse put it in a recent book on the role of the 'super-CFO': 'presiding over processes that cut across the business, these CFOs set strategy, lead crucial change initiatives and act as real partners in decision-making with their CEOs.'[9]

NOT YET SWITCHED ON

So how aware are CEOs of the impending shift from the exclusive to SD in general – and to more inclusive forms of corporate governance in particular? On the basis of a content analysis of the CEO forewords of 100 corporate environmental reports (CERs) from around the world,[10] we concluded that many were totally blind to the true implications of the sustainability agenda they have publicly embraced in recent years. Precisely 0.00% of the business leaders mentioned corporate governance – and, again, precisely 0.00% discussed the role of the board in guiding their corporation's SD programmes. When we published our report, *The CEO Agenda*, this began to change, but there is big difference between carefully word-smithed CEO forewords to CERs and the genuine integration of TBL thinking into board-level agendas.

This is important. Boards are often seen as the brains of corporations. And, like all brains, they can be active or inactive, 'wired' or tired. As in other areas, inactive, tired or disengaged boards are dangerous. Corporations and industries that want to respond successfully to society's emerging TBL priorities need 'switched-on' boards – alert both to the upsides and downsides of the impending sustainability transition.

The ability of business leaders and of corporate boards to pick up and amplify 'weak signals' in their business environment will be a crucial factor determining whether or not their corporations are globally competitive. Fundamental to this ability to detect and analyse weak signals will be the composition of each board – and particularly the role of non-executive directors.

There is growing evidence that the boards of many major corporations are, to put it mildly, dysfunctional. Listen to consultants Arthur D. Little (ADL). When they surveyed managers of environmental, health and safety (EHS) at 185 US corporations, they concluded that most EHS managers are blocked by a 'green wall' between the top management processes addressing EHS and 'mainstream' business issues. As a result, most company boards are still both deaf and blind when it comes to monitoring the emerging TBL agenda. Many, as a result, end up acting dumb.

A contributory weakness is a lack of integration between the economic, social and environmental bottom lines, partly caused by the failure of many corporate environmental and social professionals to convince their boards of the importance of their work. This is a problem we have come across consistently in our own work, with growing appeals from managers to help communicate the importance, urgency and scope of the TBL agenda at board level.

GREENING THE CEO

Against this backdrop, a number of prominent CEOs have been engaging their fiercest critics and speaking out on TBL issues. Take Monsanto's Bob Shapiro, whose interview in The Harvard Business Review marked something of a milestone in the debate.[11] He pulled together a group of some 25 critical thinkers from around the company and sent them off to ponder the issues with a number of non-traditional thinkers, including Paul Hawken of the Natural Step Foundation. 'That off-site meeting in 1994 led to an emerging insight that we couldn't ignore the changing global environmental conditions,' Shapiro recalled:

> 'The focus around sustainable development became obvious. I should have been able to come up with that in about 15 minutes. But it took a group of very good people quite a while to think it through, to determine what was real and what was just puff, and to convince themselves that this wasn't a fluffy issue – and that we ought to be engaged in it.'

Monsanto, however, soon found itself embroiled in a roiling controversy around genetically modified (GM) foods in Europe. The company showed every sign of having grasped the importance of the SD agenda intellectually, but of failing to walk the talk. Shapiro went from being everyone's favourite green CEO to a pariah in less time than it takes to plant and harvest a single GM crop.

Shapiro and Monsanto (now part of Pharmacia-Upjohn) may yet recover their reputations, although they have dug themselves into a pretty deep hole. But in the meantime others are moving to fill the gap. In mid-1999, for example, two successive issues of *Fortune* magazine covered the trend towards greener CEOs. The first was headlined 'The Green CEO', focusing on Ray Anderson of Interface and a number of the individuals and organisations working to help business leaders address the TBL agenda. In the very next issue, BP-Amoco CEO Sir John Browne was profiled. The focus here was on Browne's astonishing moves to take over rivals like Amoco and Arco, but his solid green credentials and growing investment in renewable energy were central to the story.[12]

One key aspect of the sustainability transition that CEOs will need to focus on increasingly is what is called 'value migration'. As the transition builds, we are likely to see extraordinary shifts in the centre of gravity of our economies. This is the agenda that CEOs like John Browne are moving to address. According to Adrian Slywotzky's book *Value Migration*, as industries and companies develop, they go through a period of value inflow (where they begin to absorb value from others whose business designs are outmoded), then through a period of stability (where they are well matched to customer priorities and overall competitive equilibrium), followed by a period of value outflow (as better, competing business designs emerge).[13]

When the US Vinyl Institute commissioned a study of the market prospects for vinyl, or PVC, through to

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9. Price Waterhouse, *Financial Cost and Management Team, CFO: Architect of the Corporation's Future*, John Wiley & Sons, 1997.

10. Such forewords are only one place to look for such evidence, but if business leaders are not talking about SD there it is improbable that they will be elsewhere.

11. Joan Magretta, *Growth through global sustainability: An interview with Monsanto's CEO*, Robert B. Shapiro, Harvard Business Review, January-February 1997.

12. Janet Guyon, *When John Browne Talks, Big Oil Listens*, Fortune, 5 July 1999.

13. Adrian J. Slywotzky, *Value Migration: How to Think Several Moves Ahead of the Competition*, Harvard Business School Press, 1996.

the year 2020, the conclusion was that potential growth could take the industry to as much as $61 billion in value by 2020.[14] On the other hand, environmental pressures could limit the industry to less than $23 billion over the same period. The $38 billion difference between the two scenarios indicates the economic value of the TBL game that the vinyl industry – and other industries – must now learn how to play.

The capacity of most boards to handle this agenda is unclear. The need to develop sustainability audits that can help assess the capacity of given boards to detect and manage key elements of the TBL agenda will become increasingly obvious – and, we believe, will be taken for granted within the next decade.

None of this means that we should automatically suspect the motives of boards or of their executive and non-executive members. But in a world where many corporations are richer and more powerful than many sovereign states, the challenge for 21st century governance systems is 'to give power to those best able to use it – and to remove it from those who use it poorly or evilly'.[15]

ABOUT THE AUTHORS

Peter Zollinger is a Director of SustainAbility Ltd. He graduated from the University of St. Gallen, Switzerland and spent eight years working for Swiss industrialist Stephan Schmidheiny, the founder of the Business Council for Sustainable Development. He was then seconded to the World Resources Institute, WRI, Washington, D.C., a policy research institute for sustainable development, to help it engage the business community with particular emphasis on sustainable forestry and climate protection. In 1997, Peter co-managed the turn-around of the FUNDES Group, a network for small business development in nine countries of Latin America. He joined SustainAbility as director in 1999 with emphasis on corporate governance. He leads Trimaran, an action research programme on the role of corporate boards in the context of sustainable development. Besides managing the SustainAbility team, real world integration of all triple bottom line dimensions (economic, environmental, social and societal) into core business strategies is the focus of Peter's portfolio of activities.

John Elkington, chairman and co-founder of SustainAbility in 1987, is one of Europe's leading authorities on sustainable development and on environmental strategies for business. In 1989, he was elected to the UN Global 500 Roll of Honour for his 'outstanding environmental achievements'. Since 1974, he has undertaken consultancy work for a wide range of national and international government and non-governmental agencies and has worked for many international corporate clients. John has spoken at several hundred conferences and other events throughout the world. John is Chairman of The Environment Foundation; member of the Board Environment Committee at Anglian Water; member of the European Union Consultative Forum on the Environment and Sustainable Development; member of the Storebrand Environmental Advisory Board; member of the Advisory Council of CERES; member, Steering Committee, Global Reporting Initiative (GRI); member of the Advisory Committee of Business in the Environment (BiE); an Honorary Fellow of the University of Dundee's Centre for Social and Environmental Accounting Research (CSEAR); member of the New Renaissance Group; and the Environmental Law Foundation (ELF).

Virginia Terry is a Director of SustainAbility dealing with issues critical to sustainable development in the private sector, particularly in the areas of corporate accountability and transparency, indicator development, stakeholder dialogue and Triple Bottom Line strategy development. She was project leader for the development of Shell International Key Performance Indicators of progress toward sustainable development and project leader for Shell Chemicals sustainable development work consisting of stakeholder engagement plan, Business Performance Indicators development and decision-making tools. She was also project co-manager for Ford Corporate Citizenship Strategy Development, project team member for MARIA (MAnaging and Reporting Intangible Assets), a multi-stakeholder project initiated by the UK Department of Trade and Industry to develop a 'How To' guide for measuring, and reporting on intangible assets and co-leader of the Pilot Test Working Group for the Global Reporting Initiative. She was project leader for an analysis of 'best practice' social performance indicators for Novo Nordisk and was a contributor to the World Bank's Business Partners for Development project focusing on indicators of successful tri-sector partnerships. She was an active member in major international multi-stakeholder initiatives focusing on sustainable development indicators (The Global Reporting Initiative, The Institute of Social and Ethical Responsibility).

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14. Gary Gappert *et al*, *Vinyl 2020: Progress, Challenges, Prospects for the Next Quarter Century*, The Vinyl Institute, April 1996.
15. Jonathan Charkham, *Keeping Good Company: A Study of Corporate Governance in Five Countries*, Oxford University Press, 1995.

A Holistic Approach to Sustainable Construction

Axel Wenblad, *Skanska, Stockholm, Sweden*

Abstract

Skanska is one of the leading companies active in construction-related services and project development in some 50 countries. Environment became a strategic issue for the whole Group in 1995 and by the end of 2000 all units within the Group will be certified according to ISO 14001. This serves as a platform for addressing environmental issues throughout the construction process.

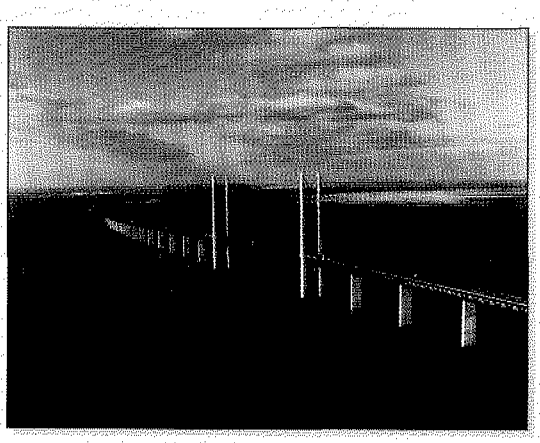


Figure 1
The Öresund Bridge connects Denmark and Sweden

THIS IS SKANSKA

Skanska's mission is to develop, build and maintain the physical environment for living, travelling and working. Skanska is active in construction-related services and project development in some 50 countries. Annual sales are about US $11 billion and Skanska has some 60,000 employees.

Operations are organised into a parent company, Skanska AB, with five business areas. Contracting operations, which provide services related to building and civil construction, take place in the Skanska Sweden, Skanska USA and Skanska Europe business areas. They all possess product-oriented specialist knowledge as well as project development know-how.

The Project Development and Real Estate business area focuses on project development in which Skanska commits its own funds. The Services business area, which is the most recently established, works with facilities management and the development of services that are related to management of commercial buildings.

The activities of Skanska are thus very diversified, from building private houses to heavy civil construction like tunnels, bridges or dams and project development for its own account, as well as facilities management and related services. Common aspects of our products are that they:

- have a long lifetime
- consist of many components
- are tailor-made for the site and to suit client demands
- are utilised to host various activities
- have a major impact on the use of resources in society.

SKANSKA AND THE ENVIRONMENT

Skanska began to apply its strategic approach to environmental issues in 1995, although many activities at project level had already been going on for a long time. This was a period when all large Swedish construction companies took environment on board as a strategic issue. The reasons were demands from public agencies concerning waste management and recycling, combined with growing client awareness.

RISKS AND OPPORTUNITIES

When environmental issues were originally introduced in Swedish business in general, the emphasis was very much on the risks, while the opportunities came in much later (Figure 2).

At Skanska we started to work with various projects focused on improving resource efficiency, both in the energy and waste sectors. We focused less on accident risks until

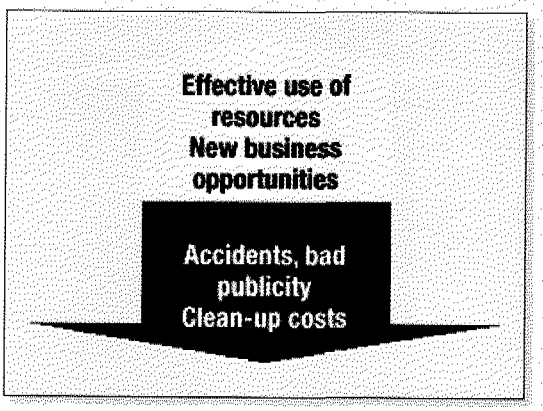


Figure 2
Opportunities and risks

	MATERIALS	CHEMICALS	ENERGY CONSERVATION	SOIL CONTAMINATION	WASTE
Land use planning				✔	
Design	✔	✔	✔	✔	✔
Construction	✔	✔			✔
Service life			✔		✔
Renovation	✔	✔	✔		✔
Demolition	✔	✔		✔	✔

Figure 3
Significant environmental aspects – an overview

an unfortunate chemical accident occurred in a project in southern Sweden where Skanska was the contractor. This had a profound impact on the way Skanska handled environmental issues. The lesson learned was that it is equally important to address both risks and opportunities.

Introducing ISO 14001

In 1998 the management of Skanska made a strategic and far-reaching decision. All units within the Group would introduce environmental management systems within less than two years (by the end of 1999) and have them certified by the end of 2000. Some companies in other industrial sectors had made similar decisions earlier. The difference, however, was that they had a large but reasonable number of factories to include in their system, while Skanska had about 10 000 large and small projects that needed environmental management. This was a great challenge. Thanks to enormous efforts throughout the organisation, we are well on our way and will meet our target by the end of 2000.

Figure 4 (below)
Scandic Hotel in Helsinki, Finland

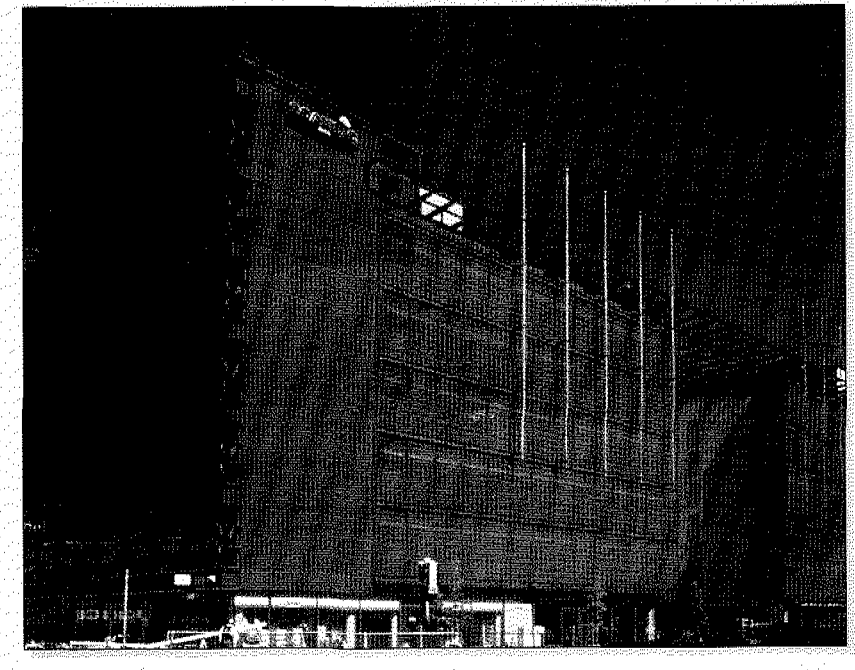
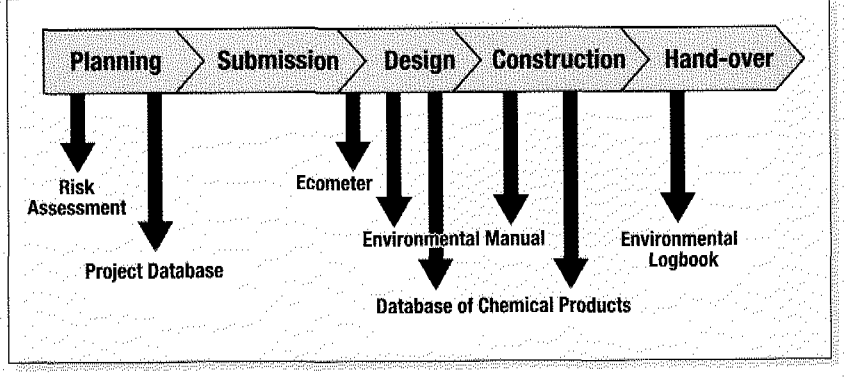


Figure 5 (bottom)
Basic elements of a construction project



Significant environmental aspects

One result of the task of introducing ISO 14001 has been that all units have worked to identify the significant environmental aspects in their projects. Figure 3 provides a brief overview of the environmental aspects that have been highlighted as being particularly important. Their importance varies over the life cycle of a project, from land use planning to construction, service life and demolition.

A PROJECT ORGANISATION

Although ISO 14001 is a powerful management tool, it does not solve all problems. On the contrary, it becomes more apparent that you need a set of more technical tools to develop and communicate your performance. The challenge is not only to develop these tools, but also to put them into operation in a project-oriented organisation: an organisation where every product is unique, tailor-made and specified by the client.

The contractor's roles

The contractor's various roles have a great impact on the potential to influence environmental considerations and solutions in a project. In general, the aim is to enter the development process as early as possible. A project in which the contractor is also the developer of course provides the greatest degree of freedom. On the other end of the scale are contracts in which the client specifies every detail. This is particularly common for public procurement. Somewhere in between are 'performance contracts' and 'turnkey contracts'.

The construction of Scandic Hotel in Helsinki is an example of a unique cooperation to enhance the environmental standard of the project (Figure 4). The user, owner and contractor have jointly developed a construction process that incorporates environmental considerations. The project involves acquisition, production and maintenance in a life-cycle perspective.

An example of a more traditional contract is the Öresund Bridge, which connects Denmark and Sweden (Figure 1). The contract was awarded through public procurement where environmental performance played an important role. The experience from the environmental work can be summarised in five key points:

- A client with clear environmental demands
- An extensive environmental impact assessment
- A commitment to environmental work by all parties
- A skilled and responsible contractor
- Good follow-up and evaluation programmes

A construction project

The following section describes the stages of a construction project, together with example of tools that have been developed (Figure 5).

In particular, many large projects include risks that have to be identified and addressed. In addition to technical, financial and legal risks, Skanska's **risk assessment** also includes environmental issues and sociopolitical issues. In the environmental field, a risk assessment takes into account such aspects as significant environmental impact, contaminated soil and relations with clients and suppliers.

The sharing of knowledge and experience is a key factor

in developing new solutions One tool that Skanska has developed is a **project database**, which is available internally on our intranet. A selection of projects with environmental dimensions is also available and regularly updated on our public Web site. This enables clients and other stakeholders to see a variety of environmental solutions that Skanska has applied.

The design phase is critical for the environmental impact of a project. It is at this stage that technical solutions are specified. This becomes even more apparent if we bear in mind that the service life phase accounts for 80 to 90 percent of the environmental impact of a structure. To help designers with their decisions, Skanska has developed the **Ecometer**, a computer tool for comparing and selecting materials, building components and systems. The Ecometer is based on a life cycle approach, in which a structure's contributions to climate change, acid rain and two more environmental aspects are factored in. It is being tested in practice in projects in Finland (Figure 6).

In order to ensure that the materials used in a structure do not contain unwanted chemicals, Skanska has developed a **database of chemical products** in Sweden. About 2000 products have been evaluated and compared with our own lists of prohibited chemicals and chemicals which are to be phased out.

Finally, when a project is completed it is handed over to the customer together with all relevant documentation. A new element in this documentation is an **environmental logbook**. It contains descriptions of the structure's environmental characteristics, including environmental product declarations for its constituent building materials.

Other tools include an **environmental manual** to help the project address environmental issues, especially during the construction phase.

CONCLUSIONS

Environmental management systems provide the necessary framework for integrating environmental issues into the various activities of a construction company. The ISO 14001 certification process is an important element in focusing the attention of the organisation on these issues. It is, however, also important to have more operational tools that can provide practical support. Experience shows that when new categories of employees in the organisation make the environment a part of their duties, they start requiring new tools. Of course these changes cannot occur overnight. They take time, and the tools are not applied throughout the organisation from the beginning.

Results are not measured in the number of environmental certificates, but in practical daily environmental work. It is a living process, in which the integration of environmental issues into all operations is the key to success.

ABOUT THE AUTHOR

Mr Wenblad joined Skanska in 1999 as Vice President Environmental Affairs. Mr Wenblad has also worked for AB Volvo 1990-1994, coordinating environmental affairs. Earlier assignments include the Swedish Environment Protection Board, Ministry of Environment and Government Committees in Sweden. During 1975–1980 Mr Wenblad had various assignments for the Food and Agriculture Organisation (FAO) and the United Nations Environment Programme (UNEP) in the field of marine pollution. Mr Wenblad has an MSc in biology and chemistry and has worked with environmental issues since 1972.

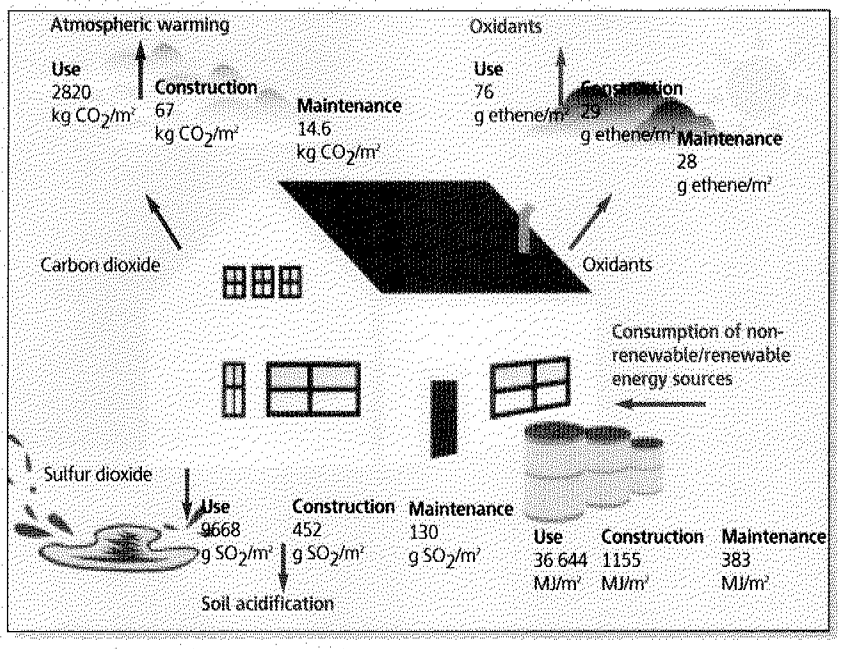


Figure 6
Results from the testing of the Ecometer

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A better world – To protect the environment, Roche relies on environment-friendly production processes

SUSTAINABLE INNOVATION

Roche's activities span the discovery, development and production of high-quality medicines and diagnostics tests, and respect for the environment is a core value in everything we do. We are working to win the battle against a wide range of diseases and to help more people stay healthy longer. Environmentally-responsible innovations at Roche are leading the way to comprehensive, individualised healthcare for all.

Roche

We Innovate Healthcare

THE CASE STUDY OF RIBOFLAVIN (VITAMIN B_2)

Riboflavin (vitamin B_2) is a vitamin that plays a major role in biochemical oxidation and reduction reactions, such as occur in metabolic processes. It is a yellow, fluorescent dyestuff which is detected in almost all living cells and which was first isolated more than one hundred years ago. Riboflavin deficiency in humans results in metabolic and skin disorders. In farm animals, even marginal vitamin B_2 deficiency leads to loss of appetite and impaired growth rates.

For these reasons, vitamin B_2 has become an important food and feed supplement with a steadily growing market demand. The amounts manufactured by Roche increased from 500 t of crude material in 1982 to 1500 t in 1999. To extend manufacturing capacity, a fermentation process was developed instead of setting up a new chemical production line. The new process, which became operational this year, has significantly improved the sustainability of riboflavin manufacturing:

- Raw materials used are 90% renewable. The amount of non-renewable starting materials has been reduced by 80%.
- Emissions of volatile organic chemicals into the air have been decreased by 50%.
- Emissions into water have been reduced by 66%. In addition, the remaining 34% consist of inorganic salts and residual biomass only.
- Solid waste from the process consists of pure biomass, which after composting is naturally recycled.

Improving sustainability is a continuous process, as stated in the "Policy on Safety and Environmental Protection in the Roche Group". Further steps in this direction will follow, led by process research committed to sustainability. This basic attitude is also underscored by Roche's active support of the International Chamber of Commerce's *Business Charter for Sustainable Development* and the Chemical Industries' *Responsible Care Programme*.

Roche

We Innovate Healthcare

XCELLSiS

A WORLD LEADER IN FUEL CELL MANUFACTURE FOR TRANSPORT SECTOR.

XCELLSiS is the world leader in the development and manufacturing of fuel cell engines for light and heavy duty vehicles, as well as auxiliary power units (APUs) for on-board power supply in vehicles.

Originally formed as dbb fuel cell engines in 1997, XCELLSiS is now an international company with operations in Germany, Canada, and the United States. These three locations develop and manufacture fuel cell engines to meet the worldwide market requirements for environmentally friendly vehicles.

Fuel cell systems in transportation applications provide alternative power solutions that produce zero or ultra-low emissions, perform better, and are significantly quieter and more comfortable for drivers and passengers.

Demonstration of prototype buses and cars in North American, South America, Europe and Australia prove the excitement surrounding the prospect of clean, comfortable and quiet transportation.

Between 2001 and 2003, larger vehicle fleets will be demonstrated in the California Fuel Cell Project, as well as in Europe and other areas. The experience gained from the vehicles and the information gathered on fuel cell infrastructure will ensure the success of the commercial vehicles. It will also generate public understanding and acceptance of fuel cell technology. Development programs will advance the engine's technical maturity and reduce cost.

Our fuel cell engines mark the beginning of a new era of mobility, an era with a sense of responsibility for society and environment. Driving a car or bus will only change for the better. Handling, comfort, dynamics and safety will be improved by the fuel cell system. The resource-saving, low or zero emission fuel cell engine offers the range of a conventional combustion engine with the emissions and sound level of an electric vehicle.

Fuel cell engines are being developed by XCELLSiS to be competitive with today's internal combustion engine with the added advantages of environmental friendliness, increased efficiency, the ability to operate on various fuels, and greater driver comfort and satisfaction. The XCELLSiS fuel cell engine has been demonstrated in five generations of light duty fuel cell vehicles in the DaimlerChrysler NECAR program and Ford's P2000 and FC5 vehicles, and four generations of heavy-duty buses.

XCELLSiS is also working with other OEMs to provide them with the same technology in the world-wide market place.

XCELLSiS
The Fuel Cell Engine Company

Earth Centre and Global Issues

Dan Epstein, *Earth Centre, Doncaster, UK*

Abstract

Earth Centre is a hybrid educational campus, visitor centre and demonstration project on the theme of sustainable development. It aims to inspire public understanding and provide an introduction to practical action. Having completed the first £40 million phase of development on a 400-acre former colliery site in South Yorkshire, Earth Centre is now branching out into a wider portfolio of education businesses, conferencing and events and consultancy with its new private business partner. This paper addresses the history of this bold initiative, describes its objectives and uses Earth Centre as a case study in considering whether holistic sustainable development is yet feasible in today's western developed economies.

WHY SUSTAINABLE DEVELOPMENT

Sustainability is the pre-eminent millennium issue facing the Planet. Sustainable development is a response to the increasing awareness that the current course of development is unsustainable. Evidence of this is manifest in all sorts of ways that are becoming increasingly familiar. Climate change, loss of biological and cultural diversity, a widening gap between the extreme wealth of the richest 10% of the world's population and the desperate poverty of the poorest 30%, are but a few of the numerous examples that face the world at the turn of the 21st century.

In response to growing concerns about the course, nature and accelerating rate of development, people from all walks of life, professions and parts of the world are responding creatively to find new ways of living that reduce our impact on the biosphere and are more socially equitable. These responses which often arise spontaneously and in isolation together form a convoy of ideas that are united by a common perspective and set of values that define sustainability. Sustainable development then is an alternative worldview underpinned by a set of values that when practised result in a very different form of development. Earth Centre defines it as:

'A process that enables all people, particularly those disadvantaged, to realise their potential and improve the quality of their lives in ways that protect and enhance the resources and life support systems of the planet for the benefit of current and future generations.'

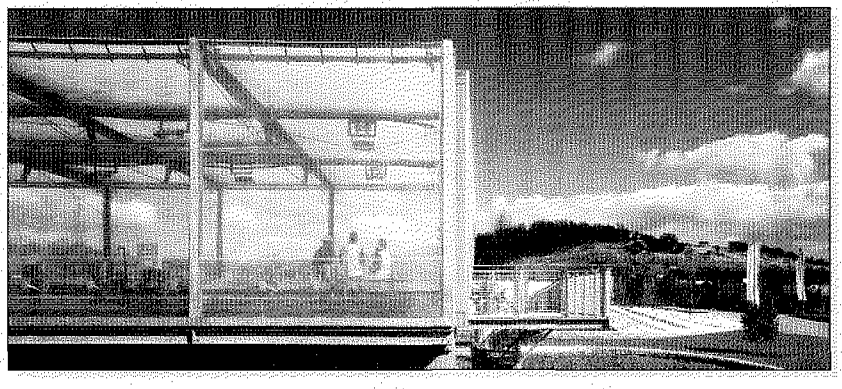

Figure 1
Water centre and living machine

In other words it involves living on the planet as if we mean to stay.

If sustainability is to take its place as the pre-eminent issue facing the planet it needs to become mainstream and impact on all our decisions and actions from the way we consume (e.g. what washing powder to use) to trans-national issues (e.g. treaties on climate change). This need to popularise and make more accessible sustainability was identified by The United Nations Commission on Environment and Development (UNCED) (1987) when they called for 'vast campaigns of education, debate and public participation in order to correct the course of development'. Earth Centre was created in response to this challenge.

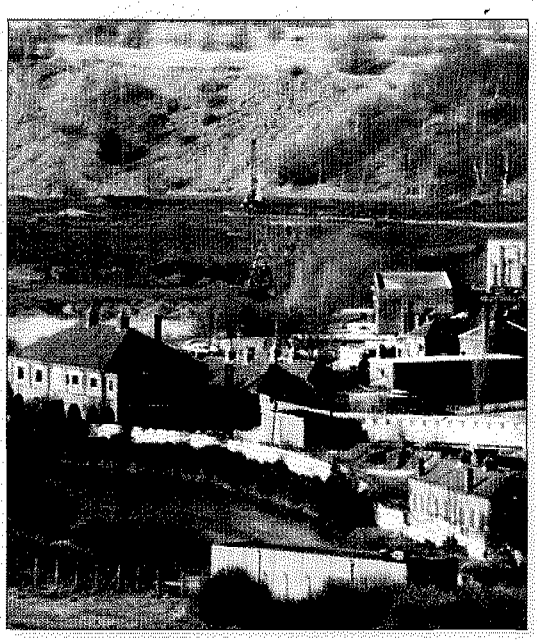

Figure 2
Original site

WHY AN EARTH CENTRE

Earth Centre was and is intended to be a major public resource for sustainability. Its aim is to celebrate the creative and often ingenious solutions, the 'convoy of ideas' and the principles and values that underpin sustainability. Earth Centre seeks to be a living laboratory where sustainability is brought together, explored and presented in one place in practical, tangible and inspiring ways.

From its inception one of the project's key features was its sheer scale and ambition: a 400-acre site, £120 million of buildings, exhibitions, gardens, demonstration technologies and accommodation. Scale was important in order to give the issue the profile and glamour to provide immediate impact for large numbers of visitors from all ages, backgrounds and interests. Its scale would give it scope to present a coherent and comprehensive account of integrated sustainability, the great idea of our time and the most difficult subject yet faced by any museum. It was designed to cover the subject from a global perspective, using eclectic media and to bridge the gap between populist visitor attraction and informative education resource.

In practice it has set out to design, build and run a high quality exemplary sustainable site that would give the project integrity and a sense of authority and permanence. It also aimed to have a spiritual and artistic dimension in order to capture the timeliness and profundity of many of the underlying issues and themes in the sustainability canon whilst avoiding the banality of much contemporary exhibition design.

The Earth Centre has always sought to be more than a visitor attraction. It aims to be:

- A place of and for education
- A research and demonstration resource
- A standard setter in sustainability design, construction and operation
- An ecological park
- A catalyst for sustainable regeneration
- A resource for the promotion of sustainable technologies, processes and products
- A place for exhibitions, events and shows.

HISTORY OF THE PROJECT

Earth Centre's development has followed a long, circuitous and often difficult route. John Letts (a trustee of Earth Centre) first conceived the idea in 1989 for a Museum of the Earth, which would focus on environmental issues. Jonathan Smales, founder of the project, who was working for Greenpeace at the time, was inspired by the idea, resigned from Greenpeace and started work on the concept in earnest in 1990. He found the site in 1990 and together with Feilden Clegg architects produced an early Masterplan that he presented to Doncaster Council. The council was inspired by the concept and a grant was awarded for research.

Between 1990 and 1994 the project raised funds for a major feasibility study and generated much local and national support and interest. However, as a result of the economic recession in the early years, which affected South Yorkshire particularly severely, the project failed to raise private capital.

In 1994, following the award of a grant from Europe and match funding from organisations like the National Rivers Authority, the first works on land reclamation started on site.

In 1995 a successful bid for a £50 million grant was submitted to the Millennium Commission towards the £110m scheme on the proviso that funding would only be provided once match funding was raised. In early 1996 the European Regional Development Fund awarded the project £9 million to part match the Millennium Commission grant and later in the year English Partnerships awarded the project £5.4 million. As a result the funders agreed to a phased development programme and work on the first phase of the project for £34m began on site in spring 1997. The majority of the funds were invested in essential site reclamation and clean-up, earthworks, landscape development, infrastructure (car park, path network), services (water, sewage, gas, electricity, telecommunications) and the first buildings including a new café and galleries at the entrance and two small pavilions on site. Very little was left for exhibitions, interpretation or signage but this phase of the capital programme clearly had to focus on creating the foundations for future phases. Sadly, because of he nature of the funding and the condition of the site, the really iconic and exciting Ark building by Future Systems, which many in the architectural press described as Britain's answer to the Guggenheim museum in Bilbao, was also put on hold.

In spring of 1999 the first phase of the project opened to the public and at the same time plans and fundraising for phase 2 of the development started. Whilst Earth Centre failed to attract the number of visitors predicted, it was recognised by those who visited (and received a guided tour) and by the Travel Writers Guild (who awarded the Earth Centre the prize for the best tourism project in 1999) that phase 1 created a very strong foundation with real integrity and great potential.

Figure 3
Planet earth gallery

Phase 2 is now underway and is designed in part to strengthen the current visitor offer and to provide facilities for other businesses, in particular the conference and consultancy offer. The capital spend is being used to: enhance exhibitions and information; provide a new conference centre, accommodation and supporting facilities for up to 150 people; build a canopy between the existing galleries and restaurant that will be covered in 1000m^2 of solar PV cells that will provide electricity to the project; and to create a new visitor entrance building.

SUSTAINABLE TRANSFORMATION OF PLACE AND ECONOMY

From the outset Earth Centre has sought to be more than a visitor attraction; it is intended to be a living laboratory for sustainability, a project of and for the future. The project would be an exemplar of sustainability in every way from the choice of site, through its relations with the local community, to the design and construction of the buildings and landscape, to the regeneration of place and economy. Details of some of the highlights of the creation of a sustainable place are as follows:

Choice of site

The Earth Centre is being built on the site of two disused collieries – Denaby Main and Cadeby. It covers an area of 400 acres around Denaby, Conisbrough and Cadeby near Doncaster in South Yorkshire. Two rivers, the Don and Dearne, border the site. The Don was canalised in the 1970s for transportation purposes and is navigable to the North Sea. A railway linking Hull to Manchester stops at Conisbrough station, which is on site. Among the dereliction and waste created over the 100 years of mining there are wonderful examples of the industrial and pre-industrial heritage. There is a stunning viaduct spanning the River Don, and Conisbrough Castle, dating back to the 12th century, which has one of the finest examples of a Norman circular stone keep in Europe and presents itself as a perfect complement to the Earth Centre's 21st century approach to a sustainable future. Throughout its 400 acres, Earth Centre's landscape features a magnesian limestone escarpment along its northern edge, two rivers and a canal, ancient woodlands and attractive wetlands. The legacy of deep coal mining left the landscape on and around the site badly damaged so that every square metre of the site was in need of restoration. In designing the reclamation, a deep understanding of the history and significance of the site was vital together with an understanding of the local ecological potential, sustainable reclamation practices and a clear vision for the long-term future of the site.

The project is situated in Mexborough travel to work area, which includes the towns of Mexborough, Denaby and Conisbrough that together form one of the poorest areas in Europe. Both Denaby and Conisbrough were since 1870 pit towns that employed several thousand miners before they were finally closed in 1986 following the miners' strike. The area has also been affected by the closure of the carriage works in Doncaster, the decline of the steel industry in Rotherham and the general demise in heavy industry in the UK since the early 1980s. As a result there is an acute need for regeneration of both the economy and the land. It was this need for new forms of appropriate social development, for jobs together with the abundance of derelict land, the rich heritage of the area, the excellent transport network and location of the site in the centre of the country that made the location attractive. The area however needs large-scale regeneration to transform the severely depressed economy. This is borne out by the European Objective 1 status of the area, but models and visions for the direction of change that will secure the future of the area and create a distinctive sense of place are lacking. Earth Centre's vision for a sustainable economy and the scale and ambition of the project provide an opportunity for a local renaissance, but the process will take time and requires strong partnerships between the local community, government and private sectors. This has already started and over time it will reap substantial rewards. In the short term Earth Centre has already created 100 jobs on site primarily for local people and through procurement policies has injected cash into the economy.

Figure 4
Over 100,000 trees planted

Landscape reclamation

Earth Centre does not seek to restore the site to its former beauty, but is rather creating conditions and habitat through the restoration process that will optimise local biological diversity, improve the visual amenity and provide public access. The land restoration and landscape design has been innovative in its attempt to implement real sustainable design, and the best examples of this are as follows:

- The biodiversity on site has substantially increased through careful habitat restoration and creation of new wetlands, meadow and woodland.
- Sustainable land reclamation techniques have been used, for example waste products have been used to create new soil (sewage sludge, spent mushroom compost and organic park waste) and planting stock that will thrive and improve the soils over time (willow, alder, oak and birch) selected.
- Sustainable materials have been specified (stone from the local quarry, recycled plastic signs, reconstituted 'conservation' kerbs, crushed brick surfaces, recycled and Forest Stewardship Certified timber etc.)
- Safe, secure and wild areas have been created for children to explore and play that are designed to help nurture a sense of affinity and identity with nature.
- Systems for the sustainable management of the site have been developed (the use of non-toxic herbicides and pesticides, peat substitutes, water and nutrient recycling processes and long term management that encourages and accelerates natural processes of succession and the evolution of self sustaining habitats on site.
- An emphasis on the selection and use of productive and edible plants used in well-designed and interesting ways.

- The design of landscapes and gardens that use ecological systems as the guiding principle (nutrient and water recycling and solar capture)
- Creating public access to an extensive network of picnic areas, meadows, woodlands and wetlands.

Design of sustainable buildings

All of the buildings on site are designed to be as sustainable as possible. Earth Centre's team produced sustainability briefs for the buildings that formed part of each of the design teams' formal commissions. These focused on a number of key areas including:

- Energy consumption through the life of the building to be less than 50% of the energy consumption for a similar conventionally designed building. For the gallery and conference buildings this was typically less than 100kw/m²/pa. To achieve this, environmental engineers have played a much larger role in the design than would be normal so that modelling environmental parameters in part decides the forms of the buildings. Examples include: setting the major buildings into the hill side to provide thermal insulation; designing a massive basement to store heat and coolth in the Planet Earth galleries and a water storage facility to store hot water in the Conference Centre; the use of hot water solar collectors and PV cells to capture solar energy for use in the buildings; the use of underfloor heating.
- Use of reused, recycled and repaired materials in the buildings including: the use of waste slag as a substitute for virgin aggregate in the concrete; the use of recycled timber including old telegraph poles and timber sections, specifying only Forest Stewardship Certified timber where virgin material is used; using recycled concrete aggregate won during the earth works from old colliery buildings and importing recycled concrete for use in gabion walls; using recycled Victorian radiators to deliver hot water in the conference building etc.
- Minimising the use of highly polluting materials such as PVC and high formaldehyde and lead based glues, paints, gaskets, sealant and board materials.
- Using local materials and craftsmen such as Cadeby stone and local masonry workers.
- Minimising damage to the existing ecology by conducting ecological surveys prior to construction and marking off sensitive sites and maximising potential wildlife habitat around and on buildings.
- Designing to minimise waste and in particular the use of materials that can't be recycled through careful management of the waste stream.

Figure 5
Walkways and cycle tracks

Design of sustainable infrastructure

This focused on a careful survey of the site and the orientation and layout of the development together with the specification of sustainable technologies to ensure that the use of resources such as water and energy could be minimised whilst sewage, water and other materials could easily be recycled. Examples are the design of a fully integrated water system around the site so that all rainwater is captured, stored and reused via a series of swales, and a holding pond that also provides a fantastic conservation resource. In the same way a vacuum sewage system was designed to transport all the sewage to a central biological treatment plant from where it could be cleaned and reused on site.

Sustainable on-site management systems

The systems have been designed to minimise the use of resources and particularly toxic resources and to maximise the use of local materials, produce and skills. Site staff were put through a five week induction and training course in sustainability before the site opened. This included a detailed introduction to the design and construction of the site, the systems on site and the principles, practices, values and examples of sustainability.

Examples of specific practices that have been put in place include a waste management system that attempts to recycle 75% of the entire waste generated and all the compostable material (except the paper) is treated and reused on site. The chef procures meat, dairy and other produce locally and, where available, organically. The main buildings have building management systems attached to ensure they are managed efficiently to achieve low energy in use targets.

Whilst Earth Centre has a long way to go in perfecting its design and systems, much progress has been made in building and running an exemplary sustainable place. This has not been easy, particularly with contractors who are notoriously conservative and unused to building or working in new ways demanded by a sustainable approach to development. The process of understanding and then putting into practice these new ideas has in many ways been the most interesting and rewarding to date and many of the designers and contractors who have worked with the project have learnt a lot from the experience.

Earth Centre, unlike other environmental developments, has deliberately chosen to work with project management, construction and operating teams who had little knowledge or experience of the concept or practice of sustainability. This has often made the job of realising the project's high aspirations more difficult and it has meant that a lot of time and effort has been invested in building and maintaining the culture.

THE FUTURE

To date the framework and foundations have been created that will allow the project to realise its earliest objectives of creating a place that can address the issue of sustainability.

The focus for Earth Centre is to create a powerful brand for a worldview of sustainability. With this in mind the project has just entered into a partnership with a private entrepreneur to create three viable and dynamic businesses on site: an education business aimed at both the residential and day visitor markets; an enhanced

visitor destination focusing on a good and informative day out that builds on the potential of a wonderful site; and a conference, event and consultancy business that builds on the 10 years of experience gained by Earth Centre's team in developing, funding and building the project and in meeting the growing demand for practical support by commercial and other organisations interested in how to plan and implement sustainability.

In order to achieve these ambitions the partnership of Earth Centre trustees and core staff, together with its new commercial partners, is working on phase 3 of the capital programme which will take the Earth Centre another step towards its vision. Concurrently, the new private company Eartheo is branching out into a wider portfolio of education businesses, conferencing and events and consultancy that will realise the potential of the site and ensure an exciting future for the project. The core theme of this new development will be the creation of an education campus for residential and day school visits. The visitor attraction will be further strengthened to meet the needs of the education market (from primary school to life long learners including research students) and other focused market sectors. In addition, Earth is building its consultancy potential particularly around events on site for businesses and professionals and will be utilising its hard earned and very practical experience in creating Earth Centre to help others understand and adopt sustainable practices. In order to achieve these ambitions, the partnership of Earth Centre trustees and core staff together with its new commercial partners are working on phase 3 of the capital programme, which is very clearly focused on these new businesses.

ABOUT THE AUTHOR

Dan Epstein, 38, is Director of Sustainability at Earth Centre, Denaby Main, Doncaster. He joined in 1993 and is responsible for the transformation of the landscape from a coalmine to parkland and landscaped gardens. He is also responsible for infrastructure design and is the client representative for design development. Prior to joining Earth Centre Dan spent five years working in the Himalayas. Originally, he worked for the VSO as a forester for a year before joining the British Government Aid Programme and managing contracts in India, Nepal and Pakistan. Here his responsibilities were varied, working as a bio-engineer fixing landslides, managing community-based projects involving the planting of two million plants a year and carrying out Environment Impact Assessments for a number of road projects. Dan has also worked in Australia and New Zealand as a tree surgeon and landscape contractor, and in Central America working in National Parks on watershed management projects. Dan has an Environmental Science Degree from University of East Anglia and a Masters Degree in Forestry Landuse from Oxford University. 'I would like the Earth Centre to be a world class centre promoting sustainability, attracting a wide range of visitors to have a fun day out while learning about how we can all find a better way to live our lives'.

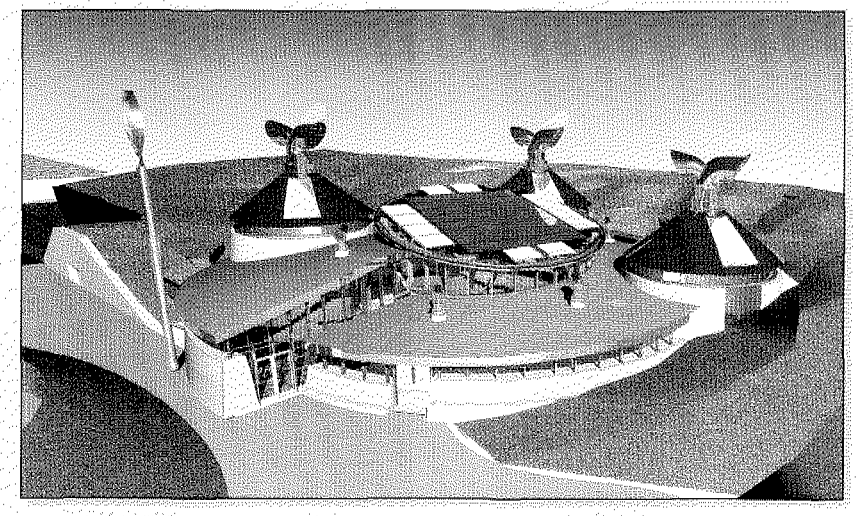

Figure 6
Conference building

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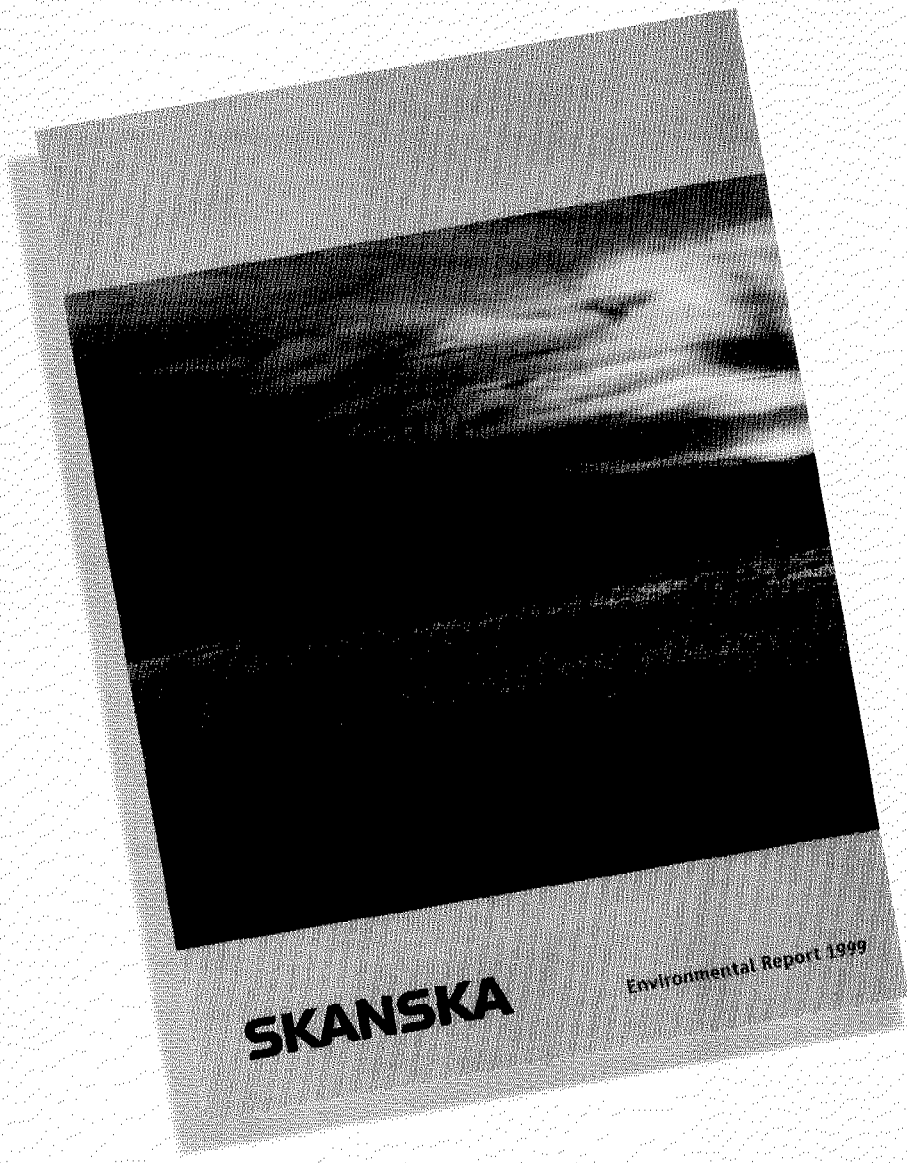

"To me it is self-evident that environmental issues will become increasingly important in the coming years. In order to achieve sustainable development, far-reaching changes are required when it comes to efficient use of resources and environmental adaptation of buildings. Skanska has the resources and expertise to speed up this development.

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Youth Participation in the Implementation of Agenda 21 – A Way Forward

David Woollcombe, *Peace Child International, Rabat, Morocco*

Abstract

Children and Youth are one of the nine major groups in Agenda 21. Its authors realised that engaging the attention of the rising generation would be key to the successful long-term implementation of the Agenda. Chapter 25 is very explicit: 'By 1993, governments must establish consultation procedures for the participation of young people of both sexes in the decision-making processes concerning the safeguarding of the environment'.

However, the Agenda does not explain where and how that participation in decision-making should take place. It was left up to governments, UN agencies and individual governments to figure this out for themselves.

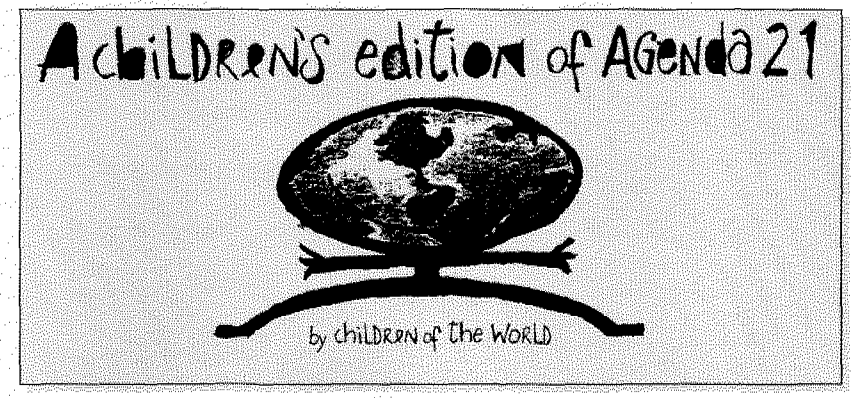

Figure 1 (top)
Young Belarussians pose together after a meeting to pool in their ideas and creativity on a new project under the Be The Change! programme

Figure 2 (above)

Though little was done by 1993, there has been a fair amount of experience in the eight years since Rio: UNICEF, UNEP, UNESCO and UNDP co-operated with Peace Child International to get young people to write, illustrate, design and edit their own highly successful young people's edition of Agenda 21 – Rescue Mission: Planet Earth (very few young people were ever going to even read the original, let alone participate in the implementation of it!). They also co-operated with CSD to produce a popular educational follow-up programme of Sustainability Indicators to enable young people to assess progress towards sustainable life-styles in their communities. The Swedish Q-2000 and Natural Step groups ran similar programmes for, and with, young people. Several US, Latin American and Canadian youth environmental NGOs changed their focus to incorporate the additional disciplines of sustainable development. In 1996, several governments (the Dutch, Swedish, Finnish, Norwegian, German, Swiss, Danish, Austrian) worked with the CSD to organise a Youth Intersessional meeting. In spite of the best efforts of the organisers, the Earth Council, Q-2000 and Peace Child International, the young participants spent so long determining the text of their 'statement' that, by the time it was finished, the CSD meeting was over and there were no government officials left with whom to discuss it.

It demonstrated a weakness in the traditional youth participation methodology at the UN: on every occasion that it happens, the young people end up pleading for the right to participate and to be included in delegations etc. But when given the chance to participate, CSD experience suggests that they do not have much worthwhile to say. Maurice Strong's experience of youth participation in creating Agenda 21 was similar: having raised several million dollars to facilitate youth participation in the preparatory process, he was heard to ask: 'Show me a line of Agenda 21 that has changed as a result of youth participation'. There was not one. Perhaps it is that the topics under discussion at CSD are so complex and technical, very few young people are equipped to comment on them.

The one area of Agenda 21 where young people are powerfully equipped to comment is Chapter 36, the

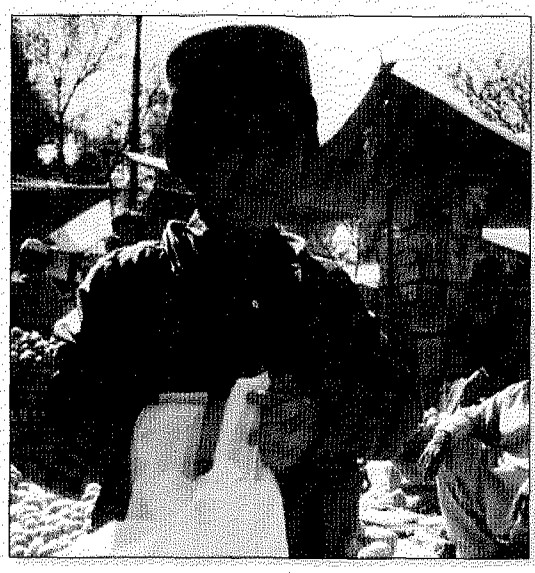

Figure 3
A young Afghan refugee boy whose family fled to Islamabad, Pakistan is now part of the Be The Change! programme

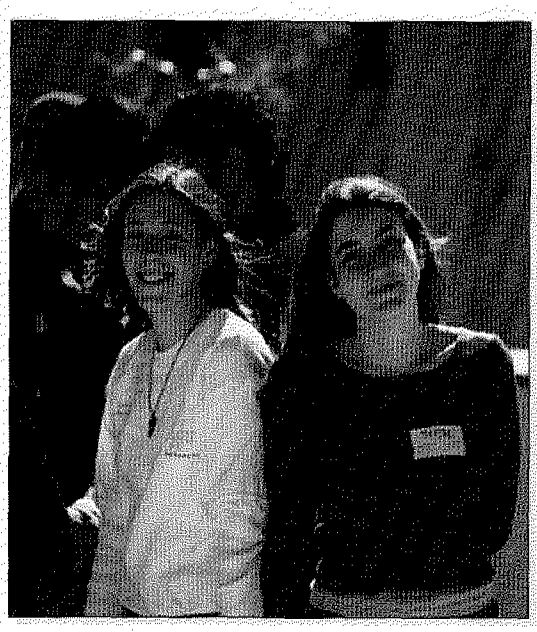

Figure 4
Cyprus is an island divided and torn since 1969. The "Greek Line" which separates Turkish North Cyprus from Greek South Cyprus, is reminiscent of the "Iron Curtain" and has divided Cypriots for more than a generation. A group of young people from both sides of the island nation express their desire for peace by working together despite government separation, to clean up a polluted area situated on the green line. A youth-managed park will replace the no-man's wasteland with a permanent symbol of peace for all to see. As part of the project, boreholes and irrigation systems will need to be constructed as the site currently houses a garbage compost over a 100-metre radius. After the park is constructed, a plaque will be installed telling all of the co-operation between the Cypriot youths in building such a special place

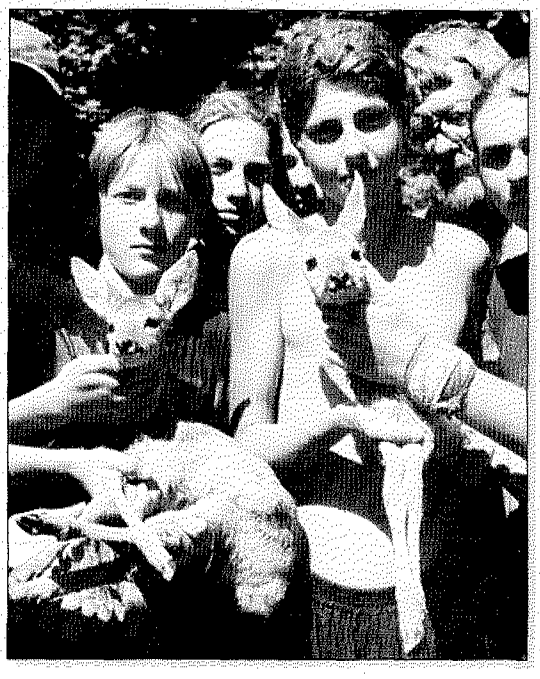

Figure 5
The fragile Eco-system of the Black Sea coast has been under threat for some time now. Concerned by the deterioration of this beautiful natural habitat for several rare species of flora and fauna, the young people of the V.I. Vernadsky Youth Ecological Centre want to create awareness among the local populace to protect the Black Sea coast. Together with the children of the local schools, they wish to set up monitoring and research facilities that would serve as an educational tool and at the same time collect valuable data

education and public awareness chapter. Education for sustainable development is an area where young people can become a driving force: more than half the members of the CSD Education Caucus are young people; indeed the Southern co-chair is a youth. A young people's Earth Summit convened in 1999 to determine youth priorities for the new millennium, determined that appropriate education was the number one priority. The CSD secretariat, noting youth interest in the area, invited Peace Child International to arrange an Upside Down session at CSD VI where education was under discussion: in it the students became the teachers, explaining to the adult audience of officials and diplomats how they would like Education for Sustainable Development to be delivered.

However, as several governments have been quick to point out, Chapter 36 of Agenda 21 has not been pursued with the kind of enthusiasm or strategic direction that might have been desired. Education remains the forgotten priority of Rio. In spite of youthful enthusiasm for the issue, neither governments nor the education establishment have welcomed the youth initiatives with open arms and funding. In the UK, a student-teacher initiative to have a pilot education for sustainable development examination course taught in 20 schools has been turned down three times for funding by the UK Environmental Action Fund. Eleven of the original 13 institutional investors in the community sustainability indicator programme mentioned above stopped funding the development of the programme after 1997 despite it being the main plea of the youth statement to the '97 UNGASS session. Of the $2 billion Chapter 36 recommended be spent on re-orienting education towards sustainble development, the best evidence suggests that only single figure millions have actually been spent. So the revolution to re-orient education towards sustainable development has not begun in earnest yet. Indeed, the framework for such a revolution has not begun to be discussed. Education continues on its merry way, producing ever-more-efficient planetary vandals, rather than the generation equipped with detailed knowledge of, and commitment to, the disciplines of sustainable development that will enable them to be cautious managers of the earth's natural resources.

I would not for one second suggest that young people should stop their lobbying on this issue. It is vital that education be re-oriented towards sustainable development eventually. But it would appear from the experience of the last eight years of lobbying at CSD, *that youth need powerful new partners in the educational* establishment to secure the changes they want to see. They cannot do it alone.

So what can they do? Felix Dodds has invited Peace Child International to help mobilise young people to take an effective role in the build-up to, and follow-up from, Earth Summit 2002. If that role is to be more effective than it has been to date, clearly a new approach is needed.

The occasion of the Millennium Young People's Congress – a kind of youth Earth Summit which canvassed the views of some 25 million young people in over 100 countries on their priorities for the new Millennium – enabled us to get youth input on what that new approach might be. The mechanical process of democratically selecting priorities was interesting: it threw up some concerns not generally at the centre of the CSD debate, specifically education, but also peace-building and a reduction in military expenditures, human rights promotion, ending corruption, eradicating AIDS, reducing youth unemployment etc. But at the heart of their Report from the Congress was a desire to take action themselves; to do small projects that contribute to the

overall aims of Agenda 21. 'Enough of talk!' appeared to be their conclusion, 'Let's have some action!'

Children and youth are often perceived as merely the beneficiaries of overseas development aid, a sector of society for whom schools must be built, healthcare provided, university places supported etc. The message from young people is that they would like to be seen as instruments of sustainable development rather than merely the beneficiaries of it.

Their report of their Millennium Summit, which includes a lot of their action projects, is called 'Be the Change', from the Gandhi line: 'You have to be the change you want to see in the world!' The Action Programme built out of the Summit has the same name: BTC. Its purpose is to provide small grants ($50-$5000) to projects led by young people under 25, and executed by them with the assistance of appropriate mentors, evaluators etc. Central funds are distributed by a Steering Committee of six youth elected by the Millennium Young People's Congress and five adults. Other funds will be raised via a website set up in partnership with the NetAid Foundation, which is a major partner in the venture.

True to its aim to be a thoroughly modern, 21st century youth-led Aid Agency, Be The Change is entirely e-based: projects are generally submitted via the website (though of course many still come in by mail and are typed on to the site at the UK Secretariat); the secretariat checks out each project, ensuring that each one meets minimum conditions before submitting them to the steering committee for approval and prioritisation. Chosen projects are then put up on the website, along with photographs of the project-leaders, the problem they aim to address, their budget needs and a credit card donation space. Individuals or schools can surf the individual projects, select one that they want to support and make their donation directly by credit card. Then, via e-mail, they get regular updates on the progress of the project. When it is completed, their names appear on the sponsor list of back catalogue projects. The list then becomes an excellent Action Database for other groups to consult when trying to answer the question: 'What can we do about sustainable development?'

To date, the projects mostly address the priorities agreed by the young people at their Congress – education, including IT education, features heavily. So does rural primary education, health education, advice and delivery of inoculations and AIDs awareness, the building of biogas plants, wind energy plants, water supplies, and many other basic services to assist in the eradication of extreme poverty. Now the website is up and running, we hope that many more projects will be received from youth in difficult circumstances both in the global south and in the emerging economies of Central and Eastern Europe where young people seem particularly eager to take the future in their hands.

The advantages of youth-led sustainable development projects are many:

They are very cost-effective: it was estimated that a water supply project developed for Tanzania that would have cost $75,000 for an adult-led development team could be done by a 'Be the Change' youth-led team + adult mentors volunteering their time, for less than $5,000.

They are educational in the best sense: this is the kind of hands-on active education that the young people begged for at their conference. They do not want to be seen as citizens-in-waiting, warehoused in classrooms until their 18th birthdays. They yearn to be active NOW during their school years. These projects give them a chance to contribute something useful to their communities, and experience the joy of leadership and societal improvement.

They seed a new generation of socially active citizens:

Figure 6
A group of young people in Malawi, distressed about the disappearing and degraded landscape in their country, would like to reduce the amount of trees cut down for firewood by providing solar cookers to the community. George Manyonje and his group plan to research, design and build a new, improved solar cooker. Currently, solar cookers in use are very big compared to a single family's requirement. They are made from imported materials and they are very expensive

Figure 7
Esther Mazhanda and her group, Chipfunde Sec, of Zimbabwe plan to set up an animal husbandry programme at a local agricultural college. Her project focuses on breeding pigs, giving students and other young people hands-on experience in raising the pigs as well as in building the required housing structures, keeping the financial accounts and marketing the final products. Financial profits will be re-invested into the project, achieving a measure of sustainability and benefiting the community on a long term basis

strengthening civil society lies at the heart of Agenda 21 but no one knows how you train socially active students. This programme aims to provide experiential learning to those who might not think of themselves as social activists. By the time they complete their project, they will have seen and experienced the power of individual leadership and collective action at the grassroots level for the common good. In this way, the BTC programme will nurture a new generation of community leaders.

Youth are good at partnership: the kind of turf wars that disrupt many adult-led initiatives are not generally present in youth-led programmes. Everybody seems ready to lend a hand to make sure that the kids' project succeeds.

Sustainability: kids are very aware that their youth is not sustainable – so a firm criteria of all projects is that they figure out how they are going to sustain their project beyond their own school days and beyond the grant period. This inculcates an understanding of the meaning of sustainability

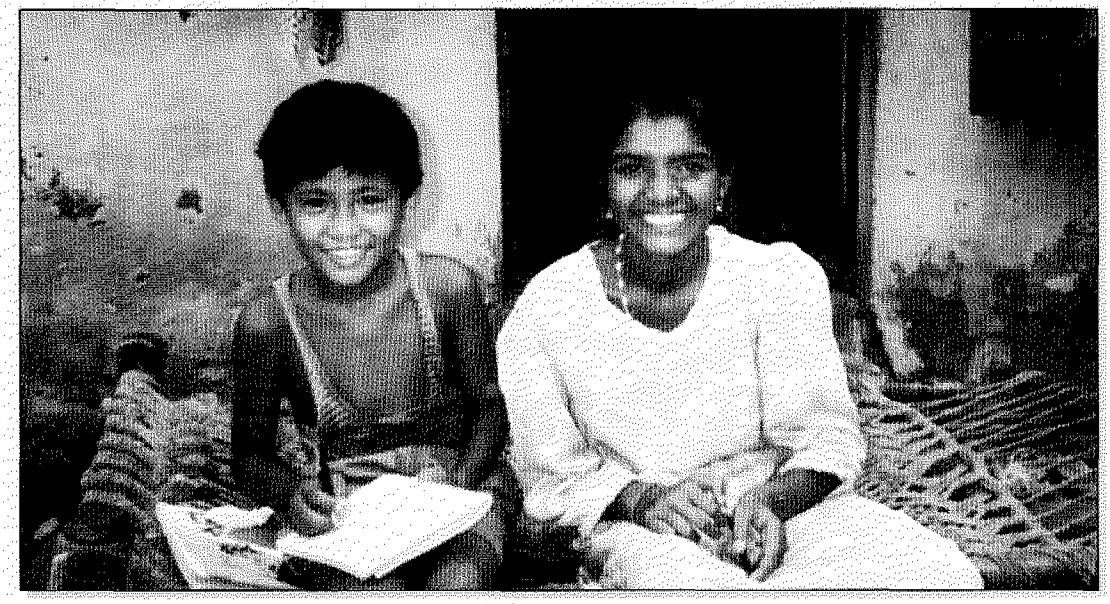

Figure 8
Anika and 20 members of her group called The Possibility Generation plan to give opportunities for earning money to slum children. They will arrange workshops with young professionals to teach the children how to make objects from waste materials. Then Anika and her fellows are going to sell their arts and crafts in the market near their town. The money will go back to the slum children

which, we hope, will be translated into every other field of endeavour that the young person turns their hand to.

North-South linking: it is hoped that many projects will be collaborative ventures between schools in the North and groups/schools in the South. Many groups already do this, but the excitement of seeing the faces of actual children from the South transforming their own and their communities' lives through funds raised and support letters written by children in the North, gives a personal connection lacking in many other types of development aid.

A one-stop information-to-action shop on sustainable development for youth. By its comprehensive series of links to the many other excellent websites dealing with youth and sustainable development plus its own ever-expanding database of completed projects and those that fail (we feel it important to show why projects fail, when and if they do), young people anywhere in the world will be able to learn about major global issues relating to sustainable development and what their peers around the world are doing about them. This, we hope, will stimulate them to submit their own project proposals to the Be The Change fund.

The goal, of course, is for young people to be able to come to Earth Summit 2002 with a raft of completed projects to show off and say: 'Look what we've done!' This will be a welcome change from the traditional whinge: 'Let youth have a voice!' Much better, we feel, that they be known by their deeds rather than their appeals which traditionally have not got them very far. We are hopeful that the project can expand geometrically with the Internet so that, in a very few years, thousands of youth-led projects will be being implemented and millions of dollars will be being raised for them. But, we must stress, this project is in its very early stages: we shall bring news of its progress in future issues of Sustainable Development International.

At best, we feel that this initiative can point an effective way forward for youth participation in the Agenda 21 implementation process, one that will empower young people to feel full and active participants, as well as providing concrete benefits for their communities. At CSD VI, we floated the slogan: '5% of overseas development aid for projects led by that 50% of the world's population that is under 25.' We recognise that it may be a while before projects like Be The Change are spending the $2 billion a year that this represents. But when/if they are, and when/if they can achieve the 1500% cost savings that some estimates show they can achieve, young people will get close to raising the additional $40 billion of ODA which successive Human Development Reports say is necessary to eradicate extreme poverty from our world.

That is a goal to which we feel all young people should rally at Earth Summit 2002.

ABOUT THE AUTHOR

David Woollcombe is the founder and president of Peace Child International, a youth-led organisation which, in its first decade, focused on ending the Cold War through encouraging East-West Youth Cultural Exchanges. In 1986, it succeeded in bringing the first Soviet young people to the USA on a youth exchange to perform the Peace Child musical show. In 1994, it empowered its network of some 500 youth eco-groups in 120 countries around the world to produce a children's edition of Agenda 21, an effort which has been followed up by several other youth-created books on key global issues. David holds a Master's Degree from the University of Durham for his research on the role of children in governance. He consults with many official bodies on this subject. He was the adult director of the Millennium Young People's Congress, and is the overall director of the Be The Change action programme. He serves on the UNED Forum Executive Board and is an advisor on youth matters to Earth Summit 2002.

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Maintaining Spatial Data in an Enterprise Land Management Environment

Jim Cory, *GeoAnalytics, Madison, WI, USA*

Abstract

The Wisconsin State Board of Commissioners of Public Lands has contracted with GeoAnalytics, Inc. of Madison, Wisconsin, to develop a flexible, user-friendly application that can edit several different spatial layers while maintaining the link to their related business records in the enterprise database. The Board was looking for a low cost Geographic Information System (GIS) to help them manage forestry and permitting operations on unclaimed, original land grant parcels. They decided to modify an existing ArcView application, built by the Wisconsin Department of Natural Resources for managing State forest boundaries and attributes. They have specified that this tool be tied to their newly rebuilt enterprise management system based on an Oracle database and custom Visual Basic user applications.

Introduction

In May of 2000, the State of Wisconsin Board of Commissioners of Public Lands (BCPL) contracted with GeoAnalytics, Inc. of Madison, Wisconsin, to develop a flexible, user-friendly application, which they could use to maintain their spatial data layers. The Board was looking for a low cost Geographic Information System (GIS) to help them manage forestry and permitting operations on approximately 80 000 acres of land, mostly in Northern Wisconsin. The project requirements specified that the tool needed to easily edit several different layers while at the same time maintaining the link between layer features and related business data records.

BCPL is responsible for managing federal grants of land in the State that were originally set aside for the support of schools and other institutions. The agency undertakes timber production on many of the parcels and returns the income from this activity to a low interest loan fund for State municipalities. In recent years the Board has sought to modernise and streamline its business workflow. They have pursued several initiatives, including document imaging, the upgrade of their legacy loan system, and utilisation of a number of land inventory technologies.

Information Management at BCPL has progressed along these tracks for several years. They are now beginning the process of bringing those threads together using modern client-server and Windows software running on high-powered NT-PC platforms. The integration of these different systems is aimed at decreasing redundancy, increasing the efficiency of data access and query, and providing the information needed to fulfill the Board's mission of stewardship, preservation and sponsorship.

Lands Held in Trust

In 1848, BCPL was established to oversee the sale of 5.2 million acres of lands that were granted to the new State of Wisconsin for the support of public education. The proceeds of these sales were deposited in permanent funds and invested in trust for the benefit of various institutions. By 1900, the Board had sold 97% of the Trust Lands into private ownership. It was after this time that BCPL began to reinterpret their mandate to act as trustee for the lands remaining.

Due to depressed real estate markets, the Trust Lands were withheld from sale for forty years, until 1954. Also during this time, BCPL land management practices became more custodial in response to dwindling timber supplies, devastating floods, State conservation laws and the beginnings of the conservation movement in the United States.

