EXECUTIVE SUMMARY: GLOBAL MEGATRENDS IN FOREST QUALITY

The United Nations Conference on Environment and Development (UNCED or the Earth Summit) agreed a global strategy to tackle environmental problems in Rio de Janeiro in June 1992. Five years on, the UN hosted a UN General Assembly Special Session (UNGASS) in New York to review progress, particularly on *Agenda 21*, the document agreed at UNCED.

Forest loss was a key issue at the first Earth Summit. The *Non Legally Binding Authoritative Statement of Principles for a Global Agreement on the Management, Conservation and Sustainable Development of All Types of Forest* - the *Forest Principles* - were agreed as a strategy to address issues such as deforestation. But has anything really changed? We review five turbulent years in the world's forests, identifying ten or *megatrends* relating to the status, treatment and perceptions of forests and five *issues to watch* in the future.

MEGATRENDS

1. ***FOREST LOSS HAS CONTINUED - and in many countries has continued to* accelerate - *since the Earth Summit.*** We identify 20 countries - only a sample - where forest loss has increased dramatically since UNCED.

2. ***NATIONAL AND INTERNATIONAL FOCUS ON FORESTS - the years since UNCED have seen intense activity on forests at both national and international levels*** - including the Intergovernmental Panel on Forests, the World Commission on Forests and Sustainable Development, regional forest conferences and many new national forest policies. We assess their significance.

3. ***FOREST QUALITY AND FOREST FUNCTIONS - this has resulted in important changes of perception, particularly amongst governments, towards issues such as forest quality and the role of local people in forest areas.*** One critical change is an acceptance, at least amongst politicians and more far-seeing members of the forest industry, of the importance of **sustainable forest management** - including consideration of ecological, social and economic factors - rather than just producing a sustained yield of timber. We review regional *criteria and indicator* initiatives.

4. ***THE ROLE OF THE STATE AND PRIVATE SECTOR - the role of the state has continued to decline, with a parallel increase in the influence of transnational companies (TNCs.*** There have been several important forest privatisations in the 1990s and many states have also been hampered by lack of money. Conversely, TNCs have spread their operations far further than in the past, and the increasing role of Asian timber TNCs is of particular importance. We look at where companies come from, where they are operating, and at the threats that they pose to forests.

5. ***PULP, FUELWOOD AND TIMBER - fuelwood use remains high, while demand for pulp will soon exceed that for industrial timber.*** The total amount of fuelwood burnt continues to increase. The importance of industrial timber is being eclipsed by the growing demand for pulp and fibre, which has important implications for forest management, choice of trees to be planted and non-timber benefits associated with forests. We identify key areas where pulp plantations are replacing natural forests.

6. ***PEOPLE AND FORESTS - people are increasingly seen as part of the* solution *to forest loss, instead of part of the problem.*** In many areas local people - if the right opportunities exist - can play a key role in maintaining stable forest ecosystems. Conversely, efforts to manage forests *without* local support usually fail. Ideas of participation, co-management and insider-driven initiatives have gained important support and international profile since UNCED. We review the changes in attitude.

7. ***PROTECTED AREAS - the role of forest protected areas is also changing.*** Protected areas that exclude local people - sometimes from their traditional homeland - are increasingly seen as unethical and unworkable. New attitudes to the role and functions of protected areas, and new approaches to their establishment and management, have emerged since UNCED. We review some new initiatives.

8. ***THE ROLE OF THE PRIVATE SECTOR - a proliferation of private, community, NGO and industry initiatives are complementing, and sometimes replacing, the role of the state.*** These include the development of forest certification - a concept that was hardly even recognised at the time of the Earth Summit, private protected areas, NGO field projects, grassroots movements in protection of forests and partnerships between different interest groups concerned with forest conservation.

9. ***AIR POLLUTION - the influence of air pollution is continuing to spread and understanding about the potential impacts of global climate change has increased since UNCED.*** Tree decline in Europe has increased every year since UNCED. New signs of decline have also been identified in North America, Asia and the Pacific. More importantly, climate change is now seen as posing a critical threat to several unique forest ecosystems. We identify some threatened ecosystems.

10. ***CHANGING VALUES - economic indicators of forest management are being superseded by recognition of other values, including cultural, aesthetic, spiritual and local benefits.*** The Earth Summit came at the peak of monetarism and an apparently unstoppable belief that everything can be reduced to financial values. Over the past five years, this philosophy has been comprehensively eroded.

ISSUES TO WATCH

The next five years will be of critical importance in determining the type of forest estate that we pass on to the next millennium. They will show if the changes in attitude can result in significant changes in forests themselves. We list five areas which we predict will become of key importance in the near future and which will, in turn, affect the shape of forest policies.

1. ***The importance of exotic and invasive species will increase and their control will start to affect forest conservation policies.*** Some conservationists already believe that of introduced species are equal to habitat destruction as a threat to biodiversity. Threats are growing, including the impact of introduced diseases, viruses and pests. Cutting roads into forests helps the spread of aliens. Local species are often out-competed. We list some alien species posing major threats to forest biodiversity.

2. ***Biomass will increasingly be used as a source of energy to replace fossil fuels.*** There is growing interest in increasing the proportion of biomass in national energy supplies, both because fossil fuels are non-renewable and for political security in countries with few other energy resources. However, even medium-scale adoption of biomass for energy in developed countries would have important implications for forest and other land management. We look at some of the implications.

3. ***The importance of non-timber forest products (NTFPs) will be increasingly highlighted, and will start to have a major impact on forest management decisions.*** On a global scale, interest in timber disguised the importance of non-timber forest products. Since the Earth Summit, the multiple purposes of forests have been increasingly recognised. Such interest will develop into concrete forest management policies. We review some key NTFPs and suggest likely trends.

4. ***The techniques and application of forest restoration will both grow rapidly.*** Forest restoration increasingly seen as an option in countries suffering environmental and social problems as a result of low or poor quality forest cover. Techniques from the new science of restoration ecology are being employed in an attempt to restore whole ecosystems. We look at options.

5. ***The spiritual value of forests will play an increasingly important role in setting management policies.*** For many people, the spiritual values of forests or even of individual trees is of critical importance, although such issues often overlooked. Collaborations between religious groups and conservation interests show the benefits of bringing such issues into the mainstream. We look at cases where spiritual values affect forest management policies and suggest possible developments in the future.

MEGATREND 1: CONTINUED FOREST LOSS

Deforestation has continued at a catastrophic rate in most tropical countries. Global losses are partially disguised by *increases* in forest cover in the temperate and boreal region. Despite claims that the problem is receding, we have identified a sample of 20 countries around the world where the forest situation has declined sharply since the Earth Summit:

- ***Losses continue in the tropics***: rapid deforestation continues in the tropics. The UN Food and Agricultural Organisation estimates annual average losses of natural forests in the tropics as running at 13.7 million hectares between 1990 and 1995, which is a slight decrease on the previous decade[1].

