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Redesigning Agroecosystems for Environmental Sustainability: A Deep Systems Approach

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Modern agriculture is unsustainable, largely because our overemphasis on production, and on its achievement through inappropriate physical, chemical and biological manipulation, has resulted in the neglect of maintenance functions within agroecosystems. This blind spot is one of a number that are indicators of our undeveloped and distressed psychosocial state. Only by including such factors in our systems analyses will it be possible to establish a truly sustainable agriculture and food system. © 1998 John Wiley & Sons, Ltd.

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> Clever people know how to solve problems, wise people avoid them.
>
> Attributed to Albert Einstein

My mission is to establish food systems worldwide that are nourishing, socially just, humane, and environmentally sustainable. I have dedicated my life to achieving that goal. If there is just one person who, after reading this paper, feels more empowered to take his or her own unique step towards the implementation of such a vision, then my efforts may be justified. But, if denial and postponement defeat the need for immediate action, then I will have wasted my time. For it is appropriate action, and not further studies or discussion, that is most required; and certainly not a perpetuation of any of the present unsustainable practices.

The roots of these statements extend beyond science into the realms of higher values and global commitment (Hill, 1979). I believe that the widespread neglect of these considerations has been the undoing of science, and has contributed to its role as a barrier in the achievement of sustainability (MacRae *et al.*, 1989). What has been particularly disturbing has been the failure of most scientists to speak out on issues relating to the state of the environment, and to examine what this implies with respect to priorities in science and technology (Suzuki, 1987); and, in the case of this topic, what this specifically implies for agricultural science and technology, as well as for associated policies, services, education and research.

I believe that at some point in the future many will wonder how present scientists and policy

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makers could have continued to knowingly advocate the expansion of specialised production systems that emphasise practices such as chemically managed row-crop monocultures, which result in soil erosion and degradation, and water exhaustion and contamination; or knowingly stand by in the face of deforestation, loss of biodiversity, displacement of farmers and loss of rural communities, and increased dependence on non-renewable resources, synthetic chemicals and antibiotics, subsidies, and markets that meet distant luxury wants versus, especially local, basic needs (Table 1) (Brown *et al*., 1984).

My explanation of why this madness continues may be as shocking for many of those who read this as witnessing the present level of degradation is for me. Throughout history we have invariably blamed others for our tragedies — the Gods, other nations, certain groups within society, lack of resources and power, multinationals, and political incompetence — but we have rarely examined the contribution of our own actions and inactions, accepted our responsibilities, and set out to change our behaviour. Thus, my analysis of the situation is primarily psychosocial, rather than just political, and that is exactly what makes such a proposition so difficult to accept, because for me this requires that I first recognise and act on my responsibilities and change myself before pointing fingers at others, or at least while concurrently doing this. This is not to deny the inequities and oppressions that exist and that need to be addressed within our societies, but rather to acknowledge that each of these can be traced to collective and individual patterns of behaviour, which if not changed will continue to wreak havoc with our precious planet, our societies and our individual wellbeing. Furthermore, I believe that the more empowered, aware, informed, competent and clear about our values that each of us is, then the more effective we are likely to be in bringing about the structural and institutional changes that are required. Trying to do the latter without addressing the former can only ever result in initiatives that will fail to address the causes of our problems, and that at best can only slightly reduce the levels of unsustainability and degeneration.

Table 1. Environmental and social indicators of inappropriate goals and activities, particularly within the food system. (Note that none are considered in the cost–benefit analyses that determine most current decisions relating to the food system)

Planet
- Exhaustion of fossil fuel reserves and other non-renewables
- Global warming and associated rising sea level
- Thinning of the ozone layer and accumulation of garbage in space
- Fluctuating water tables, drying lakes and rivers, and flooding
- Contamination of soil, water and organisms with pollutants
- Deforestation, desertification and soil erosion
- Loss of biodiversity, species extinctions and loss of varieties