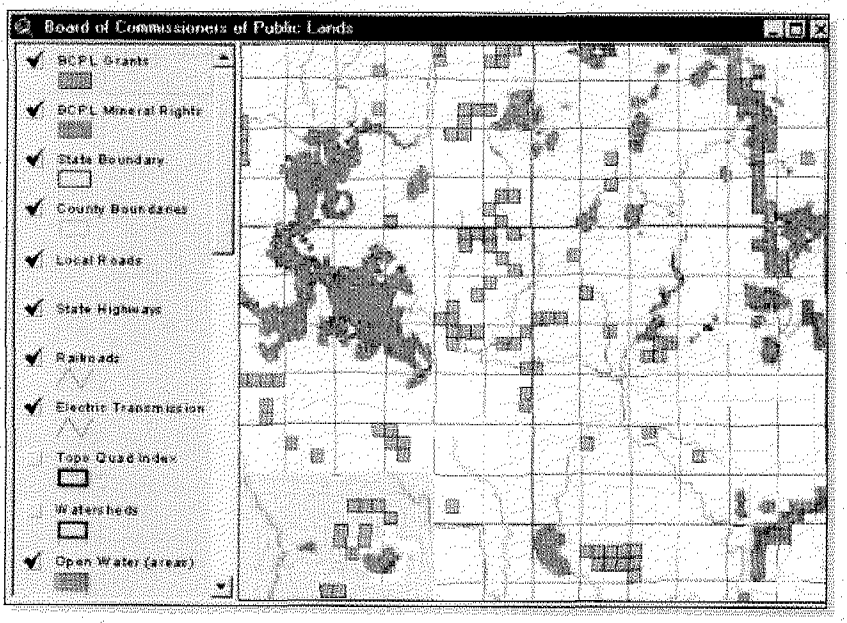


Figure 1
Board of Commissioners of Public Lands Grants

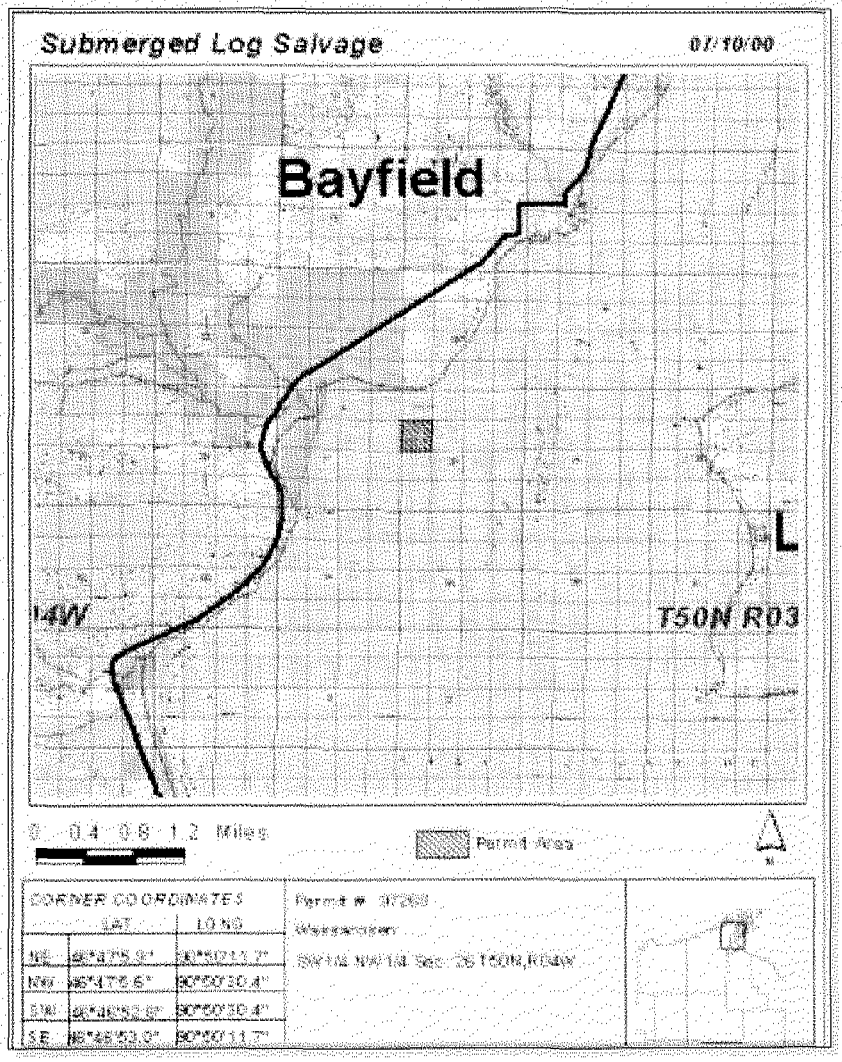


Figure 2
Submerged log salvage

With the housing boom during and after World War II, the Board made the transition from maintenance to sustained timber production. Having escaped the earlier era of timber exploitation, the Trust Lands had retained characteristics of the State's old-growth pine and hemlock hardwoods. Where these lands have been recognised as ecologically unique, the Board has ensured their protection, in part by conveying them to state and federal agencies for wilderness, natural and wildlife areas.

One problem facing the current land management strategies is the scattered nature of Trust Lands. This distribution is based in part on the method of land survey practised during the settlement of the State, known as the Public Land Survey System (PLSS). The system utilises a grid of six-mile square townships, divided into 36 one-mile square sections. The 16th section in each township was set aside for the maintenance of public schools and became the foundation of the Trust Lands. Further fragmentation occurred as 16ths of sections, known as quarter-quarters (QQ) or fortys (40 acres nominal size) were sold to private owners (Figure 1).

The quarter-quarter has become the basis of land management at BCPL. Income from land activities goes to different funds depending on the type of the original land grant associated with each QQ. The QQ is then the smallest unit to which all land management practices must be attributable. This includes property transactions, forestry, conservation and permitting. It is also the tie by which the relationship between spatial layers and business records can most often be made.

GETTING A HANDLE ON GEOGRAPHY

Spatial information has been with us for hundreds of years in the form of maps that we used to navigate the seas and to delineate boundaries. In the same way that computers helped us to organise text based information into databases and spreadsheets, they are now helping us to organise our spatial information into layers and views. Layers are groups of geometric features representing similar objects, such as soils or forest types. Each feature in a layer can be assigned a unique number, or ID. The ID can be used to associate spatial features with related tabular records. Combine this data structure with a user interface and you have a Geographic Information System.

By using classes of attributes to symbolise their linked spatial features, we can produce thematic maps to discover new patterns in the data. In this way, GIS provides another tool for visualising data and extracting information. Specifically, in land and forest management systems, there are many types of information that have a significant locational component. When these various layers are overlaid, as with soils and forest stands, a new pattern of information emerges that can lead to beneficial changes in management practices.

Since about 1995, BCPL has been investigating the use of GIS as a new means of preserving and managing the lands it holds in trust for the citizens of Wisconsin. Early efforts were directed towards data development and map generation. The Board created their first recent map of Trust Lands by matching their tabular list of QQ parcels with the Landnet layer built by the Wisconsin Department of Natural Resources (WDNR). The Landnet is a representation of the PLSS down to the QQ, and was developed in turn from a Section level layer published by the U.S. Geological Survey.

Later efforts carried out by the Board to describe their spatial assets have included the purchase of Global Positioning Satellite (GPS) receivers and interpreting software, the acquisition of multiple, complementary spatial data layers, and the development of several land management computer applications built with Environmental Systems Research Institute's (ESRI) ArcView GIS. ArcView is a customisable, user-friendly Windows program that provides a powerful query and analysis interface for spatial data.

These first spatial tools were used by BCPL to manage the wealth of spatial data they had accumulated and to produce useful products as part of business workflow. The ArcView custom applications that were built included a spatial data browser, a rudimentary land editing tool, an image cataloging and display dialog and a timber sale and permitting database with reporting capabilities. The latter application was unusual in that it recorded timber sales based on timber that had been submerged in Lake Superior for over a hundred years (Figure 2).

BEYOND A STANDALONE GIS

Historically, GIS developed as a standalone system where spatial data could be managed and maps could be generated based on internally stored attributes associated with spatial features. As with the entire computer industry, the trend in recent years has been to integrate proprietary and application specific data with data from other business processes and from different disciplines. This not only leads to new insights into the exact nature of data, but also streamlines an organisation's workflow from one operation to another.

In conjunction with the State of Wisconsin standardising on an 'open' Windows NT operating environment,

BCPL made plans to convert its legacy systems. Applications written in this new realm have the innate ability to intercommunicate. This, in addition to Windows' user-friendly qualities, would allow the Board to reduce data entry requirements, provide real-time reporting in response to inquiries, and bring data easily from one program to another in an automated way.

As part of BCPL's system modernisation plans, their initial, spatial land management tools would be expanded to include a sophisticated spatial editor tied directly to the new enterprise database. Land management attributes would now be stored with other business data for the first time, and in some cases it will be the first time this data has ever been digital. In addition to deriving the same automation benefits described above, this new system will allow BCPL to accomplish the following goals:

- Maintain an accurate tabular and graphical inventory of lands and timber;
- Assist in the prevention of trespass on state and private lands;
- Plan interactions with other state land management agencies to promote the consolidation of public lands and an ecosystem approach to land management;
- Permit the sharing of electronic data among public agencies, including counties, state departments and Federal bureaus;
- Assist in the determination of accurate survey lines;
- Accurately locate critical habitat areas;
- Avoid cutting of timber in sensitive environmental/archaeological areas;
- plan for increased timber yield harvesting.

RETROFITTING RAVE

The WDNR recognised some of these same benefits from digital access to spatial information, and so several years ago began development of what would become the Reconnaissance ArcView Editor (RAVE), a forest stand management application. RAVE is an ArcView custom extension that allows the user to easily edit forest timber-type areal features (polygons) while at the same time updating tabular records. The text-based information tied to the features contains data about species composition and planned and completed timber management activities.

As BCPL was preparing for enterprise integration, they evaluated several approaches they might take to adding the spatial component to the system. Examples of possible tools they looked at are the professional GIS capabilities of the higher priced ESRI program, Arc/Info, the extremely customisable tool kit provided by ESRI's MapObjects component modules, and the existing RAVE application for ArcView.

Being a small agency, one of BCPL's main priorities for the system was that it be cost-effective. They would rather find a functional alternative to higher priced products such as Arc/Info. MapObjects, while being by design an interoperable player in the Windows environment, is strictly what you make it, having no default, multi-functional user interface. When comparing the cost of development time for a from-scratch approach like MapObjects to modifying the existing RAVE application, BCPL decided to implement the second solution.

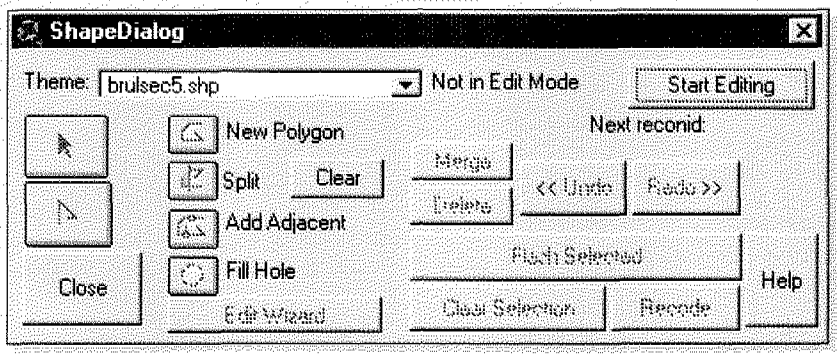


Figure 3
The polygon editing interface

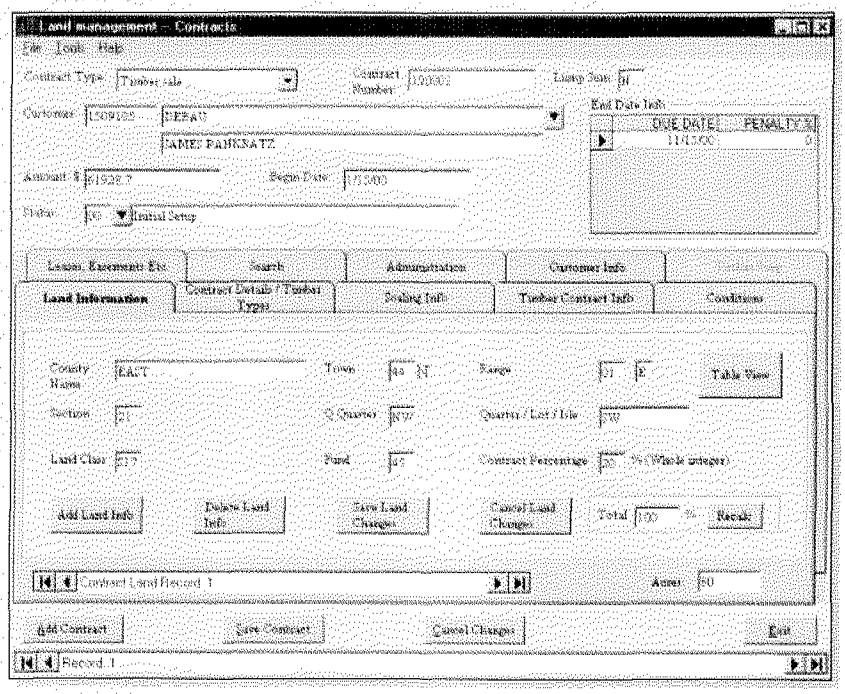
CONVERSION REQUIREMENTS AND STRATEGIES

The RAVE tool already contains several of the capabilities BCPL has chosen to implement. The polygon editing interface builds on ArcView's out-of-the-box editing routines to provide a compact, time saving dialog that also maintains the link between features and forest attributes (Figure 3). The application also contains an efficient tabular editing interface based on forms built with ArcView's Dialog Designer extension.

What RAVE does not contain is a direct connection to an enterprise database. Attributes edited in RAVE are eventually output to text files that are then manually loaded into the WDNR Oracle database. BCPL would like to replace this flow with a more efficient, interactive update of the database server, which in the Board's case is also Oracle. In addition, the tabular editing dialogs in RAVE are too restrictive for BCPL needs.

Once again, in the interest of economy, BCPL would like their spatial editor to be capable of editing a number of layers with different tabular dependencies. Even if this was not the case, the specific content and structure of WDNR's forest stand information differs enough from BCPL that just minor changes to RAVE's hard-coded references will not be sufficient. The sum of these discrepancies between the existing and proposed applications forces the design to carefully manage an economy of style. While intent on preserving as much of the previously engineered code as possible, new approaches must be pursued to provide the necessary functionality within budget.

Figure 4
A consistent set of Visual Basic derived forms



SOLUTIONS AND TRADEOFFS

In order for BCPL's Geographic Editing Module (GEM) to serve a variety of layers, the variables of tabular dependencies must be minimised. Following the pattern of earlier subsystems within the enterprise information system, BCPL would prefer that text attributes be maintained through a consistent set of Visual Basic derived forms (Figure 4). This eliminates the need to handle multiple table relationships in GEM, allowing it to focus on assuring that spatial features remain tied through a single key value to the rest of the system's related attributes.

The Oracle system developers must cooperate with this approach by denormalising some structures and by creating alternative structures, such as database views. Views are virtual tables based on SQL queries that combine records from multiple tables into a single, ArcView accessible logical entity. Once these database simplifications are in place, a layer configuration table can be built that defines a consistent set of parameters for each layer to be handled by the editor. GEM can read from this table the name of the spatial data file, the primary Oracle table, and the primary and foreign keys that join the two. Tabular fields can be assessed on the fly and generic attribute editing forms can be built accordingly.

Transforming RAVE's two step, manual method of updating the enterprise database into an interactive process for GEM could follow one of two paths. One way would be to set up a tabular link from ArcView to Oracle that lasts the duration of a GEM edit session. The tools in ArcView for managing and manipulating this type of table, however, are completely different from those that work with ArcView's native database format, dBase. By choosing the alternative route of downloading the required Oracle table to dBase format, RAVE code snippets can be reused.

Another advantage of severing the Oracle connection after making a copy is that the connection does not have to be maintained. At the end of a GEM session, records that have been flagged as being new or modified can be individually inserted or updated through a series of SQL expressions. The probability is low at BCPL that multiple editors might attempt to access the same data. This allows GEM to handle table locks in a manual way by setting a field in the layer configuration table to either checked out or in.

In the end GEM will be less specific than RAVE, but more flexible. As BCPL moves along the path of continued modernisation and automation, more sophisticated spatial tools can be incorporated. For the time being, however, GEM allows the Board to take a significant step towards integration and efficiency.

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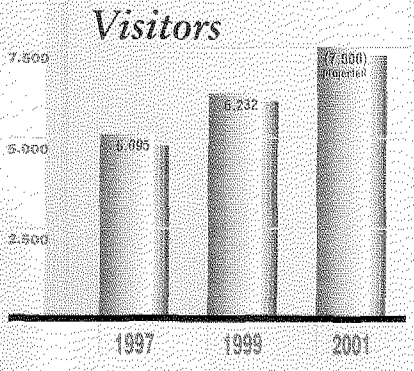

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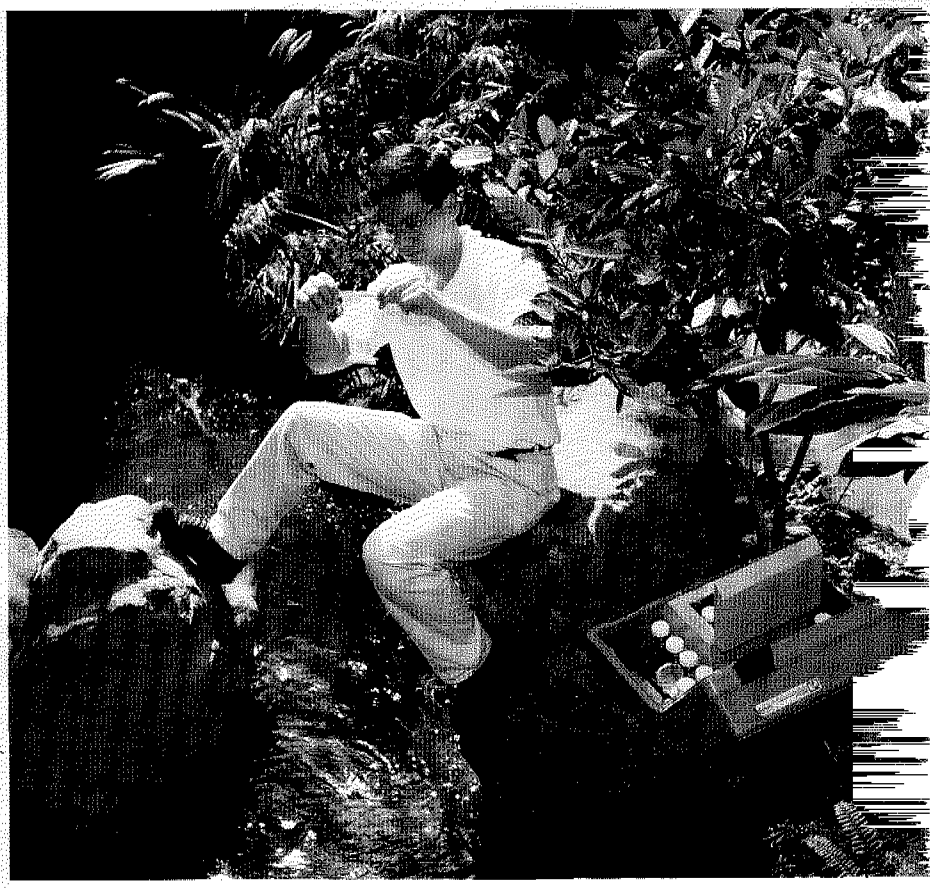

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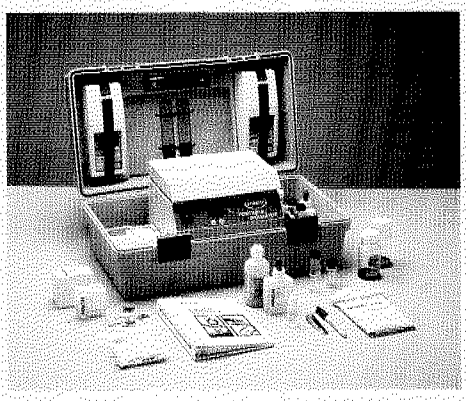

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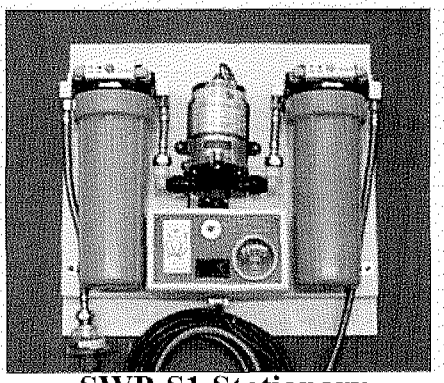

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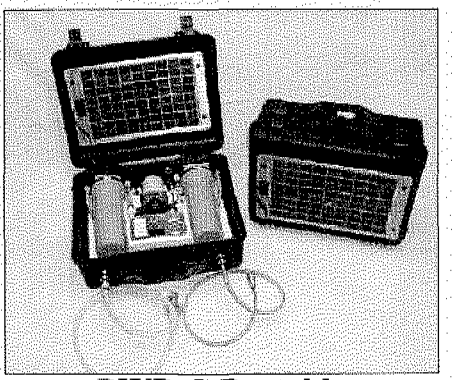

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The Caspian-Aral Sea Region: Earth System Science as a Means of Understanding and Empowering Decisions

Eric Frost & Dan Feistel, *San Diego State University, CA, USA*

Abstract

Many people in the western world have seen images of the drying up of the Aral Sea in Central Asia (Figure 1) and the resultant multiple health issues associated with the 'Aral Sea disaster'. Fewer people have seen images of, or are aware of the problems of the neighboring and much larger Caspian Sea with the rise of water level and the degradation of water quality and environment for animals and people. Our view from afar is understandably often simplistic and strongly related to media presentations of the region and problems, either from print or broadcast media. In a typically western worldview, many scientists and organizations are interested in what can be done to help or 'fix' the situation, fill the Aral again, or stop the rise of the Caspian. Much can be done; it is definitely not hopeless, but solutions are far more complicated because they involve people and governments. 'Fixing' anything is impossible without knowing what is really occurring. One of the ways to provide understanding is to quantitatively map the region and its earth systems, to help provide decision makers and aid organizations with the necessary tools to make appropriate management decisions to help the people and the environment.

This short collection of thoughts based on past efforts in Central Asia is a retrospective suggestion of what might help such individuals, organizations or governments to help the situation in this region. It is written from an Earth Systems Science approach, where, for example, the 'lost' water from the Aral Sea (Figure 2) is one of the primary providers of the agricultural livelihood for the millions of farmers in portions of Uzbekistan, Kazakhstan and Turkmenistan. Refilling the Aral to its 1960's level would decimate the economics of thousands of communities. Filling the Aral with the current agricultural wastewater would adversely affect the water quality of the existing Aral. Allowing the enormous quantities of 'agent-orange' type dioxins used in the Soviet-era to disintegrate where they are in the soils is probably a good

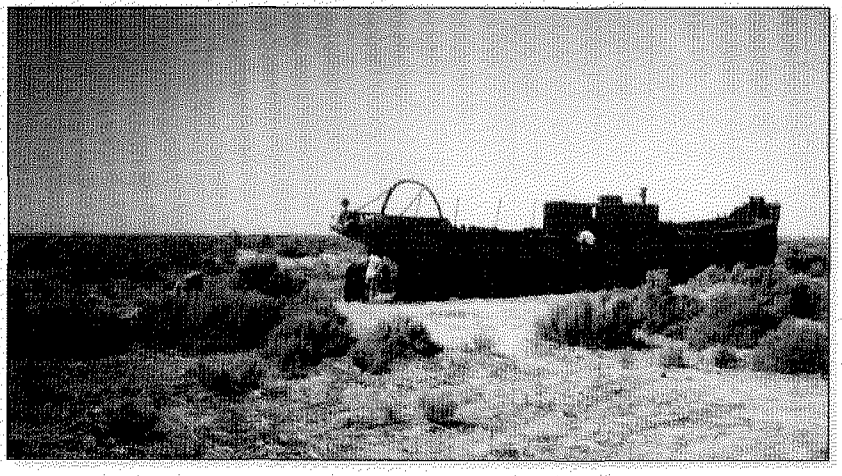


Figure 1
View of ship from former Aral Sea fishing fleet that is now on dry land with desert vegetation beginning to hide it as ecology of the bottom of the former sea passes into 'regular' desert. View is near city of Uchsai north of Muynak, the city that was the primary port on the Aral Sea, but which is now more than 50 km from the water.

answer. Bringing these dioxins to the Aral with return irrigation systems designed to reduce salinity in the fields and raise the level of the Aral is probably not be the best answer. Transport of highly saline water to the edge of the farmland in the desert, rather than the Aral, may be an effective short- to long-term solution. Improvement in drinking water quality and assistance in effectively raising crops for a better economic livelihood are some of the major ways to improve health and hope of the people. The water system of the region is so complex that it is almost impossible to manage without a significant increase in knowledge of where the needs are, where the water is, what the water quality is, and how it can be valued (priced) in some manner for its critical uses.

The rising level of the Caspian seems almost beyond real understanding, let alone finding solutions (Figure 3). 'Global change' are words that may describe what is occurring, but we know too little of the many influences on the level of the Caspian to provide a definitive answer to why the water level is rising and causing major damage to the infrastructure located at the waters edge. Decision-makers can't possibly make appropriate decisions if we cannot provide them with some understanding of what is really happening. Can we answer the simple question, 'Are the Caspian and Aral connected in their problems?' Yes and no, depending on what the questions are. We need to deal with world-class issues like this in a systems approach using answers found in other similar areas of the world (Figure 4) such as this area of Central Asia dealing with world-class developmental, environmental, and humanitarian challenges. Aid and development groups may help provide the linkage to bring solutions and problems together on a global basis.

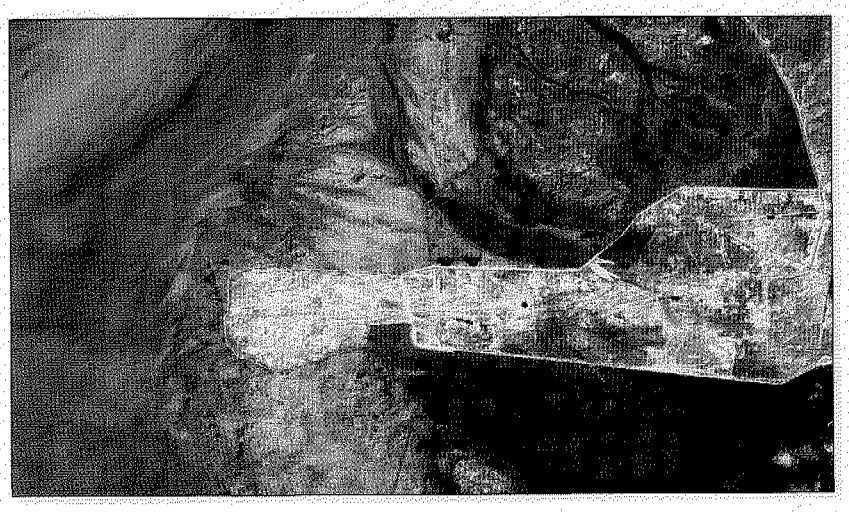
Figure 2
Landsat 7 view of the northern portion of the Aral Sea showing Little Aral and Big Aral separated by man-made dike, which was destroyed in spring floods of 2000. The dike kept water in Kazakhstan portion of Aral that was received from Syr Darya River, producing significant water level difference between the two parts of Aral. Image is Nov. 1999, 185 km across. Agricultural use of water is far greater in Uzbekistan and Turkmenistan (southern Aral water from Amu Darya) than Kazakhstan (water to northern Aral from Syr Darya).

SIZE AND LOCATION OF THE AREA

The sheer size of the Caspian and Aral reflect the difficulty of finding easy solutions. The Caspian is about same size as California and is larger than Germany. Kazakhstan itself is about seven times as large as California, with Uzbekistan and Turkmenistan both being larger than California or Germany. The overall region that needs to be considered is even larger because it involves the entire drainage basins of both the Aral and Caspian Seas, draining areas as far north as Moscow. Both these seas are closed systems, like closed bathtubs, which are fed by major rivers such as the Amu Darya and Syr Darya for the Aral and the Volga, Ural, Emba, Kura and many smaller rivers for the Caspian.

The size of the region helps explain its isolation and the difficulty for governments to understand the whole problem and implement policies and procedures to manage the regions. In the southernmost part of the Former Soviet Union it is warm enough to grow cotton and rice. It is also within the vast steppes of Central Asia, historically part of the Silk Road for connecting China and India with Europe and the Middle East. This history is critical to work through the complex political, spiritual and business framework into which any solutions must fit. Any solutions must involve the peoples and governments of the region. As an example, areas like the district in Uzbekistan around the Aral are considered as Karakalpakstan by many of the people who live there and see themselves as only a poor stepchild of Uzbekistan itself. The people of the region, however, provide the one of the most powerful motivations for helping solve problems, as they are people that are history in history, talent and potential.

Figure 3 (below)
Dikes around the large oil field infrastructure in a portion of the NE Caspian region. Rising levels of water, especially when the wind blows toward the east (right) threaten extensive infrastructure in the region. Drowned infrastructure is visible on this Landsat 7 scene (about 5 km across) outside of dike where covered by high Caspian level (processing by Tina O'Connor). Living materials in Caspian produce beautiful images of flow patterns.



CLOSED BASIN GEOGRAPHIC IDENTITY

Both the Aral and Caspian Seas are closed basins by geographic and geological definitions. Water comes into their basins but it does not flow out; it only evaporates or goes into groundwater rather than flowing to the oceans as water from most other basins does. Small-scale analogies are the Salton Sea of southern California (Figure 5) and the Dead Sea in the Israel-Jordan area, which are both about 1/30 the size of the Aral and 1/400 the size of the Caspian. Water, salts and impurities flow into the seas and the water leaves primarily by evaporation. Through time, the normal progression of geological events is that the basin becomes saltier and saltier depending on the water chemistry and the precip-

itation of salts. In many desert lakes, salt is deposited each year and the water completely evaporates, leaving a yearly deposit of salts and clay that gradually sink and compact as they fill the basin. Salts in some of these lakes form viable economic deposits such as at Searles Lake in California and in some areas of Central Asia. Many such basins in geological time also become oil and gas deposits, as organic material is brought in and thick sequences of sediment are accumulated in the sinking basin. These salts can be of great value and provide significant economic resources.

RECORD OF GLOBAL CHANGE

Constant deposition in a closed basin also produces a record of major earth processes involved in what is popularly known as 'global change' providing an excellent reflection of what is happening in an entire drainage basin. These closed records are commonly more understandable than systems connected to the world's oceans that involve more processes than we can easily separate. As records of global change, these regions contain answers and insight from past years that can be of assistance in understanding climate change in other parts of the world. As one example, the Aral Sea is mostly fed by water that is derived from glaciers in the Tien Shan and Pamir Mountain ranges, which are portions of the larger Himalayan Range. More water is generally produced when the climate is warm, less when it is cool. The receiving basin for this water has generally been the Aral, although the water has sometimes crossed out to the Caspian, not reaching the Aral at all. The Aral is thus much like the bulb on the bottom of a thermometer, recording the effect of the temperature and climate of a large region through time. This year, the sedimentary record is clearly recording the drought conditions and severe hardships on the people, their crops and livestock and indigenous animals and plants. The Caspian is a similar recorder of climate change, but from water derived from snow and rainfall runoff from a very large region, mostly to the north and west. Sediment-laden water from rivers like the Volga enter the Caspian and are immediately precipitated by the salty water, greatly affecting the environment. Spin patterns, like those in the Black Sea (Figure 6) and Salton Sea (Figure 5) make a complex Earth system.

VERTICAL AND HORIZONTAL RECORDS

As levels of both the Caspian and Aral change, they leave a vertical record of changes as sediments are deposited, slowly filling the basin and sinking under its own weight. They also leave an horizontal record, as the rise and fall of the water makes the shoreline either expand or contract, like a mud puddle after a rain. The undeveloped nature of much of this region within the Central Asian steppe has preserved these shorelines on a regional basis. Their chronology is not well known, but is clearly of major extent. One of the best ways of deciphering this chronology is from archaeological dating and study of trade routes. Most people did not walk on water in the past, so trade routes went around the water. However, most trade routes and towns were attracted to the waters edge because of the shortness of the route, the availability of fish and other food and the milder climate (especially in summer). There has thus been a complex interplay of the rise and fall of the Caspian and Aral with the location of the concentrations of people for several thousands of years and for change in shorelines for a much longer time.

Because the area is so flat, the change is very large on a horizontal scale, providing an extraordinarily sensitive measure of Earth processes. The same is occurring today, as the rise of the Caspian has demonstrated in recent years. This rise has incredible implications for cities and infrastructure around the Caspian, as it is difficult to drive on roads underwater, transport oil in metal pipelines underwater, or live in cities drowned by water. This change is the normal Earth system. Fixed shorelines, as we often tend to think of the shoreline of the Aral from the early 1960's prior to large-scale irrigation, are not the natural state of affairs of either the Aral or the Caspian. Horizontal exposure of once lake-bottom sediments can now be used for agriculture or nature reserves if the water is properly managed. As an example, the exposed former bottom of the Salton Sea of California grows several billion dollars of crops each year in a fraction of the area once covered by Aral Sea.

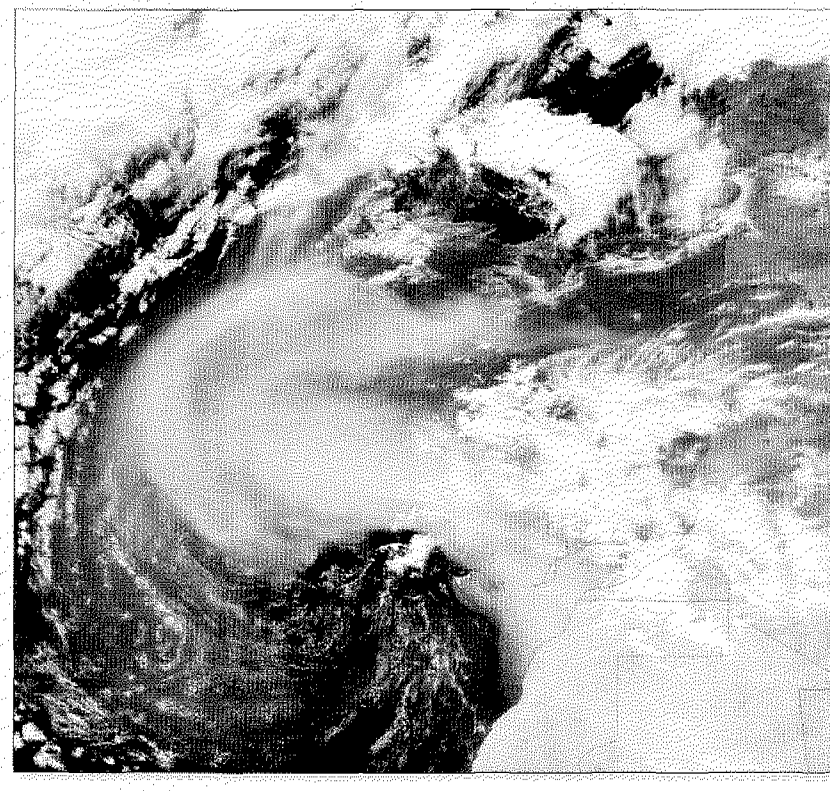


Figure 4
SeaWiFS satellite image of regional dust storm in the Spain (top right) and west Africa region, much like the dust storms in the Aral Sea region. Storm is larger than Spain. Regional imagery can help show how major atmospheric interactions and adverse health effects, as blowing of highly saline dust in the Aral region. From NASA SeaWiFS web page.

CHOICES AND DECISIONS FOR REAL PEOPLE

The reason of examining this region is not simply for a scientific understanding of Earth systems or climate change or potential natural resources. There are people living in these regions who are suffering from the non-optimal use of the water in the region, from the health effects of aspects of the Earth system, and from the non-viability of much of the economy in the region. The people that live in this region must make choices every day that affect their lives, as must the government leaders in charge of these people groups and the organizations and governments wishing to assist these people. Much can be done using tools such as Remote Sensing and Geographic Information Systems linked to the people on the ground. Understanding, however, must be of the whole system or the attempts to 'fix' the situation may well be counter-productive for the people and region. Several specific examples of this need for looking at the Earth system to try to provide 'understanding' for organizations and leaders will hopefully illustrate the need for studying the regional Earth system problem as a prerequisite for finding 'solutions'.

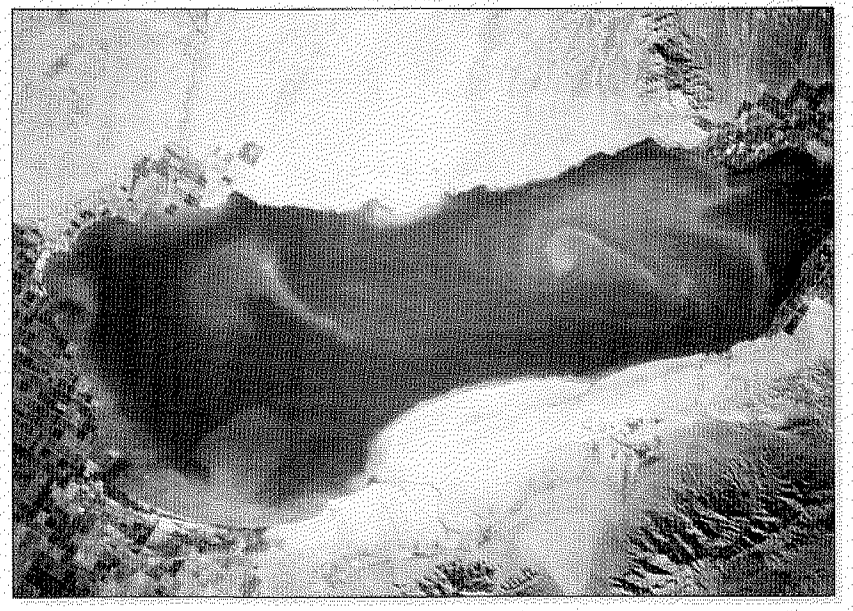


Figure 5
Salton Sea of southern California as seen from Space Shuttle, which is a tiny example of many of same systems as Aral and Caspian. Farmland was once at the bottom of the Salton Sea less than 300 years ago, but now grows several billion dollars of crops for two countries. It may be a laboratory to help the people of Central Asia for both education and practical solutions: people to people. Spin patterns in Salton Sea are similar to spin patterns in Aral and Caspian

People are the primary concern in this entire region. These people have often lived as families for several hundred years in same place and they have suffered hardships beyond anything that most of us in the West have ever experienced. They would like to be respected and appreciated for who they are, not be used as a source of Western study and promises without fulfilment. One of most effective ways to work in this region seems to be as relatively small People-to-People approaches of many Non-Governmental Groups (NGO's). Larger focus efforts involving governments are very effective to enable the leaders to understand the very complicated issues and help provide workable solutions within the context of the real people groups who live there.

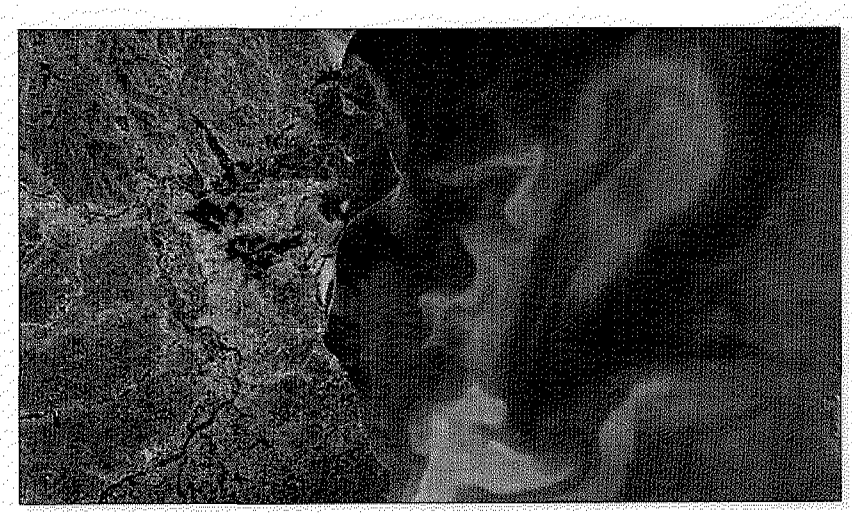


Figure 6
Circulation and phytoplankton patterns in the Black Sea that show the complexity of what occurs in seas like the Caspian and Aral, which have similar spin patterns. Environmental impacts of sediment influx, pollutants and future oil spills are much more complicated to understand and resolve given this complexity of motion. Rise of the Black Sea has drowned cities, as is now occurring on the Caspian. The reverse is happening on the Aral

HEALTH ISSUES

Health issues in the Caspian and Aral region are one of the major concerns for anyone interested in the region, especially those who live there. The 'Aral Sea disaster' is reflected in the very poor health, high risk of cancer and bronchial diseases in some areas, and generally poor health of the population. Good statistics are difficult to obtain for many reasons. Poor water quality, high salinity and hot weather, and poor wastewater and sewage treatment combine to make difficult lives and health settings for children and older people. This adds to the problems of the vast use of dioxins and pesticides associated with growing cotton and rice, dumping of agricultural and stockyard waste, and blowing of highly saline dust. Because we don't know how the water goes through the tens of thousands of canals or through the underlying old river meander channels, it is really impossible for any official or leader to formulate a wise use of water based on what is really there. Without being able to manage the water, many communities are really powerless to control their water issues or adequately grow crops or develop any new solutions: risks are not easy to take if you are on the edge of survival (Figure 7).

SALINITY ISSUES

Water in the desert rises to the surface as it evaporates bringing salts from the soils to the surface, where it then evaporates concentrating the salts. This is how water, soils and the atmosphere work everywhere. In most regions, such salinization is prevented by passing water through the soil, thus draining it and the dissolved salts away from the fields. Much of Central Asia agriculture works by flushing the ground with large volumes of water, which pass off elsewhere out of the farmer's individual fields. How to remove salts on a regional basis and maintain water quality downstream for drinking and irrigation are enormous issues in this entire region. Without this knowledge individual farmers and groups often have a very negative effect on other farmers around them.

When the impact is on people of different families, tribes or ethnic groups, the difficulty is even more pronounced because 'helping' others is not necessarily part of the culture of many of the people in this region. Conflict resolution on community to national scales is a part of the water issues of this region. Understanding the conflict or simply understanding that one group's wastewater is adversely affecting other groups is needed before people are motivated to change centuries-old practices. Point-source pollution on a large scale, like stockyard drainage, can affect huge regions and be unknown to people downstream. Pointing out the problem that one group's drainage is killing another group's children downstream is not necessarily wise in the context of the cultures of this region. 'Solving' problems often has political and cultural components that are very large and addressable only through the right cultural gateways.

IRRIGATION PRACTICES, UNLINED CANALS, WATER WITHOUT COST

One of the most widespread problems in the region is that the canals are not lined. Water leaks away from the canals and a great deal is 'lost'. However, this same water is filtered through the soil and often provides cleaner water for drinking from wells that are separated from the canals where the water is not filtered in any way (Figure 7). Water filtered through high-saline soil, however, is probably not better in many ways than the water from the canal. Unlined canals also result in an enormous amount of water being drained into the ground, with widespread evaporation and salinization. Leakage extending as much as 50 km from the Karakum canal in Turkmenistan is visible on satellite imagery. Lining the canals provides a great deal more control over what is occurring, but is clearly too large an infrastructure project for all canals. Clay lining or lining only selective canals are partial solutions, but are somewhat pointless without an overall view of what the water and pollution budgets are for the whole system. The fact that large volumes of water are needed to make the system work may be the best answer for many

areas - lining canals and reducing the amount of water may not, in fact, be a universally wise solution. The fact that the water is considered to be without cost makes its use significantly different than if it had some 'price'.

TOO MUCH WATER

At Ashgabat, Turkmenistan the ground water level is nearly at the Earth's surface because of leakage from the major canal taking water out of the Aral system, the KaraKum canal and it is literally drowning. The worst aspect of this is that the saturated ground at the Earth's surface greatly raises the seismic risk for the people of this city. Ashgabat was almost totally destroyed in 1948 because of an earthquake. With the building of Soviet-style apartment buildings and the high ground water level, the next earthquake could kill hundreds of thousands of people. Draining the water from the region could greatly reduce the risk to these people. Salt-resistant trees and plants that use large volumes of water may be an answer; taking the water elsewhere does not appear possible without large investments.

RECOMMENDATIONS

One of the most useful things that can be done is to understand what is occurring, as by regional use of Remote Sensing and Geographic Information Systems. This can empower decision-makers to understand the Earth systems and try to make appropriate choices to help the people and environment of this region. This involves a commitment to work for and with people and governments. One of the major things is to befriend people and communities to try to help them and to understand better the people, the culture and the difficulties of finding long-term solutions. NGO's are effectively working at this level so that there are specific programmes that can be joined or assisted. Larger efforts to empower governments are greatly aided by people at decision-making and educational levels connecting with and trying to assist people at similar levels in the countries in this region. Many western companies are working in the region and can help in some ways if people are willing to help find answers. The archaeology and history of this region along the Silk Road may provide a variety of opportunities for educational outreach and teaching throughout the region. Telecommunications such as fibre optic lines and oil and gas pipelines, often sited together, offer one of the hopes of solving regional problems as a by-product of specific development projects. Students working at universities on remote sensing, as at SDSU, can help enormously while doing class exercises and helping real people. Farmers, aquaculture and information technologists, and health workers can add immeasurably to the welfare of these people. Perhaps using this world-class example of Earth systems can help us all understand the world, our impact on it and some of our reasons for being here.

Figure 7
Well being dug near the bottom of nearly dry canal near the city of Shaghirlik (about 1100 people) about 20 km south of Muynak (70 km from Aral). Canal passing through town is main source of water. Shallow groundwater is too salty to use. The ability of this community to control its water is nearly zero because they are a small part of a much larger system that they do not understand and have next to no input into controlling

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Dan Feistel is a development worker in Uzbekistan with an emphasis on the Karakalpakstan region. He is attempting to use Remote Sensing and Geographic Information systems within the context of the culture and social structure to assist the people. He works with an NGO in the region, Joint Development Associates International, Inc., which has its head office in Tashkent. He has lived in Central Asia for 6 years and is functional in Central Asian languages.

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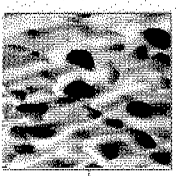

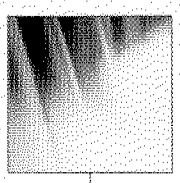

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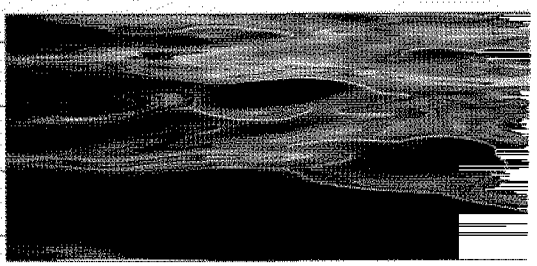

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MAMA-86 Drinking Water Campaign

Anna Golubovska-Onisimova, *MAMA-86, Ukraine*

ABSTRACT

Ukraine, one of the New Independent States with a territory of 603 700 square kilometres and a population of about 50 million, is located in the centre of Europe. With regard to water resources available for use, Ukraine belongs to the group of water limited countries. In dry years there are 670 m³ of river run-off per capita. Unequal distribution of water resources in terms of space and time throughout Ukraine makes water supply problems more complicated. Surface water is the main source of supply of drinking water. Approximately 60% of the population is supplied from the Dnieper River, 15% from other surface waters and 25% from groundwater (particularly in rural areas).

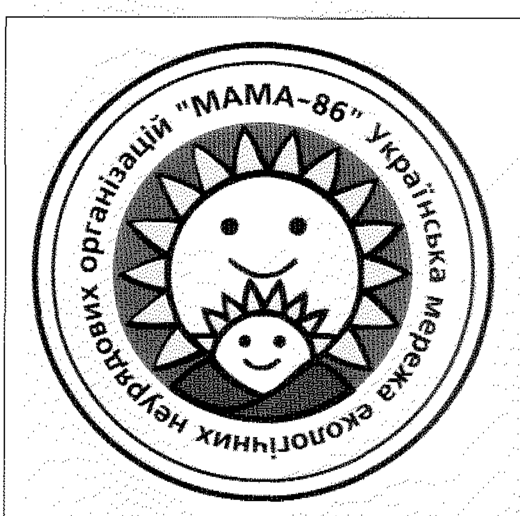


Figure 1 (above)
Collection of water for home use

Figure 2 (left)
MAMA-86 logo

As a result of a long period of administrative-command economic system development, the water resources of Ukraine have suffered from considerable anthropogenic pressure with subsequent deterioration. Basins of the main Ukrainian rivers are polluted, sometime severely, by nitrogen substances, oil products, phenols and heavy metals. The quality of surface water in Ukraine is in general too poor for drinking purposes.

During the transitional period of last 10 years in Ukraine, the economic constraints coupled with fundamental political and administrative changes have prevented the maintenance and extension of water and sewerage infrastructure. Reduced investment and decreasing activities have led to changes in polluting inputs, disruption of water supply and sanitation services, and disruption of pollution control. In general the situation in the water and sewage sector can be identified as a crisis.

The quality of drinking water is significant in determining the complexity of social and health problems in Ukraine.

In 1997 MAMA-86, an Environmental NGO in Ukraine initiated consultations on water problems. Quality of drinking water was identified by MAMA-86 network's member organisations as a key issue for action. We brought together community activists from different parts of the country with representatives of main stakeholders' groups and government to facilitate an integrated approach to finding a solution. From this network four organisations from different regions of Ukraine have started a campaign on drinking water. Today the water campaign is run by MAMA-86 Kyiv, 'Vidrodzhennia' Tatarbunary, MAMA-86 Odessa, MAMA-86 Artemivsk, 'Gaia' Sebastopol. Women's environmental groups from Mariupol, Kharkiv, Yaremche, Ternopil and Nizhin are also joining the campaign.

The short term goals of MAMA-86 drinking water campaign are to:

- monitor drinking water quality and survey public opinion;
- raise public awareness about the issues and provide information;

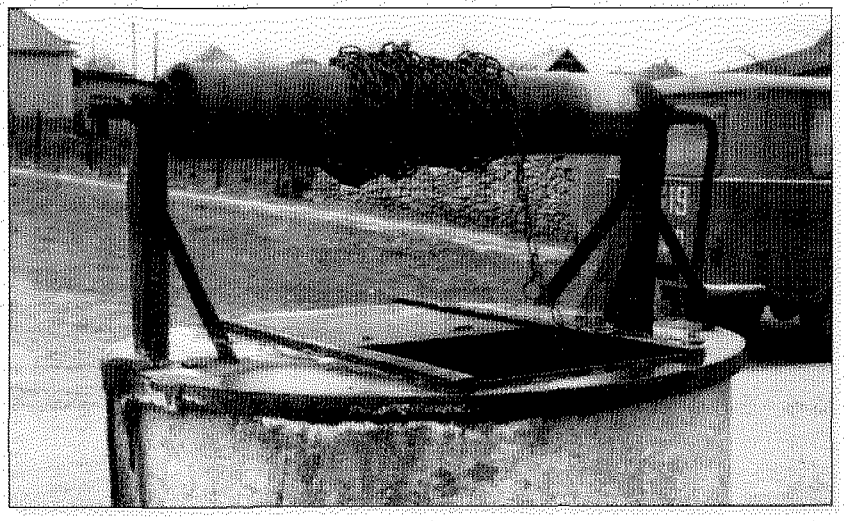


Figure 3
Conditions of water supply

- stimulate the cooperation and debates between different sectors;
- exchange already existing good practices from Ukraine and overseas;
- conduct pilot projects aimed at improving drinking water quality and rational water use;
- use international events to promote participation, consultation and partnership.

Long term goals of the Campaign are to:

- build public pressure for a change in water policy;
- activate the public and local governments to take action;
- promote the ideas of sustainable water use;
- involve the public in the decision-making process;
- build a public platform to lobby the national and local governments.

The basic activities of Mama-86 drinking water campaign are informational and educational, as well as implementation of pilot projects.

There is no tradition in Ukraine of disclosure of information and it is difficult for the public to obtain clear information from official sources. However, the public needs the information about water quality; about practical steps to improve water quality which can be taken to protect themselves and their families from health risks associated with inadequate water.

MAMA-86 undertakes their own independent tests on tap water quality and surveys public attitudes and habits regarding drinking water. The results of tap water analysis have shown the specifics of drinking water quality in cities of Kyiv and Odessa and the towns of Tatarbunary and Artemivsk, which reflect the state of pollution of water sources and the low level of water treatment. The main conclusions of the survey made in co-operation with Socis-Gallup International in 11 cities and towns of Ukraine were that 64% of respondents perceived drinking water quality as a major environmental problem, 15.6% considered that a large-scale public awareness campaign would be necessary, 21.3% believed that they had to rely on their own devices to improve water quality; many citizens interviewed agree to pay more, if the quality of drinking water were to be guaranteed. This is especially important now, when pricing of water becomes the primary issue and the majority of the Ukrainian population has very low income.

The quality of drinking water and consumers' concern about it are key factors which can help to influence the citizens' and environmental consciousness of the population in order to preserve water resources in Ukraine.

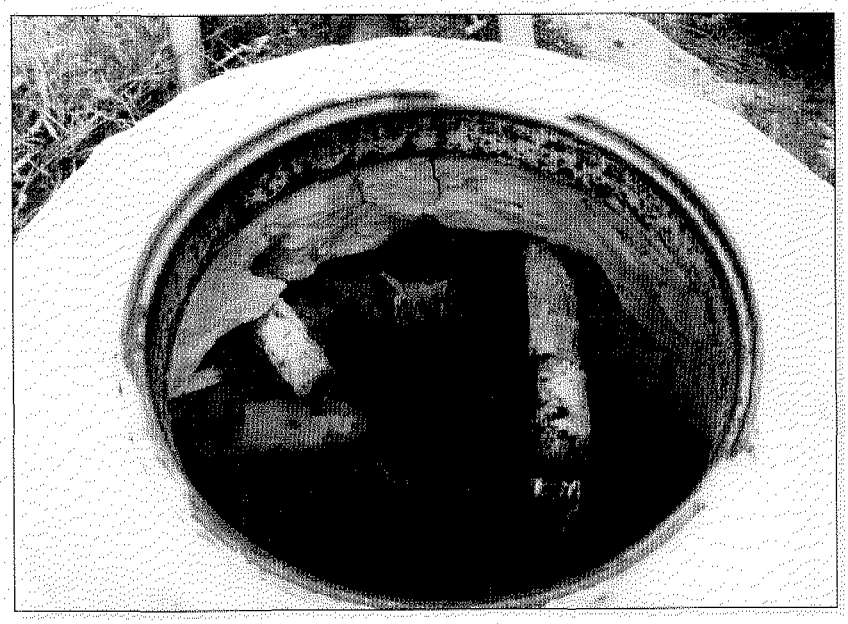
The MAMA-86 Network plays an intermediary role between the public and the Government at local and national levels to develop dialogue on water problems, to find practical solutions and help people towards a better future. According to the Aarhus Convention (ratified in 1999 in Ukraine) the public should be involved by the State in the decision-making process at the earliest stages. The implementation of this Convention in Ukraine should include the mechanisms of active environmental information provision by the State to the population, as well as the involvement of the population into the environmental decision making process, on water use in particular.

The MAMA-86 Network actively works on gathering and wide distribution of information on the water problems and the decision-making processes on environmental issues. There are many educational lectures; seminars and meetings are going on, articles and materials being published, radio and TV programmes produced on drinking water problems in the framework of MAMA-86 water campaign. We are sure that drinking water is the key issue for the building of democracy in our society. The popularisation of sustainable development and democracy-building principles with a focus on water resources management is very effective because the problems of quality of drinking water supply are very understandable as they are directly linked to people's life, performance and health. Due to the absence of state obligatory permanent environmental education, lack of awareness-raising policy and lack of economical regulative instruments, individual consumers have had no motivation to participate in the protection of water resources and economical use of them.

The objective of the MAMA-86 informational-educational campaign is to revive the feeling of citizens' ownership and their understanding of personal responsibility for national resources which are our rivers and ponds. The goal is to educate not only a rational consumer but also mainly an active citizen who becomes the main factor of sustainable development programme implementation.

On 22 and 23 February 2000 MAMA-86 held the seminar 'Basic principals of sustainable water use in Ukraine and the role of NGOs in preparation to the World Water Forum'. About 100 participants took active part in the seminar, among them: 26 Government officials, 19 experts and representatives of 25 NGOs from nine regions of Ukraine.

Figure 4
Rusting and disintegrating pipes



The implementation of sustainable development principles in management, protection and use of water resources is urgent and a vital matter for Ukraine. Today the idea of sustainable resources is not reflected in public opinion, national and local programmes, or State policy and economic performance. However, the idea of sustainable development is close to and understandable for Ukrainian environmental NGOs. It was the 'green' movement, determined by the Chernobyl accident, which resulted in important political changes and the establishment of independent Ukraine. But Ukraine needs State political will and consecutive actions for the implementation of the sustainable development concept. Development of partnerships between the Government and other sectors of the society (business, science, industry, trade unions, NGOs and public) is an obligatory precondition to solve the problems of sustainable development and to introduce the practice of sustainable water use.

Several important documents were the outcome of the seminar: NGO Position Paper 'Basic principles of Sustainable Water Use in Ukraine', 'NGO recommendations to the Government', 'Government recommendations to NGOs', linked to popularisation and promotion of the sustainable development.

One of the outcomes of the seminar was the decision to hold public hearings on new drinking water legislation. MAMA-86 has co-ordinated the NGOs' input into the new draft law, and we are going ahead with including in the new drinking water legislation the right for access to safe drinking water in adequate supply, as well as mechanisms for public participation on the monitoring and improvement of this law.

In the framework of the drinking water campaign MAMA-86 network implements the pilot projects on different practical solutions of drinking water problems at the local level.

At present, in Ukraine 25% of water treatment facilities have reached their expiry date, 22% of water pipelines are in state of emergency, 35% are worn out and inadequate.

45% of the population of Ukraine is consuming water which is below the quality standards adopted at the beginning of 1980. The health of the population in Ukraine is in a critical state; therefore small-scaled, short-term alternative solutions for the supply of safe drinking water to people today is an extremely urgent and important task.

Exchange of knowledge and experience on positive solutions of ecological problems (water pilot projects, in particular) and on citizens' role in implementing it are of the great importance for catalysing public activity. Non-governmental organisations should develop and increase the number of such pilot projects.

Development of rational water use among citizens is one of the important goals of the MAMA-86 drinking water campaign. It is important to note that during the former Soviet Union's time the concept of endless water resources prevailed. The payment for water resources never corresponded to the real value. Yet, the cost of water is not realistic and not transparent.

To compare: in the Netherlands, 1 cubic metre costs for the individual user up to 1.5 USD, whereas the same in Ukraine costs not more than 10 cents. Economical instruments are developing very slowly in Ukraine, while overuse of drinking water exceeds national standards (300 litres per person per day) by an average of 2–3 times, and 5–6 times the standards of EU countries.

Ukrainian Government has declared market reforms in Ukraine. The private sector is becoming involved step-by-step in municipal services operations. That is why the attitude to water has to start changing at the political, administrative, legislative and consumer levels as soon as possible.

Figure 5 (top)
Water purification device

Figure 6 (above)
Odessa: intake channel at the water supply station

SEBASTOPOL

In 1999 MAMA-86 initiated an international project on the reconstruction of Sebastopol City Infectious Diseases Hospital. The state of water supply, sewerage and heating systems of the Hospital are in a state of emergency. The Hospital's wastewater is insufficiently treated and contains pathogenic micro-organisms, a dangerous source of pollution to underground water and open sea.

The Tebodin consulting firm conducted a technical investigation (in June-July 1999) of the situation, resulting in a priority listing and first cost estimate for the reconstruction works. A local building firm is now conducting the construction work. NOVIB funded 90% of the project's budget. To develop the feeling of ownership among citizens of Sebastopol, MAMA-86 partner 'Gaia' has started a broad informational campaign in order to raise funds for and to involve local people, authorities and other interested parties into the Hospital reconstruction work.

ARTEMIVSK

In Artemivsk, the MAMA-86 partner has actively lobbied the local authorities to implement the City Programme on Drinking Water Supply till 2002. MAMA-86, together with major stakeholders, has prepared recommendations on: treatment plant reconstruction; putting into operation artesian wells in the town; and the production of bottled drinking water. The additional measures on drinking water improvement and finance building (8% of the town's budget) were adopted by the local authorities. In 1999, three town enterprises producing bottled drinking water were put into operation.

Figure 7
Secondary treated water

TATARBUNARY

In Tatarbunary, as a result of the MAMA-86 campaign, regional partners have received a drinking water purification device, which supplies the kindergarten with safe drinking water. This deal has activated local authorities. They have decided to buy two more devices to supply safe water to kindergartens and schools.

ODESSA

Odessa's MAMA-86 partner is actively developing their activity on rational water use. They have found that there is a 2.3–3.6 times excess of water use in Luzanivka district (about 10 000 inhabitants). The main reasons for such losses are leakages in water supply system and irrational water use. Due to public activities the local administration has conducted repairs of taps, pipes and overflow systems in apartments. Based on the data obtained, a leaflet on water saving was published and distributed in this area. This experience is broadly used in MAMA-86's educational work.

The MAMA-86 regional group in Odessa took action to provide consumers with information on the quality of commercially supplied drinking water. As the quality of tap drinking water drops, the spontaneous development of alternative systems for drinking water supply is becoming a real problem.

The volunteers of the 'Drinking Water' project in Odessa have conducted a public inspection of 98 commercial additional purified water units. The results obtained were delivered to the State Sanitary Supervision Organs. After the second government inspection 10 units were closed. The results and valid information on the situation with additionally purified water were presented in the leaflet 'What the consumer of additionally purified water must know'. This information contributed to the debates on legislation and technology aspects of alternative solutions for safe drinking water supply.

In December 1999 the regional group of MAMA-86-Odessa held a seminar on additional water purification problems. All the participants represented Odessa's water business. The experts on water purification and relevant regulations informed the business community about the requirements as to the quality of additionally purified water and the new technologies. The participants considered this seminar as highly informative and constructive.

CONCLUSIONS

Environmental NGOs play a significant role in the implementation of sustainable water use principals, making it real. But NGOs shouldn't replace the National and Local Governments in their duties. Also, when we are talking about an integrated approach to water management, this integration should not be cooked as a mixture. Structured mechanisms of performance and the true partnership of the different players are based on clearly identified duties and rights of those involved. Participation is the key word for the strategy to achieve sustainable water, although the roles of different participants should be specified. However, as for participating consumers – they should be citizens, first of all. The consumer is taking care only of his/ her tap water, while the citizen is taking care of the river where the water is coming from, and what will happen to the water after use. This is a challenge while introducing new NIS economical instruments in water management, including water meters, to promote the connection of these instruments to the environment, health and well-being; and educate citizens about it. The Governments should make better use of NGOs' information capacity and their experience to educate people about water sector reforms. We need people to understand the basic principles of ecosystem approach in water management. As water is vital to the life of each person on Earth, we believe that global thinking of people, needed for sustainable development, will be developed exactly via thoughts about water – blue gold of the Planet.

ABOUT THE AUTHOR

Anna Golubovska-Onisimova is a co-founder and acting director of MAMA-86 environmental NGO in Kyiv, Ukraine. She is 36 now, married, mother of 2 children. Anna graduated from the National Academy of Arts in 1987, where she trained as an architect, but since 1990, she has become more and more involved with environmental NGO activities. Anna participated in a large number of international projects and conferences, including UN CSD-2, CSD-5 and CSD-6, UN Women's Conference in Beijing in 1995, and a number of regional meetings organised by UN ECE. She is a Board member of ANPED (Northern Alliance for Sustainability), ECO Forum (Pan-European Coalition of Environmental Citizen's Organizations) and Women in Europe for a Common Future. Since April 1999, she has been the associate of LEAD (Leadership for the Environment and Development) International programme.

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Methodology for Selecting Desalination Processes in Water/Energy Supply Structures

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Abstract

Depending on the extent to which water becomes a more and more valuable property and its appropriation and quality protection develops as an essential importance for mankind, desalination processes will increasingly contribute to water reclamation, treatment, supply and saving measures not only in the arid areas of the earth.

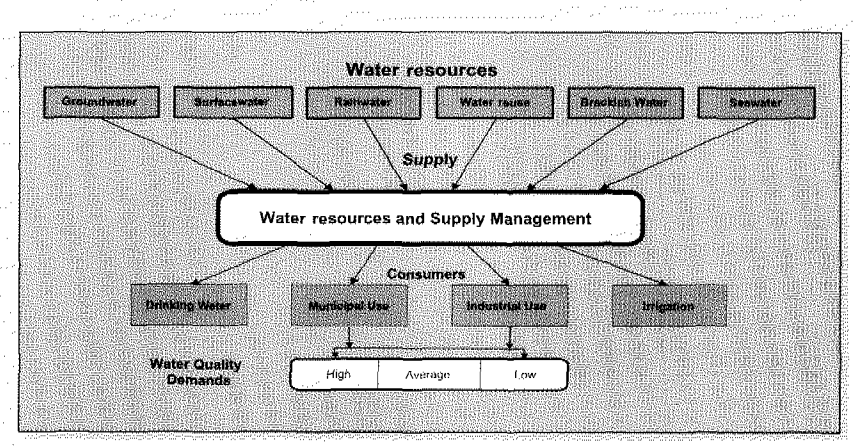


Figure 1 (top)
Role of water resources and supply management in water supply and consumption

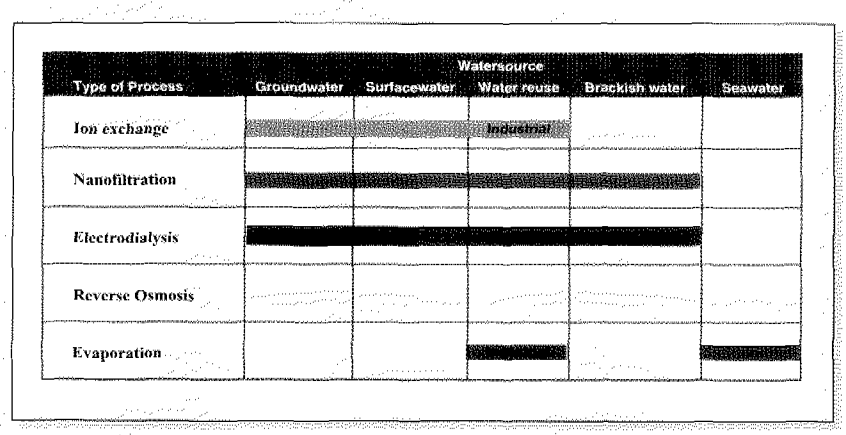


Figure 2
Desalination processes – fields of application for drinking water production and conservation

Role of Water Sources and Supply Management

Depending on the local availability of water resources and the existing consumer structure, the task of water resources and supply management is to:

- ensure optimal utilisation of the existing natural water resources
- ensure proper distribution of these with respect to water consumers
- make up for deficient resources by developing additional ones
- set up monitoring and control mechanisms to take account of future developments in population and industrial growth.

Apart from the exploitation of natural water resources – both ground- and surface water – it is possible, and also necessary, to make use on a regional basis of rainwater, to recycle and re-use water, and if these resources prove inadequate, to incorporate desalination of brackish water and seawater into the supply structure.

Re-use of effluent from municipal sewage treatment plants may be considered above all, for quality-oriented supply of municipal and industrial consumers as well as for irrigation purposes.

Desalination Processes – Fields of Application for Drinking Water Production and Water Resources Conservation

Desalination finds application in water resources and supply management for water re-use particularly in industry, but also for generating drinking water from brackish water and seawater.

Ion exchange processes are used for specific treatments, such as water softening or removal of nitrates from ground and surface waters, as well as for industrial water recycling. This also applies to electrodialysis. Evaporation processes have been employed up to now on an industrial scale in some applications in the textile industry, as well as in power plants for operating closed water and effluent water circuits. Nanofiltration has become established for treating all water resources, with a primary focus on surface water treatment as well as the re-use of municipal and industrial effluents. Although in these applications drinking water is not generated, the effect is to preserve drinking water resources. The application of reverse osmosis for water re-use may also be considered under this aspect. In municipal sewage treatment plants, reverse osmosis can be a step on the way to rendering the effluent drinkable. This process is already widely applied today for treating brackish water and seawater. Evaporation as a technology for generating drinking water is used in the main for seawater desalination.

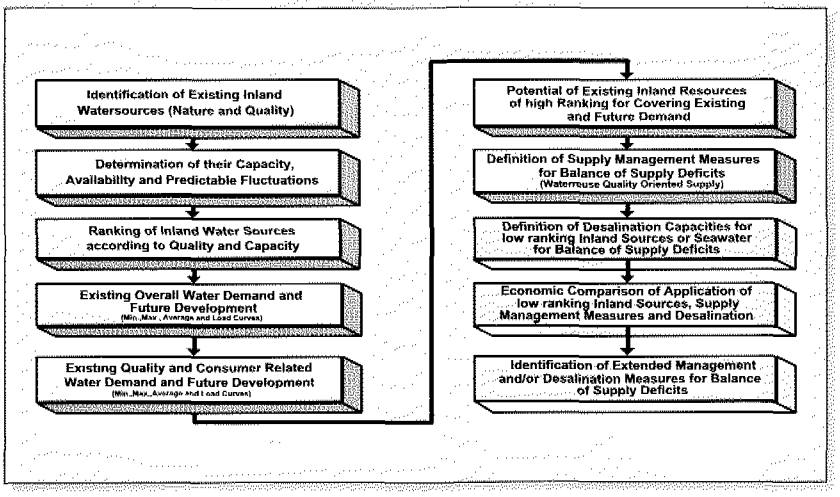


Figure 3
Role of desalination in water resources and supply management strategies

ROLE OF DESALINATION AND WATER RESOURCES AND SUPPLY MANAGEMENT STRATEGIES

In the stepwise establishment of water resources and supply management strategies, firstly existing inland water resources have to be identified with respect to their nature and quality, their capacities, availability and expected fluctuations, followed by ranking in order of their quality and capacity. The resource situation has then to be determined under the aspect of the total water demand and its future development and in addition as regards both quality and quality requirements of specific consumers.

High-ranking resources are then examined first to establish to what extent they can be used for meeting existing and future demand. In the next step, it is necessary to find out how supply deficiencies can be met by corresponding supply management – for example by water re-use and quality-oriented supply. These measures are to be compared with the application of low-ranking inland sources or of seawater with the application of desalination. To come to a decision, cost comparisons are made between the various options accompanied by investigations into feasibility, security of supply and consumer acceptance, above all of quality-oriented supply and water re-use. The decision taking process then concludes with identification of measures necessary for meeting balance-of-supply deficits with or without supply management and/or the application of desalination technologies.

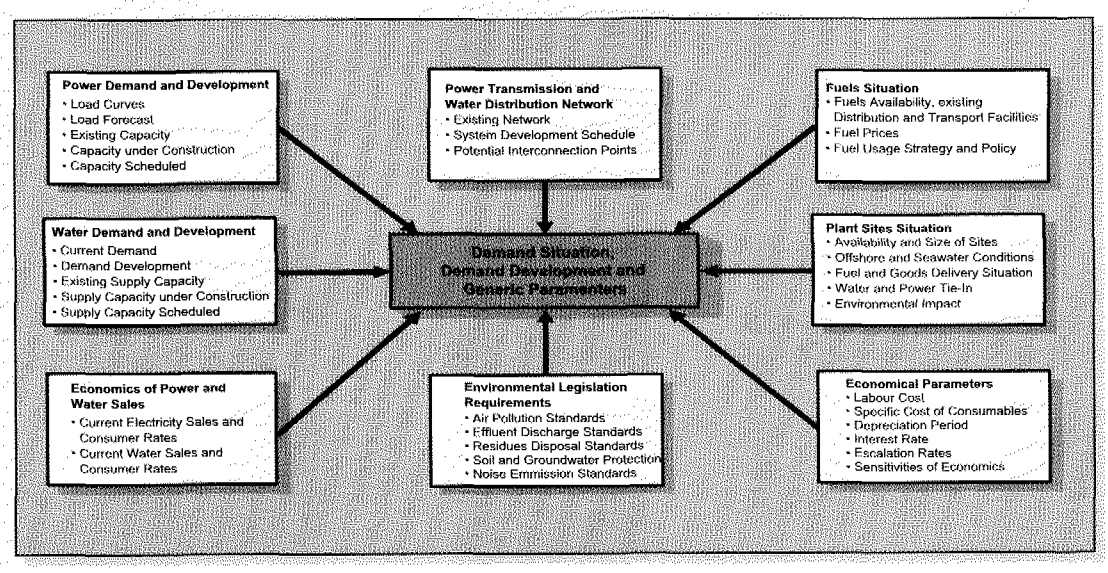
BASIC DEMAND AND GENERIC PARAMETERS

Before undertaking selection of desalination processes, firstly it is necessary to ascertain basic consumption figures for water (and of electricity in dual-purpose plants), available and planned capacities as well the electricity and water demands with future developments. Other general parameters which significantly influence the structure of the supply facilities are:

- situation of electricity transmission and water distribution network
- economics of electricity and water sales
- fuel situation
- land sites situation
- overall economic parameters
- environmental legislation and requirements
- methodology of desalination process selection.

If the supply of drinking water is the prime aim when selecting a desalination process, then at the start of the selection procedure, single purpose and dual-purpose plants are of equal ranking. In this case, electricity generation is a factor for reducing overall costs by the amount of income from sales of electricity. By comparing the drinking water production cost, in a first step the processes are ranked, and some may be screened out. In the case of single-purpose plants, this selection parameter can be quickly derived by a comparison of process economics. In the case of dual-purpose plants, first the electricity and steam production alternatives have to be compared, also under the aspect of how electricity and water load curves in their development and fluctuations can be met in the general supply structure. These alternatives will then be subjected to optimisation, followed by a comparison of their economics. This will involve estimating the costs for generating heat and electricity, which provide the starting figures for the following step of optimisation of desalination processes and a comparison of their economics. During a complex iteration process, electricity and steam production costs and their influences on the cost situation of desalination shall be matched to each other until a satisfactory balance is found, for optimisation of total costs. As a consequence, the production cost of drinking water will be known also for the dual-purpose process. However, the costs represent only a snapshot of the current situation, and by appropriate sensitivity analyses with defined

Figure 4
Basic demand and generic parameters in desalination systems selection



variation bands for fuel price, electricity export and import, escalation rates, depreciation period and product water composition, the influences on the remaining desalination options and their total costs should be investigated. The result is defined scenarios which indicate the variation band of drinking water costs under certain external influences, and so throw into sharp relief the risks and advantages of the application of various desalination processes. This provides the basis for finally selecting the process, provided that no additional investigations are to be undertaken regarding privatisation of all or parts of the supply units. In this case, the sensitivity analysis will have to be followed by a comparison of various scenarios considering:

- owner/operation alternatives for the desalination part, the electricity generation part, or both;
- influences of electricity and heat imports from external resources.

Following such analysis, a picture is obtained of the final costs and operating situation to permit selection of a process option.

CRITERIA FOR DESALINATION PROCESS SELECTION

For screening desalination processes, the key selection criteria on technical and process levels are:

- seawater quality, pollution situation and trends as well as the extraction situation, particularly for the critical site evaluation for membrane processes;
- process design and efficiency with regard to capacity, product quality and component design;
- construction materials and extent of automation;
- energy, labour and consumables requirements;
- layout and space requirements, particularly if only a restricted plot size is available;
- environmental aspects.