- ***These are partially offset by gains in temperate and boreal regions***: between 1980 and 1995, forests in the developed world expanded slowly, by some 20 million hectares, through afforestation, reforestation, plantation establishment and natural regrowth on abandoned agricultural land[2].

- ***However, old-growth forest is being lost throughout the world***: even where forest cover is constant, in many cases old-growth forest is being felled and replaced with new regrowth or with plantations.

- ***The net result still amounts to rapid forest degradation:*** we have identified (see Table 1) twenty countries in which net deforestation has increased rapidly since the Earth Summit: Russia, georgia, Latvia, Romania, Canada, USA, Brazil, Bolivia, Surinam, Guyana, Cameroon, Democratic Republic of the Congo, Indonesia, Malaysia, Laos, Cambodia, Myanmar, Papua New Guinea, Vanuatu and Australia (*see Table 1*).

Conclusions: *Forest loss has continued in many countries. It is particularly worrying that these include some of the most important remaining areas of forest in the world.*

MEGATREND 2: INTENSE POLITICAL ACTIVITY

When the Earth Summit failed to agree a Global Forest Convention, many observers thought that forests would drop off the political agenda for years. In fact, the reverse has happened and forest management has been the focus of constant international attention. Some of the main events and initiatives include:

- **Post-UNCED development**: A long process of international research and debate arising from UNCED, via the Commission on Sustainable Development, the Intergovernmental Panel on Forests (IPF) and the Intergovernmental Forests Forum (IFF) (*see Table 2*). Confusion - sometimes apparently deliberate - between different initiatives has wasted time and opportunities to tackle urgent forest conservation issues, including ambiguity about the roles of the Convention on Biological Diversity and the IPF and infighting between the various criteria and indicator initiatives[3] (see Megatrend 3).

- **Data gathering**: A movement towards more accurate and comprehensive reporting of forest condition and forest functions, as a way of both defining and marking progress towards sustainable forest management. This includes more comprehensive forest resource assessment[4] and the global **criteria and indicators** initiatives (see Megatrend 3).

- **Research**: A fresh impetus towards research, particularly on policy issues, including the establishment of two important new research organisations (Centre for International Forestry Research and the European Forest Institute) and new developments in many existing institutions, such as FAO (see Megatrends 5 and 10).

- **Non-governmental initiatives**: A parallel series of initiatives on social and environmental aspects of forest management, including the World Commission on Forests and Sustainable Development, the launch of the Forest Stewardship Council, development of industry groups committed to sustainable forest management and in increase in NGOs committed to forest conservation (see Megatrends 6-8).

Conclusions: *Unfortunately, although official developments have created major changes in* ***attitude****, these have often not been translated into* ***action****. There is widespread frustration with many government-led initiatives and an increase in non-governmental action. Nonetheless, some governments have made positive changes in forest policy since UNCED.*

MEGATREND 3: NEW ATTITUDES TO SUSTAINABLE FOREST MANAGEMENT

One positive result of the post-UNCED initiatives is that the lip-service paid to multipurpose forest management has been strengthened by both theoretical development and practical experience. Three changes in attitude have occurred:

- ***The importance of forest quality has been widely accepted***: even where forest cover remains constant, degradation often occurs; natural forests are weakened, converted to other land uses or replaced by intensively managed forests or plantations. This often impairs ecological functions and reduces biodiversity. Over the past five years, there has been a realisation that the *quality* of forests can be as important as the *quantity* of land under trees[5].

- ***Sustainable forest management is being promoted, rather than just sustained yield of timber***: in the past, most forest management has aimed to maintain timber yield over time. Discussions at intergovernmental level have reached agreement on the inadequacy of this measure, and on the need for a broader definition of *sustainable forest management* which takes account of environmental, social and economic considerations[6].

- ***People are gradually being put back into the picture***: a major factor in these philosophical developments is a more balanced approach to the role of people in forests. This is examined in detail in Megatrends 6-8 below.

One practical manifestation of these changes on an international level has been a series of attempts to develop *criteria and indicators* of sustainable forest management, to provide ways of measuring success at a national level. The seven criteria and indicator initiatives are summarised in Table 3.

Conclusions: *There have certainly been important changes of attitude amongst governments. Criteria and indicator initiatives have been successful at stimulating debate within and between governments, and probably also in helping change forest management policies on national levels. However, it is too early to assess their overall significance - which will depend on the extent to which affect changes on the forest floor itself.*

MEGATREND 4: GROWING INFLUENCE OF TRANSNATIONAL COMPANIES

The twin trends of corporate globalisation and the reduction of state powers have continued. As a result, new forests have been opened up to transnational companies (TNCs). Most of the world's remaining tropical forests are *already* mapped in concessions, ready for logging. Most operations are unsustainable even in terms of timber harvest[7], and many have disastrous impacts on biodiversity, the environment and the lives of local people. We identify five major trends and in Table 4, look at 20 sample countries undergoing predatory logging:

- ***State ownership is being replaced by private investment***: many governments are selling off forest. For example, since privatisation of the New Zealand forest service in 1985, much of the forest has been sold to foreign TNCs, for example from Japan and Malaysia, and a state company in China[8].

- ***Government debt is encouraging private investment***: debt problems are forcing governments to accept foreign investment in logging, even when returns are poor. For example, economic problems have led the Surinam government to encourage companies from Malaysia, Indonesia and China to bid for 3.6 million ha of concessions, which would destroy the area's largest remaining rainforest[9].

- ***Globalisation is helping companies to invest in new areas***: since UNCED, TNC involvement in logging has spread to new countries and radically increased in others, including for example: the Russian Federation, Romania, Uzbekistan, the Amazon, temperate South America, Cambodia and Laos (*See Table ##*).

- ***New transnational companies are emerging***: particularly from the Asian "tiger" economies in Malaysia, Indonesia, China, Taiwan and South Korea[10]. Asian logging companies operate in every continent and have been linked with many illegal operations. Meanwhile, North American companies have extended their operations to South American particularly in the temperate regions[11].

- ***Transnational logging by European companies is continuing***: many European TNCs are continuing to operate in tropical forests, particularly in Africa[12].

Conclusions: *the detrimental impacts of transnational logging companies has* ***increased*** *since UNCED and is now the principle threat to forest biodiversity in many regions.*

MEGATREND 5: CHANGING USES OF TIMBER

Fibre continues to replace timber as a main use of industrial wood. This has important implications for approaches to forest management, the survival of natural forests and the role of forests in the control of climate change. We identify four major trends.

- ***Pulp is replacing timber as the most important output from commercial wood harvest***: currently, around 45 per cent of industrial timber production goes to pulp[13] and this is likely to increase further[14]. Fibre is used to make paper, card and a wide range of reconstituted materials.

- ***Natural forests are being replaced by plantations***: a number of countries have made a decision to become major fibre producers and are deliberately replacing natural or semi-natural forests with pulpwood plantations. For example, the government of Indonesia intends to replace 2 million hectares of forest with plantations by the year 2000[15]. Major plantations have also been established in the place of natural forests in Brazil and Chile[16] (*see Table 5*).