Agroecosystems
- Loss of natural capital (soil, water, biodiversity)
- Breakdown of maintenance functions (soil regeneration, natural pest control)
- Increased vulnerability and pest, weed, disease and stress problems
- Increased dependence on imported resources, curative inputs and 'experts'

Rural societies and economies
- War, prejudice, oppression and maldistribution problems
- Displacement from land and lack of access to basic needs
- Farm bankruptcies and decaying rural communities
- Increasing dependencies on subsidies and imported inputs
- Dependence on unstable distant and world markets and other external controls
- Malnourishment, zoonoses, allergies, stress-related and degenerative conditions
- Illiteracy, learning disabilities, emotional disturbance and depression
- 'Compensatory' addictive, compulsive, aggressive behaviours
- Feelings of isolation, hopelessness and helplessness

My thesis is this, that because throughout history people have been psychologically wounded (deMause, 1982), they have frequently established inappropriate goals, and have repeatedly done inappropriate and unsustainable things

to achieve them, things that continue to cause major harm to both people and the planet (Hill, 1991a; Meadows *et al.*, 1992). For example, the widespread hunger for power and control within families and societies, and the common obsession with the elimination of enemies, including insect pests, may have their roots in the widespread control and manipulation of children and their treatment in most families, at least some of the time, as 'pests'. As societies we act out these distresses with devastating consequences, which range from widespread malnourishment and starvation to mental depression and degenerative diseases, to environmental degradation, to social decay, to economic crises and political unrest (Table 1). If we were managing our lives and nations in appropriate ways we would not be in this mess. Yet the predominant responses to this 'feedback' from our behaviour have been denial, conducting endless studies of each problem in isolation, the seeking of curative (magic bullet) solutions, and making symbolic versus substantive changes to the design and management of our affairs. This not only reduces the options available to future generations, but perpetuates the problems and deprives each of us of experiencing a sense of meaning and fulfilment within our lives. In this paper I will argue for environmental sustainability, discuss what this implies for the design of national and local food systems, and suggest what must be done to implement such sustainable systems.

DEFINITION OF SUSTAINABILITY

The above observations both raise, and provide possible answers to, a number of questions. Why, for example, do we not yet have a logical and universally acceptable definition of sustainability, and why have most institutions emphasised economic over environmental sustainability (WCED, 1987)? I believe that our psychosocial immaturity and persistent distressed behaviours are largely responsible for this. My working definition of sustainable development is 'the maintenance of the planet and its ecosystems, and society and its communities, for optimal, equitable environmental and human health and wellbeing', i.e., sustainability initiatives should be concerned primarily with ecosystem and community rehabilitation and maintenance, and development primarily with human development and its facilitation. Planet Earth is our environment and our home, and 'absolute' requirements for its water, air, nutrients, freedom from biocides (etc.) must be met if it is to remain a place in which present and future generations can survive. Economics, on the other hand, should be used merely as an instrument to help us to live in ways that are consistent with our higher values. It has no comparable 'absolute' requirements. When used appropriately, economics can provide a useful tool for evaluating some of the costs and benefits associated with alternative courses of action, but it is inadequate as a source of values for wise decision making. To achieve sustainability we must learn to conduct our affairs within the limits of environmental absolutes, and not continue to delude ourselves that we can only do this if we can afford it (Hill, 1981a, 1991b).

Fifty years ago, Aldo Leopold (1949) observed, when discussing the related concept of a land ethic, that an ethic is a restriction on freedom of behaviour; and a land ethic is merely an extension of that restriction to our treatment of the land (other organisms, the environment and the planet) (Hill, 1979). The widespread failure of our societies to institutionalise environmental ethics is not surprising; unlimited exponential growth, rather than restriction, has characterised human behaviour in the industrialised world, particularly since the middle of the last century. It has been estimated that as recently as 1850 95% of the energy used in the world came from the muscles of people and domestic animals; now over 95% comes from fossil fuels (Othmer, 1970). In fact, industrialised societies have functioned very much like drug addicts, willing to do almost anything to ensure ongoing access to the desired resources, including going to war to secure this access, and blind to the consequences of our uses of these resources and of our addictive dependence upon them (Schaef, 1987; Slater, 1980). It follows from this that a genuine and more detailed definition of sustainability must necessarily spell out restrictions on our behaviour and provide guidelines for appropriate goals and