The cost of production of drinking water by seawater desalination today is in a range of between about 0.5 and 1.5 $/m^3$. Essential cost-determining criteria are:

- Basic design process design parameter like seawater salinity, composition and temperature and their annual fluctuations
- Capital cost for process equipment, civil works and infrastructure facilities
- Energy import and export cost (heat and/or power)
- Operation cost of personnel, consumables and maintenance
- Service life of membranes and membranes replacement cost (for reverse osmosis as desalination process)
- Site-related cost factors.

For desalination of brackish waters of lower salt content or for waste water recovery (waste water recycling in the industry, tertiary treatment of local waste water) the treatment costs mostly are below the cost level of sea water desalination.

In a comprehensive water management scheme it is to be carefully verified, under technical and economical aspects, to what extent natural water resources should be complemented by application of sea water desalination processes or alternative desalination techniques could be used in development of natural brackish water resources and within the framework of water saving measures in the industrial field.

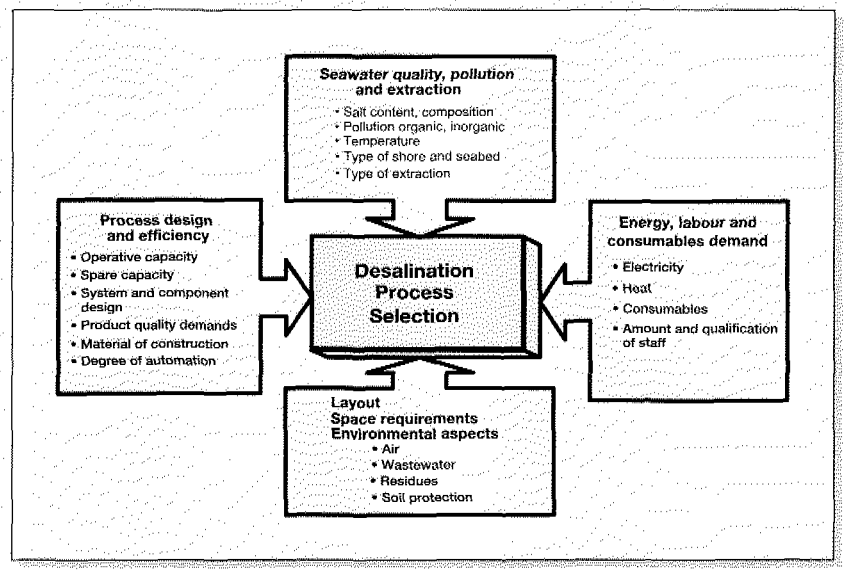


Figure 5
Criteria in desalination process selection

Depending on the extent to which water becomes a more and more valuable property and its appropriation and quality protection develop as essential importance for mankind, desalination processes will increasingly contribute to water reclamation, treatment, supply and saving measures not only in the arid areas of the earth.

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Sustainable Irrigation and the Gender Question in Southern Africa

Felicity Chancellor, *HR Wallingford Ltd, Wallingford, UK*

Abstract

The guidance from the Gender-sensitive Irrigation Design Study provides a range of practical pointers and strategies to improve the quality of participation for men and women in design. It focuses readers' attention on areas of design that are known to have given rise to difficulties for women users. It is hoped that these practical tips will assist implementing agencies to improve gender-awareness in the sub-sector and that the farmer-targeted publicity will raise awareness of gender issues and new possibilities and increase potential benefit from irrigated agriculture. More importantly, the publications aim to stimulate everyone's thought and effort in the struggle to combat poverty and inequity among smallholder irrigators.

Figure 1
Small irrigation schemes take advantage of small dams and river flows

INTRODUCTION

Smallholder irrigation is favoured in Southern Africa for a number of reasons: small-scale development is often physically appropriate to the resources available and suits traditional farming practices. Smallholder irrigation, despite its small scale, is complex; success and sustainability demand careful holistic design. Yet in general schemes are imposed on users, sometimes quite overtly, as in the case of resettlement schemes, and sometimes in a well-meaning attempt to reduce poverty and increase production. In either case, design is centred on water and plants and not on the people who will use the system. Now, not surprisingly, much of the complaint that surfaces in dialogue with irrigators relates to the difficulty of handling an irrigation enterprise with the resources available (Ubels & Horst, 1994; Chancellor & Hide, 1997).

Nonetheless, irrigation is rightly perceived as a method of boosting agricultural production (Pinstrup-Anderson & Pandya Lorsch, 1995) and it can make an important contribution to reducing poverty (IPTRID, 1999), but solutions must be found for existing smallholder irrigation schemes in southern Africa that perform poorly. Scheme infrastructure is maintained badly; leaking channels and broken down pumps abound and water distribution is often unreliable and inequitable. In such circumstances, production levels remain low; thus the impact of projects on poverty alleviation falls below expectations.

The majority of people directly involved in irrigated agriculture in Southern Africa are women and they are involved to the greatest extent at the lowest level. They provide much of the human labour in the fields although they do not usually have either land or water rights. Although they participate in the management of small schemes they are usually outnumbered on committees and take a minimal role in decision-making.

The trend for women to be solely responsible for irrigated farming has increased significantly as urbanisation accelerates and the AIDS pandemic takes effect. This change has not been matched by women's increased control of resources or involvement in management decisions. Yet future development of smallholder irrigation in southern Africa will depend on improved returns to investment in irrigation and more than ever this means that women's needs must be prioritised.

TRYING TO FIND SOME ANSWERS

The Department for International Development (DFID), UK, funded multidisciplinary research carried out by HR Wallingford, UK, together with Silsoe Research Institute, UK, working in partnership with institutions, government departments and NGO staff in each of Zimbabwe, South Africa and Zambia. The study investigated ways

Figure 2
Women participating without men are uninhibited

in which gender considerations contribute to smallholder irrigation performance and increase positive livelihood impacts of irrigation for women. The objective is to improve southern African smallholder irrigation through greater gender-sensitivity in design and operation (Chancellor *et al.*, 1999). Here the term 'design' is used in a broad sense including various aspects of planning.

> Gender-sensitive design refers to design that recognises the different starting points, job-obligations, constraints and aspirations of men and women regarding the use of irrigation facilities. A good gender-sensitive design would be one that maximises sustainability and production, while empowering both men and women to fulfil their objectives for an acceptable level of effort.

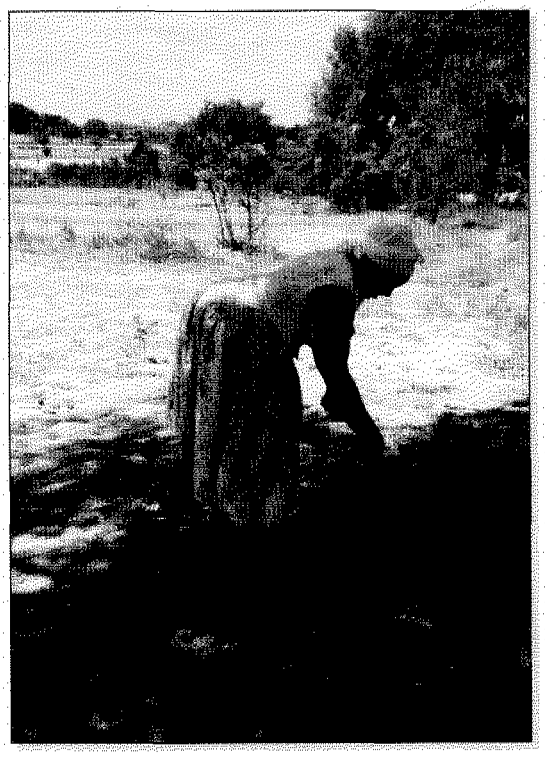

Figure 3
Women use the hoe for weeding and levelling

The study provided an interesting range of smallholder irrigation scenario and some variety of institutional arrangements that typified the sub-sector in Southern Africa. In Zambia the study focused on individual adoption of relatively inexpensive low technology for private use; in Zimbabwe, on communal, largely formal, irrigation on government assisted schemes, or NGO garden developments; lastly in South Africa, on regeneration of badly run down schemes and their turnover to farmer management.

An early survey in Zimbabwe answered the 'who does what' questions and looked at the problems particular groups identified in their workload. Analysis of the survey enabled prioritising of issues for further investigation in fieldwork. In-depth interviews and focus group methods were used later to establish understanding of the dynamics of gender-relations in the irrigators' households and in the sub-sector as a whole. Small interventions were used to illustrate the potential of some suggested strategies.

IDENTIFYING SOURCES OF PROBLEMS

Focus group discussions revealed that many difficulties arose from mismatches between design and user needs, largely due to the lack of participation of users at the pre-design and design stages and often causing disparity between men and women. It was already apparent that women are the main users and that men commonly participate in irrigated farming on a part-time or supervisory basis, their main employment being off-farm or in rain-fed and livestock enterprises.

> Women's labour is particularly increased by irrigation because of:
>
> - the year round nature of cultivation
> - the extra weed growth resulting from applying water (traditionally, women weed)
> - the extra burden of land preparation and levelling (now largely the responsibility of women)

Participation of women at the pre-design stage is important but difficult to achieve. Women are often neglected in the participatory process, often lack confidence and social backing to argue their case, and usually lack the information they need to make participation worthwhile. This crucial point was emphasised time and again and indicates that resources must be specifically devoted to innovative ways to include men and women in design (Figure 2).

The priority concerns were marketing, land preparation and equipment. Smallholders are characteristically widely dispersed and offer small quantities of produce for sale, which puts them at a disadvantage in relation to commercial growers. In irrigation there are additional considerations because, in the drive to grow high value crops (to fund the cost of irrigation), farmers grow vegetables with high perishability and for which local demand is low. Good marketing is essential to profit; it determines the resources available for land preparation and to buy and maintain equipment: more sophisticated planning is needed. Often smallholders have difficulty with formal planning and limited access to the required information. This is particularly the case for women, many of whom are handicapped by illiteracy and unrelenting

work schedules. In all three countries, seasonal glut seriously threatens the smallholder's ability to sell reliably at a profit. Commonly women face greater problems because they market small quantities and have difficulty with cost and logistics of travel. However, women are innovative and readily adopt value-adding activities or barter where cash is a problem for customers.

In land preparation, control of farm power is a critical issue and affects men and women differently. To hire tractors, cash is needed; if oxen or donkeys are mobilised, men control the timing. Women have significant problems with these aspects of land preparation. Their efforts to hire men to do their ploughing for them are sometimes subject to social judgements.

> 'The lady who has just left this place is one good example of a 'loose widow'. Who can allow her husband to plough for such a person? By allowing him, you will be giving him away for free', said one lady. A Matshalga, 1997

Design has a direct bearing on land preparation, for example a design that features large plots will increase the users' need for mechanisation and farm power, thereby increasing their production costs. Field application of water, by gravity via long furrows or by pressure delivery through sprinklers, determines user need to level land or plough even furrows. Designers should identify who will be responsible for land preparation and what their access to resources will be and take this into account when considering the type of design that is needed if farmers are to use the available water effectively. Men too have difficulty hiring tractors. Tractors are often in short supply and corruption flourishes in relation to obtaining their services. In South Africa designers and farmers addressed this issue by redesigning for short furrows.

Land preparation affects workloads, especially for women who add land preparation to traditional responsibilities for weeding and watering. When men report that land preparation is not onerous, women say it is hard; work that not only reflects their physical strengths but also that men have tractors or teams of oxen whereas women have hoes (Figure 3).

Sprinklers are often seen as a solution to land levelling problems. On sprinkler schemes other problems arise in relation to technology-use, availability and cost of spare parts. This was of particular importance where pumps are used in conjunction with sprinklers or to feed gravity distribution systems. Reliability of pumps is crucial to smallholder irrigation yet many pumps covered by the study functioned poorly. The cause of this poor performance was generally poor care and operation, rather than the pump in itself. Men are keen to be associated with pump ownership but are often absent at the time of breakdowns (Figure 4).

Training must be targeted at women to help them develop mechanical skills to assist them to deal with routine maintenance, simple breakdowns and avoid slow expensive external repairs that often cause serious interruption, reducing yield and, in the worst cases, causing total crop failure. *Training material often lacks appeal for women* (Figure 5). Women are highly motivated to undertake technical training and, where it has been possible, they prove to be conscientious and painstaking. The costs associated with pumps and the need for maintenance plans must be made clear to users to overcome problems of poor maintenance and to encourage timely repair and replacement.

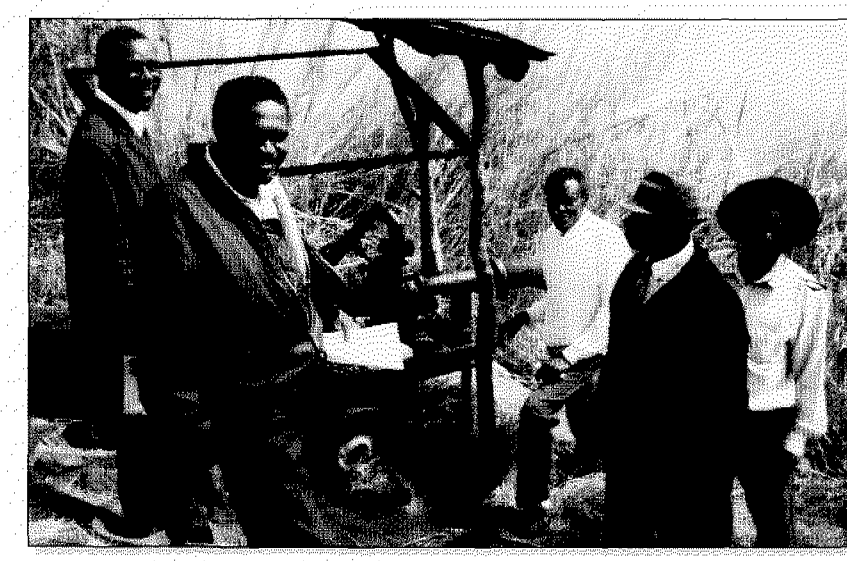

Figure 4
Men take pride in pump ownership

Another opportunity to improve performance comes from improving communications and practices, where pumps are operated and maintained by an agency. Poor institutional arrangements make it difficult for users to access responsible departments and request essential repairs. Women, who have difficulty travelling to distant towns to tangle with bureaucracy, suffer disproportionately from poor communication.

In general, maintaining infrastructure or machinery used on a communal basis is problematic: planning, organising contributions and allocating responsibilities is fraught with difficulty. The disparity between men and women in relation to objectives, workloads, resources and access to benefits contributes to the difficulty, as was illustrated at one irrigation scheme by a conflict between men, who wanted to use the tractor for a journey to town, and women who prioritised ploughing; there are many possible examples. Much improvement will result from gender-balanced participation in design.

GENDER ASPECTS OF TREADLE PUMPS

In Zambia, where shallow groundwater is widely available, there is relatively little formal irrigation and government and NGO staff actively promote the sale of treadle pumps to raise irrigation water for individual use. Treadle pumps rely on the operator for power and are an attractive, low cost technology common in Asia. They

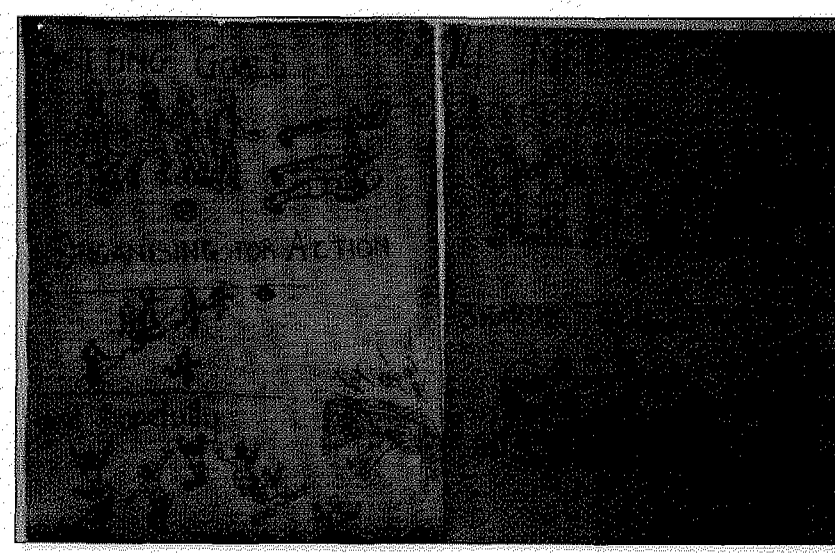

Figure 5
Training materials may not appeal to women

Figure 6
This pump had a seat added so the wife can use it when he is marketing

are relatively simple and cheap to manufacture, they are affordable to farmers, they are cheap to operate and maintain, relatively easy to repair, spare parts are readily available and improvisation is possible. As a result they are increasingly popular in development circles and are seen as a route by which African smallholders can access the benefits of small-scale irrigation (Figure 6).

In contrast to smallholder schemes that rely on farmers' ability to co-operate, the treadle pump can be owned, controlled, operated and managed by a household or individual. It does, however, require that water is accessible and the required lift is relatively small. It also requires substantial input of human energy (Figure 7).

Claims are made that the treadle pump empowers women and will have a positive impact on poverty reduction by assisting them at a level that matches their resources. Whilst these attributes are valid, the study revealed that other aspects should be taken into consideration and performance of current treadle pump users should be monitored to provide information to feed the participatory processes between designers and users. Although information is limited, the study revealed the following points:

- In Zambia treadle pumps market at around $US 67 without the hoses. This is a reasonable price for a locally manufactured pump with a guarantee, but it is still more than most rural women can afford. Hoses are expensive and may cost as much as the pump; thus less than 1% of direct buyers are women.
- Treadle users are able to grow more and better vegetables through reliable access water and increasing the area of land irrigated (land is not in short supply in Zambia). This increases the labour required to weed, both because more land is irrigated and because more water is applied.
- Women are able to do the extra weeding and transplanting as they no longer have to carry water by bucket and usually they do not operate the treadle pump because the work is too hard. Men and young boys operate the pumps; sometimes women pay the young boys to do the job.
- Previously, women marketed a wide range but small amounts of vegetables cheaply and locally. Because of the individual nature of treadle pumps and the access to shallow groundwater, growers are widely dispersed and may be far from market. Now the increase in volume of a limited range of vegetables (rape is very popular because it is easy to cultivate and matures quickly) make it necessary to market at greater distances. Little is known about how this impacts on the distribution of benefits within families or family decisions on crops; thus sustainability is questionable.

A number of issues arise from these observations:

Firstly, the cost of pumps needs to be low enough for women to buy, otherwise the extent to which women will benefit will be limited.

Secondly, if women are to be empowered, treadle pumps must be redesigned taking account of ergonomic and social needs of women.

Thirdly, to sustain treadle pump-use, the support necessary to develop new market strategies and environmentally and socially acceptable practices must be identified (in hand in Zambia through training programmes).

Lastly, attention must be given to evaluating different adoption patterns for treadle pumps and the associated links with the other livelihood activities of the users.

In addition it is crucial to consider the impact on poor people by monitoring non-users' access to shallow groundwater and the impact of increased production on market prices and the impact this has on poor buyers and producers.

IMPROVING GENDER AWARENESS

Studies that provide information on the dynamics between men and women and changes that result from new technology are urgently needed. The design of projects and developments, institutional arrangements, essential support services and related training all need to be considered in design of infrastructure and equipment. Although only one example of treadle pumps in Zambia was used for illustration, interventions to redress gender balance are complex in all situations. Participation of men and women separately and together is crucial to determine ways forward. There is no single solution; site-specific aspects of cultivation, land, resources, markets and social and cultural traditions dictate the options. More grassroots intervention is needed to ensure appropriate solutions are adopted.

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Part 1, Guidance for Smallholder Irrigation Development, offers guidance on participation, specific aspects of scheme design, training and considerations for future development, distilled from all three country experiences that are detailed in the remaining five Parts.

Part 2, Group-based irrigation schemes in Zimbabwe, provides an account of the gender issues that are common to this type of development taking into consideration the different management scenarios found among the schemes studied.

Part 3, Gender considerations relating to treadle pump adoption: experiences from Zambia, provides a brief overview of the situation of individual families who invest in treadle pumps and the impact on workloads, productivity and incomes.

Part 4, Gender issues in smallholder irrigation rehabilitation: cases from South Africa, looks at the special problems that arise for men, women and agencies that already have a vested interest in an existing, failing scheme and are faced with the challenge of turning it around.

Part 5, An assessment of the implications of pump breakdown and community participation in irrigation schemes, Masvingo Province, Zimbabwe, provides a rough costing of pump failure and draws attention to the gender impacts that were evident in the Province.

Part 6, Consultation on gender issues in smallholder irrigation, prepared by Zimbabwean sociologists, provides insights into the views and concerns of men and women on irrigation schemes in Zimbabwe.

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Felicity Chancellor has a professional background in Agricultural Economics Social Work. She concentrates on the rural development sector, specialising in water issues and irrigation, assessing the importance of socio-economic parameters in influencing performance of water use projects. Her recent work has centred on the issues facing smallholders, resource-poor farmers. Understanding changing social roles and objectives, and the implications for future access to water for demographic groups such as older people, women, widows, land-less people and the poor, is crucial to her approach. This approach has been central to winning research funds from DFID, UK, and to evaluation work for the EU.

Figure 7
Women often find treadle pumps hard work

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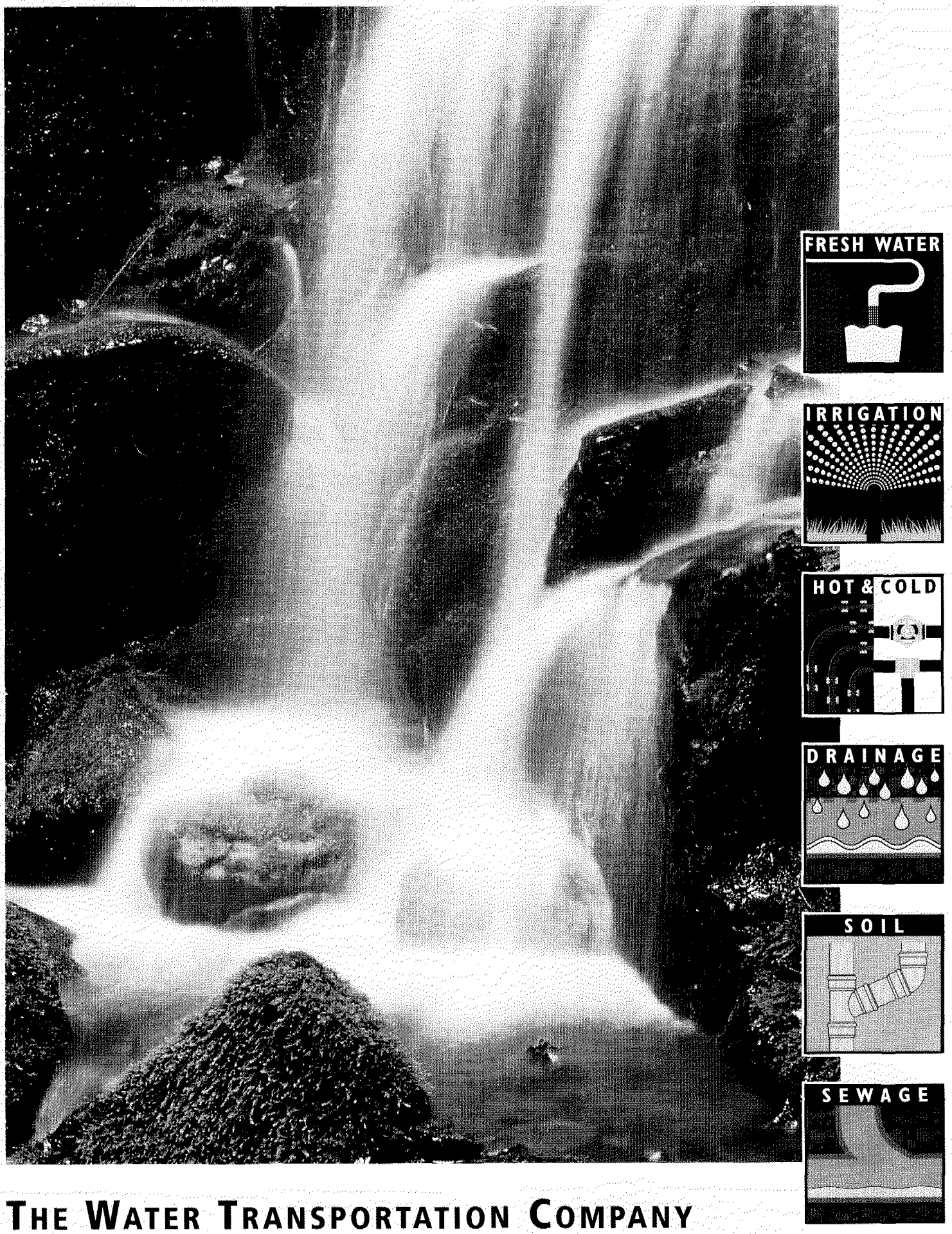

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Water Supply Management by Communities: A New Challenge for Support Agencies

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Raju Khadka, *NEWAH, Kathmandu, Nepal*

Abstract

This article looks at sustainability of dispersed rural water supply systems and distinguishes what we would like to call 'Management for the community' and 'Management by the community'. It then focuses on 'Management by the community' and outlines consequences for communities as well as agencies if this management option is chosen. Throughout the article, illustrations are provided showing how NEWAH, a Nepali NGO being primarily an implementing agency that participated in a four-year action research on this issue, supports communities in the development of a viable management system.

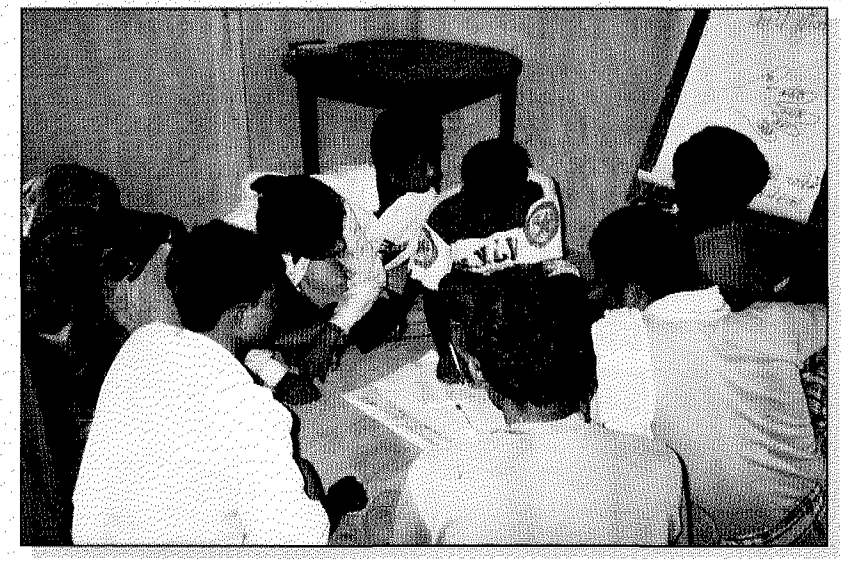

Figure 1
A planning exercise in Gajedi

The call for sustainability

In many developing countries the successful operation and maintenance of widely dispersed rural water systems can not be done without the full involvement and commitment of the users. Whereas donors usually do support the implementation of water systems, they leave the organisation of the systems' management to government agencies, whilst at the same time paying insufficient attention to sustained institutional support. However, central government agencies do not dispose of sufficient staff, transport and budgets to provide this type of service to rural populations, which leads to broken down systems, dissatisfied consumers and demoralised agency personnel (see Box 1).

Among the commitments made by world leaders at the Earth Summit in Rio de Janeiro in June 1992, was a comprehensive programme to bring sustainable water supply and sanitation services to the hundreds of millions of people who currently lack them. One of the guiding principles adopted in the New Delhi Consultation in 1990 and reconfirmed in Agenda 21, the Earth Summit's strategy for sustainable development in the 21st century, is: 'Community management of services, backed by measures to strengthen local institutions in implementing and sustaining water and sanitation programmes' (Evans & Appleton, 1993). This calls for states and support agencies to find ways to best support communities and local institutions. Making the transition from being providers of water supply systems to facilitators of processes in communities that results in better community management, is a way to do that. Done efficiently and effectively this can enlarge benefits from investments made and reduce costs otherwise involved in centralised, ineffective management. Supporting a more prominent role for communities as managers of improved water supply systems has several advantages. It can lead to greater efficiency in system performance, improve cost-effectiveness for both communities and agencies and has better prospects for the long-term sustainability of water supply systems. Resources otherwise used for reconstruction or rehabilitation of broken down systems can be diverted to increase water supply coverage.

Box 1

According to the World Bank only 6% of the population in Nepal have access to sanitation and 48% to safe water. These are some of the lowest rates in South Asia. Projects to increase coverage are undertaken by government, donors and NGOs, who work with local users groups to provide such services. Yet the government is plagued by problems, not least of all by instability and political differences among its civil servants. As a result staff changes are frequent at all levels, leading to insufficient coordination, little accountability of civil servants to District Development Committees and a general poor performance of operational departments such as the Department of Water Supply and Sewerage.

Figure 2
Improved water supplies in Yampaphant

THE CHALLENGE

Many governments embraced the idea of changing from 'providers to facilitators' and have become convinced that centralised systems cannot deliver the required services for the sector. Hence the strong push towards decentralisation that started in the late eighties and a growing trend to encourage rural communities to manage their water resources (see Box 2).

Still, many challenges are to be addressed. A first assessment of the situation in six countries that took part in a participatory action research on the role of communities in the management of rural water supplies (IRC, 1997) indicates that:

- In each of the countries, community management of rural water supply systems is the accepted national policy, but implementation is not universal and each agency has its own ideas on how this is best to be done.
- In spite of the national policy, governments do not treat communities as future managers in the sense that they can make their own choice from a range of options, each with their own pros and cons. Such choices concern the use of water resources and system construction as well as management organisation.
- Experience with existing community managed-water supply systems varies. In Cameroon, 438 schemes were built to be community managed. At the time of the assessment only 9% of these schemes are broken down. Many other schemes built without community involvement are no longer operational. Other countries report that a lot of community managed systems do not function well, partly for technical and ecological reasons, partly because of poor administration and lack of management training and back-up support.
- Training to prepare communities for management is often focused on technical tasks and bookkeeping, and is mostly given to men.
- Quite a few community members are not served because of poor water distribution and poor network management. Although many of these people have contributed to the construction of the system in cash or kind, they do not obtain the benefits.
- Problems with existing systems are of technical, managerial and socio-economic nature, but communities just mention technical problems. Other problems surface only after further probing and discussion.
- Record keeping, both financially and concerning agreements in meetings, is very limited and erodes the confidence of the community members. The same goes for communication and information sharing that is sparsely done and is mainly in the hands of the local leadership.
- Many agencies stipulate preconditions for future management, usually the formation of a water committee with some women representation and the establishment of a maintenance fund according to the agencies' principles. However little is done in developing management tools or management training.

A statistical analysis of an assessment done in 88 communities showed that good governance at the community level during project cycle is positively correlated with a more sustained water supply. 'Good governance' comprises characteristics such as: a local organisation monitors contributions to construction and deals with defaulters, women participation in monitoring and control, male and female community members are trained in technical, managerial, financial, and water use/hygiene aspects, and accounts are shared with the entire community (World Bank/IRC, 2000).

MANAGEMENT BY COMMUNITIES

Many definitions of community management exist and we do not intend to provide one overall, universally accepted definition here. We feel it is more useful to clarify the concept of community management by making a distinction between management *for* the community and management *by* the community and to subsequently take a look at the consequences of 'management by the community' for the actors involved. Without denying that many 'in-between forms of management exist' we distinguish three major actors; i) the public sector,

BOX 2

The main objective of Nepal's Government is 'to provide all Nepalese with water supply facilities of basic service level by the end of the period (2002) within a conceptual framework of sustained development, effective service delivery and equitable distribution of the WS&S services, defining and deliberating clear cut rules and responsibilities of the government and local institution, non government and user groups, emphasising on the general mass awareness to promote environment and personal hygiene and to mobilise and empower the local users groups and make them fully responsive to their roles and responsibilities'.

Ninth Plan includes the following objectives:

- To redefine the roles and responsibilities of the existing institution for effective and efficient service delivery and facilitate decentralised operational modalities.
- To develop the Non-government organisation, community based organisation and the private sector organisation as a partner agency for the overall development of the sector.
- The users groups and the local authorities shall be made fully responsible in the process of project formulation and operation and maintenance of the services.

ranging from national government to local authorities, ii) the private sector, ranging from small local entrepreneurs to multinational companies, and iii) the community, a heterogeneous group of people being or to be served by a water supply system. (IRC, publication forthcoming).

Management for the community can be described as a situation whereby, generally speaking, water users have neither the knowledge nor the interest to get involved in decision making as long as service levels remains acceptable. This is often the case in more urban areas. Consumers exercise their influence through selection of members of the management institution or by not paying the bill. The management institution can be a public utility or a private company being authorised by the public authority to manage the water supply system.

Management by the community can be described as

BOX 3: JUST TRAINING A CARETAKER AND A BOOKKEEPER WILL NOT DO

In Nepal, identification of problems revealed managerial problems that required strategies to improve managerial skills to address financial and leadership issues. This was translated into a five-day training course for the Water Users Committee. The objectives of the training course were to share knowledge and skills on group development in organisations, to highlight aspects of leadership, and to provide information on legal issues and on financial management and accounting.

Mr. Rameswor Lamichhane, one of the trainees, can now keep his financial records up to date. He commented that his bookkeeping system 'is an achievement of the training'. In Lele, Mr. Rajendra Silwal introduced a receipt and voucher system. In Lele and Gajedi, the WUC drafted their own constitutions, based on a sample provided during training, and initiated the process of legalising the committees. In Gajedi, a decision was made to reform the committee and Ram Bahadur Thapa was selected secretary at a mass meeting. For a long time Mr. Shiva Paudel was both chairperson and secretary. During the training he realised the importance of the leadership skills and the division of the work. A woman was selected as treasurer, because 'women are more loyal and honest than men'.

BOX 4: BASIC REQUIREMENTS FOR MANAGEMENT BY THE COMMUNITY

There is a need for political will to transform new concepts into action.

There is a need for an enabling environment, which guarantees that communities can establish legal entities that can take and follow up on management decisions, including for example tariff setting.

Communities should be allowed to ownership of the water supply system.

The choice of technology needs to be linked with operation, maintenance and management requirements clarifying what management it takes both at the local level and in terms of possible back-up by private sector or government.

There is a need to ensure that the level of service responds to a realistic demand of the community.

Agencies and communities need to operate in a partnership in which perceptions of problems and solutions can be discussed on the basis of equity and respect, valuing both agency and community knowledge in the same way.

Where communities collaborate with more than one agency, contradictory approaches agencies use should be avoided.

Decision-making needs to be transparent, ensuring that informed choices can be made by communities.

Management arrangements need to be made and agreed upon and should include building the communities' capacity to use practical management tools as well as the agencies' capacity to support communities as and when required.

Agencies need to recognise that the community does not exist and that gender as well as wealth differences and the conflicting interests that may result from those differences need to be addressed.

There needs to be an impartial institution that has the power of authority and the skills to mediate between the local management organisation and the users in case of important differences of opinion.

Both the agency and the community need to accept a learning period in which training and learning go hand in hand until local management organisations and the communities can cope by themselves with limited back-up support.

Adapted from Visscher ed., 1997 and Brikke et al., 1997

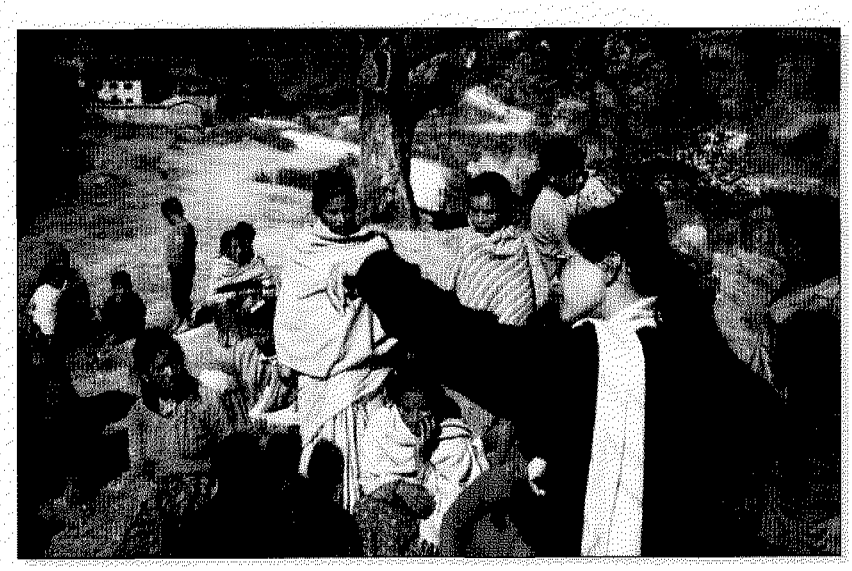

Figure 3 (top)
A meeting in Lele

Figure 4 (above)
Newah staff meeting women in Lele

a situation whereby water users are owners. Having ownership, they feel and are responsible for sustaining or even improving the water supply service level and hence directly or indirectly (through a local management organisation) take part in management decisions. Users contribute in cash or kind. Management by communities does not imply that communities must take care of everything or pay the full costs. A partnership with the other actors allows scope for sharing responsi-bilities between the local management organisation of the community on the one hand and the public and/or private sector on the other. The functions to be performed by the users or their local management organisation can thus vary considerably, depending upon the agreed division of responsibility between the actors. The different actors or their representatives thus have to come to an agreement on what the specific contributions and responsibilities will be over time. This they can only do on the basis of informed decision making by community members already during system construction, which particularly addresses the expected service level and the long term management of the system.

Whether managed by or for the community, for any water supply service to be sustainable, it is crucial that there is a demand and that users are involved in decisions related to service level and tariff setting.

IMPLICATIONS OF MANAGEMENT BY COMMUNITIES

Community management, however, faces a lot of constraints for agencies, public or private as well as for communities. As indicated above, agencies have a strong tradition and focus on construction of water supply systems. Still too little emphasis is put on the establishment of management capacity at local level for lack of experiences and strategies. It needs to go beyond training a caretaker and a bookkeeper (see Box 3).

The same is valid for the establishment of support capacity within the agency. On the community side, there is often a lack of experience with management of water supply systems and a lack of tools to cope with their management. On the agency side there is often a lack of skills to facilitate community processes. The legal and policy environment may also not offer sufficient framework for community management.

There are a number of basic requirements for management by communities (see Box 4).

An issue often overlooked is monitoring and the development of simple monitoring tools. If they are provided at all, most monitoring tools are reporting forms and not tools that help communities to identify potential problem areas and that initiate and stimulate action. Often more importance seems to be adhered to reporting on achievements (positive or negative) than to sustaining the service of the water supply system at the desired level. Monitoring should help tackle the technical, economical and managerial problems related to the performance of the system. Communities or their local management organisations need to be assisted in the development of indicators for potential problem issues and ways to collect information. Action to be taken if the desired level for specific indicators is not reached needs to be determined (see Box 5).

BOX 5

In Nepal exchange visits were used to monitor the process and outcomes of management improvements.

When visiting Lele people from Yampaphant the following was noted:

- a regulator can be used to equalize the flow of water; in their previous visit to Lele they noted that the water supply was poor, and that it was not supplied in all taps equally, but the problem had been solved by a regulator;
- daily cleaning of tap stands was also new; in their previous visit, the sanitary condition of taps and village was very poor, but now they found that the tap stands were kept clean;
- the use of water tariff payments cards was also found very effective; if households pay their water bills in time, they get a 50 Paisa discount.

SOME CONCLUDING REMARKS

Currently in most countries, community management of rural water supply systems is the accepted national policy. However, political will is needed to transform policy into practice. Communities are usually not treated as future managers in the sense that they can make their own choices from a range of options. Nor do they get sufficient opportunity to learn the required management skills. This and the lack of back-up support for problems going beyond the community level are important reasons for the sub-standard performance of many systems. This will continue to be the case unless the managerial aspects are better taken in hand and practical management tools are developed together with communities.

Fortunately, new learning approaches emerge and are gradually being adopted in challenging institutional settings where community knowledge and institutional knowledge are equally valued and people start to respect each others' views.

The partnership approach means for agencies that strategies and methods are needed to foster management capacity with communities, building on existing knowledge and practices. This also implies that agencies need to make the necessary adjustments and strengthen their own capacity to replace a top-down approach by an approach whereby they provide effective support to communities. Communities also need to come to grips with working with the agency staff in a horizontal relationship. On both sides there is a need for the paradigm shift of communities participating in agency projects to one of the agencies participating in community projects.

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Figure 5
A hot debate in Lele

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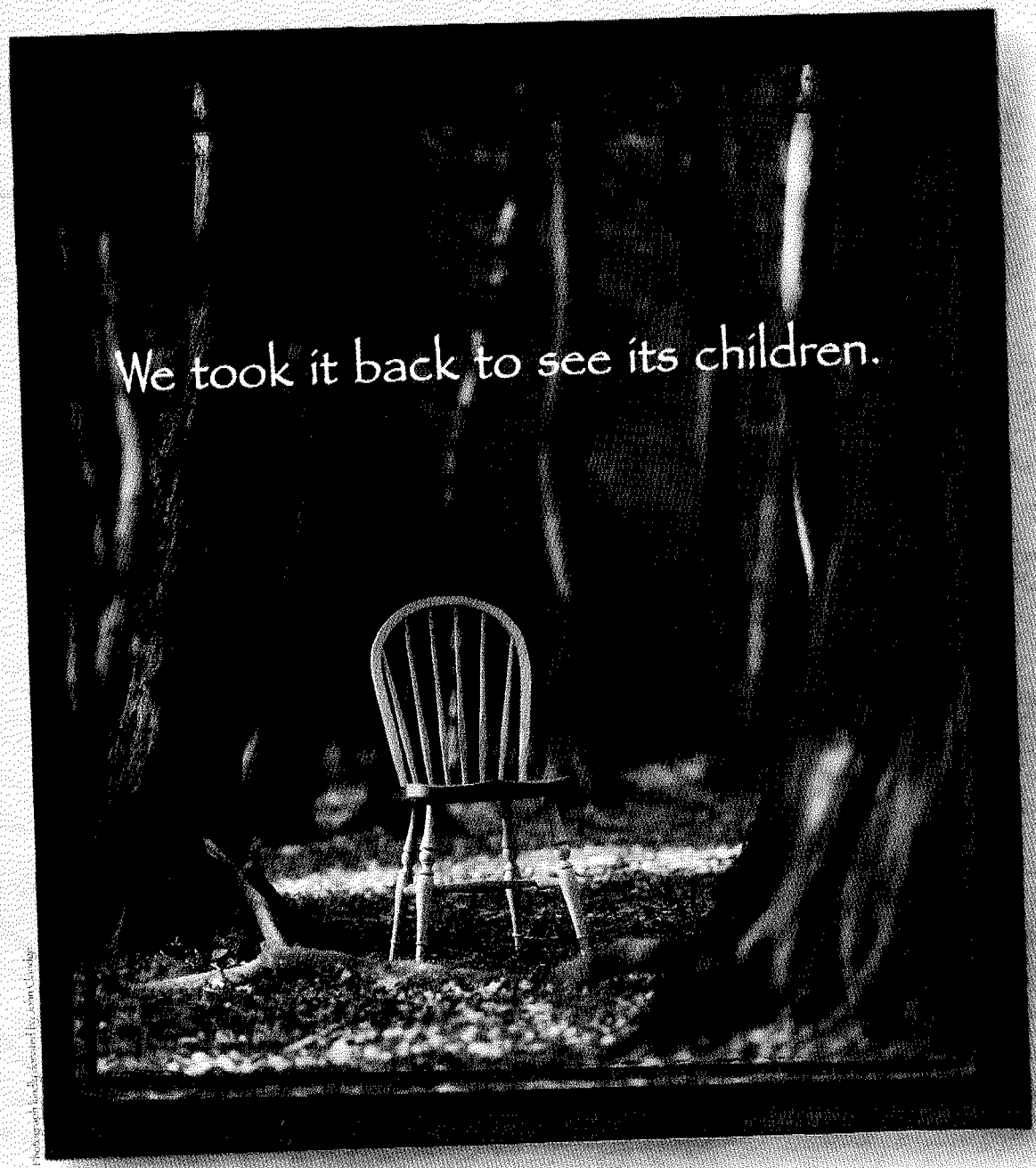

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SECTION 3

FORESTS

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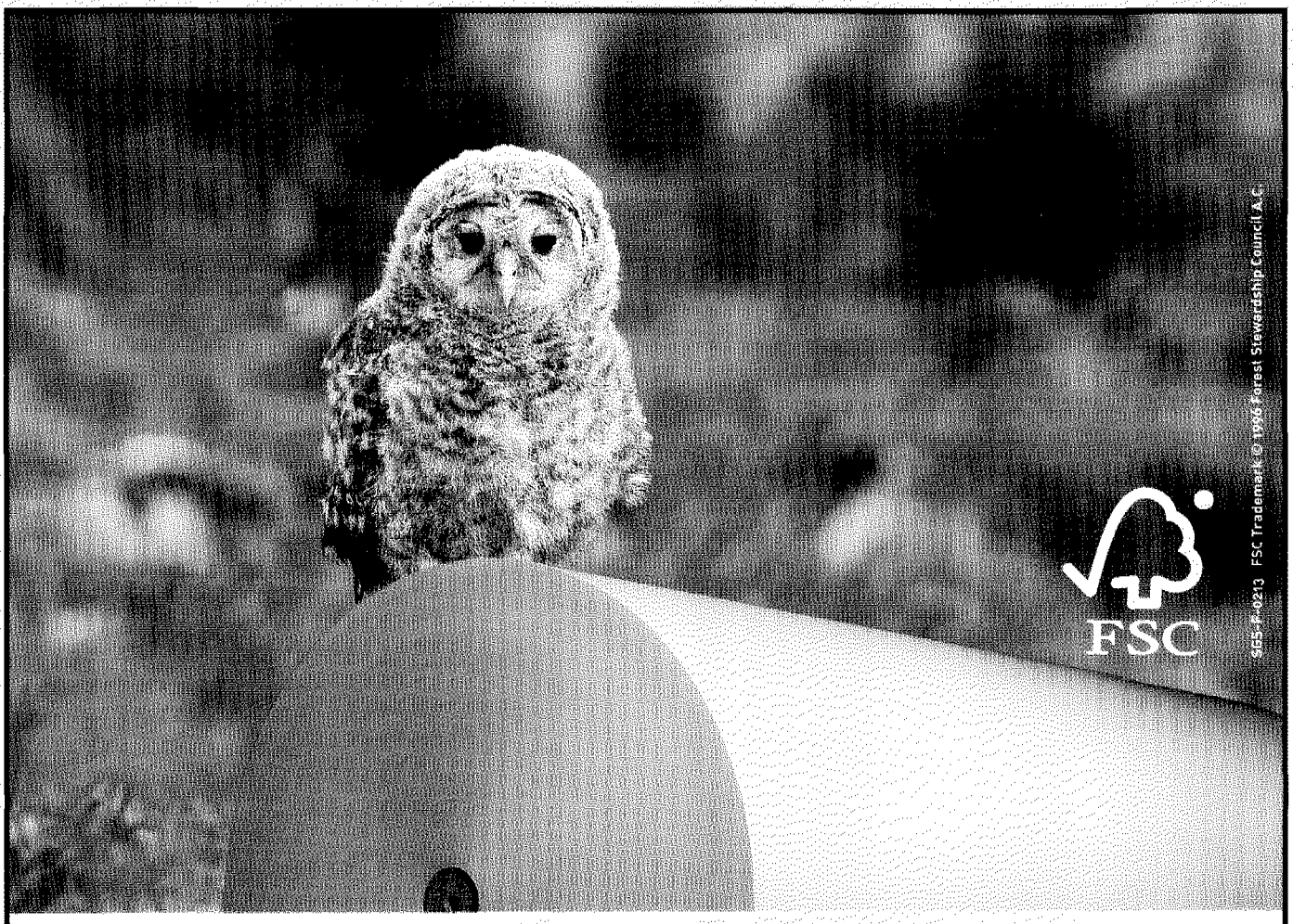

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The Challenge of Risk Management within Analog Forestry Interventions

Aaron M. Becker & Emily S. Goldman, *Counterpart International, Washington, DC, USA*

ABSTRACT

The integration of environmental conservation with economic development has historically faced considerable challenges. Convincing poor rural farmers to adopt new technologies requires a high degree of trust, support and accountability between farmers and implementers. Based on the principles of Analog Forestry and Community-based Ecosystem Management, Counterpart International and its partners implement the Forest Garden Programme to provide economically viable and environmentally sound opportunities for raising rural incomes, restoring degraded land, and preserving native biodiversity through community-led management of watersheds, forests and agricultural lands. This study focuses on the participation of Sri Lankan farmers in the programme. Success of the programme, rates of adoption of and withdrawal from the programme, as well as its long-term sustainability are highly dependent on project implementers' ability to reduce risk and make substantial functional linkages between farmers and their fledgling Forest Garden-based enterprises as well as their sustainable use and stewardship of their natural resources.

Figure 1
Dr. Ranil Senanayake (r.), developer of Analog Forestry, discusses a Forest Garden farm plan with an extensionist. Extensionists and farmers assess plot designs on a regular basis to evaluate plot progress and ecological succession

THE FOREST GARDEN PROGRAMME

The Forest Garden Programme assists farmers in creating sustainable livelihoods through environmentally-friendly agroforestry and the cultivation of multi-crop tree and shrub gardens that:

- produce a range of subsistence and cash crops,
- arrest erosion, build soil productivity, and retain groundwater, and
- mature to approximate natural forests in architectural structure and ecological function.

Forest Gardens (FG), founded on the principles of Analog Forestry developed by Dr. Ranil Senanayake, mimic the structure and function of endemic forests in the region, thereby producing plots analogous to natural forests. These organic agroforestry systems are composed of canopy trees, vines, understorey shrubs, valuable subsistence and perennial cash crops, fuelwood, medicinals and other products. The choice and placement of each species is determined by both its economic and ecological functions. Specifically, the Forest Garden Programme fosters the introduction of sustainable farming through a network of seedling nurseries and community seedbanks, seeds-and-tools funds, technical assistance and training, and certification and marketing of Forest Garden Products (FGPs) (Senanayake & Beehler, 2000).

FOREST GARDENS, SRI LANKA

Sri Lanka is the birthplace of Analog Forestry. Devastated by widespread deforestation, low agricultural yields and the introduction of high-input monoculture crops, FGs were developed to rehabilitate Sri Lanka's landscape, build its soil fertility, boost annual incomes, enhance and diversify subsistence-level crop production, and strengthen appropriate traditional land management practices undermined by decades of extractive natural resource policies. FGs are low-cost, provide communities with a greater variety of foodstuffs, and serve as biological corridors connecting forest islands which offer contiguous habitat for forest-dependent wildlife. This programme provides rural Sri Lankan communities with a viable alternative to destructive high-input agricultural practices and encroachment on protected forest areas.

- The programme works with nearly 500 farmers (over half of them female), rehabilitating 870 acres of land.

Figure 2
Some of the young monks who participate in the Temple Forest Garden Programme in Walapane, Sri Lanka. Analog Forestry complements the Buddhist worldview, with both placing an importance on planting trees and careful stewardship of natural resources

- Tree and seedling nurseries have been established in 12 communities, propagating a total of 73,308 plants for reforestation – a value estimated at $52,400.
- FGPs from mature sites are being purchased by several organic products exporters (Lanka Organics, Guayapi Tropicals, and Quickshaws Ltd) paying premium prices for export-quality certified products. The average monthly income, Rs. 3000/month prior to project inception, increased on average Rs. 824 with the introduction of income generation activities such as vegetable and spice cultivation, seed collecting and plant nursery development.
- In addition to bi-weekly extension to farmers, over 100 training courses were conducted last year, including soil and water conservation, nursery practices, traditional methods of pest control, processing, packaging, and marketing of FGPs, and data collection.

These enriched plots are proving to be a steady source of income for rural farmers. Efforts to restore native biodiversity have been successful – rare birds such as Lady Torrington's Wood Pigeon and the Three-toed Kingfisher, which had been absent for many decades from Sri Lanka's deforested valleys, have reappeared in mature FGs.

THE REAL SCOOP: MANAGING RISK

The above summation paints a tidy picture. What it fails to describe are the inherent risks and challenges involved in introducing new ideas to disadvantaged farmers, and the continuous negotiation between project implementers and beneficiaries required for a project to be successful, as well as the 'wild cards' presented by the weather, markets, land tenure and socio-political mores. The beneficiaries are small-scale farmers with limited access to land, capital, new technologies, market leverage, and economies of scale, who employ mostly unskilled family labour. The commitment and willingness of these farmers to adopt new agricultural and land/watershed management practices depends on their perception of the risks involved and their confidence in being able to overcome them successfully. In the initial phases of the project, it is the role of the implementing organisation(s) to help minimise and manage farmers' risk. Counterpart International's ability to help solve farmers' problems through the promotion of new concepts depends on our effective linking of wise stewardship of farmers' resources with their own and future generations' well-being. While risk factors such as political upheaval, land tenure instability, and environmental disasters are difficult to contend with and often hard to predict, the following illustrate a few ways risk has been managed in the programme thus far.

DIALOGUE AND APPROPRIATE TECHNOLOGY

Each farmer household represents a unique set of circumstances, values and risk tolerance. These are traits that shape how each household perceives the problems it faces and selects ways to solve them. It is critical, then, for project implementers to understand the needs of each family and community, and to be able

Figure 3
Samples of certified Forest Garden Products from Sri Lanka currently on the market

to exchange ideas in mutual respect. Programme personnel must take time to build relationships with the people among whom they will work, gaining their confidence and trust. Only dialogue, requiring critical thinking, is capable of producing critical thinking. Without dialogue, communication is impossible (Freire). Only then can the project be informed to embody the interests and concerns of both parties and make adoption of new ideas by individual farmers more likely. Through this dialogue, a critical rapport is nurtured and a learning process developed between interventionist and farmer. This process requires project officers to 'be honest and reliable with farmers, to be a partner and to build with farmers' (Analog Forestry Network, 1997, p.16).

The introduction of Analog Forestry is the outgrowth of a dialogue between farmers and interventionists, comprising a bundle of ideas that 'meet a felt need, are simple to teach and understand, and use resources poor people already have' (Bunch, 1982, p. 97). While all appropriate technology is not assured long-term success, the farmers' active participation throughout the process of identifying the problems, choosing solutions, and implementing them on their own lands will lessen their reticence to try the new techniques.

Dialogue is the first building block that can produce participation and buy-in to FG from the target beneficiaries. Dialogue must be geared toward mutually identifying farmers' felt needs, instilling confidence in the farmers that they can solve their own problems, and demonstrating the project personnel's competence and desire to help the farmers (Bunch, 1982, pp. 24–25). By working together to identify problems requiring resolution, farmers and project staff become a team, clarifying the inherent risks involved and increasing the farmers' confidence in the programmes' methodologies. This can only occur when farmers are adequately informed throughout the project, participate in all project-related decision-making, and assist in project evaluation. This concerted effort to join project implementers and beneficiaries in common cause presents opportunities for improving the situation without raising false expectations. Farmers are thus adequately prepared to manage associated risks and accept both the benefits and potential consequences of implementing new ideas.

Establishing rapport and project credibility requires *time*. A commonly overlooked requirement for long-term project success is to start slowly and start small. A slower pace protects project personnel from falling prey to the common mistake of trying to 'teach too much. By teaching everything ... they have failed to explain any one practice enough to convince the farmers of its value or make sure the farmers can apply it successfully' (Bunch, 1982, pp.5–6). Teaching a limited number of innovations and proving the programme's value through a stepped process then increases the number of farmers adopting the programmes and implementing them correctly.

SITE-SPECIFICITY AND PROGRAMME FLEXIBILITY

The programme begins with a participatory rural appraisal (PRA) process, followed by an introductory workshop explaining the programme and inviting community and farmer participation. Farmer households are self-selected, with some joining the project individually and others working through a farmer collective. Viewed in conjunction with community socio-economic priorities, access to land, and other tenurial issues, the PRA process is followed by:

a) an interview with the individual farm family to assess its social and economic priorities,

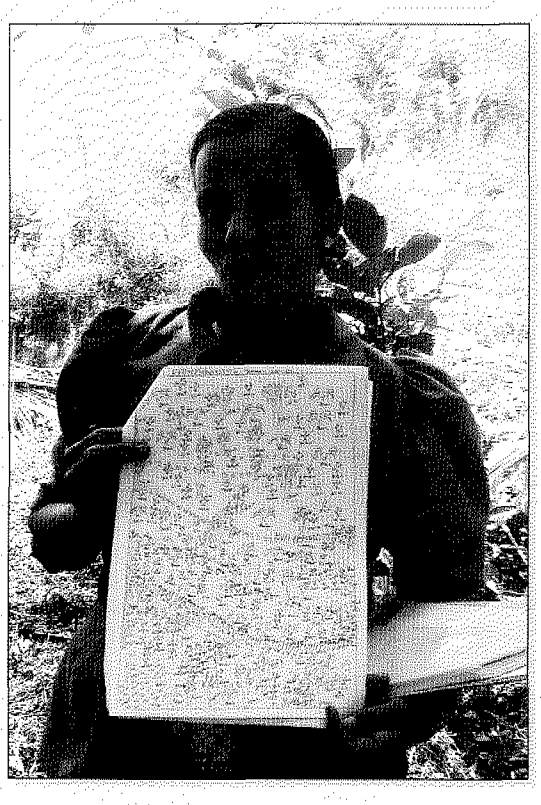

Figure 4
Participating farmer holds the farm plan for her Forest Garden. An important focus of the Forest Garden Programme is working with women

b) an examination of remnant forest patches and identification of flora and fauna therein, along with their ecological roles and any anthropogenic uses or value,

c) establishment of nurseries, and

d) studies of the suitability and synergy of native and exotic species in the gardens.

During the interview with the farmer, other issues of concern not strictly related to FG may arise (such as health, literacy and access to safe drinking water); it is Counterpart International's responsibility to respond in a holistic fashion to these felt needs such that perceived risk associated with project adoption is diminished.

Analog Forestry extension workers then begin working with the farmers to implement site-specific farm management plans. Each farm plot represents a unique environment. Careful consideration of farm-specific variables in planning provides the information needed to create designs tailored to each plot, thereby reducing farmer risk. By profiling their land, farmers come to a

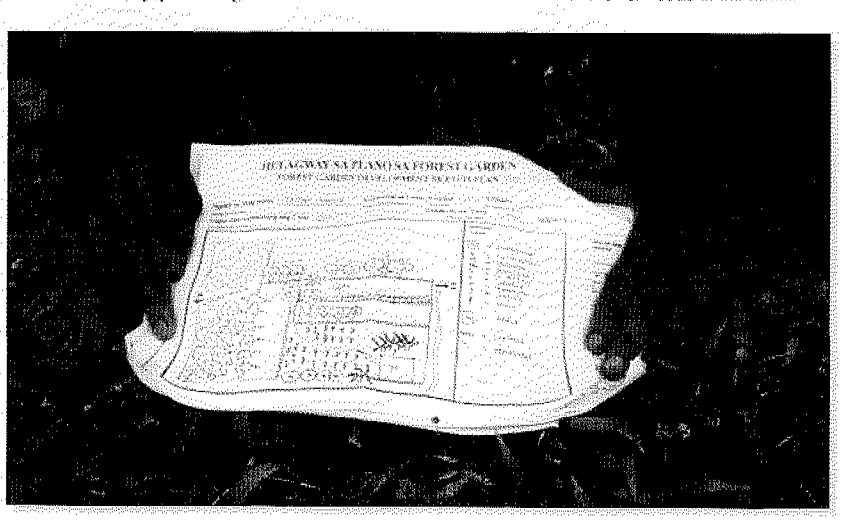

Figure 5
Participating Sri Lankan farmer displays the design of his Forest Garden which he developed in conjunction with the FG Programme extensionists. FG designs incorporate information on a variety of trees and other vegetation species, producing a plan that addresses the specific ecological needs and challenges of each plot as well as financial and other needs of the farmer

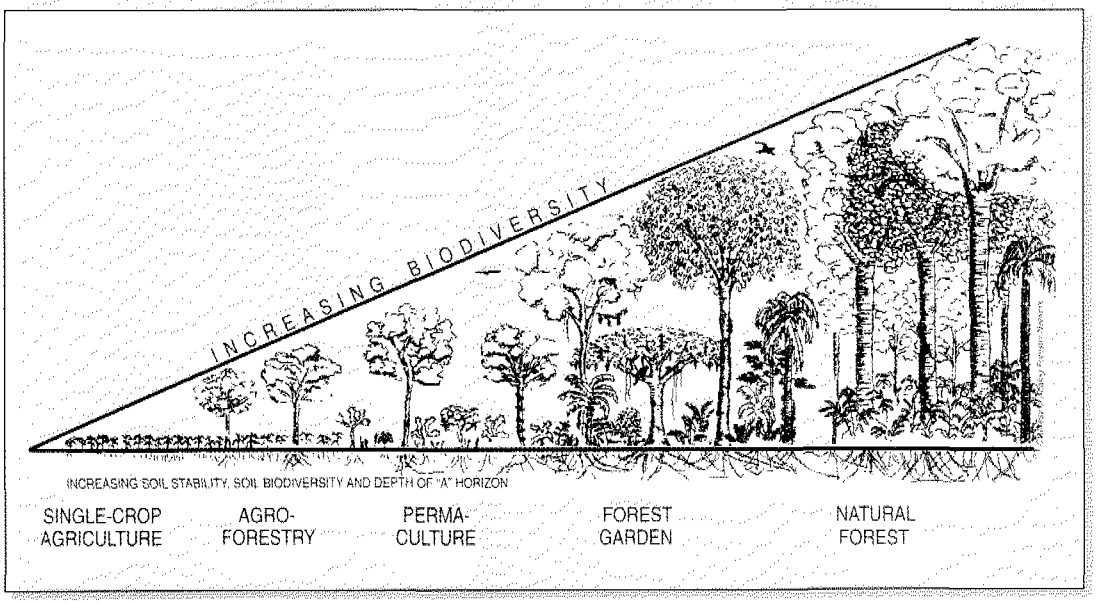

Figure 6
Ecological succession is the process by which the vegetation on a plot of land progresses towards an increasingly stable ecosystem. The process of moving from colonisation of degraded land through to the growth of climax ecosystem. With improved soil productivity, increased biodiversity, and canopy cover is called seral progression. At each seral stage the complexity of the vegetation community increases as does its ability to maintain a stable environment (Analog Forestry Manual, p.3)

more detailed understanding of its composition, strengths, and weaknesses, and thus determine the best way to design their FGs and incorporate species that increase crop productivity potential and canopy cover, improve soil quality, reduce erosion, protect water catchments, etc. With an individualised farm plan, a farmer can gradually adopt programme principles and move her land through successional stages of restorative growth by employing techniques such as composting/mulching for soil and crop improvement, hedgerows for soil conservation, integrated pest management, windbreaks, and production of saleable products. These short- and long-term farm plans allow farmers with limited resources to predict their labour and input costs more accurately, estimate projected economic returns and associated benefits, understand challenges and risks they face in adopting Analog Forestry, and provide them with the analytical tools to troubleshoot their problems in a timely manner. These plans help increase farmer adoption of FG principles by incorporating modern sustainable agricultural and ecosystem knowledge with proven indigenous systems of resource husbandry, creating a flexible tool that is culturally appropriate.

One field example of the flexibility of the FG model is found in Walapane, Sri Lanka. The Temple Forest Garden Programme takes advantage of the central importance of Buddhism in the lives of most Sri Lankans. Reverence for nature, and especially trees, is a key tenet of the Buddhist worldview. FG principles thus provide a natural complement to Buddhism. The programme is developing a network of temples as individual project sites. Each reflects the vision and goals of that particular temple and surrounding community and incorporates the training of monks in Analog Forestry, establishment of demonstration plots and nurseries, and the provision of extension services to nearby farmers. Some Buddhist temples support small tracts of old-growth forest; when combined with strategically-placed FGs developed by the monks and local farmers, these tracts provide significantly improved habitat for wildlife and native species of plants.

ANALOG FORESTRY DEMONSTRATION SITES

Analog Forestry demonstration sites in CBO/agricultural cooperative nurseries, or found on plots of farmers demonstrating a firm grasp of Analog Forestry and a willingness to teach other farmers by example, have proven very useful in Sri Lanka as 'dynamic laboratories' of Analog Forestry. Such sites provide an arena for farmers and extension personnel to jointly investigate innovations, exchange information on activities undertaken, and actively shape the programme as it progresses, sharing responsibility for its implementation. These plots thus help to inform farmers' assessment of the risks involved in adopting FG management principles. While demonstration plots can sometimes give farmers a false impression of how 'easy' FGs are to develop, due to all the attention and inputs given them by extensionists, they can also help to convince farmers of the efficacy of FG principles, encouraging them to design FGs on their own plots.

FINANCIAL INPUT

A formidable barrier commonly faced by small-scale farmers is a severe lack of disposable income. Limited-resource farmers are hesitant to invest even small amounts of money and time when they are not absolutely assured at the outset of its success. Thus, access to funds for developing FGs was addressed through the creation of a seeds-and-tools credit mechanism. This fund is designed for qualifying FG farmers, providing the financial leverage to permit them to purchase necessary materials to develop sound farm management practices. Repayment is tied to updated land-use plans, specific crop seasons, and proven agricultural production by the borrower. Thus, there has been a known/expected source of income for repayment on an appropriate time scale. The fund targets farmers with proven skills, an interest in new crops, and innovative planting/harvesting methods. This credit fund is often the necessary start-up facility that has helped reduce farmer risk and allowed cash-starved communities to make small but critical investments in constructing a productive resource base.

PRODUCT MARKETING

Small-scale farmers worldwide are most interested in:

1.) producing enough to satisfy their subsistence needs and
2.) producing a surplus to sell at the highest price and lowest cost to themselves.

Marketing their products thus becomes critical to their financial well-being, as well as to maintaining their active interest and participation in the Forest Garden Programme. Marketing presents what amounts to the greatest challenge to programme promoters and the biggest risk to participating farmers. Surmounting it starts with a frank acknowledgement on the part of interventionists of the difficulty of establishing product niches and markets. Market studies are conducted locally and regionally to ascertain what products will secure the most profitable niches and at what times of the year; project staff and farmers then incorporate this information into FG farm designs. Counterpart International provides farmers with enough training to enable them to produce dependable quantities of high-quality FGPs that first meet farm-household subsistence needs. Cooperative capacity-building activities enabling farmers to achieve some economies of scale, set product quality standards, process and transport products on a regular timeframe, as well as gain business skills to increase the farmers' profit are important to our initial focus of tapping into local markets. Only after a market foothold is achieved in project sites are the larger venues of regional, national, and international markets targeted. This steady though tempered progression keeps farmer expectations realistic, yet gives them ever-larger goals to shoot for.

GENERAL RISK MANAGEMENT

Whether farmers are inclined to adopt the methodology for the programme's offer of improved soil and water conservation, the potential for increased income, or to gain the support of the local extension officer and associated resources, farmer risk must be minimised through a dynamic approach. Risks associated with FG implementation can be minimised by:

- continually monitoring and evaluating project successes and failures by project staff and farmers and jointly discussing the findings;
- developing a strong network of farmers and farmer cooperatives among project sites, and providing opportunities for 'farmer-to-farmer' exchanges and training, as well as exchanges of inputs among sites and nurseries. This creates a platform for innovations to be attempted, evaluated and, if valuable, incorporated into the programme, as well as resources shared;
- a constant focus on programme flexibility and ongoing consultation with farmers is critical. This creates room for increased community participation and continual project improvement by building on lessons learned.

While the adoption of Analog Forestry involves some inherent risks to limited-resource farmers, Counterpart International has developed mechanisms to address these risks in a manner that actively involves farmers and project staff in both the identification of those risks and the development of appropriate solutions.

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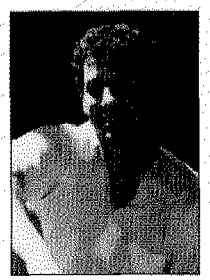

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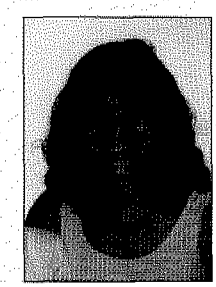

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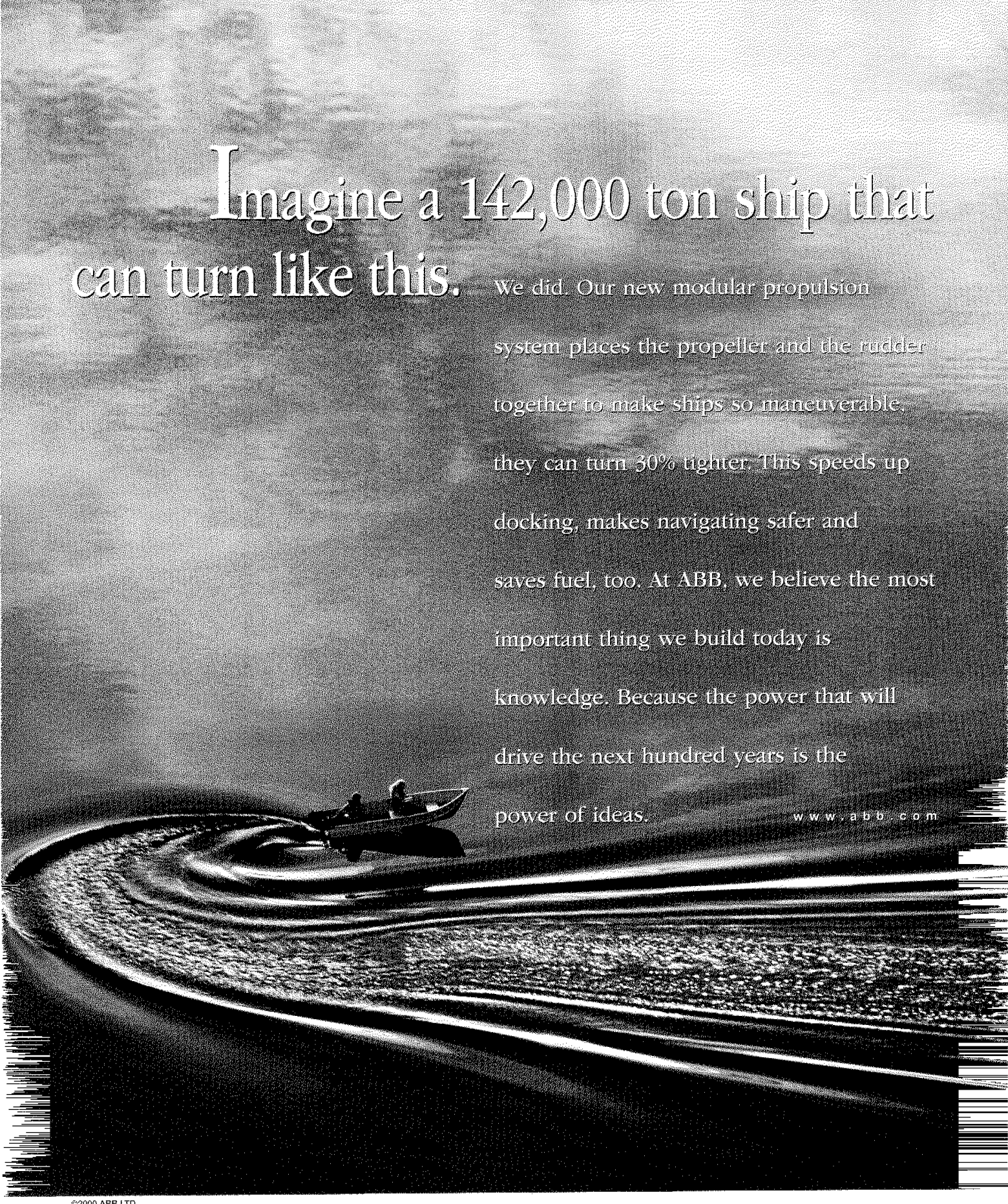

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ABB

FSC Certification: The Greening of an International Commodity Market

Steve Howard, *WWF UK,*
Margaret Rainey, *WWF Sweden,*

Abstract

Illegal logging, forest fires and bad forest management practices pose serious threats to the world's forests. The Forest Stewardship Council (FSC) was created to support environmentally appropriate, socially beneficial and economically viable forest management all over the world. The FSC administers a forest certification system that allows products from responsibly managed forests to carry the FSC logo. This provides a powerful market tool for forest product companies to communicate good environmental practice to consumers. The WWF organised Global Forest and Trade Network, which promotes trade in certified forest products, consists of 14 networks in 18 countries. Together these networks have over 650 company members, including some of the market leaders such as Home Depot and IKEA. Governments in different countries are FSC certifying their forests. The foundation community in the US is coordinating its funding activities in support of sustainable forestry worldwide and places its principal focus on the FSC. The achievement of responsible forestry based on broad stakeholder representation can become the model for sustainable development and natural resource management in general.

