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Sustainable Land Use: Interdependence between Forestry and Agriculture

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Introduction

"Ill fares the land, to hast'ning ills a prey, where wealth accumulates, and men decay."

'The Deserted Village'

by John Goldsworthy 1728-1774

Over one-third of the land area of the world is in cropland or pasture, and a third is still covered in forests and woodlands. The two dominant land use activities are forestry and agriculture. While increasing amounts of land have been and will continue to be lost to cities, infrastructure and various forms of permanent degradation brought about through desertification, erosion, salinity, toxic waste and mining, it is successful agriculture and forestry that will ultimately decide whether life on earth can be sustained. This does not exclude the need to better manage the aquatic resources of the planet; however, I shall not discuss land and water interactions in this paper, though many of the issues I shall discuss are equally relevant. What I intend to do is to outline the demands of increasing numbers of people for biological products; which will only be met through more effective cooperation between, and integration of, forestry and agriculture.

Population Growth: Meeting Human Needs

As foresters, you have a unique understanding of time: the time it takes for trees to grow and the need to plan ahead.

In just over 50 years, the world's population will have increased from just over 5 billion to 10 billion: twice as many mouths to feed, twice as many families needing energy, clean water, fibres, paper, vegetable oils, timber, latexes and shelter.

In the last 50 years, the World's population has doubled from about 2.5 billion. It grew most rapidly in the 1960s; however, the children that will double the population of the Earth are already born - all that

now remains is for them to enjoy a normal healthy life and have children that survive. The conclusions and recommendations of the Cairo Conference on Population and Development could succeed in helping governments and families devise and adopt culturally-acceptable measures that will slow the rate of population increase - but they will increase.

Demographers tell us that, on current projections, the population of the Planet will stabilize around the year 2100, at between 11-12 billion; so by the time an oak seedling in the south of England reaches maturity, we will know whether we can meet sustainably the demands of the human race for biological products.

History shows that our ingenuity and strong instincts for survival will drive us to meet our immediate needs; we have been remarkably successful, even if this has been achieved at costs to the environment.

Populations have more or less stabilised in the industrialised countries, but continue to grow in the emerging and developing nations. The World's population is urbanising faster than it is growing. The majority of people in industrialised countries and Latin America already live in an urban environment, so it is in Asia and Africa where urbanisation will increase most rapidly. People who live in urban areas have different, often more demanding, patterns of consumption of food, building materials, water and energy; they have higher expectations for a better quality of life.

I do not propose to discuss the current projections for the increasing demands for biological products; all the projections I have seen show that even if we succeed in reducing waste, increasing efficiency and recycling, and in modifying patterns of consumption, the trends in demand are upwards. Some of the trees required to meet these demands are already growing.

We should therefore be wise, adopt the precautionary principle and plan to meet these future human needs for biological products in ways that do not further damage our life support systems.

The Rio Summit

In 1987, the Report of the World Commission on Environment and Development (the Brundtland Report) concluded that it should be possible to achieve sustainable development - for all! Economic growth, with equity and environmental conservation, could be attained through a careful blend of clean technology, sensible policies and social awareness. The United Nations Conference on Environment and Development (the Rio Summit 1992) tried to capture this positive message into an action plan for the 21st Century (Agenda 21). The Rio meeting recognised the special challenge faced by forests and agreed the Forest Principles for the 'conservation, management and sustainable development of forests'.

The United Nations Commission on Sustainable Development (UNCSD) was set up in 1992 to maintain the momentum on the agreements reached at Rio and to monitor progress. In April of this year, the UNCSD agreed to establish an Inter-Governmental Panel on Forests to promote international consensus, cooperation and action on forest management. In his concluding remarks, the Chairman of CSD

underlined:-

"An integrated approach to the planning and management of land resources was presented as a cornerstone in combatting deforestation, desertification and drought; promoting sustainable agriculture, rural and mountain development; the conservation of biological diversity and the sustainable management of all types of forests. An essential element in addressing those initiatives is a people-oriented, balanced approach, adapted to specific circumstances so as to solicit participation at the local and intermediate levels of decision-making.