actions. In particular, we must restrict our consumption of resources, dramatically reduce our impact on the environment, and distinguish between goals that relate to the universal satisfaction of basic needs and those that cater to the unlimited greed of a few (Hill, 1981b).

Thus, environmental sustainability is more likely to be achieved when: (a) our goals and actions to achieve them result in levels of consumption of renewable resources that are below or in balance with the carrying capacity of the environment, and when non-renewable resources are conserved, recycled, and reserved for prioritised (especially 'structural' and emergency) uses; and (b) when the level of impact on the environment is below both its capacity to recover and to continue to evolve towards more stable configurations. Clearly this is easier to achieve with a smaller population of responsible conservers than a larger one of irresponsible consumers. The implications for agriculture are that it must aim to achieve its production goals (and meet needs versus greeds) while maintaining its natural and social capital resource bases. A central task is to find ways to build up and maintain the natural and social capital and live off the interest. All of the environmental, cultural and personal degradation that we are presently witnessing are partly the result of our habit of living off (not valuing) and eroding the capital.

DEEP SUSTAINABILITY AND RESOURCE MAINTENANCE

A more important question relates to why these directives have yet to be taken seriously by most individuals and societies. My experience of examining proposals for action is that very few dare to address the real issues of environmental sustainability. To help recognise these real issues I distinguish between shallow (short-term, symbolic) and deep (long-term, fundamental) sustainability (Table 2).

Shallow sustainability focuses on efficiency and substitution strategies with respect to the use of resources. It usually accepts the predominant goals within society without question, and aims to solve problems by means of curative solutions. Deep sustainability, in contrast, re-evaluates goals in relation to higher values and redesigns the systems involved in achieving these goals so that this can be done within ecological limits (Hill, 1991b). This approach focuses on solving problems by prevention, often indirectly by creating healthy environments. This distinction is particularly evident within the food system, and is especially clear with respect to our approaches to pest control (Figure 1) (Hill, 1984, 1990b).

Thus, conventional agriculture's dependence on pesticides exemplifies such a curative approach that has numerous negative side-effects on both people and the environment (Hill, 1984). Although the efficient use of pesticides and the substitution of biological and other more benign controls reduces these side-effects, neither of these 'shallow' approaches confronts the causes of the problem — the inappropriate design and management of the agroecosystem — which must be redesigned and managed in different ways if permanent 'deep' solutions are to be found. To protect agroecosystems (and indeed nations) from problems, and to increase the resilience of these systems, efforts must be made to build up and maintain their ecological integrity and natural capital (and concurrently also our supportive cultural capital). In most countries, farmers are rewarded for productivity, but not for this kind of rehabilitation and maintenance, and indeed they are often penalised economically and socially for spending time and energy on the latter. Until ways are found to support farmers who spend time designing their agroecosystems to conserve such resources as water, soil and natural pest control agents, we can expect continued erosion of these and other resources through neglect and degradation. Indeed, paradoxically it is only by valuing and rewarding maintenance activities that sustained productivity will ever be achieved. Interestingly the willingness of some consumers to pay more for organically produced foods — because they believe it is better for the health of themselves and the environment — is one hopeful sign of a recognition by at least a portion of the population of the importance of maintenance.

