DE GRUYTER OPEN
Economics and Business
doi: 10.1515/eb-2016-0013
2016 / 28

Management Modelling for Forest Landscapes

Elena Dragozova-Ivanova [1], Ivan Paligorov [2], Ivaylo Ivanov [3], Stanislava Kovacheva [4]
[1–4] *University of Forestry*

***Abstract* – The article presents alternatives for sustainable management of forest landscapes based on the analysis of Teteven area in Bulgaria. The conclusions are a result of research of 21 main factors, which are identified and evaluated with varying weight by experts and classified in five groups: environmental, social, economic, technological and political. In order to identify the most important and key factors, a structural analysis is applied. The alternatives are summarised in four scenarios called *No Management*, *Ecological and Close to the Nature*, *Traditional Management* and *Maximum Potential Benefit*.**

***Keywords* – Forest landscapes, INTEGRAL project, management modelling.**

I. Introduction

According to the European Landscape Convention, the landscape is an area, whose character is the result of the action and interaction of natural and/or human factors (European Landscape Convention, 2000). The forest landscape is an area, whose territory is covered mainly by forest. The forest landscapes have a vital environmental and socio-economic role for development of countries, regions and areas, which is well documented and acknowledged in the policies of both the European Union and its member states (Act for Restitution of Property of the Forest and the Lands in Forests, 1997; Forestry Act, 1997; Regulations for the Implementation of the Forest Act, 1998; Regulation on Income Statement and the Order in which They Are Established and Implemented and Reported in the National Fund *Bulgarian Forest*, 1998). Nevertheless, there are critical incoherencies among national and local forest-related land-use policies. The relevance of the topic is determined by discrepancies between the policies and their implementation at the landscape level.

The forest landscapes are not carefully studied. The positive and unfavourable visual effects of the forest landscapes are the topic of research by Galev (2011). Most studies are oriented to the forest. Yovkov is focused on the production function of forest (Yovkov *et al.*, 2009; Yovkov *et al.*, 2010) and the forest policy in Bulgaria (Yovkov *et al.*, 2001). Georgieva (2005) studies the selection forest and suggests a method of economic assessment. Kolev (2008) researches the conflicts in forest. Alexova (2006) is focused on the assessment of the water-preserving functions of forests. The timber market in Bulgaria is presented in several studies (Paligorov *et al.*, 2002a; Paligorov *et al.*, 2002b; Paligorov *et al.*, 2004). Paligorov *et al.* (2001) study the financial problems of the forest enterprises. Velushev (2011) presents the public goods received from forests.

The aim of research is to present stakeholders the alternative scenarios for development of forest landscapes.

The object of research is Teteven municipality, Bulgaria, a typical area where the different interests of stakeholders (forest owners, entrepreneurs, stewards, environmentalists and citizens) are meeting.

The tasks of research are to describe a set of main factors; classify these factors by the level of influence and by essence; identify most important factors by structural analysis; process the data set by Parmenides EIDOS™ and define scenarios for development of forest landscapes in Teteven area.

The article presents interim results obtained by the INTEGRAL project whose goal is bringing the landscape dimension closer to Europe by providing demand-driven information for the decision makers in Europe about the challenges in forest management in 20 regions throughout Europe.

II. Methodology of Research

The methodology of research is presented in Fig. 1. The workflow corresponds the tasks of the research described in Introduction.

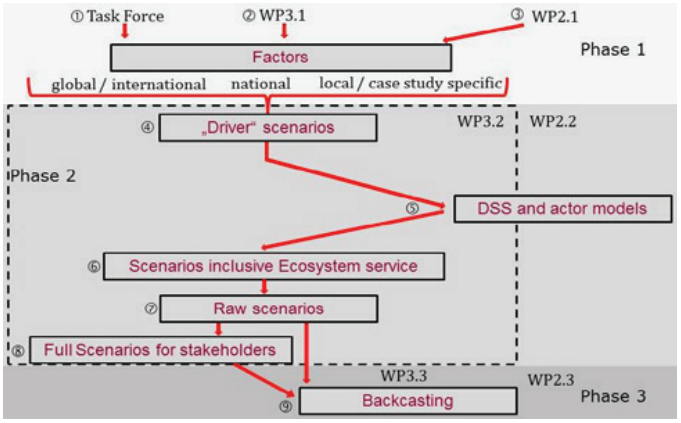


Fig. 1. The general workflow of the INTEGRAL project (Phase 2).

The first step is the description of a set of factors, which are identified by interviews of the stakeholders in Teteven area. Twenty-one factors are pointed out as main for sustainable development of the forest landscapes by the groups of "environmentalists", "entrepreneurs", "stewards", "owners" and "citizens" in Phase 1 of the project.

The second step is classification of the factors by the level of influence and by essence. The three levels of influence are defined. The macro level covers the state. The meso level covers Lovech district. The micro level is a local and covers Teteven municipality (see Table I). The five groups of essence are defined, which are social, technological, economic, ecological and political factors.

The next step is identification of the most important factors by stakeholders. The assessment is made through a matrix, in which each factor is given ranks. The ranks show, first, how the given factor influences the other factors and, second, how the given factor is influenced by the other factors.

©2016 Elena Dragozova-Ivanova, Ivan Paligorov, Ivaylo Ivanov, Stanislava Kovacheva. This is an open access article licensed under the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), in the manner agreed with De Gruyter Open.

