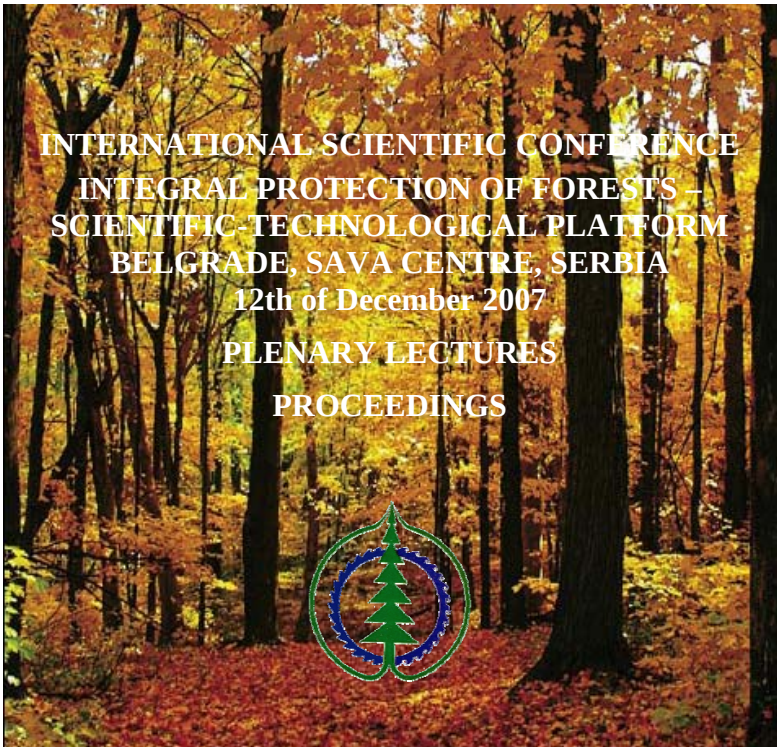
INSTITUT ZA ŠUMARSTVO INSTITUTE OF FORESTRY
BEOGRAD BELGRADE

ZBORNIK RADOVA

COLLECTION
TOM 56

Yu ISSN 0354-1894



BEOGRAD BELGRADE
2007

INSTITUT ZA ŠUMARSTVO BEOGRAD

ZBORNIK RADOVA

Izdavač
Institut za šumarstvo
Beograd, Srbija

Za izdavača
Dr Ljubinko Rakonjac

Redakcioni odbor
Dr Mara Tabaković-Tošić
Institut za šumarstvo, Beograd
Dr Miloš Koprivica
Institut za šumarstvo, Beograd
Dr Radovan Nevenić
Institut za šumarstvo, Beograd
Dr Pero Radonja
Institut za šumarstvo, Beograd
Dr Dragana Dražić
Institut za šumarstvo, Beograd
Dr Ljubinko Rakonjac
Institut za šumarstvo, Beograd
Dr Mihailo Ratknić
Institut za šumarstvo, Beograd
Dr Zoran Miletić
Institut za šumarstvo, Beograd
Dr Milorad Veselinović
Institut za šumarstvo, Beograd
Dr Dragana Stojičić
Institut za šumarstvo, Beograd
Assoc. Prof. Dr Iantcho Naidenov
Bugarska
Prof. Dr Nikola Hristovski
Makedonija
Dr Kalliopi Radoglou
Grčka

Glavni i odgovorni urednik
Dr Mara Tabaković-Tošić

Tehnički urednik
Mr Tatjana Ćirković

Sekretar Zbornika
Mr Tatjana Ćirković

Tiraž
150 primeraka

Štampa
Standard 2

INSTITUTE OF FORESTRY BELGRADE

PROCEEDINGS

Publisher
Institute of Forestry
Belgrade, Serbia

For Publisher
Ph.D. Ljubinko Rakonjac

Editorial Board
Ph.D. Mara Tabaković-Tošić
Institute of Forestry, Belgrade
Ph.D. Miloš Koprivica
Institute of Forestry, Belgrade
Ph.D. Radovan Nevenić
Institute of Forestry, Belgrade
Ph.D. Pero Radonja
Institute of Forestry, Belgrade
Ph.D. Ph.D.agana Ph.D.ažić
Institute of Forestry, Belgrade
Ph.D. Ljubinko Rakonjac
Institute of Forestry, Belgrade
Ph.D. Mihailo Ratknić
Institute of Forestry, Belgrade
Ph.D. Zoran Miletić
Institute of Forestry, Belgrade
Ph.D. Milorad Veselinović
Institute of Forestry, Belgrade
Ph.D. Dragana Stojičić
Institute of Forestry, Belgrade
Assoc. Prof. Dr Iantcho Naidenov
Bulgaria
Prof. Dr Nikola Hristovski
Macedonia
Dr Kalliopi Radoglou
Greece

Editor in Chief
Ph.D. Mara Tabaković-Tošić

Technical Editor
M.Sc. Tatjana Ćirković

Secretary
M.Sc. Tatjana Ćirković

Printed in
150 copies

Printed by
Standard 2

International Scientific Conference

INTEGRAL PROTECTION OF FORESTS – SCIENTIFIC-TECHNOLOGICAL PLATFORM

PLENARY LECTURES

PROCEEDINGS

Citiranje	**Citation**
Međunarodna naučna konferencija	International Scientific Conference
Integralna zaštita šuma –	Integral Protection of Forests –
Naučno-tehnološka platforma	Scientific-Technological Platform

Belgrade, December 2007.

CIP – Каталогизација у публикацији
Народна библиотека Србије, Београд

630

Zbornik radova / Institut za šumarstvo = Collection/Institute of Forestry; glavni i odgovorni urednik Mara Tabaković-Tošić. – 1991, t. 34/35- Beograd (Kneza Višeslava 3): Institut za šumarstvo , 1991- (Beograd: Standard 2). - 24 cm

. – Je nastavak: Зборник радова – Институт за шумарство и дрвну индустрију = ISSN 0351-9147
ISSN 0354-1894 = Zbornik radova – Institut za šumarstvo
COBISS.SR-ID 27739138

International Scientific Conference

INTEGRAL PROTECTION OF FORESTS – SCIENTIFIC-TECHNOLOGICAL PLATFORM

PLENARY LECTURES

PROCEEDINGS

Address of the Organizing Committee
INSTITUTE OF FORESTRY
Kneza Viseslava 3
11030 Belgrade
Serbia
www.inforserb.org, www.izas.org.yu

SADRŽAJ CONTENTS

INSTITUT ZA ŠUMARSTVO • BEOGRAD
INSTITUTE OF FORESTRY • BELGRADE
International Scientific Conference
INTEGRAL PROTECTION OF FORESTS – SCIENTIFIC-TECHNOLOGICAL PLATFORM
December 12th, 2007., Belgrade

SCIENTIFIC SESSION I
THE ROLE OF FORESTRY SECTOR IN PRESERVATION AND DEVELOPMENT OF NATURAL RECOURSES – LOCAL AND INTERNATIONAL SCALE

PLENARY LECTURE
CONSERVATION AND ENHANCEMENT OF NATURAL RESOURCES IN SERBIA – ADJUSTMENT OF LEGISLATION WITH INTERNATIONAL AGREEMENTS OF ENVIRONMENTAL PROTECTION

Radovan NEVENIĆ[1], Dragana DRAŽIĆ[1], Ljiljana BRAŠANAC[1], Srđan BOJOVIĆ[2]

Abstract: *Conservation and advancement of natural resources is the base of sustainable development. The concept of sustainable development was adopted by the European Union in 1990, and at the world level, it was officially adopted at the Second United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992. The adoption of this concept at the global level was stimulated by the knowledge of large-scale changes of the environment, global climate change, pollution of air, water and soil, degradation of many ecosystems and consumption of great quantities of natural resources. It was understood that the environment could not be conserved and enhanced by partial policies and measures and that it is only possible by the implementation of the concept of sustainable development. The Rio Summit adopted the Declaration on environment and development (Rio Declaration), the Kyoto Protocol to UN Framework Convention on Climate Change and Convention on Biological Diversity, adopted the Principles on the Management, Conservation and Sustainable Development of all Types of Forests.*

Sustainable development requires the changes of development policy, a better integration of the sector policies with the environment policy and the

[1]Radovan Nevenić, Ph.D., Dragana Dražić, Ph.D., Ljiljana Brašanac, M.Sc., Institute of Forestry, Belgrade, Serbia
[2]Prof. Srđan Bojović, Ph.D., IBISS BU, Belgrade, Serbia

adaptation of economic system to the environment policy. Sustainable development includes the implementation of three principles:

- *precautionary principle, favouring the preventive approach related to subsequent correction of mistakes and consequences;*
- *principle of solidarity between the present and future generations and among all populations of the world, and*
- *principle of participation of all social actors in the decision-making mechanisms.*

Utilization of potentials and natural resources in Serbia should be harmonized with goals of environmental protection defined by Law on environmental protection, Law on Strategic Environmental Assessment and other laws which conside .

To achieve the sustainable development, the structural, technical and technological changes are necessary, as well as the adaptation of the structure and dynamics of human activities to the structure and dynamics of the environment.

Serbia is the signatory to a number of international conventions and agreements in the field of environmental protection, which have directly or indirectly influence to the development of the forest sector. Republic of Serbia continued its active participation in regional initiatives. Disregarding the disadvantages of many preconditions, the frameworks of environment management strategy formulation should be defined in the new, changed conditions, relying primarily on the elements of the existing legal regulations.

Preparation of National strategy of sustainable use of natural resources in Serbia has started in 2005. National strategy should contain: principle of sustainable development, status analysis and so far level of exploitation, valuation methods and conditions for sustainable use of natural resources, ecological-spatial principles on the potentials of natural resources, conditions for progressive substitution of natural resources as a way of conservation, guidelines for further research in the area of individual natural resources etc.

As internationally recognized factor, Serbia should take an active part in the processes of development of future international agreements, taking into account the protection of its national interests. There for, it is necessary that Serbia realized its commitments by their implementation in the national legislation.

Key words: conservation, enhancement, environment, natural resources, international conventions and agreements.

1. INSTEAD OF INTRODUCTION

The relationship between economic development and environmental degradation was first placed on the international agenda in 1972, at the UN Conference on the Human Environment, held in Stockholm. After the Conference, Governments set up the United Nations Environment Programme (UNEP), which today continues to act as a global catalyst for action to protect the environment. Little, however, was done in the succeeding years to integrate environmental concerns into national economic planning and decision-making. Overall, the environment continued to

deteriorate, and such problems as ozone depletion, global warming and water pollution grew more serious, while the destruction of natural resources accelerated at an alarming rate.

By 1983, when the UN set up the World Commission on Environment and Development, environmental degradation, which had been seen as a side effect of industrial wealth with only a limited impact, was understood to be a matter of survival for developing nations. The Commission put forward the concept of sustainable development as an alternative approach to one simply based on economic growth – one "which meets the needs of the present without compromising the ability of future generations to meet their own needs".

After considering the 1987 Brundtland report[1], the UN General Assembly called for the UN Conference on Environment and Development (UNCED). The primary goals of the Summit were to come to an understanding of "development" that would support socio-economic development and prevent the continued deterioration of the environment, and to lay a foundation for a global partnership between the developing and the more industrialized countries, based on mutual needs and common interests, that would ensure a healthy future for the planet.

The three Rio Conventions[2] – on Biodiversity, Climate Change and Desertification – derive directly from the 1992 Earth Summit. Each instrument represents a way of contributing to the sustainable development goals. The three conventions are intrinsically linked, operating in the same ecosystems and addressing interdependent issues.

In Rio, Governments – more then 178 represented by heads of State or Government – adopted three major agreements aimed at changing the traditional approach to development:

- Agenda 21 – a comprehensive programme of action for global action in all areas of sustainable development;
- The Rio Declaration on Environment and Development – a series of principles defining the rights and responsibilities of States;
- The Statement of Forest Principles – a set of principles to underlie the sustainable management of forests worldwide.

In addition, two legally binding Conventions aimed at preventing global climate change and the eradication of the diversity of biological species were opened for signature at the Summit, giving high profile to these efforts:

- The United Nations Framework Convention on Climate Change and
- The Convention on Biological Diversity

[1] Report of the World Commission on Environment and Development

[2] Agenda 21, the Rio Declaration on Environment and Development and the Statement of principles for the Sustainable Management of Forests were adopted by more than 178 Governments at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil, 3 to 14 June 1992.

Agenda 21 addresses today's pressing problems and aims to prepare the world for the challenges of the next century. It contains detailed proposals for action in social and economic areas (such as combating poverty, changing patterns of production and consumption and addressing demographic dynamics), and for conserving and managing the natural resources that are the basis for life – protecting the atmosphere, oceans and biodiversity; preventing deforestation; and promoting sustainable agriculture.

Governments agreed that the integration of environment and development concerns will lead to the fulfillment of basic needs, improved standards for all, better protected and better managed ecosystems and a safer and a more prosperous future. "No nation can achieve this on its own. Together we can – in a global partnership for sustainable development", states the preamble. The Rio Declaration on Environment and Development supports Agenda 21 by defining the rights and responsibilities of States regarding these issues. Among its principles:

- That human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature;
- That scientific uncertainty should not delay measures to prevent environmental degradation where there are threats of serious or irreversible damage;
- That States have a sovereign right to exploit their own resources but not to cause damage to the environment of other States;
- That eradicating poverty and reducing disparities in worldwide standards of living are "indispensable" for sustainable development;
- That the full participation of women is essential for achieving sustainable development; and
- That the developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command.

The Statement of Forest Principles, the non–legally binding statement of principles for the sustainable management of forests, was the first global consensus reached on forests. Among its provisions:

- That all countries, notably developed countries, should make an effort to "green the world" through reforestation and forest conservation;
- That States have a right to develop forests according to their socio-economic needs, in keeping with national sustainable development policies; and
- Those specific financial resources should be provided to develop programmes that encourage economic and social substitution policies.

At the Summit, the UN was also called on to negotiate an international legal agreement on desertification, to hold talks on preventing the depletion of certain fish stocks, to devise a programme of action for the sustainable development of small island developing States and to establish mechanisms for ensuring the implementation of the Rio accords.

Standard-setting- Central to the ability of Governments to formulate policies for sustainability and to regulate their impact is the development of a set of internationally accepted criteria and indicators for sustainable development. The Commission on Sustainable Development is spearheading this work, which will enable countries to gather and report the data needed to measure progress on Agenda 21. It is hoped that a "menu" of indicators — from which Governments will choose those appropriate to local conditions — will be used by countries in their national plans and strategies and, subsequently, when they report to the Commission.

Achieving sustainable development worldwide depends largely on changing patterns of production and consumption — what we produce, how it is produced and how much we consume, particularly in the developed countries. Commission on Sustainable Development CSD's work programme in this area focuses on projected trends in consumption and production; impacts on developing countries, including trade opportunities; assessment of the effectiveness of policy instruments, including new and innovative instruments; progress by countries through their timebound voluntary commitments; and extension and revision of UN guidelines for consumer protection.

In 1995, the Commission also adopted a work programme on the transfer of environmentally sound technology, cooperation and capacity building. The programme places an emphasis on three interrelated priority areas: access to and dissemination of information, capacity building for managing technological change and financial and partnership arrangements. The Commission is working with the World Trade Organization, the UN Conference on Trade and Development and the United Nations Environment Programme (UNEP) to ensure that trade, environment and sustainable development issues are mutually reinforcing.

1.1. Protection Of The Atmosphere – Protection of the atmosphere is a broad and multidimensional endeavor involving various sectors of economic activity. The options and measures described in the present chapter are recommended for consideration and, as appropriate, implementation by Governments and other bodies in their efforts to protect the atmosphere. It is recognized that many of the issues discussed in this chapter are also addressed in such international agreements as the 1985 Vienna Convention for the Protection of the Ozone Layer, the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer as amended, the 1992 United Nations Framework Convention on Climate Change and

other international United Nations Climate Change Conferences such as - Bali, 3 - 14 December 2007[1], including regional, instruments. In the case of activities covered by such agreements, it is understood that the recommendations contained in this chapter do not oblige any Government to take measures which exceed the provisions of these legal instruments. However, within the framework of this chapter, Governments are free to carry out additional measures which are consistent with those legal instruments.

The basic objective of this programme area is to improve the understanding of processes that influence and are influenced by the Earth's atmosphere on a global, regional and local scale, including, physical, chemical, geological, biological, oceanic, hydrological, economic and social processes; to build capacity and enhance international cooperation; and to improve understanding of the economic and social consequences of atmospheric changes and of mitigation and response measures addressing such changes.

1.2. Transboundary Atmospheric Pollution – Transboundary air pollution has adverse health impacts on humans and other detrimental environmental impacts, such as tree and forest loss and the acidification of water bodies. The geographical distribution of atmospheric pollution monitoring networks is uneven, with the developing countries severely underrepresented. The lack of reliable emissions data outside Europe and North America is a major constraint to measuring transboundary air pollution. There is also insufficient information on the environmental and health effects of air pollution in other regions.

The 1979 Convention on Long-range Transboundary Air Pollution, and its protocols, have established a regional regime in Europe and North America, based on a review process and cooperative programmes for systematic observation of air pollution, assessment and information exchange. These programmes are continued and enhanced till now days such as ICP Forests[2], and their experience shared with other regions of the world.

1.3. Integrated Approach To The Planning And Management Of Land Resources- Land is normally defined as a physical entity in terms of its topography and spatial nature; a broader integrative view also includes natural resources: the soils, minerals, water and biota that the land

[1] The Conference, hosted by the Government of Indonesia, took place at the Bali International Convention Centre and brought together representatives of over 180 countries together with observers from intergovernmental and nongovernmental organizations, and the media. The two week period included the sessions of the Conference of the Parties to the UNFCCC, its subsidiary bodies as well as the Meeting of the Parties of the Kyoto Protocol.

[2] ICP Forests was launched in 1985 under the Convention on Long-range Transboundary Air Pollution of the United Nations Economic Commission for Europe (UNECE) due to the growing public awareness of possible adverse effects of air pollution on forests. ICP Forests monitors the forest condition in Europe, in cooperation with the European Union using two different monitoring intensity levels. The first grid (called Level I) is based on around 6000 observation plots on a systematic transnational grid of 16 x 16 km throughout Europe. The intensive monitoring level comprises around 800 Level II plots in selected forest ecosystems in Europe. Currently 41 countries participate in the ICP Forests.

comprises. These components are organized in ecosystems which provide a variety of services essential to the maintenance of the integrity of life-support systems and the productive capacity of the environment. Land resources are used in ways that take advantage of all these characteristics. Land is a finite resource, while the natural resources it supports can vary over time and according to management conditions and uses. Expanding human requirements and economic activities are placing ever increasing pressures on land resources, creating competition and conflicts and resulting in suboptimal use of both land and land resources. If, in the future, human requirements are to be met in a sustainable manner, it is now essential to resolve these conflicts and move towards more effective and efficient use of land and its natural resources. Integrated physical and land-use planning and management is an eminently practical way to achieve this. By examining all uses of land in an integrated manner, it makes it possible to minimize conflicts, to make the most efficient trade-offs and to link social and economic development with environmental protection and enhancement, thus helping to achieve the objectives of sustainable development. Land resources are used for a variety of purposes which interact and may compete with one another; therefore, it is desirable to plan and manage all uses in an integrated manner. Integration should take place at two levels, considering, on the one hand, all environmental, social and economic factors (including, for example, impacts of the various economic and social sectors on the environment and natural resources) and, on the other, all environmental and resource components together (i.e., air, water, biota, land, geological and natural resources).

1.4. Sustaining the multiple roles and functions of all types of forests, forest lands and woodlands - There are major weaknesses in the policies, methods and mechanisms adopted to support and develop the multiple ecological, economic, social and cultural roles of trees, forests and forest lands. Many developed countries are confronted with the effects of air pollution and fire damage on their forests. More effective measures and approaches are often required at the national level to improve and harmonize policy formulation, planning and programming; legislative measures and instruments; development patterns; participation of the general public, especially women and indigenous people; involvement of youth; roles of the private sector, local organizations, non-governmental organizations and cooperatives; development of technical and multidisciplinary skills and quality of human resources; forestry extension and public education; research capability and support; administrative structures and mechanisms, including intersectoral coordination, decentralization and responsibility and incentive systems; and dissemination of information and public relations. This is especially important to ensure a rational and holistic approach to the sustainable and environmentally sound development of forests. The need for securing the multiple roles of forests and forest lands through adequate and

appropriate institutional strengthening has been repeatedly emphasized in many of the reports, decisions and recommendations of FAO[1], ITTO[2], UNEP[3], the World Bank[4], IUCN[5] and other organizations.

1.5. Enhancing the protection, sustainable management and conservation of all forests, and the greening of degraded areas, through forest rehabilitation afforestation, reforestation and other rehabilitative means – Forests world wide have been and are being threatened by uncontrolled degradation and conversion to other types of land uses, influenced by increasing human needs; agricultural expansion; and environmentally harmful mismanagement, including, for example, lack of adequate forest-fire control and anti-poaching measures, unsustainable commercial logging, overgrazing and unregulated browsing, harmful effects of airborne pollutants, economic incentives and other measures taken by other sectors of the economy. The impacts of loss and degradation of forests are in the form of soil erosion; loss of biological diversity, damage to wildlife habitats and degradation of watershed areas, deterioration of the quality of life and reduction of the options for development. The present situation calls for urgent and consistent action for conserving and sustaining forest resources. The greening of suitable areas, in all its component activities, is an effective way of increasing public awareness and participation in protecting and managing forest resources. It should include the consideration of land use and tenure patterns and local needs and should spell out and clarify the specific objectives of the different types of greening activities.

To maintain existing forests through conservation and management, and sustain and expand areas under forest and tree cover, in appropriate areas of both developed and developing countries, through the conservation of natural forests, protection, forest rehabilitation, regeneration, afforestation, reforestation and tree planting, with a view to maintaining or restoring the ecological balance and expanding the contribution of forests to human needs and welfare. Ensuring the sustainable management of all forest ecosystems and woodlands, through improved proper planning, management and timely implementation of silvicultural operations, including inventory and relevant research, as well as rehabilitation of degraded natural forests to restore productivity and environmental contributions, giving particular

[1] Food and Agriculture Organization of the United Nations

[2] ITTO - is an intergovernmental organization promoting the conservation and sustainable management, use and trade of tropical forest resources.

[3] UNEP United Nations Environment Programme - provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations.

[4] The World Bank (the Bank), a part of the World Bank Group (WBG), is an internationally supported bank that provides loans to developing countries for development programs with the stated goal of reducing poverty.

[5] The International Union for the Conservation of Nature and Natural Resources - The World Conservation Union is the world's largest and most important conservation network. The Union brings together 83 States, 110 government agencies, more than 800 non-governmental organizations (NGOs), and some 10,000 scientists and experts from 181 countries in a unique worldwide partnership.

attention to human needs for economic and ecological services, wood-based energy, agro forestry, non-timber forest products and services,

Regarding the international and regional cooperation and coordination should be cooperation and assistance of international organizations and the international community in technology transfer, specialization and promotion of fair terms of trade, without resorting to unilateral restrictions and/or bans on forest products contrary to GATT[1] and other multilateral trade agreements, the application of appropriate market mechanisms and incentives will help in addressing global environmental concerns. Strengthening the coordination and performance of existing international organizations, in particular FAO, UNIDO[2], UNESCO[3], UNEP, ITC/UNCTAD[4]/GATT, ITTO and ILO[5], for providing technical assistance and guidance in this programme area is another specific activity.

2. SUSTAINING LIFE OF EARTH

Life on the blue planet is contained within the biosphere, a thin and irregular envelope around the Earth's surface, just a few kilometers deep

[1] The General Agreement on Tariffs and Trade (typically abbreviated GATT) was the outcome of the failure of negotiating governments to create the International Trade Organization (ITO).. As governments negotiated the ITO, 15 negotiating states began parallel negotiations for the GATT as a way to attain early tariff reductions. Once the ITO failed in 1950, only the GATT agreement was left. The GATT's main objective was the reduction of barriers to international trade. This was achieved through the reduction of tariff barriers, quantitative restrictions and subsidies on trade through a series of agreements. The GATT was a treaty, not an organization. The functions of the GATT were taken over by the World Trade Organization which was established during the final round of negotiations in the early 1990s.

[2] The United Nations Industrial Development Organization (UNIDO) helps developing countries and countries with economies in transition in their fight against marginalization in today's globalized world. It mobilizes knowledge, skills, information and technology to promote productive employment, a competitive economy and a sound environment.

[3] United Nations Educational, Scientific and Cultural Organization (UNESCO) is a specialized agency of the United Nations established on 16 November 1945. Its stated purpose is to contribute to peace and security by promoting international collaboration through education, science, and culture in order to further universal respect for justice, the rule of law, and the human rights and fundamental freedoms proclaimed in the UN. It is the heir of the League of Nations' International Commission on Intellectual Cooperation.

[4] United Nations Conference on Trade and Development. Established in 1964, UNCTAD promotes the development-friendly integration of developing countries into the world economy. UNCTAD has progressively evolved into an authoritative knowledge-based institution whose work aims to help shape current policy debates and thinking on development, with a particular focus on ensuring that domestic policies and international action are mutually supportive in bringing about sustainable development.

[5] The International Labor Organization - The UN specialized agency which seeks the promotion of social justice and internationally recognized human and labor rights. ILO is devoted to advancing opportunities for women and men to obtain decent and productive work in conditions of freedom, equity, security and human dignity. Its main aims are to promote rights at work, encourage decent employment opportunities, enhance social protection and strengthen dialogue in handling work-related issues. In promoting social justice and internationally recognized human and labor rights, the organization continues to pursue its founding mission that labor peace is essential to prosperity. Today, the ILO helps advance the creation of decent jobs and the kinds of economic and working conditions that give working people and business people a stake in lasting peace, prosperity and progress.

around the radius of the globe. Here, ecosystems purify the air and the water that are the basis of life. They stabilize and moderate the Earth's climate. Soil fertility is renewed, nutrients are cycled and plants are pollinated. Although scientists are now able to appreciate the complexity of this web of interacting natural processes, we are still a very long way from understanding how they all fit together. What we do know is that if any part of the web suffers breaks down, the future of life on the planet will be at risk.

