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Atlas of the forest sector in Ukraine with the focus on wood fuels

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Abstract
This is a review of the current situation of the forest sector in Ukraine by considering a collection of maps. The cartographic information is grouped in the following way: forest resources, silviculture, wood harvesting, production and the most important producers of wood-based products, forest education and research and the potential of wood energy. This review serves the information needs of different stakeholders and of those interested in the forest sector in Ukraine.

Keywords
Ukraine, forest resourches, wood harvesting, forest industry, bioenergy, forest policy

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Preface

This work was done under the umbrella of the project "Central and Eastern European Forest Information Service". The aim of the project is to create an information service for the Estonian, Latvian, Lithuanian, Polish, Czech, Belarusian, Ukrainian, and Romanian forest sectors and to strengthen knowledge relating to these countries. The goal is to determine business opportunities and new markets in the CEE[1] countries. The target groups of the project are Finnish forest sector enterprises and technology manufacturers planning to enter the business or expand in CEE countries. The project is funded by the European Social Fund (ESF) and will be executed in 2010–2012. The coordinator of the project is the Finnish Forest Research Institute (Metla). Other partners are the Mikkeli Small Business Centre at the Aalto University School of Economics, the School of Forest Sciences at the University of Eastern Finland, North Karelia University of Applied Sciences, and North Karelia College in Valtimo.

The project collects information about the business environment of the forest sector, wood availability, forest sector enterprises, and bioenergy markets of the CEE countries. The section on forest sector business environment contains a description of forest resources, forest ownership and use, wood procurement, and wood trade. Related to this, the requirements for the transfer of Eastern Finland technology and know-how are analysed from case studies. The review of bioenergy covers a survey of the bioenergy markets (energy production, infrastructure, and biomass potential) of the target countries. As a part of this, the present state and scenarios of the pellet industry and its effects on Finland and the possibilities for Eastern Finnish enterprises are mapped. The market for Eastern Finnish forest technology is estimated with the help of case studies. The manufacturers' improved knowledge of the countries appraised opens export opportunities for technology with which it is possible to utilise all parts of woody biomass.

The project examines the possibilities to improve the wood supply in the target countries, to calculate the availability of appropriate bioenergy raw material, to determine the best delivery chains to the potential targets, and to determine training needs. In addition to this, a wood energy online database will be created within the project which will contain a map application and information about the sawmills of the project countries, pellet manufacturers, and heat plants.

This atlas is the second publication within the project. The report is a description of the current situation of the forest sector in Ukraine by considering a collection of maps. The cartographic information is grouped into forest resources, silviculture, wood harvesting, production and the most important producers of wood-based products, forest education and research and the potential of wood energy. The review is based mainly on the statistical information on Ukrainian forestry and several publications related to the forest and bioenergy sector policy in Ukraine.

This review serves the information needs of different stakeholders and of those interested in the forest sector in Ukraine. All maps can be downloaded from the Internet service for CEE forestry (http://www.metla.fi/metinfo/kie/). The project will provide a series of publications about other CEE countries in the same form.

[1] Belarus, Czech Republic, Estonia, Latvia, Lithuania, Poland, Romania, Slovakia, Ukraine

Contents

1 Introduction

Ukraine is a country in Eastern Europe. It has a total area of 603,628 km² and land area of 579,330 km², which makes it the largest country on the European continent after Russia (Basic facts... 2010). Ukraine is bordered by the Russian Federation to the east and northeast, Belarus to the northwest, Poland, Slovakia and Hungary to the west, and Romania and Moldova to the southwest. The Black Sea and Sea of Azov border the country to the south and southeast, respectively. Ukraine last became independent after the dissolution of the Soviet Union in 1991.

After that began a transition period to a market economy, in which Ukraine suffered from an eight year recession (Macroeconomic indicators 2009). This was mainly caused by the collapse of the Soviet structured, weak economic development of its most important trade partner, Russia, and the ineffective administration and economic policy which did not motivate investment. During the 2000's, the economy experienced a high increase in GDP growth.