- ***Management of semi-natural forests is being intensified to produce fibre***: this can include increased use of agrochemicals, rapid rotations, whole tree harvesting, mechanised production and extensive planting of exotic species. Intensification of forest management has taken place widely in Europe, parts of North America, and increasingly also in many developing countries.

- ***Timber grown in plantations tends to be used quickly, and the carbon stored thus released into the atmosphere again***: a major argument used to justify establishing plantations is that trees can store carbon and help reduce the impact of global warming. However, the fibre from plantation trees tends to be used up quickly, in short-life products such as paper and card. Some research suggests that half the carbon stored can be released into the atmosphere again within five years of felling.

Conclusion: *The continuing shift from timber to fibre has important implications for forest quality, and for wider uses of forests, that have often been missed in general discussions about forest planning and management.*

MEGATREND 6: THE INCREASING IMPORTANCE OF PEOPLE

Until recently people have often been tacitly regarded as part of the "problem" of forest conservation - felling trees, gathering firewood and killing wildlife. Over the past decade, this analysis has come under increasing criticism. Since 1992, there has been a general change in attitude and understanding towards forest-dwelling people; the challenge remains to translate this into concrete policies. We identify three major stages in this evolution:

- ***People are not always the* cause *of deforestation***: studies by ecologists and social anthropologists have found many examples of local communities sustainably managing forest ecosystems. Examples include people on the savannah/forest edge in Guinea[17], Himalayan people in Nepal[18] and forest gardeners in the Peruvian Amazon.

- ***Forest policies which ignore local peoples' needs almost always fail***: conversely, approaches that address the needs of all stakeholders can provide long-term solutions. Projects have demonstrated that co-management, insider-driven initiatives and participatory approaches all help to develop sustainable forest management policies[19]. Examples include management of mountain forest in northern India[20], reforestation in boreal parts of Scotland[21] and maintenance of flooded forests in Amazonian Brazil[22].

- ***The importance of indigenous and local peoples' rights is being recognised***: many past attempts to conserve forests have resulted in the exclusion of local people from their traditional lands - for example 80 per cent of protected areas in Latin America have people living inside them[23]. The ethical and practical problems of such an approach are now being recognised. As a result, new initiatives have been undertaken[24], including a set of principles for conservation in indigenous lands, drawn up by WWF and the Indigenous Peoples Alliance Against Rainforest Destruction[25].

Conclusions: *Unfortunately, there is still more rhetoric than reality with respect to people and forests. Although the ideas of participation and peoples' rights are receiving attention, there has been too little change in practice. This remains a critical challenge for the future.*

MEGATREND 7: RETHINKING PROTECTED AREAS

Rapid deforestation and forest degradation has heightened the need for *forest protected areas*. We identify six major trends...

- ***The need for a coherent* network *of protected areas is now recognised*** - rather than just choosing exceptional wildlife sites (or setting aside the least valuable land) - it is now accepted that protected area networks should include *representative samples of all major habitat types large enough to allow permanent survival of all biodiversity*[26]. Planning tools, such as gap analysis, are being developed[27].

- ***Some countries are close to completing their networks***: the period since UNCED has seen a rapid increase in protected areas. However, in others the government now claims that enough areas have already been set aside.

- ***Protection is often ineffective***: either because governments do not meet commitments; or because indigenous and local people have been displaced from their traditional lands and therefore continue to use it illegally. Some parks have been opened up to mining and logging, or degazetted[28].

- ***Authorities are trying new approaches to protection, including working with local people***: such as collaborative management schemes, co-management, joint planning, participatory methods etc. Local and indigenous people are sometimes seeking protected area status for a proportion of their traditional lands as part of an integrated approach to management[29]. New categories of protected areas have been developed (*see Table 6*).

- ***New ownership and management patterns are also being tried***: including private reserves, community protected areas[30] management by local authorities, religious groups[31] and private companies.

- ***Protected areas are therefore starting to fulfil a wider range of roles than they have in the past***: rather than just places for wildlife, protected areas are now increasingly seen providing environmental services, maintaining traditional lifestyles and creating recreational benefits[32].

Conclusions: *there appears to be a new energy for developing protected area networks, for example through the WWF* Forests for Life *campaign* (see Table 7). *However, there is still a great deal of progress needed in terms of* ***management*** *of protected areas and in working out their relationship with local human communities.*

MEGATREND 8: PRIVATE INITIATIVES

Frustration with government and inter-governmental initiatives has created a wave of non-governmental post-UNCED initiatives on forests, ranging from tiny local developments to the launch of international organisations. We list five examples:

- ***Independent certification***: since the Earth Summit, cooperation between NGOs and industry has developed an international forest certification system, including an umbrella organisation (the Forest Stewardship Council *see Table 8*), moves towards national standards in a dozen countries and the growth of buyers' groups - industry representatives interested in the development of certification[33]. For example, in the UK a quarter of the timber bought now goes to sources committed to buying only certified timber in the future.

- ***Growth of private reserves***: as many states run out of funds and impetus for forest conservation, an increasing number of protected areas are being established by private individuals, foundations, conservation organisations, companies, religious groups and local authorities. Private reserves are now covering almost the same area of land as government protected areas in some countries.

- ***NGO field projects***: similarly, since UNCED the number of privately-funded forest conservation projects has continued to increase. Major conservation NGOs now invest hundreds of millions of dollars a year in forest conservation around the world, often dwarfing government budgets.

- ***Grass roots responses***: these developments have been mirrored by a surge in the number of grass roots organisations - large and small - that are addressing key issues relating to forest conservation.

- ***Partnerships***: as a result of these changes, new *partnerships* are forming - between NGOs, local groups, companies, aid agencies, indigenous peoples and others - interested in positive change in forests. This issue is discussed in more detail in *Future Issue 5*.

Conclusion: *With a few honourable exceptions, most governments have not met either the spirit or the word of the UNCED agreements,* Forest Principles *or* Agenda 21. *On the other hand, a growing network of non-governmental responses are increasingly taking on the initiative of forest conservation around the world.*

MEGATREND 9: AIR POLLUTION IMPACTS ON FOREST QUALITY

Despite the Climate Change Convention being one of the few tangible outputs of the Earth Summit, countries have failed to treat pollution control with the seriousness it requires. The five years since UNCED have been marked by scientific squabbling, an industry backlash and lacklustre policies. We identify four key trends.

- ***Tree health has continued to decline around the world***: in Europe, the annual survey by the UN Economic Commission for Europe and the Commission of the European Communities shows that the proportion of trees showing signs of serious damage has increased more-or-less steadily over the past decade (*see Table 9*)[34]. Research in Asia and the Pacific[35], and in North America[36], shows similar trends.