Biological diversity – the variability of life on Earth – is the key to the ability of the biosphere to continue providing us with these ecological goods and services and thus is our species' life assurance policy. However, as a species are degrading, and in some cases destroying, the ability of biological diversity to continue performing these services. The 20th century saw a fourfold increase in human numbers and an eighteen-fold growth in world economic output. With these came unsustainable patterns of consumption and the use of environmentally unsound technologies.

There are now more than six billion of populations and human are placing unprecedented strains on the planet's ability to cope. Worse, the fruits of this growth are extremely unequally divided.

Whilst some enjoy better standards of living than at any time in history, nearly half the world's population is unjustifiably poor, making do on less than $2 a day. Worse still, the poor suffer disproportionately from the damage done to the environment (Töpfer 2000).

Interactions among the various components of biodiversity make the planet habitable for all species, including humans. Personal health, and the health of economy and human society, depends on the continuous supply of various ecological services that would be extremely costly or impossible to replace. These natural services are so varied as to be almost infinite. For example, it would be impractical to replace, to any large extent, services such as pest control performed by various creatures feeding on one another, or pollination performed by insects and birds going about their everyday business.

"Goods and Services" provided by ecosystems include:

• Provision of food, fuel and fiber
• Provision of shelter and building materials
• Purification of air and water
• Detoxification and decomposition of wastes
• Stabilization and moderation of the Earth's climate
• Moderation of floods, droughts, temperature extremes and the forces of wind
• Generation and renewal of soil fertility, including nutrient cycling
• Pollination of plants, including many crops
• Control of pests and diseases
• Maintenance of genetic resources as key inputs to crop varieties and livestock breeds, medicines, and other products

• Cultural and aesthetic benefits
• Ability to adapt to change

2.1. Biodiversity under threat

Species have other ecosystems that pose radiation reach the Earth's been disappearing at 50-100 times the natural rate, and the gravest threat to surface where it damages this is predicted to rise biological diversity. Forests living tissue. Global dramatically. Based on are home too much of the warming is already changing known terrestrial habitats and the distribution current trends, an estimated 34,000 plant and 5,200 biodiversity, but about 45 of species. Scientists warn animal species – including per cent of the Earth's that even a one-degree one in eight of the world's original forests are gone, increase in the average bird species – face cleared mostly during the global temperature, if it extinction past century. Despite some comes rapidly, will push re growth, the world's total many species over the brink.

For thousands of years forests are still shrinking. Food production systems have been developing a vast rapidly, particularly in the could also be seriously array of domesticated plants tropics. The loss of biodiversity food. But this treasure richest ecosystems – have house is shrinking as been destroyed, and one often reduces the productivity of ecosystems, modern commercial third of the remainder face agriculture focuses on collapse over the next 10 to thereby shrinking nature's relatively few crop varieties 20 years. It destabilizes ecosystems, and weakens their ability to deal with natural disasters such as floods, droughts, and hurricanes, and with human-caused stresses, such as pollution and climate change. Already, are spending huge sums in response to flood and storm damage exacerbated by deforestation; such damage is expected to increase due to global warming.

The reduction in biodiversity also hurts mankind in other ways. Cultural identity is deeply rooted in our biological environment. Plants and animals are symbols of our world, preserved in flags, sculptures, and other images that define us and our societies.

While loss of species has always occurred as a natural phenomenon, the pace of extinction has accelerated dramatically as a result of human activity. Ecosystems are being fragmented or eliminated, and innumerable species are in decline or already extinct. These extinctions are irreversible and, given our dependence on food crops, medicines and other biological resources, pose a threat to our own well-being. It is reckless if not downright dangerous to keep chipping away at our life support system.
It is unethical to drive other forms of life to extinction, and thereby deprive present and future generations of options for their survival and development.

Can be the world's ecosystems saved, and with them the species we value and the other millions of species, some of which may produce the foods and medicines of tomorrow?

The answer will lie in mankind ability to bring demands into line with nature's ability to produce what we need and to safely absorb what we throw away.

3. CONSERVATION OF BIOLOGICAL DIVERSITY

Planet's essential goods and services depend on the variety and variability of genes, species, populations and ecosystems. Biological resources feed and clothe us and provide housing, medicines and spiritual nourishment. The natural ecosystems of forests, savannahs, pastures and rangelands, deserts, tundra's, rivers, lakes and seas contain most of the Earth's biodiversity. The current decline in biodiversity is largely the result of human activity and represents a serious threat to human development.

Governments at the appropriate level, with the cooperation of the relevant United Nations bodies and regional, intergovernmental and non-governmental organizations, the private sector and financial institutions, and taking into consideration indigenous people and their communities, as well as social and economic factors, should:

Press for the early entry into force of the Convention on Biological Diversity, with the widest possible participation; Develop national strategies for the conservation of biological diversity and the sustainable use of biological resources; Integrate strategies for the conservation of biological diversity and the sustainable use of biological resources into national development strategies and/or plans; Take appropriate measures for the fair and equitable sharing of benefits derived from research and development and use of biological and genetic resources, including biotechnology, between the sources of those resources and those who use them; Carry out country studies, as appropriate, on the conservation of biological diversity and the sustainable use of biological resources, including analyses of relevant costs and benefits, with particular reference to socio-economic aspects; Strengthen support for international and regional instruments, programmes and action plans concerned with the conservation of biological diversity and the sustainable use of biological resources.

4. 2010 BIODIVERSITY TARGET

Targets are increasingly being used in various areas of public policy. Clear, long-term outcome-oriented targets that are adopted by the international community can help shape expectations and create the conditions in which all actors, whether Governments, the private sector, or civil society, have the confidence to develop solutions to common problems. By establishing targets and indicators, progress can be assessed and appropriate actions taken. Biodiversity is crucial.

As demographic pressures and consumption levels increase, biodiversity decreases, and the ability of the natural world to continue delivering the goods and services on which humanity ultimately depends may be undermined. Other Convention on Biological Diversity Targets - In addition to the 2010 Biodiversity Target, the Convention has established other targets in the Global Strategy for Plant Conservation, and in the Programme of Work on Protected Areas.

All of the Parties to the Convention on Biological Diversity (CBD) have committed themselves to achieving the 2010 Biodiversity Target, and its commitments go beyond as an all-inclusive global target.

In 2005, Countdown 2010[1] was launched at the stakeholder conference "Sustaining Livelihoods and Biodiversity: Attaining the 2010 Biodiversity Target in the European Biodiversity Strategy". Through a multitude of activities, this initiative assists Governments worldwide in moving closer to the 2010 Biodiversity Target.

At the initiative of the Secretary-General of the United Nations, presented to 61st session of the General Assembly in 2006 in the Report of the Secretary-General on the work of the Organization, the 2010 Biodiversity Target was incorporated as a new target under Goal 7 ("Ensure environmental sustainability") of the Millenniums Development Goals.

The meeting of the environment ministers of the eight leading industrialized countries, the G8, and of the five major newly industrializing countries - China, India, Brazil, Mexico and South Africa – held in Potsdam, Germany from March 2007, endorsed the Potsdam Initiative – Biological Diversity 2010. The ministers of the G8+5 agreed to the process of analyzing the global economic benefit of biological diversity, the costs of the loss of biodiversity and the failure to take protective measures versus the costs of effective conservation and renewed their commitment to develop and implement national targets and strategies in order to achieve the 2010 Biodiversity Target and beyond.

In summary, the 2010 Biodiversity Target has been agreed in a variety of flora and formulations and its achievement presents a truly global challenge to which actors around the globe respond in different ways and according to their capacities and priorities.

[1] Countdown 2010 is a powerful network of active partners working together towards the 2010 biodiversity target. Each partner commits additional efforts to tackle the causes of biodiversity loss. The secretariat – hosted by the World Conservation Union (IUCN) – facilitates and encourages action, promotes the importance of the 2010 biodiversity target and assesses progress towards 2010. An Assembly of all partners meets annually to review the overall direction of Countdown 2010. In its implementation, Countdown 2010 is guided by a core Advisory Board. Nearly all countries of the world came together for the World Summit on Sustainable Development in 2002 and promised to 'achieve by 2010 a significant reduction in the current rate of loss of biological diversity'. Countdown 2010 and its partners assist governments worldwide in moving closer to this 2010 biodiversity target. Approach is: Through a multitude of activities on all levels, it makes the case for biodiversity and its conservation; call upon decision makers to do their very best to keep their promise to save biodiversity by 2010; and take action ourselves to stop the loss of biodiversity. Countdown 2010 Hubs in many regions worldwide assess the specific threats to biodiversity and possible approaches to alleviate them, and work with stakeholders to increase the level of action towards the 2010 biodiversity target. Governments as Countdown 2010 Partners - Fourteen European governments have joined Countdown 2010 officially. Some partners pointed out though that some commitments signed were rather weak, and that others were not being implemented.

What are the prospects for achieving the target - According to the Biodiversity Synthesis of the Millennium Ecosystem Assessment, unprecedented additional efforts would be needed to achieve, by 2010, a significant reduction in the rate of biodiversity loss at all levels. The magnitude of the challenge of slowing the rate of biodiversity loss is demonstrated by the fact that most of the direct drivers of biodiversity loss are projected to either remain constant or to increase in the near future. Moreover, inertia in natural and human institutional systems results in time lags – of years, decades, or even centuries – between actions being taken and their impact on biodiversity and ecosystems becoming apparent. Several of the 2010 Biodiversity sub-targets adopted by the Convention on Biological Diversity could be met for some components of biodiversity, or some indicators, in some regions. For example, the overall rate of habitat loss, which is the main driver of species loss in terrestrial ecosystems, is now slowing in certain regions. This may not necessarily translate, however, into lower rates of species loss for all taxa because of the nature of the relationship between numbers of species and area of habitat, because decades or centuries may pass before species extinctions reach equilibrium with habitat loss, and because other drivers of loss, such as climate change, nutrient loading, and invasive species, are projected to increase.

The second edition of Global Biodiversity Outlook suggests that the policies developed under the Convention are sufficient to meet the 2010 Biodiversity Target. However, they must be widely applied, in all relevant sectors, if conservation and sustainable use are to be achieved.

Biodiversity considerations must be integrated into any poverty reduction strategies in order to ensure their sustainability.

Biodiversity will be better protected through actions that are justified on their economic merits.

5. ENVIRONMENTAL LAW REFORM IN SOUTH EASTERN EUROPE

Since 2001 the REC[1] has implemented a European Commission assistance project that is funded through the Community Assistance for Reconstruction, Development and Stabilization (CARDS)[2] programme to help the countries of South Eastern Europe to re-establish and develop their environmental legal systems in accordance with EU norms and standards.

The project supported ministries in the drafting of 19 pieces of legislation in conformity with the EU environmental acquits. A prime

[1] The Regional Environmental Center for Central and Eastern Europe (REC). The REC has studied the region's environment and guided its stakeholders for more than 15 years. REC experience and knowledge, gained in concert with its donors and beneficiaries alike, represent both an asset for future work and a responsibility of everyone involved

[2] Since 1991 the European Union has committed, through various assistance programmes, € 6.8 billion to the Western Balkans. In 2000 aid to the region was streamlined through a new programme called CARDS (Community Assistance for Reconstruction, Development and Stabilisation)

example is the recent assistance in the drafting of new chemicals legislation to support approximation in a complex and critically important sector for Albania, the former Yugoslav Republic of Macedonia, the Republic of Serbia, and the Republic of Montenegro.

The Environmental Law Programme of the REC is dedicated to the progressive development of environmental law and governance, both internationally and within each country of Central and Eastern Europe, through support to the development of multilateral environmental agreements, state-of-the-art legislation, conflict-reduction tools, citizens' environmental rights and legal professionalism. Serbia already have a progress towards Regional Priority on air quality prepared a new law. By the end of 2005 a new law on Air Pollution Prevention, harmonized with European Union legislation, prepared by the Ministry for Science and Environmental Protection, on that time.

After the adoption of the law, a set of bye-laws and regulations will also be adopted. The main regulated topics are: Surveillance of indoor air quality, Tobacco: Since 2002 the Ministry of Health has initiated strong activities against smoking and for tobacco control. In 2003 the National Committee for Smoking Prevention was established, and it prepared the draft version of the Strategy for Tobacco Control in Serbia, adopted in 2005[1], Outdoor air[2], Protection against air pollution[3], The National Environment Action Plan (NEAP)[4].

[1] Legislation related to tobacco control: Law on Smoking Ban in Close Premises (Official Gazette of the Republic of Serbia, 16/1995; 101/2005), such as care centres, schools, daycare centers, workplaces, and public transportation. In 2005 fines were substantially increased and law has been enforced.
New Law on Tobacco was adopted in December 2005 (Official Gazette of the Republic of Serbia, 101/2005) and it banned selling tobacco products to minors and terms such as "low tar", "light", "ultra light" and "mild", introduced ISO standards for testing and measuring, disclosure by manufacturers - health warnings on toxic contents of the tobacco products, etc.New Law on Advertising adopted in September 2005 (Official Gazette of the Republic of Serbia, 79/2005), banned all forms of tobacco advertising and sponsorship, particularly close to the schools, sport centres etc.

[2] Investing in the reconstruction of the Serbian Electric Power System (EPS): The most important step forward to improve outdoor air quality was the donation of 26 million euros from the European Agency for Reconstruction, to reduce pollution from two thermal plants which are major air and environment polluters. The funds will make technological improvements in the system of ash deposition at the thermal power plant Nikola Tesla B Obrenavac. Four million euros will also go for the same purpose to the thermal plant Kostolac. In the production of electric energy, these thermal plants produced over 8 millions tons of ash per year. Since the thermal power system in Serbia is responsible for over 80% of all harmful pollutants, this is a very important action in improving air quality.Recently a new project, "Energy Efficiency in Serbia" was launched by the World Bank with the aim of improving energy efficiency in the Clinical Centre in Serbia and numerous health care facilities, schools and nurseries. The budget is US $21 million. The expected results are that the use of heat will be reduced by 40%, that expenses will be cut by 50%, and the production of electrical energy with a high level of use will be around 87%. Furthermore it is expected that air pollution within the CCS will be reduced from 780 ton per year of SO2 to 20 SO2, NOx from 100 tons a year to 35; for CO2 to be halved; and airborne ashes will be virtually eliminated. The project started in 2004 and finished by the end of 2007.

[3] The area of protection of air from pollution has been regulated by the Law on Environmental Protection ("Official Gazette of the Republic of Serbia", no. 135/04), By-Law on Limit Values, Methods of air quality Metering, Criteria for Determination of Measuring Points and Data Recording ("Official Gazette of the Republic of Serbia" no. 54/92), By-Law on Emission Limit Values, Manners and Deadlines of Metering and Data Recording ("Official Gazette of the Republic of Serbia" no. 30/97) and By-Law on Closer Conditions that must be fulfilled by expert organizations that conduct emission and air quality metering ("Official Gazette of the Republic of Serbia" no. 5/2002).

[4] The National Environment Action Plan (NEAP) is in the final stage of preparation. Within this Plan, the Serbian Government will adopt action plans: for water protection, air and atmosphere protection, eco-system protection, chemical management, protection from ionizing and non-ionizing radiation, protection from hazards, protection from noise and vibration, sustainable energy management, information system development, scientific research development and education in two years, counting from the day the above mentioned Law enters into force.

6. NATIONAL ENVIRONMENTAL STRATEGY REPUBLIC OF SERBIA – Some statements

The Constitution of the Republic of Serbia provides for the right to a healthy environment as one of the basic rights and freedoms of every citizen. Article 72 of the Constitution stipulates that the Republic is responsible for the environmental protection and the protection and enhancement of flora and fauna. The Law on Environmental Protection (The Official Gazette RS Nr. 135/04) requires that the National Environmental Strategy (NES) is developed for the period of at least ten years. One of the key issues in a successful NES is building of understanding, consensus and ownership among different stakeholders of the NES, and an effective management structure that provides for an efficient management of the NES process. Much effort was put to address those issues. The Ministry of Science and Environmental protection – the Directorate for Environmental Protection and the Inter-ministerial Committee for Sustainable Development provided the political driving force for the NES process.

The National Environmental Strategy contains:

- Description and appraisal of the state of environment;
- Policy objectives, criteria for enforcement of environmental protection in general,
  by sectors and geographical areas indicating priority measures;
- Conditions for implementation of the most favorable economic, technical, technological and other measures for sustainable development and environmental protection;
- Long-term and short-term measures for prevention, mitigation and control of pollution;
- Implementing institutions and implementation plan;
- Financing plan.

The National Environmental Strategy is to be implemented through Action Plans and remediation plans adopted by the Government for the period of five years. In addition, the Government is to submit every two years the NES progress report to the Parliament. Individual action plans are developed by the ministry in charge of environmental protection in cooperation with the relevant sectoral ministry.

The Republic of Serbia faces significant challenges in improving its system of environmental protection while continuing profound socio-economic transformation to market economy and civil society. This process implies improvement of the traditional environmental policy by including all sectoral policies towards management of the environment and natural resources based on the principles of sustainable development.

The National Environmental Strategy was developed with the objective to guide the development of modern environmental policy in the Republic of Serbia over the next decade. The NES is followed by

Environmental Action Plans that provides detailed implementation plan for the next five years. The NES is developed to enable improvement of the quality of the environment, and the quality of life for citizens of theRepublic of Serbia. Furthermore, the NES facilitates the EU approximation process in Serbia.

The National Environmental Strategy (NES) document that stipulates the priority policy objectives in the short- (till end of 2010) and medium-term (till end of 2015), and the key policy reforms that are needed to implement those objectives. The NES can be considered as a road map that will guide the reforms of policy and legislative framework over the next decade. It will also facilitate integration of environmental considerations in other sectoral strategies and guide development of environmental programmes. The National Environmental Action Plan specifies packages of actions that are required to implement the NES policy objectives in the short-term horizon of 2006-2010, as well as presenting financial plan, implementation and progress monitoring arrangements. The Action Plan provides a direct link to project pipelines.

The body of environmental legislation in Serbia consists of a large number of laws and regulations[1]. Legislative, executive and judicial powers are mostly practiced through the legally prescribed scope of competencies of the republic's authorities. According to the law, certain competences are delegated to the autonomous province and the local government.

Environmental legislation includes laws and regulations on: planning and construction, mining, geological survey, water, soil and forest protection, flora and fauna, national parks, fishery, hunting, waste management, production and trade of chemicals, trade and transport of explosive and hazardous materials, protection of ionizing and non ionizing radiation, nuclear safety etc.

The new legal framework for environmental protection was introduced in 2004 in the Republic of Serbia by the Law on Environmental

[1] LIST OF LEGAL ACTS IN THE ENVIRONMENT SECTOR:
1. General regulations
1. The Constitution of the Republic of Serbia (Off. Jour. of RS, No. 1/90)
2. Law on Environmental Protection (Off. Jour. of RS, No. 66/91, 83/92, 67/93, 48/94, 53/95)
3. Law on Environmental Protection (Off. Jour. of RS, No. 135/04)
4. Law on Strategic Environmental Impact Assessment (Off. Jour. of RS, No. 135/04)
5. Spatial Plan of the Republic of Serbia (Off. Jour. Of RS 13/96)
2. Protection of Nature
1. Law on national parks (Off. Jour. of RS, No. 39/93, 44/93, 53/93, 67/93, 48/94)
2. Regulation on protection of natural rarities (O.H. RS 50/93, 93/93)
3. Decision on placement under control the use and trade of wild flora and fauna (Off. Jour. of RS, No. 31/05)
4. Regulation of categorization of natural goods (O.H. RS 30/92)
5. Regulation on methods of marking protected natural goods (O.H. RS 30/92, 24/94, 17/96)
6. Regulation on the registry of protected areas (O.H. RS 30/92)
3. Environmental Impact Assessment
1. Law on Environmental Impact Assessment (Off. Jour. of RS, No. 135/04)

Protection, Law on Strategic Environmental Assessment[1] (This Law regulates the conditions, methods and procedure according to which the assessment of impact of certain plans and programmes on the environment - hereinafter referred to as: strategic assessment- shall be carried out in order to provide for the environmental protection and improvement of sustainable development through integration of basic principles of environmental protection into the procedure of preparation and adoption of plans and programmes), Law on Environmental Impact Assessment and Law on Integrated Prevention and Pollution Control. The most significant issues addressed by the Law on Environmental Protection include: main principles of environmental protection, management and protection of natural resources, measures and conditions of environmental protection, environmental programs and plans, industrial accidents, public participation, monitoring and information system, clearly identified competences of the Environmental Protection Agency, reporting, financing of environmental protection, inspection services and fines. The new laws are harmonized with the EU Directives on Environmental Impact Assessment (85/337/EEC), Strategic Impact Assessment (2001/43/EC), IPPC (96/61/EC) and Public Participation (2003/35/EC).

The principle of preservation of natural values are: The achievement of objectives of sustainable development requires respecting of the principle of sustainable use of natural resources and the substitution principle. Natural values are used under the conditions and in a manner ensuring the preservation of values of geological diversity, biodiversity, protected natural values and landscape. The exploitation of renewable resources is carried out under conditions enabling their continuous and efficient renewal and enhancement of their quality. Non-renewable resources are exploited under conditions ensuring their long-term cost-effective and reasonable exploitation, including the imposing of limits on the exploitation of strategic or rare natural resources and their substitution with other available resources, composite or synthetic materials. The substitution of fossil fuels and non-renewable energy sources by renewable materials and materials/energy recovered from waste stream is specifically addressed by the substitution principle.

The principle of cross-sectoral integration are: The authorities of the state, autonomous province and units of local self-government provide for the integration of environmental protection and enhancement of environmental policy with all sectoral policies. This is achieved by implementing mutually adjusted plans and programs and by enforcement of legislation through strengthening of the permitting system, technical and other standards and norms, provision of funding, incentives and other environmental measures. This principle requires that environmental considerations are incorporated into sectoral policies such as industrial

[1] LAW ON STRATEGIC ENVIRONMENTAL IMPACT ASSESSMENT. Published in the "Official Gazette of the Republic of Serbia", No. 135/2004

policy, agricultural policy, energy policy, transport policy, social policy etc. Environmental protection should be seen as an integral part of social and economic development.

In July 2003 the Government of the Republic of Serbia adopted the Action Plan for harmonization of draft legislation with the laws of the EU, identifying the scope of laws that need to be adopted in line with the EU requirements. This Action Plan includes also justification for the need to adopt certain laws, the institutions in charge of implementation, and other elements of significance for the harmonization of the national legal system with the EU acquis.

Harmonization with the EU acquis communautaire is a voluminous and imperative task for a state which aspires for EU membership. The parts of the EU acquits communitarian relevant to the environment consists[1] of more than two hundred legal provisions (framework directives, daughter directives, regulations and decisions) addressing water pollution and management of water resources, air pollution, waste management, management of chemicals, nature conservation, etc.

[1] Law on Acknowledgement of the UN Convention of Climate Change (Off. Jour. SFRY International treaties, No. 2/97)
1. Law on Acknowledgement of the Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, (Off. Jour. SFRY International treaties, No. 2/99)
2. Law on Acknowledgement of the Convention on Biological Diversity (Off. Jour. FRY International treaties, No. 11/2001)
3. Law on Acknowledgement of the Convention of International Trade of Endangered Species of Wild Fauna and Flora (Off. Jour. FRY International treaties, No. 11/2001)
4. Convention on Co-operation for the Protection and Sustainable Use of the Danube River (Danube River Protection Convention), (Off. Jour. S&M International treaties, No. 4/2003)
5. Amendments to the Montreal Protocol on Substances Depleting Ozone Layer (Off. Jour. S&M International treaties, No. 2/2004) International agreements which indirectly regulate environmental protection
1. Law on ratification of Geneva Maritime Conventions from April 29, 1958, ratifying Convention of Territorial Seas and Outside Sea Zone (Off. Jour. SFRY, No. 4/65)
2. By-law on ratification of Treaty on Financial Contribution to the North-Atlantic Department for Protection from Ice (Off. Jour. SFRY, International treaties, No. 3/59)
3. Directive on ratification of the Treaty for Establishment of the General Council for Fisheries of the Mediterranean Sea (Off. Inf. of Presidium of the National Parliament, No. 25/51)
4. Directive on ratification of Convention on Fisheries and Conservation of Biological Goods of High Seas (Off. Jour. SFRY, International treaties, No. 4/65)
5. By-law on ratification of International Convention for Protection of Human Life on the Sea (Off. Jour. SFRY, International treaties, No. 4/65)
6. By-law on ratification of International Convention on Civil Responsibility for Damages caused by Oil Pollution (Off. Jour. SFRY, International treaties, No. 7/77)
7. Law on ratification of International Convention for establishment of International Fund for Compensation of damages caused by Oil Pollution (Off. Jour. SFRY, International treaties, No. 3/77)
8. Law on ratification of Convention on International Rules for Avoiding Collision on the Seas (Off. Jour. SFRY, International treaties, No. 60/75)
9. Law on Conventions adopted on the bases of Versaille Peace Treaty from June 8, 1919, and on the bases of corresponding directives from other conventions on peace adopted on International conferences held in Washington, Genova and Geneva 1919 – 1926, Off. News. Of Kingdom of Yugoslavia No. 44 XV/30)
10. By-law on ratification of Convention Concerning Protection against Hazards of Poisoning Arising from Benzene (Off. Jour. SFRY, International treaties, No. 16/76)
11. Law on ratification of Convention on Prevention and Control of Occupational Hazards Caused by Carcinogenic Substances and Matter, (Off. Jour. SFRY, International treaties, No. 3/77)
12. Law on Prohibition of Experiments with Nuclear Weapons in Atmosphere, Universe and under the Water (Off. Jour. SFRY, International treaties, No. 11/63)

7. FOREST POLICY OF SERBIA – Some statements

The forestry sector of Serbia has documents in preparing that address adequately the goals of the sector development. The incentive to develop a document at the State level is in progress, which will reflect the trends and methods of solving the numerous issues in Serbian forestry in harmony with the sector requirements, its significance for the sustainable development of the Republic of Serbia, and the intentions to join the European Union in near future. The constraints in the development of the forestry sector in Serbia are the decade-long backwardness in the technical-technological development and the absence of communication with the international community due to UN sanctions, institutional weaknesses and the slowness of the adaptation to the changes of forest management at the global level, from practical, educational and research aspects.