Ukraine is a unitary state which composes of 24 oblasts (provinces), one autonomous republic (Crimea), and two cities with special status: Kiev, the capital and largest city, and Sevastopol. The country has 46 million inhabitants, 78% of whom are ethnic Ukrainians. Sizable minorities consist of Russians (17%), Belarusians and Romanians. The Ukrainian language is the official language in Ukraine, but Russian is also widely spoken. The dominant religion is Eastern Orthodox Christianity.

Fertile plains (or steppes) and plateaus dominates the Ukrainian landscape. Rivers such as the Dnieper, Seversky Donets, Dniester and the Southern Buh flow south into the Black Sea and the Sea of Azov.

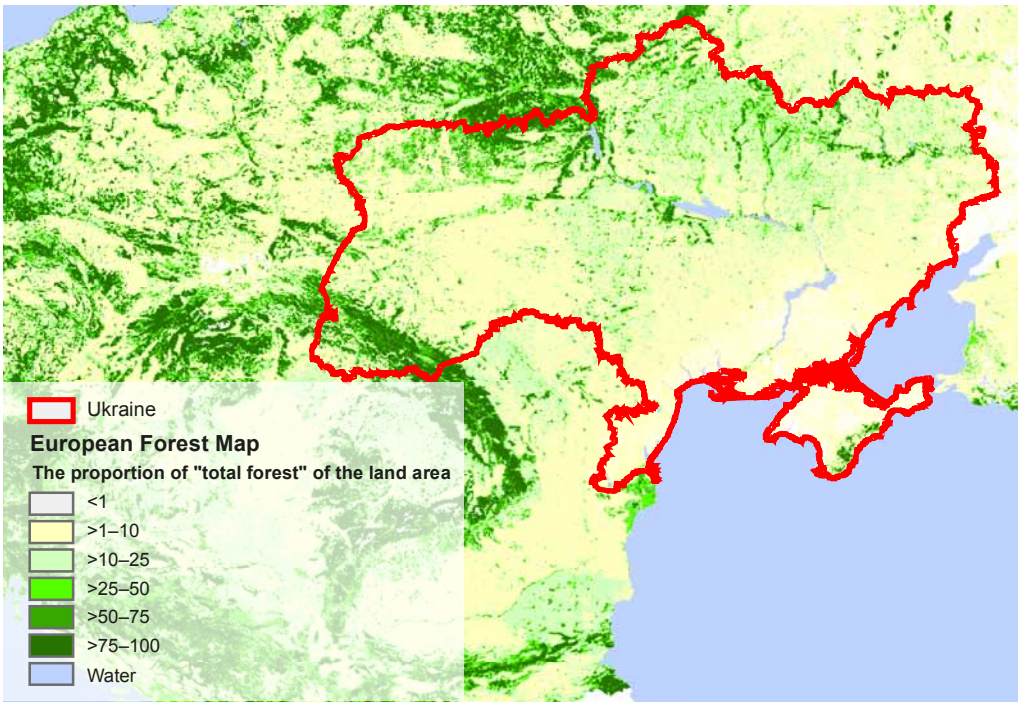


Fig. 1.1. Ukraine on the European Forest Map[1] (Schuck et. al. 2002).

[1] This information is based on outputs from the project "Forest tree groupings database of the EU-15 and pan-European area derived from NOAA-AVHRR data", which was awarded by the European Commission, Joint Research Centre (Institute for Environment and Sustainability), to a consortium of organisations under contract number: 17223-2000-12 F1SCISPFI.

Notable natural resources in Ukraine include iron ore, coal, manganese, natural gas, oil, salt, sulfur, graphite, titanium, magnesium, kaolin, nickel, mercury, timber and an abundance of arable land.