- ***Causes of forest decline are likely to be complex***: most forest decline is due to a variety of factors, which can include management practices, climate[37], air pollution levels[38] and pests and diseases. Growth rate of trees in central Europe has actually increased over the last few years[39], perhaps due to the fertilising effects of some air pollutants, although health continues to decline[40]. Air pollution is also linked with declines in many forest-living species, including susceptible lichens, mosses and flowering plants[41]. Air pollution levels continue to exceed those capable of being neutralised by ecosystems throughout much of Europe[42].

- ***Global warming is increasingly recognised as a significant threat to forest ecosystems***: although the precise impacts remain the subject of intense debate. Forests at threat have been identified in the boreal region, some fragmentary tropical forests and isolated or relict communities, including many island forests.

- ***Political ground has been lost since UNCED and countries are failing to meet pollution reduction targets***: major energy corporations have successfully pressurised governments to renege on commitments made under the Climate Change Convention. Attempts are being made to shift the focus towards carbon sequestration and the scientifically dubious approach of planting trees to soak up carbon[43].

MEGATREND 10: THE DECLINE OF THE DOLLAR

The Earth Summit came at the crest of a wave of monetarism and at the end of the "greed decade" in the 1980s. Analysts and politicians were obsessed with the power of the financial mechanism, and many people argued that *everything* could and should be reduced to economic terms. Environmental protection, biodiversity and even the value of a view became subject to analytical methods that produced a value in dollars, marks or yen.

Such approaches were encouraged by the common view that everything of importance to forest quality should be measured in strictly quantifiable terms. In practice, this resulted in many important forest functions either being ignored because they could not be measured, or assessed using inaccurate or distorting methods.

In the five years since the Earth Summit, such extremes have been quietly abandoned. The question is not so much if it is possible to provide an economic yardstick for such issues, but whether such measures are accurate, or useful. One of the heartening aspects of discussions about criteria and indicators of forest condition, for example, is that there is now a widespread acceptance that not all the important aspects of forest quality can be represented by neat figures on a table.

This, in turn, has opened up the possibility of including far more subtle and complex issues within the forest debate. Issues of the spiritual value of forests, the role of people, ethical values of conservation, local distinctiveness and aesthetic and cultural considerations have, once again, had the opportunity to be heard.

FUTURE ISSUE 1: ALIEN INVASION

For the past decade, conservationists have been concerned with deforestation and forest quality. We predict that a third element will soon assume equal importance: **the integrity of forest systems and the impact of alien and invasive species of flora, fauna, pests and diseases** (*see Table 10*). Four issues are important:

- ***planting exotic tree species in the place of natural forests***: this has already advanced to an extreme level in some temperate countries - for example Scotland has over 90 per cent of its forest cover as exotic species[44] - and is increasing fast in many tropical countries such as Peninsula Malaysia and parts of Indonesia.

- ***other alien plants***: on a global scale a greater threat may be caused by accidentally or deliberately introduced plant species capable of spreading quickly and out-competing native species[45].

- ***alien animals***: of equal importance in some countries - particularly Australia and New Zealand[46] - is the impact of invasive animal species, which often penetrate into native forests along logging roads and can wreak havoc with native species.

- ***pests and diseases***: a fourth factor, of immediate relevance to forest managers, is the impact of introduced pests and diseases, which in the absence of natural control mechanisms can sometimes destroy huge areas of forest - for example the damage currently being caused by the exotic root pathogen *Phytophthora cinnamoni* to oak in the Mediterranean[47].

Controlling aliens is already the number one conservation question in parts of Australia, New Zealand and Hawaii - this concern is likely to become more general in the future.

FUTURE ISSUE 2: BIOMASS FOR ENERGY

Currently, wood fuel is often regarded as an energy source for the poor. We predict that over the next decade this attitude could well undergo some dramatic changes, with the issue of biomass for energy assuming central importance in discussions about forest policy. Two issues will be critical:

- ***small-scale energy sources***: particularly the need to maintain stocks of woodfuel for the two fifths of the world's population currently using this as their major source of energy[48];

- ***alternatives to fossil fuels***: will be needed, partly as a result of the finite nature of fossil resources and partly for political reasons as oil-poor countries look for domestic alternatives. In the future, plant material will not just be used for combustion, but will be converted through a series of physical and chemical processes, including pyrolysis, gasification, hydrogasification, anaerobic digestion, fermentation and chemical reduction (*see Table 11*)[49].

Energy needs will increasingly shape forest policies, and raise the attractiveness of intensive plantations, which will itself have major implications for forest policy.

FUTURE ISSUES 3: NON-TIMBER FOREST PRODUCTS

For the last fifty years, the needs of timber production have tended to dominate those of other forest functions in many areas. We predict that this will gradually change, and that the importance of non-timber forest products (NTFPs) will also be increasingly recognised (*see Table 12*).

Over the last few years, research has shown that NTFPs play a key role in rural communities, both in developed and developing countries. The FAO lists many products, including pharmaceuticals, toxins (for hunting, pesticides etc), aromatics (including essential oils for cosmetics, unguents, incense etc), biochemicals (such as non-edible fats and oils, waxes, gums, latex, dyes, tannins, paints, varnish, etc) and fibres (for cloth, matting, cordage, basketry, brooms, stuffing for pillows, cork etc)[50].

In the next decade, several trends will become apparent:

- ***production***: there will be an increased emphasis production of NTFPs in forests, which will affect forest management[51];
- ***marketing***: a larger range of NTFPs will become available on both national and international markets[52];
- ***evaluation***: NTFPs will be the subject of more careful analysis in forest resource assessment, national forest plans etc[53];
- ***conflict***: friction between those interested in timber and NTFPs will increase, particularly in areas where resources are scarce or populations are high.

Management of potential conflict between those interested in timber and non-timber forest products will become an increasingly important element in forest landscape management in the future.

FUTURE ISSUES 4: FOREST RESTORATION

To date, most of the world's attention regarding reforestation projects has focused on industrial methods of afforestation, often incorporating large plantation-style approaches. Whilst these can sometimes be useful, we predict that in the future far more emphasis will be given to the many other options available, many of which offer a considerably wider range of benefits[54]. Many other models are actively and successfully being pursued by local communities, far from the gaze of international policy groups and corporations. There is now an urgent need to draw this experience together into national and global commitments to the *restoration of high quality forests* in the many areas where these have declined or disappeared.

We predict that forest restoration will become increasingly important in four situations:

- ***historical losses***: in places where historical forest loss has altered the landscape, there will be increasing moves to replace this - often as community forests or multipurpose forests. For example the UK government intends to double the area of woodland in England, adding a million hectares of trees[55].

- ***current deforestation***: where forest loss is often resulting in soil loss, desertification etc and more trees are urgently needed. For example, around a million hectares of non-industrial forestry were re-established in India each year between 1980 and 1990[56].

- ***areas with high tree cover but low forest quality***: where forests still exist but there are currently efforts to improve the quality of these from a social and/or ecological perspective.

- ***areas where agriculture is being abandoned and alternative land-use options are needed***: as is happening for example in large areas of upland Europe.