The Government of the Republic of Serbia, recognizing the fact that forests and other wooded land in the Republic of Serbia cover cca 2.5 million hectares, which is cca 1/3 of the territory; recognizing that the entire society supports the sustainable management, i.e. forest management and utilization which ensures the conservation of biological diversity, the promotion of productivity, regeneration potential, vitality and the potential of satisfying the ecological, economic and social functions in the present and future periods; aware of the unsatisfactory forest state which is characterized by a high share of poor-quality forests, inadequately tended artificially established forests and an insufficient share of high-quality and valuable high natural forests; convinced that the priority is to improve the forest state by tending and protection of actual forests, and to enlarge the forest area by the establishment of new forests; acknowledging that forestry, as a branch of economy with a long tradition, developed structure, personnel and other potentials, scientific and professional knowledge, is a significant segment of Serbia's development in general; recognizing the fact that Serbia has a very rich biological diversity, mainly in forest ecosystems; establishing also the universal nature of wild fauna, as an inseparable and invaluable part of forest ecosystems; expecting a significant role of the forestry sector in the sustainable development of Serbia; conscious that the actual level of the production-technological process in forestry, due to technical-technological and organizational backwardness and insufficiently developed forest road network, makes forest management more difficult; conscious also that the actual state of forestry education, due to multi annual economic difficulties and international isolation, resulted in over numerous but insufficiently qualified professional staff, unable to meet the challenges and modern achievements in forestry, acknowledging that, for the same reasons, the scope and quality of scientific research is at an unsatisfactory level; noting that in the Constitution the forest status is in accordance with its significance, and that current legislative-regulatory instruments do not ensure the adequate protection and enhancement of actual forest resources.

The issues of management in private forests, which occupy cca one half of the total forest area and which are characterized by a poor state and fragmented holdings, which makes forest management even more difficult, stressing the fact that the State intends to participate in the stimulation of the private sector development, aiming at the implementation of the goals of sustainable development.

To realize the goals of forest policy, the Government and the Ministry of Forestry will launch the activities on the formulation of the National Forestry Programme, as the strategic framework for the development of the forestry sector.

Within the overall legal system, the Government will, based on the general significance of forests for the well-being of the nation, the specificities of forest management and biological characteristics of resources, provide the mechanisms for real valuation of forests and quality and the efficient sanctioning of the illegal actions related to forests. The Government will promote communication, co-ordination and cooperation with other forestry related sectors.

The identification of the optimal solutions will condition the definition of forest area – forest holding on which it is possible to realize the principle of sustainable management, i.e. sustainable production and yield, with simultaneous creation of the preconditions for commercial management. The objective of forest policy is to increase the contribution of the forestry sector to the economic and social development of the Republic of Serbia. This includes the following:

• Increase the area of forest cover by encouraging the activities and by providing assistance for the afforestation of the land on which it is economically and ecologically feasible to raise forests (degraded soil, abandoned agricultural land, treeless forest land, etc.) regardless of the ownership;

• Increase the productivity by maximal and rational use of the overall production potential of forest areas;

• Establish and maintain the optimal quality and density of forest roads, and the accessory infrastructure (houses, resting points, etc.) aiming at the implementation of sustainable forest management and meeting the social and cultural demands of the society;

• The forestry sector will encourage the advancement of co-operation with other sectors (agriculture, tourism, etc.), financial institutions and the general public, aiming at the most complete planning and use of other potentials of forest areas;

• Encourage the establishment and development of private forest owner associations in order to build their capacity for sustainable forest management and the application of scientific and professional knowledge, which will create the conditions for rational use of forest products and other forest functions;

• Encourage the participation of stakeholders, especially in rural regions, in decision-making and allocation of responsibility for the crucial issues of forest management;
• Support the establishment and development of small and medium enterprises for forestry operations and other activities in the forestry sector;
• Create and maintain a national information system of the forestry sector;
• Start the research on the role of forests in the mitigation of energy balance issues, which will create the preconditions for international funds for the advancement of bio-fuel consumption and carbon sequestration. The economic policy measures will stimulate the consumption of wood for energy and simultaneously help solve the issues of forests with fuel wood as the major product;
• Define the mechanisms that will enable a part of the income realized by state forest utilization to be allocated to local communities (villages) to meet the common demands or to solve the common social issues (roads, water supply, schools, etc.);
• Enable the land tenure right of state forests to socially endangered families in rural regions under the identified conditions.

7.1 Forest status and protection -A somewhat better state of state-owned forests compared to the state of private forests, and the significance and the role of that part of the growing stock in overall economic activities, as well as the more significant engagement of the society and the State in forest protection and advancement, impose the following decisions: reserve the property right, protect, increase and legally strengthen the property. At this moment, when private forests by all criteria of forest quality lag behind the state-owned forests, the focusing of attention on the state forests is considered appropriate, rational and unavoidable.

Sustainable management implies the commitment of permanent protection, maintenance, regeneration and the realization of numerous multiple benefit forest functions.

Sustainable management of state forests, taking into account the state of private forests, is an imperative commitment and at least the aim which should be permanently realized in each unit of planning in the aim of simultaneous realization of the logical principle of multiple forest functions. Its base and the capacity of implementation is grounded in large state-owned forest complexes, and not the small spatially distant holdings of numerous owners of different interests, and even more different economic potentials and attitudes to their forests.

Bearing in mind that the former socio-political system did not attach importance to property-legal issues of the public property, and especially forests, either from the aspect of enhancement or from the aspect of protection, the proposed measures are unavoidable for the realization of the goal. They include the reserving of property, its legal insurance,

delimitation, re-distribution of holdings, establishment and updating of the forest cadastre.

The objective of forest policy is sustainable management of state forests by their conservation, enhancement and increase. This objective requires:

• The development of the system of planning and the development of national criteria and indicators for sustainable forest management aiming at their quality and quantity improvement by modern management methods, with special significance focused on monitoring the forest condition, protection of forests and biological diversity of forest ecosystems, and the realization of education, research, recreation, tourism and other functions;

• The State will reserve the ownership of the forests under its jurisdiction, and during the regulation process of restitution and re-privatization, special attention will be devoted to the problem of sustainable forest management;

• Identification of ownership and the harmonization of state-owned forests and other woodland categories with the internationally accepted categorization;

• Identification and delimitation of state-owned agricultural and forest land;

• Upgrading and harmonization of regulations on the change of land use and transfer of property, as well as the purchase (if the State is interested) of state forests and woodland;

• Creation of legal conditions, stimulating measures and mechanisms for the enlargement of state-owned forest estates;

• Updating of the cadastre of forests and other woodland;

• Control of the management activities in state-owned forests and other Woodland;

• Protection of state forests against harmful biotic and abiotic factors, illegal felling, unlawful occupation, illegal building and other illegal actions;

• Development of partnership between the State and other stakeholders by adequately identifying the rights and responsibilities for forest management.

7.2. Upgrading the quality of information on the significance of protected Nature - Conservation and enhancement of biodiversity in forest regions Serbia, as the country of conserved nature, and the Balkan area, as the centre of European biodiversity, require the adequate treatment also in the national context through the system solutions of the conservation and enhancement of the most valuable parts of forest ecosystems.

The objective is the conservation and the appropriate enhancement of forest biodiversity, and the sustainable management of the wild flora and fauna species which are the components of forest areas. This requires:

• Development and implementation of regulations for protection and enhancement of biodiversity;

• Promotion of inter-sectoral co-operation in biodiversity protection and Enhancement;

• Advancement of the methods of directed use of the gene pool of forest tree species by in situ and ex situ conservation and advanced production of quality forest seed and planting material of controlled origin;
• Support to the implementation of international commitments in biodiversity protection,
• Enhancement of quality information on the significance of biodiversity at all levels,
• Updating of the register and maps of the ranges of wild plant and animal species,
• Development and harmonization of the regulations with modern demands of sustainable management of wild plant and animal species (protection and forbidden harvesting of rare and endangered wild plant and animal species; control of trade in protected species and their products, introduction of exotic species, plant or animal diseases or pests, autochthonous and domesticated plant or animal diseases or pests and the species of fauna with a harmful effect on the environment or harmful effect to autochthonous species of wild flora and fauna).

7.3. Protection of forest and environment - Forest, as the most valuable part of the ecosystem, capable of significantly improving the general life conditions, occupies a special position in the global concept of environmental protection. Therefore, it requires a special treatment by an appropriate system of protection, harvesting, management and sustainable development. The harmonization of the basic elements of the sustainability system is essential for the survival of forest ecosystems and healthy environment in general. The objective is to reduce to a minimum all the adverse effects on forests and environment and the damage to forest ecosystems. This requires:
• Assessment of the effects on the environment of the potentially harmful activities in forest regions, i.e. protected nature;
• The State organ responsible for forestry will define the activities in forestry for which it is necessary to analyze the effect on the environment, i.e. the activities in forests which can directly endanger forest ecosystems;
• The utilization of water and mineral raw materials from the forests will be allowed only if it does not bring about the serious changes or damage to forest ecosystems and the environment;
• The Government will help especially the conservation of the forest protection functions - reclamation and rehabilitation of eroded and degraded lands and forests and the protection of headwater areas. The disposal of the hazardous waste in forest ecosystems will be strictly sanctioned.

The key elements of the support to the forest policy implementation are:
A. Sectoral planning
B. Investments in the sector
C. Sectoral co-ordination

D. Institutional reforms
E. Forestry legislation
F. International and regional co-operation
G. Monitoring and evaluation

Serbia is a signatory to a number of international agreements which affect the forestry sector. The Government will meet its commitments to these agreements by the national legislation and by the implementation of activities on their implementation. A series of other future agreements is in the phase of development and Serbia will participate actively in their development to meet, first of all, the national objectives. The key ratified international agreements which address the forestry sector and include the commitments and possibilities are:

• Agenda 21
• UN Framework Convention on Climate Change (UNFCCC) (1992)
• Convention on Biodiversity (2001)
• Convention on Long-range Transboundary Air Pollution (1979)
• Convention on Wetlands of International Importance (Ramsar Convention)(1977)
• Convention on International Trade in Endangered Species (CITES) (2001)
• Protection of the World Cultural and Natural Heritage (1972)
• Resolution of the Ministerial Conference on Forest Protection in Europe (2003).

8. CONLCUSION

Agenda 21, the Rio Declaration on Environment and Development and the Statement of principles for the Sustainable Management of Forests addresses today's pressing problems and aims to prepare the world for the challenges of the next century. It contains detailed proposals for action in social and economic areas (such as combating poverty, changing patterns of production and consumption and addressing demographic dynamics), and for conserving and managing the natural resources that are the basis for life – protecting the atmosphere, Achieving sustainable development worldwide depends largely on changing patterns of production and consumption – what we produce, how it is produced and how much we consume, particularly in the developed countries oceans and biodiversity; preventing deforestation; and promoting sustainable agriculture. Commission on Sustainable Development CSD's work programme in this area focuses on projected trends in consumption and production; impacts on developing countries, including trade opportunities; assessment of the effectiveness of policy instruments, including new and innovative instruments; progress by countries through their time bound voluntary commitments; and extension and revision of UN guidelines for consumer protection: Protection Of The

Atmosphere, controlling Transboundary Atmospheric Pollution, Integrated Approach To The Planning And Management Of Land Resources, Sustaining the multiple roles and functions of all types of forests, forest lands and woodlands, Enhancing the protection, sustainable management and conservation of all forests, and the greening of degraded areas, through forest rehabilitation afforestation, reforestation and other rehabilitative means.

Biological diversity – the variability of life on Earth – is the key to the ability of the biosphere to continue providing us with these ecological goods and services and thus is our species' life assurance policy. However, as a species we are degrading, and in some cases destroying, the ability of biological diversity to continue performing these services. The 20th century saw a fourfold increase in human numbers and an eighteen-fold growth in world economic output. With these came unsustainable patterns of consumption and the use of environmentally unsound technologies.

Can be the world's ecosystems saved, and with them the species we value and the other millions of species, some of which may produce the foods and medicines of tomorrow?

The answer will lie in mankind ability to bring demands into line with nature's ability to produce what we need and to safely absorb what we throw away.

„Attaining the 2010 Biodiversity Target in the European Biodiversity Strategy". Through a multitude of activities, this initiative assists Governments worldwide in moving closer to the 2010 Biodiversity Target.

Since 2001 in Serbia several projects are running under European Commission assistance that is funded through the Community Assistance for Reconstruction, Development and Stabilization (CARDS) programme to help the countries of South Eastern Europe to re-establish and develop their environmental legal systems in accordance with EU norms and standards.

The Republic of Serbia faces significant challenges in improving its system of environmental protection while continuing profound socio-economic transformation to market economy and civil society. This process implies improvement of the traditional environmental policy by including all sectoral policies towards management of the environment and natural resources based on the principles of sustainable development.

The National Environmental Strategy was developed with the objective to guide the development of modern environmental policy in the Republic of Serbia over the next decade.

The Government of Republic of Serbia, recognizing the fact that forests and other wooded land in the Republic of Serbia cover cca 2.5 million hectares, which is cca 1/3 of the territory, showing that the entire society supports the sustainable management.

The identification of the optimal solutions will condition the definition of forest area – forest holding on which it is possible to realize the

principle of sustainable management, i.e. sustainable production and yield, with simultaneous creation of the preconditions for commercial management. The objective of forest policy is to increase the contribution of the forestry sector to the economic and social development of the Republic of Serbia.

Sustainable management implies the commitment of permanent protection, maintenance, regeneration and the realization of numerous multiple benefit forest functions. Forest, as the most valuable part of the ecosystem, capable of significantly improving the general life conditions, occupies a special position in the global concept of environmental protection. Therefore, it requires a special treatment by an appropriate system of protection, harvesting, management and sustainable development. The harmonization of the basic elements of the sustainability system is essential for the survival of forest ecosystems and healthy environment in general.

REFERENCES

1. 1992: *Rio declaration on environment and development*. United Nation Document Chapters 11-15. The United Nations Conference on Environment and Development, Rio de Janeiro.
2. Topfer, K. 2000: *Sustaining Life on Earth. How the Convention on Biological Diversity promotes nature and human well-being.* Secretariat of the Convention on Biological Diversity. UNEP and UK Government, ISBN 92-807-1904-1.
3. 2004: *Forest Policy Of Serbia* – Draft. The Republic of Serbia Ministry of Agriculture, Forestry and Water Management. Belgrade.
4. 2004: *Law on strategic environmental impact assessment.* Published in the "Official Gazette of the Republic of Serbia", No. 135/2004. Belgrade
5. 2004: *National Environmental Strategy*. The Official Gazette Republic of Serbia. Nr. 135/04. Belgrade
6. 2005: UNECE, Geneva, *"Europe's Forests in a Changing Environment, Twenty years of Monitoring Forest Condition by ICP Forests",* Federal Research Centre for Forestry and Forest Products (BFH).
7. 2006: Regional Environmental Center, REC. *Promising harvest – the fruits of environmental law reform in South Eastern Europe.* Legal Commentaries.
8. Nevenic, R. at al., 2006: *Forest Condition Monitoring in the Republic of Serbia.* Annual Report 2006. National Focal Centre of Serbia (NFC). Institute of Forestry. ICP Forests – Level I. Belgrade.

SCIENTIFIC SESSION II
PROTECTION AND DEVELOPMENT STATE OF FORESTS AND ENVIRONMENT – EDUCATION, RESEARCHING, TRAINING, NEEDS

PLENARY LECTURE
SUSTAINABLE USE OF FORESTS AND FORESTS ECOSYSTEMS – THE CONDITION OF INDICATORS IN SERBIA

Mihailo RATKNIĆ, Ljubinko RAKONJAC, Milorad VESELINOVIĆ[1]

Abstract: *The definition of criteria and indicators of sustainable forest management and the possibilities of their use in the forest management planning are determined.The norms used directly in the theory and practice of the forest management planning in Serbia, which are in accordance with Pan- European criteria and indicators for sustainable forest management, are shown and evaluated in a great detail.*

Criterium 1 The preservation and promotion of forest resources and their contribution to the global carbon cycle: The use of soil and forests (Quantitative indicator: Land covered by forests and other forest land and the change of land areas(classified according to the forest and vegetation types, land structure, ownership structure, age structure, the origin of the forest);

Total volume (Quantitative indicator: The changes in total volume, average tree trunk volume on the forest land- classified according to the vegetation zones or habitat types, age structure and indescrement stages);Carbon balance (Quantitative indicator: Total carbon stock and the changes of the stocks in the forest habitats).

Criterium 2 Forest health condition and vitality: Total amount and the changes in the last five years in the emitting of the air pollutants (estimation on the permanent areas); The changes in the forest defoliation and deforestation using UN /ECE and EU classification of defoliation (classes 2,3 and 4) in last five years; The

[1]Mihailo Ratknić, Ph.D., Ljubinko Rakonjac, Ph.D, Milorad Veselinović, Ph.D., Institute of forestry, Belgrade
Translation: Marija Stojanović

serious damages caused by biotic and abiotic agents (serious damages caused by insects and illnesses, with the determination of the seriousness through dessication and increment loss, annual amount of the burnt forests,annual amount of areas damaged by storms and the scope of felling in these regions, the amount of the regenerated land damaged by game, cattle and damages caused by grazing);

Criterium 3: The productive functions of forest: Timber production (Quantitive indicator: Balance between increment and felling in last decade; The percent of forest land according to the management plan); Non-wood forest products (Quantitive indicators: Total amount and the changes of values and/or the quantity of non-wood forest products (hunting, game, fruit-woods, healing plants, fungi, etc.).

Criterium 4 Biodiversity: Typical, rare and endangered forest ecosystems (Quantitative indicators: The changes of land area – natureand preforest types, strictly protected reserves, forests protected by special management treatment); Endangered species (Quantitative indicator: The changes in number and percent of the endangered species according to total number of the forest species (using reference lists – IUCN, The European Council, EU Habitats Directive, etc.); Biodiversity in the productive forests (Quantitative indicator: The changes of the amount of habitats intended for the preservation and use of forest genetic capacity (genofond, seedling collection, etc.) differentiation between native and introduced species; The changes in the proportion of the mixed stands containing 2 or 3 tree types, The ratio between the annual amount of the land areas that are regenerated naturally and total land area) ;

Criterium 5 The protective functions in the forest management (with the emphasis on the land and water): Land erosion (Quantitative indicator: The percent of the forests with the primary land protection); The protection of water in forests: (Quantitative indicator: The percent of the forests with the primary water protection);

Criterium 6 Socio-economic functions and conditions. The importance of the forestry domain: (Quantitative indicator: The contribution of the forest sector in the Gross Domestic Income); Recreation (Quantitative indicator: maintanance of the recreational function: forest area per inhabitant, percent of total forest land);Employment: (Quantitative indicator: The changes of employment rate in the forestry, particularly in the rarural areas (emploees in the forestry, felling and wood industry); Research and education; Public consciousness; Public participation and Cultural heritage.

Key words: forest recources, management, protection, ecosystem.

CRITERION 1. THE PRESERVATION AND PROMOTION OF FOREST RESOURCES AND THEIR CONTRIBUTION TO THE GLOBAL CARBON CYCLE

Forests and forest ecosystems fall into the category of the most important bioecological resources and are the most comprehensive renewable natural resources which, along with the socioeconomic importance (through biomass production as the essential raw material for the

mechanic and chemical wood processing), represent the most stable ecosystems of invaluable importance to the environmental protection and the quality of the environment.

Forests are an indispensable factor for finding the solution to the problem of preservation, protection and promotion of the quality of the environment, not only in the regional scopes, but they have the global positive influence and are of biospheric importance to the all component of the environment.

We have become aware of the fact that the ecological imporatnce of forests and forest ecosystems significantly exceeds their economic importance.

The condition and level of the forest preservation reflect to the great extent the level of the enviromental preservation. Clearance, damaging and degradation of forests in Serbia resulted in the degradation of the other natural resources, particularly in the hilly-mountainous area, which had the adverse effect on the major component of the environment: air, soil, flora and fauna, landscape and the space as a whole.

The total area of forests and forest land according to the common basis is 2.190.924,79 ha. The total area of covered land accounts for 2.003.067,28 ha (91.42%), and the total area of the uncovered land accounts for 187.857,51 ha (8.57%). As the result of the large scale afforestation (mostly by conifers) and of the spontaneous forest spreading in the hilly-mountainous region, since the World War II, the relative area under timber expanded from 19.3% to 25.9%. The area of state-owned forests is 984.500 ha, which contitutes 49.1% of the total area of forests in Serbia, wheras the forests managed by private owners is 1.018.600 ha, which consitutes 50.9% of the total area of forests in Serbia (condition in 2005). (Forest managed by private owners in central Serbia make up 58.4%, and 4.7% in Vojvodina (Table 1).

Table 1. *The condition of covered land [000 ha]*

Year and the source of data[1]	Covered			Uncovered			total
	Total (area under timber)	State-owned	Private-owned	Total (forest land)	State-owned	Private-owned	
2005 (OOGŠ)	2003,1	984,5	1018,6	187,8	185,9	1,9	2190,9
1995 Jović et al.	2.349,5	1.179,5	1.170,0	303,6	148,8	154,8	2.653,1
1992 Jović et al.	2.232,9	1.143,3	1.169,5	1.415,7	281,4	1.134,3	3.728,5

The structure of the forest reserves is characterized by numerous stands with the dominant deciduous tree species. Deciduous trees account for

[1] Data for 1992 and 1995 refer to the territory of Serbia with KiM

64.1%(1.283.400ha), conifer trees account for 11.8%(237.000ha),where as mixed stands account for 24.1%(482.700ha)(condition in 2005). (Table2).

Table 2. *Area covered by forests [000 ha]*

Year	Total area (1000 ha)	Type of forest (1000 ha)		
		Conifer	Deciduous	Mixed
2005[1]	2003,1	237,0	1283,4	482,7
2000[2]	2349,5	329,0	1950,0	70,5
1992[3]	2232,9	315,7	1888,8	68,4

The parcels are usually irregular, long and narrow, which is the result of the frequent divisions between the owners of the parcels during the process of inheritance. The small and chopped parcels are the hindrance to the forest management based on the principles of sustainable growth, providing of the efficient service and training of the owners, which would enable the prudent management with the environmental protection and biological diversity. Since this domain is ill-organized the condition of forests on private parcels have deteriorated, which has resulted in the timber production of thinner sortiments and lower quality.

The average volume of timber is 276.671.000 m^3 (2005) (Table 3).

Table 3. *Area, volume and volume increment in the Serbian forests [000 ha]*

Year	Area (000 ha)			Volume (000 m3)			Increment (000 m3)		
	total	State	Private	total	state	private	total	state	private
2005 OOGŠ	2003,1	984,5	1018,6	276.671 (138 m3/ha)	164.912 (167,5 m3/ha)	111.759 109,7 m3/ha)	6.472 (3,23 m3/ha)	4.175 (4,24 m3/ha)	2.297 (2,25 m3/ha)

The average volume of timber in state forests in central Serbia is 167,5 m^3/ha and 109.7 m^3/ha in private-owned forests. The distribution of stands according to the age classes is presented in the Table 4. There are 61.35% land covered by forests in the classes younger than 40 years, wheras stands older than 100 years account for only 2.34% (condition in 2005.)

[1] Data for 2005 are found in the OOGŠ
[2] For 2000 from Condition and Problems of the private-owned forests (Ratknić et al, 2000)
[3] For1992 from Development of Foresty and the Condition of Forests (Jović et al, 1992)

The basic parcel of the private-owned parcel covered by forest is characterized by its small size. There are about 500.000 owners of the private forests in Serbia which have approximately 5.000.000 parcels registered in 7.500 cadastral municipilities. The aproximate parcel size of the Serbian private forests is under 0.5 ha (often smaller than 20 - 30 ares).

Table 4. *Distribution of the stands of the same age according to the age*

Category	Year	Age classes (1000 ha)									
		≤10 years	11-20	21-40	41-60	61-80	81-100	101-120	121-140	>140	Ostalo
Forests	2005	275.0	296.0	500.0	379.0	186.0	70.0	31.0	10.0	0.0	0.0
	2000	349.0	347.0	460.0	331.0	157.0	60.5	25.5	8.0	0.0	0.0
	1990	522.5	409.0	400.5	293.5	108.5	43.0	17.0	3.5	0.0	0.0
Of which forests for timber production	2005	241.5	260.0	439.0	333.0	163.0	61.5	27.0	9.0	0.0	0.0
	2000	309.0	307.0	408.0	293.0	139.0	53.5	22.5	7.0	0.0	0.0
	1990	458.0	358.5	351.0	257.0	95.5	38.0	15.0	3.0	0.0	0.0

In Table 5 and Graph 2 the average distribution of trees according to the diameter increment for the forests of the different age is presented. The maximum scope of the tree distribution ranges from 20 to 39 cm (168.7 m^3/ha), whereas the average tree volume thicker than 60 cm is 22.9 m^3/ha (condition from 2005).