TABLE I

THE CODES BY THE NUTS CLASSIFICATION RELATED TO TETEVEN MUNICIPALITY

Level	Codes	Description
NUTS 0	BG	Bulgaria
NUTS 1	BG3	North and South-East Bulgaria
NUTS 2	BG31	North-West Statistical Region
NUTS 3	BG315	Lovech District
LAU 1	LOV33	Teteven Municipality

The processing of data set is the fourth step. It is made by Parmenides EIDOS™. The software calculates and defines the factors as active, passive, critical and buffering. The key factors are pointed out by experts. They are used for the cluster analysis in the next step.

The fifth step is a cluster analysis and defines the driving scenarios, whose usefulness and applicability in the management are described by Pillkahn (2008).

III. Results and Discussion

Once Phase 1 of the project has formulated a set of 21 main factors influencing forest areas, the task is to find the exact description of these factors and their possible directions of influence. The factors are *public opinion*, *population aging*, *forestry paradigms*, *environmental paradigms*, *timber market*, *bioenergy market*, *climate change*, *internal political struggles*, *environmental policy*, *forest management planning*, *depopulation in rural areas*, *demand for non-wood products*, *harvesting technology*, *bioenergy technologies*, *timber processing industry*, *protected species*, *ownership structure – state*, *high level of bureaucracy*, *availability of financial sources*, *state of forests*, *ownership structure – non-state*.

The main factors are classified in five groups (*society*, *technology*, *economy*, *ecology* and *politics*) by the level of analysis. The factors are presented in a STEEP-table and a corresponding glossary, which indicates the level of influence of the individual factors and the description of each factor by using data of different empirical scientific sources (Fig. 2).

No.	Level	Title	Definition	Empirical information on present situation	Why relevant?	Comments
ECO1	macro, meso	Timber Market	Trends in timber demand-supply and prices	The trade intensity of almost all forest-based products increased in the last two decades with Europe having the highest share of production traded internationally. Sale of timber is the most important source of income in the forestry sector in Bulgaria. It provides approximately 90 % of income and revenues in forestry economy.	It influences economic performance of State enterprise Forests, communal, municipal or private owners as well as wood processing	W.P.3.1,See 2.3, 2.4, 4.1

Fig. 2. Example of glossary of key factors.

In order to identify the most important (key) factors, a structural analysis according to Glenn/Gordon (2009, ch. 11) is applied. The basic idea is to assess the relative effects of the factors under study, i.e. for every factor it is evaluated how strongly it influences the other factors included in the analysis and how strongly it is affected by the other factors. The aim of the structural analysis is to find out which factors act strongly on the system under study and which factors are acted upon strongly. The basic idea is to focus on those factors that have a high active value, i.e. have a strong impact on other important factors and, at the same time, can somehow be controlled – ideally by the addresses of the scenarios because that would make them relevant.

The assessment is made by using the matrix showing the influence between factors (Fig. 3). The sums of the lines and columns can be considered a measure for the degree of networked interrelationships. While the "line sum" of any factor represents the so-called "Active Sum" (AS) and indicates how strongly that factor affects other factors, the "Column Sum" of a factor represents the so-called "Passive Sum" (PS), which shows how strongly that factor is influenced by other factors. In this way, every factor has been evaluated according to the relationship between its Active and Passive Sum.

from, to	SOC1	SOC2	SOC3	SOC4	SOC5	SOC6	TEC1	TEC2	TEC3	ECO1	ECO2	ECO3	ECO4	ECL1	ECL2	ECL3	POL1	POL2	POL3	POL4	POL5
SOC1	X	2	2	3	1	1	2	1	3	2	2	2	1	2	1	2	3	2	2	1	2
SOC3	2	1	X	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	1
SOC4	2	1	2	X	2	1	2	2	2	2	2	1	1	3	2	2	1	3	2	2	1
SOC5	2	2	2	2	X	1	1	1	1	1	1	2	1	1	1	2	2	1	1	2	1
SOC6	1	1	1	2	1	X	1	1	2	1	1	1	2	1	2	2	1	2	1	1	1
TEC1	2	1	2	3	1	1	X	2	2	2	1	3	2	2	1	2	1	2	3	2	2
TEC2	1	1	2	2	2	1	2	X	2	2	2	2	2	1	2	1	2	2	1	1	2
TEC3	2	1	2	2	2	2	2	2	X	2	2	2	3	1	2	2	2	2	2	3	2
ECO1	2	1	2	2	1	1	3	2	2	X	2	3	3	2	1	3	3	2	2	2	3
ECO2	2	0	2	2	1	2	2	3	2	3	X	2	2	2	1	2	2	2	3	2	2
ECO3	2	1	2	2	1	1	3	2	1	2	2	X	3	2	1	2	3	2	2	2	2
ECO4	2	1	2	2	1	2	2	2	2	3	2	3	X	1	1	2	2	2	2	2	2
ECL1	2	0	2	2	1	2	2	2	1	2	3	2	1	X	2	2	1	2	2	2	2
ECL2	2	0	2	2	1	2	2	1	1	1	1	1	1	1	X	2	1	2	2	2	1
ECL3	3	1	2	2	2	2	3	2	1	3	2	3	2	2	2	X	3	3	2	3	2
POL1	3	2	2	2	2	1	2	2	3	3	2	2	2	1	1	2	X	2	2	2	2
POL2	2	0	2	2	1	2	3	2	2	2	2	2	2	3	3	2	2	X	2	1	1
POL3	2	0	2	2	1	2	2	2	2	3	2	3	3	2	2	3	2	2	X	2	2
POL4	1	1	2	2	1	2	3	2	2	2	1	2	2	2	1	2	3	2	3	X	2
POL5	2	1	1	2	1	2	2	1	2	2	1	1	2	1	1	2	2	2	2	2	X

Fig. 3. Matrix of the influence between the factors of Teteven area.