Forest restoration is gradually evolving away from the relatively simple science of planting trees into a more complex science (and to some extent art) of restoring ecosystems and cultural landscapes. This trend will continue in the future.

FUTURE ISSUES 5: SPIRITUAL AND CULTURAL VALUES OF FORESTS

A large proportion of the world's forests have a spiritual or cultural importance to someone or some group. We predict that these aspects of forest quality will become both better recognised and more completely integrated into forest management in the future.

Spiritual values have, until recently, tended to be ignored by people managing forests. They are hard to measure and draw on particular philosophies which may well not be shared by forest managers or by policy makers. However, they are a major, and sometimes the dominant, motivation for managing a significant proportion of the world's remaining natural or semi-natural forests - as sacred groves, burial sites, or because forests are associated with particular religious institutions or beliefs. Since UNCED, there has been a rapid growth of understanding about these issues, and a recognition that spiritual values are often complementary to management for conservation or for relatively non-intrusive uses such as collection of some non-timber forest products.

Examples of such interactions include:

- management of *kaya* forests in coastal regions of **Kenya**, which have spiritual importance to local people and also provide the last examples of unique forest habitats;

- conservation of sacred groves in otherwise deforested areas of **Ghana**;

- use of pilgrims to a Hindu shrine in northern **India** to take part in reforestation activities as part of their spiritual activities;

- the conservation of *tembawangs*, which act as fruit gardens and burial sites in Kalimantan, **Indonesia** and also form the main biodiversity sites in areas that have been degraded by slash and burn agriculture.

Partnerships between spiritual and conservation interests offer important opportunities for new approaches to forest management, which are now starting to be addressed, and will become increasingly important in the future.

Table 1: Countries undergoing serious forest loss since UNCED

Region/Country	Details
Former USSR	Collapse of internal order and rapid growth of illegal logging, including operations by foreign logging TNCs and major pollution problems have all increased pressures on forests in **Russia**[57]. Many other former Soviet Republics have increased logging, sometimes as a result of domestic energy shortages (eg **Georgia**) or to satisfy a growing export market (eg **Latvia**[58]), putting unique old-growth forests under threat.
Central Europe	Similar changes are taking place in other former Soviet bloc countries; for example in **Romania** there is currently increasing logging for fuelwood and a growing impact from foreign TNCs.
North America	Important new areas of **Canada** have been opened for logging since UNCED, and controls on logging old-growth forests have been relaxed in the **USA**, putting whole forest ecosystems at risk[59].
Amazon basin	Rate of forest loss has increased by 34% since UNCED in **Brazil**[60] and deforestation has reached critical levels in **Bolivia**.
Northern Latin America	**Surinam**[61] and **Guyana**[62] are opening forests for logging mainly to Asian TNCs, threatening the largest area of pristine rainforest in the region.
West Africa	Logging has increased by 400% in **Cameroon** in the last few years, and is rising fast in other areas including the **Democratic Republic of the Congo**.
South-East Asia	The government of **Indonesia** plans to convert 2 million hectares of forest to plantations[63], and much of the remaining area is leased to loggers. In **Malaysia**, logging concessions now cover virtually all of Sabah and Sarawak. Demand for timber in Thailand has had massive impacts on forest cover in **Laos**, **Cambodia** and **Myanmar** since UNCED, threatening the entire forest ecosystem of the region[64].
Pacific	Virtually all of **Papua New Guinea** and **Vanuatu** are now leased out to logging companies, threatening one of the world's largest remaining forest frontiers[65].
Australasia	Despite an excellent protected areas policy, deforestation in temperate forests has reached critical levels, making **Australia** sixth in the world in forest loss (and the only developed country in the top ten[66]).

Table 2: Developments in international forest policy since UNCED

A Summary of Key Events

Initiative/event	Details and sources
United Nations Conference on Environment and Development (UNCED or the Earth Summit)	Met in Rio de Janeiro in June 1992. UNCED failed to agreed a global forest convention but did agree a *Non Legally Binding Authoritative Statement of Principles for a Global Agreement on the Management, Conservation and Sustainable Development of All Types of Forest* which has formed the background to many of the following initiatives[67]. It also agreed a Convention on Biological Diversity.
Convention on Biological Diversity (CBD)	Agreed at UNCED. Has since agreed a protocol on forests and is developing indicators of forest biodiversity[68]. Confusion about the roles of the CBD and IPF (see below) slowed action for some time.
Climate Change Convention (CCC)	Agreed at UNCED. Highlighted issues of forest biomass loss and has pioneered procedures for joint implementation encourage forest establishment, although these remain controversial.
United Nations Environment Programme	Developed new forest policy in the wake of UNCED, which concentrates on developing a 1996-2000 action programme[69]
Commission on Sustainable Development (CSD)	The CSD was established to follow up the work of the Earth Summit, and has helped define SFM by acting as a focus for several other initiatives and by establishing the Intergovernmental Panel on Forestry (see below).
Indo-UK Initiative	Drew up criteria for reporting on forests at the June 1995 CSD meeting[70]. Unfortunately, only 34 countries completed surveys and these were finished too late to be of use to the FAO report to the CSD meeting.
Intergovernmental Working Group on Global Forests (IWGGF)	The IWGGF, set up by Canada and Malaysia, produced a series of working papers as input to the 1995 CSD meeting. These covered sustainable forest management, criteria and indicators, trade, mobilising additional financial resources, institutional linkages, participation and transparency and cross sectoral integration[71].
Intergovernmental Panel on Forests (IPF)	The IPF was established by the CSD to investigate sustainable forest management over a period of 2 years. It resulted in many discussion papers and a range of regionally coordinated meetings looking at specific issues such as certification and criteria and indicators[72]. Latterly discussion focused largely on whether or not there should be a global forest convention. The IPF reported finally to the CSD in April 1997[73] and has been replaced by the Intergovernmental Forum on Forests (see below).
Intergovernmental Forum on Forests (IFF)	Established at UNGASS (see below) in June 1997, to continue the work of the IPF. Its remit remains unclear, although early discussions are expected to focus on the possible role of a convention.