"Practical and successful tools recommended for the implementation of sustainable solutions were, amongst others, the development of land use planning systems, the promotion of pest management programmes in agriculture, and regional sub-regional agreements in relation to mountain ecosystems.

"Enhanced productivity in agriculture and other rural activities could be further obtained through the appropriate use of renewable energy sources as well as fossil fuels."

"... a people-centred focus in the paradigm of sustainable development."

Finite Resources

The basic resources of the planet are finite and, for the most part, 'given'. We have the capacity to enhance or degrade the biological diversity, water quality and soil fertility but, despite our rapacious consumption of fossil fuels, the realities of climate, geography and geology are largely beyond our control. We must work with what we have, where we have it!

Our Challenge is, therefore, to meet growing human needs for biological products, now and in the future, from finite resources, while satisfying the aspirations of many for a better quality of life.

Sustaining What and for Whom?

Sustainable patterns of production and consumption are popular concepts that are universally accepted as an the ideal towards which we should move. They are not a Utopian plateau upon which, once achieved, we can rest. Population growth, natural and man-made disasters, fluctuations in weather patterns and commodity prices, and rising expectations will require constant vigilance, maintenance and adaptation. Old technologies and some of the new ones will prove deficient in some way, as the sensitivity of our monitoring techniques improve our tolerance to imperfection decreases and our demands increase.

Many aspects of sustainability are measurable and monitorable - such as land use, biodiversity, vegetation, land productivity and pollution levels - but others are about opinion, democracy and choice. Social, economic, institutional and financial criteria will increasingly dominate decision-making on sustainability. Acceptable indicators or standards can be negotiated amongst stakeholders. The decisions made by societies on what we should sustain, where, how, for whom and for how long will have an

increasing influence on land use practices. In the United Kingdom, the decisions in land use and the ownership of forests are increasingly influenced by public, often urban, opinion. It is the role of science and technology to help meet human needs, and realise their aspirations and goals - sustainably. The agenda is not set by scientists; but it can be informed and facilitated by them.

Historically, forests have usually lost ground to more intensive and quicker-yield forms of land use (Table 1). Some destruction of forests has been accidental as a result of disaster and fire; some has been caused by distorting policies that have encouraged people to over-exploit or destroy forest; and some from needs for timber and fuel, but the over-riding cause of deforestation has been the need for agricultural land to produce food, oils, beverages, carbohydrates, fibres, latexes and other biological products. But simply understanding the causes of contemporary deforestation will not necessarily provide us with the solutions we seek.

Table 1. Land area and land use 1975-87.

	Total land area, Billion ha	Population density 1993, 1000 / ha	Forest & wood-land, bn ha	Percent change, 1975-87	Crop-land bn ha	Percent change 1975-87	Pasture bn ha	Average annual population growth, % 1985-90
WORLD	13.1	398	4.1	-2.1	1.47	+2.7	3.4	1.73
AFRICA	2.9	212	0.7	-4.0	0.18	+4.6	0.90	3.00
Kenya				-7.5		+5.6		3.14
Ghana				-7.7		+5.5		4.22
Cote d'Ivoire				-42.1				
N&C AMERICA	2.1	197	0.7	-2.2	0.27	+2.1	0.36	1.28
Canada				+5.9		+5.4		0.88
USA				-8.8		+0.9		0.82
El Salvador				-35.4				
S. AMERICA	1.7	166	0.9	-4.5	0.14	+14.1	0.49	2.07
Brazil				- 4.2		+ 22.7		2.76
Bolivia				- 1.3		+ 3.0		2.07
Ecuador				- 19.6				
ASIA	2.7	1139	0.5	-1.5	0.45	-0.8	0.76	1.85
India				-0.4		+ 0.5		2.08
China				-0		+ 1.2		1.39
Thailand				-18.4				