Table 2. Comparison of three approaches to sustainable agriculture

Unsustainable	Shallow sustainability		Deep sustainability
Conventional	Efficiency	Substitution	Redesign
Examples			
Factory farm	Low-input and resource-efficient agriculture	Eco-agriculture	Permaculture, natural and ecological farming
Approaches			
High-power	Conservation	Conservation	Low-power
Physico-chemical (soluble fertiliser, pesticides, biotechnology)	Physical/chemical/ biological (slow release band)	Biological and natural materials	Bio-ecological, *in situ*
Imported input-intensive	Efficient use	Alternative inputs	Knowledge/ skill-intensive
Narrow-focus, farm as factory (linear design and management)	Efficient factory	Softer factory	Broad focus, farm as ecosystem (integrated design and management)
Problems as enemies to eliminate and control directly with products and devices	Efficient control (monitor pest, integrated pest management)	Biocontrols	Prevention, selective and ecological controls (pests as indicators)
Goals			
Maximise production (neglects maintenance)	Maintain production while improving maintenance	Improved maintenance	Optimise production (emphasises maintenance)
Create demand, manipulate wants			Meet real needs

PSYCHOLOGICAL ROOTS OF SHALLOW SUSTAINABILITY

It is tempting to assume that our neglect of maintenance is determined only by economics. This is reflected in the common complaint of farmers who frequently say 'I wish I could afford to farm in the way I know how.' I believe, however, that this neglect has deeper psychological roots. Collectively, most of us vote for, or tolerate, governments and technologies that promise more for less, that aim to solve social problems by increasing production, export and consumption, that ignore long-term and distant effects of current policies, and that maintain the illusion of the good life around the corner. This is, of course, blatantly irresponsible and untruthful by omission. Such formulae dig us deeper into personal and institutional pits out of which it becomes increasingly difficult to climb. We go along with, and are attracted to, such formulae because they appeal to the 'needy' (wounded) parts of our psyches. They provide what appear to be simple answers to problems that we perceive to be so complex, and so difficult and frightening to consider in their entirety (and with honesty), that we are easily attracted to 'magic bullet' solutions and other distractions. We do this largely without being aware that we are doing it. I believe that the habitual nature of this behaviour has its origins in how we learned to survive physical and emotional traumas as small children. It is shocking to discover, for example, that most children who were sexually abused temporarily forget that this happened to them, until some subsequent crisis or experience