Initiative/event (continued)	Details and sources
United Nations General Assembly Special Session (UNGASS)	Also known as *Earth Summit 2*. Met in New York in June 1997 to review progress in implementing *Agenda 21*. Failed to reach agreement between governments, specifically regarding a global forest convention - the IFF (see above) was set up as an alternative.
International Tropical Timber Agreement (ITTA)	A new ITTA was signed in 1993 and re-established the International Tropical Timber Organisation (ITTO). Temperate countries blocked moves to extend the agreement to all timbers, and set targets on sustainable forest management more stringent than those agreed by European forest ministers at the Helsinki Conference (see below). However, the ITTO developed the first set of criteria and indicators for management of forests[74] and also has a year 2000 target for sustainable management of all tropical forests.
World Commission on Forests and Sustainable Development	The WCFSD is investigating issues relating to SFM in a series of workshops around the world, which attempt to give all stakeholders a chance to state their perspective and will report in late 1997[75].
Criteria and indicator initiatives	A series of seven regional attempts to set a framework for sustainable forest management on a regional level[76]. Described in detail in Megatrend 3. The first two meetings that helped establish the c&i process are mentioned below.
Pan-European Process	An initiative of the Finnish and Portuguese governments, launched in June 1993 at the *2nd Ministerial Conference on the Protection of Forests* in Helsinki, which agreed four Forestry Resolutions[77]. (Originally known as the Helsinki Process.)
Montreal Process	Effectively launched in October 1993 at a *Seminar of Experts on Sustainable Development of Boreal and Temperate Forests*[78]; it has drawn up criteria for SFM with 10 non-European temperate and boreal countries[79]. Early attempts to amalgamate the Helsinki and Montreal processes floundered.
Certification of forest management	One result of the changes has been a worldwide movement to develop certification standards for forest management, described in detail in Megatrend 8. Two key initiatives are mentioned briefly below.
Forest Stewardship Council	Launched in October 1993 as an umbrella organisation for independent certification of forest management[80].
International Organization for Standardisation	ISO is also considering options for timber certification.
Research initiatives	The post-UNCED years have seen a development of new initiatives for R&D.
European Forest Institute	Launched in 1993 and based in Joensuu, Finland.
Centre for International Forestry Research	Launched in 1994 and based in Bogor, Indonesia. Carries out research throughout the world on tropical forest issues.

Table 3: International criteria and indicator processes

Process	Organising body	State of development
Processes		
Pan-European[81]	Council of Ministers in Europe, secretariat in Finland and Portugal	Criteria and indicators developed and agreed, first interim report prepared[82], and guidelines at stand management level developed. Originally known as the Helsinki process.
Montreal[83]	Originally the Committee for Security and Cooperation in Europe and Canadian government; secretariat now in Canada	Criteria and indicators developed and agreed[84], first interim report prepared.
Tarapoto[85]	Amazon Pact countries	Draft criteria and indicators prepared.
Dry-Zone Africa[86]	FAO	Draft criteria and indicators prepared.
North Africa and the Middle East	FAO	Draft criteria and indicators prepared.
Central America[87]	FAO	Draft criteria and indicators prepared.
Attempts to harmonise indicators		
Harmonisation of early c/i initiatives	FAO/ITTO	The FAO undertook a meeting to instigate harmonisation of various forest management initiatives in Rome in February 1992, in cooperation with ITTO[88].
International Seminar on Criteria and Indicators of Sustainable Forest Management[89]	Government of Finland in association with the IPF	An international seminar, as part of the IPF process, which attempted to find common ground between the various C&I processes.
Research programmes on criteria and indicators		
Testing C&I	Centre for International Forestry Research	Series of field evaluations in Germany, Indonesia, Côte d'Ivoire and Brazil[90]

Table 4: Areas of the world undergoing predatory logging by transnational companies

Country	Issues
Russian Federation	Although official figures for timber extraction have halved since the collapse of the USSR, unofficial estimates suggest that illegal logging now far outstrips official felling, with as much as 12 million ha/year logged illegally compared with 2 million ha recorded in official figures.
N. America	
Canada	Natural forests in British Columbia are being felled by TNCs based in Canada and elsewhere[91]. In Alberta, 17% of forest is leased to 2 Japanese TNCs[92]. In Ontario, two thirds of the remaining 1% old-growth forest is slated for logging[93].
S. America	
Argentina	Temperate forests in Tierra del Fuego are rapidly being logged by foreign companies, including some from North America[94].
Brazil	Illegally felled mahogany has been traced back to the UK[95]. In some areas research found that 95 per cent of inspected management plans did not comply with existing legislation and illegal logging in indigenous and extractive reserves continues, particularly in border areas[96].
Chile	Many of Chile's forests are now controlled by transnational interests. In May 1996, a Chilean court halted the controversial logging of 741,300 acres of old beech woods on Tierra del Fuego by Trillium, based in Bellingham, Washington. However the TNC has said that it will continue because the environmental study is still only voluntary under Chilean law[97].
Guyana	The freeze on foreign logging concessions in Guyana may be about to break. Guyana is introducing "exploratory licenses" which in effect allow logging. Interested companies include Solid Timbers Sendirian Berhad of Malaysia and Buchanan Forest Products of Canada. A 1995 World Bank study found that royalties, taxes and forest fees are about a tenth of those in Africa and Asia[98].
Paraguay	Illegal harvest continues in the 300,000 ha of protected forests, despite the devastation of other forest lands. High-level politicians have been involved in land speculation and associated illegal activity in the Alto Paraguay region in the far north and illegal cross-border trade with Brazil has occurred[99].
Surinam	Logging plans by Asian timber companies could affect a large area of the remaining natural rainforest. Companies bidding for 3.6 million ha of concessions, including Berjaya of Malaysia, MUSA and Suri Atlantic of Indonesia and two Chinese state companies. Canada's Gordon Capital Corporation has also reportedly offered US$25-45 million for a majority share of the state's Bruynzeel company[100].

Africa	
Cameroon	High demand for tropical hardwoods in Asia, linked with devaluation of the CFA, has created a surge in timber exports[101]. Logging, mainly by European companies, increased by 400 per cent between 1993 and 1994, threatening some of West Africa's richest rainforest areas. Companies operating in Cameroon are based in France, Italy, Germany, Denmark, and the Lebanon. Most large timber companies in Cameroon were found to be involved in illegal trade[102], with threats to forest species and an estimated loss of tax revenues of over 50 per cent between 1992 and 1995.
Central African Republic	90% of the forests have been allocated to 10 companies, including 4 from France, 2 from Romania and 1 from former Yugoslavia[103].
Congo	At least 15 of 36 active timber companies are foreign-owned, controlling about half the cut. They rare based in Germany, the Netherlands and France[104].
Gabon	Most timber production is under European control, predominantly from France but also from Germany, Italy and Switzerland. Latest estimates for deforestation are 0.6%/year.
Ghana	Misuse of aid money has funded illegal logging in Ghana[105] and it is estimated that about a third of logs continue to be harvested illegally. The twelve most popular species will be virtually extinct by 2006 at current rates of exploitation[106].
Liberia	Foreign companies have had a long history of unsustainable logging in the country[107]. Recent reports from the country suggest that illegally felled timber is continuing to be sold to European markets[108].
Nigeria	The Cross River National Park, containing 40 per cent of Nigeria's remaining forest, is threatened with logging by WEMCO, a Hong Kong-based company. Although officially operating in the buffer zone, WEMCO has built a pulp mill which requires more timber than can be supplied by the concession[109]. The company has already faced criticism for illegal logging elsewhere in Nigeria
Republic of the Congo	Around ten timber companies are operating, and most logging is carried out by foreign-based firms from Belgium, Canada, Denmark, France, Germany and Italy[110]. Logging was increasing rapidly at the start of the civil war.
Asia/Pacific	
Cambodia	Forest loss has accelerated, and researchers suggest that half the remaining forests have been affected in the last few years. A logging ban, imposed in January 1995, is being ignored. One recent timber concession to a Malaysian company covered 12 per cent of the remaining forest[111]. The International Monetary Fund has cancelled a US$20 million loan to Cambodia after the government failed to meet an October 31 1996 deadline for taking measures to control illegal logging[112].
Laos	Illegal logging has increased rapidly as a result of a ready market created in Thailand due to the latter's logging ban and through transboundary incursions along the Vietnamese border[113].
Papua New Guinea	Logging, including illegal logging, is the major cause of forest loss in PNG[114], mainly involving expatriate firms from south east Asia - especially Malaysia[115]. Virtually all the remaining