EUROPE UK Germany	0.5	1050	0.2	+ 1.3 + 12.6 + 0.7	0.14	- 1.0 + 0.8 + 1.2	0.08	0.23 0.11 0.16
FORMER USSR	2.2	128	0.9	+ 1.9	0.23	0	0.33	0.78
OCEANIA Australia Solomons	0.7	33	0.2	- 6.7 - 9.6 - 0.0	0.05	+ 14.0 + 14.1 + 10.6	0.43	1.44 1.22 3.97

Adapted source: World Resources 1994-1995

However, there is a growing body of evidence that, as population growth slows, standards of living improve and food security is achieved; individuals and communities start to plant more trees and to return land to forests. This is the case in the United Kingdom where, in the last 90 years, the land under forests has increased from about 5% to over 12%. However, much biological diversity and old growth forest was lost before this change.

The rate at which the restoration of forest cover proceeds - often at the expense of marginal agricultural land, on land reclaimed from industrial sites or simply along the ever-growing network of motorways - is heavily dependent on financial incentives and public opinion. Investment of borrowed money at current discount rates could be ecological and economic sense but financial suicide.

Prerequisites for Sustainable Land Use

There are many criteria used for assessing sustainability - ecological, economic, social and institutional. It is possible to identify some key elements without which the prospects for sustainable land use are poor:

- a thorough knowledge of the nature, extent, state and best management practice for the land resources; and the means to detect and monitor the impact of change;
- a range of tested technologies and options for land use that will meet human needs and aspirations;
- effective means to monitor the impact of development activities on the key elements of sustainability;
- the involvement and support of local communities and other stakeholders and potential beneficiaries;
- social stability and greater equity;
- a sensible and supportive policy environment; and
- competent, affordable, accountable and honest institutions, and the ability to develop human capital.

If current land use cannot satisfy the needs and expectations of communities, it stands little prospect of being sustainable. A dynamic state of land use can be described as sustainable, provided it does not destroy or permanently degrade the basis of its productivity.

It is important to recognise the negative impact of poor people in any land use system. People are 'poor' for many reasons, some of which are outside their control. They may lack access to land of sufficient quantity or quality; they may not have the control, labour or capital to work that land; they may be sick, victims of strife or inappropriate social and economic policies, or they may lack the know-how, technology or infrastructure to improve the productivity of their environment. Identifying and addressing the specific causes of poverty is essential; treating only the symptoms leads to recurrent welfare and dependency. Better education, improved health and access to resources and the means to best manage them are important elements in any strategy for helping people out of poverty. Ownership and tenure are also critical factors.

Many poor people are 'food insecure'; lacking the ability to produce or purchase adequate food of sufficient quality to enjoy a normal, healthy and active life. Poor people lack opportunities; they have, inevitably, short-term perspectives in their decision-taking. Immediacy and survival dominate their decisions - food, water and firewood today - forests tomorrow!

How Much Forest, Where and for What?

We are hampered by a lack of absolute performance measures for forestry. The current international debate on criteria and indicators for sustainable forest management will help; but the questions: how much forest we need, where, and for what purpose, remain largely unanswered! For agriculture, food or commodity security is well-understood and there are ways of determining whether individuals have enough food to sustain a normal health and active life. We know that about 1 billion people are malnourished. We know where they are and for the foreseeable future, world agriculture can produce enough food, but we must improve its universal availability. There is a clear objective: maintain and, where necessary, increase supplies of high quality food at affordable prices to meet biological and cultural needs. In rich industrial countries, consumers and society have reached a point where they want also for their food to be produced safely, humanely and in aesthetically pleasing ways. The opinion of consumers will increasingly influence, if not decide, the production systems to be used.