Figure 1 (left and below)
During the past ten years illegal logging and forest fires have dramatically reduced the amount of forests on the earth. 10% of the Brazilian Amazon was logged during this time and millions of hectares burned
Photo credit: F. Parker, WWF

Illegal logging and forest fires made the last decade of the 20th century a dark one for the world's forests. Ten percent of the world's largest rainforest, the Brazilian Amazon, was logged during this period. Illegal logging accounts for as much as 80% of the 60 million cubic metres cut annually in the Brazilian Amazon. As for Indonesia in 1993, the World Bank's forestry sector review warned that the official timber harvests were 50% greater than was likely to be sustainable. When combined with illegal logging, which was estimated to be approximately equal in volume to the legal cutting, timber exploitation clearly exceeded sustainable levels. In 1997/98 forest fires destroyed more than 15 million

Figure 2
The Sami are the indigenous people of Northern Scandinavia. Of the 17,000 Sami people living in Sweden, about 3,000 rely on reindeer herding for their livelihoods. In FSC-certified forests, the traditional reindeer grazing rights of the Sami are fully respected
(Photo credit: Roine Magnusson/Naturbild)

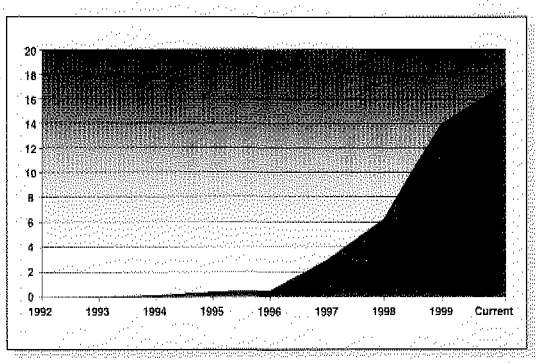

Figure 3
Area of FSC Certified Forest (millions of hectares)

Figure 4
Products from certified forests are labelled with the FSC logo. Certified wood in an FSC-labelled product is traced from the forest through all manufacturing stages by an independent certifier accredited by the FSC

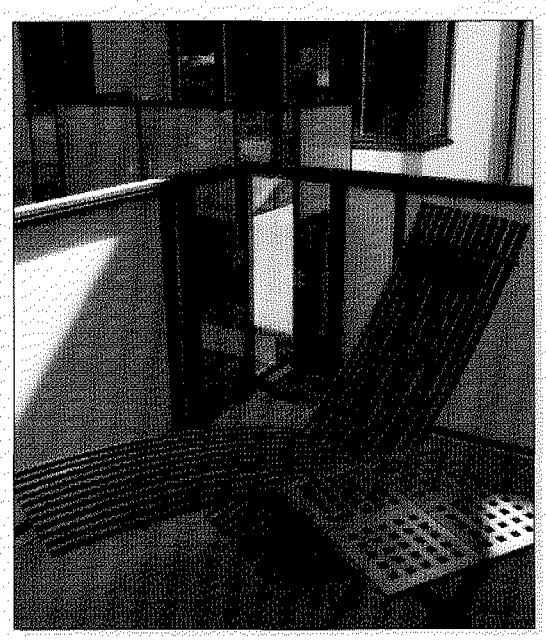

Figure 5
The first FSC-certified apartment house in the world was recently built by the construction company JM in Sweden, in a Nordic Forest and Trade Network co-operation project.
The picture shows an FSC-certified teak chair (Berga Form)
(Photo credit: Fotogruppen, SOS)

hectares of forest around the world, causing serious environmental problems and billions of dollars' worth of damage, and adversely affecting more than 100 million people.

Threats to forests are increasing, which in turn effects adversly the fates of the people who depend on them, the watersheds they protect, the climatic services they provide and the plants and animals that they shelter.

Environmental groups and the forest industry have traditionally been in disagreement over how to care for and maintain forest resources. There is an assumed dichotomy in the positions of the different camps and 'never the twain shall meet', or so everyone has believed. Both environmentalists and industrialists have been guilty of turning a blind eye to the social dimension of conservation. Maintaining the cultural values and livelihoods of local communities and indigenous peoples, and how important this is for the protection of forests, has not always been taken into account.

THE FSC IS BORN

Some would say that the twain have now, in fact, met. In 1993, a group of industrial, social and environmental representatives agreed to form a non-profit organisation to administer a voluntary accreditation programme for forest certification. The Forest Stewardship Council (FSC) was born. The FSC's mandate is to support environmentally appropriate, socially beneficial and economically viable management of the world's forests. Its main activity is to accredit organisations that certify responsibly managed forests. The FSC has defined international principles and criteria for good forest management. National and regional standards based on these principles and criteria are developed by consensus-based working groups, with broad and balanced stakeholder representation. For the first time environmental groups, forest owners and industry have common ground on which to meet, and it is a common ground where social groups are also represented on equal terms.

Since 1993, the amount of forest certified according to the FSC has increased in a steep curve upwards (see Figure 3) to the present 19 million hectares in 33 countries, from Belize to Russia. This is equivalent to about 3% of the world's production forests. In Europe, forest certification is now universally accepted as an important tool for communication of management practices, and several other certification programmes besides the FSC have been established. However, no other certification system at present has the FSC's global or its broad and balanced stakeholder participation.

In 1998, the World Bank, the world's largest financial institution, and WWF – World Wide Fund for Nature, entered into an alliance to work with governments, the private sector and civil society to promote forest conservation and internationally recognised best practices in forest management. One of the goals of the alliance is that 200 million hectares of the world's production forest will be under independently certified sustainable management, for example according to the FSC, by the year 2005.

Forest products derived from FSC certified forests are allowed to carry the FSC trademark. In addition to inspecting forest management, the FSC – accredited organisations audit the chain-of-custody of the forest products from the forest to the saw mill or pulp mill and on through the manufacturing process. In this way, products bearing the FSC logo (see Figure 4) provide a credible guarantee that they are sourced from well-managed forests. There

are several thousand product lines bearing the FSC logo around the world, mainly in Europe and North America (see Figure 6).

THE GLOBAL FOREST AND TRADE NETWORK

Together with all of the major environmental non-governmental organisations, WWF supports forest certification and the FSC. WWF has established the Global Forest and Trade Network which encourages and supports the formation of local Forest and Trade Networks (FTNs). Formally known as Buyers' Groups, these FTNs are partnerships between environmental groups and industry whose members are committed to producing and purchasing forest products from well-managed forests and to supporting independent certification.

There are 14 FTNs active in 18 countries which make up the Global Forest and Trade Network (see Table 1). FTNs are widely represented across the European Union and North America. FTNs for East Asia, Japan and Italy will be launched within the next year. WWF is also supporting the formation of producer-focused groups in Central and West Africa, Latin America, South East Asia and Indo-China, to drive the improvements in forest management in some of the areas where they are most needed.

Together the FTNs have at present over 650 members and, at the current rate of growth, it is expected that there will be a total of 1000 members by the end of 2001. FTN members range from small family-owned businesses to world-leading companies, such as the home furnishing giant IKEA and the world's largest do-it-yourself chain Home Depot.

Why do companies join trade networks for responsible forestry products? Perhaps because they think that certification makes good business sense: not only does it provide a selling point with consumer appeal, it also ensures that the forest resource will be there for future use. Other companies may be looking for promotional opportunities. There is increasing evidence of a direct and positive correlation between corporate responsibility and improved financial performance. The Millennium Poll on Corporate Social Responsibility interviewed 25,000 citizens from across 23 countries on six continents. The poll, sponsored by PriceWaterhouseCoopers, found that two out of three consumers want companies to go beyond financial performance and contribute to broader societal goals and that more than one in five consumers report rewarding or punishing companies in the past year based on perceived social performance. The FSC can provide a tangible way for companies to demonstrate their corporate responsibility.

What is for certain is that many companies speaking with a common voice deliver a powerful message to their suppliers. The member companies of the FTNs are starting to effect change on an international commodity market.

THE GROWING NETWORK

In a recent study, nearly 90% of the adults in the United Kingdom rated the environment as the most important issue for corporate responsibility. So perhaps it was no coincidence that the first FTN was established in the UK in 1991, even before the FSC was founded. Major British retailers such as HomeBase, Sainsburys and the do-it-yourself chain B&Q were the driving force in their quest for wood products sourced from responsible forestry. These companies intend to make certified products mainstream. Today the British FTN has over 100 members which together represent 20% of the total wood and paper consumption in the UK. As a result of the FSC certification of large areas of forest in Britain, industry predicts that 75% of UK timber production will be certified by the end of the year.

Great Britain's leading magazine publisher and a member of the British FTN, BBC Magazines, is determined to print its magazines on FSC-certified paper. Thus far they have achieved this goal for a supplement

TABLE 1. THE GLOBAL FOREST AND TRADE NETWORK

Region	Launched	Current Members
United Kingdom	1991	102
Belgium	1994	41
Netherlands	1995	41
Austria	1996	25
Australia	1997	4
Germany	1997	58
Switzerland	1997	20
North America (USA & Canada)	1997	258
Spain	1998	11
Nordic (Denmark, Finland, Norway & Sweden)	1998	34
France	1999	9
Ireland	2000	6
Brazil	2000	38
Russia (Producers Group)	2000	14
Total		**661**

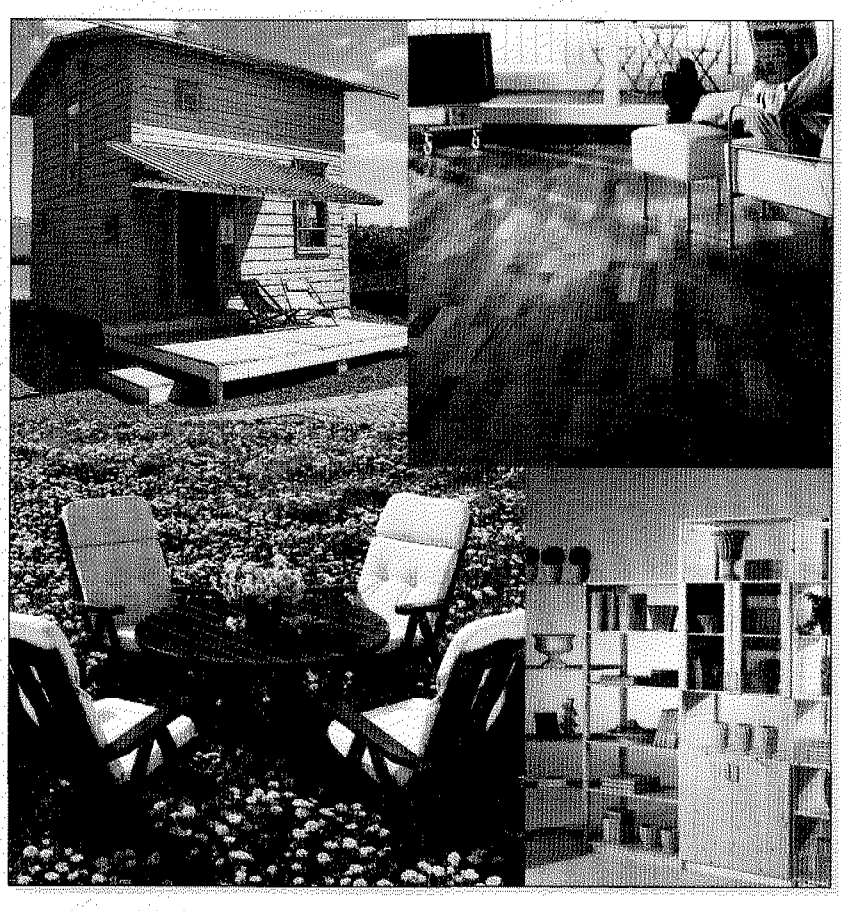

Figure 6
There are many thousands of FSC-labelled products on the market in Europe, mostly in the United Kingdom and Germany. These include wooden houses, garden furniture, parquet flooring and shelving (Photo credit: Gärdslunet, Hillerstorps Trä, Tarkett Sommer, AssiDomän)

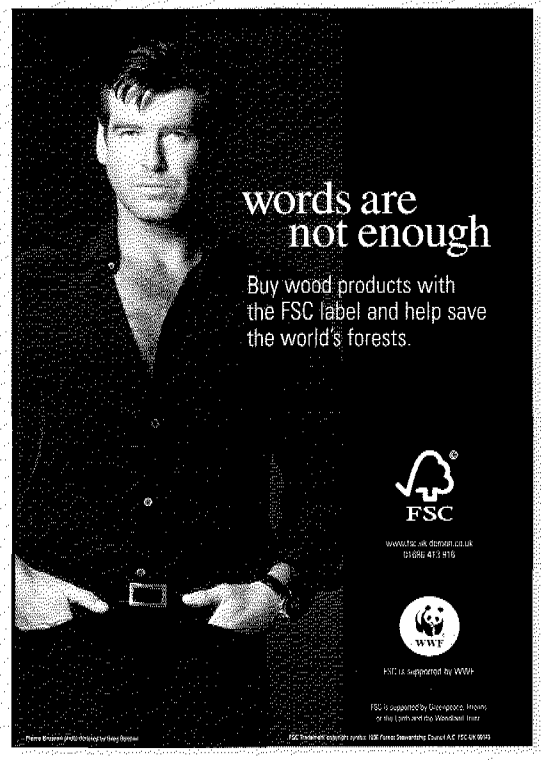

Figure 7
An advertising campaign promoting the FSC features James Bond 007 (aka Pierce Brosnan) urging consumers to support the FSC. The poster and ad campaign, displayed throughout the UK and the United States, gives a clear message to the public that the FSC is a powerful trademark which can contribute to sustainable forest management (Photo credit: Pierce Brosnan photo donated by Greg Gorman)

to the *Radio Times*, the largest magazine in the UK. During the autumn they will switch to FSC paper for their *Wildlife Magazine*.

The North American FTN, the Certified Forest Products Council (CFPC) is a trade association of a different calibre than the usual. Supported by major environmental groups and industry and comprised of nearly 260 members, the CFPC has a clear mission to put certification into the mainstream of the North American market. When Home Depot, the largest do-it-yourself company in the world, joined the CFPC, a powerful message was sent out that that mission might not be too far in the future. Home Depot, with over 1000 stores and new stores opening every other day, has committed in the long-term to sell only third-party certified forest products. This single company sells 10% of the world's entire production of sawn timber products.

The CFPC has also focused on the construction industry, with members like Turner Construction, the largest construction company in the US. In 1998, Habitat for Humanity, an organisation that builds affordable homes around the world, and talk-show host Oprah Winfrey, jointly sponsored the building of a house out of certified timber. Other 'showcase' buildings involving certified wood across the US include college facilities, public offices, museums, town halls, post offices and corporate headquarters.

Of all of the countries in South America, Brazil has come furthest towards creating a domestic market for certified products. The recently founded FTN in Brazil, co-ordinated by Friends of the Earth in Sao Paulo, now has nearly 40 members, including retailers, furniture makers, construction companies, plywood manufacturers, and state government representatives.

The Nordic FTN, WWF Skog 2000, functions as a regional group open to companies from Norway, Sweden, Denmark and Finland. One member is Scandinavia-based IKEA, the global home furnishing company, with 155 stores in 29 countries. IKEA recently announced its long-term goal of ensuring that all wood products in its range will come from well-managed forests. Wood and wood fibre are IKEA's most important raw material accounting for approximately two-thirds of its total use of materials. Nordic Network-initiated projects include building FSC-certified

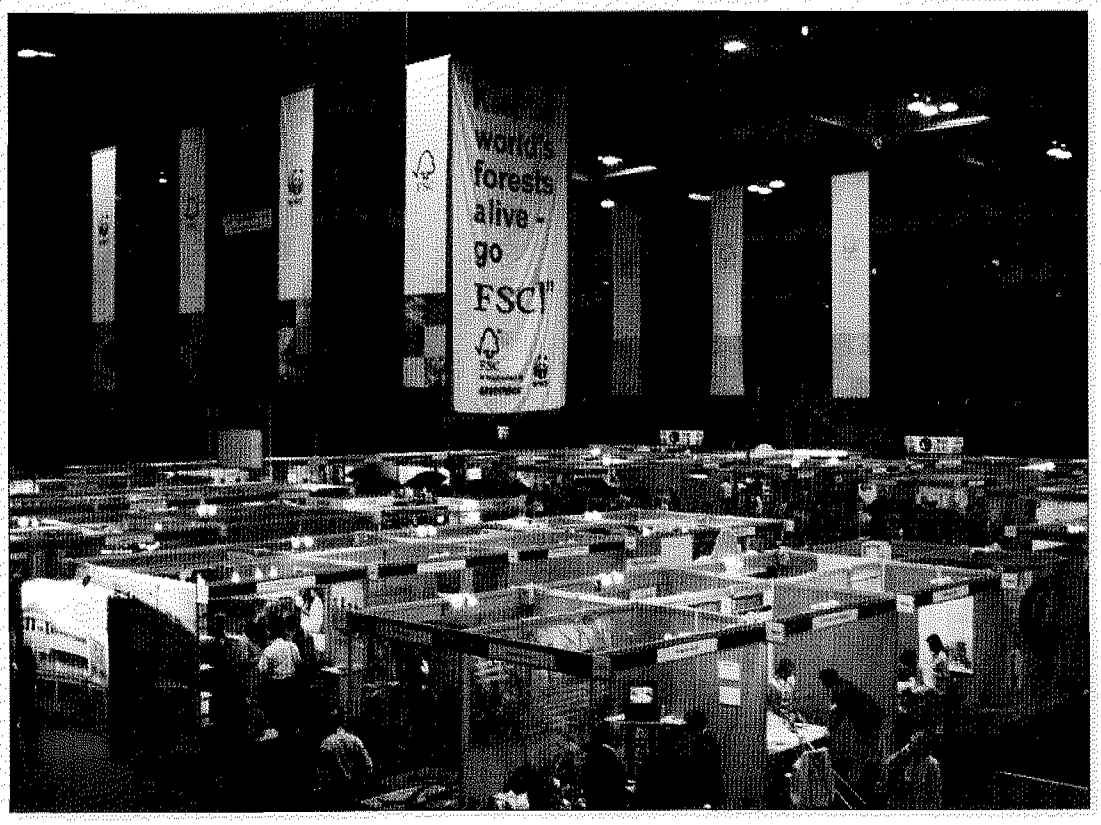

Figure 8
Photo caption: The WWF/FSC trade fair and conference in London in June attracted 1000 visitors from over 50 countries. Altogether, one third of world's total production of forest products was represented there (Photo credit: E. Parker, WWF)

houses and apartment houses in Sweden (see Figure 5). Nordic FTN member AssiDomän is one of Europe's leading forest product companies and the largest private forest owner in Europe. AssiDomän and WWF have established a partnership to encourage environmentally sustainable forestry through, among other things, the promotion of certification.

GOVERNMENTS TAKE THE LEAD

Corporate action is clearly one of the driving forces behind the market shift towards certified wood and paper products. Governments and local authorities have in many places also made important contributions to the establishment of certification.

Governor Jorge Viana from the Brazilian Amazonian state of Acre, estimates that as much as 10% of the forest area in his jurisdiction has already been cut. The state recently set a goal to maintain more than 80% of the total forested area and to FSC-certify 25%. This is part of an overall strategy that will see the forests of Acre zoned for various purposes, such as for the use and benefit of the indigenous peoples and the families of rubber tappers who have lived in the forests for many generations. Governor Viana has received some assistance from Brazil's federal government for his plans. Acre is situated at the headwaters of the Amazon: Governor Viana's fellow governor in the region at the mouth of the Amazon has expressed interest and support for Viana's plans and they now are working together to involve the other states in between theirs.

Several state governments in the United States have already certified their forests or have ambitious plans to do so. The state of Pennsylvania has over 1 million hectares of FSC-certified forest, more certified hardwood forest land than any other state in the United States. The state of New York has FSC-certified its 320,000 hectares of forests and Governor George Pataki recently encouraged all public and private forest owners to follow suit. Washington State plans to FSC-certify its forests, which cover 12% of the state, partly to meet the demand from those who are specifically seeking sources of FSC timber. Other governments that have FSC-certified their forests include Sweden, the Netherlands, the UK and Poland.

FSC ENTERS THE GLOBAL MARKET

In June 2000, WWF and the FSC organised a conference and trade fair in London with close to 90 exhibitors and 1000 participants from 52 countries. The 'Millennium Forest for Life Conference' attracted twenty-three of the world's largest producers of wood-based products, including eight of the top ten. Together, these represent one third of the world's total production of forest products. The trade fair showed that FSC products have acheived a breakthrough with the producers and retailers of forest products (see Figure 8). A mix of large and small companies opened new channels between suppliers and buyers, something unique for the FSC.

'A representative from B&Q [one of the world's largest retailers] came into our stand and asked us if we were interested in selling in the UK,' says Andreas Prabe, son in the family-owned furniture company Berga Form from Southern Sweden. The chances of B&Q and Berga Form finding each other at a traditional trade fair are minimal. FSC is a new market, and everybody is more or less new at it, which opens up for new contacts.

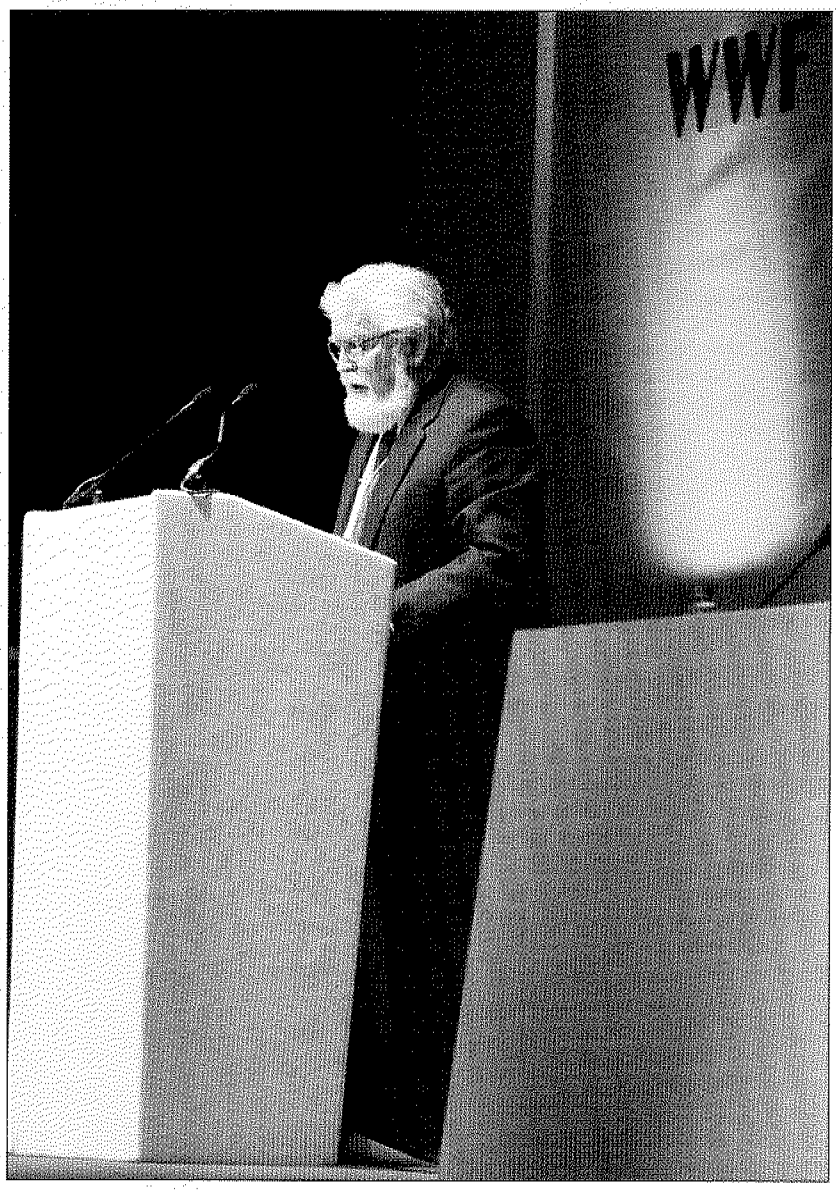

Figure 9
Michael Conroy, Senior Program Officer at the Ford Foundation, sees the FSC as a powerful instrument for alleviating poverty and injustice in communities around the world that are dependent on forests. Here he is speaking at a recent WWF/FSC conference in London (Photo credit: Jan Nässlöm)

FOUNDATION SUPPORT FOR CERTIFICATION

The international foundation community has recognised the vital role of certification and of the FSC in particular. One of the most influential support institutions is the North America-based Ford Foundation which invests more than 500 million US dollars annually in social innovation. The Ford Foundation acts as a donor to the FSC, to the North American Forest and Trade Network, CFPC, and to the FSC-accredited organisation SmartWood.

'We see certification systems, such as the FSC, as one of the most important methods for encouraging and rewarding production practices that rise to the highest global standards,' stated Michael Conroy, Senior Program Officer at the Ford Foundation, who spoke at the WWF/FSC conference in London. 'The FSC is the most important new tool that we've seen in a decade for protecting forests worldwide. Our interests rest not solely in the protection of biodiversity and other environmental characteristics of the forest. We see the FSC as a powerful instrument for alleviating poverty and injustice in communities around the world that are dependent on forestry.'

The Ford Foundation is a member of a sustainable forestry funders group that includes some 40 other

funding organisations, such as the Rockefeller Brothers Fund and the MacArthur Foundation. This group meets regularly to coordinate its funding activities in support of sustainable forestry worldwide and places its principal focus on the FSC.

'The environmental movement has learned that the market only understands its own language. You can't just protest you have to offer attractive solutions. FSC certification is one such solution, where it's a win-win situation. It's the only forest certification system that has financial value on the global market,' Conroy concluded.

CERTIFICATION PROVIDES THE CATALYST

The demand for FSC products is huge, and according to WWF's calculations it will increase by a factor of ten in the next five years. The main problem at present is that the current supply cannot meet the demand. Certified products must be available on the market before they can be traded. Here is a challenge for all forest stakeholders to promote responsible forestry by supporting FSC certification.

The international community, from the 1992 Rio Summit onwards, has found the problem of forest degradation difficult to tackle. With the 10th anniversary of Rio just around the corner, perhaps certification can provide the catalyst we need to begin to really make a difference. Hopefully, the achievement of responsible forestry based on broad stakeholder representation can become the model for sustainable development and natural resource management in general.

Unmarked wood products from well-managed forests are indistinguishable from those derived from illegal logging. Through support of credible, third-party forest certification, government and industry can provide the consumer with a choice – the choice between verified, responsible forestry and unknown forestry, with all the latter may represent in illegal logging, environmental destruction and social devastation.

ABOUT THE AUTHORS

Dr. Stephen Howard is Director of WWF's Global Forest & Trade Initiative, which was established in 1998. Dr. Howard has a degree in Ecology from London Guildhall University and a Ph.D. in Ecophysiology and Environmental Physics from the University of Nottingham. Prior to his present post, he was Senior Forest Officer with WWF UK.

Dr. Howard has also been involved in various UN negotiations on forest policy, which include acting as a lead NGO spokesperson on forest issues at the United Nations General Assembly special session (Earth Summit 2).

Margaret Rainey joined WWF in 1998 as the co-ordinator of the Nordic Forest and Trade Network. Previously, Ms. Rainey worked as an environmental consultant mainly within the private sector and with the development of criteria for environmental labelling programmes. Ms. Rainey has also worked with other major environmental non-governmental organisations in the past.

WWF World Wide Fund for Nature is one of the world's largest non-governmental conservation organisations. It has 4.7 million supporters and a global network active in nearly 100 countries. WWF has forestry projects in 70 countries and provides the largest amount of non-governmental funding for forestry work in the world. WWF has 110 forest issue experts working in Europe and Asia alone.

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Temperate Rainforest Management in New Zealand – A Challenge to Convention

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Abstract

The history of attempts to manage temperate rainforests in New Zealand has, as with all management of natural forests world-wide, been fraught with controversy. Various largely unsuccessful attempts over the last 50 years in New Zealand created a basis of mistrust and dissatisfaction in concepts to manage such forests for timber in a sustainable way. Nevertheless the last decade saw the emergence of an approach to sustainable management that proved a challenge not only to the conventions of forest management in New Zealand, but also a challenge to the very role and ethos of elements of the organized conservation movement in New Zealand. Widely hailed as an important model for the world to watch, the ultra-low impact and ecologically based management approach was nevertheless abandoned in late 1999 by an incoming Government. That decision, based by admission on 'value-judgements' to attract a marginal vote has created a significant debate in New Zealand. The consequences of the decisions now made will only become apparent over the next decade.

NEW ZEALAND – A ONCE FORESTED LAND

New Zealand today is a land dramatically different from that when human habitation began. An Island nation separated from Gondwanaland, New Zealand until relatively recently was a nation of birds and forests. It had developed free of all land mammals except bats, and had over the millennia, evolved a range of fauna that exhibited high levels of endemism.

With the arrival of the first human inhabitants from the Pacific, bringing with them rats and fire, the land became subject to forces of change that would irrevocably alter its ecological trajectory forever.

Following the arrival of significant European immigrants, a process started just 200 years ago, the rate of change was to accelerate and the land would never again at any point be able to acquire unassisted, an ecological resemblance to what had once been.

A LAND ETHIC OF PASTORALISM

As a 'new Dominion' of Britain, the pioneers in New Zealand set to work to build a nation. Food, wool and timber were the prime resources of the day, providing for exports and the establishment of housing and infrastructure. Here the forests served as both supplier of essential building materials but also a hindrance to the production of food and fibre so strongly sought by Britain. A land ethic of pastoralism predominated and forests were cleared relentlessly from many parts of the country. It was an ethic that was so persuasive that by the early years of the last century, there were warnings and predictions that there would be no forests left by the later half of the 20th Century. These dire predictions led ultimately to the development of extensive radiata pine plantations that formed over 99% of the New Zealand forest industry in recent years.

By the 1970's the era of clearance came to an end. A combination of changing attitudes and increased environmental awareness, changing economic and cultural ties with Britain and a recognition of the accelerated rate of decline in much of New Zealand's

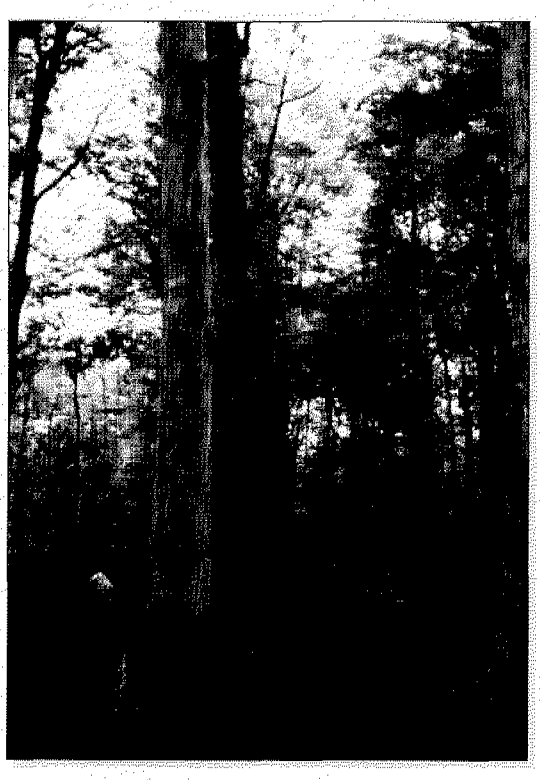

Figure 1
Clearfelled rimu forest in the early 1980's

Figure 2
'Gapmakers' form a typical opening. A common representation of the scale of natural disturbance and forest replenishment in beech forest

indigenous biota led to a general swing toward the protection of indigenous forest habitats. By that time only 20% of New Zealand's pre colonization vegetative cover remained and in many bio-geographical regions the indigenous habitats were severely fragmented and degraded. The declines in fauna were largely attributed to habitat removal but are more recently accepted as a function of predation by introduced pests.

Only one region contradicted the general trend: the west coast of the South Island of New Zealand. In this region, despite a long history of exploitative industry, the forested lands were extensive to the extent that the region represented the diametric opposite of the national average land use. With around 80% of the total land area under protected status, agricultural activity occupied only 8% and forestry, including production from indigenous forests, 7%.

TABLE 1.
COMPARISON OF TRADITIONAL AND MODERN MANAGEMENT SYSTEMS

TRADITIONAL APPROACH	CHANGED EMPHASIS
Increased harvestable increment	Large old trees retained
Balanced age-classes disjoint ages	Spatially & temporally
Healthy trees	Health ecosystems
Maximize wood quality processes	Protect ecosystem
Preferred species	All species

AN UNEASY TRUCE

The large forest areas on the West Coast became the focus of environmental concerns over continued unsustainable clearfell logging by the late 1970's following State backed proposals for the extensive use, chipping, and in some cases, conversion to pine plantations of native beech (*Nothofagus* spp) forests.

The conflicts were intense, bitter and disruptive, but the forests and the industry they supported were a significant part of the regional economy and the methods of forests management employed reflected an historic legacy of Government assigned contracts that had yet to fulfil their term.

In 1986 as part of a sweeping range of economic change and deregulation brought to New Zealand by the centre left Government, a significant attempt was made to resolve the conflict. Under the auspices of the newly created Ministry for the Environment, the various stakeholders were bought around the table for the first time to try to hammer out solution that all parties could accept.

The resulting 'West Coast Accord' was widely hailed at the time as an important step forward in approaches to resolving difficult environmental issues. The Accord, a signed document between all the parties, was to provide an uneasy truce during which a period of substantive change could be executed within the industry and its dependent community while at the same time guaranteeing significant environmental outcomes.

The essence of the Accord was the delivery of defined outcomes through both a practical, structured framework and an ethical foundation. It had one simple overriding objective: to achieve a change in a regions economy from what was a blatantly poor land use to an integrated use of land that established high standards of management for biodiversity protection and timber production at a sustainable, high value niche oriented level. It sought to maintain an indigenous timber industry as an important part of the region's economic diversity and part of its comparative advantage relative to other more intensively developed regions.

The practical structure of the Accord involved three elements:

- The immediate transfer of substantial additional areas of forested land to protective status (especially lowland forests);
- The establishment of a transitional unsustainable phase during which, on defined lands in accordance with fixed timetables and a two stepped reduction in indigenous log supplies, the industry could transfer to a largely Radiata pine plantation base;
- Other defined areas would only be available for a sustainable supply of indigenous timbers in perpetuity.

Similarly the ethical foundation of the Accord involved some significant components:

- The establishment of 'the Accord' represented a solemn agreement implicitly entwining trust and fidelity to a long term vision and plan between the signatories;
- The process of managing change was vested in a structure at arms-length from day to day political involvement and with strong community accountability via a regionally based State Owned Enterprise;
- Finally, at the highest (Government) level, there was a discipline that stakeholders who had bought into the process could not simply opt out when it suited. The Government would not bail out their disagreements.

The latter element was crucially important as a mechanism to force the parties to communicate with, rather than past, each other if disagreements were to eventuate. By the time the Accord had been signed and following subsequent related decisions affecting other lands in the southern part of the West Coast, the region stood as an example of unprecedented levels of protection that could not be replicated anywhere else in the nation and few places in the world. It boasted a comprehensive interlinked reserves system that saw nearly 72% of most pre-European vegetation cover still present and around 77% of that protected. Of 94 defined ecotypes within 26 biogeographic entities, only 10 fell below a level of 10% original cover being protected. Those types owed their poor status to past competition for agricultural land.

Under this uncertain truce the Crown owned company moved, as required by Government, to lay plans for a future based on the development of sustainable management systems. Such systems were hitherto untried, unworkable in economic terms at the time of commencement and in the eyes of many in the industry little more than an idealistic forestry and conservationists jargon.

THE PRACTICAL CHALLENGE

In the early stages of planning, it was recognized that any successful programme would be a major challenge to past conventional methods. The forests under consideration, lowland podocarp, mainly rimu (*Dacrydium cupressinum*) and elsewhere, beech (*Nothofagus* spp), were sensitive to physical damage on difficult terrain and exhibited structural elements such as large old hollow trees that were recognized as important to the habitat requirements of some declining native bird species.

The public aversion to past harvest practices also meant that the forests would need to look unaffected.

All these factors created a management 'poverty cycle' whereby controversy lead to uncertainty, that in turn discouraged investment, which in turn could not support prices that led to good management.

To progress, the cycle had to be broken and the points of focus to make the break were log grading, industry structure and pricing, followed by the introduction of low impact aerial (helicopter) harvesting. With pricing moving up and sufficient to enable the application of aerial technology, the flexibility and relative cost indifference of aerial harvesting to volume density and average haul distance opened a new world of options to the forest manager.

As the new generation of management plans were developed they did so on the back of five fundamental goals. It was determined that:

- The biomass of the forest should be maintained;
- The structural and spatial composition of the forest should be maintained as closely as possible to the surrounding unmanaged conservation estate;
- The species composition should be maintained at near natural distributions and ratios;
- Native fauna should be maintained or enhanced if possible through appropriate pest management;
- The forest should remain looking the same.

The achievement of these goals required a paradigm shift away from what have often been the traditional signatures of 'good forest management'. The change is summarized in Table 1.

Figure 3
Seven years after the signing of the 'Accord' sustainable rimu management became a reality

The effective translation of these revised management principles to the ground led to a relatively unique management system.

The native forests proposed for management involved species with long natural life cycles averaging 300 years for beech and over 500 years for rimu. The forests concerned regenerated in response to various disturbance regimes ranging from natural attrition of single trees to small patch windthrows to large scale periodic disturbance from large magnitude earthquakes (force 8 Richter scale) that occur periodically along the main alpine fault every 260 years or so. On average, however, between the major disturbances, forest ecological studies provided information on the nature and scale of the disturbance events. Typically small

Figure 4
The beech proposals like the rimu operation involved the lowest possible impacts

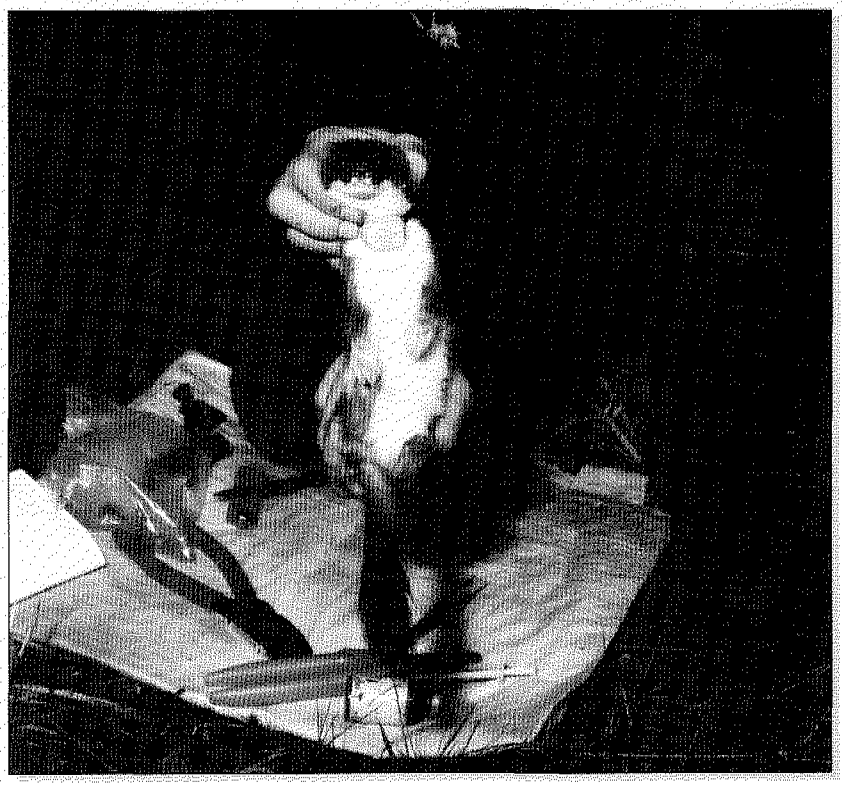

Figure 5
Introduced pests like this Stoat are the recognised cause of decline of much of New Zealand's native fauna. Harvest revenues were contributing to control and research

gaps of 0.01–0.05 hectares were created by 'gap makers', moribund trees that died *in situ*, creating a local contagion of insect attack that spread to adjacent trees, or windthrows that damaged or destroyed adjacent trees as they fell.

The practical challenge was that if the five goals of management were to be achieved, the natural, spatial and temporal patterns and intensity of disturbance would have to be closely mimicked. To do so would ensure that species compositions, biodiversity and habitat requirements were maintained. Similarly, yield regulation was based on the principle of selection of yield around the likely sites of mortality initiation. Through such a process, the application of very careful felling practices and especially directional felling to avoid damage to significantly advanced growth, a regime of mortality pre-emption or subsummation of mortality into harvest was executed. The implications of this were that average age of the forest and structural characteristics, important to maintaining a presence of old and faulty trees for threatened species habitat, could be maintained. Further precautions to protect the structural composition of these forests included a harvest set to only 50% of the available increment and the retention of large old trees.

Ultimately, the key to make these ecological management objectives a practical reality on the ground was the introduction of aerial harvesting. While a high cost operation, a revolution in the processing and marketing of the product enabled the cost threshold to be passed. With this new tool, a whole new world of operational flexibility was opened and almost any environmental constraint could be accommodated. Group tree harvesting with minimal roads became possible to the extent that for rimu, the average harvest for any given hectare amounted to just 3–4 trees per hectare once every 15 years and for beech was forecast to be 15 trees per hectare.

In economic terms in rimu forests that had been managed under this regime for 7 years, the operation had, on a cubic metre basis, become the most profitable forestry operation in New Zealand. This had enabled the expenditure of small continuous sums of money into pest control that were starting to show an ecological dividend of upward trends in most bird species.

THE ETHICAL CHALLENGE

Despite the successes of the rimu operation, the attainment of ISO14001 by the State SOE and having advanced as far as pre-audit status for Forest Stewardship Council certification, the proposal to extend the management system to 45 000 ha of beech forest as enabled under the West Coast Accord re-ignited controversy.

Figure 6
Along an unbroken hill face, protected conservation land shares the landscape imperceptibly with forest harvested just months before. Six months later the New Zealand Government closed the operation down

The conservation movement became split as groups, despite being signatories to the Accord, sought to short-circuit its integrity by political lobbying prior to a national election. Management, people and forests became lost in a media war pitting preservation 'sustainability is something for third world nations' versus sustainable development. The unique needs of a relatively remote and economically disadvantaged region of New Zealand were lost on a largely environmentally detached, urban political constituency. A mode of land based operation that had accepted and met the practical challenges thrown down to it for sustainable management now found its remarkable success a challenge to the very reason for existence of some small domestic environmental NGOs.

Just as the plans for beech management started their passage through New Zealand's Resource Management Act (RMA), the newly elected Government instructed its Crown enterprise to withdraw its application for consents. A bill is now before Parliament to annul the contractual status of the Accord without payment of compensation to the businesses adversely affected.

The RMA was a comprehensive piece of environmental legislation modelled around the principles of Rio and Agenda 21. Designed to provide a framework for transparent, legally supported, public and community resolution of environmental and resource use issues, the Act provided a basis by which all normal resource use decisions could be achieved at the political 'arms length', often essential for long term issues.

AN ETHICALLY SUSTAINABLE SOLUTION?

For New Zealand the decisions have been made. All sustainable harvesting of indigenous timbers on Crown Land will have ceased by 2002 without consultation, scientific or economic evaluation. While some supplies of high value timber will eventuate from private lands elsewhere in the country, the bulk of the shortfall may arrive on the shores of New Zealand from the forests of our pacific neighbours. Few if any of those sources will match the standards of the operation they replace.

While providing adjustment assistance to the region as a whole of $120 million (about one third of the value of the opportunity lost), New Zealand has exported a region's jobs and the nation's consumption to those who continue to harvest forests. The question will remain open for some years as to whether this was an ecologically or ethically sustainable solution, or whether we have simply adopted an ethic of sophisticated urban-driven 'shifting cultivation'. The question also remains as to whether the New Zealand Government has treated a segment of its society in accord with the intent of Rio, Agenda 21 and the Montreal process, protocols to which it subscribed.

ABOUT THE AUTHOR

Kit Richards was General Manager Planning at Timberlands West Coast Ltd, the Crown Company charged with managing the Government's commercial indigenous forestry interests. He managed the overall development team that undertook the sustainable development project and was a participant negotiator to the original West Coast Accord negotiations. He now acts as a private consultant practising in forest and environmental management and strategic planning.

IF YOU HAVE ANY ENQUIRIES REGARDING THE CONTENT OF THIS ARTICLE, PLEASE CONTACT:

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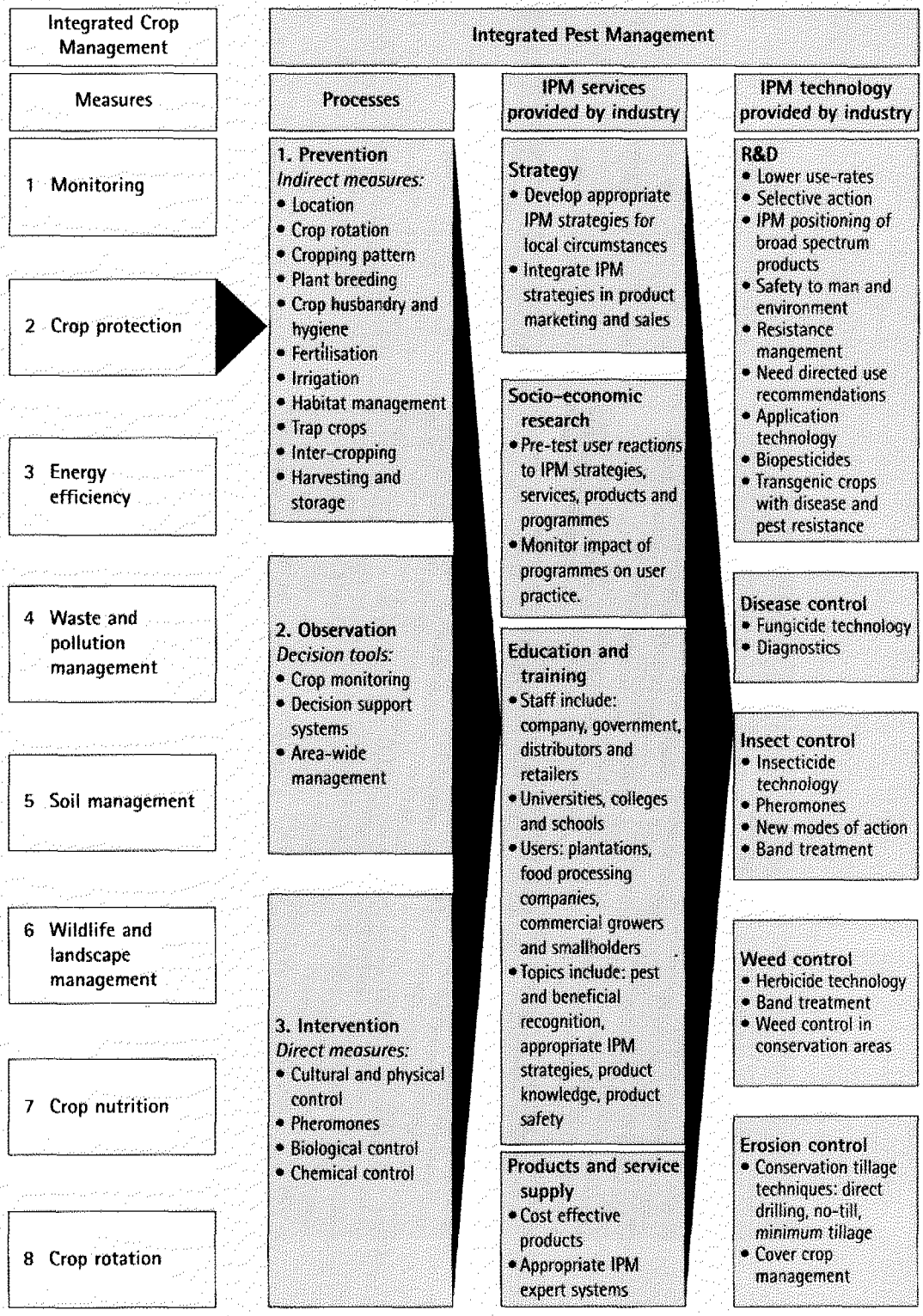
The global crop protection industry has a key role to play in archieving the goals of IPM and sustainable agriculture



Global Crop Protection Federation

Global Crop Protection Federation

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SECTION 4

AGRICULTURE

Picture courtesy of International Fertilizer Industry Association

SUSTAINABLE AGRICULTURE
ZENECA'S GLOBAL CONTRIBUTION

Zeneca Agrochemicals

recognises the importance of sustainable agriculture – to farmers, to the environment, to the people of this and future generations, and to the continued success of our own business. Our mission is to be the leader in providing innovative solutions to growers and the food/feed chain. In doing this we will:

- **actively encourage the adoption of sustainable principles and practices, as part of integrated farming systems;**
- **always take into account the social, economic and environmental dimensions;**
- **work in partnership with others to identify and disseminate best practice.**

IPM Training projects in India and Pakistan

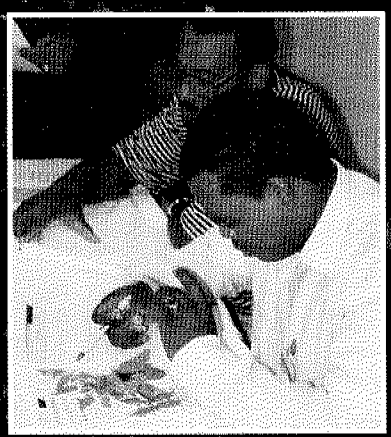
Zeneca has been working with local partners in research and extension help smallholder cotton farmers adopt IPM practices. Field-based training programmes have focused on promoting good crop and pest management practices including the safe and effective use of crop protection products. Farmers in the pilot projects have reaped clear benefits: significant reductions in the number of spray applications and associated crop production costs, equivalent or even improved crop yields, and increased profitability. Additional benefits included better awareness of the importance of the safe use of agrochemical products to reduce risk to end-users, their families, neighbours and the environment.

ICM Demonstration Farm: UK

The Jealott's Hill Farm is a commercial working farm attached to Zeneca's international Research and Development Centre in the UK. The farm has been working to ICM principles for a number of years and is part of the LEAF (Linking Environment and Farming) national network of demonstration farms established to help farmers improve their environment and business performance and create a better public understanding of farming. The Jealott's Hill Farm has become a model for the sustainable agriculture practice that we both endorse and promote.

IPM Rural Schools Project in the Dominican Republic

Zeneca has been collaborating with the Ministry of Education (SEEBAC) and the Junta Agroempresarial Dominicana (JAD) to introduce a schools programme to teach rural school children about IPM principles and practices. The project pack contains a teachers' guide plus pupil materials including posters, worksheets, games and a comic. Experience has shown that children enjoy and learn from these activities and encourage their parents to adopt improved practices all in the interests of both individual families and the larger community.



Conserving Wildlife in Costa Rican Banana Plantations

A research project conducted by EARTH and funded by Zeneca was carried out to assess the impact of banana cropping practices including pesticide usage on wildlife. Results confirmed that biodiversity within the banana monoculture was relatively high and that planting of trees along canals and reforestation along rivers to connect forest fragments can further help to sustain populations of many rainforest-margin species.

Assisting Village Healthworkers in Malaysia

Zeneca has been working with the Department of Health in Sarawak on a project to train village healthworkers to provide health education focused on the safe use of agrochemicals to local farming communities, an important issue in this predominantly agricultural country. Special teaching aids such as flipcharts and posters have been developed to help deliver the key messages, and trained officials from the Department of Health are now running their own courses for health workers throughout Sarawak.

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Australia's 'Landcare' Model – A Blueprint for Sustainability?

Jack Whelan, *International Fertilizer Industry Association, Paris, France*

Abstract

Australia's 'Landcare' movement has demonstrated its powerful role in the promotion and application of sustainable agriculture practices and integrated resource management policies. Landcare projects are successful because they provide opportunities for everyone to contribute expertise and participate in the solution of local and regional problems. Landcare has flourished over the last decade with multi-stakeholder support from government, farmers' organisations, research, industry and advisory sectors, environmental conservation organisations, NGOs and, above all, rural communities.

The innovative solutions being found by these rural communities, participating in a network of over 4500 Landcare groups, put into practice the UNCED Agenda 21, Chapter 14 commitment to "create the conditions for sustainable agriculture and rural development" (SARD). As a result, opportunities are being sought to extend the land stewardship and community-oriented development philosophy of the Landcare approach to other countries. The success story is spreading, for example to South Africa, which began its own Landcare programme in 1998. There is an increasing interest in Australia's Landcare approach from African and Asian countries, many of which have similar conditions or similar problems.

Introduction

Landcare in Australia is a farmer-first, voluntary, community-based approach to tackling environmental problems and ensuring the long-term sustainability of the country's agricultural and natural resources.

The term 'Landcare' was coined in the mid-1980s, when the movement emerged as a response by farmers and conservationists to land degradation, particularly in the states of Victoria and Western Australia. The catalyst for Government support was an alliance between the Australian Conservation Foundation and the National Farmers Federation. Launched nationally in 1989 by the then Prime Minister Bob Hawke, the 1990s were declared a 'Decade of Landcare', with the emphasis on local action through a network of groups, coordinators and facilitators.

Landcare is supported by all levels of government, industry, rural communities, conservation groups and individuals in recognition of the need to establish a progressive and consistent approach to manage the land and water resources wisely. There are now more than 4500 Landcare groups across Australia involved in a wide range of activities aimed at improving the productivity and long-term sustainability of Australia's natural resource base.

Land Degradation in Australia

Agriculture in Australia produces A$22bn (US$13bn) per year in export earnings, together with a further A$12bn (US$7bn) in processed food and beverage exports. Farmland or grazing accounts for 60 per cent of the land area, and 70 per cent of the water consumption is for agricultural use. Sustainable natural resource management therefore relies heavily on the introduction of more sustainable agricultural practices.

Since the European settlement of Australia in 1788 natural resource management has been characterised by an initial period pioneering agricultural development in the most economically viable parts of the continent. During this period, extensive livestock and broadacre cropping industries were established with strong export orientation. Increased intensification of land use brought great

Figure 1
A typical Australian landcare group, including representatives of the community, stakeholders and farmers, discussing management issues and potential solutions.

Unilever and Sustainable Agriculture

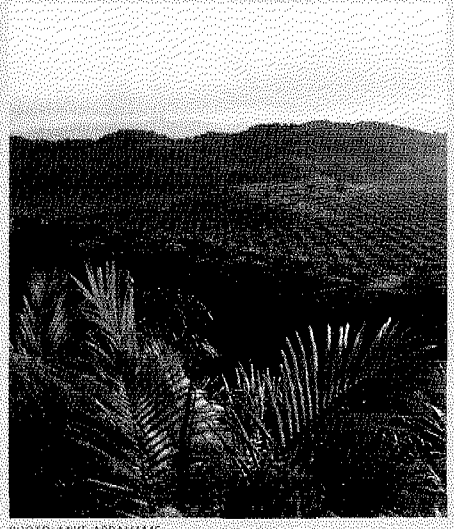


PHOTO: MIKE ABRAHAMS

PHOTO: CHRIS MARTIN

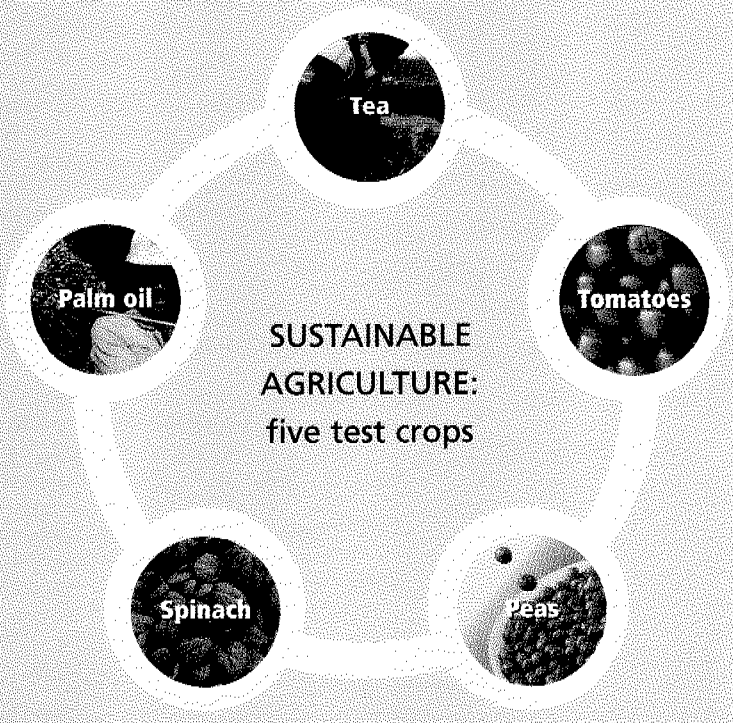
Since the mid-1990s, Unilever has been consulting with experts and engaging with suppliers, customers, consumers and business partners around the world to find a sustainable way forward for agriculture.

This has led us to develop the Sustainable Agriculture Initiative. In our definition, sustainable agriculture must be productive, competitive and efficient while at the same time protecting and improving the natural environment and conditions for local communities.

This is why we support the following principles:

- Produce crops with high yield and nutritional quality to meet existing and future needs, while keeping resource inputs as low as possible.
- Ensure that any adverse effects on soil fertility, biodiversity, water and air quality from agricultural activities are minimized and positive contributions are made where possible.
- Optimize the use of renewable resources while minimizing the use of non-renewable resources.
- Enable local communities to protect and improve their well-being and environments.

Unilever has initiated a series of pilot projects around the world to implement 10 indicators, as a way to learn more about sustainable agriculture. We hope to understand and agree the ecological, social and economic conditions that sustainable agriculture must meet. This will eventually lead to the definition of standards for sustainable agriculture.



Pilot projects in tea, tomatoes, palm oil, peas and spinach are assessing operations according to the following indicators:

Indicators	Sustainable agriculture practices can:
Soil fertility/ Health	Improve beneficial components of the soil's ecosystem.
Soil loss	Reduce soil erosion.
Nutrients	Enhance locally-produced nutrients and reduce losses to the environment.
Pest management	Substitute natural controls for some pesticides, so reducing dependence on externally introduced substances.
Biodiversity	Improve biodiversity – both by 'greening the middle' of fields as well as 'greening the edge'.
Product value	Maintain or improve product value and other desired outputs from agricultural systems.
Energy	Improve the energy balance and ensure that it remains positive – there is more energy coming out than going in.
Water	Make targeted use of any inputs, and so reduce water losses.
Social and Human capital	Improve both social and human capital to facilitate the sharing of new knowledge and continuous innovation.
Local economy	Help to make the best use of local and available resources in order to increase efficiency.

Our approach is to focus on the underlying health and vitality of agricultural systems – in social, economic and environmental terms. We believe that there needs to be a greater diversity of approaches to farm and plantation management. All agricultural systems have something to offer and we want to find out what works best under differing circumstances.

We are at the beginning of a very long journey and we need the continued help of others if we are to make progress. We are committed to engage with our stakeholders we urge them to make contact if they wish to contribute in any way.

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Growing for the future

Unilever

leaps in production and productivity. The increase in land area under agriculture was accompanied by extensive tree clearing, grazing, improved pastures, cropping and the diversion of water for irrigation purposes. Mechanisation improved the capacity for landholders to modify the environment.

With the benefit of hindsight, these changes in the landscape also initiated changes to groundwater balances and mobilised salts which were to have significant effects, albeit on occasions some distance away and removed in time from where and when decisions were taken. Increasing wind and water erosion became apparent as did deterioration in water quality, rising water tables and significant impacts on biodiversity. These symptoms are testimony now that the traditional agricultural approaches imported to Australia from other cultures were unsustainable in the long term.

Paradoxically, as one of the most arid countries in the world, Australia is suffering from too much groundwater. The water table in many areas has been rising, primarily due to the clearance of deep-rooted natural vegetation for annual crops and livestock pastures, leading to the deposition of salts on or near the surface. For many scientists and environmental experts, the salinity issue is now Australia's most significant long term problem.

Figure 2
For many scientists and environmental experts, the salinity issue is now Australia's most significant long term problem

The *Financial Times* on 4 July 2000 reported, 'The impact of salinity is dramatic, and it is not just confined to desertification. According to John Williams, Deputy Chief of the CSIRO – Commonwealth Scientific and Industrial Research Organisation, Land and Water Division – a government-sponsored think-tank, the drinking water in Adelaide will be unusable within 50 years because of salinisation. If nothing is done to contain the problem, some 15 to 19 million hectares will become salinose or only marginally productive before a new equilibrium is reached, says Alex Campbell, Chairman of the Western Australia State Salinity Council. Western Australia, one of the worst affected regions, would account for around 6 million hectares, equivalent to a third of its cleared agricultural land. The sustainable solution involves a shift in farming patterns to involve more forestation and crops that are suited to Australian conditions'.

Notwithstanding the priority given to salinity, encouragement is given to efforts to develop integrated and strategic approaches and linkages among individual properties within catchments (watersheds) and regions. The catchment represents an efficient and effective scale for management and enables the inter-relationships between various forms of degradation to be understood and addressed. For example, dryland salinity, soil acidification, soil structure decline, vegetation decline and water erosion are often observed in the same catchment. Often one form of degradation accentuates the other and hence there is a need to devise solutions that address all the issues in an integrated way.

LANDCARE PARTNERSHIPS

The development of Landcare at the national level was boosted with the realisation by the National Farmers' Federation and the Australian Conservation Foundation that a coordinated approach, addressing the *causes* of land degradation, rather than *symptoms*, would be crucial to ensure broad political support for public funding and for encouraging participation by their respective constituents.

From its grass roots origins fifteen years or so ago, Landcare is now a partnership approach between government, industry and the community, with clearly defined roles and responsibilities in natural resource management. Effective relationships have been established between farmers and environmentalists, scientists and land managers, rural and urban populations, businesses and communities, Federal and State Governments, and agricultural and environment departments within Government. A strong feature of Landcare is its inclusive approach, embracing indigenous communities, farmers, environmentalists, scientists, land managers, businesses, rural and urban populations.

True to its hands-on philosophy, the establishment of the National Landcare Program supports the activities of Landcare groups and emphasises the importance of devolving decision-making as far as possible to the local level. Landcare is often quoted as a successful example of a community-driven, capacity-building process that is delivering a more sustainable agriculture and land management programme.

FARMERS' SUPPORT

A recent survey by the Australian Bureau of Agricultural and Resource Economics (ABARE) showed that the participation rate of farmers (or property representatives) in Landcare activities has grown to reach over 37%. It also revealed that 60% of farmers reported that they had learned of the causes of land degradation from their involvement with Landcare. Seventy percent learned how to treat or avoid degradation through Landcare, and 64% reported that their participation had taught them the benefits of good natural resource management.

Group-based approaches are generally more effective for providing the information and skills that landholders need to improve their land management practices. Group approaches for learning and the transfer of information and skills, results in wider communication of interests, issues and information throughout the community. The effectiveness of group approaches is enhanced by the influence of peer pressure, which provides an incentive for landholders to take part in concert with others, who might otherwise not participate. It is also more efficient for extension agencies wishing to transfer information and skills to deal with groups rather than individuals; and groups facilitate the use of multidisciplinary technical support services.

CORPORATE SUPPORT

Landcare Australia Limited and the Landcare Foundation were established by the Federal Government as non-profit companies to help raise public awareness of Landcare, and to provide a vehicle to generate and disburse corporate sponsorship for projects. In 1998–99, Landcare

Australia Limited secured A$18 million in corporate sponsorship and media support, involving a broad range of interests including mining companies, wine producers and breakfast cereal products. Together with sponsors and partners, it introduces innovative marketing ideas to promote Landcare, particularly by capitalising on national and international events such as the Sydney 2000 Olympic Games. For example, in the lead up to the Games more than two million trees are to be planted across the country, linked to endorsements and dedications by prominent sports people, in the biggest on-ground Landcare project ever seen in Australia.

COMMUNITY COMMUNICATION AND SUPPORT

Surveys indicate that over 81% of all Australians know something about Landcare and recognise its clever and distinctive 'caring hands around Australia' logo. To develop such widespread awareness is a remarkable feat among a predominantly urban population. Farmers, the rural landscape and indigenous communities have long occupied a special place in the national culture, and increasingly, the environment in general, with its abundant and unique wildlife and physical features, is being valued and protected.

With rural populations declining in many rural areas, Landcare has provided vital social benefits, especially by bringing people together, maintaining morale, and encouraging education and training through numerous conferences, field days, workshops, project management and fundraising.

The importance of community Landcare groups having a voice in policy making has been recognised with the establishment of the Australian Landcare Council, the provision of a National Landcare Facilitator, and of national, state and local magazines, TV programmes and national awards for excellence. The Australian Landcare Council comprises representatives of the major stakeholder groups, and is the Federal Government's policy advisory body on natural resource management.

GOVERNMENT SUPPORT

The Government's support for Landcare helps landholders and communities manage resource problems where there are wider public benefits involved. Project funds do not subsidise aspects of the farming system or activities where actions are normal farm management for a given area. Financial support is only available via Landcare groups to build skills and networks and to undertake on-ground work. The Natural Heritage Trust was established in 1997 as the Government's national funding mechanism. In 1999–2000 the Trust provided A$320 million (US$192 million) to natural resource management and environmental projects in Australia, of which A$71 million was allocated to 870 Landcare projects.

A wide range of community or Landcare group projects may attract funding from either government or the corporate sector, or both. They do not necessarily have to be in the agricultural sector but may involve related projects such as 'Coastcare', 'Bushcare', 'Rivercare' and 'Water Watch'. 'Salt Watch' and 'Frog Watch' are two school-based projects that deliver useful data to people in the local watershed or catchment area.

INTERNATIONAL LANDCARE

The Landcare approach is attracting interest internationally, and elements of the programme are increasingly being recognised and emulated in other countries. An internet-based International Landcare 'Clearinghouse' has been established by the Commonwealth Department of Agriculture, Fisheries and Forestry to act as a central point of contact for international interest in Landcare in Australia, and as a gateway to a network of community and professional representatives with skills and expertise in developing Landcare in Australia and internationally.

Figure 3
The clever and distinctive 'caring hands around Australia' Landcare logo, known to two-thirds of all Australians

The potential for Australia to 'export' its model for sustainable agriculture was realised in 1997 when delegates from overseas attended a National Landcare Conference in Adelaide. In particular, a group visiting from South Africa became the pilot programme in the first Landcare Partnering Forum. South Africa launched its national Landcare programme in 1998.

The Secretariat for International Landcare (SILC) was established in 1998 as a non-profit company to promote Landcare internationally and provide an opportunity for overseas visitors to explore Landcare and share skills and experience through field-based training programmes. Representatives from several countries have since benefited from visits to Australia. Around 300 Landcare groups are now active in the Philippines, primarily as a result of collaboration with the Australian Centre of International Agricultural Research (ACIAR), SILC and other project partners including the International Centre for Research in Agroforestry (ICRAF).

Other organisations and State Departments of Agriculture are also involved in international Landcare and AusAID, Australia's international development agency, has increased its budget allocations for community Landcare-type projects. For example, AgWest International, a division of the Western Australian State Department of Agriculture, has been involved in South Africa, the Middle East, Pakistan and India. In cooperation with AusAID, AgWest continues to assist South Africa by preparing feasibility studies, exchange visits, study tours, technical advice, programme design and capacity building.

Over 1200 delegates from 22 countries attended the first International Landcare Conference 'Changing Landscapes - Shaping Futures', held in Melbourne in March 2000. In a unique Landcare education programme, SILC and ACIAR conducted a 12-day study tour prior to the conference with delegates from the Philippines, Indonesia, Cambodia, Laos, Vietnam, Thailand, Kenya, and following the conference with a group from the USA.

LANDCARE AS A VEHICLE FOR SUSTAINABLE AGRICULTURE

The International Landcare Conference 2000 was an inter-sessional meeting of the eighth session of the United Nations Commission on Sustainable Development (CSD) in April 2000, on the sectoral theme of Integrated Planning and Management of Land Resources. In his statement during the CSD session, the Australian Minister for the Environment and Heritage, Senator Robert Hill, MP, said 'We are keen that the issues we have faced and the lessons we have learned, combined with the experience and knowledge of practitioners around the world, be available to assist land managers and policy-makers everywhere plan their own integrated sustainable natural resource management solutions'.

Mr Bernard Wonder, Deputy Secretary, Commonwealth Department of Agriculture, Fisheries and Forestry, emphasised the value of community-based partnerships such as Landcare to address sustainable development objectives, and proposed that 'Landcare, with its focus on regional planning, on-ground projects, sustainable systems, research and development, education and training, provides win-win outcomes for both non-trade policy and agricultural trade objectives'.

The international application of Landcare skills in research and technical 'know-how' is a very real contribution that Australia can make to the world through exciting cooperative trade, aid, education, research and development programmes and opportunities.

CONCLUSION

In the early 1980s, rural people, and later policy-makers, realised that relying on government activity alone would not control land degradation. However, they recognised the potential of voluntary community-based self-help groups as a mechanism for addressing common problems and they directed increased funding, or redirected existing resources, towards activities by these groups.

Various Landcare-oriented initiatives during the 1980s and 1990s, including the Decade of Landcare, the National Landcare Program, the National Landcare Facilitator Project, and the establishment of the Natural Heritage Trust, represented the evolution in policy and programme structure towards integrated management of land, water and related resources, based on a strategic cooperative approach involving all levels of government and the community.

FURTHER INFORMATION

The International Landcare Clearinghouse. www.landcare.gov.au

To receive 'International Landcare News', a free periodical email service from the Clearinghouse which distributes general items of interest to anyone interested in international Landcare issues, send an email to: international.landcare@affa.gov.au with the message 'subscribe'.

Landcare Australia Limited. www.landcareaustralia.com.au

Secretariat for International Landcare. www.silc.com.au

AgWest International. www.agric.wa.gov.au/programs/trade/html/agint.htm

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Joys and Sorrows of No-Tillage Sowing in Western Australia

Bill Crabtree, *WANTFA, Australia*

Abstract

The adoption of no-tillage in Western Australia has been a rapid revolution. The management flexibilities that no-till offers and the sharpening of farmers' skills has allowed farmers to realise the power of no-till to improve their agronomic performance and to understand their systems better.

RATE OF NO-TILL ADOPTION

The adoption of no-tillage in Western Australia (WA) has been a rapid revolution (Figure 1). The change from full tillage systems to knife-point seeding or zero-till disc seeding has been explosive. The adoption was farmer driven. Much of the scientific data being presented during the time of explosive change, during the early 1990s, was negative towards no-tillage.

It was the bigger systems issues and longer-term sustainable benefits that farmers observed that helped no-till to forge ahead. Information provided by, and shared among, the Western Australian No-Tillage Farmers Association's (WANTFA) network was, and still is, an important key to the large adoption of no-tillage. The WANTFA membership is now 1400, from the 50 who started the movement in September 1992. Our group was modelled on ManDak.

BACKGROUND

Climate

Southern Western Australia has a strong Mediterranean climate. The 44 million acres of land, with sufficient winter dominant rainfall (of 12–24 inches) capable of growing dryland crops, has a latitude similar to southern California (28–35°S). It has a cool winter growing season from May to October, with hot and dry summers – when annuals do not survive (see Figure 2). A typical winter day would range from 40°F to 60°F, warmer by 5° in the north. Summer maximum temperatures can readily and regularly reach 115°F in the northern and central regions.

Crops grown in southern WA are mostly wheat, barley, lupins, canola, oats, peas and other pulses and are mostly all sown in early May and harvested in November. Each day's delay in seeding reduces yields by about 1% – irrigation is not an option. Australian soils are cooling down and wetting up in May and the daylight hours are short (10.5 hours).

At seeding, farmers are not too concerned with drying soil as winter rains often occur weekly. Therefore, cultivating below the seed zone is not harmful to crop emergence. It is common to cultivate 4" deep with a knife-point (0.5" wide) to reduce rhizoctonia which is worse in zero-till initially. In deep sands that compact, a 30% tillage response can be achieved by no-tilling with a 10" deep knife point on 12" row spacings. This is common on the Wongan and Eradu sands.

Soils

The soils are mostly very infertile and sandy with little buffering capacity. About 60% of the soils are duplex, or sand over clay at 4-20 inches depth. There are large areas of deeper sands also. These duplex sands usually contain only 1-5% clay and in the natural state the soils grew Eucalyptus trees and contained almost no copper, zinc, molybdenum or phosphorus (1-5 ppm). The red loams, in the river flat systems, typically had enough nutrients to grow low-modest plant production.

Age of agriculture

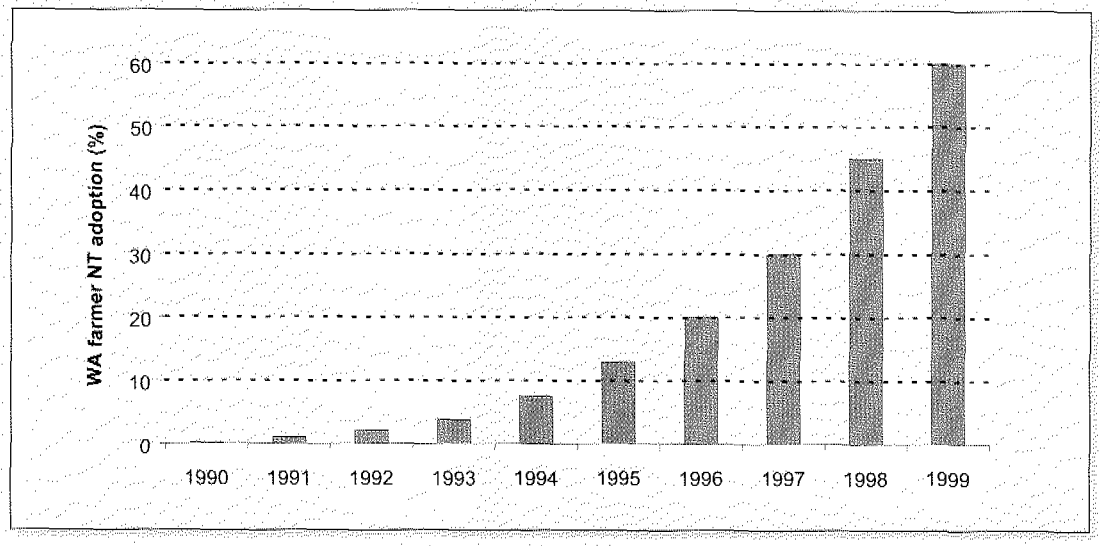
The somewhat fertile river loams were able to grow crops and pastures when first cleared of trees in the 1870s. The sandy soils were not used until in 1946 after they discovered the soils lacked trace elements. Then in a decade during the 1950s the government cleared more than a million acres a year. Now, 40 years later, 9% of this land is salt and they expect it will total 30% of the land by the year 2025. This is our crisis issue. More on this issue later. Many other crisis issues of the past in our agriculture have been solved by the widespread recent adoption of no-tillage.

Sheep and pasture

During the hot summers merino sheep roam inefficiently in search of food and water. Their roaming loosens the dry soil and predisposes it to wind and water erosion and structural damage on heavy soils. However, sheep have been an important part of Australian farming. The sheep require fences, forages (pastures) and a dam in each paddock. Paddocks are often 150-300 acres in size and farms are often 2000-10 000 acres in size and each farm has a large shearing shed and pens for shearing and pest management.

Pastures naturally regenerate in April-May after enough rain falls and the temperature drops. This is called the break to the season. Annual germinating pastures are weeds in crops, but since there are no perennial weeds to kill (dry summers) low rates of glyphosate (120 ml/ha) often work effectively. Pastures produce a lot of nitrogen. Some cereal crops would only get 25 lbs

Figure 1
Estimated farmer adoption of no-till in Western Australia



N/acre while canola might get 80 lbs. The cool and raining conditions after seeding make urea 4 weeks after seeding a sensible option in WA.

WHY WAS NO-TILL ADOPTED? – THE JOYS!