The factors can be displayed in coordinate axes using the individual active- and passive sums as their x- and y-coordinates. The resulting distribution shows at a glance how strongly each factors acts on all other factors involved and how strongly it is affected by the others. Using the structural analysis data for the direction of influence and weighting to each factor the data are given for:

- active (influential) factors,
- passive (reactive, depending or result) factors;
- critical (dynamic or relay) factors;
- buffering (excluded or lazy factors).

The results are presented in the Active-Passive Map generated by using Parmenides EIDOS software (Fig. 4).

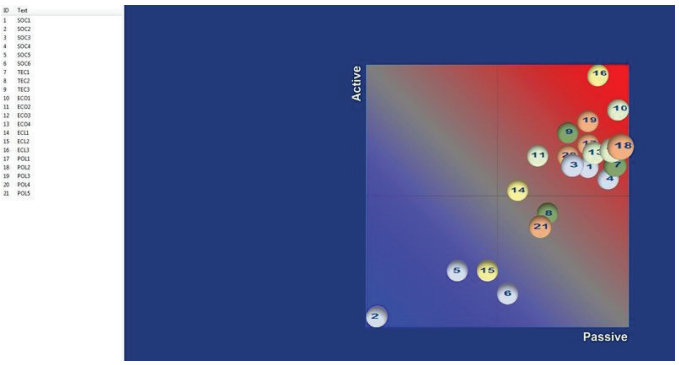


Fig. 4. Active-Passive Map of Teteven area.

The factors have different positions within the Active-Passive Map. More than half of them are located in the area of highest

impact and closest links (upper right corner). The results confirm the opinion of experts and foresters about the impact force as a direct link to the individual factors. The highly dynamic factors, influential factors, buffer factors and passive factors are defined in several aspects.

Most dynamic factors are in the upper right corner and express the strongest influence. These factors are: *state of forest*, *timber market*, *forest management planning*, *high level of bureaucracy*, *environmental policy*, *timber processing industry*, *availability of financial resources*, *bioenergy market*, *ownership structure*, *forest paradigms* and *public opinion*. The passive factors are in the left bottom corner.

A. Economic Factors

Economic factors that have emerged with the most dynamic influence and change are precisely those that define the basic changes in the system and show the main alternative scenarios of development. A strong and direct link is established among factors *timber market*, *bioenergy market*, *timber processing industry* and *availability of financial resources*. This relationship determines the direction of motion of the system and the change of the factors related to ecology, politics and society. The market and its development are the mechanism that moves most of the other elements in the system. Factor with passive and reactive influence is *demand for non-wood production*. This factor lies in the area depending on dynamic factors, but there is almost no effect on them. Lack of financial resources has a direct impact on the technological level of enterprises working in forestry and indirectly affects the market. This influence is identified in the quality of the activities performed and the cost of production.

B. Political Factors

Political factors such as *environmental policy*, *ownership structure* and *forest management planning* give a strong influence on the market, public opinion and environmental law. Institutions as part of the political system are focused heavily on environmental aspects in the management of forest areas. The structure of ownership of forests composed of mainly state forests is in direct relation and defines the planning process and the type of all forestry activities. Of course, the planning process is carried out under the direct control of the authorities implementing an environmental policy. There is no strong influence of environmental factors, except the factor *state of forest*.

C. Economic Factors

Economic factors, in turn, are in direct contact and have a strong influence on forest management. These effects can be seen and are considerably stronger on the planning process in forests.

D. Social Factors

The main influence and strong correlation are observed in the factors *public opinion* and *forest paradigms*. Society favours the forest paradigm and is prepared to make any compromises with the environmental paradigm to increase its wealth through the timber market and running business in the woods. Local people and the direct interested parties consider the impact of economic factors to be the most important to improve social conditions in the region and the return of young people to these areas.

Consequently, the results of structural analysis provided useful information for the research team and their solutions in possible scenarios for the development of the region. Based on the identified factors, relationships and interactions, several key directions and valences of influences are outlined. The structural analysis supports the process of researching the environmental conditions and significantly reduces its uncertainty. Therefore, the research team focused on some key factors described in detail. The results of this analysis cannot be absolute but give additional contribution to the overall study for the research object of Teteven area. Thus, three operating scenarios are adopted that provide a description of the factors and variants in their appearance over a longer period.

The descriptions of the individual factors are made by using a cluster analysis reflecting the connections and the severity of the impact (Fig. 5).

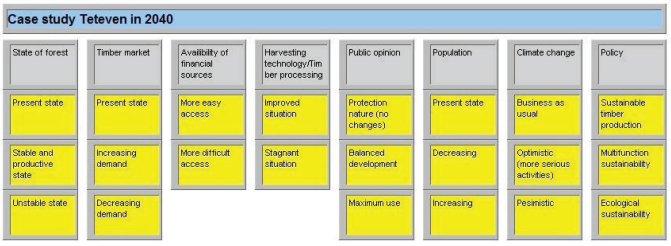


Fig. 5. Overview of the Scenario Space of Teteven area.