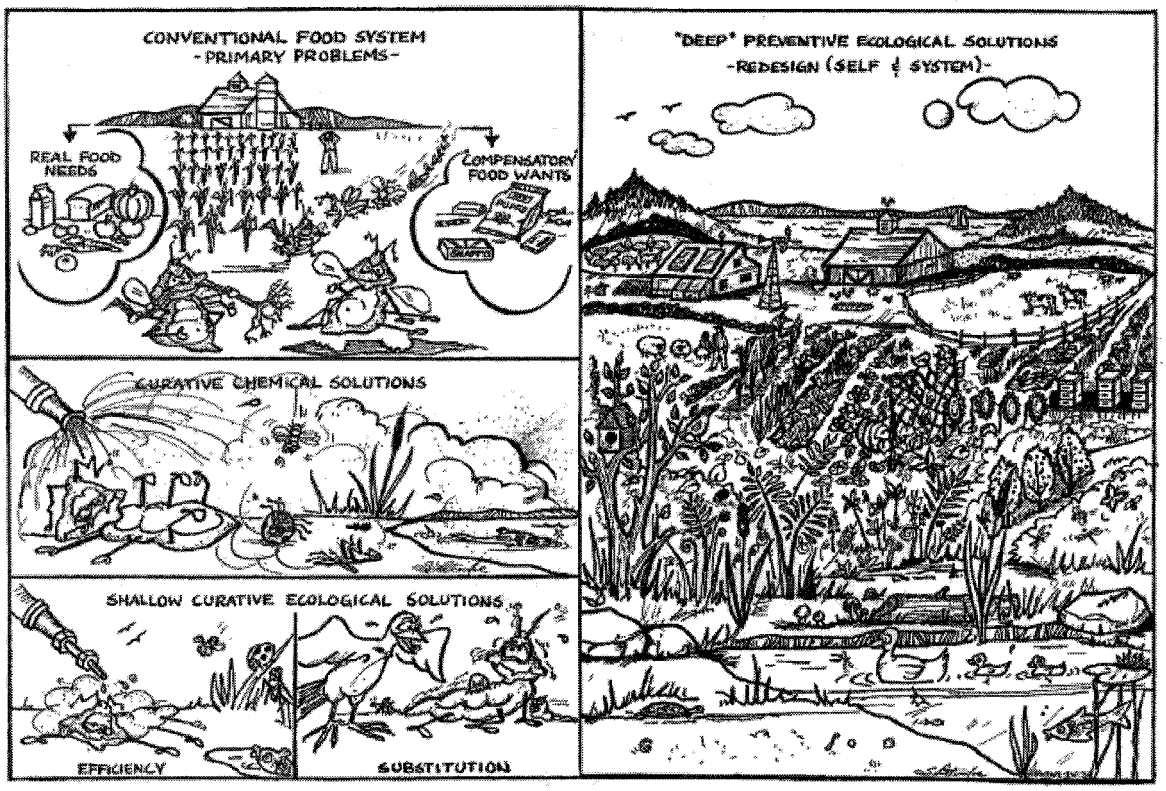

Figure 1. Comparison of conventional, shallow ecological and deep ecological approaches to pest control

gradually or suddenly opens up the channels to that lost memory, providing opportunities to both heal the wounds, and to eventually collaborate with others to take initiatives required to minimise the chances of such abuse continuing within our societies. Lesser traumas are numerous and also significant in their influence, and can be understood and dealt with in the same way (Hill, 1991a; Jackins, 1978; Janov, 1973; Miller, 1984). In this process of adapting to such oppression we temporarily 'lobotomise' ourselves to protect us from the pain that would accompany the repeated recall of past hurtful experiences. Laing (1971) put it well when he observed that 'it is as if we were hypnotised twice, firstly into accepting pseudoreality as reality, and secondly into believing we were not hypnotised'. Until we reclaim these memories, and recover from them, we will continue to perform way below our potential, continue to confuse shallow and deep sustainability, and continue to consume and waste the world's scarce resources in our pursuit of unsustainable 'dream goals'. In a previous paper (Hill, 1990a) I have examined how the design and management of agroecosystems may be related to childhood experiences.

DIRECTION, ACTION AND REGULATION

What can be done to avoid any perpetuation of our unsustainable behaviours and to ensure that real progress is being made, and how can we recognise this progress? Psychological (Hill, 1981a, 1990a, 1991a, 1991b; Jackins, 1978; Mahrer, 1989; Solter, 1984, 1989) and social (Barlow, 1988; Pearse, 1979; Stallibrass, 1989) 'solutions' to this have been examined elsewhere and will not be discussed further here. In the remainder of this paper I will focus on the issues of direction, action and regulation (Figure 2). These correspond to

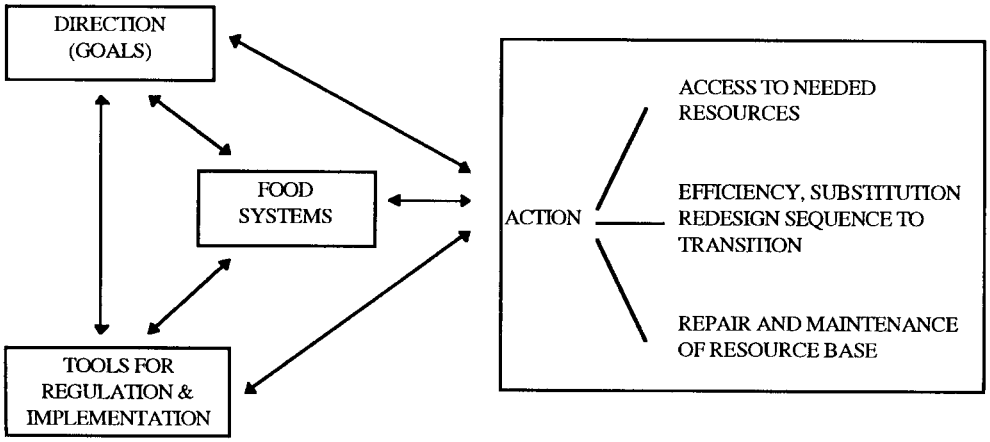

Figure 2. Relationships between the three domains that determine food system sustainability