The massive amount of wind erosion that occurred in WA, and in particular along the south coast, in the early 1980s and early 1990s, created a fertile atmosphere for change. Farmers – and their wives – were tired of severe wind erosion and dust problems. Not to mention the loss of a very useful sandy soil that was often shallow and overlying an inhospitable sodic clay subsoil. These soils are called duplex and are not common (existent?) in North America.

Once farmers experimented with no-till they discovered lots of unexpected benefits. They could not only stop wind and water erosion, but they could seed into drier soil, they had improved earthworm activity and yields were not decreased (when put into the right part of the rotation). Farmers also found they could spend more time with their families at seeding, trafficability was improved, they could sell excess equipment, they had more seeding management flexibility and they found their over-all agronomic knowledge improved. This was because mistakes are more obvious with no-till and better monitoring was essential and more possible with no-tillage.

Farmers also discovered, within a few years, that weeds could be more effectively controlled if they were left on the soil's surface with no-tillage. This was particularly so when using trifluralin with knife-points on wide row spacings (9-11"). In fact, all soil active herbicides were more effective in the no-till systems, compared to full cultivation systems. With the widespread severity of herbicide resistance to many herbicides, particularly to the fops, dim and SUs, this better weed control has been a driving force for no-till adoption in recent years.

Another most powerful observation has been the better crop yields in drought years. Each cultivation encourages about 8/10"of an inch of rainfall to evaporate. Not only does no-till conserve soil moisture, it allows farmers to seed into dry conditions and ensures that water harvesting into the furrows occurs at the beginning and the end of the season. This extra moisture is channelled to where the crop roots and fertiliser are placed, making it more difficult for weeds to compete with the crop.

WHAT ARE THE CURRENT NO-TILL ISSUES?

We are at a time of continued great change in our cropping systems in Western Australia. Some of these include; the diminishing role of sheep over the last 10 years (poor wool prices), trying to find more diverse and appropriate rotations, and trying to survive with increasing herbicide resistance.

The fading of sheep has created a niche for other options. Without sheep there have been improved crop grain yields from retaining stubble and better time of sowing and not allowing sheep to spread weeds over the whole farm. Conversely, not having pasture in the farming system removes grazing as a management tool for herbicide resistant weeds.

SORROWS OF NO-TILLAGE SOWING

Herbicide resistance

Increasing reports of glyphosate resistant weeds is the biggest threat to no-tillage seeding. Without an effective and cheap broad spectrum burn-down (knockdown) herbicide, and tillage (with all the damage it does) – how else can we no-till? Most of our problem weeds have demonstrated resistance to most herbicide groups. There is glyphosate resistance in two confirmed cases in Australia, and several more are highly suspected. At least two glyphosate resistant weed populations have been identified in California, and Malaysia has recently reported several populations of glyphosate resistant weeds. We desperately need another glyphosate herbicide soon.

A strategy developed in Western Australia to extend the life of glyphosate is the "double knock" technique with Spray•Seed™ (paraquat 135 g ai/l + diquat 115 g ai/l) use. Most no-tillage farmers now apply Spray•Seed™ onto weeds that are still dying from glyphosate uptake. The Spray•Seed™ is applied within 1-10 days of the glyphosate application. This double knock technique has become the normal practice with most no-tillage farmers in Western Australia over the last ten years. Apart from delaying the occurrence of knockdown resistance, the technique also ensures quicker weed root release, improves herbicide mix options, can achieve an extra kill of new weeds, ensures barer ground for longer and can clean up areas that may have been missed with the first knockdown.

Farmers have been making significant changes to their weed management strategies over the last 10 years. Resistance to all herbicides is well understood in our farming communities. Farmers are swathing, manuring, cutting hay, using chaff carts, mixing up rotations, changing seeding time, burning header rows, adopting no-till, using the Chaff Top, growing short season crops and ensuring

a weed emergence flush occurs before spraying and then seeding with minimal disturbance. Some have even brought sheep back in (though the sheep may not be profitable alone) and many are experimenting with warm season crops.

It is clear that we must develop more diverse ways of killing all weeds. In Western Australia, this is particularly important for ryegrass and radish. No-tillage has provided significant biological weed management tools – with allopathy and surface placement rotting and predation (by ants, in particular). However, these must be complimented with other physical tools, particularly those tools that are still to be developed, like crushing the seed.

Insects and diseases

Obviously these pest problems are best managed with diverse three crop-type rotations – as Dwayne Beck would say. But the search for finding these profitable and diverse rotations in our environment is very challenging and has only recently begun in earnest. This search for diversity is ridiculed by most experienced researchers. The other option, which many researchers keep coming back to is – plough and burn! Neither of these excite many WANTFA members, who are keen to go forward – not back to the problems this approach offers.

There are only two crop types used in WA; they are cool season grasses and cool season broadleaves. Three years of farmer experiments suggest that sunflowers and grain sorghum may have some potential, with likely poor yields. Our hot and dry weather soon after seeding in September in sandy soils (holding only 10% moisture) is evidence for scepticism of their potential.

However, without this desperately needed diversity our cropping systems need modest pesticide inputs (low compared to European agriculture). Our hot-dry summers do not kill many crop disease problems, while our long-cool winters give many diseases ample time to build up and move on the wind throughout the state.

Most of our pests are protected by stubble retention and are worse with no-tillage with our limited cool season crop diversity. Some of these pests include falsewireworm, slugs, red legged earth mite, various grubs, snails (in patches of alkaline soils), mice, Rutherglen bug, septoria in wheat, various barley leaf diseases, blackleg in canola, Ascochyta in chickpeas, blackspot in peas. It is a rare plant pathologist who does not recommend burning and tillage to manage these problems.

Too few progressive researchers

While no-till has been rapidly adopted by farmers, many researchers are still negative about no-tillage. This has restricted the amount of useful research that has been done. Many researchers are very quick to say 'we told you so' when problems emerge. It would be great if they said 'let's push on and refine the system to cope with the new challenges'. One thing is for sure, the farmers are not keen to go back!

It makes water repellence worse

With very little surface area in our sands, they easily become coated with waxy material from retained organic matter. No-tillage makes this problem worse and now many farmers are applying 250 t/ha of clay on the surface and mixing it in to raise the clay levels to 5%. Water repellent soils severely exacerbate crop production – reducing yields by 20–60%

BRIEF NO-TILL HISTORY IN WA

Interestingly, the Agricultural Department's early trial work showed lower yields with no-till. The advent of severe wind erosion, fops, better legume crops, clean break crops, tungsten carbide, press wheels and better crop agronomy made for better no-till yields. Wheat crops of 18 bush/acre were common in the late 1970s with conventional tillage.

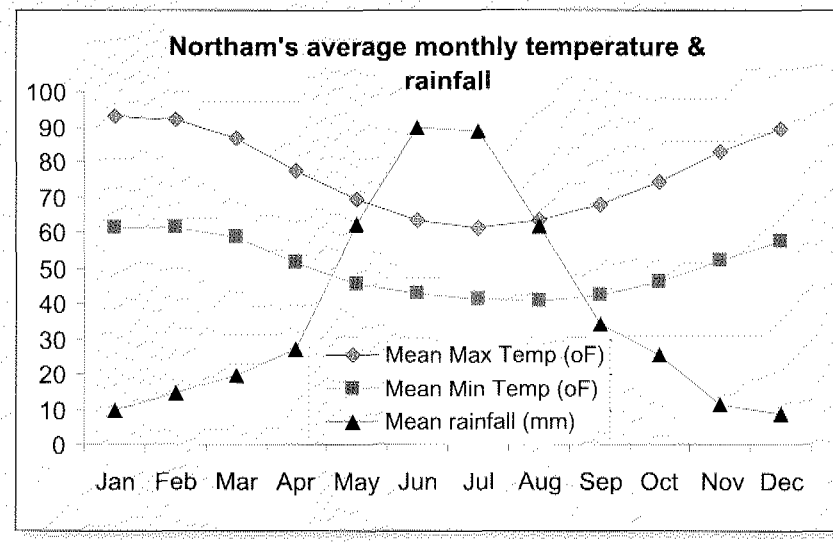


Figure 2
Typical climatic data for Western Australia

By the late 1980s high yielding (50 bush/ac) crops were common, leaving high levels of trash. This easily blocks seeders on our sandy soils and farmers attempted to selectively burn while others burnt whole fields prior to seeding. However, strong winds and a poor 'break' caused severe soil erosion. The loss of valuable topsoil was a powerful incentive for change. Those farmers that no-tilled did not lose paddocks and they produced a crop.

SEEDING MACHINES

Which type of no-till machine farmers should buy is not clear cut. Some environments favour zero-till discs while others no-till knife-points. Press wheels are always favoured. Trash flow is best with the discs and they ride over rocks better. The wear rates on either machine type are high and changing tips every 300-500 acres occurs often in Australia. Tungsten carbide tips are now common. Australian farmers can zero till with some very cheap machines although many of the expensive Canadian seeders are commonly bought.

SUMMER MANAGEMENT ISSUES

The 2-3 thunderstorms that might occur during summer may drop some rain before the true break and this will allow weeds and insects to grow. Some of these will not drought prior to the break, and if these weeds are not quickly controlled they are hard to kill before seeding. Their growth allows insects to grow – which damage emerging crops. Without early weed control no-till can fail; with it, the extra moisture conserved allows early crop establishment, but increases the threat of the rising groundwater.

CONCLUSIONS

Farmers continue to be enthusiastic about the benefits of no-tillage. This is despite many of the pest management issues that have arrived since no-till. The management flexibilities that no-till offers and the sharpening of farmers' skills has many farmers realising the power of no-till to improve their agronomic performance and to understand their systems better.

There is a continuing need for farmers to take control of their own agronomic destiny. Researchers tend not to be leaders, but followers, and the lag phase is often very frustrating – especially when you are on the edge.

Keep up your good work, and on behalf of WANTFA President Mr Geoffrey Marshall and myself, many thanks for your willingness to share freely with us! All the best!

ABOUT THE AUTHOR

Bill grew up on a wind erosion stricken farm at Jerramungup (where there are some of the most severe erosive winds in world agriculture) on very sandy surface soil. He obtained a B. Ag. Sci. from the University of Western Australia in 1985. He worked as a researcher/ extension worker on a project called 'minimum tillage for wind erodible sandplain soils' from the Jerramungup Department of Agriculture from 1985-1987 before becoming general extension officer at Esperance and Jerramungup from 1987-1990 and 1992-1995 (working on a Masters degree in 1990-91). In 1996 he had a one year job exchange to Canada where he worked closely with the big farmer group 'Manitoba North Dakota Zero Tillage Farmers Association' and co-edited their book called 'Advancing the Art of Zero-Tillage'. Since returning in April 1997, he has been employed by the Western Australian No-Tillage Farmers Association (WANTFA) as their Scientific Officer.

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Agricultural Research: Towards a Shared, Global Vision for the New Millennium

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Abstract

The notion of high returns to investment in agricultural research is closely linked to the degree to which research results can find widespread application among the intended beneficiaries: farming communities. A critical test of research success is the effectiveness of the technology development and diffusion process in tailoring the results to the needs and requirements of farmers. Ironically enough, the rapid pace of scientific accomplishments in this field has been accompanied by a very sluggish adoption of modern technologies by the intended end-users, who found them to be largely unsuited to their particular biophysical and socio-economic circumstances. This has caused considerable frustration and led the scientific community to take a new and careful look at the conventional modes of conducting applied research.

Figure 1
Small farmer Sheiu Braimah waters 'Bawku Red' onions on her plot in Bugri.
'If the water was not here, there would be no reason to be here. Everybody would leave the town'
Photo: Robert Grossman

In response to the above impasse, the international agricultural research community is endeavouring to make a truly qualitative shift in the way in which it operates. Initiatives are now under way to promote productive partnerships and there are considerable grounds for believing that research results will soon be able to find rapid fruition in farmers' fields. Success in this domain would also be critical in renewing enthusiasm among policy makers and the international donor community for increasing investments in research.

Rationale for Revisiting the Technology Generation Process

Although the issue of sustainability, particularly with regard to long-term management of natural resources by the rural resource-poor, has been to the fore for quite some time now, the need to address local-specific issues – such as incentives to adopt particular technology prototypes; the socio-economic context of food production, availability and access by the disadvantaged; and the policy and institutional environment – has only recently started to attract the attention of those involved in the technology generation process.

The latest scientific achievements are transforming the institutional context of agricultural research. Advances in genetic sciences have led to an increasingly profound knowledge of the genetic map of living organisms, whereas improvements in gene transfer techniques are making it possible to generate, plant species and varieties that promise resilience and adaptability to harsh agricultural environments hitherto considered unfit for agricultural production. Developments such as these can potentially change the economics and even the very structure of agricultural production.

The private sector has now become a particularly strong player, pouring massive investments into state-of-the-art research. Furthermore, intellectual property rights and breeders' rights are gaining increasing importance within the knowledge generation process, while issues relating to farmers' rights, international public goods with transparent developmental objectives, and critical questions relating to access to technology and knowledge empowerment, are currently generating a lively public debate, cutting right across scientific, legal, economic, environmental and institutional constituencies.

Building New Partnerships

The International Consultation on the NARS Vision of International Agricultural Research took place in Rome in December 1994, hosted by IFAD, and examined the

Figure 2 (right)
A female beneficiary talks with an extension worker about her rose garden in India
Photo: Anwar Hossain

question of how the NARS in developing countries could play an active part in shaping a vision for international agricultural research. Participating NARS representatives pointed to specific niches in which they felt capable of making a meaningful contribution to the global research system, through to the next century.

The partnership between NARS, the CGIAR Centres and the private sector represents a collective, global capacity to provide solutions to strategic problems and to fulfil the overall objective of combating rural poverty – an objective which has now become an integral part of the CG's overall mandate and philosophy.

Increasing the relevance of technology to small farmers, and improving the chances of adoption of that technology by the farmers themselves, is also the rationale for the current, progressive move from international strategic and applied research towards national and more location-specific research efforts. Many donors are already supporting initiatives to transfer some of the responsibilities of international centres – particularly with regard to training and on-farm testing – to stronger, national research institutions. A step in the right direction here is also being made by the establishment/strengthening of collaborative research networks and consortia arrangements that draw-in national programmes as full and effective partners in research and training.

While the individual strengths of NARS, CGIAR Centres and the private sector may vary, their collective strength is undeniably formidable. There are exceptional opportunities today for new forms of partnership, due to the arrival of new research tools, such as biotechnology, genetic engineering, information technologies and others, in many aspects of which NARS can provide effective leadership.

Figure 3 (below)
Woman from Thies in Senegal learn from an extension worker how to conserve green beans or 'niebé' for family use
Photo: Roberto Faidutti

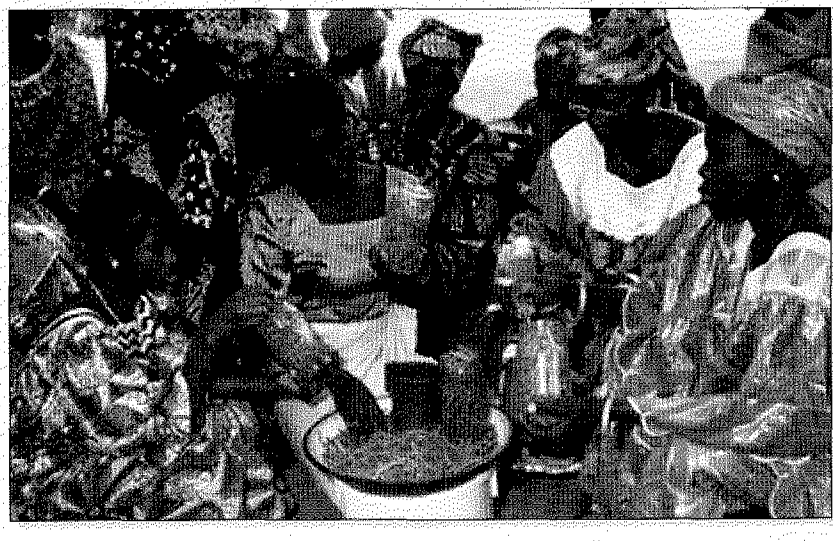

Figure 4 (right)
Woman carries millet in the Segou region, Mali
Photo: Roberto Faidutti

A GLOBAL FORUM FOR AGRICULTURAL RESEARCH – A REALITY

The CGIAR celebrated its 25th anniversary in October 1996. One of the major highlights was the Global Forum on Agricultural Research (GFAR), considered as a milestone in the history of the CGIAR. The Forum brought together, for the first time, representatives from all the stakeholders in the global agricultural research system. These include leading scientists and research scientists and resource persons from the CGIAR, NARS, universities and the academia, the advanced research institutions, the private sector, civil society/NGO community and farmer organisations, as well as the international donor community and, of course, the members of the CGIAR.

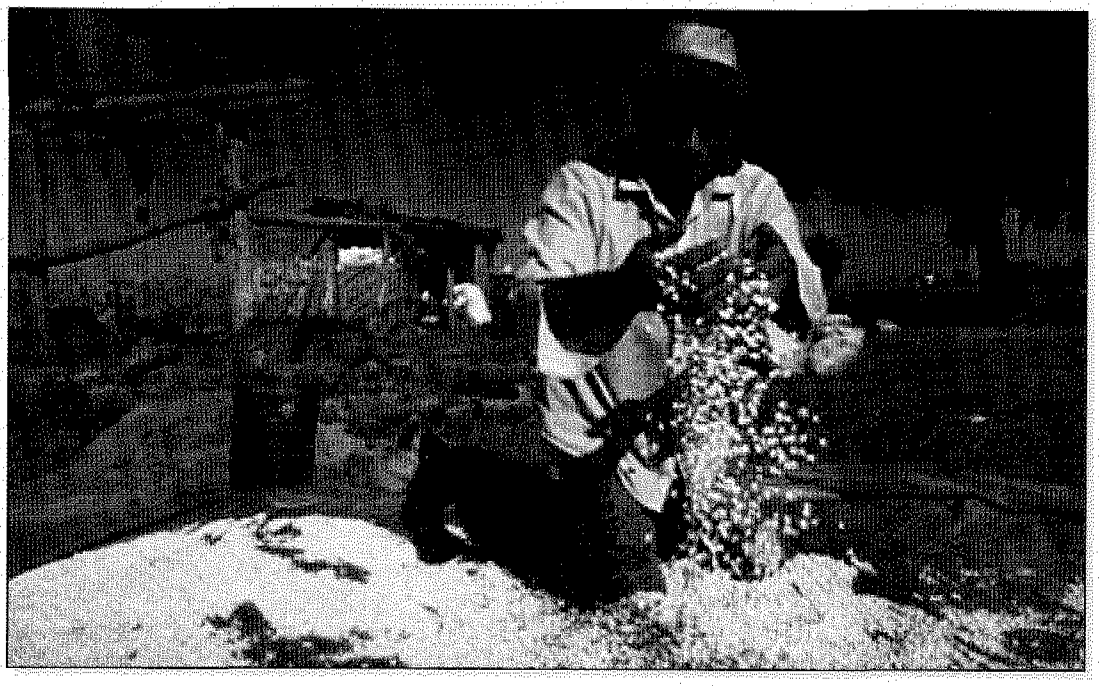

Figure 5
A min-fundio farmer in San Luis de Palmar, Argentina, stores harvested maize that is then ground into flour. He has received credit from the project to grow this maize
Photo: Guiseppe Bizzarri

The GFAR was successful in obtaining explicit expressions of support from the broad range of constituencies. It must be remembered, however, that this is still an evolving process: its Plan of Action is a living document, leaving scope for constant refinement. Meanwhile, GFAR stakeholders have agreed to work together in five critical areas, which are:

(a) new institutional and organisational approaches to agricultural research and development;

(b) genetic resources management and biotechnology;

(c) natural resources management and agroecology;

(d) the development of global/regional research networks on important crops, based on a commodity-chain approach; and

(e) the establishment of a global knowledge system for agricultural research and development.

IFAD'S ONGOING ROLE IN GFAR

IFAD is currently chairing the GFAR Donor Support Group and is an active member, as a facilitating agency, of the Global Forum Steering Committee. The Fund is also playing a key role in defining the work plan and budget for all GFAR activities.

TOWARDS A SHARED, GLOBAL VISION

Food security, poverty eradication and natural resources management are not only matters of concern to developing countries, they have in fact become critical global issues; given their impact on the well-being of society in general. A truly concerted effort is needed, therefore, to provide an immediate and collective response to these challenges. The rapid process of socio-economic and environmental deterioration taking place in many parts of the world is a further indication – if one were needed – of the urgency with which action must be taken.

The potential for combining the knowledge and capacity generated by scientific advances, and utilising this combination to address development challenges, is now greater than ever. The last milestone appointment for the GFAR stakeholders was Dresden, at the Global Forum for Agricultural Research 2000 which mobilised the world scientific community for this very purpose.

Sensitive to the challenges and opportunities facing the rural resource poor, and responsive to new scientific developments, here is a truly Global Agricultural Research System for the new millennium.

Through its Research-for-Development grants programme, IFAD has supported a large number of collaborative research initiatives based on mutual strengths and needs of all stakeholders. In the process it has encouraged participation of its clients among farming communities in the developing world. Such a process of strengthening the role of the small farmers in the generation of technologies has had enormous spin-offs, including their empowerment. A sharpening of focus on socio-economic research and participatory training which takes into account a broad spectrum of non-bio-physical factors – gender relations, for instance – contributes to enhancing the self-confidence and capability of some of the Fund's major stakeholders – the poor rural women. The individual strengths of farm households may vary but their collective strength is formidable and the effort is to capture this collective strength for charting the path towards sustainable food security and for eradicating rural poverty and bring the disadvantaged stakeholders into the global exchange of knowledge. This contributes to effective/efficient research systems, linked as they are to agents of change which afford the process to build on relevant local dynamics, traditional knowledge and coping strategies.

The above now represents the standard approach adopted in all IFAD-financed research programmes and is an important criterion used for the selection of collaborative research initiatives the Fund intends to support. Among the on-going programmes, IFAD is promoting collaboration between local research entities and farmer-run private micro-enterprises to produce Urea super-granule briquettes – a farmer-driven partnership that is proving successful not only in optimising the management of soil nutrients in resource-poor rice growing areas of Bangladesh, India, Nepal and Indonesia, but equally importantly it is creating a vibrant local economy in areas where the technology has found rapid adoption as a source

of off-farm income for the rural poor. Elsewhere in East Africa, the Fund is promoting adaptive research partnerships led by farming communities, with the assistance of NGOs, the private sector and, international and local research partners, leading to widespread adoption of sericulture and apiculture technologies that promise considerable pecuniary benefits to both farmers and middlemen alike. The latter are viewed as the change agents helping create a financially sustainable environment for the new technologies being introduced while poor farmers in Kenya, Uganda, Ethiopia, Tanzania and Zambia stand empowered by knowledge and skills to supply highly demanded products for the honey and silk industry and markets in Africa and beyond.

ABOUT THE AUTHOR

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Integrated Crop Management Strategies in Snow Pea: A Model for Achieving Sustainable NTAE Production in Central America

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Abstract

Expansion in non-traditional agricultural exports (NTAEs) has stimulated public and private investment throughout Central America, and focused regional policy on promoting continued NTAE expansion. However, in recent years the potential for an entirely new set of constraints to trade have been exposed. Central American NTAEs have experienced an increase in sanitary and phytosanitary regulatory violations at United States and European ports-of-entry as producers and exporters have aggressively sought expansion of their markets without appropriate concern for the field production and post-harvest handling protocols embodied in good management practices. These non-economic constraints to trade represent the newest and potentially most challenging limitations to future regional development in the NTAE sector, because current violations restrict market access and inhibit market expansion.

Introduction

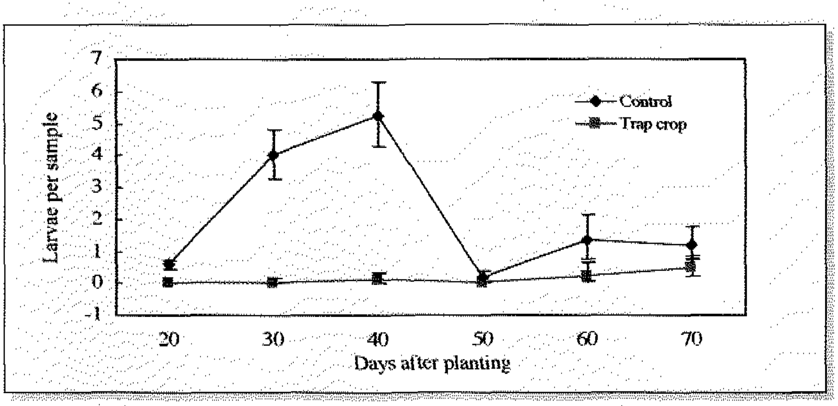
In order to address these issues in a proactive manner, the first requirement focuses on the development and validation of integrated crop management (ICM) strategies that result in economically and environmentally sustainable NTAE crop production. The USAID sponsored Integrated Pest Management Collaborative Research Support Program (IPM CRSP) in Central America targets development of scientifically-based integrated crop management systems. Implementation of such fully integrated crop management programs, along with proper post-harvest handling, help ensure that regional NTAEs meet marketplace demands, and at the same time encourage growth and sustainability in this important sector of rural economies throughout Central America. This paper summarises IPM CRSP integrated biorational pest management strategies developed to achieve these objectives, their impact on reducing reliance on chemical pest control practices, as well as, the economic and socioeconomic implications for enhancing Central America's NTAE production.

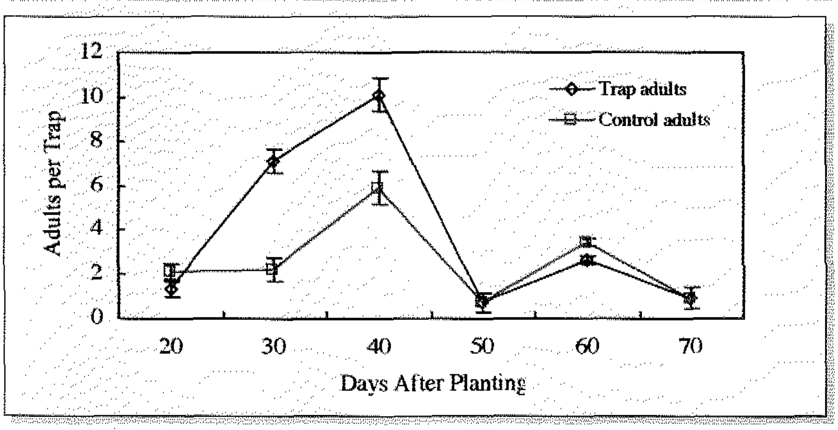
Integrated Biorational Strategies

Integrated crop management strategies are increasingly being recognised as important NTAE production practices to achieve reduced pesticide applications, increased product quality and more sustainable economic benefits. Biorational strategies focus on component production practices that are sensitive to balance and sustainability in the overall ecosystem when integrated into holistic production management systems. IPM CRSP research in Central America during the last seven years has concluded that fully integrated management approaches incorporating intercropping, scouting, trap cropping, mobile trapping, minimum threshold pesticide applications, optimum crop cultural practices, cultivar selection, and the coordinated transfer of this knowledge to growers provides a solid foundation for future growth and sustainability in the NTAE production sector in a substantially biorational manner. The underlying premise of IPM CRSP is that when current, scientifically proven production technologies are properly

Figure 1
Changes in larval density over time

Figure 2
Change in adult population over time





transferred, integrated and precisely managed, the production goals of immediate economic gain, long-term sustainability, and safe food supplies are mutually reinforcing. Snow pea research in the IPM CRSP provides just one example of how fully integrated biorational production management strategies provide the basis for achieving the aforementioned objectives for NTAE crops in Central America.

Research approach

Snow pea (Pisum sativum) is an important non-traditional export crop in Central America, and leaf miner (Liriomyza huidobrensis) has become an increasingly important pest problem. Control of leaf miners using total chemical means on a calendar application basis has become the standard practice in many production regions throughout Central America. As the leaf miner pest has developed greater resistance to chemical insecticides labelled for its control, producers have been forced to seek alternative approaches to achieve effective control. The IPM CRSP approach includes non-chemical component research regimes that are integrated into a holistic system to effectively control leaf miner problems in a more sustainable manner. When incorporated into a holistic crop management system, these various component strategies enable snow pea producers to achieve the overall objectives of fully integrated crop management. The objective of our research was to establish a fully integrated demonstration site for grower training and technology transfer.

A holistic, ICM system was evaluated at nine field sites in the Guatemalan highlands where 80% of snow pea production occurs. The ICM plots were managed by IPM CRSP technicians, and pest control measures were based on scouting and the determination of pest thresholds. Incorporation of trap crops, sticky traps, and minimum-use pesticide applications were included in the pest management regimes. This was in contrast to farmer managed plots where pest control relied primarily on application of pesticides using a 7-10 day calendar programmed application schedule. Most producers were small family farmers with < 0.5 ha. Few were acquainted with integrated pest management (IPM), and relied heavily on the agrochemical distributors for pest management information.

The IPM CRSP integrated crop management system was based on performance proven component research, including effective intercropping techniques, which had previously been evaluated for leaf miner control. Laboratory and field experiments conducted with 'Oregon Sugar Pod II' snow pea and faba bean (Vicia faba) investigated the potential of faba bean as a trap crop for leaf miner. Trap crops are used to attract insect pests away from the primary income crop being produced, in this case snow peas, thereby lowering the insect pressure in the crop and reducing the need for chemical pesticide applications. Greenhouse choice and no choice experiments previously investigated leaf miner preference for faba bean versus snow pea. The greenhouse and laboratory results indicated faba bean was highly attractive to leaf miner adults and showed excellent potential as a trap crop.

Field experiments in 1999 at Xeabaj, Chimaltenango, Guatemala were established to confirm these positive greenhouse results using faba bean trap cropping strategies for leaf miners. Plots were managed using proven agricultural practices without use of pesticides. The experiment included two treatments: faba beans as a barrier trap crop around snow peas and snow peas alone as the control. Sampling of leaf miner infestation was conducted 20, 30, 40, 50, 60, 70 and 80 days after planting at eight locations in the trap crop and at 13 locations within the snow peas. Sampling involved cutting the upper 50 cm of the plant stem and counting emerging larvae after six days.

Additional studies were conducted for incorporation into ICM systems to determine the effect of intercropping on leaf miner infestations and the economic impact on returns to growers in snow pea production. Intercropping strategies, sometimes referred to as strip-cropping, incorporate multiple crops of economic value into the production regime in an effort to achieve lower pest problems and greater net returns per area of production. Field trials at Xeabaj (Table 1) tested crop combinations of: snow pea+black bean (Phaseoulus vulgaris); snow pea+carrots (Daucus carota), snow pea+beets ; snow peas+lettuce (Lactuca sativa); and two monocultured snow pea plots treated exclusively with insecticides for leaf miner management (farmers control); or leaf miner control in snow pea plots with portable yellow sticky traps called 'toritos'.

Factors evaluated were snow pea export-quality yield and leaf miner larval populations 35, 65 and 90 days after planting. All plots except the chemical control plot

Table 1. Summary of the economic analysis performed on yields and total direct costs of snow pea intercrop field trials for snow peas in the Guatemalan highlands, 1999.

Treatment	Unit	Unit Cost (US$)	Unit Price (US$)	Yield (Ha)	Direct Cost (US $)	Net profit	Profit margin
Snow pea monoculture non-chemical	Kg	0.37	0.73	6,126	$2,267	$2,205	97.3%
Snow pea +	Kg	0.36	0.73	3,083	$1,110	$1,141	120.6%
Lettuce	Kg	0.07	0.17	12,727	$891	$1,273	
Snow pea +	Kg	0.14	0.73	3,247	$455	$1,916	251.6%
Black beans	Kg	0.39	0.92	1,711	$667	$907	
Snow pea +	Kg	0.38	0.73	2,982	$1,133	$1,044	71.3%
Beets	Dozen	0.31	0.35	1,300	$403	$52	
Snow pea+	Kg	0.41	0.73	2,763	$1,133	$884	52.6%
Carrots	Dozen	0.30	0.24	1,324	$397	-$79	
Snow pea monoculture Chemical	Kg	0.47	0.73	6,337	$2,978	$1,648	55.3%

Table 2[1]: Number of eggs and pupae per gram of fresh weight of tissue per species in no choice and choice experiments[2]

	No choice experiment		Choice experiment	
Treatment	Eggs/g FW	Pupae/g FW	Eggs/g FW	Pupae/g FW
Faba bean	2.06**	0.43**	5.41**	2.14**
Snow pea	0.20	0.04	0.12	0.25

[1] Data presented are means for three separate experiments.
[2] Data were analyzed using a square root transformation. Data presented for the untransformed values.
** Significant difference at P<0.01 found between means.

were managed according to the IPM CRSP integrated crop management guidelines. Leaf miner populations were monitored twice a week and insecticide applications made at the threshold of 10 adult leaf miners per meter.

Summary results

These biorational pest management strategies were fully integrated using the IPM CRSP integrated crop management approach, and managed by trained on-site field technicians. The ICM snow pea test plots (1100 m2) were compared to identical plots managed entirely by regional farmers using traditional pest management regimes. In contrast to traditionally managed plots, ICM-managed plots required half, or less than half, the amount of insecticides applied by farmers in the control plots, and achieved equal or better results. Insect pest populations and diseases were similar in the ICM plots and the control plots even though farmers applied insecticides on a program scheduled basis in the control plots. In nine out of nine comparisons, the ICM plots required less insecticide sprays and in seven out of nine comparisons, the ICM plots had higher yields. This translates into an average 61% reduction in pesticide use, and a 6% increase in average total yield. In two of the sites, export-quality yields were 30–50% higher than the national average, with outputs ranging from 9500–10 800 kg/ha. These results indicate that the production and export of high quality edible NTAE crops is entirely possible using performance proven IPM strategies. The key to success centres on the effective transfer of such performance proven production knowledge, and the implementation of highly focused grower training programs on a regional basis.

When leaf miners were exposed only to faba bean or only to snow peas, there was a significantly higher number ($P < 0.01$) of eggs laid on faba beans (2.06/g FW) than on snow peas, (0.20/g FW) (Table 2). The number of emerging pupae from faba bean foliage (0.43/g FW) was also greater than from snow pea foliage (0.04/g FW). In choice experiments there was a higher ($P < 0.01$) number of eggs laid on faba beans (5.41/g FW) than on snow peas (0.12/g FW) (Table 2), and the number of emerging pupae from faba bean foliage (2.14/g FW) was also greater than the number emerging from snow pea foliage (0.25 /g FW). Greenhouse data concluded that female leaf miners prefer faba beans over snow peas as a host for oviposition.

Faba beans have excellent potential as a trap crop for leaf miners in snow pea fields. In field experiments, the number of larvae emerging per snow pea plant was significantly ($P = 0.05$) higher in monoculture control treatments than in snow peas surrounded by the trap crop treatment (Figure 1) for tissue sampled at 20 to 60 days after crop planting (larvae were significantly different at $P = 0.10$ level for days 50 and 70 after planting). There were no significant differences in the number of larvae emerging from snow pea plants in either treatment 80 days after planting. The number of adults caught on sticky traps in the trap crop treatment compared to the control treatment was significantly different only on days 30 ($P = 0.05$) and 40 ($P = 0.1$) after planting (Figure 2). Faba beans were again found to be a preferred host for leaf miner oviposition compared to snow pea. Further, faba beans were found to have excellent potential as an effective season-long trap crop to reduce leaf miner infestations in snow pea culture. This translated into a reduction in the level of leaf miner infestation, as well as the number of insecticide applications required to control the pest. Currently, over 30% of Guatemalan snow peas are grown using the faba bean trap crop system developed by in the IPM CRSP research, and incorporated into an ICM production system (G. Sánchez, pers. comm, 2000).

Intercropping was found to be an attractive option for farmers in the highlands of Guatemala. There were no significant total yield differences in any of the various cropping combinations (Table 1). However, economic assessments found that the most profitable regime was the intercropped snow pea black bean combination with net profit margins exceeding 251% (Table 1). In contrast, mono-cultured snow pea using standard chemical pest control practices had only a 55.3% net profit margin as a result of increased chemical applications and associated labour costs. The diversification of crops favours long-term sustainability for both export and locally marketed vegetables. The results obtained in this study suggest that the ICM strategy developed by the IPM CRSP in Guatemala is applicable to multi-crop systems throughout Central America, thus resulting in increased economic benefits to the farmer. Profit margins were increased due to lower pest pressures and reduced usage of chemical insecticides, plus the fact that farmers can diversify crops grown to take advantage of not only the NTAE market, but local and regional markets as well. The ICM systems described above, developed through IPM CRSP research, have been shown to be critical elements for achieving potential long-term sustainability in the NTAE production sectors of Central America.

Conclusions

Our research concludes that NTAE producers and exporters throughout Central America can benefit from a serious effort to institutionalise policies that encourage the adoption of fully integrated biorational crop management practices. Performance proven component pest management strategies, when fully integrated into a holistic production and post-harvest management system, result in more effective

IPM CRSP collaborators in Guatemala are: (from front left) Guillermo Sánchez, Glenn Sullivan, Steve Weller, and (back row) Rich Edwards

insect and disease control with less reliance on chemicals. Further, these fully integrated crop management systems generate higher marketable yields, safer food supplies, and greater economic sustainability at all levels. Perhaps even more importantly, biorational crop management systems help assure long-term sustainability to the fragile natural resources and overall ecosystem which serve as the foundation of all NTAE production activity in Central America.

The component research summarised in this paper clearly validates the underlying premise of the IPM CRSP; when current scientifically tested and proven production technologies are properly integrated and precisely managed, the production goals of immediate economic gain and long-term sustainability are mutually reinforcing. The research and development initiatives of the IPM CRSP have shown that when integration is the critical focus of IPM, Central American NTAE producers can expand production in a manner commensurate with market expectations and consistent with their economic and socioeconomic development objectives. In both the near and long-term, fully integrated crop management strategies serve to significantly increase the region's capacity to meet product quality standards for safe food supplies and help compete more successfully in an increasingly more demanding international marketplace.

ACKNOWLEDGEMENTS

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How to Make Agri-Food Supply Chains Sustainable: Unilever's Perspective

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ABSTRACT

It is not sufficient to make good and safe products and to market them successfully. We believe we should also seek to align economic, environmental and social objectives throughout our supply chain. Our purpose, to meet the everyday needs of people everywhere, implies that we must also ensure the raw materials we use continue to be available in the future. Through the Unilever environmental programme, we run a number of initiatives on product improvement and process control in the supply chain. In addition, Unilever has embarked on three sustainable development initiatives in fisheries, water and agriculture. This article provides the background to Unilever's contribution to sustainable agriculture.

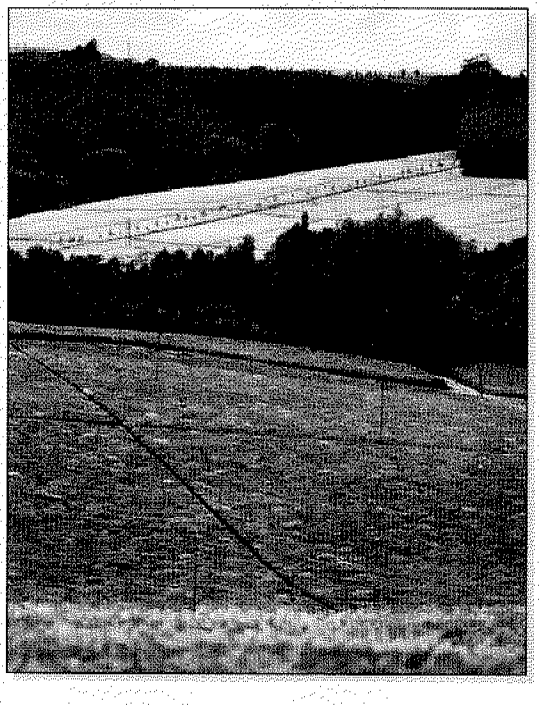


Figure 1
Unilever has a long history with both tea and palm oil plantations. Some of the tea bushes on the Brooke Bond Kenya estate are over 75 years old

Figure 2
After processing, empty fruit bunches on the Pamol estate in Malaysia are returned to the groves for composting

INTRODUCTION TO UNILEVER

Unilever is a multinational company, producing branded fast moving consumer goods in foods, and home and personal care products. Unilever foods represent over half of the business. About two thirds of all Unilever raw materials come from potentially renewable sources, mostly agriculture and fisheries.

SUSTAINABLE AGRICULTURE: KEY REQUIREMENTS

In 1995, Unilever commissioned two studies on sustainable development. One concentrated on external stakeholder perspectives on sustainable agriculture. The stakeholders interviewed were drawn from leading players and opinion formers among consumers, farmers and the agribusiness, food industry, retail sector and environmental NGO communities. Stakeholders were asked what they thought sustainable agriculture should be and what role a company like Unilever could play in making it happen. The second study looked into existing literature on sustainability indicators, and selected a group that was relevant to Unilever's business, measurable and within its range of control.

The studies revealed a complex set of criteria for sustainable agriculture:

- Output must be high enough to meet demand
- Negative environmental impacts on soil, air, water and biodiversity must be minimised

1. **Soil fertility/health.** Soil is fundamental to agricultural systems, and a rich soil ecosystem contributes to crop and livestock performance. Sustainable agriculture practices can improve beneficial components of the soil's ecosystem.
   Typical parameters: number of beneficial organisms, soil organic carbon.
2. **Soil loss.** Soil eroded by water and wind can lose both structure and organic matter, so diminishing the assets of an agricultural system. Sustainable agriculture practices can reduce soil erosion.
   Typical parameters: soil cover index, soil erosion.
3. **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 and emissions to the air. Sustainable agriculture practices can enhance locally produced nutrients and reduce losses.
   Typical parameters: amount of inorganic nitrogen/phosphorus/potassium applied, balance of nitrogen/phosphorus/potassium over crop rotations.
4. **Pest management.** When pesticides are applied to crops or livestock, a small but significant proportion can escape to water and air, kill beneficial or non-target wildlife or accumulate in foods, thus affecting human health and ecosystems. Sustainable agriculture practices can substitute natural controls for some pesticides, so reducing dependence on externally introduced substances.
   Typical parameters: amount and type of pesticides (active ingredient) applied.
5. **Biodiversity.** Agriculture has shaped most ecosystems in the world, and biodiversity can be improved or reduced by agricultural practices. Some biodiversity is highly beneficial for agriculture. Sustainable agriculture practices can improve biodiversity – both by 'greening the middle' of fields as well as 'greening the edge'.
   Typical parameters: level of biodiversity on site, habitat for natural predator systems, cross boundary effects.
6. **Product value.** Product value is a measure of the desired outputs of an agricultural system. Sustainable agriculture practices should be able to maintain or improve product value.
   Typical parameters: total value of produce per ha., nutritional value, including minerals, ratio of solid waste re-used/recycled over solid waste disposed to landfill.
7. **Energy.** Although the energy of sunlight is a fundamental input to agriculture, the energy balance of agricultural systems depends on the additional energy supplied from non-renewable sources. Sustainable agriculture practices can improve the energy balance and ensure that it remains positive - there is more energy coming out than going in.
   Typical parameters: total energy input/total energy output, ratio renewable over non-renewable energy inputs.
8. **Water.** Some agricultural systems make use of irrigation water, others pollute or contaminate ground or surface water with pesticides, nutrients or soil. Sustainable agriculture practices can make targeted use of any inputs, and so reduce losses.
   Typical parameters: amount of water used, leaching and runoff of N/P/K to surface and ground water.
9. **Social/human capital.** Finding ways to ensure we use natural resources sustainably demands initiatives in the social sphere such as collective action, the sharing of new knowledge, and continuous innovation. Sustainable agriculture practices can improve both social and human capital in order to ensure normal outputs. The prime responsibility for this should remain with the local community, leading to realistic and actionable targets.
   Typical parameters: group dynamics/organisational density of rural community, rate of innovation.
10. **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 can help to make the best use of local and available resources in order to increase efficiency.
    Typical parameters: amount of money/profit spent reinvested locally, employment level in local community.

Figure 3
Unilever's Sustainable Agriculture Indicators

Figure 4
Pilot Projects and Share of World Volume in Key Crops

Key crop	Unilever share of world volume (approximate)	Countries with pilot projects	Pilot project status
Palm oil	6%	Malaysia	Started 1999
Peas	13%	United Kingdom	Started 1997
Spinach	28%	Germany, Italy, Spain, Austria	Started 1999
Tomatoes	5%	Australia, Brazil	Started 1999
Black tea	15%	Kenya, India	Started 1999

Sustainable Agriculture	Define Unilever's goals for sustainable agriculture
	Unilever aims to support these Principles in its Sustainable Agriculture Initiative
Principles	Principles are difficult to operationalise
Indicators	10 general indicators covering environmental, social, and economic aspects of agriculture
	Define the areas that all pilot projects focus on and monitor
Parameters	Several parameters developed for each indicator
	Local stakeholders help define appropriate parameters
	Parameters must be measurable and related to the Principles
	Pilot projects should be able to influence the indicator through their farming practices
Practices	Pilot projects are working to define practices that can positively influence the parameters
	Eventually, these practices will help Unilever define sustainable agriculture standards

Figure 5
A framework for defining sustainable agriculture standards

- Quality and safety of products must be guaranteed
- Changing consumer demands must be met
- Profitability must be competitive with other industry sectors
- Agriculture must offer an attractive livelihood to workers.

Although stakeholders' views vary, the following goals, described by Professor Jules Pretty of the University of Essex, UK, and author of 'Regenerating Agriculture', summarise the prevailing views on how these criteria can be met:

- Maximise the incorporation of natural processes such as nutrient recycling, nitrogen fixing and pest-predator relationships
- Minimise the use of external and non-renewable inputs that damage the environment or harm the health of farmers and consumers
- Encourage participation of farmers and rural communities in the processes of problem-analysis, and technology development, adaptation and extension
- Ensure a more equitable access to productive resources and opportunities
- Increase productive use of local knowledge, practices and resources
- Increase self-reliance among farmers and rural communities

Figure 6
Harvesting spinach in Germany: a group of farmers is participating in a pilot project to define sustainable agriculture best practices

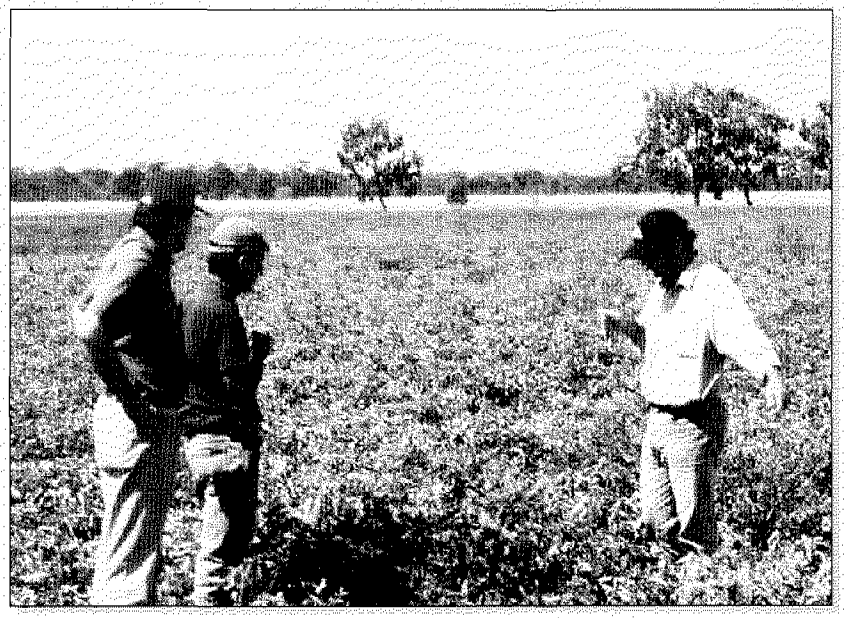
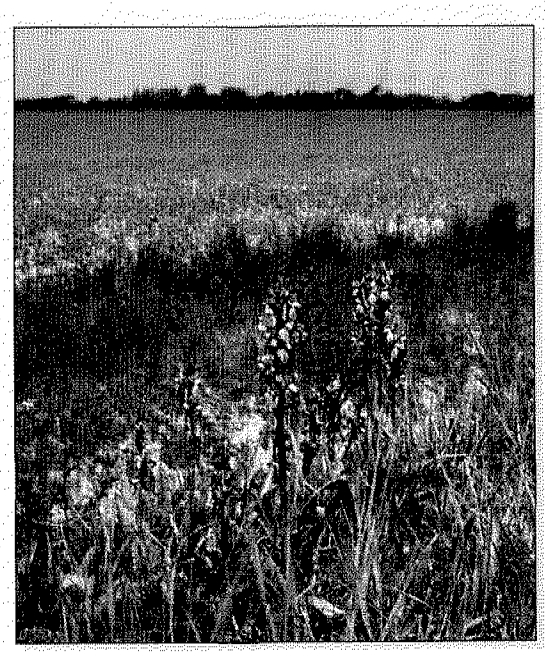


Figure 7 (top)
Inspecting tomato fields before harvest in Australia. Water issues are among the most pressing concerns for tomato growers in this region.

Figure 8 (above)
A contract farmer speaks with a BEW fieldsman during harvesting. BEW has been working closely with its farmers for over 30 years to define agricultural best practice.

Figure 9 (right)
Field margins, such as this, provide habit for flora.



Actual measurements within the indicators are wide-ranging and include:

- Activity levels in soil microfauna (worms and beetles) are monitored.
- Energy inputs (mainly diesel) are recorded.
- A bird nesting survey (an element of biodiversity monitoring) has identified the importance of field Actual measurements within the margins.
- Activity within local economies is monitored, as is communication between farmers, BEW and consumers.

Partners play a key role producing data and also interpreting and suggesting ways of improving scores. BEW finds the project is helping to improve its relationships with the farmers, whose co-operation is integral to the success of the pilot and subsequent standards.

A closer look: progress with peas in the UK

Consulting widely is an essential part of the Sustainable Agriculture Project at Birds Eye Wall's (BEW), the Unilever company running the project with growers in the UK.

BEW's first step was to work with its advisers to develop a discussion paper based on the proposed indicators. The paper was sent to opinion formers in the farming community and those working on sustainable agriculture in academia and government. This was done to ensure that proposals were realistic and also to identify partners who could help provide data for the parameters specified within the indicators.

Twenty-one farmers from among more than 500 growers who work with BEW were selected to participate in the pilot. The choice was determined by the need to have representative soil types and at least one grower from each group in the co-op system used to supply BEW's factories.

A closer look: progress with tea in the Kenya

Most tea bushes in commercial production are those that were planted when the plantations were first established: many are over 100 years old. This longevity has encouraged the adoption of a wide range of conservation measures, but there is scope for improvement and the wider adoption of best practice.

Since early 1999, the Brooke Bond Tea estates in Kericho, Kenya, have been running a pilot study to test the indicators. The specific indicator set has been developed with the initial emphasis on agricultural indicators, such as soil conditions, pest management and biodiversity. Early results confirm that the levels of organic matter are well sustained by current practices and that good pest management is able to avoid the use of pesticides on the tea crop. Although tea is a monoculture, the retention of over 10% of the property as riverine forest strips and conservation areas is supporting natural biodiversity.

Figure 10
Brooke Bond Kenya tea plantation: taking water samples to monitor runoff

- Build strong rural social organisations and dynamic rural economies.

In our definition of sustainable agriculture, land is managed in a way that guarantees continuing high yields of agricultural produce over time, while minimising inputs and costs in terms of fossil energy, fertilisers, pesticides, herbicides or other auxiliaries. It is not sustainable to keep yields high by continuously increasing inputs into the process, while eroding the inherent productivity of the soil.

Obviously, this suggests a significant move away from the principles of so-called 'intensive' agriculture, but we believe it is also different from 'organic' farming and in certain respects more comprehensive. The emphasis is on a total systems approach towards sustainable production, based on rational analysis and validated assumptions. All this needs to be achieved while meeting the nutritional needs of a growing world population with increasing disposable incomes.

The challenge in sustainable agriculture is to combine the latest scientific views on all aspects of agronomy with empirical, sometimes traditional knowledge on pest management, crop rotation etc. This body of knowledge needs to be developed and brought to the rural community through participative learning, involving the people concerned. In this way, the learning process itself (which will have to continue once outside involvement has stopped) will be sustained.

UNILEVER'S SUSTAINABLE AGRICULTURE INITIATIVE

Based on the outcome of the external studies, Unilever ran a workshop in 1998, attended by employees, NGOs and agriculture experts, to agree the foundation of a Sustainable Agriculture Initiative.

Mission Statement

A Sustainable Agriculture Mission Statement was drafted during this workshop and formally adopted by Unilever in December 1998. This is an excerpt, listing the four Principles that Unilever aims to support with its Sustainable Agriculture Initiative:

Sustainable Agriculture is productive, competitive and efficient while at the same time protecting and improving the natural environment and conditions of the local communities. Our approach to sustainable agriculture is to support the following principles:

- *Producing crops with high yield and nutritional quality to meet existing and future needs, whilst 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 contribution will be made where possible*
- *Optimising the use of renewable resources whilst minimising the use of non-renewable resources*
- *Sustainable agriculture should enable local communities to protect and improve their well-being and environments.*

Sustainable agriculture indicators

Ten general indicators (Figure 3) have been chosen to help define and monitor progress towards sustainable agriculture practice. In selecting indicators, priority has been given to understanding ecological sustainability in agriculture. We believe that without this foundation we cannot meaningfully address social and economic factors: agriculture must first be environmentally sustainable in our view. Parameters for each indicator must be refined and tailored to address the characteristics of different crops and the particular local environment in which they are grown.

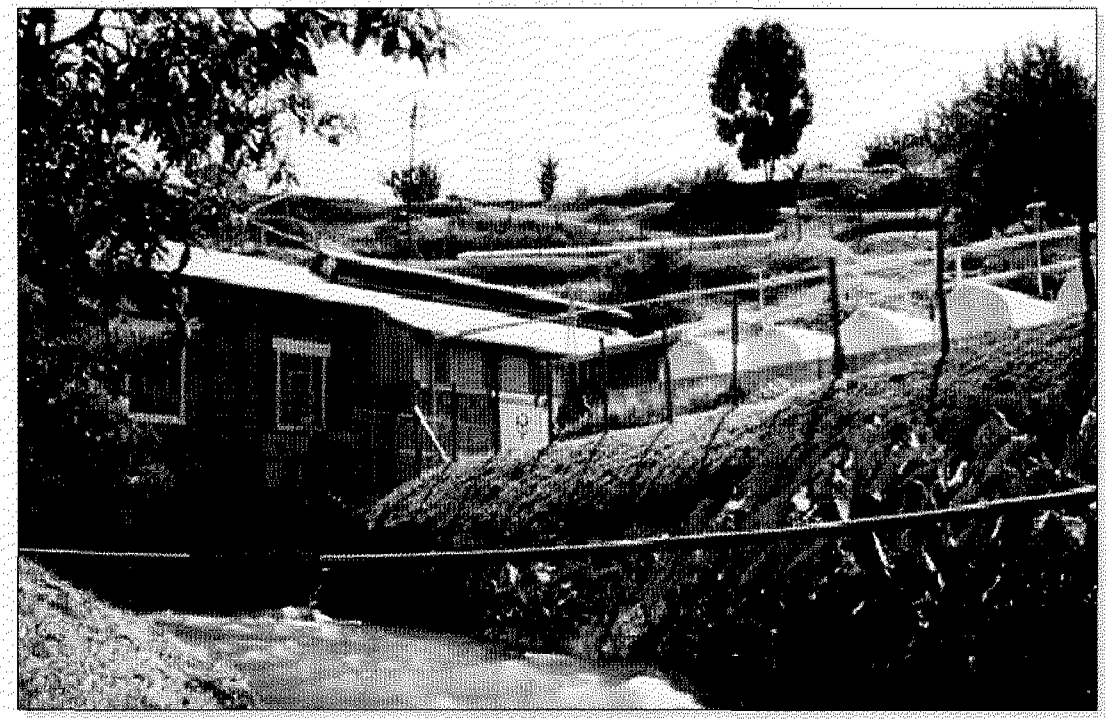


Figure 11
Brooke Bond Kenya meets its energy needs through hydro generation and fuel wood grown on site

Unilever's key crops

Unilever uses many different agricultural raw materials. To focus our efforts, we chose five key crops (tea, peas, spinach, palm oil and tomatoes) based on their strategic importance to Unilever's business (Figure 4) and the level of direct influence we have over the agricultural operations. Vegetables and tomatoes are being grown by farmers under contract to Unilever, oil palm and tea are grown on Unilever owned plantations (although not all of the volume needed by Unilever comes from these sources: the remainder is bought on the open market). Oil seed crops, such as sunflower and rape seed, are also extremely important to Unilever's business. These raw materials are bought almost entirely on the open market, thus limiting direct influence over the agricultural operations.

Energy consumption is largely met from the estate's own hydro schemes and renewable fuel wood plantations. The measurement of social capital and economic contribution is more difficult to benchmark but the tea industry is at the heart of both the local and national economy, and tea estates support a wide infrastructure in respect of medical care, education and general welfare.

The project is being substantially driven by the Brooke Bond agricultural team in the initial stages, but the findings will be used to develop guidelines which will be offered as an example of best practice to others in the industry. If others agree, this platform could be used to encourage the many Unilever suppliers, from large estates to small-holders, to adopt more sustainable practices.

Pilot projects

Unilever is taking steps to understand the ecological, social and economic conditions that sustainable agriculture must meet by initiating a series of field-level pilot projects on five key crops. Each pilot project aims to implement the sustainable agriculture indicators and develop practices that support the Principles defined in the Mission Statement. These projects have begun in Australia, Brazil, Germany, Kenya, Malaysia, India, UK, Spain and Italy. (Figure 4)

Pilot projects are managed locally by teams familiar with the specific crop and agricultural operation. The goal of each pilot project is to identify farming practices that move the agricultural operations towards sustainability. A first step towards reaching this goal is to develop, for their specific crop and circumstances, measurable parameters for each of the 10 indicators. Pilot project teams are encouraged to involve a range of local stakeholders in this process. Stakeholder consultation is essential to ensure that the parameters appropriately reflect the local environmental, social and economic circumstances.

Parameters chosen by pilot projects must fulfil two requirements: they must be related to Unilever's Sustainable Agriculture Principles, and it must be possible to influence the parameter through farm-level agricultural practices. The first requirement helps ensure that the pilot projects are all working towards a common goal: supporting Unilever's Sustainable Agriculture Principles. The second requirement limits the scope of the pilot projects to include only those factors within the control of the agricultural operation. Figure 5 illustrates this concept.

Several years of measurement will be needed to show whether these parameters can be influenced to move

towards sustainable agriculture. All of Unilever's future activities in this area will build on the experience gained from these pilot projects.

FUTURE WORK

Based on the results of pilot projects, Unilever hopes to develop standards that describe the ecological, social and economic conditions a sustainable agricultural system must meet. Indicator measurement results serve to make this process transparent. Once agreed, those standards will provide an objective basis for assessing the benefits and drawbacks of a wide range of agricultural methods and techniques. Such standards for sustainable agriculture would need endorsement by a wide variety of experts and stakeholders, e.g. organisations such as FAO, the World Bank, UNEP, NGOs, etc.

Unilever would welcome a recognised position in the market for 'sustainable agriculture', that is, mainstream agriculture, using proven technologies, which tries to align economic principles with environmental protection and social progress. Market mechanisms could be developed on the basis of sustainable agriculture standards (e.g. through certification schemes), to allow raw material buyers and consumers to express their preferences. Where such mechanisms prove effective, companies such as Unilever will be able increasingly to base their sourcing policies on the underlying standards and promote more sustainable agricultural practices.

ABOUT THE AUTHORS

Jan Kees Vis joined Unilever in 1985 with a PhD in Chemistry. After six years in research, he started working on environmental life cycle analysis of food and agricultural production systems. In 1990, he began to set up an implementation programme for environmental management systems and environmental reporting in the Unilever Food business in Europe. He has been involved in the Unilever sustainable agriculture initiative from the start in 1996.

Myles Standish joined Unilever in 1999 after completing a Masters in Systems Engineering and Environmental Ethics at the University of Virginia in the United States. His thesis focused on applying a systems methodology to the implementation and management of sustainable development initiatives. While in graduate school he wrote a series of case studies for the Darden School of Business on Unilever's sustainable agriculture initiative. His work at Unilever focuses on development of standards for sustainable agriculture.

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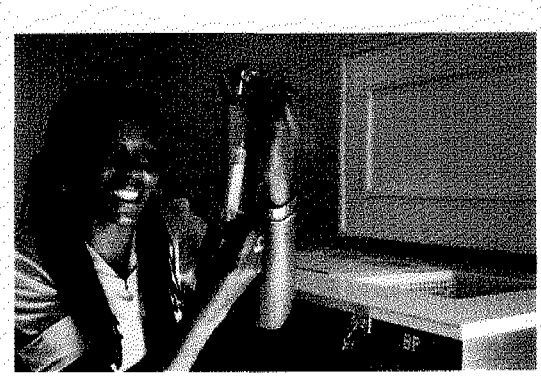

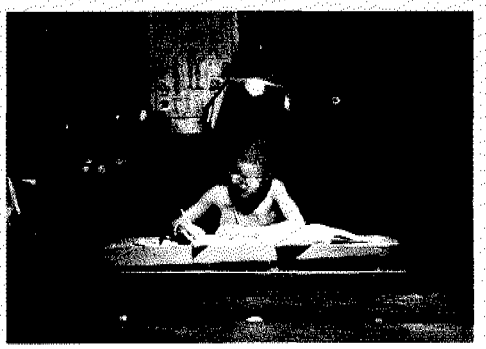

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SECTION 5

ENERGY

Picture courtesy of Gothenburg Energy International

Ocean Thermal Energy Conversion: An Extensive, Environmentally Benign Source of Energy for the Future

Thomas H. Daniel, *Natural Energy Laboratory of Hawaii Authority, Hawaii*

Abstract

Ocean thermal energy conversion (OTEC) has been shown to work at research scales, and plans are underway to build pilot scale plants. Private sector developers will probably be unwilling to make the enormous initial investment required by the inherent large scale of commercial OTEC, until the price of fossil fuels increases dramatically and/or governments provide suitable financial incentives. If, however, the pilot scale plants now being planned for some expensive-energy niche markets are successful in demonstrating low cost long-term operation, OTEC will be much more financially attractive. It offers tremendous potential for reducing man's input of CO_2 into our atmosphere, and the development should not be further delayed.

INTRODUCTION[1]

French Scientist Jacques D'Arsonval first proposed in 1881 that useful energy could be extracted from the temperature difference between the surface and deep water in the tropical ocean. For this process, now called ocean thermal energy conversion (OTEC), he proposed using a working fluid such as ammonia in a closed cycle engine (Figure 1)[2]. In the 1920s and '30s, D'Arsonval's student, Georges Claude, developed the idea of an open cycle system that uses the seawater itself as the working fluid (Figure 2)[3]. Claude actually built a plant in Cuba that generated energy from this process. In 1935, Claude obtained a patent for a 50 MW open cycle plant that used eight turbines, each generating about 6 MW. Little further progress was made on OTEC until the 1970's, when a dramatic increase in oil prices led to renewed interest in alternative energy sources. Governments around the world formed executive units such as the Energy Research and Development Agency (later the U.S. Department of Energy) in the United States which initiated programs to investigate a wide range of alternative energy sources, including OTEC. In 1974 the State of Hawaii, largely dependent on increasingly expensive fossil fuels, formed both the Hawaii Natural Energy Institute at the University of Hawaii and the Natural Energy Laboratory of Hawaii, at Keahole Point on the Big Island of Hawaii (Figure 3). The latter operates under the State's Department of Planning and Economic Development, now the Department of Business, Economic Development and Tourism. The Natural Energy Laboratory of Hawaii Authority has grown to become the world's foremost site for research, development and commercialisation of OTEC and related technologies.

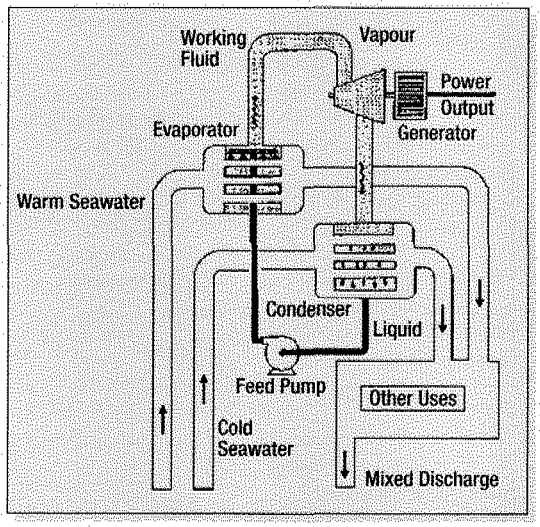

Figure 1
Closed-Cycle OTEC Schematic Diagram. Surface seawater flowing through the evaporator vaporises a working fluid, such as ammonia, which expands through the turbine, turning the generator to provide electrical output. The working fluid vapour is condensed by thermal contact with deep seawater flowing through the condenser. The condensed liquid is then pumped back to the evaporator, where the cycle (named the 'Rankine' cycle) repeats. Much development work has focused on the evaporator and condenser heat exchangers, which must have large surface area and must be resistant to seawater corrosion. Research indicates that aluminium heat exchangers can work well in these applications

Work at NELHA and elsewhere has produced engineering advances and some creative modifications to the basic cycles proposed by D'Arsonval and Claude. Specifically, a recent proposal for a Kalina Cycle plant[4] that uses an ammonia water mixture provides a significant efficiency improvement over the traditional Rankine cycle proposed by D'Arsonval. The 'Mist Lift' cycle tested at NELHA by Stuart Ridgway[5] overcomes the scale-up problems of the large turbine required for low pressure operation in the Claude cycle. Liquid water droplets couple with water vapour and are thereby lifted to sufficient height so that their potential energy can operate a hydraulic turbine.

POTENTIAL BENEFITS OF OTEC

The extent of the resource

OTEC represents a tremendous potential energy resource for the future. Figure 4 shows contours of the annual average temperature difference between the sea surface and 1000 m depth for the world ocean. OTEC is feasible with temperature differences of 20°C or

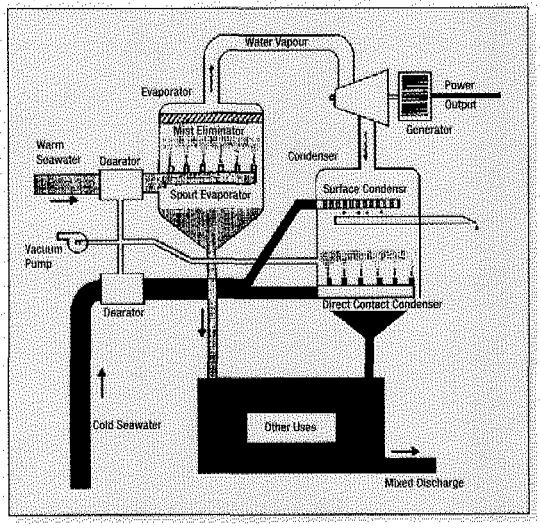

Figure 2
Open Cycle OTEC Schematic Diagram. Surface seawater vaporizes due to low pressure in the evaporator. The water vapour (low temperature steam) then expands through a turbine to the condenser where cold seawater condenses it back to liquid water. Since the salt is left behind in the evaporator, a surface condenser (such as that used in the closed-cycle process) will condense potable water. A direct contact condenser, in which the seawater directly contacts the vapour, will provide more electrical output but no potable water. The pressure drop across the turbine is very small (<3.5 kPa), so the turbine must be very large for relatively small electrical outputs. Turbines larger than ~6 MW cannot be built with present technology

greater, so all of the area between these contours in Figure 4, i.e. most of the area of the tropical ocean, is available for extraction of energy. Though the relatively small available temperature difference limits the achievable thermodynamic efficiency to less than 3%, various methods yield estimates that about 10 TW (1013 watts) of continuous electrical output could be extracted from this resource without significantly changing the thermal structure of the ocean[1]. The sun continues to replace heat removed from the surface layer, and the tremendous mass of the cold deep ocean water (the average temperature of the ocean is 3.5°C!) represents an essentially inexhaustible heat sink. OTEC could thus potentially supply most of the present energy consumption for all human activities, which was estimated at 386 EJ/yr in 1997 (1 EJ = 10^{18} J, 386 EJ/yr =1.22 x 10^{13} W = 12.2 TW)[6]. Other non-nuclear alternatives to fossil fuel energy sources, such as hydroelectric, wind, photovoltaic, geothermal, waves and tides each have, with presently available technology, at least two orders of magnitude less potential than OTEC[7].

Environmental considerations

OTEC can fulfil its tremendous potential with minimal impact on our environment. First, OTEC is not inherently exothermic, so large-scale utilisation will not contribute directly to global warming. Also, though the deep and surface seawater do contain dissolved carbon dioxide, straightforward engineering techniques can prevent its release into the atmosphere, so that OTEC produces much less greenhouse gas than fossil fuel generation systems. In addition, reasonable engineering and suitable spacing of plants throughout the tropical ocean can keep impacts on ocean temperatures and living resources well below objectionable levels.

By-products

The feature that most distinguishes OTEC from other renewable energy sources is the tremendous range of by-products that derive from downstream uses of the cold deep ocean water (Figure 5)[8,9]. The following paragraphs summarise some of those that have been investigated at the Natural Energy Laboratory of Hawaii Authority.

Air Conditioning – The most financially attractive of these by-products at the present time is 'space cooling' (air conditioning). The cold seawater can either chill freshwater in a heat exchanger or flow directly into a suitable chilled water loop, effectively replacing the chiller which consumes more than 90% of the energy of a traditional air-conditioning system. Simple systems of this type have operated for several years cooling buildings at NELHA, saving almost $4000/month in electricity costs for the facility. Economic and engineering analyses[10] indicate that the pay-back period may be as short as 3 or 4 years for commercial-sized projects. Developers in many tropical locations, such as Curacao, the Philippines, Guam and the Cape Verde Islands, are seriously considering installation of deep seawater air conditioning systems for new resorts. The positive experience at NELHA has led Cornell University in Ithaca, New York to install a 'lake source cooling' system that uses cool water from nearby Cayuga Lake to cool the

Figure 3
Aerial view of The Natural Energy Laboratory of Hawaii Authority, Keahole Point, Island of Hawaii. Mount Hualalai is in the background, and the Kona International Airport is immediately shoreward of the facilities. The green ponds are part of the facilities of Cyanotech Corporation, a NELHA tenant which grows microalgae for healthfood and pharmaceutical products

campus in the summer[12]. The University determined that the reduction in energy usage and consequent reduction in CO_2 emissions to the atmosphere more than justified the investment in the project. This system now serves as a model of potential savings for new developments in the tropics.

Industrial Cooling – The deep seawater represents a large 'heat sink' for many potential industrial applications. Specific examples tested at NELHA include condenser cooling for distillation processes, moisture and CO_2 removal during drying of algal products and cost-effective assistance to refrigeration and freezing systems.

Chilled Soil Agriculture – Cold seawater flowing through underground pipes chills the surrounding soil, providing a large temperature difference between roots and leaves – a 'perpetual springtime' for plants. Many temperate plants thus thrive in an arid sub-tropical climate where they would not normally grow. The cold also induces significant condensation from the humid atmosphere, providing a large fraction of the irrigation needed for the crops. The Common Heritage Corporation[13], started by NELHA founder Dr. John Craven, maintains a demonstration garden with more than 100 different fruits and vegetables, many of which would not normally survive in Hawaii. Strawberries grown in the chilled soil have five times the sugar content of those grown in neighbouring control beds. Varying the temperature by modifying the cold seawater flow through the underground pipes has induced pear trees to flower and produce fruit four times in a year. In June 2000, the Japanese Prefecture of Okinawa initiated a deep seawater system on Kume Island that will provide 600m-deep seawater to chill the soil to allow the year-round cultivation of spinach, a staple crop that will not grow locally in the hot summer. Projections indicate that the high summer spinach prices will quickly pay back the cost of the pipelines.

Aquaculture – The most visible and publicly recognised by-products of OTEC are the wide range of marine organisms that are being grown in suitable mixtures of deep cold and warm surface seawater being pumped ashore for OTEC research and development. The deep seawater is important to aquaculture for three basic characteristics:

1. Its **cold** temperature not only allows culture of many valuable organisms – such as salmon and Maine lobster – that would not normally grow in the tropics, it also provides cost-effective temperature control of large seawater volumes over a wide temperature range.
2. The deep water is significantly enriched in **nutrients** compared to normal oligotrophic tropical surface water, providing enhanced growth of marine algae.
3. The water is **clean** – it contains few of the pathogens that typically cause problems with culture of marine organisms.

Many private companies are now commercial tenants at NELHA, growing a variety of valuable crops in suitable mixtures of surface and deep seawater[14]. Organisms now being cultured include: microalgae such as *Spirulina* (a popular healthfood supplement) and *Hematococcus* (being used as a source of astaxanthin, a pigment and pharmaceutical), macroalgae (seaweeds being cultured largely for local consumption in Hawaii), oysters (being grown both for food and pearls), clams, abalone, shrimp and food fish such as hirame (Japanese flounder used in sushi) and moi (pacific threadfin), a Hawaiian fish delicacy.