Table 5. *Distribution of volume (forests of different age)*

Category	year	Forests of different age Diameter classes (in cm) (in m^3/ha)			
		0-19	20-39	40-60	>=60
Forests	2005	30.2	168.7	135.7	22.9
	2000	28.4	161.0	126.6	18.1
	1990	24.9	145.9	108.2	8.4
Of which forests for timber production	2005	n.a.	n.a.	n.a.	n.a.
	2000	n.a.	n.a.	n.a.	n.a.
	1990	n.a.	n.a.	n.a.	n.a.
Conifer trees	2005	27.4	218.5	140.1	24.2
	2000	25.4	209.5	127.6	19.3
	1990	21.4	191.5	102.6	9.5
Deciduous trees	2005	23.4	115.0	127.4	27.8
	2000	22.2	109.9	122.0	22.5
	1990	19.8	99.7	111.2	11.9
Mixed	2005	39.8	172.5	139.7	16.7
	2000	37.7	163.5	130.1	12.4
	1990	33.5	145.5	110.9	3.8

The total volume of timber is 246.504.000 m^3 (year 1990), i.e.

241.275.000 m^3 (year 2005), which points to the decrease in the volume of about 5.229.000 m^3 or 327 m^3 averagely per annum (Data by Serbian Bureau for Statistics) – Table 6. Decrease in volume from 1990 to 2005 was reported in conifer (3.768.500 m^3) and mixed forests (15.567.000 m^3), whereas the volume increase was reported in the deciduous forests (14.106.500 m^3). The average volume of timber in Serbia is 166.9 m^3/ha (data refer to the state forests).

Table 6. *Volume according to the type of forest*

Category	year	Total volume (1000 m^3)	Type of fores (1000 m^3)		
			Conifer	Decidious	Mixed
Forests	2005	237202,0	22134,5	146236,5	68831,0
	2000	237545,0	20188,0	136852,0	80505,0
	1990	243460,0	25903,0	133159,0	84398,0
Forests for timber production	2005	186550,0	17573,0	116625,0	52352,0
	2000	187158,0	17695,0	117050,0	52413,0
	1990	191658,0	18181,0	119969,0	53508,0
Other forest land	2005	4073,0	0,0	4073,0	0,0
	2000	3730,0	0,0	3730,0	0,0
	1990	3044,0	0,0	3044,0	0,0
Other forest land suitable for timber production	2005	0,0	0,0	0,0	0,0
	2000	0,0	0,0	0,0	0,0
	1990	0,0	0,0	0,0	0,0
The total number of forests and forest land	2005	241275,0	22134,5	150309,5	68831,0
	2000	241275,0	20188,0	140582,0	80505,0
	1990	246504,0	25903,0	136203,0	84398,0

The condition of forests in Serbia is unfavorable on the basis of the use of habitat capacity and the providing of the commonly useful forest functions. The average volume is 50%, and volume increment account for 40% of the maximum possible (determined according to the productive capacity of the habitat).

Forests of seed origin account for 40.68%, coppice forests 29.97%, artifically established forest cultures and plantations 18.31%, bushland 4.91% and scrub forests 6.13% of the total forest reserves managed by Public Enterprises "Srbijašume", "Vojvodinašume" and national parks.

Table 7. *Condition of stands according to the origin (volume)*

Origin	Srbijašume		Vojvodinašume		National parks		Total	
	m^3	m^3/ha	m^3	m^3/ha	m^3	m^3/ha	m^3	m^3/ha
Forests of seed origin	79521897	243.6	8072506	348.6	12417049	326.4	100011451	258.0
Coppice forests	2987877	130.8	2150118	89.6	6714443	202.9	38743339	135.7
Artifically established plantations and forest cultures	8911636	74.6	10519786	206.5	691299	176.0	20122722	115.5
Low forests	602	383.6			62	47.0	664	229.9
Bushland	62671	1.5			156	0.1	62827	1.3
Scrub forests	6989	0.1			-	-	6989	118.2

Carbon balance. Climate changes caused by the increase in the CO2 level are to result in the warming up of the troposphere, which shall promt the increase in air temperature and decrese in rainfall amount. The increase in the concentration of pollutants will lead to the increase in air temperature by 2^0C in the winter and by 2-3^0C in the summer. The decrease in rainfall by 5-15% in the summer is expected, which will result in the decrease of soil moisture by15-25%. Thus, climate changes have to be incorporated in all long-term investments, particularly in biological works, such as meliorisation of the coppice and degraded forests and afforestation (particularly during the choice of the types, techniques and technology of works).

Table 8. *Carbon balance*

Category	Year	Carbon balance (1000 m^3)	Type of forest (1000 m^3)		
			Conifer	Deciduous	Mixed
Forests	2005	143574925.0	92979446.0	32542806.0	18052673.0
	2000	143782523.0	93113886.0	32589860.0	18078777.0
	1990	147362752.0	95432448.0	33401357.0	18528947.0
Other forest land	2005	2544949.0	1653638.0	578773.0	312538.0
	2000	2330631.0	1514380.0	530033.0	286218.0
	1990	1901994.0	1235864.0	432552.0	233578.0
The total number of forests and forest land	2005	146119874.0	94633084.0	33121579.0	18365211.0
	2000	146113154.0	94628266.0	33119893.0	18364995.0
	1990	149264746.0	96668312.0	33833909.0	18762525.0

CRITERION 2. FOREST HEALTH CONDITION AND VITALITY

Analysis of the pollutants in the air and precipitation

Pollutants in the air In the territory of Serbia Kamenički Vis Station has implemented the programme of CO2 content monitoring (since 1984) and NO2 (since 1990) in the air, physical-chemical precipitation content (since 1984) and defining of the heavy metal content in precipitation. Critical concentration for SO2 defined for forest ecosystems is 20 μg m^{-3} and represents the average annual and winter concentration. The limit has been not exceeded since 1985 for any of the aforesaid periods.The critical concentration of average annual concentration SO2 in the territory of Serbia (according to the results of Oiler's unified approach used in the Meteorological Synthesized Centre West for the needs of EMER Programme) was not exceeded in any square (50x50 km) of EMER net in 2002. The greatest SO2 ranged from 4-9 μg m^{-3}
in Northwestern Serbia. Since nitrogen oxides have equally adverse effect on all ecosystems the unique critical level of the average annual concentration of 30 μg m^{-3} was defined. The critical level was not exceeded in the investigated period.

Moist deposition Annual deposition of sulfur exceeds the deposition of nitrogen from amonium ion and nitrate, whereas calcium contributes to the greatest extent to the baseness of the precipitation. The trend of the decrease in ionic types (H^+, SO_4^{2-}, -S, Mg^{2+}, Ca^{2+}, Cl^-, K^+) is the result of the reduced concentration of pollutants in the precipitation.
In the urban parts of Serbia acid precipitation occur in 30-45% cases. In the period from 1984 to 2003 the annual level of acid precipitation ranged from 14 to 39% (limit level pH=5.60). Extremely acid precipitation account for 0-6.2% of the total precipitation, moderately acid precipitation account for 4.8-25.7% and weak acid precipitation account for 5.2-17.1%.

Heavy metals. The results obtained by applying cross-border transport Cd, Pb and Hg owned by Meteorological Synthesized Centre EAST are presented. The maximum levels of lead depositions were reported in the city municipalities of Smederevo, Požarevac, whereas the maximum levels of cadmium deposition were reported in city municipalities of Bor, Negotin and Zaječar, and maximum levels of mercury depositions were reported in city municipalities of Obrenovac and Belgrade. The average levels of lead deposition range from the central parts of Vojvodina, by Ibar and Zapadna Morava Valleys and in the east by Timok Valley.The decrease in limit exceedings of acidification is expected, whereas no significant changes for nutritive nitrogen are likely to happen since ammonia emission will not change in the next 20 years.
The limit exceedings of the forest land acidification which was reported in 2000 (Bačka 50 $egha^{-1}year^{-1}$) shall occur in 2010 as well, whereas it shall reduce beyond the critical border in 2010. The gretest exceeding of nutritive

nitrogen for forest ecosystems was reported in 2000 in South Banat, north part of Braničevski County (over 1000 $egha^{-1}year^{-1}$) and in Šumadija (500-700 $egha^{-1}year^{-1}$). In the remaining part of the territory the reported exceeding ranges fron 100 to 500 $egha^{-1}year^{-1}$. It is estimated that in 2010 exceeding will range from 1000 to 2000 $egha^{-1}god^{-1}$
and will encompass the whole countrz, except for southwest and southest parts (about 750 $egha^{-1}year^{-1}$). The greatest exceeding shall occur in south Banat and Braničevski County (about 2000-3000 $egha^{-1}year^{-1}$). The condition in 2020 shall be similar to that in 2000, and the scope of the critical burden for nutritive nitrogen of 1000 $egha^{-1}year^{-1}$
shall spread to South Srem and Mačva.

Serious damages caused by biotic and abiotic agents. Forest damages[1] also influence the capacity of forest resources in Srbia to a great extent. Their scope is stated by the damaged wood volume, which decayed owing to many agents, or was used in an inapropriate way.

Table 9. *Forest damages*

Category	Year	Total area of damage	Primary damages caused by biotic agents		Primary damages caused by abiotic agents		Primary damages caused by human activities	
			Insects & diseases	Wild and domesrtic animals	Storm, wind, snow etc.	fire	Forest works	other
		(1000 ha)						
Total number of forest and other forest land	2005	n.a.	33,0	1,5	1,5	0,5	n.a.	0,5
	2000	n.a.	3,0	0,0	3,5	20,5	n.a.	0,5
	1990	n.a.	0,5	0,0	0,5	2,5	n.a.	0,5
Damages according to the typesof stands:								
Conifer	2005	n.a.	0,5	0,0	0,5	0,0	n.a.	0,0
Decidious	2005	n.a.	25,5	1,5	1,0	0,5	n.a.	0,5
mixed	2005	n.a.	7,0	0,0	0,0	0,0	n.a.	0,0

Table 10. *Forest damages in the state forests according to the causes /ha*

year	Fire		Insects and plant diseases	Extreme weather conditions	Game	Domestic animals	Illegal land occupation	Total
	Floor	High						
1990.	927	156	3076	0	0	0	232	
2000.	17851	2667	2772	3359	1	13	222	16966
2005.	49	5	33404	1304	1259	38	40	36077
Conifer	17	1	348	277				643
Decidious	8	3	26021	1011	1248	26	26	28344
Mixed	24		7035	16	11	12	13	7090

[1]All data refer to the state forests.There are no readily available data for the damages in the private-owned forests.

The total damages vary by age and are usually the results of the weather conditions, occurance of the disease or gradation of the harmful insects.

Strategic choice: The number of bioindication points should be raised in order to obtain more reliable data on the condition of population dynamics and harmful organisms in the forests.

Wildfires Data on wildfires are processed only for state forests. Deliberately caused wildfires accont for 1% of the total number of fires, whereas the remaining ones were caused by the careless and irresponsible behaviour displayed during the burning of the dry grass on the brims of the forest complexs. The wildfires are usually caused by throwing away cigarette butts and firelighting in the forests.

The state of anti fire equipment is unsatisfactory. The condition of anti fire railways in the bigger complexs covered by forest cultures is extremely bad. Byilding of the new anti fire railways is hindered by the lack of money. Existant anti fire railways are not wide enough, and the crowns of he edge trees have closed owing to the neglectance, which made them unfunctionable. Dry grass areas are to be found on them during the summer, which can promt the spread of floor fires.

The Plans of Fire Protection were implemented in all state forests, the anti fire staff was trained by Public Enterprise "Srbijašume, in Deliblatska Sandy Terrain, Vlasinska Plateau and Ibarska Gorge (areas with the greatest complexs of conifer cultures). In addition, local measurument stations for defining the scope of danger of wildfires. The equipments for quick anti fire actions were formed in the forest administrations. The project of setting radio connection systems in the all territory of Serbia was supplemented. Nevertheless, there are not enough lookouts and microaccumulation for effective fight against wildfires in the regions with greater areas covered by conifer, antropogenic and nature forests.

Primary damages caused by human activity. In 1990 57.5% of annual volume increment was subjected to felling, and in 2005 55.3% (Table 11). Since the scope of felling is smaller than increment and pland, it should create preconditions at the state levels for improving the condition of forists by raisind timber volume to optimal level[1].

Table 11. *The scope of felling in Serbian forests (condition in 2005) [000 ha]*

The type of user	Area(ha)	Volume(m3)	Volume increment (m3)	Yield (m3)
State	984,5	164.912	4.175	2.705
Private	1.018,6	111.759	2.297	900
Total	2.003,1	276.671	6.472	3.605

According to the estimations and surveys in the mountain regions, the need for fuelwood per rural household accounts for at least 10.0 m^3

[1] Data from common sources

annualy, taking into account only so-called large wood which is a subject of statistics.It is estimated that 5-6 cubic metres from the total 10 cubic metres are derived from forests.The remaining part is obtained by so-called outstatistical timber volume, in the significant quantities although there not the subject of the statistical analysis, and derive from the line of trees which do are not treated as forests in cadastres. Solitary trees by brooks and rivers, on the diving lines, fruit trees, etc. fall into this category. The total scope of felleing in private-owned forests is about 2.000.000 cubic metres, and the felling from so-calles outstatistical timber volume is included in this quantity.

The numerous cases of illegal felling, as well as other forms of illegal use of forests are major problems. Ilegal forests are typical in the municipilaties in the vicinity of Kosovo- Bujanovac, Medveđa, Preševo and Kuršumlija. The usurpation of forests and forest land, the actions by local inhabitants aimed at prevention the use of forests established on rural leas and nationalised land, as well as the uncontrolled cattle grazing are also unfavourable conditions.

CRITERION 3. PRODUCTIVE FUNCTIONS OF FOREST

Timber production. In 1990 57.5% of the annual volume increment was subjected to felling, whereas in 2000 56.3% was subjected to felling, and 56.3%, in 2005 (Table 12). Since the scope of felling is lower than increment, it should create preconditions at state level in order to improve the state of forests by increasing timber volume to optimal level[1].

Table 12. *Scope of felling in state and private-owned forests*

year	Current annual increment	Total number of felling	Forest felling				Total number of felling	
			In state forests		In private forests			
			conifer	deciduous	conifer	deciduous	conifer	deciduous
2005.	5232.0	2484491	169567	1670262	41236	603426	210803	2273688
2000.	5232.0	2946617	213614	2060234	79659	593108	293272	2653342
1990.	5643.0	3243510	187032	2036547	53689	966242	240721	3002789

The average number of felled gross volume in Serbia ranges from 600.000 to 900.000 cubic metres, which is 8 to 12 times smaller than the estimated needs. In the private-owned forests 384.000 to 576.000 EUR is collected by 3% tax for felled timber driven out on the truck road. If the legalisation of the total felled timber is introduced, 4.608.000 EUR could be collected . This estimation is based on the assumption that the total felled timber is used as fuelwood. Since the technical timber accounts for 20-30% of the total volume felled in private-owned forests, it is possible to collect

[1] Since there are no readily available felling data for KIM in 2001, the percentage of felling refer only to central Serbia and Vojvodina.

the 6.000.000 EUR tax. This estimation of the felled timber points to one more fact, i.e. that the estimated scope of felling in private-owned forests exceed the annual volumeincrement of 6.180.000 cubic metres by 16.5%. If the feeling in state forests of is added to the felling in the state forests (averagely 2.000.000 cubic metres), it points to the fact that 48.9% is subjected to felling, which exceeds the estimated volume increment. The scope of felling in our state forests is always under the standard levels owining to the insufficiently open forests, unstimulating price, etc.

By products. Forests with pastures and other areas within them, as well as water areas within the forest localities represents the insufficiently used resource capacity, which is equally important as the timber production. There are huge possibilities for using forest habitats, such as establishing production of applicable biological and industrially healthy products without pests and other harmful agents (fungi, medicinal plants, fruits and forest fruits), organization of cattle husbandry with meat production, game meat production, beekeping and fish production in natural water flows or fish ponds, as well as the agriculture crops growing. These activities will contribute to a great extent to the development of recreational- health, commercial and sports-hunting tourism. The trends of using products collected in forsts in the years (1990, 2000 and 2005) are shown in the Table 13.

Table 13. *Products collected in the forest*

Sold plant products	year	Sold plant products			Sold animal products	year	Sold animal products		
		size	Quantity	Value (1000 din)			size	quantity	Value (1000 din)
Christmas trees	2005	1000 pieces	50,0	20000,0	Game meat	2005	tob	909,1	454550,0
	2000		75,0	30000,0		2000		4171,9	2085950,0
	1990		n.a.	n.a.		1990		5738,1	2869050,0
Fungi and truffles	2005	ton	5498,1	8797960,0	Hunted game	2005	1000 pieces	331,3	662600,0
	2000		2300,0	4600000,0		2000		303,0	606000,0
	1990		n.a.	n.a.		1990		1199,0	2398000,0
Fruits, berries and edible kernels (walnuts, hazelnuts,etc.)	2005	ton	107,8	8624,0	Skin and trophies	2005	1000 pieces	10,6	254400,0
	2000		193,2	15456,0		2000		5,3	127200,0
	1990		119,0	9520,0		1990		12,8	307200,0
Decoration plants	2005	ton	n.a.	n.a.	Honey and beewax	2005	ton	3665,0	916,0
	2000		n.a.	n.a.		2000		2663,0	666,0
	1990		n.a.	n.a.		1990		2659,0	665,0
Resin, healing and aromatical plants, substances for dying	2005	ton	18,3	14640,0	Raw material for medicinal purposes	2005	ton	n.a.	n.a.
	2000		3,1	2480,0		2000		n.a.	n.a.
	1990		18,1	14480,0		1990		n.a.	n.a.

Sold plant products	year	Sold plant products			Sold animal products	year	Sold animal products		
		size	Quantity	Value (1000 din)			size	quantity	Value (1000 din)
Other plant products	2005	ton	557,5	446000,0	Other animal products	2005	ton	1230,5	984400,0
	2000		27,2	21760,0		2000		1100,0	880000,0
	1990		59,9	47920,0		1990		n.a.	n.a.

Trend of development represents the future economic base for prosperity of forest-indstrial organizations which existed in the past almost solely on the production and timber placement as the only forest product.

The species which can be collected as forest fruits are important for the less fertile habitats. Since these products are very attractive they deserve a better place in the development planning. Thus, it is essential to establish a network encompasses all phases, from purchase to selling.

The parallel view of quantities of some plant and animal species gathered in 1993 and 2006 is shown in Table 14 and Graph 1. The gathering and circulation of these species are regulated by the Decree on taking control use and circulation of wild plant and animal species.

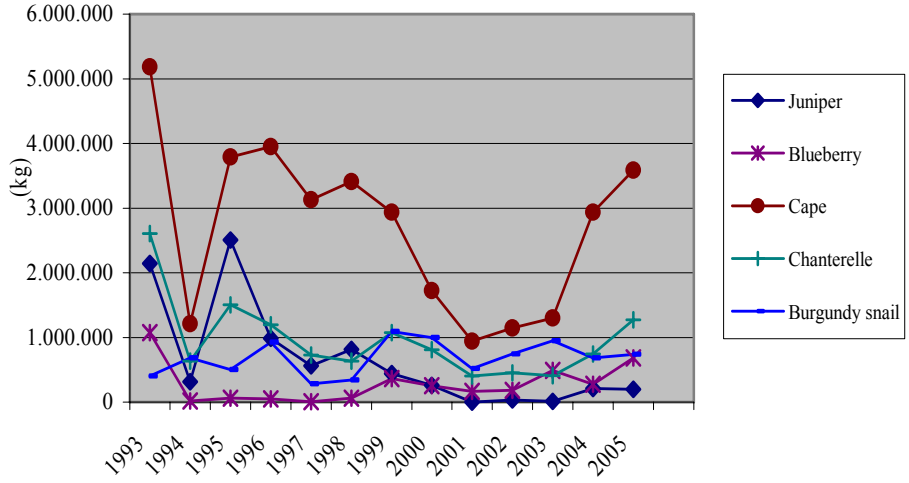
Table 14. *Quantities collected in nature in 1993 and 2005*

Species from the Decree	1993 (kg)	2005 (kg)
Marsh Mallow (*Althea officinalis*)	2.000	8.322
Lemon Balm (*Mellisa officinalis*)	1.000	704
Juniper (*Juniperus communis*)	2.142.500	200.980
Dog Rose (*Rosa canina*)	-	296.984
Blueberry (*Vaccinium myrtilus*)	1.072.800	680.850
Cepe *Boletus edulis*)	5.186.100	3.584.300
Chanterelle (*Cantharelus cibalius*)	2.605.500	1.274.700
Burgundy snail (*Helix pomatia*)	404.600	740.152

The number of farms for snail raising has increased in the last few years to a great extent, as well as of the areas serving as plantations for healing and aromatical plants. Therefore, we expect that the pressure on the natural populations of resources will be reduced. However, the pace and scope of the reduction will undoubtedly depend upon the nuber and areas of the plantations and farmsm as well as of the pace of growth of market demands.

Apart from using spontaneously formed stands, groups or solitary fruit trees from forest plants, the establishment of stands of walnut, black walnut Turskish hazel, hazel, wild apple, wild cherry, rowan berry, and other attractive species for processing industry (rapsberry, blackberry, blueberry, etc.).

Graph 1. *Some plant, fungi and animal species collected in the period 1993-2005.*



Beekeeping. Forests and forest formations are very important to the beekeeping development and they are the source of good beekeping grazing in the certain period.Apart from melliferous tree types, there are also other melliferous species in the low and middle floors. The great importance is attached to the the forest as a natural resource in the organized and intensified beekeping as a result of the chemistrization of agriculture and pollution of the area in the vicinity of settlements and industrial complexies. According to the estimated habitat capacities (Vlatković, S. 2001), the current number of beekeeping associations (350.000) could be quintupled. Therefore,we should pay more attention to this potential, not only because of direct economic benefit, but because of its importance to the enriching and preservation of flora and fauna richness, life processes in biosphere and enviromental protection.

Hunting. Game is an important compound in the forests and forest ecosystems, since it serves as a bioregulator and nature ornament. The importance of it is reflected in the multier potential benefits.The state of population of autochtonious, economically most valuble game species (deer, roe, wild hog) is the potential capacities of the forest areas in Serbia.The number of these game species per unit of area belnog to the lowest density in Europe. Inadequate and irational use of certain game species was multiannual practice and has resulted in the direct risk to their number and spread.

The current unsatisfactory condition of game populations is, above all, the concequence of the inappropriate state approach to the questions of ownership of game, estate-law problems which is the result of the rights concerning the ownership of the game and rights concerning the ownership of the areas for game breeding and growing, as well as of the inappropriate

definition of the hunting as the industrial activity and hunting as a way to satisfy the personal needs of an individuals or groups, i.e. hunting as a hobby. The strategy of sustainble game management and hunting development, based on the principles of prudent and rational land use, with the adequate intersector treatment and adopting multifunctional approach, will define the importance and need for improving the condition of the resources. The condition of hunting and hunting game in Serbia is shown in Table 15 and 16.

Table 15. *The state of hunting grounds and game in Serbia*

Region/ Number of hunting grounds	Area	Roe		Wild hog		Rabbit		Pheasant		Gray partrige	
	(ha)	m.f.	bag	m.f.	m.f.	m.f.	bag	Bag	bag	m.f.	bagl
Vojvodina 57	1.987.830	39.975	2.747	1.198	127.893	53.562	569	47.158	265	288.419	38.131
Central Serbia 144	4.933.536	54.558	1.644	8.392	277.581	225.266	6.230	93.200	1.760	319.949	62.473
Total 229	7.904.006	94.533	4.391	9.590	405.474	278.828	6.799	140.358	2.025	608.368	100.604

Table 16. *Summary according to the type of game*

	Vojvodina	Central Serbia (without counties)	Ratio optimal/real
Optimal roe breeding stock	57.910	97.260	100 %
Optimal use	15 %	15 %	100 %
Primary **roe** fond	39.975	54.558	55,9 %
Bag	2.747	1.644	17,3 %
%	**6,9**	**3,0**	
Optimal wild hog breeding stock	5.000	20.000	100 %
Optimal use	40 %	40 %	100 %
Primary **wild hog** fond	1.198	8.392	27,4 %
Bag	265	1.760	14,5 %
%	**22,1**	**21,0**	
Optimal rabbit breeding stock	323.600	378.800	100 %
Optimal use	25 %	25 %	100 %
Primary **rabbit** breeding	288.419	319.949	78,6 %
Bag	38.131	62.473	52,0 %
%	**13,2**	**19,5**	
Optimal pheasant breeding stock	179.125	284.300	100 %
Optimal use	50%	50%	100 %
Primary **pheasant** fond	127.893	277.581	87,5 %
Bag	47.158	93.200	60,6 %
%	**36,9**	**33,6**	
Optimal gray partrige breeding stock	143.850	248.300	100 %
Optimal use	5 %	5 %	100 %
Primary **gray partrige** fond	53.562	225.266	59,4 %
Bag	569	6.230	30,0 %
%	**1,1**	**2,7**	

Healing plants Forests are the habitat of numerous healing plants of exceptional features, which are greatly valued in the European and world markets of pharmaceutical and cosmetics industries.

CRITERION 4. BIODIVERSITY

Typical, rare and endangered forest ecosystems. The territory of Serbia is rich in endemic and relict associations considering the fact that 9% of the total flora of the country belongs to the endemic species 2% of which are local. Besides numerous weed, turf and water plant associations and especially a large number of endemic and sub endemic herbaceous fitocenosis. Edificators, subedificators and dominating species in these associations are relict and endemic. Endemic vegetation alliances and files[1] represent an exceptional quality. The largest number of higher endemic syntaxons and endemic associations appear in rock, turf and peat bog vegetation. Forest and shrub associations of endemic woody plants represent a special value. The greatest significance is attributed to spruce, whitebark pine, Balkan pine, Balkan maple, **polydominant** forest with Acer intermedium Pančić, Corilus colurna L., lilac osier-beds, etc.