Scenario S0: No Management (Theoretical) (NoM)

This scenario is theoretical and is motivated by the expectation of the society to drastic changes in climate and ecosystems. Stakeholders cannot imagine giving up wood and products thereof, as well as non-timber forest resources, both at the local and national level. Forestry and forest industry determine life and employment to nearly 20 % of the population in the country. This option implies the limitation of all activities in the forest and should be accompanied with financial subsidies for loss of income from forest owners. This is possible only in theory because, on the one hand, it is very difficult to find funds to be compensated to the owners; on the other hand, wood products and non-timber forest products cannot be completely replaced by other products. The second reason is the leading role of environmental factors, and especially climate changes. The studies in the field of climate change in Bulgaria for the period of last 40 years show a steady increasing trend in the average annual temperature by 1.5 degrees and decrease in the annual rainfall by 50–100 mm. Predictions for the future in the worst variant are an average annual temperature increase by 4 degrees and a decrease in average annual rainfall by 150–200 mm. Combinations of extreme periods of drought and high temperatures or pouring of the annual rainfall in a very short period become more frequent. More and more often there are phase changes of phenological development of the plantation and plant shifting climatic zones in height registered. This trend in the case will have a major impact on forest landscapes and the object of study,

because Teteven is located at medium altitude over a wide range from 800 to 1800 m, where the changes will be significant in the zone up to 800 m. Two positive developments supported this vision. First, available funding to the National Strategic Plan of Rural Development increased for 2014–2020. Consequently, the financial instruments (including compensation and subsidies) for forestry and nature conservation measures are appropriately supported. Second, together with strong social demand for nature conservation, the political interest shaped forest policy in favour of environmental policy. The result is an environmental paradigm enforced politically and based on limitation of man's interference. The disagreements between foresters and environmentalists on disputed territories are resolved subsequently as the compensation given to the private forest owners for the impossibility of property management. At first, these strong changes in the policy lay the groundwork for reclassification of all production forests into fully protected forests. The aim is toward the coordinated efforts to tackle nature conservation, particularly biodiversity maintenance and utilisation of recreational, hunting, water-management and scientific functions of forests. This enforces some changes in the organisation of forest management and landscape protection. The large part of production forests are transformed into Natura 2000 plots.

Scenario S1: Ecology and Close to Nature (ECO) Active Management – Biodiversity Maintenance

In phase 1 of the INTEGRAL project, high influence of public opinion was found on the management and protection of forests. The tendency is that the role of the NGOs will increase, which is the core of the selection of this scenario. The systematic strengthening of sustainability and ecological stability of forests are necessary. Particularly, sustainability and close-to-nature forestry are applied in state forests during the past 25 years. With the worsening state of forest and fear for sustainability, there was not much to choose. Specifically, finer ways of management increase the range of changes in damaged stands with non-original tree species, and increase range of transfers from clear-cut to shelter wood and selection system with the ambition for their natural regeneration. As frequency of calamities are increased, more massive artificial forest regeneration is applied with motivation to plant tree species suitable to the area and resistant to the impacts of climate change. Some territories are even left to the successive self-development. Tending interventions are oriented either towards significant strengthening of ecological stability of even-aged stands, or towards introduction and preservation of even-aged forest conversion into more diverse one (uneven-aged forest with natural composition of tree species). As a result, the proportion of young forest stands increased, which in turn caused decreased reproduction felling. In some cases, continuous tree or group reproduction felling is applied. The disagreement between foresters and environmentalists on disputed territories did not turn into the decades of ongoing conflict that many had feared. In fact, quite the opposite: strong economic growth returned in force across Europe in general and in Bulgaria in particular. The progress and available funds invited a range of solutions and progressive ideas concerning growing demand for nature conservation. Inspired by the success of similar projects in other countries, the government, state forest enterprises, administration of protected areas and NGOs acted together and launched with a new vision of creating a national forest management policy in the area. All participating sides commonly agreed that the best roadmap to the vision concerning nature conservation was rewilding of the area, especially around the National Park "Centralen Balkan". The stakeholders in Teteven area had expectation of strong economic, societal and environmental benefits to the area. The second reason was the leading role of environmental factors, and especially climate changes. These studies of the influence of environmental factors require a change of management that covers all silvicultural systems – logging, technology and equipment for all activities in the forests. The technology improvement and equipment modernisation directly depend on the technological factors. From one point of view, this technology can be made and delivered, and from the other, it has been motivated by economic factors, and in particular by financial availability. The EU grants play a significant role to facilitate access of financial resources, provided free of charge programme for rural development from the Regional Development Plan (2014–2020) (RDP) and National Development Plan (NDP 2020). Facilitating access rules and providing financial resources of NDP and RDP are enshrined among the priorities of the Bulgarian Rural Development Plan for 2014–2020. Two positive developments supported this vision. First, available funding of the National Strategic Plan for Rural Development increased for the period of 2014–2020. As a consequence, most financial instruments (including compensation and subsidies) for forestry and nature conservation measures will be appropriately supported. Second, together with strong societal demand for nature conservation, the political interest shaped forest policy in favour of environmental policy. The politically enforced environmental paradigm based on limitation of man's interference was the result. In other words, existence of finances for compensation for financial loss due to nature protection restrictions, on the one hand, and strong societal demand, on the other hand, lead to the legal enforcement of nature protection in favour of economic interests of current forest owners. Hence, the disagreement between foresters and environmentalists on disputed territories was subsequently resolved as compensation for the impossibility of management was ensured to the private forest owners. At first, these strong changes in policy laid the groundwork for classification of all production forests. Coordinated efforts were taken to tackle nature conservation, particularly biodiversity maintenance and utilisation of recreational, hunting, water-management and scientific functions of forests. This invited some changes in forest management organisation in the area. For instance, this also decreased political impact and influence of traditional lobbying groups concerning timber business. Reduced political dependency enabled state forest enterprises and municipality forest directorate to better manage forest resources as well as its functions. The active interventions of state and municipality forests are permitted to a minor extent only on the naturally less valuable parts and peripheral territories with changed trees composition or in poor health conditions, in order to speed up the conversion to the close-to-nature status. Management activities are also permitted in surroundings of the rivers and water