the three questions: what do we want to achieve, or what are our goals; what can and should we do to achieve them; and, how can we make sure we stay on course?

Directions and Goals

As indicated above, because our goals, however poorly defined, strongly influence our actions and our actions determine the outcomes, it is essential that we examine and revise our goals. Because goals such as productivity, profit and power will always place us on the treadmill of unlimited growth, and result in the exhaustion of resources and associated impact on person and planet, they must be rejected as being incompatible with sustainability (Table 3).

Rather we must look to what positive aims lie behind these unsustainable goals, and reformulate them as our true or high goals. We usually say that we want to increase productivity to enable everyone to have access to the required foods, and for producers to receive a fair wage, to allow them to be free to live meaningful lives. Thus, nourishment to support optimal physical, mental, emotional and 'spiritual' development, and not simply productivity, is a more appropriate primary goal (MacRae *et al.*, 1990b). This has broad qualitative and quantitative implications for the selection of crops, the design and management of agroecosystems, and for the nature of the required institutional supports. For example, more attention must be paid to nutrient density when selecting crops and providing subsidies. With this approach, health-destroying crops, such as tobacco, might be eliminated or receive little or no support. Other goals, in addition to nourishment, that can be examined in the same way include social justice, humane treatment of livestock, and environmental and agroecosystem sustainability.

Agroecosystem Design and Management

To achieve the above goals, we first need to identify, or assemble, build up and maintain the necessary physico-chemical, bio-ecological and socio-cultural resources that underpin the food system. Mechanisms range from the protection of Vavilov Centres and gene pools, to soil and water conservation strategies, to the collection, preservation and integration of indigenous wisdom and skills. For example, programs for capturing water, slowing its movement across the land, and directing it to points of need, through the use of dams, retention and interception banks, swales, and channels are of paramount importance (Yeomans, 1978). The optimal design and siting of these structures require a profound knowledge of ecological processes, a detailed local knowledge of seasonal and topographical characteristics, and an understanding of socio-cultural constraints and opportunities (Altieri, 1987;

Table 3. Implications for the food system of having sustainable versus unsustainable goals

Lower goals		Higher goals
Productivity		Nourishment
Profit		Human development
Power		Justice
Competitiveness		Humaneness
Growth		Sustainability
↓		↓
Exploitation	*Resources*	Conservation
Market forces		Priorities
Non-renewables		Solar/renewables
Imported		Local
Specialised	*Farms*	Diversified
Separated		Integrated
Larger		Smaller
Dependent		Self-reliant
Disseminator	*Extension*	Facilitator
One way		Two-way
Products		Service, skills
Isolated		Participatory
Research station plots	*Research*	On-farm
Short-term		Long-term
Single discipline		Holistic
Technologies		Knowledge, skills
Reactive	*Programs and Policies*	Proactive
Status quo		Evolutionary
Defensive		Visionary
Competitiveness		Efficiency/substitution/redesign
Subsidies		Supports/rewards/penalties

Mollison, 1988; Mollison and Slay, 1991; Yeomans, 1978).