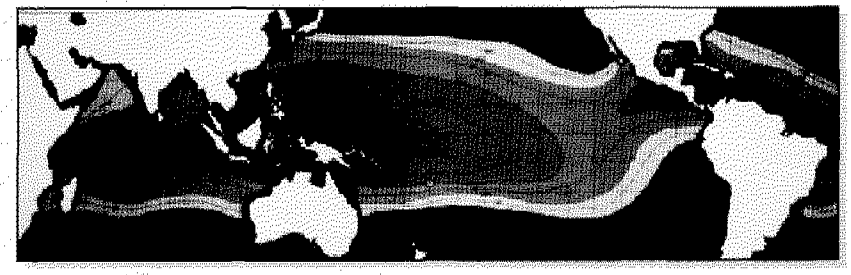

Figure 4
Distribution of the OTEC Resource. This map portrays contours of the annual average temperature difference between the surface and 1000 m depth throughout the world ocean. Since OTEC will work where the temperature difference is at least 20°C, the orange to red colours on the map shows that the resorce is generally available between the tropics

OBSTACLES TO OTEC DEVELOPMENT

Though the OTEC resource is very large, it exists mostly where people don't (Figure 5). There are only at most a few hundred land-based sites where deep water

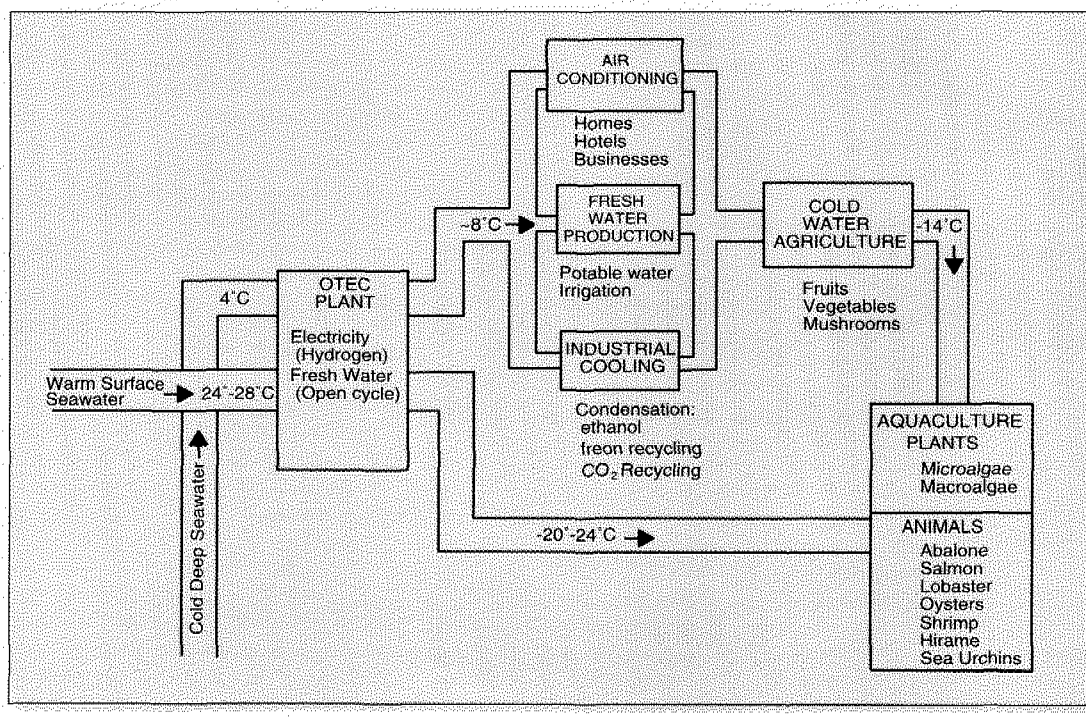

Figure 5
Schematic Diagram of a Multi Product OTEC System. The seawater discharge from an OTEC plant can supply large volumes of flowing seawater at any temperature between the 4°C of the deep seawater and the minimum 24°C of the surface seawater, merely by twisting a valve. The value of this resource in the tropics is limited only by the imagination of the user

is close enough to shore in the tropics to make land-based OTEC plants feasible[2]. Any significant development of the resource will, therefore, require siting of plants in mid-ocean. Not only is the cost of working things at sea higher than on land, but there are also problems with transmitting energy generated offshore to land-based populations. Deep sea cables would be very expensive and are not efficient for long range power transmission, and alternative transmission schemes, such as microwave transmission via reflecting satellite, aren't feasible with current technology. The solutions currently considered most viable involve using electricity generated by OTEC on offshore platforms to produce alternative fuels such as methanol[15] and, eventually, hydrogen. OTEC could thus become a major component of the hydrogen-based economy that many envision for man's energy future[16].

The OTEC cold water pipe (CWP) must transport large volumes of deep seawater to the plant from about 1000 m depth. For shore-based plants, the CWP must be at least 3 km long, even with the steepest bottom slopes known. Small pipeline diameters are inherently inefficient, due to friction losses and temperature increase. Because of this and the fact that the CWP represents almost 75% of the cost of current plant designs, optimisation studies conclude that plants smaller than about 50 MW cannot compete economically with other present energy alternatives. A 50 MW plant will require about 150 m/s of deep seawater, necessitating a pipeline with an inside diameter of at least 8 m. Current technology requires costly reinforced concrete pipe (RCP) or even more expensive fibreglass reinforced plastic (FRP) materials for pipelines of this diameter. Proposals for developing 'soft' pipelines, which deploy the pumps at the bottom end and use the water to 'inflate' the pipe, offer hope of significantly reducing the cost of these large pipelines.

OTEC is thus inherently a large-scale technology, requiring a large capital investment up front. The size of the investment dictates that, even though the process requires no fuel and will have relatively low operating costs, the investment will only be recouped over a number of years. The economic viability of OTEC is thus determined by factors such as the financing cost, the plant life-cycle and the future cost of competing energy sources. If an OTEC plant could be guaranteed to operate for 30 years without major overhaul, conservative projections of energy cost and interest rates predict a 30% return on investment, and investors would be eager to invest. However, it is not possible to predict the life cycle of a 50 MW plant from the limited intermittent operation of the largest plant built thus far, the 250 kW open cycle experiment at NELHA. World Bank advisors have determined that a pilot plant of about 5 MW operating for 5 years would be needed to justify investment in the full-scale technology. Such a plant would still be very expensive, however, and it would almost certainly lose money.

Some current projects plan to overcome this obstacle by building pilot-scale plants in situations where the high cost can be offset or justified by unusual circumstances. One such site is the US Navy base on the British Island of Diego Garcia in the Indian Ocean. The Navy is considering a proposal to replace the existing 15 MW gas turbine power plant there with an 8 MW OTEC plant backed up by a 2 MW gas turbine. This is possible because about 5 MW of the existing electrical load is for air conditioning and the existing 2 MW generator is primarily for backup anyway. An attractive side benefit is the ability to replace the island's dwindling freshwater supplies with drinking water that is either condensed from the atmosphere or produced from seawater in a flash distillation plant. Both of these processes use the deep seawater as a source of cold to promote the required condensation.

NELHA has also received a proposal to construct a closed-cycle plant using new 140 cm diameter surface and deep seawater pipelines that the State is installing primarily for aquaculture. The company plans to employ the new Kalina Cycle, producing about 1.3 MW gross electrical output to power the primary and secondary pumps that will supply seawater to the plant and to other users in the Hawaii Ocean Science and Technology (HOST), NELHA's commercial expansion area.

CURRENT STATUS

In addition to the pilot scale plants planned for Diego Garcia and Keahole Point, the State of Madras, India is preparing to build and test a 1 MW floating plant offshore[17]. Sea Solar Power, Inc. of York, PA, USA has proposed a 10 MW pilot plant on Guam and 100 MW floating plants for several areas around the world, but has been unsuccessful in obtaining financing[18]. The Puerto Rico Electric Power Authority has investigated OTEC for many years and has recently considered a plant on the offshore island of Vieques that is now used as a target island by the US Navy. The Japanese continue research and development on OTEC and sponsored a major 1999 symposium on OTEC and other deep ocean water applications (DOWA)[19]. The Taiwanese government has a long-standing interest in OTEC, and Taipei is home to the International OTEC/DOWA Association (IOA) which publishes a quarterly newsletter that serves as the primary link between OTEC/DOWA researchers worldwide[20].

PROSPECTS

As noted earlier, many island locations throughout the world are seriously considering installation of deep seawater supply systems for air conditioning. Most plan to develop additional by-product industries around the pipelines thus installed. Though such systems will not be of sufficient scale for economical OTEC power generation, they may lead to engineering developments in pipelines and pumps that will improve the feasibility of larger-scale OTEC systems.

In summary, OTEC has been shown to work at research scales, and plans are underway to build pilot scale plants. Private sector developers will probably be unwilling to make the enormous initial investment required by the inherent large scale of commercial OTEC until the price of fossil fuels increases dramatically and/or governments provide suitable financial incentives. If, however, the pilot scale plants now being planned for some expensive-energy niche markets are successful in demonstrating low-cost long-term operation, OTEC will be much more financially attractive. As it offers tremendous potential for reducing the input of CO_2 into our atmosphere, the development of OTEC should not be further delayed.

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How to Heat a City Without Fuel

Kjell Eriksson, *GEI, Gothenburg, Sweden*

Abstract

Gothenburg, located on the Swedish west coast, has the largest integrated community heating system in the country. Practically all buildings within the city are connected and a special project has started to connect 16 000 single family houses, up to now heated by electricity. More than 70% of the heating is produced without the use of conventional fuels. Instead, reliance is put on the incineration of waste, the recycling of energy from sewage and industrial surplus heat (in this case from oil refineries) – thus gaining energy and heating 'from nothing', as it were. The energy system in Gothenburg means large scale energy conservation and has furthermore contributed more than anything else to a better environment in the city.

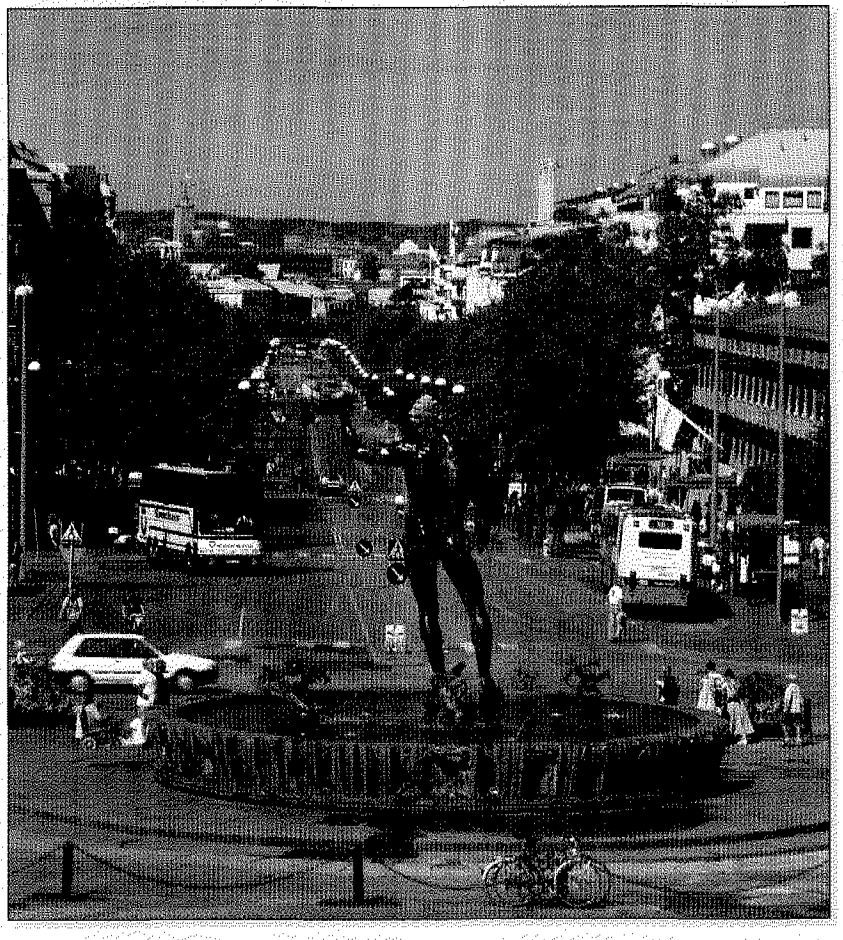


Figure 1 Gothenburg

Introduction

The problems for many cities in the 21st century are and will be air pollution, a growing mountain of waste, and an increasing need for electric power. Functional and long-term solutions are rare, but there is one that will provide a substantial solution on these problems, while at the same time lowering costs. In Gothenburg the solution is spoken of as 'the sustainable city'.

What is the concept of the Gothenburg heat system? Briefly, it is a system where energy is not taken from fossil fuels or non-renewable resources, but where existing sources of energy are used. 'It is a system that we believe every city in the world needs to create as a long term way of providing energy,' says Kjell Eriksson, Managing Director of Gothenburg Energy International.

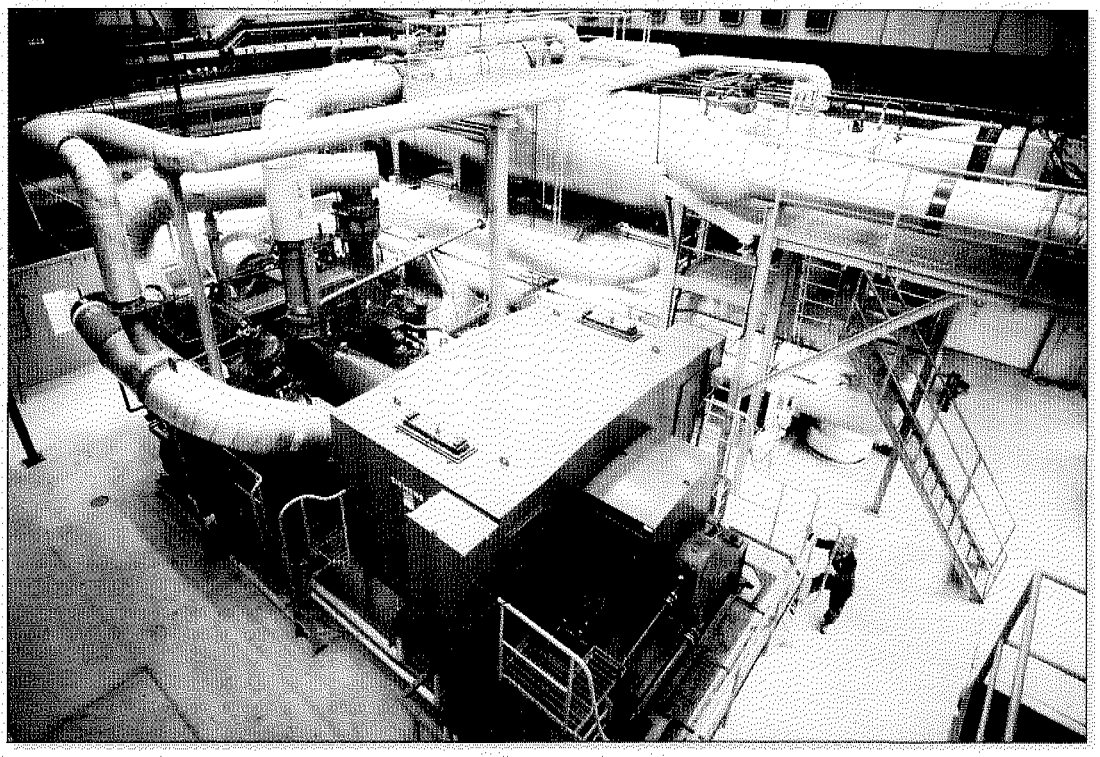
More than 70% of the heating is produced without using conventional fuels. The remaining 30% comes from natural gas, in itself a vital contribution to improving the air. The gas is used in heating boilers and has replaced heavy oil which was the main fuel in the whole system before the big change started.

Energy from the Sewage Water

The sewage water from the Gothenburg region is led to a waste water purifying plant just outside the city. After the cleaning process the water is pumped through large heater pumps which provide the energy source for 13% of the annual demand for heat systems. The heat pump plant consists of four units with a total heat capacity of 165 MW. The heat energy gained from the heat pumps is about 3.5 larger than the electrical energy used for the electric motors of the compressors. In Gothenburg, with its Nordic climate, sewage water has been chosen as energy source for the heat pumps but for other circumstances a lake or a river could constitute an relevant alternative.

Since the start the heat pumps have delivered more than 600 GWh energy annually to the community heating system. They represent a well-known and proven technology, the same as we all have at home in our refrigerators, but in a new mega-scale application in order to match the energy needs of a large city.

Figure 2
Heat pump plant



ENERGY RECOVERY FROM INDUSTRIAL PROCESSES

Tremendous quantities of energy are wasted from industrial plants like paper mills, chemical factories and refineries. To take care of all this energy and use it for the energy supply of a city is a great and fascinating challenge.

In the city of Gothenburg energy is recovered from two refineries, contributing in total about one third of the annual heat demand. In a 'normal' year the deliveries to the community heating system amount to 1300GWh, which is a considerable contribution to the supply of the city and the work for a better environment. If not recovered this way the energy would have been lost into the river or into the air. A normal way of cooling a refinery is by the use of big ventilators but in this case the water in the community heating system is doing the same job.

Every refinery in the world offers the same possibility of energy recovery. What is needed is a connecting community heating system that brings the energy to the consumer. All this is conventional technology and should not cause any problems. Furthermore a refinery is an excellent energy source for a heat system due to its continuous operation. Heat can be recovered at 100°C day and night all year around.

In Gothenburg energy has been recovered in this way since 1980, which has so far made it possible to save more than 2 Mtons of heavy oil. In countries with coal as the basic fuel in the energy system, the gains for the environment etc. will be even greater.

Figure 3
Oil refinery

ENERGY FROM SOLID WASTE

After customary recycling, all the remaining solid waste within the Gothenburg region is transported to an incinerator plant located within the community heating system. In this way 400,000 tons of garbage annually are transformed to heat and electricity instead of being dumped on a landfill. The contribution to the energy supply of the city amounts to 1000 GWh annually. Many cities of the world have tremendous problems with their landfills, which is not the case in the Gothenburg region.

Unfortunately it is almost impossible to introduce this technology in many countries due to protests from people saying that this is a disaster for the environment. Recently a new plant in northern Sweden was put into operation and one argument against it, from an internationally well-known activist group, was 'poison in – poison out'. This argument makes it clear that some people are not informed about the development within the field of flue gas cleaning etc. Located in a densely populated area, the Gothenburg incineration plant is a good example of what can be achieved using modern technology.

Another argument used against incinerating the waste is recycling. I can only refer to our experiences from Gothenburg where recycling and re-use of solid waste has been given top priority for many years. Still there are 400,000 tons annually in the Gothenburg region to be used as 'fuel' for energy production. There has never been any conflict between recycling and incineration.

Improved waste management in combination with modern technology makes solid waste a valuable energy source for our cities. To put this resource on landfills should be the last thing to do.

THE IMPLEMENTATION

The current energy supply system in Gothenburg is a result of long term planning and a strong-minded attitude among all people involved in energy conservation and environment improvements.

The sulphur emissions are down by 99% and NO_2 by 83% compared to the original heavy oil-based energy production. Remaining environmental related problems are related to traffic and we strongly support the introduction of natural gas fuelled buses and other vehicles to bring these emissions down to lowest possible levels.

To realise the idea of how to 'Heat a city without fuels' is only possible if there is a strong local community with the power to make plans for the entire city and to carry out the implementation of the chosen strategy for a long time. The key is the network of pipes, distributing hot water all over the city. This is proven technology but seems to be difficult to establish without city owned energy utilities as we had in Scandinavia during the time when these systems where constructed. The network in Gothenburg is the largest integrated in Sweden with 600 km of well insulated pipes serving about 500,000 citizens with heat and domestic hot water. All local boilers are history and with them the transportation of fuels all over the city, another source of environmental disturbances.

CONCLUSIONS

If cities of the world want to reduce the use of conventional fossil fuels for their energy supply, a good example is already in place. This is not an easy task to carry out but sooner or later it will, for different reasons, be necessary everywhere in the world. The driving force to do this will be the concern for the environment, the cost of conventional energy production or an increasing problem to supply a growing population in the world with all the fuels needed. The idea of using on a large scale the surplus energy you already have before you bring in fuels seems an obvious but absolute condition, but it needs support from city governments with the power to handle this challenge.

We were lucky to have that in the city of Gothenburg and therefore it has been possible for us to create a reliable and cost efficient energy system which more than anything else has contributed to the excellent environment we have in the city. In the course of our activities, we have built up a high degree of competence and gathered much experience in finding, constructing and using a wide variety of different waste heat techniques. Our experience of using waste energy on a large scale makes us unique.

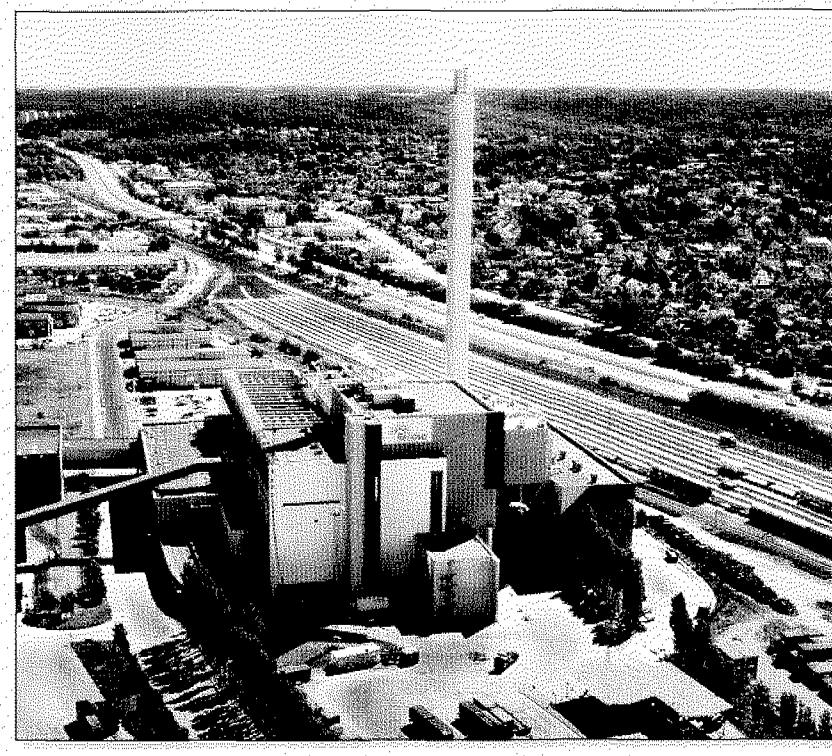


Figure 4
Incinerator of solid waste

ABOUT THE AUTHOR

Mr Kjell Eriksson received an MSc in Mechanical Engineering from the Chalmers University of Technology in Gothenburg 1970. He worked with European and Swedish suppliers of combined heat and power plants during the seventies before he joined Gothenburg Energy as Director of Planning. As such he had the responsibility for the development of the 'Gothenburg Waste to Energy' district heating system. He also held the position of Director of Operations before he took up the position as Managing Director for Gothenburg Energy International, a subsidiary offering consultancy services on the international energy market.

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Sydney Solar Olympic Village

Dave Reed, *Rocky Mountain Institute, Snowmass, CO, USA*
E. D. Spooner, *The University of NSW, Australia*
P. Zacharias, *ISET, Kassel, Germany*
D. Morphett, *Pacific Power, Sydney, Australia*
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Abstract

Australia has gone further than any other modern Olympics in addressing environmental considerations, due largely to a unique collaboration. In the early 1990s, Greenpeace International head Paul Gilding participated with environmental consulting group Manidis Roberts, the Rocky Mountain Institute, and developer Lend Lease/Mirvac in the open bidding process in Australia for creating an Olympic Village concept that could sell the International Olympic Committee on Sydney as host for the 2000 Summer Games. Greenpeace and the other environmental partners wanted to demonstrate what a city could do if it was truly committed to the environment. Their vision was an Olympic Village that was powered by the sun, used no cars, used land carefully, avoided toxic materials, and provided a highly visible platform for cutting-edge green technologies. These green ideas helped Sydney win the bid, and the green partners, including Greenpeace Australia, worked with lead developer Lend Lease/Mirvac in creating the Athletes Village.

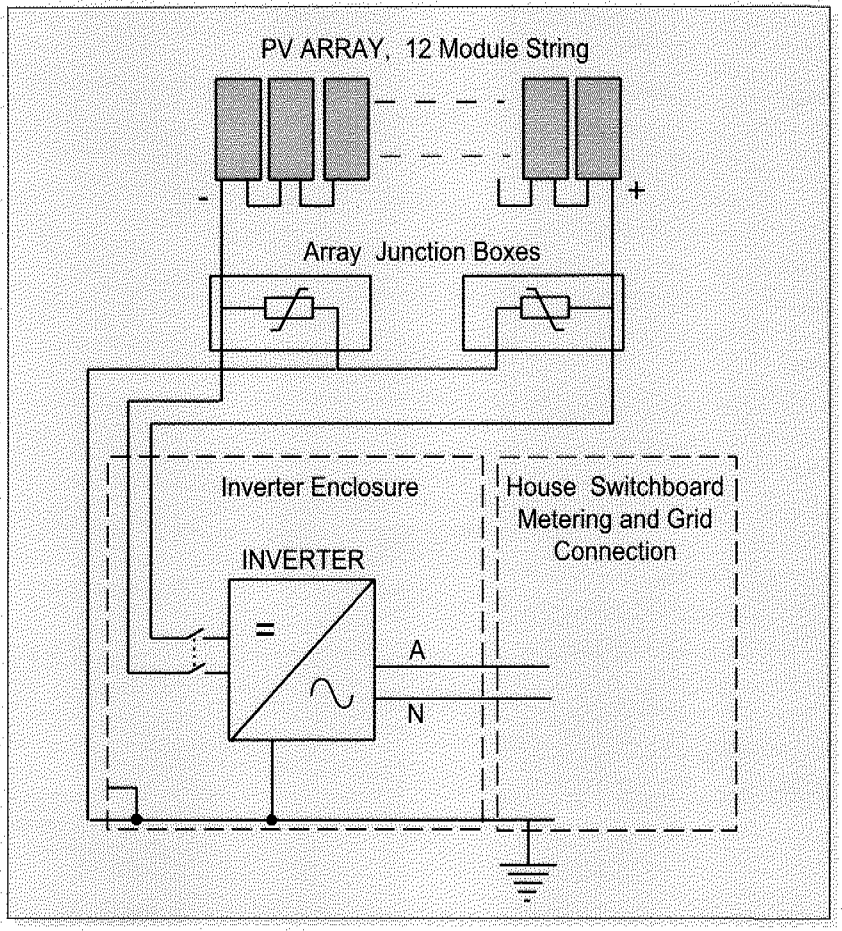

Figure 1
Schematic of single house PV system

INTRODUCTION

So how did they make out? As might be expected, when faced with the realities of essentially building a whole city within an extremely compressed timeline, some of the initial idealism of the Green Games' environmental emphasis fell by the wayside, but there are some remarkable successes:

- 665 homes in the Olympic Athletes Village have solar water heating and grid-connected, one kilo-watt photovoltaic (PV) arrays.
- Following the Games, homes in the Athletes Village will be sold and become Newington, a village organised into three New Urbanist neighbourhoods.
- The Sydney Olympics was almost entirely car-free. Athletes and spectators relied on public transport, including new train lines built for the Games.
- Habitat for two threatened frogs and a small remnant virgin forest were protected from development.
- The use of polyvinyl chloride (PVC) has been sharply curtailed, though not eliminated, at the Games. Elimination of PVC has been one of Greenpeace's most vocal causes in recent years.
- Refrigerants that deplete ozone or contribute to global warning (CFCs, HCFCs and HFCs) have been significantly reduced. In fact, on June 28 Greenpeace announced that Coca-Cola had finally bowed to pressure and announced a plan to shift away from HFC refrigerants.

Other issues are still pending or not likely to be achieved. Some corporate sponsors of the Olympics, for example, have not agreed to abide by the Environmental Guidelines that Sydney has adopted. And cleanup of toxins in Homebush Bay, near the

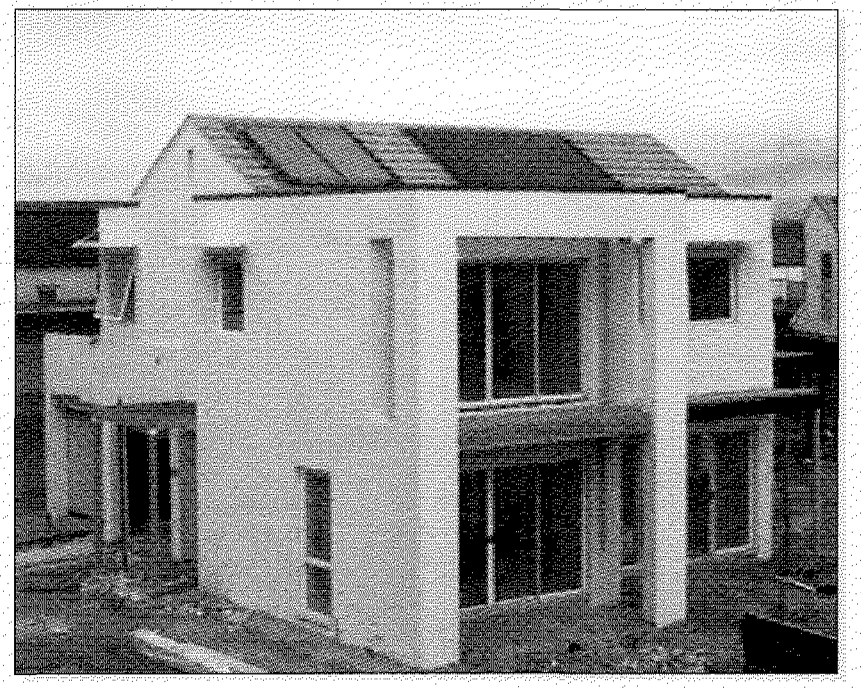

Figure 2
Typical house in solar village showing hot water system and PV on roof

Olympic Village, has not progressed to the extent hoped for. Nonetheless, tremendous progress was made in the design and construction of the Sydney Olympics. Proponents hope to see many of these ideas carried forth with future games. Bill Browning, who was the point person for RMI's participation, feels pretty good about what they were able to accomplish with the Olympic Village and the Games in general. Among the big successes, he says, was getting the attention of Lend Lease, one of the largest developers in the world and owner of Bovis Construction. He was also impressed with the extent to which life-cycle assessment (LCA) was used in the project and how widely it is used throughout Australia. 'All told it's pretty impressive,' says Browning of the Olympic Village.

THE PLANS

The athletes' village is one of the world's largest grid connected residential PV systems contained in a small geographical area. The final development consisted of 665 permanent homes concentrated in the area of a normal residential sub-division. Each home had 1kW (peak) of roof integrated PV connected to the grid via an inverter system. This solar village brings together all of the most interesting aspects of achieving a high penetration of PV in a typical domestic supply network while still maintaining quality of supply, safe protection systems and acceptable levels of radio emissions.

The solar village is located adjacent to the main Olympic venues at Homebush Bay, only a few minutes' walk from the Olympic Stadium. During the Olympic Games it provided accommodation for 15 300 athletes and officials and up to 7000 for the Paralympics. The solar village consists of up to 665 permanent homes, 1380 home units and up to 500 specially designed relocateable modular dwellings. The vision is that the solar village will leave a legacy for future generations of sustainable development and will assist in the establishment of villages based on similar principles in the future.

Photovoltaic systems were fitted to all permanent houses and townhouses built in time for the Games. They were not installed to home units or modular dwellings.

CONSTRUCTION STAGES

The solar village was constructed in stages. The first stage of development is located outside the athletes' area and will be sold to the public. These houses will be used to evaluate a range of house design options for use in the final village. This first stage commenced in late 1997 and will not be fully completed until post Olympics. The next phase of construction was for the major section of permanent homes to be used for accommodation during the Olympic Games.

ORGANISATIONS INVOLVED

The solar village has brought together a number of parties all interested in cooperating to produce a world class design installed to world's best practice. These parties include:

Mirvac Lend Lease Village Consortium (MLLVC), Sustainable Energy Development Authority of NSW (SEDA) and Pacific Power. The project represented a major opportunity to create a leading example of transition to a sustainable energy future. The solar village is based on an agreement between MLLVC, SEDA and Pacific Power. Under the agreement MLLVC agreed to build houses with roofs suitable for PV and assist with financial support, SEDA agreed to assist with financial support and advice on marketing of energy efficiency and Pacific Power agreed to install the PV systems and to take on the full commercial and performance risk for the PV project. The PV systems will be included as an integral part of houses when they are sold, with Pacific Power operating and maintaining the systems up until that time.

EnergyAustralia is the local electricity distribution authority responsible for the network supplying the whole Olympic site.

The University of NSW have been consulting on design, installation, testing and commissioning aspects of the PV systems.

PV SYSTEM OVERVIEW

Each of the 665 permanent homes in the solar village has 1kW peak (at STC) of photovoltaics on the roof connected to the local low voltage (240/415V) grid via an inverter, mounted in a weatherproof box adjacent to the house switchboard, which in Australia is generally fitted to the outside wall of the house. (see Figure 1)

A variety of roofing materials is being used to incorporate architectural diversity in the house designs. The majority of the photovoltaic installations are being integrated into the roof structure using a steel roof pan for waterproofing with the photovoltaics supported above the pan. (see Figure 2)

AUSTRALIAN GUIDELINES FOR GRID CONNECTION OF ENERGY SYSTEMS VIA INVERTERS

In 1996 in Australia a committee composed of people from electricity utility and inverter manufacturers was formed to develop guidelines for grid connection of energy systems via inverters. One of the major reasons for forming this committee was the rapid increase in activity in grid connected photovoltaic systems. This has led to the development of a set of guidelines [1] which it is hoped will be adopted throughout Australia by electricity utilities. The guidelines allow for type testing of an inverter and once approved it is envisaged that the inverter will be accepted for grid connection by authorities throughout Australia.

The Olympic site is within the distribution territory

of energyAustralia, which has been a major contributor to the development of the guidelines and is also one of the leading utilities in Australia in the implementation of renewable energy onto their grid. This has provided a positive environment for managing the process of resolving grid connection aspects of the solar village.

A UTILITY PERSPECTIVE

A key focus for the project from the view of Pacific Power and energyAustralia has been to resolve concerns regarding any impacts of multiple PV systems on the grid to pave the way for future developments. For utilities the impact of installations in the solar village can be viewed from a number of perspectives. On one hand as an opportunity to test what has, up to now, been theoretical assumptions on the behaviour of densely packed grid connected inverters. On the other hand there is concern about the consequence of the same solar installations in the areas of safety of staff and the public and quality of supply. These concerns are highlighted by the following:

- There is limited prior experience available worldwide relating to a project of this magnitude.
- The venue will be normal residential housing both before and after the 2000 Olympics.
- The focus of the world will be directed in this area of the energyAustralia network during the 2000 Olympics.

To address these concerns the following broad areas are seen as critical:

- Safety for both the public and utility staff;
- Voltage effects due to varying output from the inverters;
- Quality of supply matters relating to inverter operation, i.e. harmonics, flicker, DC current injection and reactive power flow.

In addressing these issues, Pacific Power through its 70% owned subsidiary Pacific Solar and energyAustralia were fortunate to have been members on the working group which has recently formulated the 'Australian National Guidelines for grid connection of renewable energy systems via inverters'. The solar village was seen as the ideal opportunity to test these guidelines. Pacific Power and energyAustralia jointly contracted the University of New South Wales to undertake assessment of grid connection issues and BP Solar contracted UNSW to conduct type testing of inverters for guidelines compliance.

This has led to a very careful assessment of the protection and quality of supply issues in the solar village.

DESIGN ASPECTS

The design of the solar village has to be viewed in light of its initial application as the athletes' village for the Olympic Games. The Olympics is a very high profile event and because of this the electrical system for the solar village has been designed for a high level of supply security. A low supply impedance in the village is a result of this type of design. This has many design benefits as can be seen below.

As is generally accepted in the inverter industry, the issue of safety with respect to islanding is one of the major concerns of most utilities, the underlying reasoning being that if the grid is disconnected for whatever reason, the inverter may not be able to maintain reasonable quality of supply, and safety for both the public and utility staff may be compromised. Safety issues for utility staff and the public in the village are largely addressed by existing safe work practices and the fact that the village is fed by underground cabling.

The probability of a viable island forming is significantly increased where a large number of moderate sized inverters are installed in a small geographical area. The inverter chosen for the solar village includes active frequency shift with over and under voltage and frequency monitoring, but in addition it has a form of impedance protection. As the impedance protection function is a relatively recent innovation, all testing of the islanding protection was carried out both with and without the impedance function enabled. If the impedance function led to false operation or any grid interference, this function could be disabled with confidence that the remaining protection would be adequate for the job.

Testing has been carried out on one inverter under a range of local loading conditions including matched loading and it has demonstrated that the inverter trips within 2 seconds under all conditions of grid loss. This testing included both cases where impedance protection was enabled and disabled and the results were very similar.

Further testing was carried out on five inverters supplied from photovoltaic arrays on the DC side. The AC outputs were all connected to the same point and connected to one phase of the grid. Testing was carried out under worst case load matched conditions over a range of output powers. The results showed that no viable island formed at any stage of the testing and the tripping time was in all cases less than 2 seconds. These multiple inverter tests were carried out with the impedance protection disabled. When the impedance protection was enabled it appeared that the inverters tripped randomly. This it is presumed was due to the coincidence of impedance measuring current pulses, causing the inverters to interpret the grid impedance incorrectly, initiating a trip. It is unclear whether this situation will prevail in the solar village. When installed in the village there will be a small amount of impedance between inverters caused by the individual house cabling. The inverters will however be installed adjacent to the house main switchboard and hence will have only low impedance between the inverter and the main 240mm^2 cable in the street. Final testing in the solar village will answer the question of the efficacy of the impedance protection in this circuit configuration.

IMPACT ON FAULT LEVELS

The impact of the solar village inverters on the local protection relates heavily to their ability to form a viable island. Generally a viable island could only form once any fault is isolated from the system and, as noted previously, exhaustive testing has been completed with every indication that this is not possible. The following discussion therefore relates to the grid protection's ability to operate correctly during the short period of time between a fault occurring and the inverters disconnecting from the system.

In the case of LV protection we need to consider the impact of the inverters on the LV fuse protection provided on each circuit from the distribution transformer.

The anticipated system fault level on the 415 volt side of the distribution transformer is approximately 20 kA. Initial calculations indicate that the fault level at the most extreme end of the 415 volt system would be approximately 3200 amps. The inverters being used in the village

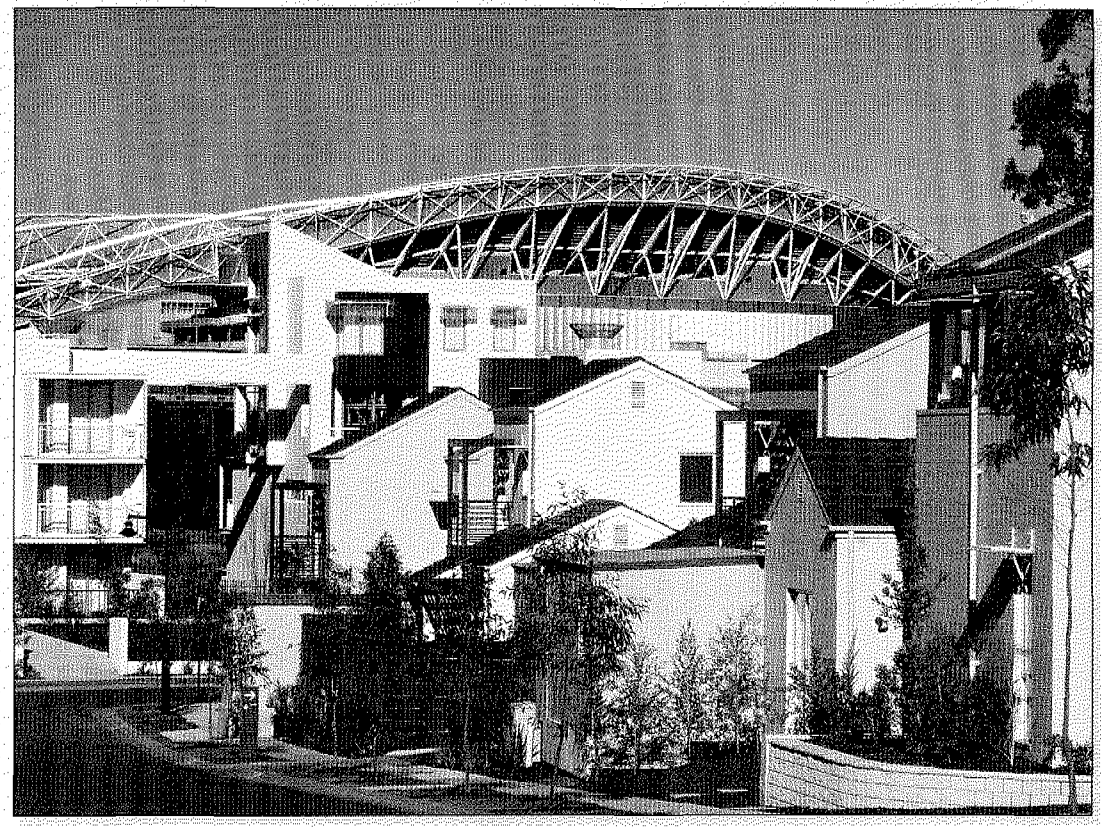

Figure 3
Sydney Olympic village
(Photo credit: Photo Allsport UK)

have a maximum output current of approximately 3.7 amps with no significant extended overload capability.

The network design is broadly based on four 415 volt circuits from each transformer with each distributor loaded with no more than 25 homes per phase. As each of the distributor circuits is separately fused it is only necessary to consider the contribution from the inverters on the faulty circuit, as any contribution from other inverters on that phase will add to the current seen by the protecting fuse.

In a worst case, the total contribution from the inverters to fault current would be 92 amps on the load side of the circuit fuse. As noted above, the worst case fault level at the circuit extremity would be approximately 3200 amps. It is clear from this that the contribution from the inverters would not have any significant effect on the operation of the circuit fuse for a normal high level fault.

In the case of the HV protection, the fault level on the 11 kV system is 5.5 kA at the distribution transformer. As the combined output capability of the inverters is in the region of 30 amps per phase at 11 kV, it is fairly evident that the inverter contribution will not impact on system protection.

VOLTAGE REGULATION

Normally the voltage profile in any distribution system allows for load induced voltage drop from the source of supply to the end consumer. Compensation for this voltage drop is provided by tap changing transformers at the source, appropriate fixed tap selection of distribution transformers at the last voltage change point, and finally by the accepted operating voltage range at the customer's premises.

In the case of the solar village the source tap-changing transformer will see a load of which the solar village is a small part. In this instance the tap changing equipment may select a tap to provide higher voltage at the source, and if the solar village inverters are generating significant output there is the possibility for local high volts. There are two factors which may assist in this area.

The output of the inverters will be almost pure watts so there will remain a net import to the solar village of VArs. This will assist in maintaining a normal voltage profile.

The solar village is part of a new network development. In line with current Australian design standards, the 11kV and low voltage cabling is of large cross sectional area. Additionally, system loading and network arrangement have been given particular attention due to the importance of this part of the network.

Computer simulation load flow studies have been carried out on the part of the network in question. These studies indicate that voltage changes due to solar generation will be less than 1% as a worst case. This will not present a problem. The studies used lumped generation and load, and further studies may be undertaken using more distributed modelling. Additional checks will be made when a representative part of the system is actually installed.

HARMONICS

Because the distribution system impedance in the solar village is very low, a simple check of worst case harmonic voltages at the extremity of the village was carried out.

All harmonic voltages produced by the inverters are below IEC limits even when calculated for an unrealistic worst case. Under actual operating conditions the harmonic current components will not be in phase due to: physical distribution of the inverter systems over the cable length; and differences in operating points caused by different insolation and orientations of the PV arrays. The high order harmonics in particular are expected to have much greater diversity in phase and hence the sum of these will be much less than (number of inverters) x (individual harmonic amplitude) [2].

TESTS AND COMMISSIONING

The test programme was developed which involved testing of:

- prototype roof structures;
- one inverter to the Australian guidelines for grid connection;
- five inverters for harmonic and islanding performance at the University of New South Wales test facility at Little Bay, Sydney;
- multiple inverters after installation in the solar village.

One of the unique features of the solar village was that a large number of houses were built and were unoccupied until the Olympic games. The houses will be constructed and locked away in a security zone. In many housing development projects it is very difficult to perform islanding and harmonic testing under controlled conditions because developers understandably want to sell houses as quickly as possible after completion. This inevitably means that there is never a large block of houses available for testing. Once the houses are occupied, the last thing that owners want is for the grid to be switched to perform islanding tests. The solar village is unique because a large number of grid connected houses were unoccupied and available for testing of islanding, harmonic and EMI performance before the Olympic games.

The solar village has a large number of identical inverters. This has many advantages. From an operational perspective, the inverters can be readily linked with a RS485 communication system to allow monitoring of the systems and this also enables operational parameters to be easily modified if required. From a testing perspective, because the inverters are the same type, the study of harmonics in the village potentially demonstrates a worst case situation where there will be correlation of current harmonics. The practical measurements demonstrate the extent to which different operating points of the inverters and the physical distribution of the inverters throughout the village can cause diversity in the phase and amplitude of harmonics seen at critical summing junctions of the system. Another advantage of having similar inverters in each house is that the protection systems will all act in a similar manner in an island situation. This it is hoped will lead to less probability of islanding. This same advantage is also a disadvantage from a purely academic viewpoint as it would be interesting to investigate the possibility of forming an island in a real life situation where there was greater diversity of inverter system types.

CONCLUSIONS

The solar village is a demonstration of the practicality of large scale PV systems in residential applications. It is already providing an opportunity for investigating many interesting design aspects of large scale PV systems in Australia. The village will provide more opportunities for testing the operation of such systems, providing useful input to assist the further international development of these systems. The village will also leave a legacy for Sydney of a viable solar powered village and it is hoped this will lead to further such development in the future.

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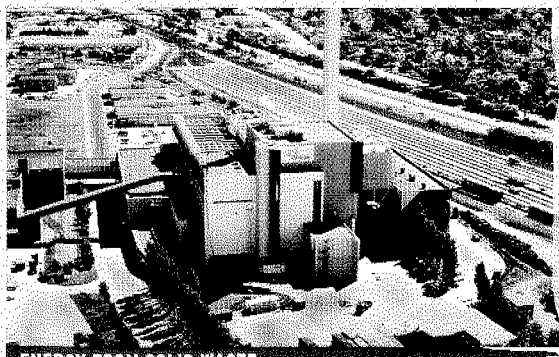

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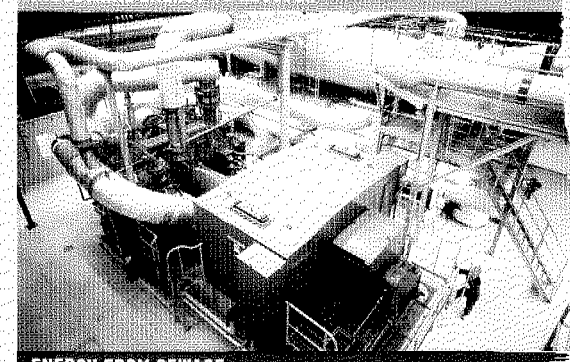

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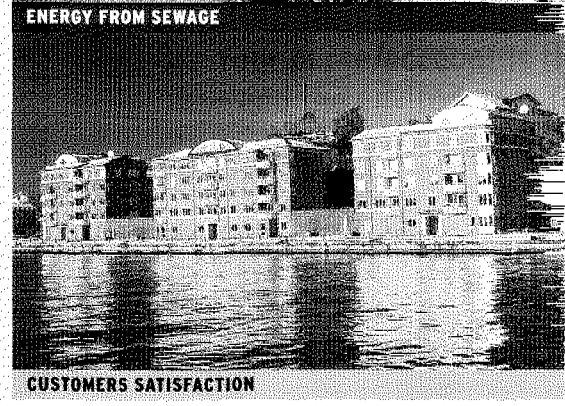

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The First Six Months of Operation of The 60 MW Mokai Geothermal Project: A High Pressure, Sustainable and Environmentally Benign Power Plant

Hilel Legmann, *Ormat Industries Ltd, Israel*

Abstract

Following the deregulation of the New Zealand electricity industry, several medium and small sized projects have started their operation. The Mokai Geothermal Project is the largest privately developed geothermal project in New Zealand. The 60 MW development has been undertaken by the Tuaropaki Trust in Taupo, New Zealand. The Trust, that owns the majority of the land at Mokai, operates its project through its wholly owned project company the Tuaropaki Power Company. The power plant uses the geothermal fluid extracted from the production wells and reinjects the full quantity into the reinjection wells. The plant utilizes steam turbine and binary turbine technology to obtain the maximum energy from the resource with minimal environmental impact. The electricity generated is delivered via a 20 km, 110 kV line to the Whakamaru national grid substation and is sold in to the national pool. Financing of the development was undertaken on a non-recourse and long-term basis by a group of financing institutions with Westpac Banking Corporation acting as leader. During the first six months of operation the power plant has generated an average output of above 60 MW with an availability of above 96%.

Introduction

The 60 MW Mokai geothermal project is one of a number of new geothermal projects being developed in New Zealand by the private sector following the deregulation of the electricity industry. What makes the project unique is the ownership structure – the development is owned by Maori (indigenous people) landowners – and its technology, which allows economic development of the high-pressure geothermal resources.

New Zealand lies in the Southwest corner of the Pacific "ring of fire", the chain of volcanic activity which extends up through the Pacific Islands, Indonesia, the Philippines, Japan, Alaska, the West coast of the US, and down to the tip of South America. The main geothermal area is centred near the towns of Taupo and Rotorua and the geothermal activity is of volcanic origin; with some of the volcanoes still active.

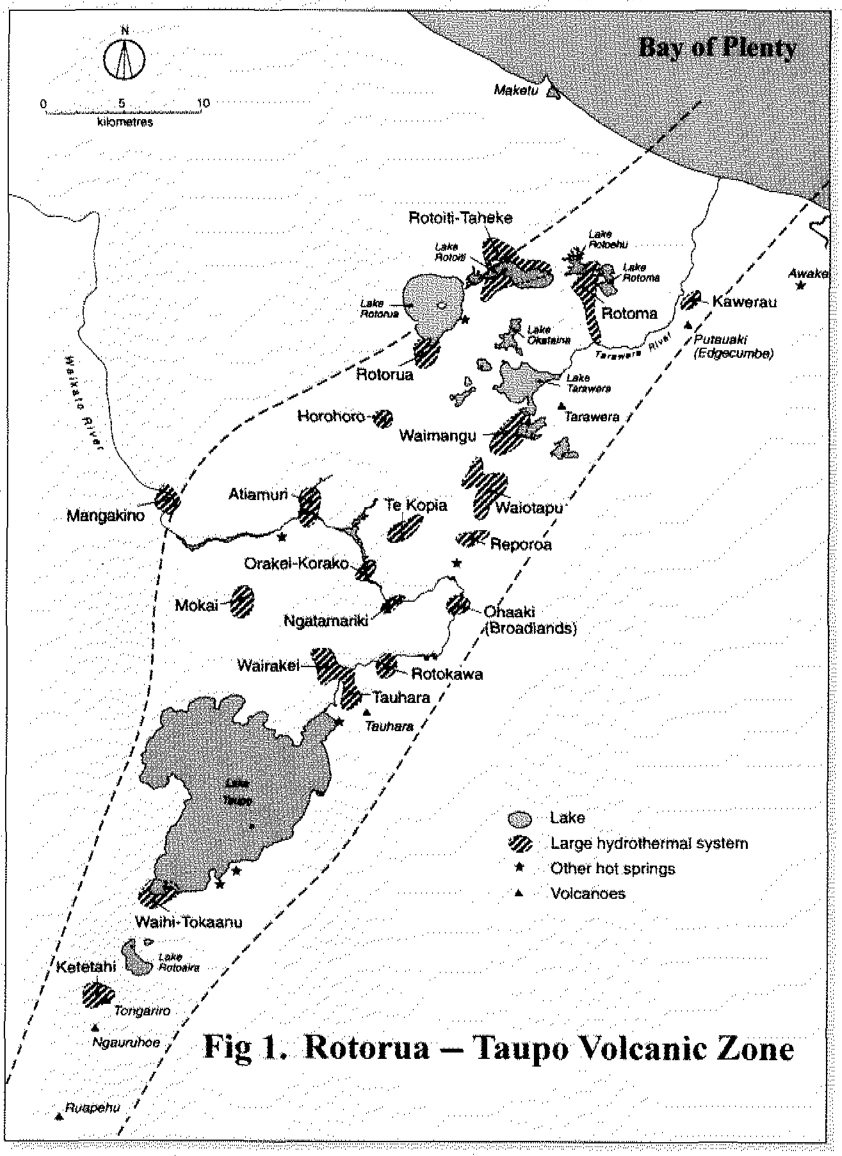

Fig 1. Rotorua – Taupo Volcanic Zone

Figure 1 Rotorua-Taupo volcanic zone

Some of the world's early geothermal development was undertaken in New Zealand with the Wairakei project (currently 156 MW) being the first large-scale development of a water dominated geothermal field. Construction of the first station commenced in the mid 1950s, with the original layout of the station allowing

Table 1: New Zealand's Geothermal Generating Plants

Station	Location	Geothermal Field	Net Capacity MW	Output GWh	Year Commissioned
Wairakei	Taupo	Wairakei	156	1300	1959–63
Tasman Paper	Kawerau	Kawerau	8	60	1959
TG1	**Kawerau**	**Kawerau**	**2.6**	**18**	**1988**
TG2	**Kawerau**	**Kawerau**	**3.8**	**28**	**1993**
Ohaaki	Reporoa	Broadlands	80	750	1989
McLachlan	Taupo	Wairakei	53	280	1997
Rotokawa	**Taupo**	**Rotokawa**	**27**	**200**	**1997**
Ngawha	**Wangharei**	**Ngawha**	**12**	**100**	**1998**
Mokai	**Taupo**	**Mokai**	**57**	**475**	**2000**
Totals			**323.8**	**2,625**	

Station Parameters	
Steam turbine output	31.1 MW
Binary bottoming units output	4 x 6 MW
Binary brine units output	2 x 6 MW
Net output	57 MW
Annual energy output	475 GWh
Steam flow rate	308 t/hr
NCG flow rate	4 t/hr
Steam quality ex separator	99.98%
Steam pressure; separator outlet	18 bar (a)
Steam temperature; separator outlet	208°C
Brine flow rate	860 t/hr
Brine inlet temperature	207°C
Brine outlet temperature	150°C
Design ambient air temperature	12°C

for the installation of a plant to produce heavy water for the British nuclear programme. This was dropped before station completion, but its influence is still present in the multiple steam pressures of the older station.

THE ROTORUA-TAUPO GEOTHERMAL REGION

There is geothermal activity spread over both islands of New Zealand with the main high temperature fields associated with the volcanic activity in the Rotorua-Taupo area. Most of the other geothermal activity in the country is of tectonic origin and the heat flows and temperatures are not sufficient for commercial power generation.

The original settlers of New Zealand, the Maoris, who arrived about 800 years ago from the Island of the Central Pacific, used the natural geothermal springs for bathing and the very hot springs and geysers for cooking. There have been a number of major volcanic eruptions in the region; the most recent being the Tarawera eruption of 1886 which destroyed the world famous Pink and White Silica Terraces, and the largest being the eruption which formed Lake Taupo around AD 400. The latter eruption was one of the largest known eruptions, with the ancient Chinese recording the impact of the emitted ash on their weather.

The major geothermal fields of the Rotorua-Taupo area are identified in Figure 1. The Wairakei, Rotokawa, Kawerau and Ohaaki fields have been developed for commercial power production as detailed in Table 1, and the Mokai field is currently being developed by an initial 60 MW plant.

THE MOKAI GEOTHERMAL RESOURCE

The Mokai geothermal field is a deep, high temperature field located approximately 25 km northwest of Taupo within the conspicuous western margin of a large volcanic-filled topographic depression. The investigation wells drilled in this field by the New Zealand government (the Crown) have encountered intracaldera volcaniclastics of significant vertical and horizontal permeability to a depth of over 160 m. It is generally held that the Mokai geothermal system occupies these volcaniclastics as an up flow of geothermal fluids in the vicinity of Mokai and a related northward outflow influenced by the regional groundwater hydrology.

The surface hydrothermal manifestation in the vicinity of the Mokai wells is relatively minor, and is confined to features characteristic of steam heating. Warm chloride springs occur in the fault-aligned Waipapa steam gorge about 5 km north of the drilled area.

A northeast-trending fault system crossing the caldera's floor has been interpreted as a major source of vertical permeability. Enthalpies measured quickly stabilised at 1450 kJ/kg and the well chemistry indicated high temperatures for the production zones, as well as for the reservoir (350°C and 325°C respectively). The field has an estimated capacity

of over 250 MW, with the initial development being a 60 MW station to allow for careful monitoring of the resource before any further development is undertaken.

THE PROJECT STRUCTURE

The project is unique in its structure and technology; the former brings the indigenous Maori people into the development as a developer and owner; and the latter provides effective use of the high-pressure steam from this resource.

The Tuaropaki Trust administers the Tuaropaki E land at Mokai for the benefit of its owners. Initially the land was developed for pastoral farming under the direction of trustees and management of the Department of Maori Affairs.

In 1979 they repaid the development department and the sole responsibility for the land was vested in the trustees. The Trust purchased the Crown's interests in 1996 and decided to develop the field. After considering different options and project structures, including the lease of the land to developers or participation in a project together with other partners, the trustees decided that the Tuaropaki's best interests were kept when the Tuaropaki people, themselves, acted as the owner and developer.

The Trust undertook a thorough review of various plant configuration and technology options, and decided finally to go ahead with the Geothermal Combined Cycle configurations using both the steam and brine components of the geothermal fluid. The plant configuration selected was the more flexible and modular Geothermal Combined Cycle technology, which uses a backpressure steam turbine and binary plant to capture the best features of each technology. The turnkey contractor and supplier of the equipment for the 60 MW plant was the ORMAT Group of Companies. Mighty River Power entered into an agreement with the Trust to provide a guaranteed minimum floor price for the electricity produced and for the supply of the Operation and Maintenance services for the plant. Additional production well and reinjection wells were required for the project and a contract for well drilling and testing was awarded to Century Drilling. Westpack Banking Corporation arranged the construction and long-term finance for the development.

PROJECT DESIGN

The project has four production wells of approximately 2000-metre depth, producing a two-phase fluid, which is piped to a separator at the station. Steam is separated from the brine at 18 bar and both the steam and the brine are used for electricity generation. The condensed steam is pumped up to the brine pressure, combined with the high-pressure brine, and reinjected with no further pumping. There are three reinjection wells of around 500-metre depth, one of which was constructed using two of the original field exploratory wells.

To maximise the benefits of the high steam pressure a General Electric backpressure turbine of 32 MW output is utilised to reduce the steam pressure to approximately 1.3 bar. This low-pressure steam is condensed in four bottoming ORMAT® ENERGY CONVERTER binary units of 6 MW output each. This configuration, referred to by ORMAT as a Geothermal Combined Cycle Unit, has the advantage of the low capital cost of a simple backpressure turbine, and of condensing the steam in a tube and shell heat exchanger where steam wetness is not a problem. Two additional ORMAT® ENERGY CONVERTER binary units, also of 6 MW output, were installed, utilising the hot brine flow and cooling it from 219°C to 150°C. The motive fluid in the binary units is pentane and cooling is effected by air-cooled condensers.

Level I Steam Turbine & Generator

Steam turbine type	GE multi stage, single cylinder reaction
Steam inlet pressure	18.6 bar(a)
Steam outlet pressure	1.3 bar(a)
Speed	3000 rpm
Construction	Horizontal split casing
Generator rated output	32 MW
Voltage	11 kV, 3 phase, 50 Hz
Power factor	0.85 (lagging)
Efficiency	97.5%
Manufacturer	GE

Level II ORMAT®Energy Converter

Organic vapour turbine type	Impulse
Speed	1500 rpm
Construction casing	Horizontal (overhung) vertical split
Number of stages	2
Motive fluid	Pentane
Generator rated output	6 MW
Voltage	11 kV, 3 phase, 50 Hz
Speed	1500 rpm
Efficiency	97%

Heat and mass balance

The geothermal steam exiting from the separator and the brine flowing into and out of the brine binary unit have the following average conditions:

Main equipment description

The GE steam turbine is a backpressure, multi-stage, and reaction-type turbine. The turbine housing, shaft assembly and nozzle ring were designed to ORMAT's specification for operation with geothermal steam.

The power plant consists of the geothermal combined cycle unit, the brine driven OEC unit, plus the following main systems:

- Power plant geothermal fluid gathering and reinjection system
- Auxiliary systems
- Electrical systems
- Main station control
- Fire fighting systems
- Auxiliary buildings
- High voltage T-line

The generator circuit breaker, control and auxiliary electrical equipment for each binary unit is housed in a container, and was delivered to site fully wired and pre-tested. This reduced construction time, and speeds up commissioning on site. The overall station control is from a control room attached to the steam turbine building. The central station control computer utilises software and graphics developed by ORMAT.

Construction programme

The modular nature of this plant allowed a very short construction period on site. All the binary turbines are mounted on simple low-level foundations. As the steam turbine has no attached condenser, it too is mounted on

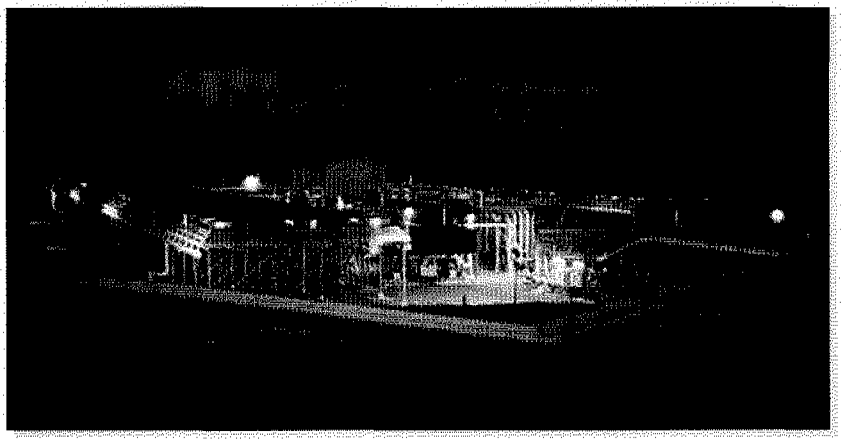

Figure 2
Mokai Geothermal Power Plant

a low level foundation, allowing a simple turbine building of modest size. The binary plant components were designed to be shipped in packages of standard container size and within days of the shipment arrival the main components were bolted down and the air-cooled condenser erection was under way. The overall programme for the plant development was as follows:

Notice to Proceed	February 1998
Delivery of turbine-generator	February 1999
Commissioned	December 1999

ENVIRONMENTAL IMPACT

The station was designed to have minimal environmental impact. Under normal operating conditions the geothermal fluid is completely contained from production to reinjection, with the only emissions being negligible quantities of steam emitted by the steam traps and the non-condensable gases emitted above the air coolers. The plant has a relatively larger footprint, but a much lower profile than a conventional condensing steam turbine, with an underslung condenser. The air cooler structures have a significantly lower profile than wet cooling towers, and have the advantage of never producing a visible plume. In addition to its low profile, the plant has no water or chemical consumption and no blow-down of contaminated cooling tower water. The power generation technology implemented at Mokai fully complies with the resource consents and is dedicated to the needs of a sustainable, environmentally benign and reliable geothermal power plant.

Because the development is small relative to the ultimate capacity of the very deep resource, it is expected that there will be little impact on the surface features. A comprehensive baseline-monitoring programme was undertaken prior to project operation and an ongoing programme monitors the field behaviour.

OPERATION AND MAINTENANCE

Operation of the station was contracted to Mighty River Power to provide 24-hour operator coverage on a 12-hour shift basis. Only one operator is on duty during the day shift and one at night. Operators are required to undertake routine and emergency minor maintenance work as well as operational duties. An Operations Manager, who is also involved in the ROTOKAWA geothermal power station (a 27 MW geothermal combined cycle power plant supplied by ORMAT in 1997), supervises the station. During the first 6 months of operation the power plant and the geothermal resource fulfilled the owners' expectations with an availability exceeding 96 % and a generated output of over 58 MW.

FUTURE DEVELOPMENT

The Mokai field has been assessed as having a development potential of greater than 250 MW. This initial conservative development of 60 MW is not expected to have any significant effect on the resource, neither from a temperature/pressure perspective nor from a surface environment perspective. However, before the joint venture partners embark on any further development, a programme of environmental and reservoir monitoring is being undertaken to monitor reservoir and environmental changes. Subject to these impacts being within acceptable limits, the partners will look to the next stage of development.

CONCLUSION

The Mokai Geothermal Project is a working example of the indigenous landowners developing their own resources through a partnership with a power company. In addition to the scientific resource modelling and resource behaviour projections there were two essential comfort factors, which were taken into consideration by the project developers:

The use of a power generation technology which ensures the sustainability of the geothermal reservoir and avoids drainage of the resource and assures long term maintenance of the fluid level and characteristics of the field; and

The option of a power plant configuration, which maximises the use of the geothermal energy, minimises the risk factors for the equity partners, and generates the highest possible income at the lowest possible operation and maintenance cost.

ABOUT THE AUTHOR

Hilel Legmann studied at the Technical University RWTH Aachen/ Germany, with a Master's Degree in Thermodynamics from the RWTH Aachen. In 1983 he was a project engineer at Rheinbraun in Bonn responsible for the development of the heat pumps technology for central heating in Germany. From 1983 to the present he has been the Marketing manager at Ormat Industries Ltd. Where he is responsible for business development of geothermal, biomass and industrial projects in several countries among others. He has developed and boosted sales of Ormat in Iceland from zero to US$10 Million, developed and boosted sales of Ormat in New Zealand from zero to over US$100 Million, developed and concluded worldwide's first ORC based heat recovery system in a cement plant, presented together with others several patents to improve the efficiency of the heat recovery systems in the industry, and presented and published several papers describing new developments in the geothermal and industrial power generation sector.

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Wind Energy in India

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Abstract

Due to constant increase in the price of fossil fuel and its consequent effect on the environment and ecology there is a consciousness all over the World of the importance for generation of power from Renewable Energy Sources wherever it is possible. Out of all Renewable Energy Sources, wind energy is the most promising due to its cost effectiveness and for delivering grid quality power. In India the wind energy programme started during the early nineties and considering its vast potential and constant power shortage in the economy there is a strong likelihood of harnessing wind energy in a big way in the near future.

INTRODUCTION

For thousands of years wind energy has been exploited but its re-emergence as one of the most cost-effective renewable sources of generation of grid-quality electricity is of relatively recent origin. India has not only been quick to make a foray into this area but has also made a mark as one of the top-ranking countries in the world in wind power generation. With an installed capacity of 1080MW of wind power, India now ranks 5th in the world after Germany, USA, Denmark and Spain and has earned recognition as a new 'Wind Super Power' as per State of World 1998 World Watch Institute's Report. According to a recent study, the gross wind power potential is estimated to be about 45 000MW at 50m hub height.

ENERGY SCENARIO IN INDIA

India has the second largest population in the world with a billion people, and is considered a rapidly growing economy. Being a developing country, the energy technology base in India is relatively inefficient and has a slow turnover; consequently, the economy is highly energy-intensive. India's commercial energy system is heavily dependent on coal, with oil and natural gas being the other major sources of primary energy among the commercial fuels. The traditional biomass fuels of fuel-wood, animal waste and crop residues play an important role, especially in the rural areas where they meet a very large proportion of the energy requirements. While the share of commercial energy from fossil fuels is seen to be increasing every year, the traditional fuels are estimated still to contribute over one-third of the total energy.

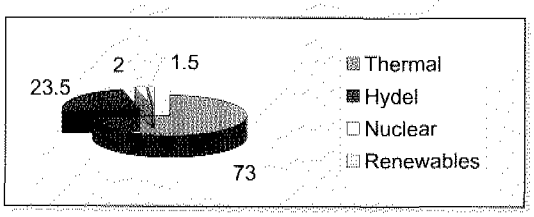

Figure 1
Installed power generation capacity in India (as on 31 March 2000)

The total installed capacity in India is 91066.18MW as on 31st March 2000 including thermal, hydel, nuclear and renewables. However there is a demand gap of 8–10% and peak load demand of 18–20%. This has also been accentuated by the non-decentralised nature of power generation with vast areas in the rural segment not connected by the grid power.

POTENTIAL OF WIND ENERGY IN INDIA

The wind power potential had initially been estimated at 20 000MW. This has now been revised upwards to

Table 1. State-Wise Wind Power Installed Capacity (As on 31.12.1999) (MW)

State	Demonstration Projects	Commercial Projects	Total Capacity
Andhra Pradesh	3.050	64.740	67.790
Gujarat	17.345	149.565	166.910
Karnataka	2.575	25.050	27.625
Kerala	2.025	–	2.025
Madhya Pradesh	0.590	20.845	21.435
Maharashtra	6.440	26.585	33.025
Rajasthan	2.000	–	2.000
Tamilnadu	19.255	739.080	758.435
Others	1.565	–	1.565
Total	54.945	1025.865	1080.810

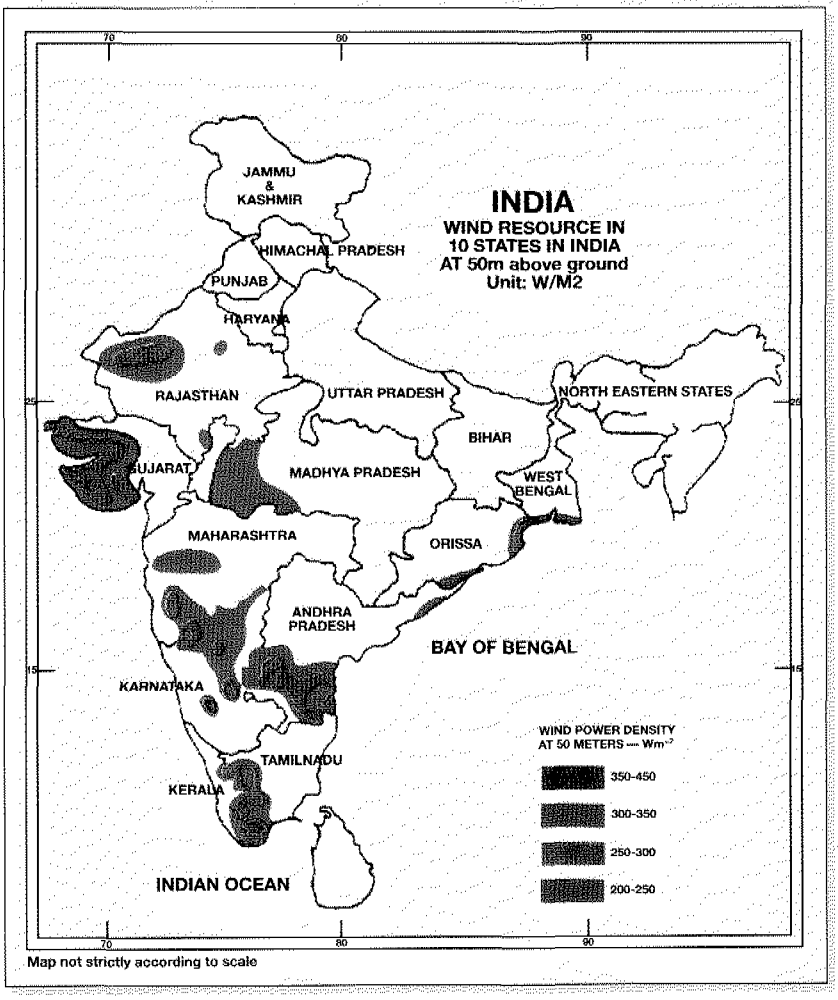

Figure 2
Wind resource map of India

45,000MW considering the technological advances and the availability of more modern equipment. The wind power programme in the country was initiated way back in 1983–84, but actual development took place during the early nineties, when the Ministry adopted a market-oriented strategy to attract private investment in commercial projects. Today, power generation from wind has emerged as one of the most successful programmes, making a meaningful contribution to bridging the gap between supply and demand for power. The present installed capacity of 1,080MW of wind power represents a little more than 1% of the total installed capacity in the country. As such, 860MW of wind power capacity was added during the Eighth Plan period as against the initial target of 100MW and the revised target of 500MW. More than 5 billion units of electricity have been generated and fed to the utility by the wind power projects. State-wise wind power installed capacity is given in Table 1.

WIND RESOURCE POTENTIAL

The most prominent feature of the wind climatology in India is the monsoon circulation. Wind speed and power density are influenced by the strong south-west summer monsoon, starting in May-June, when cool, humid air moves towards the land, and by the weaker north-east winter monsoon, starting in October, when cool, dry air moves towards the ocean. From March to August, the wind is uniformly strong over the entire Indian Peninsula, except the eastern peninsular coast. The wind speeds during the period November to March are relatively weak, though winds of higher speed blow during part of this period along the Tamil Nadu coastline.

Potential windy locations have been identified in the flat coastal terrain of southern Tamil Nadu, Kerala, Gujarat, Lakshadweep, Andaman & Nicobar Islands, Orissa

TABLE 2. NON-CONVENTIONAL ENERGY POWER POLICIES (AS ON 15.5.99)

State	Programme	Wheeling 2%	Banking 12 months	TP Sale	Buy-back Rs.2.25/kwh	Annual Escalation 5%
Andhra Pradesh	Wind	Yes	2%, 8–12M	Yes Not<HTT	Yes	1997–98
Gujarat	Wind	-	-	-	-	-
Himachal Pradesh	Wind	Yes	Yes	Yes	Yes	X
Haryana	Wind	Yes	Yes	Yes	Yes	1994–95
Karnataka	Wind	Yes	2%	Yes	Yes	1994–95
Kerala	Wind	Yes	2%,6M	X	X	X
Madhya Pradesh	Wind	Yes	X	Yes	Yes	X
Maharashtra	Wind	Yes	Yes	Yes	Yes	1994–95
Punjab	Wind	Yes	Yes	Yes	Yes	X
Rajasthan	Wind	Yes	Yes	Yes	Yes	Yes
Tamilnadu	Wind	Yes	2%	X	Yes	1994–95
Uttar Pradesh	Wind	12%	Yes	Yes	Yes	1995–96
West Bengal	Wind	Yes	6M	X	X	x

and Maharashtra. Favourable sites have also been identified in some inland areas of Karnataka, Andhra Pradesh, Madhya Pradesh, West Bengal, Uttar Pradesh and Rajasthan. Locations having an annual mean wind power density greater than 150 watts per sq. metre at 30 metre height will be considered suitable for wind power projects. There are 177 locations so far identified with an aggregate potential of about 5500MW capacity in 13 States. The wind resource map of India is shown in Figure 2.

COMMERCIAL DEVELOPMENT

A notable feature of the Indian programme has been the interest evinced by private investors/developers in setting up commercial wind power projects. Commercial projects with an aggregate capacity of 1025MW have so far been established, mainly in Tamil Nadu, Gujarat, Andhra Pradesh, Maharashtra, Madhya Pradesh and Karnataka. A photograph showing wind farm developed by a private developer in Maharashtra State with a total installed capacity of 9.6MW is shown in Figure 3.