Protected areas. There are significant activities in the field of international area protection (Ramsar Convention; Man and Biosphere; IBA areas; Transboundary area). Since Serbia is not an EU member, protected areas in Serbia are not included in EU protection mechanisms (EC Birds and Habitats directive). Certain international regulations and actions have gained importance in Serbia in recent years, so certain areas are included in different systems of international protection. Besides Ramsar convention, Serbia is included in UNESCO Man and Biosphere program, International Bird Habitats Protection (IBA), and through Park for Life Project Serbia is included into Transboundary areas protection program. Protected areas are regulated by a set of regulations: the Law on environment protection (2004), the Law on National Parks (1993), Book of Regulations on natural resources categorization (1992), Regulations on Registry Protected Nature Objects (1992), Regulations on ways of marking Protected Nature Objects (1992). The Bill on Nature Protection, which will contribute considerably to the nature protection quality, is in procedure. During last 25 years in Serbia there has been a significant increase in numbers of protected areas (for about 300%). The cumulative number of areas under protection in Serbia for a period from 1980 to 2005 is shown in Table 17.

Percentage of protected areas in Serbia is 6.59%, by 2010 protection of 3.41% is planned, and then the total protected area would be 10%, as is foreseen by the Regional plan of Republic of Serbia (1994).

The greatest part of protected areas belongs to Nature Parks. According to the IUCN Nature Parks belong to the V category; the protection degree of dominant category of protected areas in Serbia is very low. Having in mind a wide heterogeneousness in IUCN national parks categorization (II to V), a

[1] 204 forest and border shrub associations are recognized in Serbia; they are divided in 36 alliances, 12 files and 6 grades. Since many authors did not take into consideration researches in other regions so there are a large number of different names for the same fitocenosis. Some subsections and facies, ecological and geographical subtypes have gained the rank of associations, new connections and sub connections have been established.

conclusion can be drawn that the protection level, then the significance attributed to the protected areas in Serbia is still very small. As it is stated in the National Regulations, national parks are grouped in the first category of natural resources of significant importance.

Taking into consideration the different categorizing levels in relation to the importance of certain areas, and bearing in mind the fact that Serbia as a part of Balkans represents an important diversity center of European and world scope, it is necessary to raise the protection level of especially valuable areas. Based on the concept of the new Law on Nature Protection, all protected areas will be classified according to the IUCN categorization which could lead to the change in structure and protection quality improvement.

International protection programs. Serbia joined Ramsar convention in 2002. 4 Ramsar areas have been declared on territory of Serbia spreading over approximately 21.000 ha in 2005. Golija Nature Park was included into the Golija – Studenica biosphere reservation list in 2001 within the UNESCO Man and Biosphere Project. Areas in Serbia protected by Ramsar convention and UNESCO Protection program still represent a small portion of the total number of protected areas. Based on IBA area criterion (Bird Life International) 35 bird habitats of international significance have been singled out.

Table 17. *Protected natural resources in Serbia (December 31, 2005.)*

Type of the protected natural resource	Serbia		Public Enterprise Srbijasume		Public Enerprise Vojvodinašuma	
	Number	Area/ha	Number	Area/ha	Number	Area/ha
National park	5	158 986.36	-	-		
Nature park	8	228 055.02	3	225 148.64	2	887.59
Regional nature park	10	24 200.29	4	11 561.64	1	4177.00
Amenity forest	20	273.00	1	19.65	1	4.71
Region of exceptional shapes	8	18 897.35	2	3 860.83	1	5369.90
Special nature reservations	6	73 428.00	1	115.72	5	70813.92
Nature reservations	84	3 791.00	42	2 143.86	7	198.56
Nature monuments	247	3 117.14	30	1 844.58	6	228.24
Memorial nature monuments	31	2 328.00	9	491.19		
Area around stationary cultural resources	14	1 926.00	5	769.24		
	433	515001.19	97	245954.35	23	81679.92

Within the framework of Support to protected transboundary areas – a part of the action plan Park for Life projects (IUCN, EUROPAC) nine areas have been singled out: Nature Park Subotičke sume, special nature reservations Selevenjska pustara and Zasavica, National Parks Fruška Gora, Djerdap, Tara and Šar –planina; Nature Park Stara Planina. 9 areas more have been nominated for biosphere reservations (Man and Biosphere UNESCO) as a part of initiative for declaring internationally significant

areas. Also, 5 areas have been suggested for the world culture and nature heritage UNESCO, 4 nominations are being prepared for another 4 Ramsar areas in Serbia.

Condition of protected natural resources. National Parks are classified into the first category of natural resources of exceptional significance.

According to the IUCN classification not all National Parks satisfy the IUCN criteria; in order to be classified National Parks Tara and Šarplanina partially meet these criteria (N.P. Tara 2 category; N.P. Šarplanina 2 category; N.P. Djerdap 4 category; N.P. Fruska Gora 5 category; N.P. Kopaonik 5 category). Dissatisfying conditions concerning protection and upgrading state of natural values, coordination and activity monitoring and performance have been stated; thus the implementation of all relevant monitoring parameters, controlling and development, cannot be carried out.

Protection and development programs contain protection criteria, preservation and upgrading of natural values through activities in National Parks. National Park public enterprises carry out National Park programs as company programs not as area programs. Part of the program task referring to the obligation of other area users is not being realized. This problem requires intersection solution and coordination starting from the users, then local community, state organs, scientific and professional institutions as well as funding. Certain authorizations in area managing, stopping of unauthorized actions and occurrences are not applied entirely. The occurrence of unauthorized building in areas of National Parks Kopaonik and Tara represents a particular problem. There is pronounced number of foreign investors wishing to build tourist centers with participation of local community in protected areas of National parks (e.g. on Zaovina Lake in N.P. Tara; building of a ski – center in area of Nature Park Stara Planina, etc.)

Monitoring has not been set up methodically; the analysis of the state of natural values has not been performed as well as the quality of environment, particularly regarding the state of biodiversities.

Based on the Acts (Law on environment protection), management plans were made (short term protection and development programs) for natural resources for which the Government passes the Act on protection. All protected natural resources have management plans and the percentage of execution directly depends on providing the funds.

The state of affairs in the management field: incomplete regulations (undefined concept of protected natural area management and concept of an administrator) undetermined conditions for entrusting business of natural resources protection; undeveloped system of integral natural resource management. The absence of financial support from the budget of the Republic and local governments to management plans, inability to access international funds; a unique information system is undeveloped and the

indicators for the biodiversity state monitoring are not prescribed; administrators are not organized according to the regulations or they do not have at their disposal trained staff; revision and categorization of natural resources is needed.

Endangered and protected species. Endangered species protection mechanisms are different on global, regional and national levels. Most species on the IUCN list of globally endangered species registered in Serbia are included in European protection mechanisms; it is necessary to include these species in national protection mechanisms. Having in mind the Balkans flora and fauna wealth, Serbia's responsibility in preservation is immense.

Due to the exceptional wealth in flora and fauna and a large number of endemic taxa, Balkan Peninsula represents one of the more important biodiversity centers in Europe. Based on the evaluation of endangerment on national and international level Serbia has, in pursuance of biodiversity preservation and upgrading, regulated the protection of rare and endangered species on national level. Although the large number of endangered species from the IUCN list registered in Serbia included European protection mechanisms (especially birds) it is necessary to continue the process of including globally endangered species in national protection mechanisms (foremost fish and mammals). Having in mind that territories of Balkans and Serbia are characterized by an extremely large wealth in invertebrates, through the understudy of this group, the scale of protection on a national level is inadequate.

Lists of endangered animal species differ on a global and national level. A large number of species treated as endangered by domestic experts (SRBIUCN), are not on the globally endangered fauna list. Bearing in mind the significance and specific Balkans and Serbia's flora and fauna it is necessary to enlarge the IUCN list with species which are endangered on these territories based on the judgment of the experts.

Table 18. *Total number of species in classes and number of endangered species according to IUCN and SRBIUCN*

	Number of species	IUCN	SRBIUCN
Mammals	100	11	8
Birds	345	11	117
Reptiles	24	3	13
Amphibians	23	0	14
Fish	100	12	12
Insects*	230	8	79

In order of biodiversities preservation and upgrading, a large number of animal species is protected by the Decree on Protection of Natural Rarities. Besides that, a number of species in the Decree is protected only in certain parts of the Serbian territory or is in the regime of permanent or periodical fence season. These protection mechanisms are not included in analysis, but their contribution to fauna preservation is considerable. The largest number of species from the list (mammals, birds, reptiles and

amphibians) is included in European protection status. Specified endangered fauna status in Serbia and EU members is mostly reflected in protection mechanisms of certain species on national and international level. Due to relatively good preservation of natural habitats in Serbia, a number of species from the EU25 protected species list, on this territory is not endangered and additionally protected. Having in mind the significance and remarkable flora and fauna in the Balkans and Serbia itself, it is necessary to coordinate national with European and global protection mechanisms[1].

Genofond preservation. The presence of 122 kinds of fruit-trees sorted in 23 families and 38 genera is recognized foremost within natural forest ecosystems in Serbia. In autochthonous flora of Serbia are present progenitors of kinds of apple (Malus silvestris, Malus florentina and Malus dasuphyla), pear (Pirus communis, Pirus amygdaliformis), and plums (Prunus cerasifera, Prunus spinosa), sweet cheery (Prunus avium), cheery (Prunus fruticosa), walnuts (Juglans regia), certain kinds of almonds (Prunus amygdalis), hazelnut (Corylus avellana), chestnuts (Castanea sativa), raspberry (Rubes ideus), gooseberries (Rubes glossularia), red currants (ribes petraneum, Ribes moultiflorum), strawberries (Fragaria fresca, Fragaria viridis, Fragaria moschata), etc. It is supposed that the territory of Serbia is PRIMARY GENUS CENTER for most kinds of fruit which are grown today, pointing out to their great presence in natural, primarily in forest ecosystems. Based on the analysis of conditions in seed – production facilities in which were represented 73 types of trees 24 coniferous and 49 deciduous trees. 27 of the mentioned tree types are alien trees or decorative, so the number of autochthonous types in seed – production facilities is 46. A special problem in forest genofond preservation is felling down old trees hundreds of years of age. Unique trees or at least certain genotypes are irreversibly lost by removal of these trees within every kind of our forest flora. The seed – material of these trees contains genetic inscriptions and solutions to the survival in different and changing abiogenic and biogenic conditions. Whole micro habitats of the cenobionats are destroyed; without which the equilibrium of these ecosystems shaken and questioned (Jovanovic, S. 2001).

The difference between indigenous and alien species. The destruction and disappearance of certain species and habitats influences the reduction of genetic, species and ecosystem diversity on regional and global level. Causes are: complete destruction of natural habitats and replacement with secondary or completely artificial habitats unsuitable for survival of primary ecosystem indigenous species, natural ecosystem fragmentation, partial intervention leading to changes in structure and functions of ecosystems, excessive exploitation, and introduction of allochthonous types of flora and fauna, indirect or direct pollution of water, air and soil.

[1] The data on taxa and endangerment categories have been obtained from referent institutions and experts. Data on national endangerment category (SRBIUCN) of certain animal groups are based on conditions up to 1995.

Introduction of allochthonous types of flora and fauna determines the changes in structure of autochthonous fauna, flora and ecosystem. The area under introduced and invasive types of trees is given in the table 19.

Table 19. *Introduced types of trees*

Category	Year	Habitats with dominant participation of introduced species (1000ha)	
		Total	Invasive ones
Forests	2005	1.6	0.0
	2000	1.3	0.0
	1990	2.0	0.0
Rest of forest land	2005	0,0	0.0
	2000	0.0	0,0
	1990	0.0	1.0
Forest and the other forest land total	2005	1.6	0.0
	2000	1.3	0.0
	1990	2.0	1.0

Introduced tree types include: Pseutsuga taxifolia, Larix europea, Larix leptolepis, Cedrus atlantica, Pinus strobes, Pinus excelsa, Robinia pseudoacacia, Ailantus glandulosa, Amorpha fruticosa, Ulmus pumula, Populus euroamericana (different clones). Invasive tree types include: Robonia pseudoacacia, Ailantus glandulosa, Amorpha fruticosa.

Ratio between annually naturally renewable areas and total area. Significant reduction in areas in 2005 in comparison with the state in 1990 and 2000 was reported in all types of renewal (natural renewal, natural renewal complimented by planting, renewal by planting and/ or seeding) (Table 20). The renewal l of coppice stands by resurrection felling is a method which is used in Serbia only in the cultures of black locust.

Table 20. *Renewal of forest land*

Category	Year	1000 ha			
		Natural renewal	Natural renewal complimented by planting	Renewal by planting and/ or seeding	Renewal of coppice forests by resurrection felling
Forest: Stands of the same age	2005	216,0	190,0	165,0	0,0
	2000	263,0	232,0	201,0	0,0
	1990	352,0	310,0	269,0	0,0
Forests: Stands of different age	2005	0,0	0,0	0,0	0,0
	2000	0,0	0,0	0,0	0,0
	1990	0,0	0,0	0,0	0,0
Other forest land	2005	0,0	0,0	0,0	0,0
	2000	0,0	0,0	0,0	0,0
	1990	0,0	0,0	0,0	0,0

Category	Year	1000 ha			
		Natural renewal	Natural renewal complimented by planting	Renewal by planting and/ or seeding	Renewal of coppice forests by resurrection felling
Forest and other forest land-total	2005	216,0	190,0	165,0	0,0
	2000	263,0	232,0	201,0	0,0
	1990	352,0	310,0	269,0	0,0
Forest and other forest land					
Conifer	2005	76,0	51,0	114,0	0,0
Decidious	2005	140,0	139,0	51,0	0,0
Mixed	2005	0,0	0,0	0,0	0,0

CRITERION 5. PROTECTIVE FUNCTIONS IN FOREST MANAGEMENT (WITH EMPHASIS ON LAND AND WATER)

There are readily available data for the forests at the different levels of protection (shown in Table 21) for 2005.

Table 21. *Protected areas*

Category	Year	MCPFE Class1.1	MCPFE Class1.2	MCPFE Class1.3	MCPFE Class 2
		(1000 ha)			
Forest and forest land-total	2005	6,9	182,0	196,0	53,0
	2000	0,0	0,0	0,0	0,0

The land covered by forests include the following areas:
Class 1.1 – I zone of protection in national parks and strict nature reservations
Class 1.2 – II zone of protection in national parks and biospheric reservations
Class 1.3 – Nature parks
Class 2 – Protected areas (culture, ethnics, spiritual and historical)

Protective forests-land, waters and other functions of ecosystems. The areas under the protective forests which protect the land, waters ans other functions of ecosystems include the following entities intended for special purposes: water protection - water supplying protection of the I degree (**code** 19); water protection - water supplying protection of the II degree (**code** 20), waterprotection forests of I degree (**code** 21), waterprotection forest of II degree (**code** 22), land protection of I degree **(code** 26), landprotection of II degree **(code** 27**),** climate protection (**code** 31), permanently protective forests (not included in ownership treatment) (**code** 66).

Land erosion:

land protection of I degree – **code** 26 130854.86 ha
landprotection of II degree – **code** 27 243.67 ha

It is estimated that 86% of the total area of Serbia is endagered by the water erosion of different intensity, and 72.29% in Vojvodina (Lazarević, P., 1983). The permanent land loss in Serbia is estimated at 3.117 ha with 0,3 metre diameter per annum.Torrent water is a consequence of the erosion processes. There are 12.424 torrent waters in Serbia (Vančetović, Ž., 1966) and they are all located in the hilly-mountainous area. The most severe forms of erosion falling into the I-III category are to be met in these regions, and account for 2.390.121 ha of the Serbian territory.

Water protection in forests Quantitive indicator: The percentage of forests with primary protection of water:

water protection – water supplying protection of the I degree – **code** 19 6494.42
water protection – water supplying protection of the II degree – **code** 20 3582.25
waterprotection forest of I degree – **code** 21 3412.86
waterprotection forest of II degree – **code** 22 279.84

Table 22. *Protective forests-land, waters and other functions of ecosystems*

Category	Year	land, waters and other functions of ecosystems
		Subclass MCPFE of Class 3
		(1000 ha)
Forests	2005	162.0
	2000	162.0
Forest land	2005	17.0
	2000	17.0
Forests and forest land – total	2005	179,0
	2000	179,0

Other functions of ecosystems:

climate protection-code 31 6494.42
permanently protective forests (not included in ownership treatment) – **code** 66 3582.25

Negative habitat influences on forests and forest ecosystems. The changes of the natural regime of waterflow as a consequence of the hydroenergetic system Đerpap caused the deterioration of the survival conditions, growing, use and renewal of the existing forests and forest cultures in the domain of influence which is felt as far as Novi Sad, and to the territory of Sremska Mitrovica on the Sava River.These changes resulted in the permanent melting of the lower parts of terrain in the lower part of accumulation, as well as to longterm flooding of the lower parts of

microrelief and extended the flooding in the higher parts of mocrorelief. All these had influenced the forest decay and dessication, which resulted in the loss of huge areas for forest trees growing. In the existant poplar establishemnts the increment reduced to a great extent, and numerous poplar habitats have turned into the willow habitats, and the willow habitas are permanently lost for production. In Srem the building of wells for supplying of habitats resulted in the abrupt lowering of ground water levels, which promted the physiological weakening, decay and dessication of the lower forests of oak, ash, hornbeam and elms.

CRITERION 6. SOCIO-ECONOMIC FUNCTIONS AND CONDITIONS

The importance of forestry sector. Forestry is a sector which has been neglected and iadequately treated by the economic policymakers for a long time. This approach is the result of the modest participation of forestry in GNP. The participation of forestry in GNP is extremely small and ranges from 0.34 to 0.57%. The result of these trends is the lack of money needed for investement in the biological reproduction of forests. The regime of the administrative control were for decades the guiding principle for the prices of the products. As a result, the prices of the most timber assortments are 2-4 lower than these on the world market, which greatly influenced the scope of forestry participation in GNI.

Energy derived from timber. The major coal deposits are located in Kolubarski, Kostolački and Kosovo-Metohijski Basins. There are estimated 16 billion tons of coal without taing into account reserves in KIM, which will suffice for 55 years of exploitations, if the current trend of use continues. In Serbia 14% of households use regional heating, 33 % use electricity for that purpose, 39% use coal, 7% use fuelwood and 7% natural gas.

Recreation Quantitative indicator: maintanance of the recreational function: forest area per inhabitant, percent of total forest land (Table 23).

Table 23. *Use of forests for recreational purposes*

Category	Year	Area which are legally approved for use		Area with capacity for using for recreational purposes		Use of areas for recreation as a primary purpose	
		total (1000 ha)	% of total	total (1000 ha)	% of total	total (1000 ha)	% of total
Forests	2005	1815.3	100.0	1815.3	100.0	5.0	0.3
	2000	1822.0	100.0	1822.0	100.0	5.0	0.3
Other forest land	2005	187.8	100.0	187.8	100.0	0.0	0.0
	2000	162.0	100.0	162.0	100.0	0.0	0.0
Forests and forest land-Total	2005	2003.1	100.0	2003.1	100.0	5.0	0.3
	2000	1984.0	100.0	1984.0	100.0	5.0	0.3

Employment. The number of employees in forestry has decreased in the last few years owing to the rationalisation and reorganization of the forest organizations. At the end of 2005 there were 4.383 employees in forestry sector in Srbia - 1.857 of which worked in the sector of forest establishment and growing, and 2.526 worked in the domain of exploitation (Table 24).

Table 24. *Employees in forestry*

Year	Total	Foresty	Forest establisheme nt and growing	Forest exploitation	Other actions
2005.	6196	4383	1857	2526	1813
2000.	7960	6585	2356	4229	1375

Cultural and spiritual heritage. The number of some cultural heritage in 2005 is shown in the Table 25.

Table 25. *Cultural and spiritual heritage*

Year	The type of cultural and spiritual heritage					
	Archeological sites	Monuments of nature			Historical sites	Other areas with recognizes cultural and historical heritage
		Afforestation landscape	Trees	Other similar forests		
	(number)					
2005	2	0	130	84	40	24

By assuming international responsibilities the Republic of Serbia has committed to preservation and improvement of the existent biological diversity, and sustainable use and forest management. In the past forest management planning practice norms and standards were not checked and compared with the criteria and indicators for sustainable forest management. The aim of this project is the comparison between the current planning forest management norms and standards and the criteria and indicators for sustainable forest management and the possibility of applying them in forest management planning. The norms and standards used directly in planning forest management theory and practice in Serbia should be given a detailed description and evaluation, in reference to the Pan – European Criteria and indicators for sustainable forest management. The evaluation of the complementarity, compatibility, and conflicts of existing norms and standards was done against the criteria and indicators for sustainable forest management and the level of quality of the available pieces of information according to MCPFE indicators.

CONCLUSION

Ecosystems are large, complex and highly variable in time and space. Ecosystems are bringing elements of risk and uncertainty to decisions on forest management and policy, because complete knowledge of ecosystems and their response to management will never exist. Current forest policy gives priority to environmental, sociopolitical and economic values. Indicators are the tools that can be used to conceptualize, evaluate and implement multiple-value systems in sustainable forest management. The use of a proper set of indicators enables evaluation of performance and assists in understanding what sustainable forest management means.

The discord of the official data obtained from the different state institutions in Sebia was reported, as well as the insufficient readily available data on private-owned forests. It requires the strengthening of the forest sector aimed at condition monitoring and changes of the indicators of the sustainable use of forests and forest ecosystems. The realization of sustainability, however, will remain an ongoing dynamic process.

REFERENCES

1. Blaženić, J., Cvijan, M., Laušević, R. (1995): Diverzitet slatkovodnih algi Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
2. Hunting assotiaton of Serbia (2005): Average weight and price of game, www.ecolss.com, Hunting assotiaton of Serbia, Belgrade
3. Institute of forestry, (2000): Christmas trees in 2000, Documentation, Institute of forestry, Belgrade
4. Institute of forestry, (2005): Christmas trees in 2005, Documentation, Institute of forestry, Belgrade
5. Instituite of forestry (2005): Forest Condition Monitoring in the Republic of Serbia, Annual report ICP Forests 2004, 2005 (Level I), Ministry of forestry, agriculture and water management – Directorate for forestry, Belgrade
6. Institute of natura protection (2005): Register for protection of natural goals in Serbia, Documentation, Institute of natura protection, Belgrade
7. Ivančević, B. (1995): Diverzitet makromiceta u Jugoslaviji sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
8. Janković, D., Krpo-Ćetković, J. (1995): Diverzitet slatkovodnih riba (Osteichthyes) I kolousta (Cephalaspidomorpha) Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
9. Jakovčev, D., Kalafatić, V., Martinović-Vitanović, V. (1995): Diverzitet oligoheta (Oligochaeta) kopnenih voda Jugoislavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.

10. Jovanović, J. B. (1995): Diverzitet puževa (Gastropoda, Mollusca) Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
11. Kalafatić, V. (1995): Diverzitet Rotatoria kopnenih voda Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
12. Kalafatić, V. (1995): Diverzitet Cladocera I Copepoda (Crustacea) kopnenih voda Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
13. Karaman, S., Stojanović, M. (1995): Diverzitet faune kišne gliste (Lumbricina; Oligochaeta; Annelida) Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
14. Karaman, G. (1995): Diverzitet Amphipoda (Crustacea) Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
15. Karaman, I. (1995): Diverzitet kmosaca (Opiliones, Arachnida) Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
16. Krnjajić, S., Krnjajić, Đ. (1995): Diverzitet kopnenih valjkastih crva (Nematodes) u Jugoslaviji, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
17. Ministry of science and environmental protection (2005): Contingents of plants and animals species which can be collected in 2005, Gazette No 36, Republik of Serbia
18. Milutinović, M. (1995): Diverzitet krpelja (Acari: Ixodidae, Argasidae) u Jugoslaviji, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
19. National parks Tara, (2005): General management plans for forestry in National park Tara, Documentation, Bajina Basta
20. National parks Kopaonik, (2005): General management plans for forestry in National park Kopaonik, Documentation, Kopaonik
21. National parks Djerdap, (2005): General management plans for forestry in National park Djerdap, Documentation, Donji Milanovac
22. National parks Fruska gora, (2005): General management plans for forestry in National park Fruska gora, Documentation, Karlovac
23. Petrov, B. (1995): Diverzitet Anostraca, Notostraca I Conchostraca Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
24. Petanović, R., Stojnić, B. (1995): Diverzitet fitofagnih I predatorskih grinja (Eriophyoides, Tetranychidae I Phytoseiidae, Acari) Jugoslavije, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
25. Public Enterprise “Srbijasume” (2005): Data for Forestry in Srbijasume, Documentation, Belgrade
26. Public Enterprise “Srbijasume” (2005): General management plans for forestry districts in Serbia, Documentation, Belgrade
27. Public Enterprise “Srbijasume” (2005): Data for General management plans for forestry districts in Serbia, Documentation, Belgrade
28. Public Enterprise “Vojvodinasume” (2005): Data for Forestry in Vojvodinasume, Documentation, Novi Sad

29. Public Enterprise “Vojvodinasume” (2005): General management plans for forestry districts in Vojvodinasume, Documentation, Novi Sad
30. Public Enterprise “Vojvodinasume” (2005): Data for General management plans for forestry districts in Vojvodinasume, Documentation, Novi Sad
31. Publik Enterprise “Srbijasume” (2005): Price-list of roundwood, www.srbijasume.co.yu, Belgrade
32. Puzović, S., Simić, D., Saveljić, D., Gergelj, J., Tucakov, M., Stojnić, N., Hulo, I., Ham, I., Vizi, O., Šćiban, M., Ružić, M., Vučanović, M. & Jovanović, T. (2003): Birds of Serbia and Montenegro – sizes of nesting populations and trends: 1990-2002.
33. Radović, I., Mesaroš, G., Pavićević, D., Mihajlović, Lj., Protić, Lj., Ćetković, A. (1995): Diverzitet entemofaune (Insecta) Jugoslavije, sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
34. Ratknic, M. (2002): Forestry sector in Yugoslavia, Documentation, Belgrade
35. Ratknic, M., Tokovic, Z. (2001): Condition, problems and management in private forests (book of metods), Ministry agriculture, forestry and water management, Belgrade
36. Report (2005): Carbon stock in forestry ecosistems in Serbia, Ministry for agriculture, forestry and wathermanagemant, Belgrade
37. Savić, S. (1995): Diverzitet lišajeva (Lichnes) Jugoslavije sa pogledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
38. Savić, I., Paunović, M., Milenković, M., Stamenković, S. (1995): Diverzitet faune sisara (Mammalia) Jugoslavije, sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
39. Statistical bulletin (1992): Forestry 1991, No 1961, Federal statistical office of the Yugoslavia, Belgrade
40. Statistical bulletin (2002): Forestry 2000, No 2326, Federal statistical office of the Yugoslavia, Belgrade
41. Statistical bulletin (2006): Forestry 2005, No 459, Statistical office of the Republic of Serbia, Belgrade
42. Statistical Document (2006): Energetic balance of accounts for electric and warmth energy, No 53, Statistical office of the Republic of Serbia, Belgrad
43. Stevanović, V., Pavić, S., Stevanović, B. (1995): Diverzitet flore mahovine (Bryophyta) jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
44. Stevanović, V., Jovanović, S., Lakušić, D., Niketić, M. (1995): Diverzitet vaskularne flore Jugoslavije sa pogledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
45. Ćurčić, B. (1995): Poreklo I diverzifikacija fauna pseudoškorpija iz dinarskog i kapratsko-balkanskog krša (Srbija i Crna Gora), sa pregledom taksona od globalnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
46. Džukić, G. (1995): Diverzitet vodozemaca (Amphibia) i gmizavaca (Reptilia) Jugoslavije, sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
47. Vasić, M. (1995): Diverzitet ptica Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet, Beograd.