protected areas. The reason was ensuring and strengthening the fulfilment of clean water and recreational functions that are expected from the stakeholders. Otherwise, active management was applied. The goal was to implement active forest management in the way that forests would reach their natural condition. This leads to economic development. In the context of applied innovations in woodworking industry in the last 24 years, lack of financial resources and now lack of timber resources, especially beech sawnwood, many business were on the brink of their existence with many forced to shut their capacities by 2020. Taking together, the situation on the timber and biomass market, and other societal requirements for ecosystem services had no impact on the management of the area. The part of production forests were involved in Natura 2000 plots. As nice as it sounded, compensation for financial loss due to nature protection restriction was not enough to fulfil expectations of forest owners that would match lost income from timber and biomass production. As funds of the National Strategic Plan of Rural Development would slowly drift by 2020, the long awaited income from protected concept would be more than welcomed. Although politically the conservation paradigm was fully implemented stating that the natural evolution of the ecosystem was homeostatic and the best means of ensuring the ecological stability of forest was in the strengthening of its biodiversity, finances supporting such paradigm became also limited to the state forest enterprise. As the share and uptake of forestry measures within the Rural Development policy supported an introduction, some employment opportunities were added. After 2020 when the word concerning rewilding spread around, the vision for forest development will start to fulfil not only conservational but also its economic and societal goals. Focus of promotion of the rewilding area was threefold: tourism, hunting and nature protection. Thousand meters of elevation difference laid ground for experiencing an amazing variety of fauna and flora of the area.

Scenario S2: Traditional Management (Business as Usual – BU) Active Management – Worsened State of Forests

This is the most likely scenario, which is recommended and desired by all stakeholders. This scenario allows for the development of sustainable forest and forestry, woodworking and furniture industry, which is highly developed in the region. This option implies the use of preservation of the state, municipal and private forests in the long term, and is based on the sustainable increase of demand for wood and other forest products. This scenario is developed based on the understanding of the public for the balanced development of forests and forestry, which is based on sustainable timber production and climate change that are within the one established now. It is imperative to keep the current state of the forests. The amendment of the timber market is sustainable for the benefit of slow and gradual increase in demand. It is possible to maximise the benefit if an easy access to financial resources is provided. This will allow improving the technologies performed in silvicultural activities. The systematic strengthening of the sustainability and ecological stability of forests are necessary. Particularly, sustainability and close-to-nature forestry are applied to state forests during the past 25 years. With the worsening state of forest and fear for sustainability, there was not much to choose. Specifically, finer ways of management increased the range of changes in damaged stands with non-original tree species, and increased range of transfers from clear cut to shelterwood and selection system with the ambition for their natural regeneration. As frequency of calamities increased, more massive artificial forest regeneration was applied with motivation to plant tree species suitable to the area and resistant to the impacts of climate change. Some territories were even left to the successive self-development. Tending interventions were oriented either towards significant strengthening of ecological stability of even-aged stands or towards introduction and preservation of even-aged forest conversion into more diverse one (uneven-aged forest with natural composition of tree species). As a result, the proportion of young forest stands increased, which in turn caused decreased reproduction felling. In some cases, continuous tree or group reproduction felling was applied. Due to deterioration of the age structure of forest, representation of mature stands dramatically decreased. This was mainly due to general decline in stock and quality of wood, and decline in share of even-aged stands. As a consequence, strategic planning was very unreliable and tactical plans were subject to substantial adaptive revisions. This, in turn, led to the fracturing income mainly because of temporary retreat from even felling and because of climbing management costs, especially forest tending and regeneration costs. There were other downsides, as the volume of rotation felling decreased and investment opportunities were thus limited by the lower income and improvement in technologies was only a wish. However, the negative trend occurred in steady worsening of state of road infrastructure as a result of lack of finances for forest road rehabilitation and reconstruction. These dire circumstances along with societal pressure naturally increased the importance of the fulfilling of other services as their implementation was at risk. Particularly, clean water function was endangered in the whole area as stands started decaying. Generally, the trade-off between sustainability and timber production was costly. Most of the forest owners could no longer afford their lock-in costs. Income from timber production was limited not only because of restricted production base and wood resources, but also because of critical situation in wood processing industry. Specifically, the price of input resources increased as fast as price of production causing pressure on effectiveness in this industry sector. In the context of applied innovations in the last 24 years, now lack of finances and lack of timber resources, especially beech sawnwood, many business were on the brink of their existence with many forced to shut their capacities by 2020. Taking together, the situation on the timber and biomass market, and other societal requirements for ecosystem services had no impact on the management of the area. Depressed economic activity combined with expensive strengthening of ecological stability of forests would have dramatic consequences by 2040. State forest enterprise and municipality directorate were under economic pressure. Institutional change within state forest enterprise and in municipality directorate finally became a reality. Specifically, forest administrations were reformed and dominant role of state and municipality was redefined. This also decreased political impact and influence of traditional lobbying groups concerning timber business. Increased nature protection