Figure 3
Wind farm in Maharashtra State, India

TABLE 3. SCHEMES OFFERED BY IREDA FOR DEVELOPMENT OF WIND POWER IN INDIA

For Wind Farm Developers

S. No.	Financing Scheme	Interest Rate (exclusive of interest tax)	Loan Repayment Period including Moratorium Period (Years)	Moratorium Period (Max.) (Years)	Minimum Promoter's Contribution
1.	i) Development of wind farms on lease basis	13.75%	10	1	25%
	ii) Development of wind farms on ownership basis	13.50%	10	1	25%
	iii) Development of wind farm/ estates with minimum station capacity of 10 MW by Cooperative Sector/ Public Sector/Joint Sector/Private sector Companies on built, own, operate, lease, transfer basis subject to following conditions:	12.75%	10	1	25%
	*Applicant having minimum net worth of Rs.100 crores *Applicant having AAA (or equivalent) rating	12.50%	10	1	25%
	iv) New Technology above 750 kW machines				
2.	Equipment Financing (up to 1 MW per party per financial year)	14.50 %	10	1	20%
3.	Development of wind farms by Machine suppliers/ manufacturers up to 5 MW/party/per year on built, operate, own, lease, transfer basis.	13.00 %	10	1	25%
For State Electricity Board/Utility					
1.	Grid Interconnection Facility Scheme for Evacuation of Electricity	14.00%	10	1	25 %
For Renewable Energy Users					
1.	Transmission/ distribution facility scheme (where borrower uses not less than 50 % of his electricity requirement from renewable energy)	14.00 %	10	1	25 %

TABLE 4. MANUFACTURERS OF WIND GENERATORS/WIND TURBINE EQUIPMENT

Name	Foreign Collaborator	Model	Capacity
Arul Mariamman Taxtiles Ltd.	Wind World Denmark	W2920 W4200	250KW 600KW
Asian Wind Turbine Pvt. Ltd.	NEG-Micon Denmark	M1500 NM750-175/44 NM-600-150/48 NM-750-200/48	600KW 750KW 600KW 750KW
Bharat Heavy Electricals Ltd.	Nordex, Denmark	N29/250	250KW
Das Lagerway Wind Turbines Ltd.	Lagerwey, Netherlands	LW30	250KW
Elecon Engineering Company Ltd.	Turbowinds n.v. Belgium	T400-34	400KW
Enercon India Ltd.	Enercon GmbH, Germany	E-30 E-40	230KW 600KW
Kirloskar Electric Co. Ltd.	Wind Energy Group, UK	MS3-400L	400KW
NEPC India Ltd.			225KW 250KW 400KW
Pioneer Wincon Ltd.	Wincon, Denmark	W-250/29	250KW
REPL Engineering Ltd.	Bonus, Denmark	MKII	320KW
Suzlon Energy Ltd.	Sudwind Energie Systeme, Germany	N3 127 N3335	270KW 350KW
Tacke Wind Energy India (Pvt) Ltd.	Tacke Windenergie GmbH, Germany	TW600e	600KW
TTG Industries Ltd.	Husumer, Schiffswerft, Germany	250T	250KW
Vestas RRB	Vestas, Denmark	V-27 V-39	225KW 500KW
Windia Power Ltd.	Nedwind, Netherlands	NW30 NW40 NW44 NW46/3	250KW 500KW 550KW

PROMOTIONAL POLICIES

A package of incentives is available for promotion of wind farms. This includes tax concessions such as accelerated depreciation, tax holiday, soft loans, customs and excise duty reliefs, liberalised foreign investment procedures etc. The income tax, import and excise duty regimes are constantly being reviewed to allow induction, development and deployment of the latest technologies in the Country. Non-conventional energy power policies announced by States with potential for Wind Power Development are given in Table 2.

SOFT LOAN FACILITY FOR DEVELOPMENT OF WIND ENERGY

The Indian Renewable Energy Development Agency (IREDA) Ltd. has been playing a significant role in promoting wind power projects through its well-designed funding programme. Schemes offered by IREDA for development of wind power in India are given in Table 3.

MANUFACTURERS OF WIND ENERGY GENERATORS (WEGS)

The wind turbines installed so far in the country are predominantly of the fixed pitch 'stall' regulated design and pitch regulated design. However, the recent trend is towards better aerodynamic design, use of lighter and larger blades, higher towers, direct drive and variable speed gearless operation using advanced power electronics. Technology excellence is on the way either to total elimination of reactive power consumption or to reduce the reactive power consumption. This is an important development considering the typically weak local grid networks. The unit size of machines has gone up from 55–100KW in the first few projects to 400–750 KW in the recent projects. The list of machine manufacturers and capacity of machine is given at Table 4.

ECONOMICS OF WIND POWER DEVELOPMENT

Economics of wind power is quite attractive for investors. Economics of a typical wind farm are given in Table 5.

POLICY FRAMEWORK FOR WIND FARM DEVELOPMENT

A favourable fiscal/policy environment exists in India for development of Wind Power. In the last 10 years, wind power development in India has been promoted through R&D, demonstration projects/programmes supported by Government subsidies and fiscal incentives outlined below

From Central Government

- Income Tax Holiday
- Accelerated Depreciation
- Concessional Custom Duty/Duty Free Import
- Capital/Interest Subsidy

From State Governments

- Energy buyback, power wheeling and banking facilities
- Sales Tax concession benefits
- Electricity Tax exemption
- Demand cut concession offered to industrial consumers who establish power generating units from renewable energy sources
- Capital Subsidy

9TH PLAN PROSPECTS

During the 9th Five-Year Plan, the additional capacity envisaged is over 40 000 MW. It is expected that about 300 MW of power will be from wind. The currently estimated investment for commercially proven wind energy technology will be Rs9567 million.

BARRIERS IN WIND POWER DEVELOPMENT

The main bottlenecks for large-scale development of wind power include the following:

- Distortions in energy market
- Stiff competition from subsidised conventional energy and its universal applicability
- Technological constraint for limited level of grid penetration (20% maximum)
- High capital investment and marginal commercial viability
- Lack of infrastructure for effective power evacuation
- Lack of awareness

- Lack of adequate capital at affordable cost
- Limited access to financial resources and high cost of finance
- Lack of adequate policy and institutional framework
- Lack of trained manpower

MARKET FOR WIND ENERGY

- Government Market
- Government Driven Market
- Cash Market
- Loan Market

INTERNATIONAL ASSISTANCE FOR WIND FARM DEVELOPMENT

Sl.No.	Organization	Line of credit
1	World Bank	US$28 million
2	Asian Development Bank	US$36 million
3	KfW, Germany	60 million DM

NEW INITIATIVES FOR SUSTAINABLE DEVELOPMENT

The Centre for Wind Energy Technology (C-WET) is formed as an autonomous body by the Ministry of Non-Conventional Energy Sources with the assistance from Danish Government for taking up different issues pertaining to the development of the wind energy in the country on sustainable basis. The main objective of the Institute is to conduct research and development work for indigenous technology, preparation of standard for certification of wind turbines, award of certificate for wind turbines and also undertake consultancy activity for the market development.

Wind Energy Producers Association (WINPRO). The objective of WINPRO is to create the awareness in line with the development that has taken place in Denmark and other Countries regarding various technical problems and also its possible solution besides organising seminars and training programmes for the development of skilled manpower. They also publish a monthly journal wherein the performance of wind turbine of their members is covered.

Indian Wind Turbine Manufacturers Association (IWTMA). The All India Wind Turbine Manufacturers Association has been formed in the country with wind turbine manufacturers as main members. The function of the association is to discuss various issues that may require support from different organisations and government and also to take up such issues with the appropriate authority for immediate action so that the wind energy can grow in a healthy way with the penetration of new technology in the country.

TABLE 5. ECONOMICS OF A TYPICAL WIND FARM

Parameter	Economics
Installed capacity	**1MW**
Investment	US$1 million
Expected generation	2.5 million kwh
Power buy back rate of the utility annual escalation	7 cents with 5%
Operation & maintenance cost per annum (including insurance coverage	US$15 000
Pay back period	5–6 years
FIRR	29%
Levelised cost of generation	6 cents

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Dr. V. Bakthavatsalam, Managing Director, Indian Renewable Energy Development Agency Limited (IREDA), has over 20 years of experience in Renewable Energy planning, policy, financing, promotion and institutional development. He is a Mechanical Engineer, MBA-Finance and a Doctor of Science in Renewable Energy.

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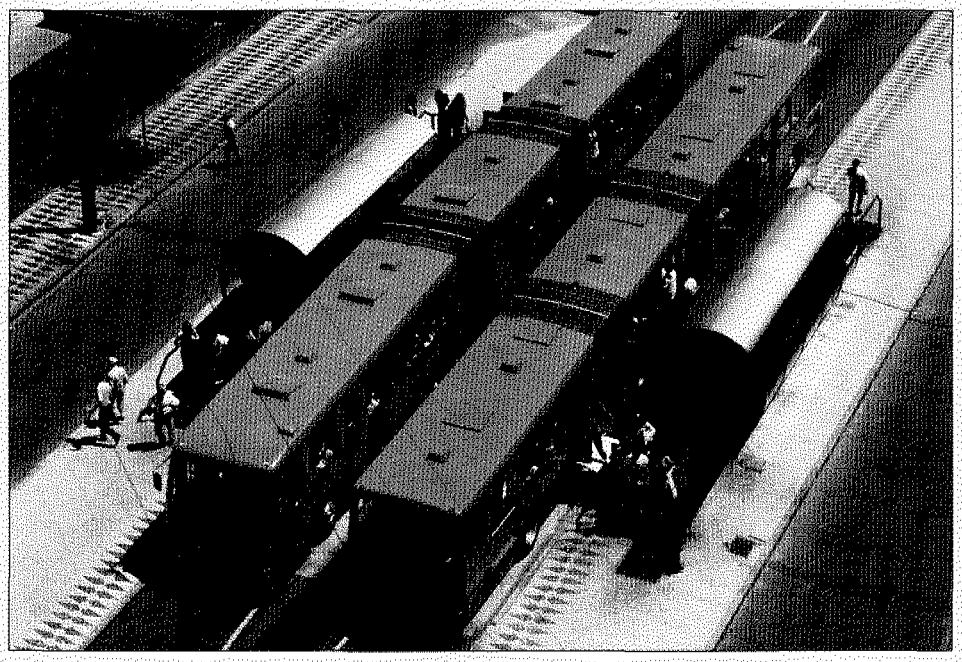
SECTION 6

TRANSPORT



Picture courtesy of Uppsala University

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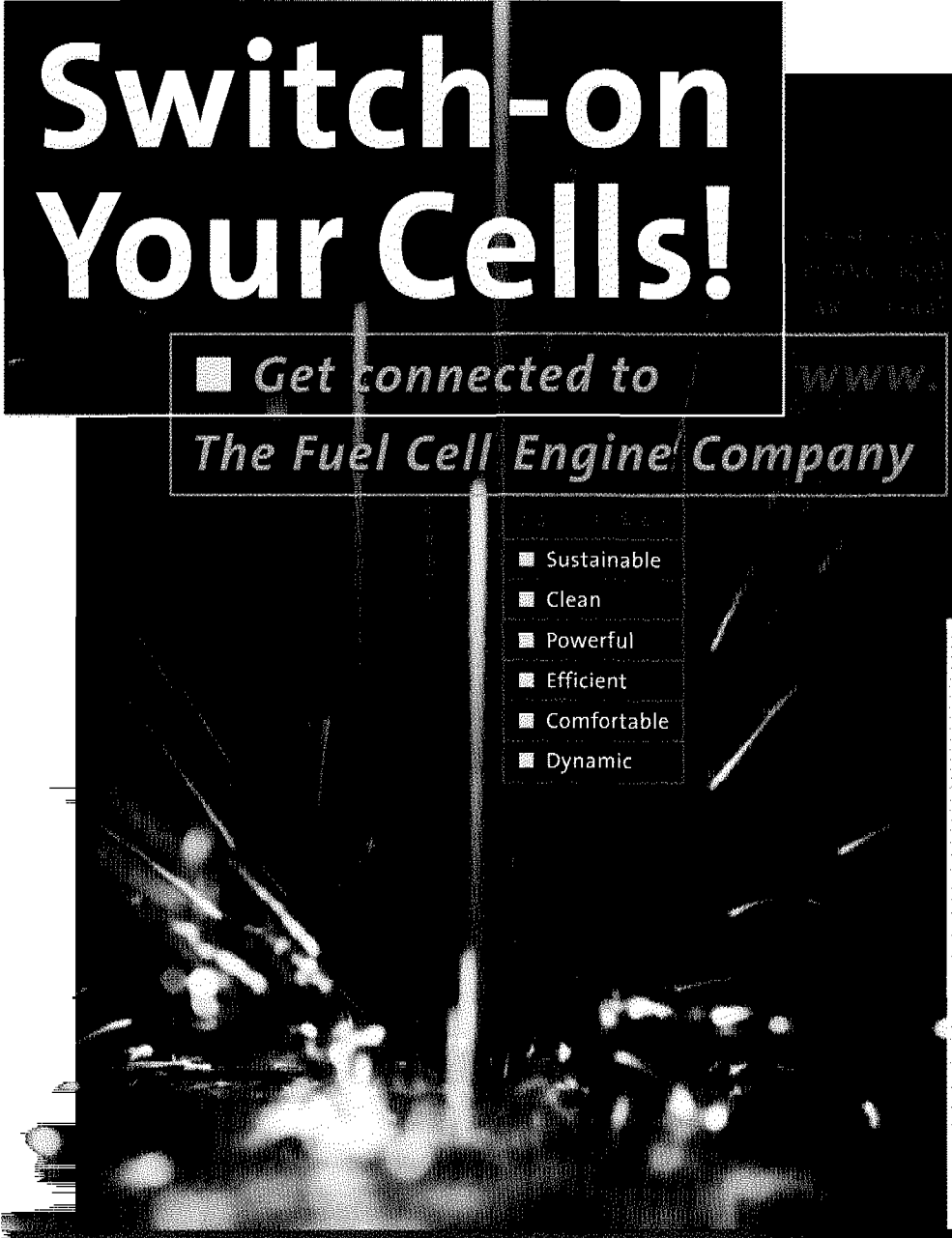

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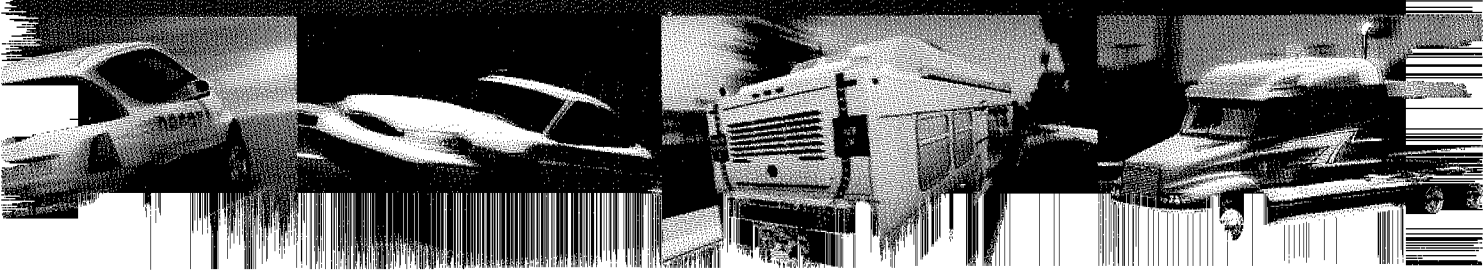

Fuel Cells for Transportation

Bernadette Geyer, *Breakthrough Technologies Institute, Washington D.C., USA*

Abstract

The rise in the price of gasoline has been a contentious issue over the past year in the United States, where many drivers are dependent on their cars and elsewhere in the world, where drivers are more accustomed to paying high prices for gasoline and diesel fuel. Annual Vehicle Miles Travelled (VMT) continue to rise, and with the revival of the Asian economy, the number of vehicles on (and off) the road around the world is increasing dramatically. All of this adds up to a greater demand for transportation fuels, an ever-increasing strain on natural resources, and greater amounts of pollutants entering the environment. Fuel cells are being developed for a variety of transportation applications, including light-duty vehicles (passenger cars, scooters and sport utility vehicles), heavy-duty vehicles (trucks and buses), locomotives, marine applications and speciality vehicles (off-road). Use of fuel cells in transportation applications would increase efficiency of fuel use, decrease the amount of pollution released per mile travelled, and ease pressure on the earth's natural resources – all while enhancing the mobility of people in both developed and developing nations.

What is a fuel cell?

A fuel cell is an electrochemical engine. It generates electricity by harnessing the reaction of hydrogen and oxygen. Because it converts the chemical energy of a fuel into electrical energy without combustion, the process is highly efficient and extremely clean. When renewably-produced hydrogen is used, the only byproducts are water and heat.

In principle, a fuel cell operates like a battery. Unlike a battery, however, a fuel cell does not run down or require recharging. It will produce energy in the form of electricity and heat as long as fuel is supplied. Fuel cell types are generally differentiated by their electrolytes: polymer electric membrane (PEMFC), phosphoric acid (PAFC), alkaline (AFC), molten carbonate (MCFC), solid oxide (SOFC) and other experimental types.

Fuel flexibility

Fuel cells can promote energy diversity and a transition to renewable energy sources. Hydrogen, the most abundant element on earth, can be used directly, or a fuel cell system that includes a 'fuel reformer' can utilise the hydrogen from any hydrocarbon fuel: natural gas, ethanol, methanol and even gasoline. Hydrogen can also be produced using wind or solar power, or it can be extracted from 'novel' feedstocks such as landfill gas or anaerobic digester gas from wastewater treatment plants (Figure 1).

Fuel cells for transportation applications

Fuel cells are quickly being recognised as a way to help ensure and increase the mobility of the world's people, while allowing a transition from depletable natural resources.

In the United States, the number of annual Vehicle Miles Travelled increased by 30% for the period 1988–1998, to a staggering 2.6 trillion miles[1]. During that period, the average fuel economy of vehicle fleets

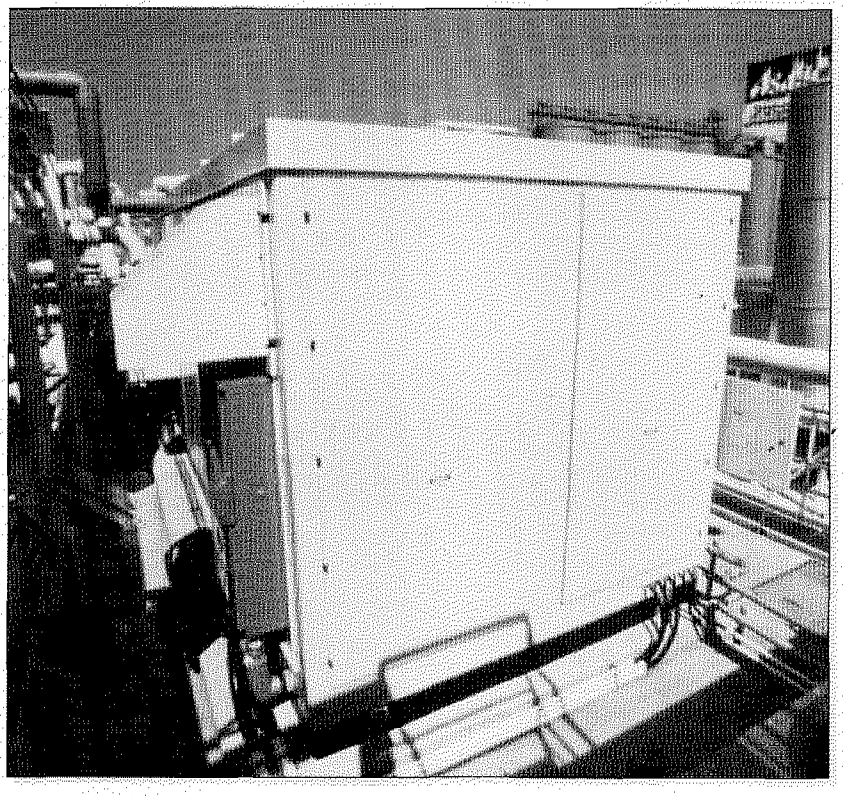

Figure 1
Toshiba fuel cell at Asahi Brewery in Japan

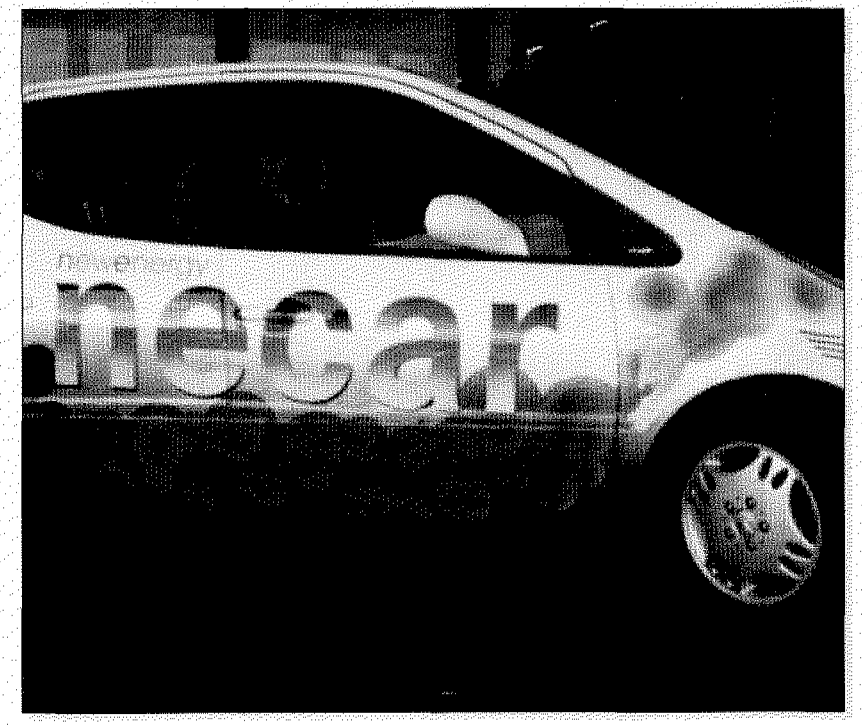

Figure 2
DaimlerChrysler's NECAR 4 fuel cell passenger vehicle

stagnated, primarily because of the increase in purchases of light trucks and Sport Utility Vehicles, which have lower average fuel efficiency than passenger cars. Since 1970, the global fleet has been expanding at the rate of 16 million vehicles per year[2].

With the increasing number of vehicles purchased and the rise in annual miles travelled, global demand for oil is expected to increase dramatically in coming years. According to the Worldwatch Institute's State of the World 1998, if car ownership and oil consumption per person in China were to reach US levels, 'the country would need 80 million barrels of oil per day. In 1996, the world produced 64 million barrels per day.'[3]

The US Geological Survey estimates that, taking into account probable future oil discoveries, the number of barrels of oil remaining to be produced worldwide would sustain the current rate of consumption (1995) between 63 to 95 years[4]. With projected increases in demand for oil, advanced technologies such as fuel cells are absolutely crucial to slowing oil use in the transportation sector.

Efficiency of fuel use

The average automobile internal combustion engine (ICE) is about 15–20% efficient at utilising the energy content of a fuel, and the best diesel engine available has an overall efficiency in use of about 24%[5]. The most recent fuel cell system, built by Ballard Power Systems and used in DaimlerChrysler's NECAR 4 fuel cell vehicle, has an efficiency of 37%, and the automaker expects to get more than 40% efficiency from future fuel cell engines [5]. Gains in efficiency mean that less fuel is used to go the same distance. Because fuel reformers will be able to process a variety of fuels for use in fuel cells, the efficiency gains and fuel flexibility will mean less dependency on declining supplies of easily-accessible oil.

Decreased emissions of pollution

Even though there has been progress in reducing pollution emitted by newer vehicles, those gains are offset by the increased amount of driving and the rising number of vehicles on the roads. There are days when vehicles are banned from the downtown areas of Rome, Paris, Athens and Mexico City, due to high pollution. In many major cities, scooters with two-stroke engines are also a significant contributor to smog.

The increased efficiency of fuel cell technology, as well as its ability to use cleaner fuels like natural gas in addition to renewable fuels, means less pollution per mile travelled. Using fuel cells in locomotives, buses or heavy-duty trucks means air conditioning/heating units can be powered without having to idle the diesel engines. And imagine the air quality in downtown Shanghai or Rome if all the scooters had clean fuel cells.

Enhanced mobility for people in both developed and developing nations

Clean, efficient fuel cell-powered transportation, able to run on a variety of fuels, would be a boon to developing nations concerned about limiting their increases of greenhouse gas emissions. Fuel cell vehicles would allow countries to enhance mass transit by increasing bus fleets using cleaner engines and transitioning from more polluting technologies. Perhaps zero-emission vehicles would even be allowed in restricted downtown areas on high pollution days. And fuel cell locomotives would be able to operate underground in urban areas.

STATUS OF DEVELOPMENT

Light-duty vehicles

Every major car company in the world is evaluating the use of fuel cells in passenger vehicles, and almost all of them are testing fuel cell concept cars on the road. DaimlerChrysler, Ford, General Motors and Toyota all say they will have commercially available fuel cell vehicles for some markets by 2004–2007 (Figure 2).

Current fuel cell concept cars and sport utility vehicles (SUVs) are being demonstrated running on hydrogen or methanol, and advances have recently been made in the reforming of gasoline for use in fuel cells. Fuel cell stack size has decreased dramatically in the past five years: Ballard Power Systems and International Fuel Cells have built and demonstrated fuel cell engines that fit under the hood of a standard size family sedan. General Motors expects its fuel cell Precept will achieve 108 miles per gallon gasoline equivalent.

For fuel cell vehicles to be commercially competitive with traditional engine technologies, stack size and cost must still be brought down. Additionally, issues of infrastructure must be addressed. While reformers are being developed to allow fuel cells to be used with the existing fuelling infrastructure, research and development must also focus on facilitating the distribution of cleaner alternative transportation fuels.

International workshops have been held to discuss the feasibility of fuel cell powered scooters. Companies in Taiwan are developing demonstration models. Manhattan Scientifics is demonstrating a 'Hydrocycle', a bicycle that operates on a hydrogen-fed fuel cell and has a range of 70 to 100 kilometres.

Heavy-duty vehicles and locomotives

Fuel cell transit bus demonstrations are ongoing in the United States, Canada and Germany. Running on fuels such as natural gas, hydrogen and methanol, these buses are much cleaner than even the most advanced diesels. For example, tests performed on Georgetown University's second generation fuel cell bus – featuring a fuel cell built by International Fuel Cells and running on methanol – showed zero emissions of particulate matter and hydrocarbons, and near-zero emissions of carbon monoxide and nitrous oxides. The levels were far below the 1998 standard emission levels for buses.

DaimlerChrysler has said it plans to make as many as 30 fuel cell transit buses commercially available by 2003, with delivery starting by late 2002. The automaker has been demonstrating a NEBUS fuel cell bus since 1997. As with other fuel cell vehicles, the cost of the fuel cell buses needs to come down in order to be competitive with standard diesel buses. Infrastructure issues are not such a concern, since buses are refuelled at a central location.

Freightliner is demonstrating a Class 8 heavy-duty truck with a hydrogen-fed 1.4kW PEM fuel cell auxiliary power unit developed by XCELLSIS. The fuel cell will allow the truck driver to run air conditioning, a television, or other appliances without having to idle the engine or drain the battery.

International workshops have determined that fuel cells could feasibly be used in locomotives, and there is interest on the part of locomotive manufacturers and railroads. Funding and research efforts are expected to increase in coming years.

Speciality vehicles

Just as important as on-road emissions are off-road and speciality vehicles. These vehicles accounted for nearly one-third of the carbon monoxide emissions from the transportation sector in 1998[6]. While there are no fuel cell speciality vehicles being sold commercially, there are fuel cell powered boom lifts, forklifts, golf carts and utility vehicles being demonstrated around the world (Figure 3). BMW has said it will develop hydrogen fuelled fuel cell forklift trucks, deploying about 2000 in the company's own facilities prior to marketing them to other users.

Marine applications

Fuel cells are being developed for a variety of marine uses, from small recreational boats to shipboard power for naval vessels and submarines. High temperature fuel cells that can use hydrocarbon fuels directly without separate reformers are being developed for the larger applications. Currently, fuel cells are being demonstrated on small passenger boats, such as the 'Hydra,' a 22-passenger boat developed by Etaing GmbH of Germany, which features a 5kW alkaline fuel cell built by ZeTek Power.

Siemens has built and tested a fuel cell that is to be used in all of the German Navy's future 212-class submarines, due to be commissioned beginning in 2003. The features that attracted the Navy to the fuel cell were its low noise signature, high efficiency, low maintenance, and the exhaust of only water vapour.

CONCLUSIONS

Mobility is an essential part of a developing economy. People need to be able to travel reliably to work sites, schools and hospitals, be it on efficient public transportation systems or in their own vehicles. Goods and services need a way of getting from country to country, from one city to another, or from cities to rural communities. The efficiency, reliability and environmental benefits of fuel cells make it a key technology for ensuring mobility in both developed and developing nations, without putting further strain on the environment or its natural resources.

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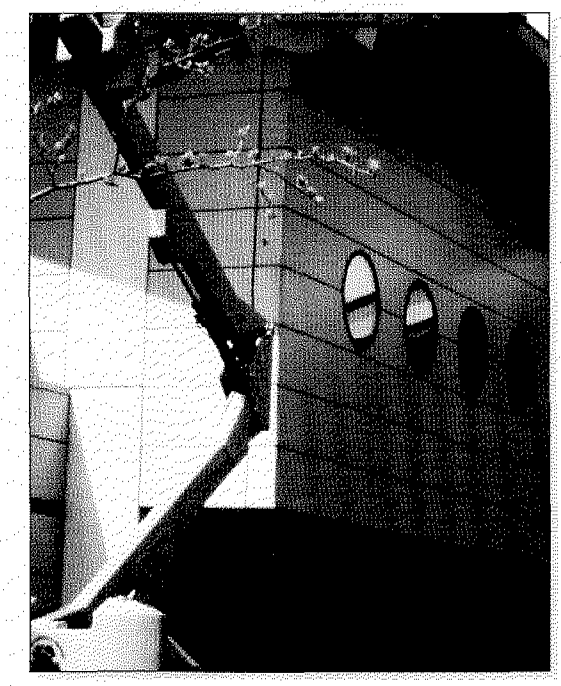

Figure 3
JLG Industries fuel cell powered boom lift

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Innovative Solutions for Public Transport; Curitiba, Brazil

Lars Friberg, *Uppsala University, Sweden*

Abstract

Curitiba, capital of the Brazilian state Parana 400 km south east of São Paulo, has over the last 30 years developed a non subsidised, private owned, public transport system. Today it stands as a model recognised internationally. Insightful, long term planning with several innovative solutions has provided the citizens with an effective system that gives priority to public instead of private transport. It has the highest user rates of all Brazilian state capitals, 75% of all weekday commuters. All this during an unprecedented city growth.

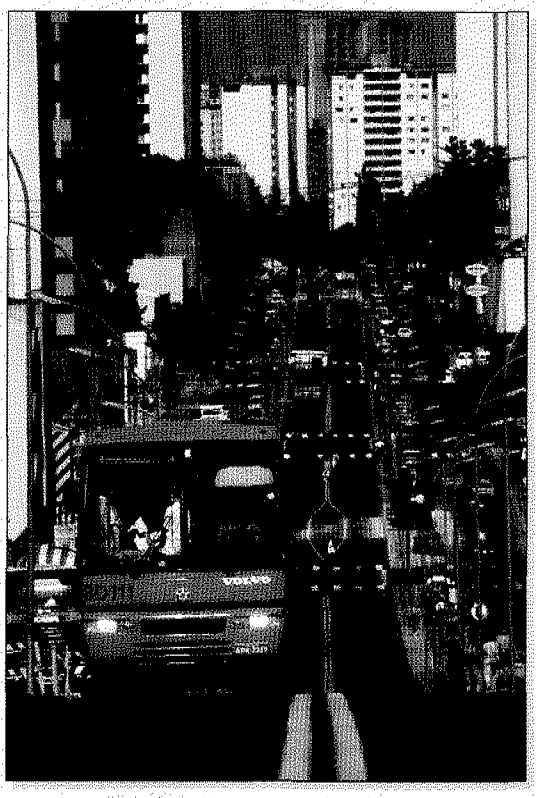

Figure 1
Along the structural corridors the building density is high, changing the city growth pattern from radial to linear. Here the buses run on exclusive lanes

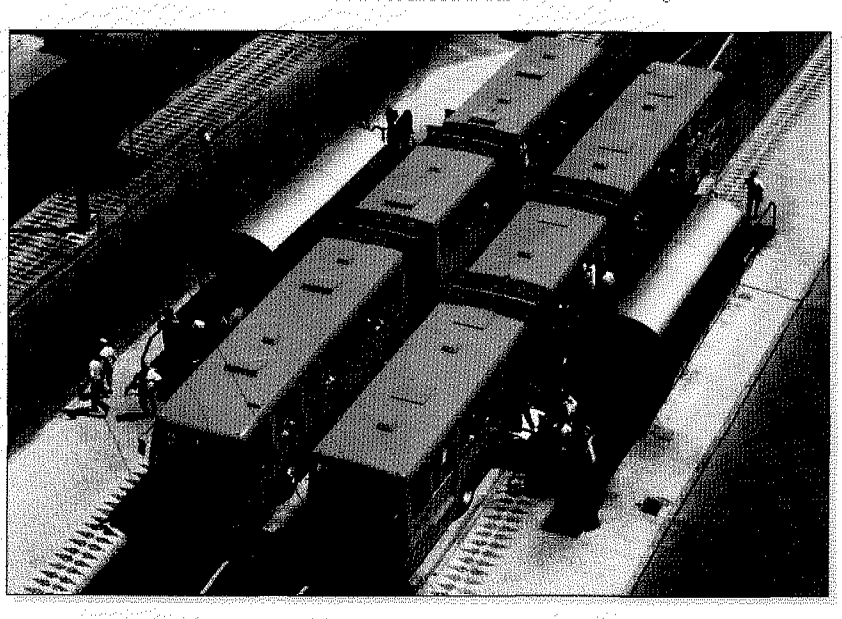

Figure 2 (below)
Two of the special bi-articulated buses with a carrying capacity of 270 passengers at a tube station

Introduction

During the last fifty years Brazil has, as many countries in the South, witnessed a rapid urbanisation. People leave the countryside and the shrinking agrarian sector for the seducing city lights in hope for a better life, but unlike the urbanisation process of Europe at the turn of the last century there are no longer any factory floors to accommodate the growing labour force. The influx of people from the country-side combined with a growing population created city growth numbers around five per cent annually.

The last years burdensome financial situation of the Brazilian economy and the crippling effect of widespread corruption put the bureaucracies of all levels of state under increasingly high pressure to accommodate the basic services expected from the public, including a functioning public transport system. Curitiba is, in this aspect, no exception: since the 1940s when the population was around 140 000, it has increased ten-fold and the city proper now has a population of 1.6 million citizens with a metropolitan population depending on the services of the state capital reaching 2.3 million.

The key features of Curitiba's transportation system began to evolve in a process in the late 1960s. City planners decided to address the increasing growth by developing a master plan for the city. This master plan, designed by several Brazilian architect firms in cooperation with city planners, had five key principles:

- changing the radial urban growth trend to a linear one by integrated land use, road network and transport strategy;

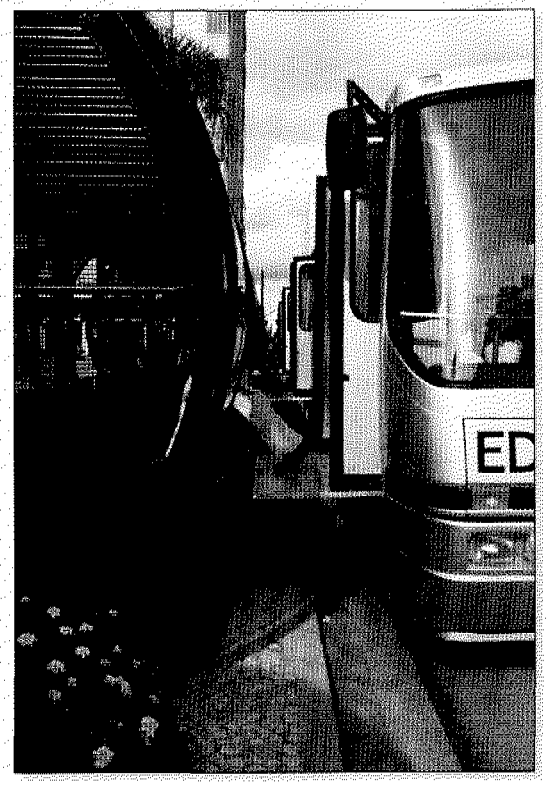

Figure 3
The direct bus has special platforms for quick docking at the tube station

- decongest the city centre and preserve its historical buildings and neighbourhoods with legislation and economic incentives;
- demographic control and management;
- economic support to urban development; and
- infrastructure improvement.

These principles established in the master plan have guided the city growth for more than 30 years now and the plan, by now revised a number of times, still has these principles at its core.

The planners recognised that the transportation systems can serve as the backbone for the development and growth of the city in the future. Unlike many other Latin American cities at the time, the city planners of Curitiba did not embark on brutal reconstructions of its downtown area or large scale highway constructions, which has a tendency to give only temporary relief from the problems of congestion as can be seen in the United States.

Even if the city today has the second highest car per capita ratio in Brazil, the city gives priority to its public transport instead of individual vehicles. Curitiba decided to use buses as its primary means of public transport, not only because it was the choice of transport in the past; it was also the most cost effective means of transport. According to calculations done by Instituto de Pesquisa e Planejamento Urbano de Curitiba (IPPUC), the institution responsible for planning the implementation of Curitiba's master plan, the biarticulated bus system as it is developed in Curitiba costs 3 million USD/km to construct compared with 8–12 million for a tram system and around 50–100 million USD/km for a Subway.

The backbone in the combined land use, road and transport system are the structural axes and the road hierarchy. In 1974 the most significant changes in the transportation system were taken with the creation of the road hierarchy and land control system. In coordination with the master plan the planning department began to construct the first two out of five arterial structural roads that would eventually form the structural growth corridors and dictate the growth pattern in the city.

These structural corridors are composed of a triple road system with the central road having two restricted lanes dedicated to express buses. Parallel to the express bus lanes were two local roads running in opposite directions. They allowed local traffic to pass through the city.

In 1982, all five structural corridors were completed with inter-district and feeder lines. In accordance with these structural roads, zoning laws were set in place to structure the growth of the city. Large buildings holding a high density of people were permitted to be built along these corridors, but as one moved away from these central corridors the admissible densities declined from urban apartment buildings to residential neighbourhoods.

The 60 km of bus way along these axes are 'fed' by 300 km of feeder routes which concentrate passenger demand on strategically placed terminals. On these terminals, but only here, the passenger can change between different lines on the same fare with extending public transport access to 90% of the city area. These terminals are linked in turn by 185 km of circular inter district routes (Interbarrios). This network is supported by 250 km of 'direct' bus routes (Ligeirinhos) that stop only at special 'tube' stations.

The average operating speed of the buses is:

biarticulated	20 km/h
direct	30 km/h
conventional	18 km/h

compared with the average speed of the MTA Subway system of New York of 32 km/h and other Brazilian cities with conventional bus system where the actual speed can go below 10 km/h due to traffic congestion during peak hours.

The tube stations were constructed to speed up the system. Passengers now enter from the tube station at an even level to the bus floor and the passengers pay their fares by tokens or in cash to an attendant at a turnstile when entering the tube station. Boarding times are thus reduced, approaching those of subway passengers, and the short waiting times are in a relatively sheltered and safe environment. The tube stations are structures made

Table 1. Capacity of bus operations in Curitiba

Bus Configuration	Capacity (passenger/day)
Conventional bus on average street (80 passengers)	1,000
Conventional bus on bus way (150 passengers)	1,800
Double (Articulated) bus on bus way (150 passengers)	2,500
Direct route with boarding tubes (110 passengers)	3,200
Biarticulated bus on bus way with boarding tubes (270 passengers)	4,000

Note: These figures are a simplification of operational data, taking in to account the capacity of the vehicles and their respective commercial running time.

Source: URBS, Urbanizacao de Curitiba

of steel and glass that are 10 m long and 3 m in diameter and they are equipped with side elevators to allow access for the physically handicapped and old.

The latest improvement to the system is the biarticulated buses that were specially designed for the Curitiba system in cooperation with Volvo do Brazil. These huge buses operate in the special lanes and have a capacity of 270 passengers. Due to the system design with special lanes, pre-paid passenger boarding and the priority the buses receive in road hierarchy, the bus system can operate with a much higher capacity than traditional city bus systems.

ECONOMY AND MANAGEMENT

The Curitiba Integrated Transport Network is managed by URBS, *Urbanizao de Curitiba*, a state-owned company created in 1963. They monitor and coordinate the system, the private companies that operate the bus lines, and maintain the infrastructure of the system. The buses are owned and run by 16 private companies who receive licences for specific lines and who are paid not per passenger but per km. URBS monitor both the mileage and the number of passengers, adapting the number of bus lines and frequency according to demand. The system is completely financed by the bus fares without any public subsidies. The fare is based on calculations done by URBS and it covers the profit percentage for the bus companies, personnel costs, maintenance and depreciation of the bus fleet. To avoid an inflated fare price, a law established in 1990 states that revenues from the transportation system can only be used to pay for the system itself. According to another municipal law, the buses must not be older than ten years, resulting in a fresh bus fleet with an average age around five years. Due to this fact, combined with the regulated regular maintenance, the buses are in good condition which helps to keep the exhaust pollution levels down. Experiments are conducted at URBS with different diesel additives like soy oil and ethanol to bring down pollution levels further.

Curitiba's use of the public transport system is the highest of all Brazilian state capitals with 75 per cent of commuters using the system on weekdays. As a result, the city's fuel consumption is 30 per cent lower than in eight comparable Brazilian cities.

INTEGRATED TRANSPORTATION NETWORK

To accommodate the growing population over the past 30 years, the mass transportation system has grown to utilise varying types of bus services that cater to the needs of passengers within the metropolitan areas and surrounding municipalities. The Integrated Transportation Network that has evolved between Curitiba proper and its surrounding metropolitan area, now operating with 1902 buses, is designed to allow the passenger to make travel bookings to a certain destination without paying more than one passage. The Curitiba Integrated Transportation Network today covers about 900km of routes in eight neighbouring cities. On an average day 1.9 million passengers use the system, with an 89% approval rate according to a survey done by URBS.

CONCLUSION

Even if the system today shows some signs of fatigue with crowded buses during peak hours, it is still a good model for many other cities to consider. The long-term urban strategy and the political will to implement it has demonstrated positive results, not only in the field of public transport

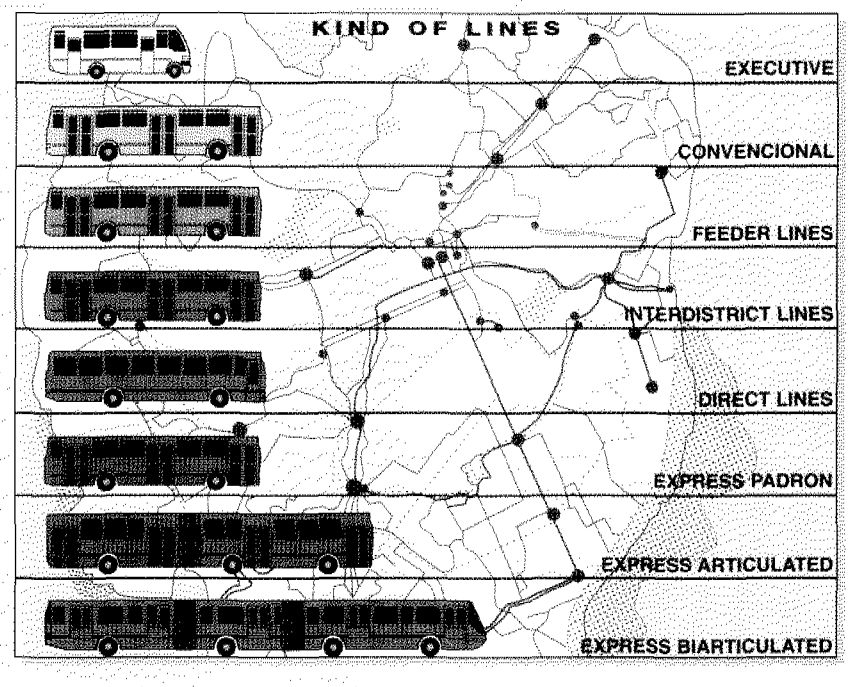

Figure 4 (above)
The Curitiba Integrated Transportation Network uses 5 different bus models that serve 8 different kinds of lines. The buses are colour coded for easier recognition

Figure 5 (middle)
The interior of a tube station; boarding is facilitated by the elevated floor and the prepaid passengers who pay at the turnstile when entering the tube

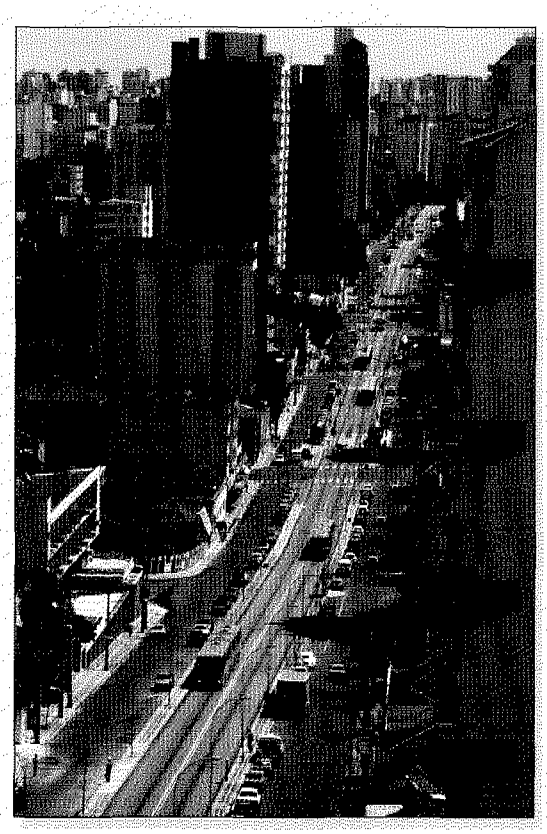

Figure 6 (bottom)
By creating a road hierarchy that prioritise public transport the bus system of Curitiba can operate efficiently

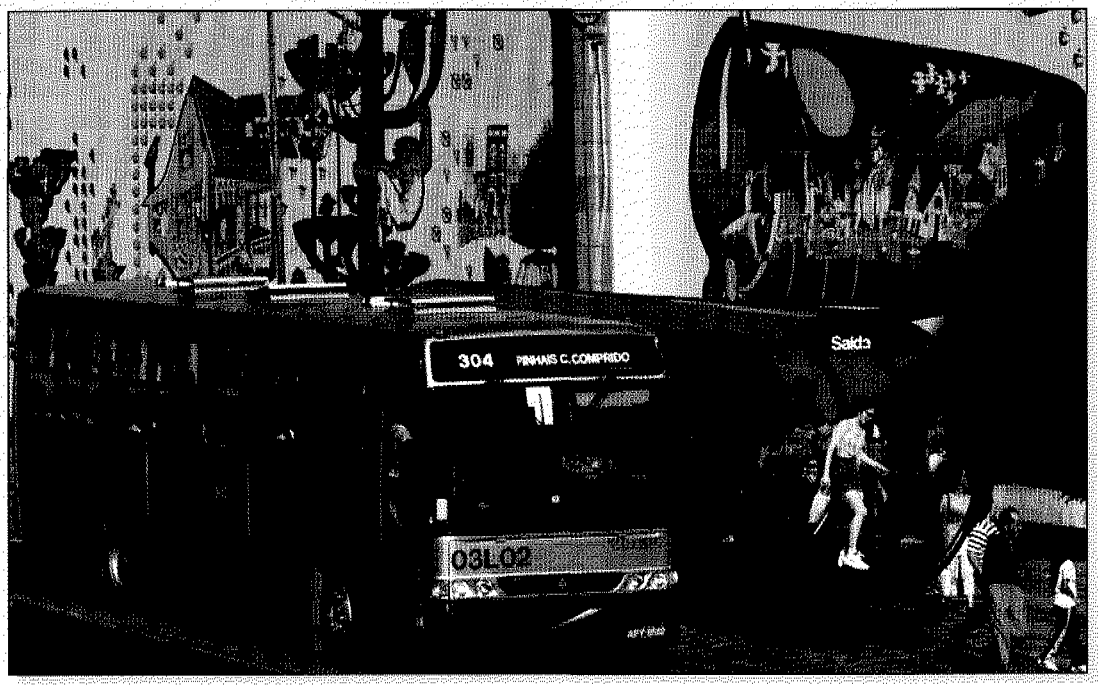

Figure 7
The express bus system with it's special lanes and tube stations serves the citizens with fast, safe transport throughout the city

but in the overall integrated strategies of the city.

Curitiba was for example the pioneer in Brazil when it created its pedestrian network in the centre of the city in 1971. There are also several garbage recycling and collecting schemes, bicycle paths, and lots of green areas and parks giving the city not only recreational areas and beautiful landscapes but also important flooding control and protection for biotopes and freshwater sources. The city has also developed methods and strategies for the preservation of historical neighbourhoods, saving its culturally important parts from land speculation. There is also an incentive mechanism for developers to use part of their plots for green areas, giving them the opportunity to build higher than the land use legislation would otherwise allow. An example of the integration of the transportation with the rest of the city management are the so called 'citizen streets'. At some bus terminals in the suburbs, city hall has built satellite offices for the different branches of administration to facilitate the contact with the people.

The development has most of the time been driven by the staff of different municipal institutions without strong public participation in the planning stages. The lack of participation from the public might not be so strange as the process started in the 60s and 70s when Brazil was still under authoritarian rule that believed in the bliss of technocrat expertise, but as the system continues to evolve a greater involvement from the public might be necessary to continue the strong support.

What is then the main reason for such a widespread use and popularity of the system?

Studies have shown that 28% of the car-owning population regularly use the system.

It seems that the explanation is connected to practical reasons. The buses are fast, the network of lines covers the city very well and it's a lot cheaper to go by bus than by car. Compared with some other cities in Brazil, it's a wonder of efficiency and speed.

Fact still remains that nearly 700 000 cars are used in the city almost every day. The figure is rising along with the economic growth of the city and cars still hold a strong symbolic value as attributes of prosperity. If unregulated, the cars of Curitiba will once again start to create traffic congestion and deteriorated air quality in the city.

With simple innovative solutions the city planners have been able to create a system that is an economically self supported mix between private companies under public control serving the many thousand citizens of Curitiba and its suburbs with effective, reasonably cheap transportation in their daily lives.

ABOUT THE AUTHOR

Lars Friberg is a Swedish student of Political Science from Uppsala University who did a case study on the Curitiba public transport system as his Masters thesis during the summer of 2000.

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Life in Times of The Traffic Jam: Why Smart Cities are De-Motorising

Deike Peters, *ITDP, New York, USA*

Abstract

The spectacle repeats itself in thousands of cities across the globe every morning: a slow-moving avalanche of tin and steel boxes of many shapes and forms is moving towards the centre of the agglomeration, trapping millions of people in a noisy, polluted environment that is endangering them and the flora and fauna around them (or rather: of whatever may be left of it.) All too often, it's a 24-hour phenomenon, and does not even confine itself to a clear periphery-to-centre pattern: streets remain littered with motor vehicles at all hours of the day. We've all heard the corresponding statistics: In Bangkok, economic losses due to traffic jams amount to 3.5 percent of the national GDP every day. Breathing the air in Mexico City is equivalent to smoking two packs of cigarettes a day. The World Bank confirms that half a million people die every year in road accidents, most of them vulnerable road users.[1] In short: traffic is costly, traffic is deadly.

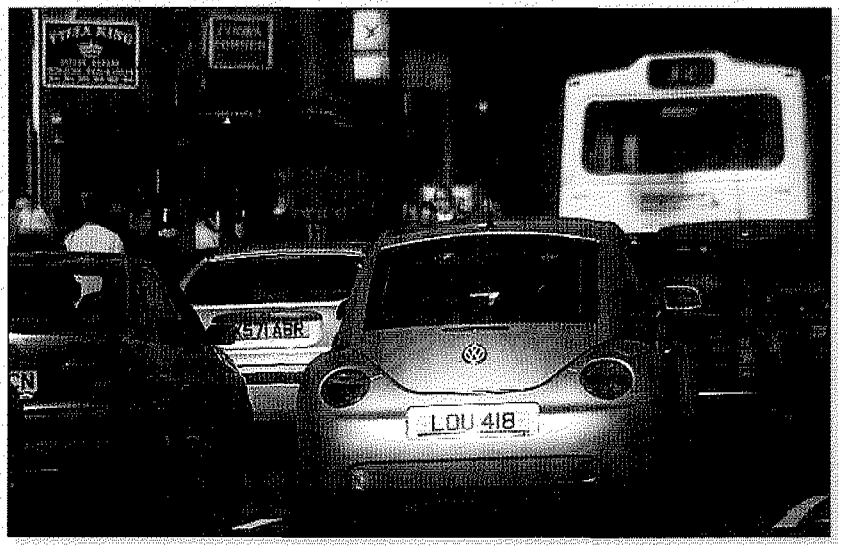

Figure 1 (top)
The global traffic nightmare: Slow moving avalanches of tin and steel
Photo credit: Ian Britton (Freefoto.com)

Figure 2 (above)
Smart traffic solutions: a special lane for non-motorized vehicles in Yogjakarta, Indonesia
Photo credit: ITDP

Traffic congestion is not a new phenomenon, of course. It was a problem in ancient China, antique Rome, medieval London and Renaissance Florence as much as it is in present-day Cairo, Sao Paulo, Teheran, Manila, Mexico City or Los Angeles. What is new, however, is that our irrational way of getting ourselves from our sleeping to our working habitats is not only detrimental to our own mental and physical well-being, but is also permanently affecting the global environment. One particular problem of modern day mobility, apart from the different order of magnitude and speed at which we are transporting goods and people, is the exhaust pipe. Transport is responsible for about 50% of global oil consumption, and for up to 90% of carbon monoxide, nitrogen oxide and hydrocarbon levels in heavily trafficked urban areas. There are only two ways to halt the depletion of non-renewable natural energy resources and to cut down emissions: driving less and/or producing more energy efficient vehicles. Technical problems as well as cost considerations make the latter alternative a limited option, forcing all of us to seriously re-consider our transport energy consumption patterns. Agenda 21 contains several useful transport policy suggestions, but no special chapter on transport. This seems to be one of the more urgent short-

1. You can find this statistic, along with many other interesting World Bank transport policy statements, in: 'Sustainable Transport: Priorities for Policy Reform,' published by the World Bank in 1996.

Figure 3
Environmentally-friendly and efficient commuting: Bike-and-Ride Parking at the railway station in Bruges, Belgium

comings of the Agenda document that could be remedied at its upcoming review. Transport will be a major topic for the CSD Dialogue sessions in 2001.

But above and beyond producing global policy documents and solemn declarations, what exactly are we to do? 'Get rid of cars and trucks and stop building roads,' scream the radical environmentalists. 'Develop lower-emission vehicles and expand road capacity!' yells the industry lobby. In fact, what one might call the emerging new 'sustainable mobility consensus' takes elements from both sides. Even industry experts increasingly admit that efficient and attractive alternatives to individual motorised transport must be the priority issue. End-of pipe solutions do not present an easy way out, not only because they are usually too costly for poorer countries to implement. Even zero emission cars still require lots of energy to produce and operate. And even if the whole world suddenly switched to non-polluting, small vehicles, roads and parking spaces would continue to take up valuable urban space and still sever natural habitats and urban communities. And if the current Sports Utility Vehicle (SUV) craze in the US and Europe is any indication, then upwardly mobile, higher income folks will always opt for the bigger, more polluting vehicles as long as their real function is that of a social status symbol.

Efforts to constrain citizens' automobilistic habits are always highly sensitive, and often tantamount to political suicide. The authoritarian city-state of Singapore is perhaps the most notable exception, boasting high luxury taxes on cars, strict area licensing and a sophisticated electronic road-pricing scheme. Yet even in places where recourse to such drastic measures is not a political option, there are lots of things cities can do. Well-designed strategies combining disincentives to car use with a variety of non-motorised and mass transit solutions and long-term land-use planning will benefit any city, thus creating a healthier, cleaner and more efficient environment for all its inhabitants.

Not all cities are the same, of course, and there are no uniform answers. Also, Lagos does not have the same economic and technical resources at its disposal as Stockholm. But regardless of how rich, how poor, how hot, how rainy, how socially diverse or segregated a city is, putting thought and money into better transit and non-motorised infrastructures will always help ease the onslaught of motorisation. What is needed is not so much a technical as a mental revolution in the minds of planners, politicians and prominent thinkers, both in the North and the South. Luckily for the rapidly developing cities in the south, this also means that solutions do not have to be as costly and as dependent on high-tech Western imports as they are often made out to be.

So our pessimistic snapshot of the global morning rush hour does not have to be a chronicle of a death foretold. What seems like the beginning of an inevitable story with a tragic outcome could just as well have a happier ending. But it is really more a question of imagination, creativity and inventiveness than of high-tech gadgets and fancy engineering. All of us, and especially transport experts, urban planners, developers, politicians and civil servants need to abandon the mistaken notion that modernisation is equal to motorisation, and that moving up in the world is equal to moving around in a bigger vehicle. Upon closer inspection, these notions indeed reveal themselves as urban myths. It is true that globally, motorisation growth rates tend to be closely associated with economic growth. It is also true that transport infrastructures, including roads, are a fundamental requirement for economic development, providing access to jobs, markets, goods, services and natural resources. But especially in dense urban environments, cars have long become a handicap rather than a solution. That's why young professionals in Amsterdam or Copenhagen use bicycles more often than cars. That's why Wall Street stockbrokers take the subway or the express bus to work. And remember that Tony Blair works mostly at home at No.10 Downing Street, avoiding London's rush hour altogether. A quick glance at some of the most successful cities around the globe shows that most of them at some point radically changed their attitudes towards transportation and mobility. In the 21st century, smart cities

Figure 4
Attractive bus and light rail transit systems help cities fight the onslaught of motorization
Photo credit: Ian Britton

exchange their policies of accommodating ever growing numbers of cars for innovative strategies that curb car use, strengthen public transport, and encourage people to walk or bike.

In **Western Europe,** Dutch cities like Amsterdam, Utrecht or Groningen are most frequently cited as positive examples for successful transport and land-use planning. In 1992, the Dutch Bicycle Master Plan made cycling an integral part of the national traffic system. In urban areas, up to a third of all trips are by bicycle. Traffic calming and pedestrian zones are ubiquitous throughout the country. In addition, a centralised and highly integrated public transport system provides a competitive alternative to car use, particularly in urban areas. This is further complemented by a national physical planning policy advocating 'Compact Cities' and 'Location Policies' that reduce the need to travel. Few other countries have gone as far as the Netherlands in limiting car dependency, but the world is increasingly taking note of the Dutch transport model.

In **Central Eastern Europe,** by contrast, motorisation rates have skyrocketed in the last decade, with car ownership rates in Warsaw, Prague and Budapest now exceeding the European Union average. Yet people are paying a high price for their newly won automobility. The tram and trolley systems in the region used to be among the most affordable, most extensive and most user-friendly public transit options in the world. Now excessive car use is exacerbating the financial crises of the already struggling transit companies, most of whom are under-funded, mismanaged or both. It is a bitter irony that just as clever Western European and North American cities are rediscovering light rail as a major solution to urban transport problems (now wishing they had never abandoned their trams systems in the first place) Central European cities repeat their old mistakes: millions are spent on costly metro prestige projects while valuable dedicated surface tram tracks suffer neglect. Hundreds of miles of precious exclusive-way transit lanes were already abandoned and the space handed over to cars. With its clever Fast Tram idea – a concept that included a very cost-effective upgrading of existing tram track infrastructures – the Polish city of Krakow could have been a notable exception. Unfortunately, unfavourable political changes at the municipal level have recently put the innovative project in jeopardy.

Automobile dependency continues to be the most extreme in **North America** and **Australia**. Yet even Los Angeles, this epitome of a wasteful, low-density, sprawling, auto-dependent metropolis, recently completed several new light rail and metro lines. Marred by construction disasters, corruption scandals and planning mistakes, the actual systems put in place leave much to be desired, but their existence proves that even a culture as car-loving as Southern

Figure 5
'Share the Road': Bicycle and pedestrian infrastructure in Tamale, Ghana
Photo credit: ITDP

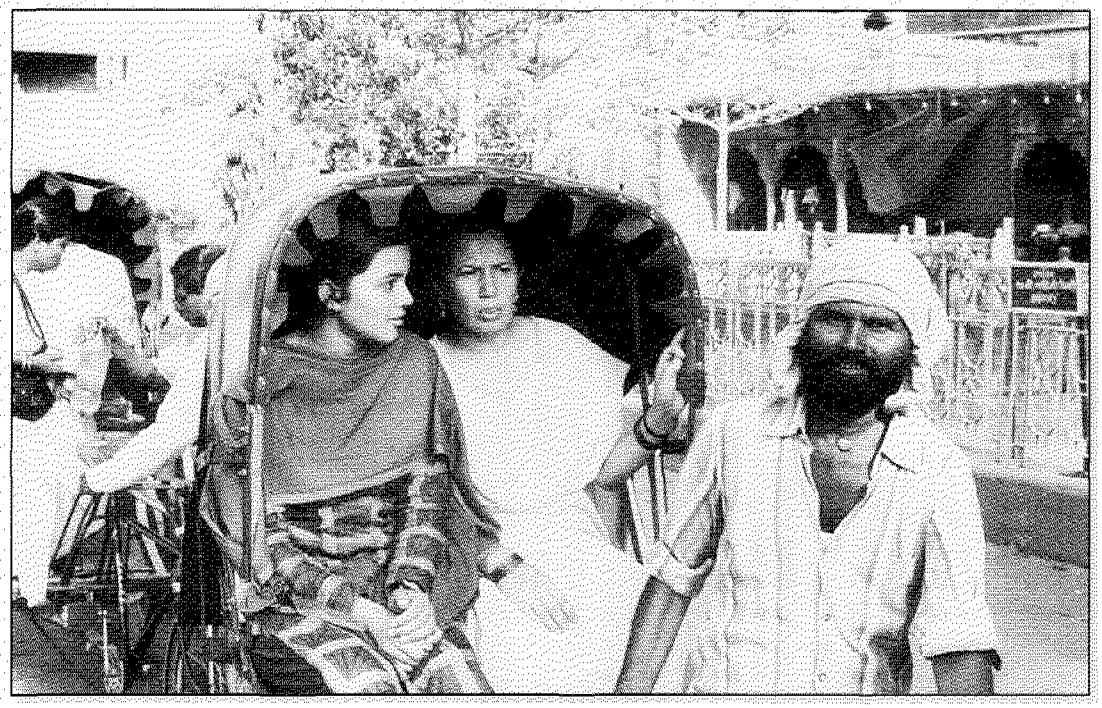

Figure 6
Women in Agra, India using cycle rickshaws
Photo credit: ITDP

California is finally coming to terms with the fact that you simply cannot build your way out of the traffic collapse.

It is now empirically proven that new road capacity attracts new traffic.[2] In practice, this means that new freeways are clogged the minute they are opened to the public. This is why even die-hard California motorists are willing to let go of their steering wheels in exchange for an early-morning and late afternoon lap-top session on the commuter train. This way, if they manage their time well, they can even leave the office an hour earlier than before. In addition to developing new mass transit systems, many US cities are now actively encouraging bicycle use.[3] So the freedom of NOT owning a car and instead making a positive statement for health and environment is increasingly becoming an option even in the US.

Bus transport is still the predominant mode of transport in **South and Central American** cities, although they, too, have experienced strong growth in individual motorisation. To take but one example, almost three quarters of the population in Bogotá, Colombia use buses, while less than one fifth use private cars. To ease congestion and air pollution, the Bogotá city government is presently pursuing several very innovative transport projects, including the implementation of a bicycle master plan and an adaptation of the famous Curitiba, Brazil, express bus scheme. Called the TransMilenio, the latter project, which requires an investment of $117 million in its first phase, will build over 40 kilometres of new high-capacity bus lanes on which a new fleet of 470 buses will be able to transport as many as 660 000 passengers per day.[4] A new bicycle masterplan is to further diversify the transport options of the Bogoteños. Other Latin American cities are considering similar schemes. Quito, Ecuador, already put its own electric trolley bus system into operation, complete with pre-boarding electronic ticket collection and automatic loading ramps that greatly reduced travel time. The initial investment for the initial 11 kilometers was a modest $57 million.[5] The Brazilian megacities of Sao Paulo and Rio de Janeiro, apart from developing their bus and metro

2. Of course, there are both supporters and dissenters of this view. For the particular case of California, one of the most important recent studies of 'induced' traffic is Mark Hanson's and Yuanlin Huang's 'Road Supply and Traffic in California Urban Areas,' published in *Transportation Research*, vol. 31A, No. 3, 1997, pp. 205-18. Probably the most authoritative study on the subject internationally is a 1994 UK government-sponsored study by the British Standing Advisory Committee on Trunk Road Assessment (SACTRA). The name of the study is 'Trunk Roads and the Generation of Traffic,' published in London by HMSO (Her Majesty's Stationery Office). SACTRA criticised that the economic benefits of road schemes were overestimated since they failed to take into account new costs derived from induced traffic. And according to SACTRA, new roads most often induced additional traffic where network were operating close to capacity, where people quickly respond to reduced travel times and where trips were suppressed by congestion. For an easily accessible online resource, see the report 'Generated Traffic; Implications for Transport Planning' on the Victoria Transport Policy Institute Website (www.vtpi.org). According to their director Todd Litman, the article 'summarizes a number of studies that show that under congested conditions, a major portion of additional road capacity is filled with additional vehicle traffic that would not otherwise occur, and that this can exacerbate other transportation problems, including downstream congestion, crashes, pollution and automobile dependency.'

3. Many US cities have made their bicycle masterplans and policies available on the web. For example, see www.city.toronto.on.ca, www.gvcc.bc.ca (for Victoria, BC), www.city.pittsburgh.pa.us, www.landofsky.org/bikeped/bpplan.pdf (for Ashville, NC), www.enteract.com/~cbf/index.htm (for the Chicago Bikeland Federation).

4. For more information on the TransMilenio try: Oscar Edmundo Diaz, Counsel in International Matters, City Hall, Bogotá, COLOMBIA, Tels: (571) 352-1611, Fax: (571) 352-1618, Home Page: http://www.alcaldiabogota.gov.co, E-mail: consnacion@interred.net.co, diazoe@latino.net.co.

5. For more information see Cesar Arias' and Lloyd Wright's article 'Quito takes the High Road' in Sustainable Transport magazine, No. 10, Fall 1999, published in New York by ITDP (www.ITDP.org) or try: Ing. Cesar Arias, Unidad de Plaificacion y Gestion de Transporte, Quito Metropolitano, PO Box 1717484, Quito, Ecuador, Fax593 2 432-643, email Fraarias@uio.satnet.net.

systems, have also recently developed bicycle infrastructures. Lima, Peru, has had a special Pilot Program for Non-Motorized Transport since the early 1990s. Given existing dangerous traffic conditions, widespread cycling only stands a chance if protective infrastructures are built. Once these are in place, ridership can grow quickly.

In **Asian** cities, the extremely high population densities ensure traffic standstills at much lower levels of motorisation than in other parts of the world. Bicycles and cycle rickshaws are still very prominent. Unfortunately many cities now increasingly ban them from key sections of the urban road network, thus creating considerable access problems for the lower-income citizens dependent on non-motorised modes. Stemming good common sense against this troubling common tide, the Southern Indian city of Pune decided to instead provide separated paths for pedestrians and bicyclists alongside major arterials and at dangerous crossings. Simple adaptations or additions to existing lanes created over 40 miles of cycle track that presented substantial time savings and safety improvements to all network users.[6] Meanwhile, efforts are currently underway in Delhi to modernize the traditional Indian cycle rickshaw. Targeted design improvements will make it more efficient to ride without substantially increasing its cost.[7]

It is important to remember that dependence on particular modes of transport often has a strong gender dimension as well. One third of all women in Dhakka, Bangladesh, are dependent on rickshaw taxis, for example. Their dependence is exacerbated by the cultural practice of purdah requiring the social segregation of men and women in public. This makes it highly unacceptable for women to use crowded public transport. Dhakka has done some experimentation with women-only bus services, but at present this is not a workable alternative to rickshaws for most women.

Similar to South Asia, motorisation in **Africa** has most prominently manifested itself in a two-wheeled form. Motorcycles are obviously much more affordable than cars, and also more flexible in crowded traffic. Nevertheless, the vast majority of Africans do not have access to any form of motorised transport, be it cars or motorcycles. Low-income people typically walk for many miles every day because they cannot even afford public transport fares. In this difficult context, access to a bicycle can truly transform people's lives, saving valuable time and transit costs. Unfortunately, bicycles are strongly stigmatised as 'poor man's vehicles' in much of Africa, especially in cities. This strong image and gender bias against this most energy efficient of all transport modes discourages many potential cyclists. Nevertheless recent success stories about NGO projects putting women on bikes in Mozambique, South Africa and Tunisia show that these biases can be overcome if approached in an appropriate, culturally conscious way.[8]

Although often favoured by high-level decision makers, technological fixes will not get us out of the global transport mess. A general moratorium on cars and road building is of course an equally unsatisfying solution, if only because the vast majority of the world's population does not have access to cars, and often not even to other motorised vehicles. Dimensions of access, poverty and sustainable development have always been intricately linked. Curitiba-style buses, Fast Trams, and bikeways are but a few ways to untie the Gordian knot of sustainable mobility. But it is certainly ironic that even in the hypermodern cities of the 21st century, simple pedal power typically remains among your fastest transport options. Incidentally, biking is also affordable, improves your health, keeps your air clean, and your community intact. So cycles are the best zero emission vehicles to take you towards global sustainability.

ABOUT THE AUTHOR

Deike Peters is the Director of Environmental Programs at the Institute for Transportation and Development Policy (ITDP), a non-profit advocacy and research agency promoting the implementation of sustainable transport policies and projects worldwide. Since 1996, she has served as co-coordinator of the CSD NGO Sustainable Transport Caucus, which monitors the implementation of the transport-relevant sections of Agenda 21 and the Habitat Agenda. She is also currently completing a Ph.D. in Urban Planning and Policy Development at Rutgers University.

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6. For more information on the Pune project, consult Tony Hathway's article in Sustainable Transport magazine, No. 4, Winter 1995 (see above footnote for publishing info).

7. For details on the Delhi project, see Walter Hook's article 'The Cycle Rickshaw can Save the Taj Mahal; the Taj Mahal can save the Cycle Rickshaw,' in Sustainable Transport magazine, No. 7, Winter 1997 (see above for publishing info) or contact ITDP.

8. For information on the South Africa project, contact Gustav Erlank at *Afribike* (www.Afribike.org - or go through the ITDP website); for Mozambique, contact Amelia Zambeze at the *Mozambican Association of Rural Women* (AMRU) – no contact info available; for Tunisia, contact Dr. Kamel Esseghari at *Women for Sustainable Development* (WFSD), BP 377 2000 Bardo, Tunesia, Fax/Tel +216 1 510 714, email: wfsd@francemel.com

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From Vision to Reality: The 'Three-Litre Car' of Volkswagen

Horst Minte & Michael Mesterharm, *Volkswagen, Germany*

Abstract

The market as well as press and environmental organisations have paid significant attention to the Lupo: In Germany sales figures for the 3L cars have exceeded Volkswagen's expectations. Almost every ninth car of the Lupo range is a 'three-litre-car'. Moreover the German Association for Transport and the Environment (VCD), an environmentally committed NGO, evaluated the performance of the Lupo 3L TDI. This organisation compares the environmental performance of all production models available on the German market every year, awarding points for the environmental and health impact of vehicle emissions. The Lupo 3L TDI is top of the current 2000 'Cars and the Environment' table, as it was in 1999.

Figure 1
VW Lupo 3L TDI: the first 'three-litre car' in serial production

Introduction

The visions of sustainable development and sustainable mobility have increasingly developed into an important global challenge for international auto-manufacturers. As a global player the Volkswagen Group accepts its responsibility to achieve this vision. The Volkswagen Group's chief executive officer, Dr Ferdinand Piëch, has summed up the situation as follows: 'As a company, we are responsible for the capital which shareholders have invested in us. As an automobile manufacturer we are responsible for protecting the environment on behalf of humankind. We must therefore strive for a world in which economic and social perspectives, but also ecological ones, apply.' This imposes the following commitments on Volkswagen: ensuring job security for up to 300 000 employees on four continents, competing successfully with popular products and achieving a good return on investment, developing vehicles which are so efficient that their manufacture, use and eventual disposal cause only a minimum of impact to the environment.

Volkswagen believes that sustainable mobility will require several contributions from the auto-industry. Although it is necessary to develop alternative drive systems that will help to conserve fossil fuel resources and emit no pollutants, it is obvious that the contributions of these drive systems will merely be a long or medium-term target. One of these systems with a high potential of contribution to environmental protection is the fuel cell on which probably all auto-manufacturers have research activities. However, the rising energy consumption worldwide demands a faster approach in order to limit or reduce the increasing emission of carbon dioxide.

The VW Lupo 3 L TDI, the world's first serial production-made car capable of consuming only three litres of fuel per hundred kilometres, stands for the Volkswagen Group's determination to make a direct contribution towards sustainable mobility. The launch of the 'three-litre car'[1] in summer 1999 has been a major step in fulfilling Volkswagen's voluntary commitment to reduce the volume of CO_2 emissions. It also contributes towards the German automobile industry's joint voluntary undertaking to reduce the average fuel consumption of new cars by 25 percent between 1990 and 2005. The 'three-litre car' has been regularly called for by politicians and other groups with an interest in the environment on the assumption that the launch of such a vehicle would be an essential element in environmental protection.

This car is also a symbol for the company's continuous development, since it has been created on the basis of the kind of innovation which will itself help to secure the group's long-term competition ability. This form of sustainable development in turn creates jobs and prosperity. Above all, the 'three-litre car' stands for the ability of market forces to inspire pro-environmental technological developments. The fact that these market forces have been strengthened by an additional positive influence from politics is surely a sign that there is scope for a more intensive dialogue between politics and the automobile industry.