SCIENTIFIC SESSION II
PROTECTION AND DEVELOPMENT STATE OF FORESTS AND ENVIRONMENT – EDUCATION, RESEARCHING, TRAINING, NEEDS

PLENARY LECTURE
THE INTEGRATED PROTECTION AND SUSTAINABLE FOREST ROLE

Snežana RAJKOVIĆ, Mara TABAKOVIĆ-TOŠIĆ[1]

Abstract: *In such a quickly changing world, can anything be sustainable? What do we want to sustain? How can we implement such a nebulous goal? Is it too late? With the contradictions and questions have come a hard look at our present forest production system and thoughtful evaluations of its future. If nothing else, the term "sustainable forest" has provided "talking points," a sense of direction, and an urgency, that has sparked much excitement and innovative thinking in the world. Keep the following in mind: a) interactions between farming systems and soil, water, biota, and atmosphere are complex--we have much to learn about their dynamics and long term impacts; b) most environmental problems are intertwined with economic, social, and political forces external to forestry; c) some problems are global in scope while others are experienced only locally; d) many of these problems are being addressed through conventional, as well as alternative, agricultural channels; e) the list is not complete; and f) no order of importance is intended.*

Role of forestry in producing sustainable raw material - timber - clear.Wide range of additional benefits: local employment and rural development; habitat creation and biodiversity; environmental protection, e.g. riparian woodland; recreation and amenity; landscape enhancement; carbon sequestration; environmental education, culture, folklore, heritage. Forestry is a multi-benefit landuse - environmental, social and economic benefits.

So, how best do we manage our forests to maximise all of these benefits without reducing their capacity to provide them to future generations?

[1] Snežana Rajković, Ph.D., Mara Tabaković-Tošić, Ph.D, Institute of forestry, Belgrade
Translation: Marija Stojanović

*Solution in **Sustainable Forest Management** (SFM)*

Key word: integrated protection, sustainable, forest, management

INTRODUCTION

During the past 50 years, the earth's population doubled to reach its current level of 6 billion. Today world population is increasing by 80 million annually, with the total projected to reach 10 billion within 40 more years. Humanity must learn to live within the constraints imposed by the physical environment as both a provider of inputs and a sink for wastes. The fact that today more than 1 billion people do not have access to clean water and 1.7 billion people lack basic sanitation illustrates that the demands of a growing human population and an expanding global economy are already placing considerable stress on natural systems. This raises huge challenges for policy-makers as they seek to reconcile the needs and aspirations of a growing population with resource limitations.

Forestry is faced with the challenge of meeting an increasing demand for wood products, as well as for an expanding array of services, such as clean water, recreation, and wildlife habitat. In most regions, these needs will have to be met from a fixed or shrinking land base. Forests may be able to produce sufficient wood but production costs will rise and so too will the cost of wood products. Forest management must consider the potential for negative impacts to the environment, as well as how to cope with the uncertainties of weather and climate change.

Ultimately the challenge is to find ways to sustain the provision of goods and services that society derives from forests in ways that…" meet the needs of the present without compromising the ability of future generations to meet their own needs." Bruntland (1987).

Following the 1992 Earth Summit, there have been numerous efforts throughout the world to define sustainable forest management (SFM). Foremost amongst these have been the efforts to establish Criteria and Indicators (C&I) that provide a common framework for describing, monitoring, and evaluating SFM. Although, the various C&I efforts originated from country-led efforts, there is a surprising similarity in the criteria that evolved. All C&I approaches seek to characterize SFM on the basis of a range of benefits derived from forests and they all incorporate elements of the following criteria (Wijewardana 1998): Extent of Forest Resources, Healthy Forest Ecosystems, Productive Functions, Biological Diversity, Protective Functions, Socioeconomic Benefits, Legal, Policy, and Institutional Framework.

The first six of the seven criteria can be viewed as a statement of the goods and services that society derives from its forests.

From this perspective, there are places in the world that are already experiencing difficulty with some of these criteria. Operationally, it seems less likely that a country will conclude that it is failing at SFM, but rather that in some locations, for some specific goods and services, society's expectations are not being met. For example, in some places the fragmentation of forests across the landscape has resulted in the reduction of many plant and animal species that rely on forest habitat. In other regions there are projections of inadequate wood supply. Insufficient water quality and aquatic habitat are issues that now affect most regions.

Agriculture and forestry account for much of the world's land use. Too often we treat agriculture and forestry separately, yet these two sectors are often interwoven on the landscape and share many of the same goals. If we are to truly meet society's needs and aspirations for forest-derived goods and services, we must find ways of augmenting traditional forestry by gleaning some portion of these benefits from agricultural lands where agroforestry can be practiced (Ruark 1999).

Agroforestry practices are an important category of planted forests or "trees outside forests" (Long and Nair 1999) that have the potential to provide a wide array of forest-related benefits to society (See Box 1). Indeed, in many places the only opportunity to provide increased forest-based benefits, like wildlife habitat or forested riparian systems, is through the increased use of agroforestry on agricultural lands. Also, in many forest-based ecosystems, agroforestry principles are being employed to derive benefits, such as non-timber forest products (Nair 2001).

Definition of Agroforestry

Agroforestry is the combination of agricultural and forestry technologies to create integrated, diverse and productive land use systems (Garrett et al. 2000). Agroforestry has the ability to provide short-term economic benefits while the farmer waits for traditional longer-term forestry products. An example of an agroforestry system is a riparian buffer planting that can attenuate flooding effects and protect water quality, while providing wildlife habitat, recreational opportunities and harvestable products, like edible berries and medicinal herbs.

Agroforestry encompasses a very large and diverse set of practices ranging from croplands in which a minimal tree component has been added to complex forest production that has been integrated into an existing forest structure. Differences exist in how agroforestry is defined and perceived between tropical and temperate zones and reflect the wide variation in the climate, soils, pressures on the land and socioeconomic values where agroforestry can be applied. After examining many definitions and examples of agroforestry used globally, Nair (1985) concluded that the "strict scientific definition should stress two characteristics common to all forms of agroforestry:

- The deliberate growing of woody perennials on the same unit of land as agricultural crops and/or animals, either in some form of spatial mixture or in sequence.
- There must be a significant interaction (positive and/or negative) between the woody and non-woody components of the system, either ecologically and/or economically."
- Scientific evidence is now available to show that the spatial and temporal heterogeneity created by the agroforestry plantings can help enhance resource, increase production, reduce risk of monocultural agricultural and forestry practices, and achieve system stability and sustainability (Sanchez 1995; Ong and Huxley 1996; Lefroy et al. 1999; Nair and Latt 1998; Nair 2001). The biological advantages of agroforestry are 1) increased site utilization, 2) improved soil characteristics, 3) increased productivity, 4) reduced soil erosion, 5) reduced microclimate extremes, 6) positive use of microclimate changes (i.e. shade), 7) enhanced above- and below-ground biodiversity (i.e. natural enemy populations). These advantages in turn provide the economic and/or social values being sought from these systems.

A general classification developed by Nair (1985) puts the many agroforestry practices existing world wide into three major types based on the combination of the components:

- Agrisilvicultural: crops and woody plants
- Silvopastoral: pasture and/or animals and woody plants
- Agrosilvopastoral: crops, pasture and/or animals and woody plants
- A fourth category, Other Systems, is also included to catch those practices that don't quite meet any of the prior three types, such as apiculture with trees.

A full discussion of the many forms and practices of agroforestry practiced world wide is beyond the scope of this paper, but readers are referred to Nair (1989), Nair et al. (1995), and Garrett et al. (2000).

The Code lists the objectives of each forest operation, e.g. the production of suitable planting stock, improving tree quality; efficient and environmentally-friendly harvesting. Key factors identify those elements of the operation likely to impact on the three values of SFM. Operational descriptions outline the components of each operation and the best practice methods to ensure compliance with SFM. Potential adverse impacts are listed in order to emphasise the need for best management practice. The most likely adverse impacts arising from careless or incorrect operations are highlighted. Also listed are best practices. These are measures needed to avoid potential adverse impacts, and include care for the physical environment, safety, efficiency and proper planning and consultation with local interests. Each section is accompanied with a list of suitable references included to provide greater technical detail and background material for each operation.

FORESTRY AND WATER QUALITY GUIDELINES have been revised, widened and updated. Sensitive water catchment areas are defined and their management prescribed. Guidelines are given relating to the best forest management practices to ensure the maintenance of high water quality. Recommendations are also made in relation to cultivation, drainage, fertilising and storage, the use of chemicals, herbicides and fuels, road-making, bridges and culverts, and harvesting.

Revised FORESTRY AND THE LANDSCAPE GUIDELINES are presented to ensure that all new plantations complement, rather than detract from, the landscape. The objectives of landscape design are introduced, together with a landscape character type approach. The forest cycle is outlined in terms of operations and their impact on the landscape. Also outlined are measures to mitigate adverse impacts and to enhance the overall landscape, involving shape, scale, diversity, visual force and unity.

Revised FORESTRY AND ARCHAEOLOGY GUIDELINES are designed to ensure that Ireland's rich heritage of archaeological sites and artefacts is not damaged by forest operations. They deal specifically with relevant legislation, sources of records of known archaeological sites, types of sites, protective measures to be employed, and contact details.

These new FOREST BIODIVERSITY GUIDELINES recognise the importance of the maintenance and enhancement of forest biodiversity, and implement the objectives in a forestry context of the National Biodiversity Plan. They describe a range of measures to conserve and enhance biodiversity in forests, such as species and structural diversity, retained habitats and open spaces, the retention of deadwood, the control of troublesome species such as rhododendron, and the use and conservation of native provenances.

The new FOREST HARVESTING AND THE ENVIRONMENT GUIDELINES have been produced to ensure that all forest harvesting operations, including felling, extraction, roading and site restoration, are environmentally sustainable. They describe the impact of harvesting on water, forest soils, landscape, archaeological sites, forest health and vitality, and biodiversity, and lay down clear instructions to ensure best practice.

SFM Criteria That Agroforestry Can Help Address

While there are certainly differences between tropical and temperate agroforestry, or for that matter between how agroforestry is perceived and practiced in developing and industrialized countries, this paper focuses on the principles and benefits they have in common for addressing SFM. Agroforestry responds to economic, environmental, and social issues common to most regions of the earth. The roles which agroforestry can play in helping the forestry sector achieve SFM can be gauged by the extent to which agroforestry is relevant to the internationally agreed upon criteria of SFM. This paper examines agroforestry's relationship to the first six criteria:

Extent of Forest Resources (inter alia, carbon)

Agroforestry systems are most extensive in developing countries where approximately 1.2 billion people depend directly on a variety of agroforestry products and services (IPCC 2002). When land conversion was examined, Watson et al. (2000) documented that the greatest potential for carbon uptake is through the conversion of previously degraded lands into well-managed agroforestry systems. Schroth et al (2002) studied the reforestation of primary forest lands in Amazonia that had been previously cleared for crops or pasture. Reforestation with multi-strata agroforestry systems allowed for high rates of biomass accumulation, with the additional benefit of the early generation of income from annual and semi-perennial intercrops. According to IPCC (2000), the potential land area suitable for agroforestry in Africa, Asia, and the Americas may be as high as $1{,}215 \times 10^6$ ha. The current area under agroforestry is estimated at 400×10^6ha; of this 300×10^6 ha are classified as arable and 100×10^6ha as forest lands.

Carbon Storage – Agroforestry plantings can sequester substantial carbon (Watson 2000), but it is important to understand the opportunities of climate change mitigation activities in the context of multiple spatial scales. Agroforestry can be used to link forest fragments and other critical habitat as part of a broad landscape management strategy that enables species to migrate for population genetics reasons and in response to climate change. Trees and shrubs planted in shelterbelts can store carbon in their shoots and roots, while protecting soils and crops and providing biodiversity and habitat for wildlife (Pandey 2002). Through either deposition of wind-blown soils or interception of surface runoff sediments, many of the linear-based agroforestry practices, such as shelterbelts and riparian buffers, can trap significant amounts of carbon-rich topsoil that would otherwise be lost from these systems (Lal et al. 1999; Kimble et al. 2003). Riparian forest buffers are natural carbon sinks and when suitable trees and shrubs are grown in these moist environments they also filter out contaminants from adjacent agricultural or community activities.

In temperate systems agroforestry practices have been shown to store large amount of carbon (Kort and Turlock 1999; Schroeder 1994). Potential C storage from agroforestry systems in temperate regions has been estimated to range from 15-198 t C ha^{-1} with a modal value of 34 t C ha^{-1} (Dixon 1995). Nair and Nair (2003) estimated C sequestration potential through agroforestry practices in the United States by 2025 as 90.3 Mt C y^{-1}. In the tropics, Palm et al. (1999) report that agroforestry systems helped to regain 35 percent of the original C stock of the cleared forest, compared to only 12 percent by croplands and pastures. Fay et al. (1998) estimated the area for potential conversion to these agroforestry systems at 10.5×10^6 ha y^{-1}. Based on a preliminary assessment of national and global terrestrial C sinks, two primary beneficial attributes of agroforestry systems have been

identified: (1) direct near-term C storage (decades to centuries) in trees and soils and (2) potential to offset immediate greenhouse gas emissions associated with deforestation and subsequent shifting cultivation. A projection of carbon stocks for smallholder agroforestry systems indicated C sequestration rates ranging from 1.5 to 3.5 Mg C ha^{-1} y^{-1} and a tripling of C stocks in a 20-year period, to 70 Mg C ha^{-1}. According to one estimate, median carbon storage by tropical agroforestry practices is around 9, 21, and 50 Mg C ha^{-1} in semiarid, subhumid, and humid ecozones, respectively. The total carbon emission from global deforestation at the currently estimated rate of 17 million ha y^{-1} is 1.6 Pg. Assuming that one hectare of agroforestry could save 5 hectares from deforestation and that agroforestry systems could be established in up to 2 million hectares in the low latitude (tropical) regions annually, a significant portion of carbon emission caused by deforestation could be reduced by establishing agroforestry systems (Palm et al. 1999).

Healthy Forest Ecosystems

Forest activity at a specific site needs to be integrated into a broader land-use context that considers the management of land and water resources as regional units (Miller 1996). Agroforestry plantings can help add structural and functional diversity to landscapes and, if strategically located, they can help restore many ecological functions (Olson et al. 2000). While agroforests are typically less diverse than native forest, they do contain a significant number of plant and animal species. This diversity can, in time, provide ecological resilience and contribute to the maintenance of beneficial ecological functions (Lefroy et al. 1999, Vandermeer 2002). Similar to plantation forests, agroforests can help relieve some of the pressure to harvest native forests (although their presence as such is not a sufficient condition for protection of old growth forests).

Productive Functions: (inter alia, wood / non-timber products)

Agroforestry practices and agroforests can be used to produce harvestable wood for fuelwood, pulp, saw timber, and veneer products. The potential for agricultural lands to augment the world wood supply is substantial (Watson et al., 2000), and has the added benefit of bolstering on-farm income. Many agroforestry designs can also be used to produce non-timber commercial products. Agroforestry plantings mixed into and at the edges of forest plantations can be used to produce a wide array of products, like medicinals, ornamentals, and food products, which are compatible with wood production. This will also allow for greater structural diversity and the development of more diverse plant communities.

Biological Diversity

There is not enough forested habitat remaining in some landscapes to support some species of plants and animals. Even when there are forest reserves in an area, they may be too small to contain the habitat requirements of all species. In addition, most species have populations that extend beyond reserve boundaries (Kramer et al. 1997). Agroforestry provides ways of augmenting the supply of forest habitat and providing greater landscape connectivity. Where croplands occupy most of the landscape, linear riparian forest buffers and field shelterbelts can be essential for maintaining plant and animal biodiversity, especially under a changing climate scenario. Agroforestry adds plant and animal biodiversity to landscapes that might otherwise contain only monocultures of agricultural crops (Noble and Dirzo 1997, Guo 2000).

The use of corridors to connect fragmented habitats has long been proposed as a mechanism to enhance population processes (Wilson and Willis 1975). There are arguments for and against the use of distinct corridors (Simberloff et al. 1992, Perault and Lomolino 2000), but it is important to recognize that corridors are not necessarily distinct and linear. Often a 'corridor' may simply mean habitat areas that are sufficiently close to each other (i.e., functionally linked) to enable dispersal. If spatial arrangement is considered agroforestry plantings can be used to connect forest fragments and other critical habitats in the landscape Freemark (2002). Modest considerations, like mixing tree species, allowing for small clearings and water catchments in planting, and incorporating understory vegetation can greatly improve habitat for many animals and create micro-site conditions for plant species (Spies and Franklin 1996).

Freemark (2002) demonstrated the important role of farmland habitat for the conservation of plant species in Eastern Canada. In the Great Plains region of the United States, where cropland occupies most of the landscape, linear riparian zones and field shelterbelts were argued to play essential roles in maintaining biodiversity (Guo 2000, Brandle et al. 1992). In Central and South America, shaded coffee plantations integrate leguminous, fruit, fuelwood, and fodder trees (Beer 2001). These systems have been documented to contain over 100 plant species per field and support up to 180 bird species (Michon and de Foresta 1990, Altieri 1991, Thrupp 1997). In mature complex multi-strata agroforestry systems of Indonesia, plant diversity was in the order of 300 species ha-1, while bird diversity was found to be 50 percent that in the original rainforest. In addition, almost all mammal species were still present at some level in these agroforestry systems (Thrupp 1997).

Protective Functions: (inter alia, soil / water)

Agroforestry plantings have the potential to contribute significantly to maintaining or improving soil and water quality in a region, while helping to maintain the carbon cycle by sequestering large amounts of carbon in their biomass. The degree to which these and other ecological functions can be provided will depend on plant species composition and their physical structure both above- and below-ground.

Soil Quality – One of the main conceptual foundations of tropical agroforestry is that trees and other vegetation improve the soil beneath them. Observations of interactions in natural ecosystems and subsequent scientific studies have identified a number of facts that support this concept. Research results during the past two decades show that three main tree-mediated processes determine the extent and rate of soil improvement in agroforestry systems. These are: 1) increased N input through biological nitrogen fixation by nitrogen-fixing trees, 2) enhanced availability of nutrients resulting from production and decomposition of substantial quantities of tree biomass, and 3) greater uptake and utilization of nutrients from deeper layers of soils by deep-rooted trees (Nair et al. 1999). The other major avenue of soil improvement through agroforestry is through soil conservation. When properly designed and managed, agroforestry techniques can contribute to ecosystem protection and restoration functions by reducing water- and wind erosion and enhancing soil productivity.

Water Quality – Most watersheds contain a mixture of land uses, including forestry and agriculture. Protecting water quality requires an integrated multi-sectoral approach to watershed management. Streams that course through agricultural lands are often devoid of vegetation in their riparian zones and runoff containing excess fertilizers, pesticides, animal wastes, and soil sediments enters surface waters unabated. Agroforestry technologies, like riparian forest buffers, have been shown to be effective in reducing water pollution from agricultural activities when they are well designed and properly located in a watershed (Dosskey 2002). These buffers can stabilize stream channels and slow and reduce the transport of runoff to streams. This allows more time for infiltration of water and contaminants into the soil and increases the ability of the environment to degrade pesticides and animal waste products. Linked systems of upland and riparian tree-based buffer systems, designed in regards to other landscape practices and features, can optimize soil and water conservation in the watershed, along with other economic and social services. Agroforestry practices are also being adapted to design best management practices to detain and treat stormwater runoff from communities and restore ecological functions to watersheds.

Socioeconomic Benefits: (inter alia, silvopastoral / green infrastructure)

In societies where a major part of the population still makes their living off the land, the first concern may be annual income and it is here that agroforestry efforts differ most from conventional 'tree plantation' efforts (Dixon 1995, Leakey and Sanchez 1997). In addition, communities are increasingly looking for ways to address social and environmental issues with "green" solutions. Two examples are provided:

Silvopastoral - Research has demonstrated that many forage plants will yield high levels of quality biomass when grown under up to 50 percent shade. This knowledge is being used to design agroforestry timber/grazing systems in conifer stands. These silvopastoral systems allow trees to be grown as a long-term product, while on the same piece of ground an annual income can be generated from grazing livestock (Clason and Sharrow 2000). In a silvopasture system trees are grown at a low stocking density to allow about half the sunlight to reach the ground to grow forage. Forest management is encouraged as trees are thinned and pruned periodically to maintain proper light levels. As a result, most of the wood produced is high-value saw timber or veneer quality. While farmers often see economic diversification as the main motivation for establishing silvopasture, other benefits include erosion control, improved wildlife habitat, and carbon sequestering. In addition, the low tree stocking and managed understory makes them inherently low risks for damage by wildfires.

Green Infrastructure in Communities - In societies where many live in urban/suburban environments, concerns over the accelerating loss of open and green space tend to become prominent. This is a quality-of-life issue to many and raises the potential for agroforestry applications at the agricultural/community interface to restore ecological functions that provide for stormwater management, wildlife habitat, recreational opportunities, and aesthetic enhancements, as well as a wide array of non-timber products (Box 2) (Thaman 1993). Communities have long understood the need for "gray infrastructure" like water and sewer lines, power lines, and roadways. More recently, the importance of "green infrastructure" that consists of a planned and managed, interconnected network of natural areas (waterways, wetlands, forests and conservation lands like greenways and parks) and adjacent working lands (farms, ranches, and corporate lands) has gained recognition in many communities (The Conservation Fund 2002). Agroforestry approaches that utilize trees, shrubs, and grasses to manage stormwater runoff are also being adapted to meet community needs to detain and treat stormwater. The vegetation can also act as a living filter to improve water quality downstream and protect stream channels.

Community Resources' Urban Non-timber Product Project

The "hidden bounty" of agroforestry technologies in communities goes far beyond aesthetics and scenic bike and walking trails. They can provide a myriad of environmental services, from air and water quality, to soil stabilization, climate modification, and wildlife habitat, and, as documented by Community Resources, simultaneously provide economic returns in the forms of non-timber forest products. From a 2-year study in the Baltimore urban forests, the following was found. Individuals and organizations collected over 100 products from 78 species. Alternative products collected ranged from edible products to medicinal, horticultural and craft materials. Collections were by a wide diversity of ethnic and socio-economic groups. The potential value of these products was on par with the per acre values suggested for the environmental services such as energy savings and pollution prevention.

The Ecological Foundation for Agroforestry

Agroforestry plantings provide us with an excellent tool to meet farmer needs while restoring ecological functions to the landscape. By adding structural and functional diversity to the landscape, these tree-based plantings can perform ecological functions that can have significance far greater than the relatively small amount of land that they occupy (Guo 2000). (Box 3)

Ecological Functions Created by Agroforestry Plantings

- HABITAT: provides resources (inter alia, food, shelter and reproductive cover) to support an organism's needs.
- CONDUIT: conveys energy, water, nutrients, genes, seeds, organisms, and other elements.
- FILTER/BARRIER: intercepts wind, wind-blown particles, surface/subsurface water, nutrients, genes and animals
- SINK: receives and retains objects and substances that originate in the adjacent matrix of land.
- SOURCE: releases objects and substances into the adjacent matrix of land.

These five functions are described in more detail elsewhere (Forman and Gordon 1986).

Site-Level Diversity - Agroforestry, as implied by its name, combines components from both agriculture and forestry through spatial and temporal manipulation of the crop and animal components. It is structurally and functionally more complex than either crop or tree monocultures alone. Greater stratification of resource utilization (nutrients, light, and water) and greater structural diversity lends itself to increased capture of sunlight and a

tighter coupling of nutrient cycles. Above- and belowground diversity provides more system stability and resilience. Enhanced site-level diversity typically results in higher levels of belowground microbial diversity and production (Olson et al. 2000).