For forests, the objectives are less clear. The multiple functions and values of forests are seldom realised by an individual or single community. The stakeholders who value forests as sequestrators of carbon, modifiers of climate and weather patterns or sources of plants with potential pharmaceutical use are different to those who need firewood, fibre, food and timber, ie the values they give them are frequently different. These constituencies want different types of forests and forest products to those who simply want clean water and recreational facilities. Without these clear agreed and, where necessary, negotiated objectives, forests or forest managers will be criticised for not maximising the benefits or values to particular user groups; they will always be wrong-footed. Eloquence, influence and importance are not always coincident. It would be interesting to run a few opinion polls on what people and societies want

of their forests, since sustainable management is too vague and imprecise a concept. I have seen no such studies. Conflicts of view and priority over land and forest use are inevitable. We need, therefore, an effective framework to negotiate and resolve these potential conflicts at local, national and international levels.

Interactions and Interdependence

Forests and agriculture are integral parts of a land use 'continuum'. The original balance and distribution were determined by climate and geology; it is now decided by people, individually and collectively, responding to external factors, ownership and their own wishes to develop and improve the quality of their lives. It is a complex model and one that varies between countries, regions and communities.

Decision and policy makers should try to understand, quantify and optimise these interactions. Many of the interactions are physical; others relate to social and institutional relationships. We know that forests have a major impact on the hydrology and hence land use of areas beyond the forest; the flow, silt load and seasonal reliability of surface water, springs and the depth of ground water cannot only have a major impact on the time spent by the women of households in collecting domestic water, but can influence the incidence of water-related disease and the opportunities for irrigation of crops and hence nutrition and income generation.

Forests can influence local rainfall, wind patterns and temperature variations, providing shelter and protection for sensitive farming systems and livestock. Forests can reduce soil erosion; they can help maintain soil fertility through recycling nutrients, and maintaining soil organic matter. In the hills of Nepal, the forests are a significant source of livestock fodder, which enhances the productivity of farm animals and availability of farm power. The manure they produce is used to maintain the fertility of the arable land. In turn, the farmers manage, control access to and protect the forests. It is interesting to note that, in many parts of Nepal, farmers - often women - are now planting trees and shrubs of recognised value within their farming areas to satisfy more conveniently their requirements for fodder, timber, shade and other products (fruit, nuts, leaves, etc.), thereby allowing the natural forests to recover.

Forests can harbour agricultural pests and diseases, or the natural predators of these pests. Understanding and managing these potential benefits or hazards has long been a subject of interest in shifting and other traditional systems of land use, and now scientists who develop integrated pest management systems. Agriculture can be the main source of seasonal fires that can be so destructive of forests and the biological diversity they harbour.

Much has been written about the non-timber forest products that provide food, medicines, fibres, resins, oils, honey, latexes and other useful forest products. Some studies have shown that the 'potential' value of these products exceeds that which could be achieved from logging or even agriculture. The difficulty has always been realising and exploiting this potential, as these products often need to be processed in some way to increase their 'shelf life' or readiness for the market. The time taken in their collection, processing and transportation can often exceed their market value, or the availability of labour to exploit

them.

The use of forests as sources of firewood and charcoal remains important to the greater proportion of rural and many urban dwellers, for income from selling firewood or charcoal, or as a convenient and renewable source of energy. Forests are often an important and essential source of employment and income for farming communities at certain times in the year.

Hence, forests and agriculture are integral parts of a land-use system; the people and communities complete the system; they exploit the interactions and determine the interface. The interactions can be positive and negative. However, this relationship can be strongly influenced by external factors.

Linkages

There has been very little systematic work on the cross-sectoral linkages and the interactions in land use between forestry and agriculture in terms of policy and institutional issues.

There is a good deal of anecdotal evidence and an increasing volume of analysis on the impact of policies on forestry and separately on agriculture, but there is very little work on how a policy and institutional framework can be established which provides for stable and sustainable land use, which promotes reasonable livelihoods and optimise the interactions.