and biodiversity justified the fact that passive management was optimal for the ecological stability of forests, but economically this became unsustainable. Thus by 2040, new ways out of this situation would be sought. With an opportunity frozen in timber production, lack of compensation and/or subsidies for nature protection and limited income from other services, new actors using this situation for their advantage emerged.

Scenario S3: Maximum Potential Benefit (MPB) Active Management – Maximum Wood Production

This scenario reflects the understanding of society to increase potential yields from forests. Because of climate change and its positive impact on forests between 1000 and 1500 m above the sea level in Teteven it is possible to increase the sustainable use of forests, reaching their maximum performance. Perception of this scenario has a necessary prerequisite, i.e. the preservation of the condition of forests and increasing demand for wood and non-timber forest resources. Maximum timber production mandatory should be based on the use of the modern equipment and technology, a prerequisite for which there is an easier access to financial resources for investment. The positive developments in timber and biomass markets result in increasing income for forest owners. Improved economic situation of forest owners is expected due to increased policy coherence and mutual cross-sectoral coordination. It is expected to have better accessibility of compensation for financial loss resulting from nature protection restrictions and/or fulfilment of other ecosystem services (e.g. water management, clean water, CO_2). There should be better availability of subsidies through Rural Development policies; new programs will introduce new supporting schemes (e.g. new art of financing of biodiversity and offering of non-forest services; plans for payments for climate-friendly forest land use; for water management and/or reducing CO_2). In 2013, the long awaited innovation in the use of hardwood in the construction sector was finally launched. These developments were quickly implemented in architecture and subsequently into the concept of green buildings leading to higher use of wood beams as well as to improvements in the use of composite materials among others. Not surprisingly, this historic progress attracted new investments into beech processing capacities in nearby area as predominance of deciduous species pre-existed for years. Historically, large deciduous, especially beech processing capacities were present in the area; however, many fundamental changes introduced after 1989 led to reduction or shut down of part of these capacities. Although application of new technologies and product innovations was also observed in the paper and pulp industry (*Sviloza*, Svishtov; *Lesoplast*, Trojan; *Kronospan*, Veliko Tarnovo), demand for pulp wood remained stagnant. In contrast, demand for the forest biomass and fire wood significantly increased. Circumstances concerning gas crisis from 2009 proved instability of gas supplies as well as led to an increase in energy prices, which forced an introduction of new policies favouring production of energy from renewable resources and wood biomass. Particularly, an increased demand for biomass was additionally secured by implementation of new legislation supporting production of biomass on fallow agricultural land and the creation of energy forests to name a few. This was driven by demand of operating heating facilities and households set up in the boom around 2011–2012. Among the population the strong interest for fuel wood and biomass remained constant. Renaissance of the wood processing industry was generally driven by favourable climate conditions as average temperature increased by 0.3 °C. This did not cause redistribution of forest vegetation zones on the territory of Teteven and it might cause an increase in ration of natural composition stands. Thanks to the stabilisation of the climate change, in the political sphere economic forest production dominated over forest sustainability. Therefore, strong political enforcement of the economic interests of forest owners won over the interests of nature protection and conservation. Despite this, the harmonisation of policies was achieved due to following reasons. First, harmonisation reflected consensus in the revaluation of protected areas. As in 2004 inconsistently assigned large territories to protection sites under NATURA 2000 were under time pressure, a common agreement on necessary changes was found. On the one hand, the reassessment of protected areas resulted in reduction of conservation area. On the other hand, compensation for financial loss due to nature protection restrictions was entirely paid to forest owners. Put it differently, rural development policy with its new supporting schemes lost its declarative character. Second, due to limited financial resources for compensation as well as increased push from the wood processing industry the share of production forests increased. Taking together, the necessary talk was driven by economic motivation. Generated profit from timber trade and compensation available to the sector notably increased political impact and influence of various lobbying and business groups. These strong forces laid the groundwork for the forest policy. Thus, political advocacy strategies concerning conservation were hampered by the economic interests. Given the circumstances, it was no surprise that multipurpose forest management dominated with a focus on maximising the economic income from forest, on increasing and stabilising production of high quality wood. This allowed for possible formation of reliable plans in strategic time frame of rotation age, which, in turn, led to normal percentage of forest stand areas and growing stock in age classes within the framework of classic even-aged forestry. Put it differently, along with lessening impact of climate change, use of more subtle ways of forest management based on natural conditions generally stabilised and gradually improved the age structure of the stands, increased their health conditions, and increased the levels of natural tree composition. As a result, management costs were under control and the volume and quality of harvest able timber and biomass rose. This reflected possible investments into technology fleet renovation and improvement of forest road network and other infrastructure. Especially, appropriate mechanisation of work in young forest stands together with improved access to these stands supported biomass production and its utilisation. An active timber forest management with special focus on maximisation of production of timber and on short-term rotation forestry at a small scale was preferred by the state forest owners. In contrast, small private forest owners applied close-to-nature management due to their interest in long-term security of continuing income while keeping the costs at minimum. Similarly, short-term rotation forestry