Soil is predominantly a medium in which organic matter decomposition is the primary activity going on. Deprived of organic matter, soil degrades and is lost to erosion; conversely, when supplied with organic matter, the soil increases in both fertility and productivity (Hill, 1989). Consequently, ways must be found to properly manage the soil, and to fix carbon, return it to the soil and conserve it. In addition to the conservation of energy, the fixation of carbon and its build-up as organic matter in the soil is one of the primary strategies available to us to prevent the accumulation of carbon dioxide in the atmosphere and associated global warming. Similarly, ways must be found to support a managed succession (mimicking a natural succession) from less productive, low-demand, hardy plant covers to mixtures including more productive and demanding crops, these often being arranged in multi-storey polycultures (Fukuoka, 1985; Mollison, 1988; Mollison and Slay, 1991).

With respect to our present high-input dependent and environmentally impacting agro-ecosystems, strategies must be found to support their evolution through the efficiency and substitution stages to redesigned sustainable systems (Hill, 1985, 1990a; MacRae *et al.*, 1990a, 1990b). Thus, integrated pesticide and fertiliser management would give way to dependence on biological and alternative inputs, and eventually to *in situ* cultural methods of pest control (Hill, 1990b), and soil fertility maintenance (Gershuny and Smillie, 1986).

Special methods will be required for the rehabilitation of 'agricologenic' areas, such as

Table 4. Alternative problem-solving paradigms

Reductionist, technocentric	Holistic, ecocentric
• Cure symptoms (eliminate enemies)	• *Prevent*, respond to multiple causes, stresses (problems regarded as indicators)
• Inputs (disrupt self-regulatory mechanisms, temporary solutions)	• *Design and management*, benign inputs (self-maintaining/regulating systems supported by cultural practices, permanent solutions)
• Single, simple, direct, instant, narrow focus, (magic bullet, single discipline)	• *Multifaceted*, complex, *indirect*, *long-term*, broad focus (multi/transdisciplinary), decentralised
• High-power, physico-chemical (synthetic), imported product, expert (high-risk, expensive, dependent), centralised control	• Low-power, *bio-ecological*, on-farm/local (low-risk, inexpensive, independent), decentralised
• Technology-intensive	• *Knowledge/skill* intensive, selected technologies
• Inflexible, ignores freedom of choice, disempowering	• *Flexible*, respects freedom of choice, empowering
• Temporary solutions	• *Permanent solutions*
• Unexpected disbenefits (environment, health, etc.)	• *Unexpected benefits*
• Incompatible with higher values	• *Compatible with higher values*

those degraded by salinisation or contamination with toxic chemicals (Hodges and Scofield, 1983). This might involve the planting and harvesting of halophytic plants and the inoculation of the soil with specialist decomposer micro-organisms.

With respect to livestock, the management of wild game and crosses with compatible domestic varieties should be pursued because of the higher ecological efficiency, and higher nutrient density of the meat, associated with the former (Renecker and Hudson, 1991). Matching herd size to carrying capacity, and the design of appropriate systems of rotational grazing that take into account the 'brittleness' of the pasture area, are of particular importance in the achievement of range sustainability (Savory, 1988). It should be noted that intensive, feedlot, and battery production systems deprive livestock of playing an ecologically helpful role within both agroecosystems and landscapes in general.

Regulation, Monitoring and Control

Ecological systems are being destroyed throughout the world partly because the marketplace rewards short-term productivity and not long-term resource maintenance. Consequently, governments have a particular responsibility to compensate for this market deficiency, and must resist such externally imposed controls, such as the General Agreement on Tariffs and Trade (GATT), and the Multilateral Agreement on Investments (MAI), which by reinforcing the primacy of the market and international trade weaken the ability of nations and regions to practise sustainable resource management and to maintain and care for their environment and society (Shrybman, 1992).

Specific instruments can be grouped under the following three headings (Hill, 1982):

(a) *Supports:* experiential self-directed learning opportunities (education), demonstrations, collaborative extension, participatory on-farm action research, as well as field station and laboratory research, the provision of appropriate services, legislation, and resource maintenance incentives.
(b) *Rewards* (incentives to cover any short-term losses associated with the necessary changes; only provided during the transition period): tax incentives, subsidies, low-interest loans, and special services to support transition initiatives.
(c) *Penalties* (for those who persist in acting irresponsibly): monitoring programs, legislation, and enforcement (including 'retraining').