Policies

Most evidence comes from policy or market failure, where policies designed to benefit or regulate one aspect of an economy impact badly on agriculture or forestry. The boom in cassava production in Thailand as a result of preferential prices in Europe for cassava starch in the 1970s and early 1980s, resulted in a good deal of forest invasion and degradation. The clearing of land for cultivation greatly increased soil erosion on the sloping sandy soils of north and eastern Thailand.

The nationalisation of forests in Nepal to strengthen the Government's control of a scarce resource resulted in a breakdown of traditional systems and values for forest management which, up until then, had stood the test of time. The need to increase beef export earnings in Brazil accelerated forest clearance. Tax concessions in UK led to the drainage and planting of single species forests in the ecologically significant 'flow country' of Scotland. The Common Agricultural Policy in the European Community has resulted in changes in land use, farming systems, and holding size throughout the United Kingdom and the rest of Europe. The early cycles of structural adjustment in Ghana accelerated the rate of logging and export of hardwood logs. Policy impacts cut across sectors and international boundaries. The globalisation of commodity markets, with prices often distorted through subsidies in the producer countries, and the availability of substitutes or alternative sources of supply, strongly influenced the land use options and commodity practices in developing countries.

It is now possible to identify which policies are most influential. Macro-economic and social policies are

particularly forceful in both the short and the long-term. Land tenure and resource ownership are also critical. Common ownership can work but is easily distorted by external forces. It would be useful to develop a 'tool-box', or methodologies, for the appraisal of the possible impact of policies on land use practices, somewhat akin to the fast-developing methodologies we now use for environmental impact assessment and audit.

Institutional Arrangements

Institutions are organisations constituted for a particular purpose. They can be formal or informal, ephemeral or long-term, public or private sector, and operate at local, community, national, regional or international level.

They are the principle vehicles by which policies and regulations are made and implemented, business and commerce are organised, and individuals and communities participate in and influence events.

One of the most frequently recorded causes of development failure has been institutional short-comings. This leads to calls for institutional strengthening and capacity-building. More recently, the need to reduce public expenditure, and to improve national economic performance, has resulted in the logical conclusion that many functions and institutions currently in the public sector to move into private control. We are all familiar with the key words of these processes: accountability; structural adjustment; institutional reform; re-inventing government; right sizing; market testing; decentralisation; and privatisation. There is a danger of replacing large ineffective bodies with smaller, powerless ones. However, we should now look critically at the institutional arrangements, mandates and ownership.

The institutional arrangement for land systems management differ between countries. Responsibility for forests and forestry can be found in ministries of environment; agriculture, state, regional and provincial bodies; industry and wildlife. For agriculture and rural space, often a different combination has evolved. Small wonder that policies can conflict. But recent developments in most countries, since Rio, to create some means of inter-ministry coordination to promote and monitor sustainable development should help improve the integrated approach to land management, and achieve a mutually-supporting and reinforcing approach.

Many non-governmental organisations have blossomed; they have done a great deal to create awareness of issues, organise communities, and increase the diversity of views that influence land use, forestry and agricultural policy. Some have played an invaluable role in developing and testing new systems and approaches to better, more sustainable practices. However, others have fueled controversy sometimes, making negotiation, compromise and consensus difficult to achieve. On balance, NGOs have probably done more to move environmental and social issues up the political and international ladder than well-founded science.

There are lessons to be learnt from the NGO experience: professional and scientific bodies could benefit by working more closely with them, while they are so effective.

Institutions should, in the future, provide effective means not only to create and implement policies, codes and regulations, and carry out research, but also to provide effective fora and mechanisms to resolve conflict, monitor the impact of development and give early warning of stress or failure in biological systems. It would be unrealistic to expect a single institution - public, private or non-governmental - to be able to handle all the complexities of this agenda. Our experience in a development agency has been that integration of effort and conflict resolution can only be effectively resolved by starting at the local level around a specific issue or problem. Local government and community based organisations can provide an institutional basis for this approach. However, activities will need to be set in an enabling framework of policies and legislations that can avoid distortions, and balance the views and needs of the constituencies.