was conducted at a small scale. Beyond doubt, the main source of income for state, municipality and private forest owners became higher timber qualities first (I) and second (II), and fire and pulp wood, whose prices increased. In case of beech timber, the price increased by 19 %. Given the circumstances, over the course of 30 years an economic situation of forest owners due to reliable strategic planning stabilised and even improved. By 2040, full use of the natural production potential would improve taking advantage of health conditions of the forests due to the following reasons. First, decrease in environmental changes and their impact reduced frequency of occurrence of extreme events. Second, consistent and appropriate management practices guaranteed and lessened negative impacts of ecological disturbances. This allowed for concentration of all activities to satisfy the production function of forests to meet the increased demand for timber and biomass resources. Yet without support of short-term rotation forestry under preservation of the sustainability and ecological stability this would not be the case. Because of maximisation of production, less emphasis was put on satisfying other ecosystem services. On top of it, due to increased timber stock, the fulfilment of climate regulation, especially the carbon sequestration function increased, which was positively accepted by the society. Thus, societal pressure on fulfilment of non-wood ecosystem services remained at the level of 2013. This mirrored the situation, and, for instance, no change in the volume of mushrooms or berries was recorded. In addition, the number of tourists or hunting activities did not change. Furthermore, clean water function remained in the responsibility of state forest enterprise and municipality directorate as many rivers were located within their property. Relative stand density index for the whole research area remained at the same level as no increase in young forests was recorded. Consequently, economic security was easier as the societal demand for implementation of other non-production services of forest did not increase. Besides, from the perspective of forest owners, economic importance of non-wood ecosystem services weakened in comparison with the production function of their forest. In other words, the motivation for fulfilment of non-wood ecosystem services decreased. By 2040, despite some societal pressure to guide smart active management, it would become clear that soon or later rapid economic growth could not continue without consideration of other services.

IV. Conclusion

In conclusion, the analysis of results has allowed defining four driving scenarios that could be offered to the stakeholders.

The *No Management* scenario is theoretical and motivated by the expectation that the society could not adapt to drastic changes in climate and ecosystems. Stakeholders cannot imagine giving up wood and products thereof, as well as non-timber forest resources, both at the local and national level. This option implies the limitation of all activities in the forest and should be accompanied with financial subsidies for loss of income from forest owners. This is possible only in theory because, on the one hand, it is very difficult to find funds to be compensated to the owners; on the other hand, wood products and non-timber forest products cannot be completely replaced by other products.

The *Ecological and Close-to-Nature* scenario is related to significant influence of public opinion on the management and protection of forests. The tendency is that role of NGOs with time increases, which is the core of selection of this scenario. The second reason is the leading role of environmental factors and especially climate changes.

The *Traditional Management* scenario is developed on the basis of the understanding of the public for the balanced development of forests and forestry, which is based on sustainable timber production and climate change that are within the one established now. It is imperative to keep the current state of the forests.

The *Maximum Potential Benefit* scenario reflects the understanding of society to increase potential yields from forests. Perception of this scenario has a necessary prerequisite, i.e. the preservation of the condition of forests and increasing demand for wood and non-timber forest resources. Maximum timber production should be based on the use of modern equipment and technology, a prerequisite for which is an easier access to financial resources for investment.

The proposed driving scenarios are the basis for the development of the raw and full scenarios.

V. Acknowledgment

The research leading to these results has received funding from the European Community's Seventh Framework Programme under grant agreement No. FP7-282887. The results of the present research have been obtained by participatingin the International Scientific Project for Future-Oriented Management of Forest Landscapes – INTEGRAL (ENV.2011.2.1.6-1/ Land Use and European Forest Ecosystems. http://www.integral-project.eu/).

References

Act for Restitution of Property of the forest and the lands in forests (1997). *State Gazette*. 110. (in Bulgarian).

Arcade, J., Godet, M., Francis, M., Fabrice, R. (2009). Structural Analysis with the MICMAC Method & Actor's Strategy with the MACTOR Method. In: Glenn, Jerome C.; Gordon, Theodore J. (Hrsg.): Futures Research Methodology 3.0. The Millennium Project. (CD-ROM) Washington D. C.

European Landscape Convention (2000). Retrieved from http://conventions.coe.int/Treaty/en/Treaties/Html/176.htm.

Forestry Act (1997), *State Gazette.* 125. (in Bulgarian).

Galev, E., (2011) Positive and unfavourable visual effects of the forest landscapes. *Forestry Ideas. 2*(17). 214–219.

Georgieva, D. (2005) Economic Assessment of the Selection Forest, Avangard Prima Publishing house. Sofia. (in Bulgarian).

Kolev, K. (2008) Revealing the Causes of Economic Conflicts in Forestry by Application of Statistical Methods. *Journal of Forest Science. 3*. 53–67. (in Bulgarian).