	rainforests, including many in protected areas, have already been put out to concession according to new data from the World Conservation Monitoring Centre.
Solomon Islands	In 1995, the Australian government cancelled US$1.65 million worth of annual aid to the Solomons, due to the unsustainable logging, claiming that at current logging rates the forests will disappear in 15 years. Two months later, the Malaysian government offered aid and expertise. Malaysian companies dominate logging in the country, and have often been blamed with mining rather than managing forests. In 1994, the Managing Director of Berjya was expelled for allegedly attempting to bribe the Minister of Commerce[116].
Vanuatu	Logging is increasing rapidly, mainly controlled by expatriate Malaysian companies.

Further references in *Bad Harvest?* by Nigel Dudley, Jean-Paul Jeanrenaud and Francis Sullivan, Earthscan, London 1996

Table 5: Examples of countries where plantations are affecting natural forests[117]

Country	Notes
Brazil	The second largest area of pulp plantations in the world, mainly of pine and eucalyptus. Large areas of natural forests have been cleared to establish plantations, both within the Amazon and especially along the coastal strip. Past experience has been mixed - it is estimated that over 3 million hectares of plantations established during the military dictatorship did not survive.
Chile	Natural *Nothofagus* forests have been replaced by pine and eucalyptus. Several species are threatened with extinction as a result, including at least three native tree species and animals such as the Chilean goat (*pudu*) and Andes deer (*huemul*).
Indonesia	The government intends to replace 2 million hectares of natural forest with plantations by the year 2000 - particularly in Kalimantan, Sumatra and Irian Jaya. There has been a poor success rate in plantations and many have been abandoned. Plantations are also often established against the wishes of traditional land-users.
South Africa	Natural temperate forest in South Africa has been reduced to a few fragments. Plantations are affecting some of these through being planted right up to the forest edge, thus destroying the ecotone where grassland and forest meet and also sometimes introducing invasive alien species.
UK	In the recent past, exotic spruce plantations have been established in the place of native woodland; plantations now make up over 90 per cent of the tree-covered area in Scotland and native woodlands are reduced to scattered fragments.

Table 6: Revised Categories of Protected Areas from the World Commission on Protected Areas

To give greater coherence to the role and scope of protected areas within conservation planning and sustainable land use, IUCN and its World Commission on Protected Areas[118] have developed six modified categories of protected area - proposed in February 1992 at the *IVth World Congress on National Parks and Protected Areas* in Caracas and agreed at IUCN's General Assembly in Buenos Aires in January 1994.[119] They are summarised below.

• Category Ia: **Strict nature reserve/wilderness protection area managed mainly for science or wilderness protection** - an area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring;

• Category Ib: **Wilderness area: protected area managed mainly for wilderness protection** - large area of unmodified or slightly modified land and/or sea, retaining its natural characteristics and influence, without permanent or significant habitation, which is protected and managed to preserve its natural condition.

• Category II: **National park: protected area managed mainly for ecosystem protection and recreation** - natural area of land and/or sea designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

• Category III: **Natural monument: protected area managed mainly for conservation of specific natural features** - area containing specific natural or natural/cultural feature(s) of outstanding or unique value because of their inherent rarity, representativeness or aesthetic qualities or cultural significance.

• Category IV: **Habitat/Species Management Area: protected area managed mainly for conservation through management intervention** - area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats to meet the requirements of specific species;

• Category V: **Protected Landscape/Seascape: protected area managed mainly for landscape/seascape conservation or recreation** - area of land, with coast or sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological and/or cultural value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area.

• Category VI: **Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural resources** - area containing predominantly unmodified natural systems, managed to ensure long-term protection and maintenance of biological diversity, while also providing a sustainable flow of natural products and services to meet community needs.

Table 7: Countries pledging to meet WWF's target of 10% protected forest areas

Country	Commitment
Argentina	"...an ecologically representative network of protected areas covering a minimum of 10% of each forest type by the year 2000."
Armenia	"...is committed to completing the establishment of a network of ecologically representative forest protected areas...about 19% of the forest estate of Armenia is under total protection..."
Australia	"Comprehensive, Adequate and Representative forest reserve system (including) 15% of the distribution of each forest ecosystem that existed prior to Europeans arriving in Australia, 60% or more of existing old-growth...90% or more of high quality wilderness..."
Austria	"Representative network of `climax, primary and other special forests' ...comprising all regionally specific forest varieties."
Bolivia	"...a network of forest protected areas, representing each of the forest types found in our country. Far more than 10% of our land is protected from disturbance and exploitation."
Canada	"...completing a network of ecological reserves by the year 2000 (consisting) of sites that are representative of Canada's diverse forests...representing up to 12% of the land base."
Chile	"... completing a network of forest protected areas, which represents each forest type...at present 18.3% of the continental national area...comes under the category of Protected Forestland."
China	Agreed to meet the target at the June 1997 UN General Assembly Special Session in New York..
Colombia	"...has already established a policy for the conservation of an ecologically representative network of protected areas covering more than 10% of its forest types..."
Greece	[The Greek government has recently committed to the target.]
Lithuania	"...complete protection from disturbance or exploitation of at least 10% of Lithuania's forests".
Malawi	"...total protection of all identified unique forest types to the internationally minimum accepted level of 10% of all forest types."
Mozambique	"...is committed to completing the establishment of a network of ecologically representative forest protected areas."
New Zealand	"...an ecologically representative network of protected areas to ensure the survival of the unique natural heritage of these islands..."
Nicaragua	"...completing an ecologically representative network of protected areas covering a minimum of 10% of each forest type."
Romania	"...the creation of a network of 17 national parks during the next 5-10 years, as well as other protected areas covering 12% of the total forested surface..."
Russian Republic of Sakha	"...the establishment of an ecologically representative network of protected areas covering a minimum of 25% of each forest type by the year 2000, demonstrating a range of socially and ecologically appropriate models."

Slovak Republic	"...effective protection of not less than 10% of each forest type."
Tunisia	"...the complete protection of at least 10% of different forest types in Tunisia"
Uzbekistan	"...the establishment of an ecologically-representative network of protected areas covering a minimum of 10% of each forest type by the year 2000, demonstrating a range of socially and ecologically appropriate models."