At an international level, we have a crop of new institutions. Apart from the UN CSD, which I mentioned earlier, we now have a series of environmental conventions and agreements, all of which focus on some important, but specific, environmental concern. These agreements are not designed to take the comprehensive (or holistic) perspective that will be needed to combine them into sustainable livelihoods at national and local level. Only the Desertification Convention recognises the strong interactions and linkages between people, livelihoods and land degradation. There is a danger that national forest biodiversity, energy, transport, food security and environmental protection plans will not mutually reinforce the objectives of each. They could create conflicting institutional mandates.

There is a need for effective means to take an overview and handle coordination at a national level.

In recent years, the UN agencies and bodies have not fared well. It is easy to sympathise with the tension they feel in trying to serve the often conflicting needs of their members. They have a vital role to play in providing fora, building consensus, promoting international standards, and improving the dissemination of information and best practise. However, with reduced budgets, they must focus their work and find ways of working better with each other. Governments have to be more consistent about what they want. Too often, Government delegations to international negotiations represent a sectional interest rather than a coherent approach to sustainable development. This encourages UN agency turf wars and allows individual agencies to go their own sweet way.

Institutions must therefore adapt and respond - if they cannot, they should go; however, we must be careful not to create new ones until we are certain that old ones cannot do the job!

Intensification

The need to meet the increasing demands for biological products will inevitably require some intensification in land use, and higher levels of output from existing production systems. I do not intend to spend time in this paper on the potentials for biotechnology and other techniques to enhance production in environmentally sustainable ways; you are the experts in this field, and your Conference brings together a wealth of talent and ideas. Nor do I wish to enter the dangerous ground of where intensification might take place.

In my view, plantations and agroforestry have important roles to play in more integrated and intensive land use systems. Properly sited and well-managed plantations can production and help to restore soil fertility, improve microclimates, protect land and water systems, as well as supply a constant, cheap and uniform source of biological products. However, they are not a 'panacea'. Large areas of monocrop of uniform age and with low genetic diversity can attract many adverse environmental and pest and disease problems. Plantations can displace local communities, destroy or destabilize traditional sources of livelihood and reduce biological diversity; which can therefore destroy the basis of their sustainability.

However, intensive monocultural systems are probably the only way that demands for biomass will be met, and at least some natural forest and other habitats will be conserved. Large markets and modern industry demand a constant supply and uniform product with which to work, and current extraction techniques from natural forest can be very wasteful and destructive.

There are examples of where it has been possible to combine areas of natural forest, plantations, farming and community needs into productive systems that have endured the test of time. In these instances, the secret has often been an overall land use policy, albeit an imposed one, and a unified management structure. In my view, plantations will be an essential component of future supply models; but we should devote more effort to developing systems that counter their social and ecological shortcomings.

Can Agroforestry Help?

Agroforestry purposely combines and aims to capture the synergies between trees, crops and sometimes livestock. It is an attractive concept.

Many traditional systems of farming are forms of agroforestry that have developed over many generations of trial and error. Shifting cultivation combines trees, crops, livestock and other extractive forms of activity to meet the needs of small communities. The productivity of these land-use systems often declines due to losses of fertility and build-up of pests, diseases and weeds, sometimes accompanied by human disease, sanitation and water problems. These types of land use can only be sustained at relatively low levels of intensity, interspersed with 'recovery periods' of several years.

A good deal of useful work has been done to enhance the components and productivity of agroforestry systems, or to finding alternatives to shifting, slash and burn land use systems. The work on multipurpose trees and alley-cropping are examples; however, this work has not yet produced the benefits expected of it. It is probably too soon to expect this, but it points to a need to monitor closely the uptake and impact of this work.