Paligorov, I., *et al.* (2002a). The Bulgarian Timber Market. Sofia: Publishing House of the University of Forestry (in Bulgarian)

Paligorov, I., *et al.* (2002b). The Market of Timber in Bulgaria. Sofia: Ministry of Agriculture and Forestry/National Forestry Office. (in Bulgarian)

Paligorov, I., *et al.* (2004) Characteristics and Trends in the Timber Market in Bulgaria. Ministry of Agriculture and Forestry and National Forestry Office. (in Bulgarian).

Paligorov, I., Georgieva, D., Kovacheva, S., Aleksova, N. (2001) Preconditions and Problems of the Forest Enterprises in Obtaining Financing through the Programme SAPARD. *Journal of Management and Sustainable Development.* 3–4. 142–148. (in Bulgarian)

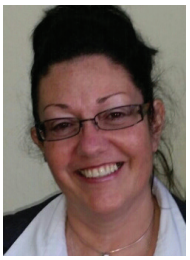
Pillkahn, U. (2008). Using Trends and Scenarios as Tools for Strategy Development. Corporate Publishing, Erlangen.

Regulation on income statement and the order in which they are established and implemented and reported the National Fund "Bulgarian Forest" (1998). *State Gazette*. 70. (in Bulgarian).
Regulations for the Implementation of the Forest Act (1998). *State Gazette*. 41. (in Bulgarian).
Shuleva-Alexova, N. (2006) Forests with Water-Preserving Proposition Functions- Essence and Approach for Valuation, *Journal of Management and Sustainable Development*. 1–2. 184–188. (in Bulgarian).
Velushev, M. (2011) The nature of the public economy, Avangard Prima Publishing house. Sofia. (in Bulgarian).
Yovkov, I., Shuleva-Aleksova, N. (2009) Efficiency of Forests' Multi-Purpose Production Function According to Pareto's Criteria. *Journal of Management and Sustainable Development*. 1–2. 26–32 (in Bulgarian).
Yovkov, I., Paligorov, I., Aleksova, N. (2001) Forest Economy Policy in Bulgaria before and after Reforms in 1998. *Journal of Management and Sustainable Development*. 1–2. 6–13 (in Bulgarian).
Yovkov, I., Shuleva-Aleksova, N., Kolev, K., Dragozova-Ivanova, E. (2009) Efficiency of the Production and Exchange of the Forest Ecosystems' Multi-Purpose Management, Proceedings of Second Scientific-Technical Conference Innovation in Woodworking Industry and Engineering Design. Yundola, 6–8 November. (in Bulgarian).
Yovkov, I., Shuleva-Aleksova, N., Kolev, K., Marinova, V. (2010) Sustainable Development to Social Economic System with Public- Privet characteristics. Avangard Prima Publishing house. Sofia. (in Bulgarian).

Elena Ilieva Dragozova-Ivanova, Assistant Professor, PhD (2012), Landscape Architect (1997). The main scientific interests lie in the fields of management of landscape architecture, human resource management in landscape architecture and forestry. She is a member of the Union of Landscape Architects in Bulgaria; member of the Union of Experts of Quality in Bulgaria; member of the Association of Lecturers of Economics and Management in Industry.
Address: Faculty of Business Management, University of Forestry, Sofia 1756, Bulgaria.
E-mail: elker@abv.bg

Ivan Petrov Paligorov, Professor (2012), PhD (1991), Forestry Engineer. The main scientific interests are in the fields of forestry policy and sustainable development of forest economy. He was a Vice Dean of the Faculty of Business Management at the University of Forestry, Sofia, Bulgaria (1995–2003). He was a Dean of the Faculty of Business Management at the University of Forestry, Sofia, Bulgaria (2003–2011). He has been a Vice Rector of the University of Forestry (since 2012). He is an Editor in Chief of the Journal of Management and Sustainable Development (ISSN 1311-4506). He is a Chairman of the Union of Bulgarian Foresters; member of the Union of Scientist of Bulgaria; member of the Association of Lecturers of Economics and Management in Industry.
Address: Faculty of Business Management, University of Forestry, Sofia 1756, Bulgaria.
E-mail: ipaligorov@abv.bg

Ivaylo Hristov Ivanov, Assistant Professor, Master of Public Administration (1997), Master of Accountancy (1998). The main scientific interests lie in the fields of regional policy, regional development, sustainable development of regional economy and tourism. He is a Secretary of the International Scientific Conference on Management and Sustainable Development. He is a member of the Union of Experts of Quality in Bulgaria; member of the Association of Lecturers of Economics and Management in Industry.
Address: Faculty of Business Management, University of Forestry, Sofia 1756, Bulgaria.
E-mail: ihivanov@abv.bg



Stanislava Draganova Kovacheva-Veleva, Associated Professor (2007), PhD (1998), Chemical Engineer (1987). The main scientific interests lie in the fields of logistics, economy and management of wood-working and furniture industries. She was a Vice Dean of the Faculty of Business Management (2007–2011). She is a member of the Scientific Committee of the International Scientific Conference on Management and Sustainable Development; member of the Editorial Board of the Journal of Management and Sustainable Development (ISSN 1311-4506); member of the Union of Scientist of Bulgaria; member of the Union of Experts of Quality in Bulgaria; member of the Association of Lecturers of Economics and Management in Industry.
Address: Faculty of Business Management, University of Forestry, Sofia 1756, Bulgaria.
E-mail: st_kovacheva@abv.bg