Table 8: Independent certification of forests to Forest Stewardship Council standards

Country	**Number of sites**	**Area in hectares**
Poland	3	1,551,563
USA	12	620,905
Sweden	1	309,000
Mexico	2	110,406
Belgium	1	66,915
Brazil	2	60,734
South Africa	5	58,782
Bolivia	1	52,000
Honduras	1	25,500
Zimbabwe	1	24,850
Costa Rica	2	18,828
Paraguay	1	16,000
Sri Lanka	3	12,726
Papua New Guinea	1	12,500
Netherlands	3	11,404
Solomon Islands	13	4,296
UK	6	2,701
Malaysia	1	251

Total number of sites: 59
Total area of certified forest: 2,959,361 hectares

Source: WWF *Forests for Life* campaign, May 1997

Table 9: European forest damage surveys: percentage of trees with defoliation > 25%

Country	1992	1993	1994	1995
Austria	7	8	8	7
Belarus	19	29	37	38
Belgium	17	15	17	24
Bulgaria	23	23	29	38
Croatia	16	19	29	-
Czech Republic	56	53	60	60
Denmark	26	33	36	37
Estonia	28	20	16	14
Finland	14	15	13	13
France	8	8	8	12
Germany	26	24	24	22
Greece	18	21	23	25
Hungary	22	21	22	20
Ireland	16	30	20	26
Italy	18	18	20	19
Latvia	37	35	30	20
Lithuania	18	28	25	25
Luxembourg	20	24	35	38
Moldova	-	51	-	-
Netherlands	33	25	19	32
Norway	26	25	28	29
Poland	49	50	55	53
Portugal	22	7	6	9
Romania	17	20	21	21
Slovakia	36	38	42	43
Slovenia	-	19	16	25
Spain	12	13	19	24
Sweden	17	11	16	14

Switzerland	13	15	18	25
Ukraine	16	22	32	30
UK[1]	58	17	14	14

Table 10: Problems with invasive species in forests

Country/region	Species	Notes
USA	Fungal chestnut blight (*Cryphonectria parasitica*)	Introduced from China. Has devastated populations of the American chestnut (*Castanea dentata*), killing an estimated billion trees over 91 million acres[120].
USA: Tahiti	Miconia (*Miconia calvescens*)	Introduced from Latin America in 1960 - a bushy plant that can grow into a 50 ft tree and has spread to 70 per cent of Tahiti's forests, shading out native species and causing soil erosion. Threatens a quarter of the island's wildlife[121].
New Zealand	560 alien species	Around 560 alien plant species have become established and 240 are common. Pigs, goats and deer have also all become feral. They threaten many native species, especially amphibians and flightless birds, several of which are now confined to offshore islands[122].
UK	Grey squirrel (*Neosciurus carolinensis*)	Introduced from North America and released into the wild - has all but eliminated the native red squirrel (*Sciurus vulgaris*) throughout Britain.
Central Europe	Locust tree (*Robinia pseodoacacia*)	Introduced from the USA as an ornamental, now spreading as an invasive weed in disturbed forest or along forest edges through several countries.
Mediterranean countries	*Phytophthora cinnamoni* (root pathogen)	Causing decline and death amongst several tree species, particularly cork oak (*Quercus suber*) and evergreen oak (*Q. ilex*). In 1991, 1,050 major foci of the disease were found in southwest Spain, and similar declines have been identified in parts of Portugal, Italy, Morocco and Tunisia[123].

[1] A change in assessment method between 1982 and 1983 balanced figures with other countries

Table 11: Options for use of wood and other biomass as an energy source

Method used	**Details**
Dry biomass	
Combustion	Energy efficiencies range from 18.6-20.9 MJ/kg dry weight for **wood chips** to eg 9.5 MJ/kg for **sugar cane bagasse**. Open fires are amongst the least efficient forms of combustion.
Pyrolysis	The heating of biomass in the near absence of oxygen, causing chemical changes. Most commonly used with wood in the production of **charcoal** along with oils.
Gasification	Heating biomass with limited oxygen, creating a **producer gas**. Gasification can be followed by: condensation to produce **methanol**, a liquid fuel; production of **methane**; or further conversion to **ammonia**.
Hydrogasification	Conversion of biomass to **methane** or **ethane** by reduction with hydrogen at high temperatures and pressure.
Wet biomass	
Anaerobic digestion	Breakdown of wet biomass in the absence of oxygen by bacteria, releasing **methane** gas which can be burnt directly to produce heat or in electricity generation. Has been used extensively in India and China.
Fermentation	Fermentation of biomass to alcohol in the absence of oxygen, commonly producing **ethanol** which can be used as an automobile fuel. A large ethanol fuel scheme in Brazil has had mixed success.
Chemical reduction	Reduction of aqueous biomass to produce a range of fuel oils.

Table 12: Examples of non-timber forest products

Country	Example
Sweden	In 100 million litres of berries are collected from the forest every year, along with 20 million litres of mushrooms[124].
Finland	In the 1980s, tax-free income from berries and mushrooms was estimated at 35-93 million Finnmarks/year (US$8-21 million)[125].
Italy	The total value of non-timber products from forests was estimated at 117,286 million lire (US$75 million) in 1986, 45 per cent from chestnuts[126].
Pacific Northwest USA	Over 25 mushroom species are harvested contributing an estimated US$41.1 million to the local economy[127].
Vermont, USA	The annual value of maple syrup as a raw product has been estimated at US$10 million, while associated jobs add another US$30 million in value[128].
Africa	Between 70-90 per cent of the animal protein consumed in forested regions comes from wild animals[129].
Tanzania	Farmers supplement their income by a variety of forest-based craft activities, along with honey collection and charcoal production[130].

GLOSSARY

C&I	Criteria and indicators of sustainable forest management, established on a national or regional basis
CSD	Commission on Sustainable Development, set up by the United Nations to help implement the *Agenda 21* strategy that emerged from the Earth Summit
Earth Summit	See UNCED
FAO	Food and Agriculture Organisation of the United Nations
FSC	Forest Stewardship Council - NGO based in Mexico acting as an umbrella organisation for the independent certification of good forest management
IPF	Intergovernmental Panel on Forests - a two-year panel set up by the CSD to examine forest management
ITTA	International Tropical Timber Agreement
ITTO	International Tropical Timber Organization
IWGGF	Intergovernmental Working Group on Global Forests, set up by Canada and Malaysia as a discussion forum on forest policy before the establishment of the IPF (qv)
NTFP	Non-timber forest product (nuts, berries, medicines, rattan, bamboo etc)
SFM	Sustainable forest management
TNC	Transnational company
UNCED	United Nations Conference on Environment and Development (The "Earth Summit") held in Rio de Janeiro in June 1992
UNGASS	United Nations General Assembly Special Session - a five-year review of progress after UNCED (qv), in June 1997.

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Machynlleth, Wales UK
28 August 1997

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