Landscape Diversity - Many ecological functions that contribute to the sustainability of the landscape, such as water and soil quality and wildlife habitat, become fully expressed only at the landscape and watershed levels. For instance, water quality is the end result of a myriad of ecological processes that occur and aggregate up through the watershed. It is influenced by the natural features of the landscape and by the cumulative activities of all the "neighbors" living in the watershed. Without some type of watershed-level coordination, the benefits ascribed to agroforestry and to the many other conservation practices for managed lands may never be fully realized. While isolated agroforestry plantings may provide the desired services at the site level, such as enhanced food or fiber production, agroforestry systems that connect with forests other landscape features are needed to get the desired services at the landscape and watershed levels. Environmental services, such as wildlife corridors, reduced flooding, and improved water and soil quality, all benefit from connectivity (Forman 1995). Agroforestry can provide more protective functions to the landscape when plantings are designed that coordinate with other landscape features throughout the working landscape.

A Planning Framework to Optimize Agroforestry's Capability for Multiple Benefits

Agricultural and urban landscapes are assemblages of interactive components that are continually being modified by humans to produce goods and services. Sustainability of forestry, agriculture, and community sectors ultimately rest on how well we can achieve any kind of coordinated land management strategy in a landscape full of mixed ownerships, management areas, and political boundaries (Sampson 1998). This is very complicated social challenge but can be approached with a planning process that is (The Conservation Fund 2002):

- Proactive ….not reactive
- Systematic ….not haphazard
- Holistic ….not piecemeal
- Multi-jurisdictional ….not single jurisdiction
- Multifunctional ….not single purpose
- Multiple Scales ….not single scale

Agroforestry designs may be typically based on site-focused assessments at the farmer level. However, many of the conservation problems that agroforestry can address are unrecognizable, or are otherwise inadequately accounted for at this scale. How agroforestry plantings are

arranged and connected within the larger landscape will determine the quantity and quality of benefits attained. To realize agroforestry's capability to provide multiple services to farmers and society, agroforestry must be planned and designed using information gathered from a variety of spatial and temporal scales. Thaman and Clark (1993) pointed out that "to maintain the landscape in good health, it is not necessary that every landholding, every stretch of land, contain trees, just as every farmer need not be an agroforester – but it is necessary that there be sufficient trees in the right places". How strategically these systems are interspersed throughout the landscape and how strategically designed in terms of species composition at the site level, will ultimately determine the types and levels of forest-related goods and services agroforestry will be able to deliver. Multiple-objective planning is based on the principle that optimal benefits are achieved by strategic placement of land uses and conservation practices. Due to landscape heterogeneity, a strategic land-use planning approach is necessary for agroforestry systems (Sanchez 1995). Designing agroforestry systems that restore or enhance targeted ecological functions will therefore be a task of creating strategic configurations across ownerships and land uses.

Melding Regional-, Landscape- and Site-Level Concerns

A planning framework that integrates regional, landscape, and site scale planning approaches, serves the primary purpose of aiding agroforestry design at the site level with the additional landscape perspective for developing landscape scale plans to guide strategies for agroforestry adoption, for creating agroforestry programs and for targeting resources to meet landscape level objectives and educating local stakeholders on the value of agroforestry (Bentrup et al. 2000, Franco et al. 2003). To realize agroforestry's capability to provide multiple services to farmers and society, tools that meld regional-, landscape- and site scale concerns can be used to deploy a variety of agroforestry practices across the landscape in strategic spatial arrangements.

Each scale in the process provides different kinds of information critical to meeting landowner and community objectives. At the regional scale, a reconnaissance of existing information provides a general assessment of environmental conditions and resource issues. At the landscape scale, more detailed information is collected and analyzed with geographical information systems (GIS) technologies to identify critical problem areas and desired future conditions. Landscape assessments are made to determine if and what agroforestry practices are appropriate for solving problem area issues and for achieving desired future conditions. The site scale component of the framework incorporates the regional reconnaissance and landscape assessments with site-specific information.

Design alternatives that integrate community-desired future conditions and landowner objectives are generated for the site. Design

alternatives include buffer size, composition, and management recommendations.

Fostering Use of Agroforestry in Sustainable Land Use Strategies

Much of the current endeavors in agroforestry worldwide are focused on meeting the needs for human subsistence. This pressing objective tends to create management aimed at maximizing that primary concern. To create system sustainability, however, requires that multiple concerns are addressed, at least to varying degrees. Agroforestry has tremendous potential to help farmers balance the sometimes conflicting goals of production with stewardship by providing tree-based goods and services while keeping the land in agricultural production. Through these services and goods, agroforestry technologies can be used to create environmental and economic linkages across the agricultural, urban and forested continuum. Agroforestry is not a panacea but should be included in the set of options when tackling issues of population growth, urban sprawl, landscape fragmentation, and the increasing need to produce forest and agricultural goods and services on a decreasing land base.

Although there are some notable exceptions, the general lack of economic rewards to farmers for the environmental services provided to society by agroforestry practices has limited its promotion and adoption (Thaman and Clark 1993). An operational shift in thinking that recognizes the broader working nature of our managed landscapes, along with new ways of valuing the productive and protective functions agroforestry provides in these systems, is needed to encourage the greater adoption of agroforestry in both temperate and tropical systems.

REFERENCES

1. Altieri, M.A. 1995. Agroecology – The Science of Sustainable Agriculture. Westview Press, London.
2. Beer, J. (ed) 2001. Highlights of CATIE's research in agroforestry during the 1990s. Agroforestry Systems, Special Issue, 51: 75-176.
3. Bentrup, G., M. Dosskey, M. Schoeneberger, G. Wells, T. Leininger, and K. Klenke. 2000. Planning for multipurpose riparian management. p. 423-426. In: P.J. Wigington and R.L. Beschta (eds), Riparian Ecoogy and Management in Multi-Land Use Watersheds. American Resources Association, Middleburg, VA.
4. Brandle, J.R., T.D. Wardle, and G.F. Bratton. 1992. Opportunities to increase tree planting in shelterbelts and the potential impacts on carbon storage and conservation. p. 157-175. In: R.N. Sampson and D. Hair (eds) Forests and Global Change, Vol. 1: Ch. 9. American Forests, Washington D.C.

5. Bruntland Commission. 1987. Our Common Future. The World Commission on Environment and Development. Oxford University Press. Oxford, United Kingdom. p.43.
6. Clason, T.R. and S. H. Sharrow. 2000. Silvopasture practices. p. 119-147. In: H.E. Garrett, W.J. Rietveld, and R.F. Fisher. (eds) North American Agroforestry: An Integrated Science and Practice. American Society of Agronomy. Madison, Wisconsin, USA.
7. Dixon, R.K. 1995. Agroforestry systems: sources or sinks of greenhouse gases? Agroforestry Systems 31: 99-116.
8. Dosskey, M.G. 2002. Setting priorities for research on pollution reduction functions of agricultural buffers. Environmental Management 30:641-650.
9. Fay, C., H. DeForeta, M. Sarait, and T.P. Tomich. 1998. A policy breakthrough for Indonesian farmers in the Krui dammar agroforesters. Agroforestry Today 10(2): 25-26.
10. Forman, R.T. 1995. Landscape Mosaics: The Ecology of Landscapes and Regions. Cambridge University Press, Cambridge, MD USA.
11. Freemark, K.E., C. Boutin, and C.J.Reddy. 2002. Importance of farmland habitat for conservation of plant species. Conservation Biology 16:399-412.
12. Garrett, H.E., W. J. Rietveld, and R.F. Fisher. (eds). 2000. North American Agroforestry: An Integrated Science and Practice. American Society of Agronomy, Inc. Madison, WI.
13. Guo, Q. 2000. Climate change and biodiversity conservation in Great Plains agroecosystems. Global Environmental Change 10:289-298.
14. IPCC (Intergovernmental Panel on Climate Change): 2000, 'Land-use, Land-use Change and Forestry, Special report. Cambridge University Press, Cambridge.
15. Kort, J. and R.Turlock. 1999. Carbon reservoir and biomass in Canadian prairie shelterbelts. Agroforestry Systems 44:175-189.
16. Kramer P., C.P. van Shaik, and J. Johnson. 1997. Lost stand – protected areas and the defense of tropical biodiversity. Oxford Univ. Press, Oxford, UK.
17. Lal, R., Kimble, J. M., Follett, R. F., and C. V. Cole (eds). 1999. The Potential of U. S. Cropland to Sequester Carbon and Mitigate the Greenhouse Effect. CRC Press, Boca Raton, FL. 128 p.
18. Lefroy, E. C., Hobbs, R. J., O'Connor, M. H., and J. S. Pate (eds). 1999. Agriculture as a Mimic of Natural Ecosystems. Kluwer Academic Publishers, Dordrecht, The Netherlands. 438pp.
19. Long, A. J., and Nair, P. K. R. 1999. Trees outside forests: Agro-, community, and urban forestry. New Forests. 17: 145-174.
20. Michon, G., and H. DeForesta. 1990. Complex agroforestry systems and the conservation of biological diversity in harmony with nature. Proceedings of International Conference on Tropical Biodiversity. Kuala Lumpur (SEA MEO-BIOTROP).
21. Nair, P.K.R. 1985. Classification of agroforestry systems. Agroforestry Systems 3:97-128.
22. Nair, P.K.R. (ed) 1989. Agroforestry Systems in the Tropics. Kluwer Academic Publishers, Dordrecht, The Netherlands, 245 p.
23. Nair, P. K. R. 2001. Agroforestry. pp. 375-393. In: Our Fragile World: Challenges and Opportunities for Sustainable Development, Forerunner to The

Encyclopedia of Life Support Systems, Chapter 1.25, Vol. I. UNESCO, Paris, France, & EOLSS, UK.
24. Noble, I.R. and R. Dirzo. 1997. Forests as human-dominated ecosystems. Science 277:522-525.
25. Olson, R.K., M.M. Schoeneberger, and S.G. Aschmann. 2000. An Ecological Foundation for Temperate Agroforestry. p. 31-61.In: H.E.,Garrett, W.J. Rietveld, and R.F. Fisher. (eds). North American Agroforestry: An Integrated Science and Practice. American Society of Agronomy. Madison, Wisconsin, USA.
26. Ong, C. K. and Huxley, P. A. (eds.) Tree-Crop Interactions. CABI, Oxon, UK., 385 p.
27. Palm, C.A., P.L. Woomes, J. Alegre, L. Arevaldo, C. Castilla, D.G. Cordeiro, B. Feigl, K. Hariah, J. Kotto-Same, A. Mendes, A. Moukam, D. Murdiyarso, R.
28. Pandey, D.N. 2002. Carbon sequestration in agroforestry systems. Climate Policy 2:367-377.
29. Perault, D.R., and M.V. Lomolino. 2000. Corridors and mammal community structure across a fragmented old growth forest landscape. Ecological Monographs 70:401-422.
30. Ruark, G.A. 1999. Agroforestry and sustainability: making a patchwork quilt. J. of Forestry 97:56.
31. Sanchez, P.A. 1995. Science in agroforestry. Agroforestry Systems 30:5-55.
32. Sampson, N. 1998. Farm and Forest: Which Way to Sustainability. IN: Agriculture and Conservation Policies: 2002 and Beyond. Center for Agriculture in the Environment. http://www.aftresearch.org/researchresource/wp/wp98-7.html(verified March 5, 2003)
33. Schroeder, P. 1994. Carbon storage benefits of agroforestry systems. Agroforestry Systems 27: 89-97.
34. Schroth, G. S.A. D'Angelo, W.G. Teixeira, D. Haag, and R. Lieberei. 2002. Conversion of secondary forest into agroforestry and monoculture plantations in Amazonia: consequences for biomass, litter, and soil carbon stocks after seven years. Forest Ecology and Management 163:131-150.
35. Spies, T.A. and J.F. Franklin 1996. The diversity and maintenance of old-growth forests. In: Biodiversity in Managed Landscapes. R.C. Szaro and D.W. Johnston (eds) Oxford University Press, New York.
36. Simberloff, D., J.A. Farr, J. Cox, and D.W. Mehlman. 1992. Movement corridors: conservation bargains or poor investments? Conservation Biology 6:493-504.
37. Thaman, R.R. (1993). Pacific Island urban agroforestry. p. 145-156. In: W.C. Clark and R.R. Thaman (eds) Agroforestry in the Pacific Islands: Systems for Sustainability. United Nations Press, NY.
38. Thaman, R.R. and W.C. Clark. 1993. Agroforestry in the Pacific Islands: systems for sustainability. p. 191-215. In: W.C. Clark and R.R. Thaman (eds) Agroforestry in the Pacific Islands: Systems for Sustainability. United Nations Press, NY.
39. The Conservation Fund. 2002. Green Infrastructure: A Strategic Approach to Green Space Planning and Conservation. The Conservation Fund. Washington DC. USA.

40. Thrupp, L.A. 1997. Linking biodiversity and agriculture: challenges and opportunities for sustainable food security. World Resources Institute, Washington D.C.
41. Vandermeer, J. H. (ed.) 2002. Tropical Agroecosystems. CRC Press, Boca Raton, FL. 268 p.
42. Watson, R.T. I.R. Noble, B. Bolin, N.H. Ravindranath, J.D. Verarda, and D.J.
43. Dokken. 2000. Land-use, Land-use Change and Forestry, IPCC Special Report. Cambridge University Press, Cambridge, 388pp.
44. Wijewardana, D. 1998. Criteria and indicators for sustainable forest management. ITTO Newsletter. Vol. 8, No. 3.
45. Wilson, E.O., and E.O. Willis. 1975. Applied biogeography. p. 522-534. In: M.L. Coady and J.M. Diamond (eds). Ecology and Evolution of Communities. Harvard University Press, Harvard, Mass., USA

SCIENTIFIC SESSION III
MULTIFUNCTIONAL USE AND SUSTAINABLE MANAGEMENT OF FOREST RECOURSES

PLENARY LECTURE
INFLUENCE OF FORESTS ON THE FOOD-STUFFS SAFETY

Yancho NAIDENOV[1], Denitsa PANDEVA[2]

Abstract: *The food-stuffs safety is determined by complex reasons including political, social, economical and ecological aspects in management of nature resources. In the fast and recently forests are of the most important factors in this matrix and affect on the food-stuffs security in three main sectors:*

Agriculture – forest ecosystems create favorable conditions for increasing the effectiveness of agricultural productivity by preventing of soil erosion, improvement of soil fertility and optimization of micro-climate. The investigations in Bulgaria show that the protective shelter-belts in Dobrudja occupy about 3% of the arable area but increase the yields averagely 25-35%. World-wide, 240 million live stocks is fed with fodder from forests.

Economy – many counties in the world depend on the utilization of non-wood forest products to ensure economic stability of municipalities and entire regions. In Canada million people are employed in organized forest excursions, study on forest ecosystems and bird live, tourist trips, extreme sports, fishing and hunting. Worldwide, more than 500 million people are economically dependant on manufacturing, trade and consummation of non-wood forest products.

Forests as foods resource – the forests are source of edible fruits, nuts, leaves, roots, mushrooms and herbs, which ensure valuable nutrition elements and balanced diet. Game meat ensures up to 75-80% of the protein for the population in mountainous regions of the world.

Key words: forest, food, economy, ecology.

[1] Assoc. Prof. Yancho Naidenov, Forest Protection Station, Sofia, Bulgaria
[2] Dr. Denitsa Pandeva, Forest Research Institute, Sofia, Bulgaria

1. INTRODUCTION

Forests and the benefits they provide in the form of food, income and watershed protection have significant and, in some cases, critical role in enabling millions of people in different regions of the world to secure stable and adequate food supply. The definition of food security concerns not only the current economic and physical access to food by people at all time but also implies sustainable food supplies for future generations (FAO, 1983). In this aspect forest management and the tendency of continuous deforestation and degradation of forests in world scale directly influence sustainable livelihoods and food security. From 1980 to 1990, an estimated 146 million ha of natural forests in the tropics were cleared, with an additional loss of 65 million ha between 1990 and 1995 (FAO, 1997). The area of degraded forest is estimated to be even greater (WRI, 1999). Deforestation significantly increases the risk of erosion processes, the frequency and strength of floods, lowers the level of underground water, negatively modifies the microclimate and decreases the protection of agricultural areas against wind erosion (Naidenov, 2006). The massive floods in Europe in the spring and summer of 2005-2006, as well as the unusually strong hurricanes in North America and Asia in the last years prove the negative effect of forest destruction and degradation, as result of overexploitation, on the environment and agricultural production. It is important, however, to recognize that deforestation and forest degradation may also generate profits, from timber or other product sales, forest food products for consumption or crop and livestock production for subsistence or market. In assessing the implications of forest degradation, it should be considered how the value obtained compares with the costs incurred, taking into account the full implications for the global community, including non-human life forms (Lipper, 2000).

2. FORESTS AS A FACTOR FOR SUSTAINABLE LIVELIHOOD

Food security is a key element of livelihood. It is determined by a complex of social and economical, political and ecological factors. Sustainable livelihood depends on 5 main forms of capital: natural, physical, financial, human and social (Warner, 2000). Forests, as source of a variety of foods supplementing and complementing what the agricultural production, wood fuels and a wide range of traditional medicines and other hygiene products, are one of most important natural factors. It has been recently estimated that one quarter of the world's poor population depends directly or indirectly on forests for their livelihood (World Bank, 2000). The role of forests in reducing poverty and increasing food supply is expressed in three main sectors:

1. Agriculture and fish-farming

Forests create and maintain favorable conditions for development of agricultural crops by decreasing soil erosion, improving soil fertility and preserving the microclimate humidity. Trees roots penetrating deeply in the ground help the active interaction between soil and main rock thus ensuring viable for the plants nutrition elements. According Radkevich (1983) and Naidenov (1990, 2003) the forest shelter-belts are the most successful ecological experiment. Established for the first time by the great Russian scientist Dokuchaev in the stony steppes of Russia in XIX century to protect the agricultural crops from dry winds and to accumulate of snow cover, recently they are widely distributed all over the world and increase significantly agricultural production. In Bulgaria shelter-belts occupy about 2-3% of the arable lands ensuring 25-30% higher yields from cereal crops. Additionally, these forests provide fire wood and timber, help development of honey production ensuring pollen collection by bees, etc.

About 240 million livestock in the world are breaded with fodder from forests. In the near past sheep-breeding, goat-breeding and, to a great extent, cattle-breeding in Bulgaria depended strongly on leaf fodder yielded through so called "branch-cutting management" – a prototype of modern agro-forestry. It is proved that the alder leaves improve the fodder quality and increase the quality and quantity of milk. Taris (1959) noticed that poplar fodder improves the quality of sheep cheese.

Fishing and fish-farming are also closely related to forests. Forest lakes and rivers create excellent conditions for development of these activities especially in the mountain regions, which ensures additional incomes for the local population. Forest ecosystems regulate the level and volume of water flow, protect watershed areas, prevent erosion and have positive influence on water resources and the biodiversity in them even outside the afforested areas.

2. Economy

In the development of human civilization forests have crucial part helping people to survive and overcome natural disasters, political cataclysms and revolutions, economical crises and poverty. According FAO (1999) data the harvesting of timber and its processing accumulates incomes of approximately 13 billions USD. Timber industry ensures tens of millions jobs, especially in the rural regions where the unemployment is usually higher. Most of the timber enterprises are small-scale, low budget and their activity is combined with agriculture. In some regions of the world up to 90% of the forest workers are women collecting mushrooms, medical plants, fruits, seeds, fuel wood, etc. More than 3 000 million people rely on fuel wood or charcoal for heating and cooking (FAO, 1995). Non-wood products also present important resource of incomes and their significance for the modern society gradually increases. The existence of about 500 million people in the world depends on transformation, purchase and consumption of

non-wood forest products. In the region of Amazon River the harvesting of fruits and rubber ensures incomes 6 times bigger that the harvesting of timber and, in the same time, this is successful alternative of coca production in the poor regions of Colombia (Gonzalez, 2000). The exploitation of the natural resources is the biggest part of Canadian trade sector with annual value of about 32.6 billion USD and 300 municipalities rely mainly on incomes from forests. The annual incomes from recreation, excursions, nature observations and other activities related with forests annually present more than 11 billion USD.

In Bulgaria resin production from conifer plantations well developed in the near past, ensuring up to 1 000 working places and good incomes for the forestry sector.

3. Foods from forests

Forests are source of edible fruits, nuts, leaves, roots and root crops, mushrooms, juices with high nutrition quality. In periods of nature disasters or poor crop yields forests are irreplaceable food storage, ensuring the survival of people.

Game-breading and hunting as alternative food resource is also fully dependant on proper and sustainable forest management. The population in Nigeria, for example, provides 84% of the necessary protein from game consumption. Hunting tourism is one of the most profitable activities for many countries, Bulgaria inclusive.

3. RECENT CHALLENGES TO FORESTRY AS A FACTOR OF FOOD SECURITY

Social and economical development of society is a complicated process determined by many different factors and phenomena. In this aspect food security should be considered as multifunctional and interdisciplinary concept. The problem is in the focus of many governmental and non-governmental institutions and organizations but practical knowledge is still insufficient. The experience in Bulgaria shows that isolated decisions taken in one sector can influence negatively other economic spheres. Typical example from the last decades is the privatization of lands, which caused direct conflict among rural communities. The disorganization of agricultural cooperatives and enterprises as result of land ownership reformation led to sharp decrease of agricultural production for a period of 10-12 years.

In a world scale it is considered that the privatization of forest areas in the equatorial regions will decrease the role of forest ecosystems for food security and lower the economic stability by increasing the risk of poverty and hunger in these communities. This is especially important for the economy of rural regions, which are most vulnerable to nature forces. In seasons of poor crop yields due to unfavorable climatic conditions the

reliance on forest products to fill gaps and complement other sources of subsistence inputs and income is expected to increase, when other sources of income are not available. Small forest enterprises are also one of the best alternatives to ensure seasonal or additional incomes for the population in rural communities.

Forests are the most species-diverse terrestrial habitat on a global level. Their genetic resources provide raw materials for improvement of food and cash crops, livestock and medicinal products. Genetic diversity in crop and livestock species may have positive benefits to producers, particularly in marginal production zones as insurance against production risks (Brush and Meng, 1998). The uncontrolled economic development, however, can have negative effect on natural environment. The deforestation for establishment of new arable lands, pastures and industrial zones causes loss of biodiversity and genetic resources, as well as aggravation of ecological conditions. In deforested regions there is no source of fuel wood and timber, the quality of water lowers and some water resources can even disappear. In this way forest destruction can strongly affect the livelihood and health of local communities.

The improvement of food security by implementation of sustainable forest management and protection of nature resources requires multidisciplinary and complex approach, including all sectors and members of the society. Many scientific and practical methods in this field were developed, most effective seeming to be the different agro-forestry systems. Agro-forestry integrates forest ecosystems with agricultural food production, increasing the level of productivity and the efficiency of land use. The implementation of contemporary modern technologies in agro-forestry allows combining harvesting of timber and fuel wood with production of high quality crops and fodders, preserving in the same time the soil structure and fertility. The establishment of forest shelterbelts, for example, improves the microclimate of arable lands. Bigger forest complexes contribute to livelihoods by providing materials for construction, baskets, storage structures, agricultural implements, boats and hunting and fishing gear, from one side, and ensure inputs for farm systems such as fodder and mulch, contribute to soil nutrient cycling, help conserve soil and water and provide shelter and shade for crops and animals, from the other.

In regions with dense population and limited agricultural lands the cultivation of different crops (maize, peanuts, etc.) can be combined with plantations of fast growing, suitable for regular pruning trees at distances from 6x6m to 12x12m as source of biomass and pulp production, fuel wood, green fertilization, etc. In Bulgaria poplars in mixed crop and tree plantations are traditionally used in the regions of Danube and Thracian Plains and prove to be very effective. The total area of poplar plantations is approximately 20 0000 ha. Some forest plantations are specially constructed to create suitable environment for cultivation of medical pants. Recently

projects on combining low density stands of valuable forest tree species with animal husbandry are under experimentation.

The future role of natural forests in food security and sustainable livelihood depends on development of proper policy, legislation and strategy taking into consideration the high price of products and services that forests provide; the institutional liberty in relation to forest ownership and management; the conservation of biodiversity and genetic resources; the necessity of investments for development of small and middle scale forest enterprises, planting of artificial stands on degraded lands in order to reduce the pressure on natural forests and to improve soil properties; working on and establishing of suitable for the concrete conditions agro-forestry systems.

REFERENCES

1. Brush, S. & Meng, E. 1998. *The value of wheat genetic resources to farmers in Turkey.* In R.E. Evenson, D. Gollin & V. Santaniello, eds. Agricultural values of plant genetic resources, p. 97-116. Wallingford, UK, CABI Publishing.
2. FAO. 1983. *Report of the eighth session of the Committee on World Food Security*, Rome, 13-20 April 1983. CL 83/10. Rome.
3. FAO. 1995. *Forests, fuels and the future*. Forestry Topics Report No. 5. Rome.
4. FAO. 1997. *State of the World's Forests 1997*. Rome.
5. FAO. 1999. *Special: biodiversity for food and agriculture.* SD Dimensions.
6. González Posso, D. 2000. *Coca, deforestation and food security in the Colombian Amazon region.* Unasylva (202), vol. 51.
7. Lipper, L. 2000. *Forest degradation and food security.* Unasylva (202), vol. 51.
8. Naidenov, Ya. 1990. *Conservation and reproduction of natural environment.* Publ. House D. Tsenov, pp 190.
9. Naidenov, Ya. 2003. *Ecology and conservation of living environment.* Publ. House D. Tsenov, pp 150.
10. Radkevitch, V. 1983. *Ecology*. Minsk, pp.320.
11. Taris. 1959. *Peuphiers et Saules dans laproduction de bois*. Paris
12. World Bank. 2000. *World Bank reviews global forest strategy.* News Release No. 2000/193/S. http://wbln0018.worldbank.org/news/pressrelease.nsf
13. World Resources Institute (WRI), 1999. *World resources 1998-99 – A guide to the global environment.* Oxford, UK, Oxford University Press.