Where will be agroforestry research in 5 or 10 years time? Will agroforestry subsume agriculture and forestry or prove to be an ephemeral? If we are dealing with a land use continuum that aims to meet human needs or aspirations, how long can we go on working on the separate building blocks without devoting more effort to their integration? Can we expect the small rural producer to cope with the

sometimes conflicting advice from various pressure groups and technologists, from agriculture, forestry, agroforestry, etc., in the face of increasingly complex market signals? Working on the rural issues requires a systems approach that looks at rural space, rural livelihoods, human needs, and balances them with biological realities and opportunities.

Conclusion

The increasing demands of humanity for biological products and other land values, such as space, infrastructure and amenities will require better land use systems. Systems include people; they dominate the system.

This implies a more ordered and orderly land use based on the judgements of local communities, conditioned by the biological realities and the needs and views of other stakeholders, underpinned or enforced by necessary legislation. It is unlikely that simple demand/supply models or market mechanisms will be able to achieve or sustain better land use practices. Negotiation, trade-offs and compromises amongst stakeholders, based on a better knowledge of options, opportunities and consequences, will be the process by which land use is decided. The difficulty will be to develop mechanisms by which the biological realities and 'voices' of the key stakeholders are balanced. Empowerment, the balancing of needs and avoiding the confusion of need and greed, is the role of government and non-government organisations. We need institutions that facilitate and research which better informs this process. What then will be the role of foresters and agriculturalists?

As the relative and, in many cases, absolute numbers of people who depend on agriculture and forestry for their livelihoods decrease, our ability to be an influential voice will depend increasingly on our ability to satisfy the needs and aspirations of the non-forestry and non-farming communities. Foresters and agriculturalists must be able to provide options, inform the debate, and develop the technologies that work.

We must shed our image of being destroyers and polluters or excluders of people from the land resource. We can and must demonstrate a capacity to understand social needs, devise systems that spread the benefits to a wider spectrum of beneficiaries and hence increase the 'value' of the resources to more people. We must be able to provide options, not single solutions. Above all, we must work together to understand people and meet the needs of society. We will become (if we are not already) rural service providers or rural space managers, delivering biological products to the specification, quality and standards set by consumers; while, at the same time, managing rural space in a way that optimises access, amenity values and other factors that contribute to wealth, equity or the quality of life.

There is much talk of comprehensive or holistic approaches, using multidisciplinary teams. These teams can be hi-jacked by the interest of special interest groups, or become adversarial experiences. The difficulty in any negotiations is knowing when, how and what to compromise. There are some absolute issues where compromise cannot work - if the productive capacity of a natural system is fixed, while the user groups want to extract at a higher level, then a compromise between midway between the two will

inevitably degrade the resource. However, a compromise on sharing the financial profits of an activity should be sustainable.

We probably need a new 'tool-box' to assess needs and design technologies. However, to use these tools effectively, we need to be clear on the objectives:

- What are we setting out to achieve?
- What does society want of its forests, agriculture and land space?

Once we have answers to these questions, the role of the researcher and resource manager becomes clearer and easier; coordination becomes more purposeful.

I have tried in this paper to depict a future in which the demand for biological products will increase. The conditions under which these demands will be met, and success judged, will be determined not only by physical, economic and ecological criteria, but increasingly by the social and cultural values of consumers, most of whom will not be foresters or farmers. We need to be better informed of these constraints, demands and values if we are to be effective in addressing them. We must recognise that the resolution of this complex of demand will require informed dialogue, negotiations and compromises that work. We need to reflect on how our own expertise and approaches might be developed to fulfil this challenge. The current institutional arrangements may not provide an adequate or efficient framework to handle these complex issues. However, given current economic realities, the creation of new institutions, using new and additional resources, is unlikely. The older ones must adapt or close.

I started by observing that foresters have a unique understanding of time and place. However, other interest groups are invading that time and space. Human needs and aspirations have accelerated time; ease of travel has reduced space. There are and will be destructive conflicts of interest unless we can improve the quality of dialogue and negotiations, and speed up biological production and better land use.

I hope that IUFRO can help and promote this evolutionary process.

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OE Nov 21, 1996