Table 5. Some characteristics of farms before and after a transition to sustainable agriculture

Before	After
• Bare soil	• Cover crops, intercrops
• Monoculture or row crop rotations	• Rotations including soil-improving crops, non-row crops, mulches
• Unmanaged field borders	• Windbreaks and insectary plants
• Exported nutrients replaced by synthetic soluble inputs	• Recycling, soil formation and N_2 fixation
• Manure — waste disposal	• Optimal management, composting
• Pesticides and antibiotics (curative solutions)	• Cultural and biological controls (preventative)
• Grain/concentrate feeds	• Forage included
• Large, expensive, unmodified machinery	• Smaller, modified, appropriate
• Fossil fuel-based	• Solar and renewable
• Specialised production and marketing	• Diversified

Table 6. Some characteristics of farmers before and after a transition to sustainable agriculture

Before	After
Role	
• Recipients of information	• Exchangers, generators
• Technology users	• Developers
• Exploiters of resources	• Stewards (maintenance)
• Economic viability emphasis	• Nourishment of people
Approach	
• Waiting for help	• Experimenting
• Seeking quick-fix (curative) solutions	• Understanding causes
• Competing	• Collaborating
• Controlling inputs and processes	• Designing and managing
• Specialisation	• Diversification
World view	
• Dependence (rights)	• Self-reliance (responsibilities)
• Helplessness	• Empowerment
• Enemy-oriented (identify, attack, eliminate)	• Collaboration, indicators (identify, facilitate, respond)
• Problem control	• Health promotion

In the longer term, however, a broader approach is required — one that aims to remove the main internal and external barriers to the achievement of a sustainable agriculture. These will include improving access to appropriate information, resources and technologies, the development of new skills and technologies, the provision of a broad range of institutional supports (Hill, 1990b), the development of sustainable visions, higher levels of awareness, and the empowerment required to take the necessary associated action (Hill, 1990a, 1991b). Alternative visions for problem solving (MacRae *et al.*, 1989), and for farms and farmers are listed in Tables 4, 5 and 6, respectively; and a vision of the relationships between the needs, priorities and barriers at the personal, institutional and planetary levels is given in Table 7. Achieving such visions will, however, eventually require that we examine and address the psychological roots of our current behaviour (discussed earlier), and of widespread lack of vision, awareness and empowerment.

Table 7. Some comparable needs, priorities and barriers at the personal, institutional and planetary levels that relate to the achievement of environmental sustainability

Persons	Institutions	Planet
• Holistic paradigms • Access to resources, specific information and technologies	• Collection, development, management, dissemination of information and resources • Accessibility	• Biodiversity • Functional relations
• Skill acquisition	• Participatory democracy	• Cycles and processes
• Empowerment • Following unique agendas • Supporting others • Agendas and collaborating	• Supporting unique agendas and facilitating collaboration	• Ecosystem diversity, integrity and rehabilitation
• Awareness	• Monitoring • Evaluation	• Feedback systems
• Vision	• Long-term planning • Facilitating psychosocial and ecosystem evolution	• Evolution
• Values	• Principles, laws, regulations, codes, ethics, supports, regards, penalties	• Bioregion and Gaia integrity

Alternative visions are still at an early stage of development. Indeed, I believe that the psychosocial evolution of our species is at a similar early stage of development, and that paradoxically this gives us some reason for hope.

In the final analysis, it will be the awareness, empowerment, vision and values of people, and our appropriate use of science (and other ways of knowing) and technology, that will enable us to achieve sustainable food systems. We need to repeatedly remind ourselves that however powerful our science and technology might be, alone they will not be able to achieve sustainability — this will only be realised through our own psychosocial evolution (Hill, 1990a, 1991b). Indeed, the ability of a single, aware and empowered individual to bring about meaningful change should not be underestimated — assume you are that individual.

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