Innovative Lupo Design

Volkswagen has developed the 'three-litre' Lupo with the aim of creating a passenger car that uses as little fuel as possible but still has a full equipment specification and also complies with the company's own high standards of safety. Numerous innovations have been introduced in the Lupo's engine, transmission, running-gear, body and aerodynamics areas. Some of the innovations can be

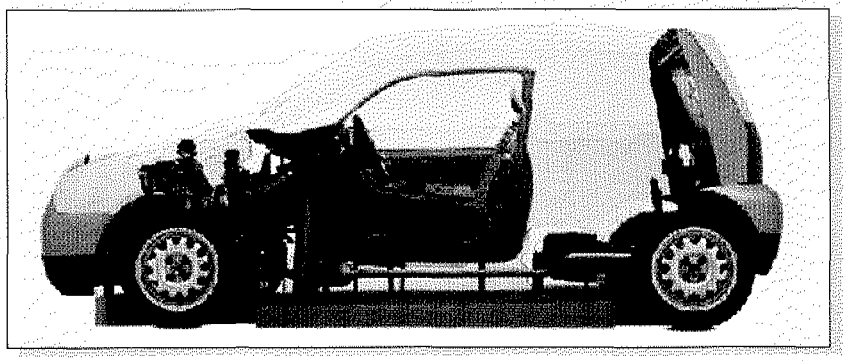

Figure 2
The 'three-litre car': High-tech for low emissions

seen on the surface, others are concealed under the skin.

The features include systematic weight-saving design and construction, an optimised aerodynamic drag coefficient of only c_D =0.29, tyres with reduced rolling resistance and an extremely economical power train. When the engine was developed, the main objective was to create an exceptionally economical unit but also one with adequate power for this class of vehicle, and in this way to ensure that fuel consumption in the MVEG cycle did not exceed 2.99 litres per 100 kilometres. The 'three-litre' Lupo is powered by a three-cylinder turbocharged diesel engine with charge-air intercooler, using the pump/ injector mixture formation principle. Its displacement is 1.2 litres. The advantages of the direct injection diesel in conjunction with pump/injector elements are derived from the high injection pressures that can be attained – more than 200 bar – and from the pilot injection principle. These combine to ensure low emissions and an overall reduction in fuel consumption.

The entire fuel injection process is controlled and monitored by the engine-management electronics. The engine has a start-stop circuit, in other words it shuts down automatically after the car has come to a halt, and restarts when the accelerator pedal is pressed. It enables the engine to run for longer periods in the most favourable fuel consumption and emission speed ranges. The 5-speed direct-shift gearbox is one of the principal components used in the 'three-litre' Lupo. Its simplicity compared with a conventional automatic transmission, the measures taken to reduce weight (for instance hollow-drilled gearbox shafts) and the improved efficiency obtained with freely selectable shift points all lead to a definite reduction in fuel consumption.

When using this gearbox the driver can, in any driving situation, choose between two shift modes: manual or automatic. In the manual-shift mode, touching the selector lever is sufficient to cause an up- or down-shift to take place, according to the familiar Tiptronic principle. An instrument-panel display tells the driver when the most suitable up-shift point is reached. The automatic-shift 'economy' mode relieves the driver of the burden of gear-changing. A steering column lever permits a choice between a performance-oriented and an economy-oriented driving style.

A car's fuel consumption not only depends on an engine and transmission rated for maximum economy, but also on the other resistance factors which impede the car's progress. These are largely to be found in the aerodynamics area, but rolling resistance also has a decisive role to play. It has been minimised in the 'three-litre' Lupo by the use of suitable tyres and wheel bearings.

The 'three-litre' Lupo emits only minimum quantities of pollutants: compared with a conventional 1.6-litre spark ignition engine, its emissions of hydrocarbons are 75% lower. The level of sulphur dioxide in the exhaust has been cut by 40% and the carbon monoxide level by 85%. The 'three-litre' Lupo is the first passenger car that easily outperforms the target of 90 grams per kilometre for carbon dioxide emissions.

A considerable contribution towards achieving the three-litre consumption goal is made by the light-weight body structure. When the 'three-litre' Lupo was under development, close attention was paid to achieving a considerable weight reduction in the engine, gearbox, body, running gear and equipment areas. For the Lupo TDI, these requirements were satisfied by designing a load-bearing steel body-shell, by adopting aluminium and magnesium for various add-on parts, by using aluminium for the complete engine block and gearbox casing and making various suspension components from the material.

This form of 'multi-material' design enables some 120 kilograms in weight to be saved in the chassis, suspension and body areas alone. With further weight-saving measures being applied to the engine and gearbox and to the equipment and trim, the result is a gross weight of at most 800 kilograms.

Although the weight of the 'three-litre' Lupo has been significantly reduced, it satisfies Volkswagen's stringent safety standards in full. Additional reinforcements and a composite side and cross-member structure transmit crash energy around the actual occupant zone. ABS and twin airbags add to the occupant's safety.

[1] This figure does not of course refer to its engine size but to the amount of fuel the car needs to cover 100 kilometres, according to the European method of measuring fuel consumption.

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Lufthansa's Contributions to Environmental Care 1991-2000: Balancing Environmental and Economic Requirements

Frank Walle, *Lufthansa Group, Frankfurt, Germany*

Abstract

Demonstrating environmental commitment is increasingly important for the aviation industry. Airlines are under mounting scrutiny by politicians and the public alike. Topics such as possible kerosene taxes, charges on emissions and noise, and night curfews at airports are discussed widely. In the wake of the Kyoto conference, air transport is demanded to cut its CO_2 emissions even further. These are but a few examples of the key role that environmental issues play in how an airline is accepted by the public.

Long before these issues found their way onto political agendas, however, environmental protection played an important role at Lufthansa. Environmental care has been part of Deutsche Lufthansa AG's corporate culture since 1978 and when we formally adopted our Environmental Guidelines in 1996, protecting nature became one of our central corporate goals. A key tenet of Lufthansa's environmental policy is to continuously improve processes that have an impact on the environment. This policy is redefined every year by setting annual goals.

Air transport and economy

Air transport – the foundation of the world economy
Air transport is one of the fastest-growing industries in the world economy. According to studies carried out by aircraft manufacturers Airbus and Boeing, worldwide transport performance is estimated to rise by about 5% per year over the decade ahead. Thanks to modern technology, fuel consumption will develop significantly more slowly. Scientists assume it will increase by about 3% per year.

These figures show clearly that progress in technology and efficiency cannot fully compensate for the effect of worldwide growth in air traffic on the environmental side of the equation. Aviation will have to tackle this challenge in the future. However, the results Lufthansa has achieved in this area so far are exemplary, and we intend to keep them that way in the future.

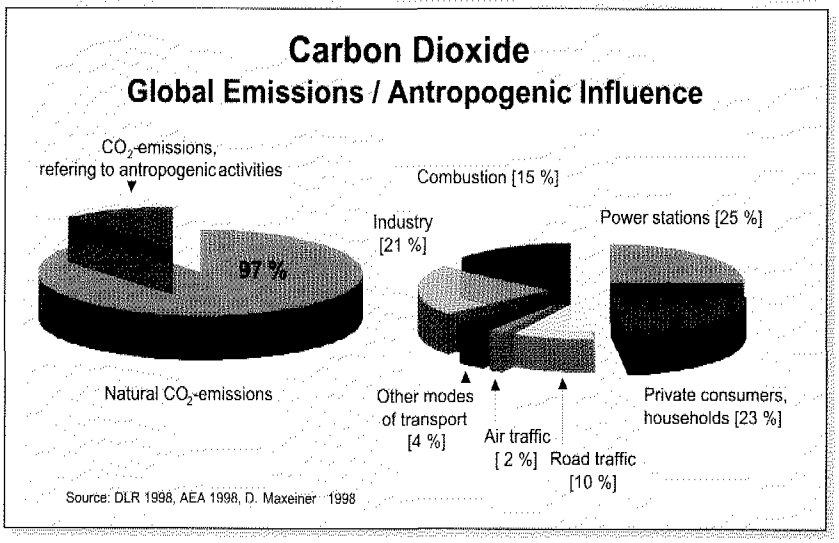


Figure 1
Global carbon-dioxide emissions: air traffic in comparison to other man-made emission sources

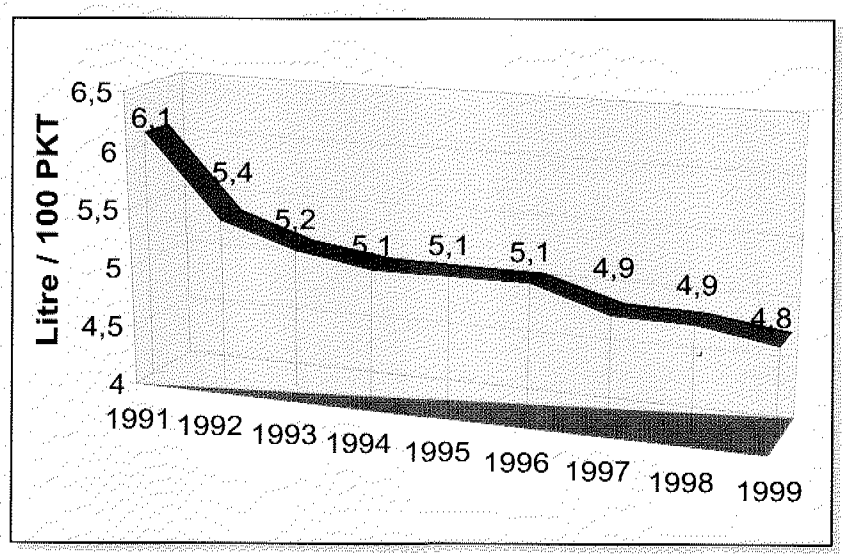
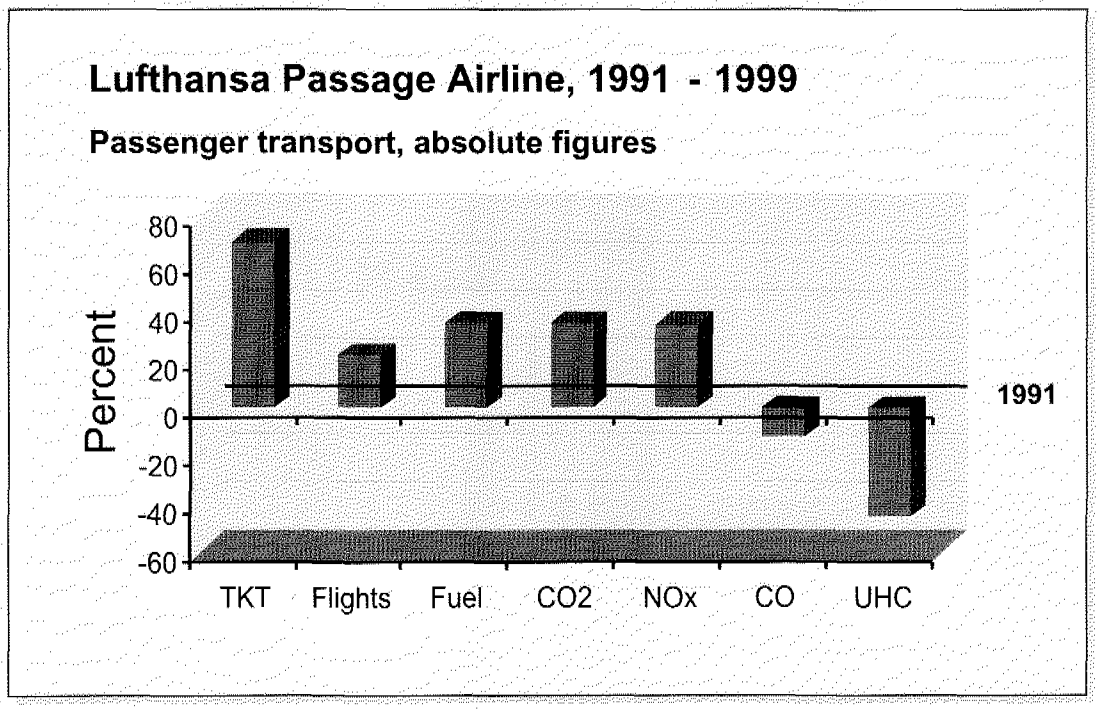


Figure 2
Development of Lufthansa's specific fuel consumption – Lufthansa Passenger Fleet, 1991–1999, real occupancy

From a politico-economic perspective
It is not only air transport's high growth rates that have a significant positive effect on national economies. In the Federal Republic of Germany, an estimated 700 000 jobs depend either directly or indirectly on civil aviation. The 396 airports represented by the international airport association ACI counted about 1.1 million employees. Arithmetically, this means 1 million passengers secure 1100 jobs. In 1999, Lufthansa employed about 66 200 people worldwide.

Figure 3
Decoupling between transport performance and environmental pollution - Lufthansa Passenger Airline, in percent (1991 = 100)



RESPONSIBLE GROWTH

Air transport's share in environmental pollution is small

Compared with other sources of emissions, the effect of air transport on the local and global climate is minor. According to the latest estimates by climate researchers, air transport has a share of about 3.5% to the world-wide greenhouse effect caused by human activity. Industry, power stations and road traffic all have double-digit percentage shares here.

At Frankfurt Airport, the maximum emissions values binding in Germany and Europe are actually undercut by a wide margin. The emissions profile shows pollution levels that are typical for the outskirts of large cities. The situation is no different around other German civil airports.

Continuous progress, lower consumption, fewer emissions

The continuous modernisation of the Lufthansa fleet offers more than just added comfort and reliability. It also results in lower operating costs and more environmentally friendly Lufthansa flights. New aircraft burn less fuel, emit fewer pollutants and fly more quietly than preceding models. The environmental compatibility of the Lufthansa fleet has increased continuously over the past years. At the end of 1999, the average age of the 333 aircraft operated by the Lufthansa Group was 7.0 years.

Energy consumption and emissions have been cut significantly over the past few years. The passenger fleets operated by Lufthansa needed only 4.8 litres on average to carry one person over a distance of 100 km. In comparison with 1991, this is a 20% reduction in fuel consumption. Lufthansa's goal is to cut specific fuel consumption by another 10% by 2008 and by a total of 35% by 2012.

One of the many steps in this direction is the systematic introduction of state-of-the-art aircraft into the fleet, such as the Boeing 757-300 at leisure airline Condor. This is the first 'three-litre aircraft' in the Lufthansa Group. Further fuel savings are expected from the Fairchild Dornier DO728 and the Airbus A340-600, which both start revenue service at Lufthansa in 2003 respectively.

Growth with less environmental impact

Lufthansa has achieved a clear decoupling of transport performance and environmental pollution. The Lufthansa Passenger Airline increased its transport performance (TKT) by 69.3% from 1991 to 1999, while the number of flights rose by only 22.2% and absolute fuel consumption increased by only 35.6%. This shows how much the impact on the environment can be eased by efficiently operating new, environmentally compatible aircraft.

This decoupling effect can also be demonstrated with regard to emissions. If Lufthansa had not invested in a modern fleet, its aircraft would have consumed an additional 1.6 billion litres of kerosene and emitted an extra 3.9 million tons of carbon dioxide over the past ten years.

Aircraft noise – as quiet as a car

Noise is the most immediately perceptible form of environmental impact from modern modes of transport. Manufacturers, airlines, airports and air traffic control operators have been working continuously for many years to reduce aircraft noise. In Germany, industry and science have joined forces in the research programme 'Quiet Traffic', which aims at finding specific solutions while taking into account all modes of transport.

Investing in state-of-the-art aircraft has already helped to decrease aircraft noise significantly. Within just a few years, a latest-technology wide-body aircraft will be no louder as it crosses an airport's perimeter fence at takeoff than a truck passing by on a city street. And modern short and medium-haul aircraft will not even exceed the noise level of a passenger car. Measurements show that the noise impact at airports – especially from Lufthansa aircraft – has fallen significantly. In Frankfurt, where Lufthansa has a 60% share of takeoffs and landings, noise levels have fallen by about 30% since 1980, while the number of aircraft movements has increased by more than half. There the number of cases where Lufthansa flights exceeded the reference noise levels is 0.2% on average. At other German civil airports this low value is undercut even further – in Dusseldorf, for example, not a single noise infraction involving a Lufthansa aircraft was registered in 1999.

Intermodality – cooperation between lufthansa and high speed trains

To improve the environmental performance of German domestic short-haul traffic, Lufthansa is now taking advantage of an intensified cooperation with the railways by applying each mode of transport's specific strengths. A declaration of intent, signed by Lufthansa and Deutsche Bahn in 1998, calls for a step-by-step shift of German domestic short-haul flights to the rails while keeping ground travelling times and passenger comfort levels comparable with air service. Tying the Frankfurt Airport into the high-speed network of Deutsche Bahn is the first step in this direction. In spring 2001, the ICE route Frankfurt Airport–Stuttgart Central Station is set to become the first pilot project to enter revenue services. Should customer acceptance show a success, the Frankfurt–Cologne/Bonn and Frankfurt–Dusseldorf routes will follow in 2002/2003.

In France, too, a cooperation between Lufthansa and the French rail service SNCF exists. To reach their Lufthansa flights at Paris Charles de Gaulle travellers from Angers, Bordeaux, Le Mans, Lille, Lyon, Nantes, Poitiers, Rennes and Tours can take the high speed train TGV, running under a LH-flightnumber.

FIT FOR THE FUTURE, THANKS TO ENVIRONMENTAL SYSTEMS

Lufthansa is a step ahead in the aviation industry when it comes to implementing environmental management systems. Such systems define, among other things, the tasks and responsibilities in the area of environmental care. In January 2000 Lufthansa CityLine became the first European airline to operate a validated, externally audited environmental management system in accordance with the European Union's ecological audit regulations (EMAS). Since August this year CityLine also possesses Certification according to the worldwide environmental Standard ISO 14.001.

After its first certification in 1996, Lufthansa Technik AG was again audited by these environmental quality standards in autumn 1999, and now holds certificates according to ISO 14001 and EMAS.

In 1999 Lufthansa introduced a Group-wide Environmental Handbook, whose reference framework of rules and regulations is currently being used by several Group companies to prepare their own certification. And also within Star Alliance, there are jointly-agreed environmental standards. In May 1999 it became the world's first industrial group to make a formal commitment to continuously improving its joint environmental care efforts.

GENERATING A MORE ACCURATE KNOWLEDGE ABOUT THE EFFECTS OF AIRCRAFT ON WORLD'S CLIMATE

A further commitment to environmental protection is demonstrated by the support Lufthansa gives to a number of renowned research institutions. The Group actively promotes scientific efforts to understand better the effects that increasing air traffic might have on the Earth's climate. To this end the airline provides aircraft, technical equipment and facilities. One example is the EU research project MOZAIC, which stands for 'Measurement of Ozone by Airbus-in-Service-Aircraft'. Lufthansa supports this research with two Airbus A340, each of which carries measuring instruments weighing 120 kg on every scheduled flight in the service of science. MOZAIC provides valuable insights into the mechanisms governing the exchange of air masses between the stratosphere and the troposphere at cruising altitude.

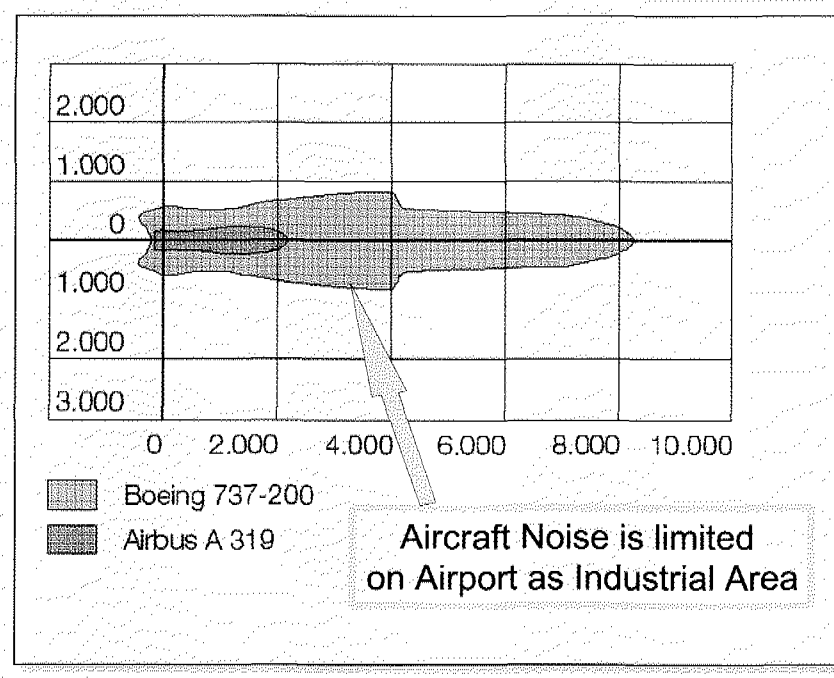


Figure 4
Comparison between the Airbus A319 and its predecessor, the Boeing 737-200- 8.5 dB(A) noise footprint at take-off (in meters)

ABOUT THE AUTHOR

Dr. Frank Walle gained a PhD. in Mechanical Engineering at Karlsruhe University, Germany. He initially joined Lufthansa in 1976. He was a consultant at the board in different functions (technical controlling and strategic projects) and was head of department for production and controlling for several years. Presently, Dr. Walle is the Environmental Representative for the entire Lufthansa Group. His department is based in Frankfurt.

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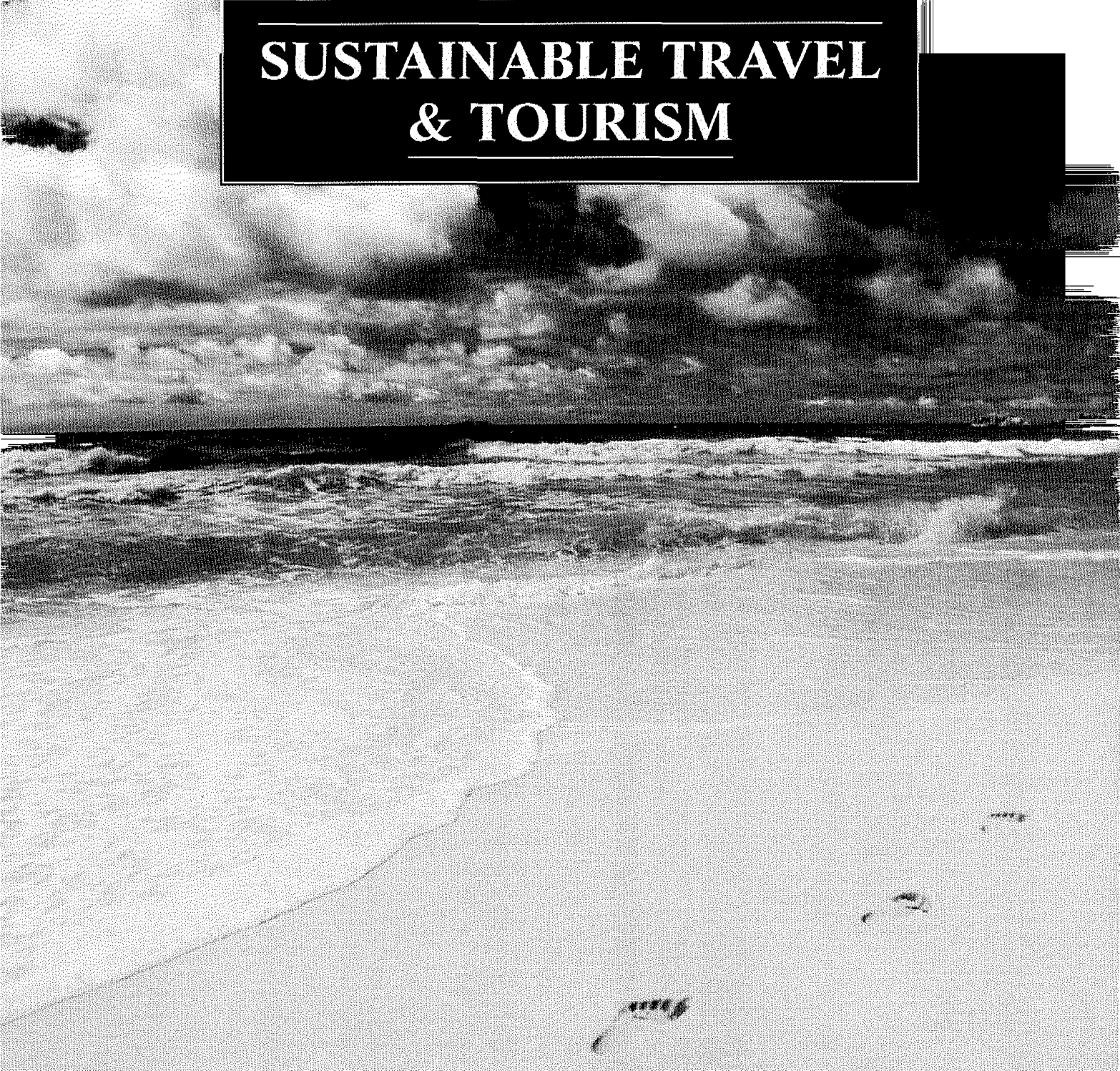

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SECTION 7

HEALTH AND SOCIAL ISSUES

Picture courtesy of Novartis Foundation for Sustainable Development

INTEGRATED COASTAL ZONE MANAGEMENT

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Health in the Context of Agenda 21 and Sustainable Development: Meeting the challenges of the 21st century

YASMIN VON SCHIRNDING, *World Health Organisation, Geneva, Switzerland*

ABSTRACT

The WHO believes that by working together with all sectors and stakeholders we can make a substantial difference to improving health and environment prospects for a majority in the future. WHO is committed to intensify its work in the follow-up to Rio, and to give support to countries to deal with pressing health, environment and development threats. Healthy people and healthy environments are values in themselves, but are also resources for development, perhaps our most precious resources.

INTRODUCTION

The first principle of the Rio Declaration states that 'Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature' (UN, 1993). This principle draws attention to the inextricable links between health, development and environment. Whilst Rio in 1992 was highly successful in linking environment with development, so too, can Rio+10 in 2002 be a similar success, in linking health with environment-and-development. Health is a key indicator of the success or otherwise of the development process. It is both a key determinant of, as well as a key outcome of, sustainable development.

HEALTH IN AN ENVIRONMENT AND DEVELOPMENT CONTEXT

Today the world faces a double burden of disease, related to poverty on one hand, and to conventional development on the other. Among the greatest current health impacts from an environment-and-development point of view, are those diseases associated with a lack of resources and basic services, in short, diseases associated with a lack of development. Age-old public health hazards such as inadequate and unsafe food and water, microbiological contamination of the environment, and overall poor sanitation and environmental hygiene are still prevalent worldwide. Conventional development has failed to address these most basic of basic human needs. Two examples illustrate this vividly.

One of the most basic human needs, and prerequisites for both health and sustainable development, is access to clean water. More than 2 million deaths occur annually from diarrhoeal disease, and several thousand million diarrhoeal episodes occur each year. Such diseases are some five to six times more common in developing countries than in developed countries, and are closely and directly related to poor sanitation and hygiene, and the resulting contamination of food and water. It is estimated that upwards of 1100 million people lack adequate and safe drinking water, and nearly three times this many people lack adequate sanitation (WHO, 1997).

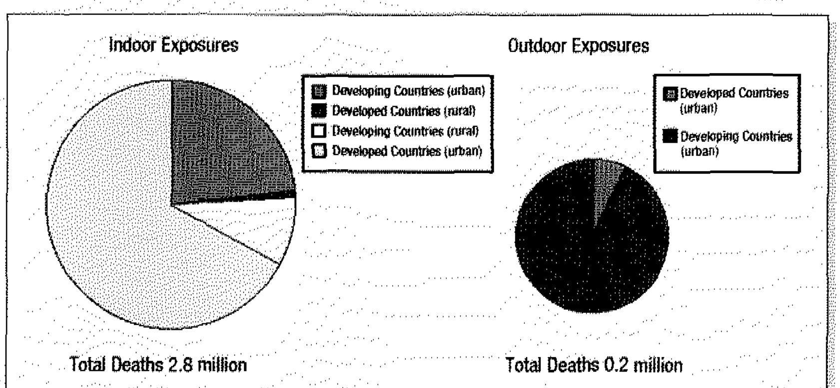
Acute respiratory infections are the top killers of young children today (WHO, 1999), surpassing even diarrhoea as a leading cause of death in under-fives. More than four million people die each year from what is an entirely preventable disease. Millions of people continue to rely on biomass burning (for example fuelwood) and use of dirty fuels such as coal and kerosene for cooking and heating of their homes. This is especially common in India, China and sub-Saharan Africa. We estimate at least 3 million deaths (probably substantially more) occur globally each year from air pollution, due mainly to the inhalation of the small particles emitted from domestic fuel burning (WHO, 1997).Today, around two billion people lack access to modern energy carriers.

The burden of disease

In addition to these two key diseases (diarrhoea and acute respiratory infections), accounting between them for several million preventable deaths each year, and with close links to the environment and poor living conditions, large numbers of people are affected by various other diseases which have their roots in the environment. For example several hundred million people are infected annually with malaria, and several thousand million people infected with intestinal parasites. Malaria alone results in 300 million cases worldwide each year, and over 1 million deaths, mainly in sub-Saharan Africa (WHO, 1999).

Add to this burden the lesser, but nonetheless significant, ill-health conditions associated with the wide variety of chemicals in the environment, in food, air and water, physical factors such as noise or radiation, injuries and deaths caused by motor vehicle accidents, and the considerable burdens of death and disease associated with unhealthy working conditions, both in the formal sector

Figure 1
Estimated global annual deaths from indoor and outdoor pollution exposure
(Source: WHO 1997)



and the informal sector. The health toll, however one measures it, is substantial, also in economic terms.

We estimate that around a quarter of the world's total loss of healthy years of life (due to a combination of death, disease and disability), may be associated with environmental factors (WHO, 1997). Estimating the exact contribution that the environment makes to exacerbating ill-health is complex, however, and will vary according to numerous factors, including individual lifestyle factors, sources of exposures, and individual susceptibility (genetic make-up, nutrition status). Nevertheless there is no doubt that environmental factors are a major contributor to sickness and death throughout the world, especially in the poorest regions.

CHALLENGES IN THE 21ST CENTURY

Widespread poverty

Clearly one of the major challenges, if not the most important one in the 21st century, is poverty reduction and eradication. At the end of the 20th century, poverty remains the number one killer, with the poor bearing a disproportionate share of the global burden of ill-health. Looking at trends in health over the past 50 years, however, it is evident that the world has seen considerable health gains. Childhood mortality and morbidity has been greatly reduced by better control and prevention of infectious diseases like measles or polio. Smallpox has been eradicated. People are living much longer. From the 1950s to the 1990s, average life expectancy has increased from 46 to 65 years, and the gap in life expectancy between rich and poor countries has narrowed considerably, from 25 years in 1955 to 13.3 years in 1995 (WHO, 1998).

And yet despite unprecedented wealth creation worldwide in the past two decades, it is obvious that not all regions of the world have shared equally in improvements to health. In the poorest regions, one in five children fail to reach their 5th birthday, mainly due to environmental diseases (World Resources Institute, 1998). Sub-Saharan Africa, the world's poorest region, still has average life expectancies far below the wealthiest countries. Even within rich countries, the poor suffer much worse health than do the better off.

The health of poor children is particularly affected by adverse environmental conditions: not only are they more exposed to health threats in the environment, but they are also more vulnerable to the ill-health effects stemming from problems such as a lack of clean air and water. In the US and parts of Europe, lead poisoning illustrates the unequal burden of risk borne among poor inner city children, who are not only more exposed to sources of lead in and around the home environment, but who also are more affected by the toxicity of lead. For example in the USA, around 16% of children aged 1 to 5 years from low-income families have raised blood lead levels (above 10 µg/dl), compared to only 4% among children from high-income families - a four-fold difference (World Resources Institute, 1998).

Often it is difficult to distinguish traditional risks from new and emerging risks associated with industrialisation. For example pesticides and faeces may contaminate the same water supplies. Air pollution may stem simultaneously from burning dirty household fuels and industrial use of fossil fuels. Developing countries have thus to deal simultaneously with problems related to poverty and a lack of basic services, as well as with the impact on health of large scale and rapid industrialisation, urbanisation and technological development.

Demographic and epidemiological changes

With populations living much longer, and a higher proportion of elderly people, it is probable that there will be an increase in non-communicable diseases, such as

TABLE 1: PROPORTION OF GLOBAL DALYs* ASSOCIATED WITH ENVIRONMENTAL EXPOSURES — 1990

	Global DALYs (thousands)	Environmental fraction (%)	Environmental DALYs (thousands)	% of all DALYs (all age groups)	% of all DALYs (age 0-14 yrs)
Acute respiratory infections	116.696	60	70.017	5.0	4.50
Diarrhoeal diseases	99.633	90	89.670	6.5	6.10
Vaccine-preventable infections	71.173	10	7.117	0.5	0.49
Tuberculosis	38.426	10	3.843	0.3	0.04
Malaria	31.706	90	28.535	2.1	1.80
Injuries - unintentional	152.188	30	45.656	3.3	1.60
Injuries - intentional	56.459	N.E.	N.E.		
Mental health	144.950	10	14.495	1.1	0.08
Cardiovascular diseases	133.236	10	13.324	1.0	0.12
Cancer	70.513	25	17.628	1.3	0.11
Chronic respiratory diseases	60.370	50	30.185	2.2	0.57
Total these diseases	975.350	33	320.470	23.0	15.4
Other diseases	403.888	N.E.	N.E.		
Total all diseases	1.379.238	(23)	(320.470)		

*DALY (Disability-adjusted life year): an index of the burden of disease which indicates the loss of a year of healthy life due to a combination of death, disease and disability (time lived with a disability, or time lost due to premature death). Thus the higher the DALYs the greater the burden of disease.
N.E., not estimated. Source, WHO, 1997

cancer, heart disease and smoking-related disorders, as well as disability and mental ill-health disorders, injuries and violence. Leading causes of death and disability in 2020 are likely to be heart disease, depression and road accidents. Tobacco is predicted to be the leading risk factor, killing more than 10 million people annually by 2030 (WHO, 1999). These non-communicable diseases are strongly associated with lifestyle and diet, and inappropriate consumption patterns.

Existing side by side there is likely to be a continuing high incidence of infectious diseases, like AIDS, malaria and TB which will remain important threats to global ill-health (WHO, 1999). The simultaneous emergence of unknown, new pathogens will probably also occur. The emergence of HIV/AIDS demonstrates how quickly new diseases can arrive on the landscape. The threat that this disease poses to the entire development process in many developing countries, particularly in Africa, is daunting. Other traditional diseases of childhood will continue to be of importance.

Rapid urbanisation

Many of these problems are likely to be exacerbated by rapid urbanisation trends. Despite its undisputed benefits, urban growth has exposed populations to serious health hazards, as well as to social ill-health conditions, and has outstripped the capacity of municipal and local governments to provide even basic health services (von Schirnding, 2000). The provision of low cost housing to address the needs of millions living in peri-urban squalor will be one of the key challenges. Badly managed and overcrowded housing makes it easier for infectious diseases to spread.

Urban growth also means greater dependence on transport systems, generating further pollution and risk of accidents. Transport-related environment and health problems themselves pose a challenge of global dimensions. By the year 2025 there could be over 1 billion vehicles on the world's roads (World Resources Institute, 1998). It is clear that the fate of cities will have a major influence on the fate of nations, and of the planet (Dowdeswell, 1996). Frequently, one is dealing with problems which are simultaneously global and local.

Globalisation

Globalisation (of trade, travel and the spread of values and ideas) is likely to have both positive and negative impacts on health. Increased trade in services and products harmful to health and the environment is cause for concern, and increased transnational trade in food and mass migration of peoples constitute additional global threats to health. Due to the rapid and transnational nature of transportation systems, an outbreak anywhere in the world must now be treated as a threat to virtually all countries. Already there have been reports of malaria near international airports in Europe followed by a single bite of an imported mosquito.

Apart from the globalisation of unhealthy lifestyles, we are likely to see an increase in global environmental threats to health and human survival. This includes changes in global climate, depletion of the ozone layer, changes in the biosphere and ecological processes (the indirect effects on health of changes to the ecosystem will become increasingly critical), and pollution. Agriculture and land-use practices have significant impacts on processes of desertification, which contribute to food insecurity, poverty and ill-health.

The first impacts may be far from the source of the problem. For example, for global warming, fossil fuel combustion processes in Europe and North America may eventually threaten the daily lives of the people of the low-lying island state of the Maldives. A rise in temperature could extend the range of malaria mosquitoes to higher altitudes. We are likely to see more of an emphasis in the future on indirect as opposed to direct health effects, on delayed as opposed to immediate health effects, and on global heath concerns.

TABLE 2: NEW TRENDS INFLUENCING HEALTH IN THE 21ST CENTURY

- Widespread absolute and relative poverty
- Demographic changes: aging and the growth of cities
- Epidemiological changes: continuing high incidence of infectious diseases, increasing incidence of non-communicable diseases, injuries and violence
- Global environmental threats to human survival
- New technologies: information and telemedicine services
- Advances in biotechnology
- Partnerships for health between private and public sectors and civil society
- Globalisation of trade, travel and the spread of values and ideas

Source: WHO 1998

THE NEED FOR EFFECTIVE INTERSECTORAL ACTION

If we take into account the very large share of burden of disease due to conditions associated with the processes of globalisation, environmental change, the population and demographic transition, urbanisation and industrialisation, and persistent poverty, it becomes apparent that protecting human health may be one of the most compelling reasons for pursuing environmental improvements, especially in conditions of poverty.

We need a shared health, environment and development agenda to address both the direct threats to health associated with poor living conditions, and the indirect threats to health associated with global processes of change and development itself. This results in a win-win situation. The health sector gains because disease prevention can move upstream and take advantage of the intersectoral approach to development and environmental improvements. The environment sector gains because environmental issues can become grounded in issues of local and direct concern to people.

Role of WHO

The WHO has for a number of years been actively working to place health concerns higher on the sustainable development agenda, encouraging an intersectoral approach to policy development and implementation. Since UNCED extensive efforts have been made to integrate health into policy and decision-making for sustainable development. In this respect Agenda 21 is of key significance to the work of WHO. As task manager for Chapter 6 of Agenda 21, the organisation is responsible for addressing the health objectives of this chapter, which include aspects such as meeting primary health care needs, control of communicable diseases, protecting vulnerable groups, meeting the urban health challenge, and reducing health risks from environmental pollution and hazards.

Most regions have been actively involved with the development of national and local health and sustainable development planning initiatives, including environment and health action plans (NEHAPs), as well as other mechanisms at the local level such as the WHO Healthy Cities project. These have become a real tool for intersectoral action in support of health and the environment (von Schirnding, 1997). They provide mechanisms for ensuring integrated approaches to health and sustainable development, and involve a wide range of sectors, government departments, NGOs and civil society.

The WHO has also been actively involved with the development of health indicators in relation to sustainable development planning (von Schirnding, in press), which provide tools for addressing the environmental, social and economic dimensions of sustainable development in an integrated way. The WHO is strengthening its work in the

development of policy instruments, including information on health impact assessment associated with sectors such as agriculture, energy, housing and urban development. Intensified efforts are also being made to help countries better address the health impacts of globalisation and trade.

Poverty alleviation, one of the key underlying themes of Agenda 21 for the coming years, forms an important focus of WHO work in sustainable development. By combining health and anti-poverty programs and strengthening efforts to support national strategies related to health and poverty reduction, a mechanism is provided for ensuring a stronger focus on the links between poverty, health and development. An example of a specific poverty alleviation and health promotion measure is the development of interventions to improve access of the poor to cleaner and safer household fuels.

In line with the WHO's commitment to sustainable development, a cluster has been created to deal with Sustainable Development and Healthy Environments, which includes a Department of Health in Sustainable Development, as well as a Department of Protection of the Human Environment. A specially designated focal point on Agenda 21 has also been appointed to coordinate organisation-wide on sustainable development and Agenda 21. In this regard Agenda 21 provides an excellent framework and entry point for addressing issues of health and sustainable development.

Future directions

The WHO was actively involved in the Rio +5 process, a highlight of which was the publication of the report 'Health and Environment in Sustainable Development: 5 Years Since the Earth Summit' (WHO, 1997). The WHO will continue to provide leadership in health to the CSD, and the Rio+10 process, by helping to ensure that health, and especially the health of the poor, is centre-staged. Particular attention will be paid to issues that intersect the health-environment-development divide, and which impact disproportionally on poor and marginalised groups, including children.

The earlier and more intensively that children are exposed to diverse environment and development threats, the more vulnerable they are as adults to a range of physical and mental health problems. By giving greater emphasis to early preventive and promotive factors we can reduce the cumulative burden of disease of populations over the lifespan, and contribute to healthier environments.

With ageing and changing lifestyles we can expect a significant increase in the number of people suffering from non-communicable diseases and injuries. These need to be tackled side by side with the communicable diseases, which often co-exist in the same households and families.

Soon ten years will have passed since Rio. Much success has been achieved in placing health more central to the development agenda at the global, national and local levels. Progress has been made in integrating health into the work of other sectors, agencies and institutions, and in incorporating health issues into sustainable development policy and planning efforts. But we need to have more concerted and decisive action in putting in place policies, strategies and practices that will tangibly and simultaneously contribute to healthier populations in healthier environments, and break the vicious cycle of poverty, environmental degradation and ill-health.

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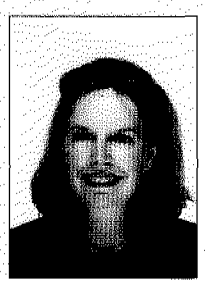

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Prior to coming to WHO she was Director of Environmental Health for Johannesburg, and Line Function Convener for Environmental Management in the Greater Johannesburg Transitional Metropolitan Council, responsible for facilitating the development of new policy and planning frameworks during the political transition process in South Africa. She has also held senior research positions at the Medical Research Council in South Africa, where she was Chief Medical Researcher and Specialist Scientist in the Research Institute for Environmental Diseases. She was also a researcher and lecturer at the University of Cape Town. She has a particular interest in bridging the gaps between health, environment and development policies, strategies and practices.

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Consigning a Dreaded Disease to History: The Final Push to Eliminate Leprosy

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Abstract

Eliminating leprosy has greater implications than simply resolving a public health problem. Leprosy is closely linked with poverty and typically affects the poorest of the poor. Early detection and treatment with multidrug therapy not only stops the transmission of leprosy, it also prevents disabilities, and thereby the downwards spiral towards social exclusion and destitution. While eliminating leprosy is not an insurmountable challenge, important hurdles remain which are being addressed in this final push to consign this dreaded disease to history.

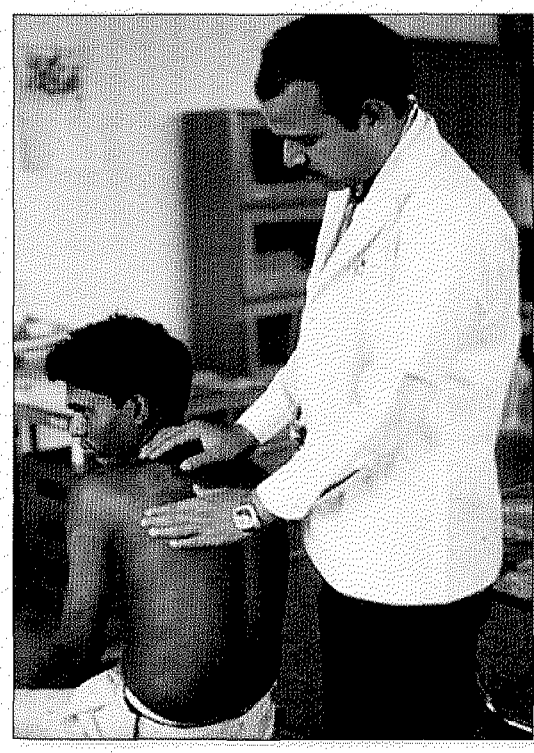

Figure 1
Leprosy usually starts with a pale or reddish insensitive patch

Leprosy affects about 1 million people in Asia, Africa, Latin America and the Pacific. The chronic symptoms often afflict individuals in their most productive stage of life and impose a significant economic and social burden on their families and society at large.

The word leprosy often conjures up images of disfigurements and deformities. That is not surprising since it is a leading cause of permanent disability in the world. WHO estimates that 2-3 million individuals are permanently disabled by leprosy. The consequences for the individuals and their families can be disastrous, as they become dependent for care and financial support on others, leading to insecurity, shame and isolation. Moreover the deformities reinforce the fear of leprosy and its negative image.

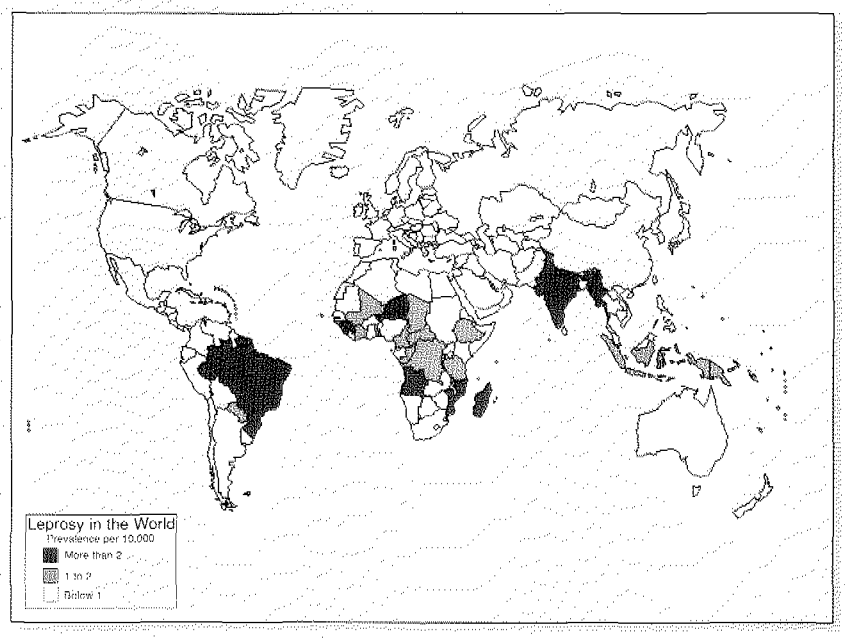

Figure 2
Map of leprosy prevalence

Leprosy can be cured

But the real face of leprosy has changed dramatically with the advent of multidrug therapy (MDT) in the early 1980s. MDT cures leprosy, interrupts its transmission and through early cure prevents disabilities. This means that patients can lead completely normal lives during their treatment.

The effectiveness of MDT in curing leprosy, its impact on transmission, ease of use under field conditions and good tolerability made it possible to envisage the elimination of leprosy. In fact, leprosy is one of the few infectious diseases that meet the demanding criteria for elimination: practical and simple diagnostic tools - it can be diagnosed on clinical signs alone; the availability

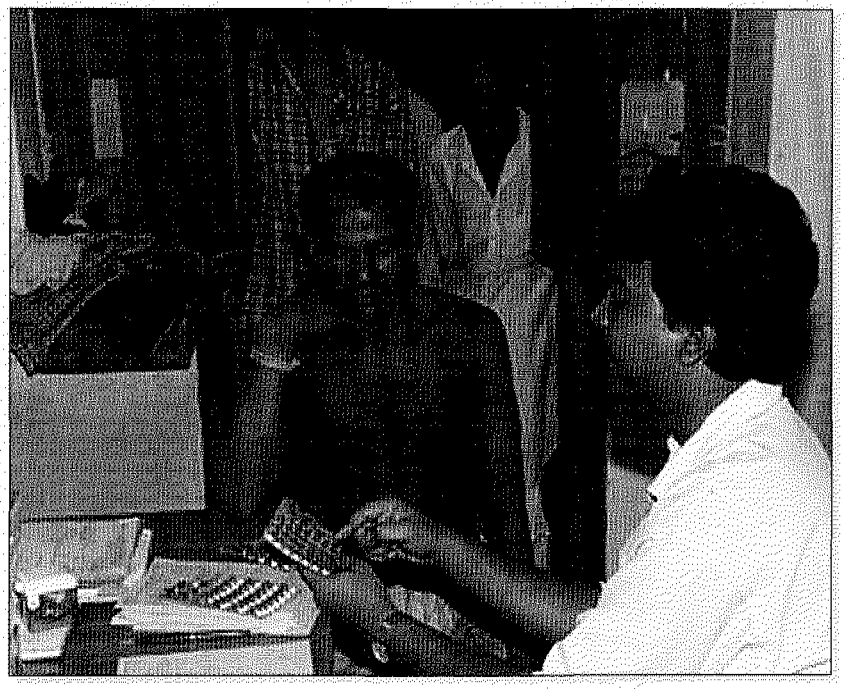

Figure 3
To eliminate leprosy we need to detect all patients and cure them with multidrug therapy

of an effective intervention to interrupt its transmission – MDT; and a single significant reservoir of infection – humans.

What is leprosy?

- Leprosy is an infectious disease caused by a bacillus, *Mycobacterium leprae*.
- It progresses slowly with an average incubation period of three years.
- It mainly affects the skin and peripheral nerves.
- The disease can be diagnosed based on clinical signs alone.
- Leprosy can be cured with multiple drug therapy (MDT) in 6 months or 1 year depending on the type of disease.
- After the first dose of MDT, patients are no longer infectious.
- If detected early and treated with MDT, leprosy will not lead to deformities.
- The best way to prevent the spread of leprosy is to treat all patients with multidrug therapy.

The term "elimination" means bringing down the disease burden to a very low level, which will lead to a reduction in the source of infection so that the disease will disappear naturally as it did in many parts of the world. This level has been defined by WHO as a prevalence rate of less than 1 case per 10,000 inhabitants. Elimination is a less ambitious target than eradication, which implies no new cases. This unfortunately is not feasible for leprosy for a variety of reasons including the long incubation of the disease, the lack of a vaccine, etc.

SUBSTANTIAL PROGRESS...

The 1991 World Health Assembly resolution to eliminate leprosy as a public health problem by 2000 gave substantial impetus to global leprosy control efforts. The results are impressive. Over the past 15 years more than 10 million leprosy patients have been cured with MDT, the prevalence rate has dropped by 85% to reach 1.4 per 10,000 inhabitants and leprosy has been eliminated from 98 countries. MDT has also prevented about 2 million people from developing deformities through early cure. The progress made is far more than simply statistical – the alleviation of human pain and suffering is immeasurable.

... BUT STILL A LONG WAY TO GO

However the established prevalence rate of leprosy in the 10 most endemic countries is still over four times the target level. These countries represent approximately 90% of the global leprosy burden and 24 countries carry the rest of the burden.

The reasons for missing the elimination deadline of the year 2000 are varied and include the high prevalence itself, the intensity of disease transmission and limited geographical coverage with MDT services. In a few countries wrought by civil strife, elimination efforts are seriously undermined by a damaged health infrastructure.

Most importantly, there is a substantial hidden caseload, as suggested by the high numbers of new cases emerging with the widening coverage of elimination campaigns. The reasons for these hidden cases are complex and include inadequate access to diagnosis and treatment, poor awareness of the availability of free and effective treatment, and delay in seeking treatment for fear of social consequences. The consequences of this delay can be devastating to individuals and their families, as leprosy can lead to progressive and irreversible deformities, often resulting in social exclusion. In addition, it also maintains a pool of infection in communities.

A GLOBAL ALLIANCE TO ELIMINATE LEPROSY

In November 1999, at the initiative of WHO, a Global Alliance for leprosy elimination was created which aims to detect and cure all the remaining leprosy cases in the world - estimated at 2.5-2.8 million - and thereby eliminate the disease from every country by the year 2005. The Global Alliance brings together all the key partners each with different yet complementary roles - Governments of leprosy endemic countries (implementation), World Health Organisation (technical and strategic leadership), the Nippon Foundation (US$24 million for implementation), Novartis (free MDT for all patients ca. US$30 million), and the International Federation of Anti-Leprosy Associations (country level assistance). Other organisations such the World Bank and DANIDA will support elimination efforts in India. The Alliance works with all organisations interested in leprosy and work together to implement a common strategy.

THE STRATEGY

The elimination strategy hinges on detecting all cases and curing them with MDT. This is a highly focused and effective way to deal with the problem. Efforts in this final phase will focus on generating and meeting "demand" for treatment through better awareness of the early signs of the disease and improving access to leprosy diagnosis and treatment.

This final push requires the synchronised implementation of the following key activities:

Capacity building to enable all health facilities, particularly in endemic areas, to diagnose and treat leprosy

Leprosy services have traditionally been provided

through specialised staff who deal exclusively with leprosy. Although this has provided high quality care, the services have limited reach and have also created the perception that leprosy is a complicated disease and only "their" concern. Leprosy diagnosis and treatment can be easily made available at primary health care facilities.

Paramedic staff can diagnose leprosy based on clinical signs alone, and start treatment. The treatment itself, available in calendar blister packs, is easy to dispense and highly effective. Integrating leprosy services in the general health services will not only dramatically improves patient access to treatment but will also enhance the credibility of the local health services. It will also ensure that health services will be in a position to treat the new cases who will appear even after the disease has been "eliminated".

Improved logistics to ensure adequate stocks of MDT at all health facilities

Local stock-outs of MDT at the health centre level is a chronic problem in most countries due to inadequate planning, poor information systems, limited distribution networks, shortage of vehicles, etc. This undermines the credibility of the health services and seriously impairs the prospects of cure. Simple logistics and delivery systems will be put into place which exploit synergies with other diseases or even delivery networks for consumer products.

Dispelling the fear of leprosy and improving awareness of the early signs of the disease in order to motivate people to seek timely treatment

Often people only recognise leprosy at a late stage of the disease – once irreversible nerve damage has occurred. At times, people also ignore the signs of leprosy for fear of the social repercussions that may follow. Many communities are also unaware that free and effective treatment is available for leprosy and accept the disease rather fatalistically – as a punishment from God or witchcraft. This has to be changed. Efforts are being made to change the negative image of leprosy and create a supportive environment in which people do delay seeking treatment – this will not only ensure their cure without deformities but also minimise the risk for other members in the community of contracting the disease. Radio, TV, posters, bill boards, bus shelters and other media have already been used successfully to generate demand for treatment in many countries.

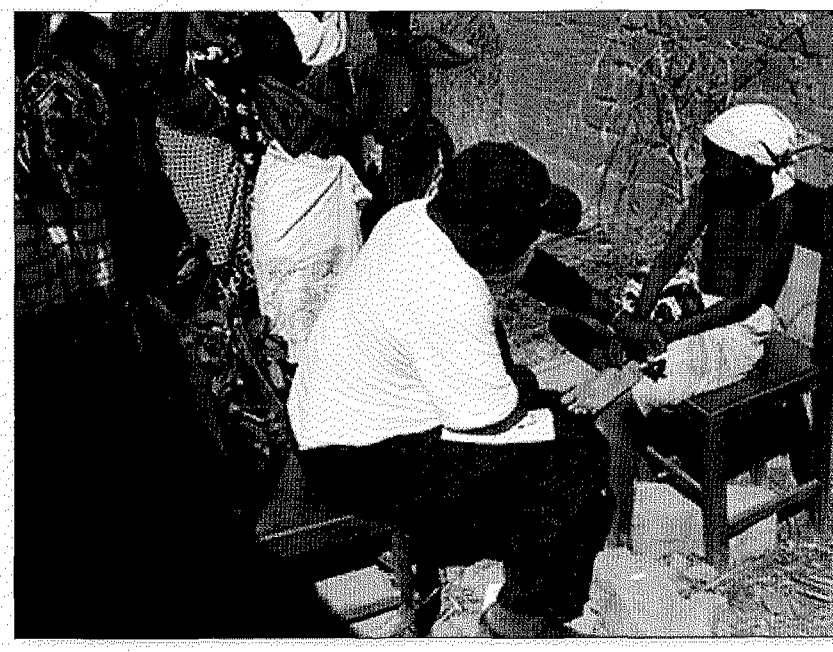

Figure 4
The best way to prevent disabilities is early diagnosis and prompt treatment with MDT

Ensuring that all patients receive a full course of treatment and are cured

Patients often have to interrupt their treatment because of a shortage of drugs at the health centre, because of poor access to health services, or simply because they live in very remote areas. Innovative approaches, such as "Accompanied MDT", help address this problem. Patients are given a choice. They can take the entire course of treatment with them and someone from their family helps them comply with their treatment, or they can return

Figure 5
Over 10 million people have been cured of leprosy

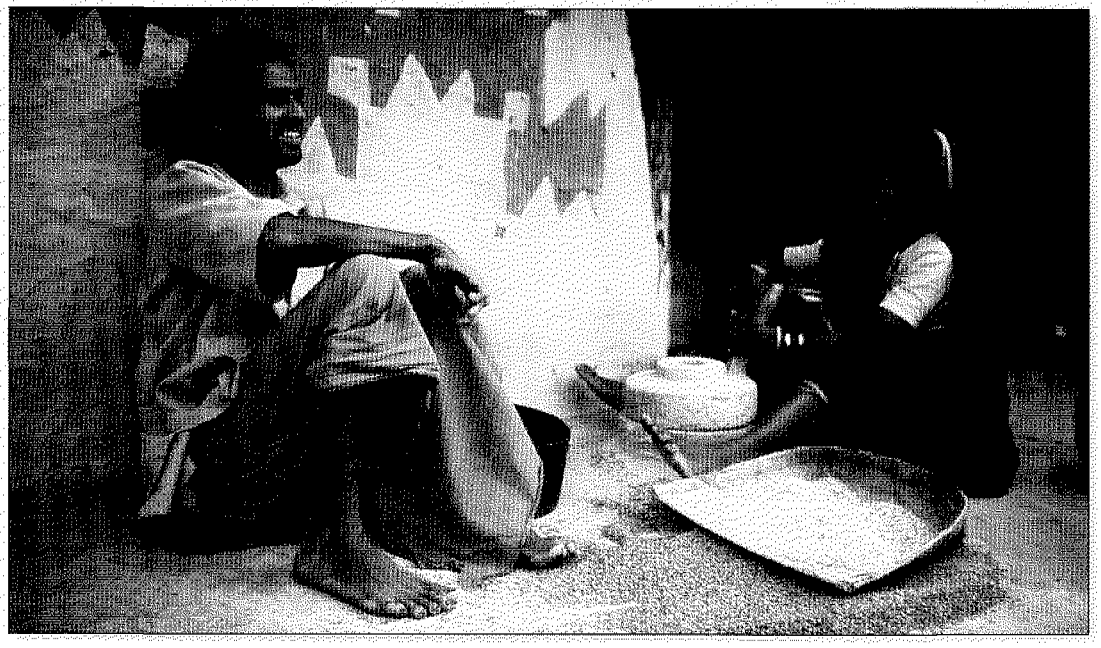

Figure 6
Leprosy patients can lead completely normal lives

to the health centre at regular intervals to collect their medication. Understandable, illustrated patient information is being developed to help patients and their families understand the disease, their treatment, how to take their drugs as well as possible complications.

CLOSELY MONITORING PROGRESS TOWARDS ELIMINATION

This can be done at all levels (national, regional, district and municipality) in order to take corrective action and find pragmatic solutions to deal with any problems. For example, expanding the coverage of leprosy services will inevitably lead to an increase in new cases and has immediate implications for drug requirements which must be catered for. The parameters to monitor progress have been simplified so that leprosy surveillance can be integrated into the regular disease surveillance.

PRIORITIES FOR INTERVENTION

In order to focus efforts on countries with the greatest leprosy burden, leprosy endemic countries have been classified into three groups based on their prevalence rates: Intensification, Acceleration and Consolidation. Countries in the "intensification" category – Angola, Brazil, Central African Republic, Democractic Republic of Congo, Guinea, India, Indonesia, Madagascar, Mozambique, Myanmar, Nepal and Niger – need the highest priority as they account for 90% of the global leprosy problem. Countries in the "acceleration" category have eliminated the disease at the national level, but still have high endemic areas within their borders, and need to intensify leprosy elimination efforts in these areas. Those in the "consolidation" category need to take active measures to ensure the continued availability of leprosy services so that the inevitable trickle of new cases will be treated.

IMPLEMENTATION UNDERWAY

Leprosy elimination is no longer a technical problem. The strategy is in place, as are most of the resources. In the priority countries, national task forces, comprising all key players, have been established who are spearheading the implementation of the strategy in the priority countries. Generic "kits" for capacity building, community awareness, MDT logistics and monitoring are under development which will be adapted to local requirements.

The determined and large-scale implementation of the intensified strategy will have positive repercussions beyond the elimination of leprosy. It will enhance the credibility and confidence of local health services and will put into place systems that can be used for other diseases. Leprosy elimination will also provide new insights into changing the perception of stigmatised diseases and will release resources to tackle other diseases. And above all, it will consign a dreaded disease to history.

ACKNOWLEDGEMENTS

Photo credits: Danish International Development Agency (DANIDA), World Health Organisation, and Novartis Foundation for Sustainable Development.

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HIV/AIDS and Treatment Access in Africa[1]

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Abstract

Africa's southern and eastern region, with less than 5% of the world's population, is home to more than 50% of those living with the AIDS-causing human immunodeficiency virus (HIV).

Thanks to new drug therapies, many people living with HIV/AIDS in most developed countries are now able to live relatively healthy lives. In developing countries and countries in transition, however, these and many other therapies used to treat HIV infection and related illnesses are unavailable for a simple reason: they are not affordable.

The paper addresses some of the issues involved in treatment access for people with HIV/AIDS in Africa, including current health care arrangements and financing of health care in developing countries; international covenants regarding rights to health care; the role of the World Trade Organisation, patented drugs and compulsory licensing in improving treatment access for people living with HIV/AIDS in Africa; and international partnerships for the future.

THE BURDEN OF HIV/AIDS

UNAIDS estimates that as of the end of 1999, more than 22.5 million people in the region carried HIV. Of the 11 people infected every minute with HIV worldwide, 10 of them live in sub-Saharan Africa. Two per cent of all babies born there are infected with HIV.

Five countries bundled together in southern Africa now form the global epicentre of the epidemic. South Africa counts 1600 new infections a day, the highest rate in the world, while in Namibia, Botswana, Zimbabwe, and Swaziland, one in four adults carries HIV. It is estimated that 90% of those infected do not know it, and therefore aren't aware that they might transmit the virus to their partners.

Southern and eastern Africa is where 60% of all AIDS deaths have happened so far. And it is where a whole generation of children are now losing their parents to AIDS. The global epidemic is now estimated to have left 11 million orphans – and 90% are African children.

Many businesses are now over-hiring to keep pace with AIDS deaths in the labour force. And this pressure is no less within African health systems.

HEALTH CARE ARRANGEMENTS

Due to many factors, in many developing countries, generally speaking, health facilities are often poorly equipped, drugs are not always available and in particular, STD/HIV prevention and care is poor. A recent WHO paper commented on the use of resources within poor countries: 'National health systems tend to spend money on poor quality and low-impact interventions.'[2] And of course, in some developing countries, the increased mortality of health sector staff due to HIV has started to affect the delivery of health services directly.

Financing of health care may be predominantly government funded, predominantly privately funded or a mixture. Governments also determine the priorities for available funds: in Zambia, for instance, only 0.8% of GNP (Gross National Product) is spent on health care, compared with about 7–10% in most industrialised countries.

It should be noted that financial resources for health are overwhelmingly provided within countries. This situation does not change even in those countries which are the recipients of significant international development assistance from sources such as development banks, bilateral development agencies, international non-governmental organisations, foundations and UN agencies. For example, in 1994 health spending in low and middle income countries totalled about US$250 billion, of which only US$2 or 3 billion was from development assistance.

Substantial reforms in the health systems of many countries in the past few decades have led in many cases to substantial privatisation or significant increases in co-payments by patients. Dr Gro Harlem Brundtland, Director-General of the World Health Organization, states in her introduction to the World Health Report for 1999 that 'Active government involvement in providing universal health care has contributed to the great gains of recent years – but many governments have overextended themselves. Efforts to provide all services to all

1. Paper includes material drawn from a recent policy paper on Migrants' Rights to Health Care prepared by the author for UNAIDS and the International Organisation on Migration.

2. WHO: 'The Global Health Priority: Reducing the burden on the poor', *World Health Opportunity: Developing Health, Reducing Poverty*, Meeting Report, May 1999, p36.

people have led to arbitrary rationing, inequities, non-responsiveness and inadequate finance for essential services.' She notes that governments cannot 'provide and finance everything for everybody' but also rejects the approach of rationing health services to those with the ability to pay: 'Not only do market-oriented approaches lead to intolerable inequity with respect to a fundamental human right, but growing bodies of theory and evidence indicate markets in health to be inefficient as well. But the very countries that have relied heavily on market mechanisms to achieve the high incomes they enjoy today are the same countries that rely most heavily on governments to finance health systems.' [3] She calls for changes in all countries to ensure participatory, fair and efficient regulation of the health sector.

Most industrialised countries provide universal or widespread health insurance for all nationals and legal permanent residents: thus, the burden of health care is rarely substantial for any individual, and in particular drug costs are relatively cheap – in marked contrast to the situation in most developing countries.[4]

Even between neighbouring developing countries, there may be disparate health care provision: Burkina Faso, Ghana and Togo have large numbers of cross-border workers: migrant patients mainly attend clinics in Ghana (sometimes crossing over specifically for this purpose), because health services cost the least among the three countries.

In many African countries, AIDS patients occupy more than half the hospital beds. The cost of HIV/AIDS prevention and care, 2.5% of gross domestic product in some countries today, could rise to 6% by 2010. Many are angry that effective drug treatments for HIV and AIDS exist, but are too expensive for poor countries to afford.

'Those countries that have come up with solutions to prolong life should be willing to share them,' says Linah Mohohlo, governor of Botswana's central bank, 'whether by giving access to the drugs, or helping to meet the costs.'

RIGHTS TO HEALTH CARE

The International Covenant on Economic, Social and Cultural Rights entered into force in 1976. A majority of the world's countries are a party to this Convention, thereby opening the door to international monitoring of their human rights practices. Among other items, the International Covenant on Economic, Social and Cultural Rights explicitly recognises the right of everyone to the enjoyment of the highest attainable standard of physical and mental health. In addition, Article 2 (1) provides that each State Party to the Covenant undertake to take steps, individually and through international assistance and co-operation, to achieve progressively the rights in the Covenant.

A forthcoming statement by the UN Committee on Economic, Social and Cultural Rights is expected to state their interpretation that health is both a fundamental human right in itself and an indispensable precondition for the exercise of other human rights.

However, as noted by Barlinguer [5], 'the notion of health as a cornerstone of economic growth, as a multiplier of human resources, and most importantly as a primary objective of such growth, has been replaced far and wide by an opposing notion. Public health services and health care for all are now perceived as an obstacle, often as the hardest obstacle, threatening public finance and the wealth of nations; reduction in health expenditure (not rationalisation, which is the imperative everywhere) has become one of the top priorities for all governments.

The model of primary health care as fundamental for the prevention and treatment of diseases has been almost abandoned. The trend is now towards dismantling the whole machinery of public health. Even in countries with minimal resources, priority is given to costly technologies.'

Some of the past change in the understanding of the importance to economic growth of health has been perceived to arise out of the policies and approach of the World Bank and the International Monetary Fund. The World Bank is now committed to highlighting that health sector reform is a means rather than an end in itself, and to ensure that there is a focus again on the determinants of health (education, poverty, environment, gender) and on tangible health outcomes.

Ngwena recently noted [6] that, in Africa, 'the state health care sectors are overburdened, ill equipped and badly managed. Declining health budgets as a result of reduced government expenditure on public services have seen many public health services collapsing in several African countries. Drugs for common diseases are either unavailable or of poor quality and so is the medical equipment. The structural adjustment programmes that have been imposed by the Bretton Woods institutions to assist Africa in economic reform, are at the same time leaving little by way of adequate resources for health care.'

The World Bank announced in July 1999 that it planned in future to take more aggressive action against AIDS. A Bank official noted that AIDS is no longer solely a health problem, but a development crisis that is particularly affecting Africa. Working with governments and other groups, the World Bank has stated it will review its existing efforts in Africa and plans to redirect funding, if needed.

Discussing the World Bank's new emphasis on the African AIDS epidemic, Mr Callisto Madavo, Vice President, Africa Region, said: 'With ferocious speed, AIDS has wiped out many of the development gains Africa has achieved over the last decades. It has reduced life expectancy in the most-affected areas and now threatens businesses and economies', he said. 'Africa is in urgent need of resources and support to turn around this catastrophe. For this reason we are putting the epidemic at the centre of our development agenda, mainstreaming AIDS into all aspects of our work in Africa.' [7]

The bank's latest research suggests that when the adult infection rate reaches 8% – it is already at that level in 21 African countries – it reduces per capita growth rates by 0.4% a year. With annual growth rates in Africa averaging just 1.2% over the past few years, that is a significant loss of income.

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3. WHO: The World Health Report 1999: Making a Difference. World Health Organization, 1999, p xiv.
4. 'The inequities are striking', says Dr Jonathan Quick, Director of Essential Drugs and Other Medicines at WHO. 'In developed countries a course of antibiotics can be bought for the equivalent of two or three hours' wages. One year's treatment for HIV infection costs the equivalent of four to six months' salary. And the majority of drug costs are reimbursed. In developing countries, a full course of antibiotics to cure simple pneumonia may cost one month's wages. In many of these countries one year's HIV treatment – if it were purchased – would consume 30 years' income. And the majority of households must buy medicines with money from their own pockets.' Quote taken from Press Release WHA/13 22 May 1999 WHO to Address Trade and Pharmaceuticals.
5. Berlinguer G. 'Indivisibility and Globalisation of Health' in The Effects of Globalisation on Health. Report from a Symposium held at the Annual Meeting of the NGO Forum for Health. Geneva, May 1998.
6. Ngwena C. 'AIDS and Right of Access to Treatment: The Scope and Limits', op. cit. p10.
7. UNAIDS Press Release: UN Officials in Lusaka Commit to Increased Action against AIDS in Africa. Lusaka, 15 September 1999.

INCREASING TREATMENT ACCESS

Thanks to new drug therapies, many people living with HIV/AIDS in most developed countries are now able to live relatively healthy lives. Combination anti-retroviral therapies allow HIV-positive people to reduce their viral load significantly, in some cases to undetectable levels, thus enabling many individuals to return to the workplace. In developing countries and countries in transition, however, these and many other therapies used to treat HIV infection and related illnesses are unavailable for a simple reason: they are not affordable. Even for those few who may be able to afford them, sometimes pharmaceutical companies conclude that the potential market is too small to bother with licensing and distribution arrangements.

The issue of the cost of drug therapies is of immense importance in relation to HIV/AIDS. Over 89% of people currently living with HIV/AIDS reside in countries ranked in the lowest 10% in the world in terms of gross national product. Even in slightly wealthier countries in Southeast Asia, there are major cost constraints. At the Bamrasnaradura hospital in Bangkok, Thailand, for example, only 20 of the 2000 patients who seek treatment each month can afford the triple drug cocktails that have become the standard of care in developed countries.

Ways to lessen or remove the gap in access between developed countries and developing countries are increasingly being explored. Two strategies that are receiving substantial attention are parallel importing, which involves bringing drugs in from another country; and compulsory licensing, which involves using a legal intervention to restrict the monopoly rights of existing patent holders and make generic drugs more available.

In July 1999, the International Council on AIDS Service Organisations (ICASO) published a background paper on the potential role of compulsory licensing and parallel importing in improving access to essential drugs for people living with HIV/AIDS.[8] The paper aimed to provide people with sufficient information to participate fully in the debate about the effect of international trade laws on access to essential drugs, especially HIV-related medications; and to help people better understand the potential for advocacy work on these matters in their own countries and with their own governments.

It should be noted that in the developing world the specific access to treatment needs of each country might be different. Only countries with more developed medical infrastructures have the widespread capacity to use combination anti-retroviral drugs. For other countries, it may be more important to obtain greater access to anti-microbial and other prophylactic (disease preventing) drugs.

CURRENT TREATMENT INITIATIVES

There are a few international initiatives in place aimed at improving access to treatment for people living with HIV/AIDS in Africa. Some that have received substantial publicity include:

UNAIDS HIV Drug Access Initiatives (pilots in Chile, Cote d'Ivoire, Uganda, and Vietnam)

Involves a controversial drug access model

Enhancing Care Initiative (pilots in Brazil, Senegal, Thailand and South Africa)

Using multidisciplinary AIDS care teams to improve HIV/AIDS care in resource poor settings

Secure the Future (five southern African countries)

Bristol-Meyers Squibb has donated $100 million to foster the development of public-private sector partnerships for solving HIV/AIDS-related public health issues

However, if there is to be progress in improving treatment access for people living with HIV/AIDS in Africa, there will need to be a concerted international effort.

CONCLUSION

Some promising steps to a concerted international effort were taken with the consideration in January 2000 by the United Nations Security Council of the spread of AIDS, especially in sub-Saharan Africa. This was the first time that a health issue had been considered by the Security Council, and exemplifies the growing awareness of the impact of HIV/AIDS.

The World Health Assembly in May 2000 carried a resolution which committed member states to match their political commitment to the magnitude of the HIV/AIDS problem by allocating resources from national budgets and from donors. The resolution also required members to promote access to drugs at affordable prices through establishment of a strong generic drug policy, negotiation with pharmaceutical companies, and incentives for production and importation of drugs in accordance with international agreements and national legislation.

In addition, Kofi Annan wrote to all heads of State and government in May 2000 calling on them 'to use the unique opportunity presented by the forthcoming Millennium Summit to rededicate themselves to the international legal framework and actively contribute to the strengthening of the international rule of law.'

This 'rededication' might usefully be directed to a real commitment to ensuring that the right of everyone to 'the enjoyment of the highest attainable standard of physical and mental health' moves beyond rhetoric to reality. We will all need to join in partnership to achieve this goal.

ABOUT THE AUTHOR

Margaret Duckett has over 25 years experience in the health sector, working at all levels and settings: international, regional, national, hospital and community. She has worked as a research scientist; as a public servant, including as a Special Adviser on HIV/AIDS to the Australian Health Department; a Visiting Scholar at the McGill Centre for Medicine, Ethics and Law, Canada; and as a Consultant to many programs in a number of countries. Countries in which she has worked include: Australia, Bosnia & Herzegovina, Canada, Fiji, New Caledonia, Papua New Guinea, Samoa, Switzerland, Tonga, Vanuatu, and Vietnam.

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8. Duckett, M. Compulsory Licensing and Parallel Importing: What do they mean? Will they improve access to essential drugs for people living with HIV/AIDS? Background Paper for the International Council of AIDS Service Organizations (ICASO) July 1999. Available on the website http://www.icaso.org in English, French and Spanish.

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