SCIENTIFIC SESSION III
MULTIFUNCTIONAL USE AND SUSTAINABLE MANAGEMENT OF FOREST RECOURSES

PLENARY LECTURE
CONROLING STRATEGY OF THE PATHOGENS IN FORESTRY NURSERY PRODUCTION

Snežana RAJKOVIĆ, Mara TABAKOVIĆ-TOŠIĆ,
Vesna GOLUBOVIĆ-ĆURGUZ[1]

Abstract: *The forest seedling material production faces the major problem of the investigators of plant diseases, most notably the phytopathogenic fungi whic causes the deseases of lodging of saplings. Their massive emergence is due to the fact that the production takes place in the open space where the sapling, during the period in which it is the most sensitive, is exposed to the numerous harmful abiotic factors, that are favourable to the development of pathogen, such as: Fusarium spp., Botrytis spp., Rhizoctonia spp. and Penicillium spp.*

The appropriate protection of saplings in the hothouses in the open space can be performed by applying the certain types of fungicides, specific effect of which is determined by the presence of the active substance.

Active ingradient which have fungicide effect and fall into the group of benomyl, ditiocarbamates, strbylirines, and triazol have the stisfactory results in the preliminary experimental investigations of the efficacy of the fungicides belonging to the aforementioned groups. Nevertheless, the current legal regulation forbids the circulation of pesticides which are not permitted to be used for elimination of certain pathogens on certain host plant. Theredore, if the preparation has not been registered for the use on the forest plant species, it cannot be used for protection. Due to the fact, there is a problem in Serbia as the producers of pesticides are not willing to register their products in forestry, since there is a small market demand for them.

[1] Snežana Rajković, Ph.D., Mara Tabaković-Tošić, Ph.D., Vesna Golubović-Ćurguz, M.Sc., Institute of Forestry, Belgrade
Translation: Marija Stojanović

The strategy that we suggest refers to the selection of active substances and preparations which can be used in the forest hothouses. We also recomended the producers and beneficial owners of pesticides to investigate the effect of their products, in order to reister them in the category of small crops, in which the forest hothouses belong.

In this way, with the respect of the legislation, the control of pathogens which cause the loding of saplings can be well-performed.

Key words: strategy, fungicides, pathogen causing lodging of saplings

INTRODUCTION

Diseases are important limiting factors in the production of forest seedlings within nurseries. Environmental conditions within nurseries are often ideal for the proliferation of disease-causing pathogens. Seedlings are usually grown in extensive monocultural systems either outdoors within fields (bare root) or within greenhouses (container). High moisture and nutrients supplied to nursery seedlings often promote proliferation of important pathogens.

The organisms inducing nursery diseases are unlike those that cause diseases of trees within forests. They are similar or the same as those pathogens that cause diseases of agricultural crops. Pathogens associated with nursery-grown seedlings are usually not problems once seedlings are planted in forest areas. Management procedures to reduce impact of diseases within forest nurseries are similar to those used to control agricultural pests. Therefore, many of the chemical and non-chemical control methods used in forest nurseries have been adopted from agricultural system that have similar pathogens.

OVERVIEW OF FOOREST NURSERY DISEASES CONTROL

I CULTURAL: diseases prevention is the main objective of cultural management of nursery diseases. Reduce inoculum in growing areas and avoid conditions which promote disease spread. Sanitary practices including greenhouse, containers, and seed.

II BIOLOGICAL: some commercially-available biocontrol materials have shown some promising results.

III CHEMICAL: use as a last resort. Fungicides often are specific to a particular group of fungi, as ase the application methods so a proper diagnosis is very important.

MAJOR DISEASES IN NURSERIES:
Fusarium spp. – seeed rot, damping off, rood diseases, stem blight

Phytopthora spp. – root disease
Pythium spp. – root disease
Botrytis cinerea – foiar blight, storage mold
Cylindrocarpon destructans – root decay

Damping-off is the disease term used for fungal-caused mortality during those first critical few weeks from germination to just after seedling emergence. The soil-inhabiting fungi associated with damping-off are capable of causing rapid decay and mortality of seeds and germlings. These fungi are not host-specific. Disease and hosts Many species of fungi, often common soil saprophytes, are associated with damping-off and root rot. They become pathogenic when temperature, moisture, soil pH, and other conditions become favorable. In forest nurseries, *Pythium* and *Fusarium* species are the most common damping-off fungi. Others are *Rhizoctonia solani*, *Macrophomina phaseoli*, *Botrytis cinerea*, and *Phoma*, *Alternaria*, and *Phytophthora* species. In general, *Pythium* species cause problems early in the season when soils are cool and wet, while *Fusarium* species cause problems later when soils are warmer and moist to semi-dry. Exceptions occur, however, and any of these fungi can and do cause disease at any time during the growing season. Damping-off fungi occur naturally in nearly all crop and forest soils. They are found worldwide in tem-perate and tropical zones alike. No conifer or hardwood is known to be resistant to damping-off. Those species or seedlots that germinate quickly and grow fast may sustain less damage from damping-off than slow-emerging, slow-growing species. Still, it is safe to assume that all nursery-grown tree species are susceptible to damping-off fungi. Symptoms Damping-off is defined as the fungal invasion of the succulent tissue of germinants or seedlings that leads to decay and early death. Damping-off attacks seedlings both before emergence (preemergence damping-off) and after (postemer-gence damping-off) and, depending on conditions, usually occurs within 30 to 45 days after sowing. The only evidence of preemer-gence damping-off in nursery beds is that the germinating seedlings are sparse and patchy. This phase is difficult to detect, but may some-times be diagnosed by digging up seeds that have not emerged and checking to see whether seeds or germinants are decayed or withered. Postemergence damping-off, which occurs in the cotyledon stage, causes seedlings to wither and collapse. When the succulent root-collar tissue or the roots are penetrated by the pathogen, the disease is referred to as soil-infection damping-off. When the fungal invasion occurs higher on the stem or cotyledons, it is called top-infection damping-off. The most obvious indicator of postemergence damping-off is the collapse of the seedling. It may be possible to tentatively identify, at least to genus, the fungus respon-sible. Stem tissues of seedlings infected by *Pythium* sometimes separate around the root collar, with the epidermis sloughing away from the inner xylem tissue as an open shirt collar falls away from the neck of the wearer. The trees then fall over. Seedlings infected by *Fusarium* undergo a softening of the root-collar tissue, and the trees fall over at the point of softening

without separation of the stem tissues. Seedlings with suspected *Fusarium* infection may be incubated over-night at room temperature in a moistened paper bag to produce a bloom of sickle-shaped macroconidia that can be easily identified under a microscope. In broadcast-sown beds, which are uncommon in Pacific Northwest nurseries, seedlings may die in irregular bull's-eye patches, with the centers containing mostly fallen trees and the borders containing trees with early symptoms. In drill-seeded beds, the mortality pattern usually runs along the rows for a distance, then abruptly stops.

Adjoining rows may be affected, showing a patchy effect. It is not unusual for forest pathologists to isolate one or more species of damping-off fungi from apparently healthy seedlings within the first few weeks of germination. The fungi may be found either on root surfaces or within internal tissues and may have come from infested seed or surrounding soil. These symptomless seedlings usually remain healthy as long as moisture stress is low and other growing conditions are optimum. Fungus biology Damping-off fungi are inhabitants of the soil. They can be spread by movement of soil on equipment or seedlings, by cultivation, or by water.

Infection occurs when seedling roots grow next to fungal inoculum, such as chlamydospores, sclerotia, or oospores. These structures then germinate and hyphae invade the seedling cells. Fungal invasion causes collapse and disintegration of cells and death of the seedling. The fungus may continue to develop in and utilize the killed tissue, often producing secondary inoculum, such as conidia, on the surface of the dead seedling. Mycelium, spores, or Damping-off may be confused with: Cutworm damage, Frost heaving, Fusarium hypocotyl rot, Heat damage Seedcorn maggot damage, other structures survive and over-winter in seedling tissue or other organic material in the soil. Viability of overwintering inoculum is dependent on a number of factors, including soil moisture and temperature. Loss potential Damping-off fungi can cause significant losses in forest nurseries. Losses may be large one year and minor the next. Mortality from preemergence damping-off can be estimated by calculating the difference between the number of seedlings and the number of seeds sown, after other factors, such as percent germination or bird depradation, are accounted for.

Postemergence damping-off is best determined by marking small plots and counting mortality every few days. Individuales can be marked with toothpicks monitor whether the disease is increasing, subsiding, or responding o treatment. Losses from preemer- gence damping-off often range from l5 to 40 percent of sown seed, while postemergence losses may be an additional 10 to 20 percent. Growers typically oversow to ensure a satisfactory crop. Damage may be heavy in seedling beds that previously contained transplants or other agricultural crops. In fact, new nursery sites developed from cleared forest soils tend to have fewer damping-off problems than those established on previous agricultural croplands. In

addition to the direct losses of bed stock, indirect losses may be reckoned in shortages of healthy seedlings for outplanting on forest sites.

MANAGEMENT

The best defense against diseases in forest nurseies are an effective and con-scientious disease prevention program because pathogens can spread very quckly and cause extensive damage in relatively short time periods within nurseries. This includes knowledge of soilborne disease populations, a well-orchestrated pesticide program, and careful attention to environ- mental conditions in the nursery. The nursery environment is the strongest influence on the proliferation of damping-off fungi. Soil moisture, timing and amount of irrigation, air and soil temperatures, method and timing of sowing, depth of soil over seed, soil pH, combinations of soil fungi and nematodes, timing and type of nutrients applied, type of organic matter, type of cover crop, history and pattern of pesticide use, and many other factors affect the incidence and severity of damping-off. It is to the grower's advantage to bring the entire crop through its initial growth stages rapidly and evenly in order to narrow the damp- ing-off infection "window." No single factor alone governs control of the disease, but good management will take the following factors into ac-count:

Once diseases symptoms appear, pathogen infection has usually been extensive and therapeutic treatments are often non effective. Therefore, successful management of nursery diseases often involves reducing inoculum of potential pathogens in seedling production areas. Another major approach is to promote conditions which are non-conductive for pathogen infection are spread. Treating with chemical pesticides is often the last desirable and often last-implemented management approach, although sometimes this is the only way to prevent extensive losses.

Successful management of nursery diseases often involves reducing pathogen inoculum in seedling production areas.

SOIL MOISTURE AND DRAINAGE

Ideally, nurseries should be located on light, well-drained soils. Wet soil generally favors damping- off. Depth of irrigation is critical to young seedlings, especially during hot weather. It is important to irrigate deeply enough for water to reach seedling roots—a depth that increases steadily as the roots grow—but not so much that the soil is saturated. Too-shallow watering stresses tender roots in moisture- deficient lower soil layers, while creating a warm, wet upper soil layer that favors the buildup of damping-off fungi. Soil moisture and rooting depth should be monitored regularly during the growing season. Cool weather that prolongs germination, or hot weather that speeds it up, require particular attention to watering.

TIMING OF SOWINGS

Sowing when temperatures are warm enough to promote rapid, even germination tends to reduce problems with damping-off. Warm-weather sowing requires constant diligence in controlling irrigation.

SOIL pH

Damping-off fungi thrive in neutral to alkaline soils. A soil pH of between 5.2 and 5.7 (moderately acid) not only helps prevent damp- ing-off problems but is ideal for growing Pacific Northwest conifer species. Aluminum sulfate drenches, sulfur (200 to 500 pounds/acre), and acid peat applications can be used to maintain the acid condition of the soil. When aluminum sulfate is used, beds should be kept moist to prevent burning of the roots. Irrigation water that is even slightly alkaline can, over a period of years, decrease soil acidity. The change usually occurs slowly because of the tremendous buffering ability of the soil. It can be reversed by acidifying the water with either sulfuric or phosphoric acid. The acidification process can be speeded up by adding sulfur to the soil and then maintaining the pH with acidi-fied water.

SOIL MICROFLORA

No two nurseries are alike in their makeup of soil organisms. Each has its own combination of soil microflora, consisting of bacteria, fungi, nematodes, and insects, and each combination influences the population of pathogenic fungi in the soil, the amount of infections, and the expression of disease symptoms. Growers should learn the soil microflora "personality" of their nurseries.

NUTRITION

Nitrogen applications made too early promote damping-off. Germi- nating seed and new germlings do not need much supplemental nutrition; the endosperm contains sufficient food to get seedlings well on their way.

MULCHES AND COVER CROPS

Cover crops grown and turned under just prior to sowing conifers may, depending on their type, retard or encourage damping-off problems. Legume cover crops promote large populations of damping-off fungi, grass crops somewhat smaller populations. Bare fallowing discourages the buildup of potential pathogenic fungi in the soil.

ASSAYS FOR SOILBORNE DISEASES

Assays for soilborne pathogens measure populations of particular fungi in the soil. Soil assays have been developed for Pythium, Fusarium, Macrophomina, and Phyto- phthora species (see the passage on monitoring of fungi in Chapter 33, Principles of Integrated Pest Man- agement). Although population levels of these fungi indicate potential risk and the severity of disease in future crops, they are not reliable predictors of crop loss. The grower should use the assay as a warning signal to give an indication of potential problems and to help determine disease prevention measures, such as fumigation.

NURSERY DISEASE MANAGEMENT

Diseases in forest nurseies are best prevented because pathogens can spread very quckly and cause extensive damage in relatively short time periods within nurseries. Once diseases symptoms appear, pathogen infection has usually been extensive and therapeutic treatments are often non effective. Therefore, successful management of nursery diseases often involves reducing inoculum of potential pathogens in seedling production areas. Another major approach is to promote conditions which are non-conductive for pathogen infection are spread. Treating with chemical pesticides is often the last desirable and often last-implemented management approach, although sometimes this is the only way to prevent extensive losses.

Successful management of nursery diseases often involves reducing pathogen inoculum in seedling production areas.

I CULTURAL CONTROL

Continual monitoring of the seedling crop is important so that the first indications of disease can be determinated and so that control efforts can be initiated promptly to reduce chance for pathogen spread.

Sanitation is an important aspects of managing diseases in forest nurseries. Many of the most important pathogens can reside saprophytically on many types of organic matter that may be present within seedling-growing aress. Removal of organcic matter within greenhouse that may harbor pathogens is very imortant in reducing disease losses. Greenhouse interios and reused styrofoam or plastic containers should be sterillized between crops to preclude carryover of pathogens onto new seedlings crops. Seedlings with disease symptoms should be periodically removed from both bare root and container stock to reduce chance for secondary spread of pathogens.

It is very important that pathogen-free seed be used to produce seedlings within nurseries. Some seedlots may require chemical treatments if

high levels of pathogens are present; all seedlots should be rotinely treated with running-water rines to help reduce pathogen surface contamination of seedcoats.

Controling timing and amount of irrigation is very important in reducing losses from some diseases such as those caused by Cylindrocarpon Pythium, and Phytopthora spp. It is especially important that container-grown seedlings are not over-irrigated; persistently high levels of water in containers promote anaerobic development of pathogens which often results in extensive root decay. Irrigation should be applied only in the morning to alow foliage to dry quickly during the day to help control Botrytis blight.

Air ciculation within greenhouse is important so that seedling foliage can rapidly dry after irrigation to help reduce losses from Botrytis and Fusarium spp., both of which may attack above-round tissues.

Another way to reduce disease losses is by restricting fertilizer during certain parts of the growth cycle. For example, nitorogen should not be applied to young, succulent sedlings when they are particulary susceptible to damping –off.

Diseases of bare root seedlings can be reduced by bare fallowing fields for one or more years between seedling crops. If cover or green manure crops are growen between seedling crops, fields must either be subsequently fallowed or fumigated prior to sowing new seedling crops because most pathogen populations increase on organic matter produced by cover crops. Rotating different seedling species among fields also helps reduce pathogen buildup within soils.

When seedlings are lfted from either production fields or containers, they must be carefully examined for indications of disease. All seedlings with disease symptoms should be culled during the packing process.

II BIOLOGICAL CONTROL

Some commercially- available biocontrol formulations – biofungicides developed for other agricultural crops show promise in forest nurseries. These are made up of either fungi or bacteria that are antagonistic towards pathogens. Bocontrol formulations are usually applied early in the growing cycle. They are either incorporated into soil-less growing media, which is made up of mixtures of peat moss with other organic or non-organic materials,or they can be applied directly adjacent to seed during sowing. Some biocontrol agents are applied to directly to seed prior to sowing.

Some ectomycorrhizae are also antagonistic toward pathogens. Commercially-available mycorrhizal preparations are available and can be applied several times during the seedling growing cycle.

Biological control formulations provide an environmetaly-friendly alternative to chemical pesticides for control of some nursery pathogens.

The use of biological control agents (living microorganisms used to control pests) is gaining recognition as an alternative disease control. There

is effective use of bacteria, actinomycetes, and fungi as agents for biological control of soil-borne plant disease.

Actinomycetes are bacteria with fungus-like growth characteristics. Several isolates of the actinomycete Streptomyces have proved effective as biological control agents against soil-borne plant pathogens. A commercial product, Mycostop.RTM. biofungicide, contains an isolate of S. griseoviridis as its active ingredient. That product is effective as a seed and soil treatment against seed rots, root and stem rots, and wilt diseases of various ornamental plants, caused by Fusarium spp. and other fungi. (Lahdenpera, et al. (1991). The Mycostop.RTM. Biofungicide Directions for Use (Kemira Biotech, Helsinki, Finland) recommends Mycostop.RTM. for use on pine and other conifers.

Another Streptomyces sp. isolate, is effective as a seed treatment against damping-off caused by Pythium spp. That patent also described some inhibitory activity against Fusarium spp. growing in agar-solidified growth media in petri plates.

Various fungi have been utilized as biological control agents to control fungal plant pathogens. Several isolates of Trichoderma spp. have also been employed to control soil-borne diseases, including Fusarium spp. on cotton.

Mycorrhizae are fungi which infect and form mutualistic relationships with plant roots. These fungi can improve plant growth by increasing the plant's assimilation of nutrients, especially phosphorus, which are sparingly soluble in the soil. Mycorrhizal infection will often make the plant roots more resistant to various soil-borne fungal pathogens. There are two major types of mycorrhizae: vesicular-arbuscular (VA) mycorrhizae, which infect most cultivated plants and produce specialized structures (vesicles or arbuscules) in the root cells, and ectomycorrhizae, which infect many forest trees such as pines and other conifers. Compositions and methods have been developed to help efforts to artificially inoculate plants with mycorrhizae (Castellano, 1994).

Ectomycorrhizal fungi are generally capable of infecting many species of plants. The ectomycorrhizal fungus which has been the most extensively investigated, Pitholithus sp., has been used to infect several species of the following woody plants: pine (Pinus), oak (Quercus), acacia (Acacia), and eucalyptus (Eucalyptus). Thus, ectomycorrhizal fungi can be generally considered to be somewhat nonspecific in the plants they infect.

Both VA mycorrhizae and ectomycorrhizae have been utilized as biological control agents, with limited success (Linderman,1994).

Ectomycorrhizae have shown some promise in controlling soil-borne diseases on conifer seedlings, but the protection to date has been unreliable due to the extreme variability of results. For example, Laccaria spp. exhibited limited control against Fusarium root rot and damping off on Douglas fir (Strobel and W.A.Sinclair ,1991), and pine (Chakravarty and S. F. Hwang, 1991), and Paxillus involutus increased resistance of pine

seedlings by 47% to Fusarium root diseases (Duchesne, et al. ,1988). Because of the limited and conditional control exhibited in these studies, the authors have expressed pessimism that they could be used effectively without further extensive research.

The present invention addresses a long felt need to provide an alternative to chemical control methods by utilizing a strategy employing novel ectomycorrhizae and Streptomyces isolates alone and in combination to effectively control conifer seedling diseases caused by Fusarium.

III CHEMICAL PESTICIDES

Chemical pesticides are usually applied as a last resort. In order to use the right chemicals, it is important to properly diagnose pathogens prior to treatments. Certain chemicals are only effective against certain groups of pathogens. For example, metalaxyl only controls oomycete pathogens (Pythium, Phytophthora) and is not effective against other pathogens such as Fusarium. Chemicals should be applied according to label instructions for timing and dosage rates.

It is best to rotate pesticides in order to reduce chances for pathogens to develop resistance. Selected pesticies should have different modes of action to limit chances for genetic mutations of pathogens.

Most pesticides are not effective therapeutically, they help prevent pathogen infection and colonization rather that kill pathogens that are alredy colonizing hosts. Pesticide applications just prior to lifting may be important to preclude fungal development during cold storage.

Chemical pestcides should only be used if other ways to control diseases are ineffective.

1. SOIL FUMIGATION

Fumigating soil prior to sowing is a common practice in nurseries. Several different materials have been used successfully, including dazomet, methylisothiocyanate/1,3-dichloropropene, and mixtures of methyl bromide and chloropicrin. Fumigation decreases Fusarium and Pythium populations sometimes to near zero. Methyl bromide with 33 percent chloropicrin will hold these pathogens in check for most of the first growing season. Follow-up disease control is done as needed with a carefully prescribed fungicide application plan.

Methyl bromide-chloropicrin soil fumigation may not be allowed after the year 2000 because its use is viewed as an environmental hazard (Smith and S. W. Fraedrich, 1993). Thus, alternatives are needed for controlling Fusarium diseases in tree.

2. FUNGICIDES

Treatment of seed with fungicides is not recommended. In previous years seed treatment was customary, but fungicides applied to the seed coat offer little or no protection to the emerging seedling. In addition, some seed treatments are phytotoxic. Although the effectiveness of fungicides to control damping-off is highly variable, many growers use them. Several fungicides are registered for use in forest nurseries to control soilborne diseases. Certain fungicides or combinations of fungicides seem to work better in one nursery than another. The fungicide metalaxyl has systemic properties and may be used prior to sowing to reduce populations of Pythium and Phytophthora in the soil. Metalaxyl is available in granular and liquid formulations. The first post-plant fungicide application should be made when most seedlings have emerged and the seeds begin to drop from cotyledon leaves. A good all-purpose preventive treatment for damping-off is a 50-50 mixture of captan and benomyl applied as a drench at rates recommended on the label. If frequent applications are planned, alternation of the captan-benomyl mix with other fungicides is advised to minimize the buildup of resistant pathogens.

With a 10-fold increase in seedling production occurring in the last few years, interest in the production and planting of longleaf pine (*Pinus palustris* Mill.) seedlings has reached an all time high. A limitation in producing even more seedlings is lack of high-quality seeds that not only germinate well, but result in plantable stock. Earlier results have shown that longleaf seed coats carry pathogenic fungi that not only reduce germination, but also result in significant seedling mortality (Barnett and others 1999). Pawuk (1978) and Fraedrich and Dwinell (1996) found that *Fusarium* sp. are commonly found on longleaf pine seeds and cause longleaf seedling mortality. Tests have shown that treating longleaf seeds with a sterilant or fungicide prior to sowing can improve both germination and seedling establishment (Barnett 1976, Barnett and Pesacreta 1993, Littke and others 1997). However, the effects of using both seed pretreatments to control seed-coat pathogens and fungicides to minimize seedling losses during the cultural period have not been reported. Our objectives were to develop recommendations for presowing treatments and fungicidal applications that will improve the efficiency of seedling production.

Results from this study demonstrate the effectiveness of reducing fungal populations on longleaf pine seed coats before they are sown in containers. Elimination of pathogenic fungi from seed coats increases seedling establishment and reduces sources of disease infestation later in the nursery cultural period. Although 30-percent hydrogen peroxide is labeled as a stimulant of pine seed germination, earlier research has shown that a 10-minute Benlate® seed drench was equally effective and is a safer means of reducing seed coat pathogens (Barnett and others 1999). Other fungicidal

chemicals or methodologies also may be effective if they are not phytotoxic to seed germination.

Combing presowing seed treatments to reduce pathogenic fungi on the seed coats with the application of appropriate fungicides to seedlings during the growing season to control pathogenic fungi greatly increases the efficiency of container seedling production.

REFERENCES

1. Boyce, J.S. 1961. Forest pathology.3d ed. New York: McGraw-Hill.572 p.
2. Phillips, D.H.; Burdekin, D.A. 1982.Diseases of forest and ornamental trees. London: McMillan. 435 p.
3. Sutherland, J.R.; Shrimpton, G.M.;Sturrock, R.N. 1989. Diseases and insects in British Columbia forest seedling nurseries. FRDA Report, ISSN 0835-0752; 065. 85 p.
4. M-L. Lahdenpera, et al. (1991), *"Mycostop--A novel biofungicide based on Streptomyces bacteria"*, pp.258-263 in Biotic Interactions and Soil-Borne Diseases, A. B. R. Beemster, et al., eds., Elsevier, Amsterdam.
5. M. A. Castellano (1994), *"Current status of outplanting studies using ectomycorrhizae-inoculated forest trees"*, pp. 261-281 in Mycorrhizae and Plant Health, F. L. Pfleger.
6. R. G. Linderman, eds., APS Press, St. Paul. R. G. Linderman (1994), *"Role of VAM fungi in biocontrol"*, pp. 1-25 Id., and L. C. Duchesne, "Role of ectomycorrhizal fungi in biocontrol", pp. 27-45 Id.
7. N. E. Strobel and W. A. Sinclair (1991), "Influence of temperature and pathogen aggressiveness on biological control of fusarium root rot by Laccaria bicolor in douglas-fir", Phytopathol. 81:415-420).
8. P. Chakravarty and S. F. Hwang (1991), "Effect of an ectomycorrhizal fungus, Laccaria laccata, on Fusarium damping-off in Pinus banksiana seedlings", Eur. J. For. Path. 21:97-106.
9. L. C. Duchesne, et al. (1988), "Interaction between the ectomycorrhizal fungus Paxillus involutus and Pinus resinosa induces resistance to Fusarium oxysporum", Can. J. Bot. 66:558-562.
10. R. S. Smith and S. W. Fraedrich (1993), "Back to the future--pest management without methyl bromide", Tree Planters' Notes 44:87-90.