In spite of this, Ukraine has a number of major environmental challenges, such as an insufficient supply of potable water, air and water pollution, deforestation, and radiation contamination in the north-east of the country from the 1986 accident at the Chernobyl Nuclear Power Plant. (Ukraine 2012)

A mostly temperate continental climate prevails in Ukraine. A more Mediterranean climate is found on the southern coast in Crimea. Precipitation is disproportionately distributed: Western Ukraine receives around 1,200 millimetres of precipitation annually, and Crimea receives around 400 millimetres. Winters vary from cool along the Black Sea to cold inland. The average annual temperatures range from 5.5–7 °C in the north, to 11–13 °C in the south.

Forestry and the forest industry are essential parts of the Ukrainian economy, with a huge potential for development (State Forest... 2012). The total forest area in 2010 was 9.7 million ha which is 17% of the total land area. Growing stock was 2.1 billion m³ in 2010 (State of… 2011).

Ukrainian forests and forest management have several distinctive features compared to other countries:

- a low percentage of forest cover
- four natural zones (Polesia, Forest Steppe, Steppe and Carpathians)
- a high percentage of reserved forests (13.7%) tends to grow
- historically forests were continuously managed by permanent users (forests were managed by enterprises, institutions and organisations under more than 50 ministries and departments)
- a large forest area is located in a zone polluted by radiation
- half the Ukrainian forests are planted and need intensive maintenance (State Forest...2012).

The economic importance of forests is significant, especially for rural areas in the northern and western parts of the country. However, the forest sector in the country suffered from a sharp economic decline from the beginning of independence. Furthermore, reforms in the forest sector have been very limited in comparison with most other transition countries in Europe (Nordberg 2007).

During the last decade the forest sector of Ukraine demonstrated steady, favourable development, and surpassing most of the industries of the national economy with respect to annual growth rates of production and the realisation of products. The attention of society and authority on the forest sector is also constantly growing. This occurs not only because wood has become a more used and scarce resource from one year to the next, but there is also an understanding of the major ecological and social roles of forests, which found its reflection in the rapid increase in the forest's naturally-protected territories, the expansion of works on the creation of new forests, etc. At the same time, against favourable official statistics, discussion of the problems of the inefficient use of forests, in particular related to illegal storage and shadow forest business, has become more important. (Regional Workshop... 2010)

Fig 1.2. Ukraine, the Ukrainian regions, and main cities.

The country contributes to the conservation of forests and environmental stability at regional and global levels, and plays an important role in the CEE forest sector. In 2011, Ukraine produced 8% of the total industrial roundwood of CEE, 13% of its paper and paperboard, 10% of its plywood, and 7% of its sawnwood (FAOSTAT 2012).

This review aims to provide a comprehensive picture of the situation of the forest sector in Ukraine, with particular emphasis on bioenergy, in a compact form by also presenting information on maps. This review serves the information needs of different stakeholders and those interested in the forest sector in CEE.

2 Forest sector policy

2.1 Forest administration

The majority of the forests in Ukraine are state property. The ownership of trees coincides with ownership of the land on which they are situated. State forest areas are given for permanent use to different Ministries and agencies. In compliance with the new Land Code adopted in 2001, three types of property are declared in Ukraine:

1. **State**: all forests of Ukraine excluding communal and private forests.
2. **Communal**: forest stands within the boundaries of settlements other than those in state or private property, as well as stands beyond the boundaries of settlements of communal property.
3. **Private**: forest stands on land plots up to 5 ha within agricultural and farming lands or stands grown on private plots.

Some privatisation occurred between 1992 and 1994, when the Land Code had been passed but the new Forest Code was not yet enacted (Ukraine: Forestry... 2006). However, Ukraine has historical experience in private forests; before 1917 about 70% of forests were private.

Land plots up to 5 ha from agricultural and farming lands may be transferred to private property. Besides, legal entities and individuals have the right to purchase plots of abandoned and degraded land for the purpose of afforestation. (Global Forest...2010)

Communal property should include the forest stands within the boundaries of settlements, other than those in ownership of the state or private property as well as beyond the boundaries of settlements of communal property (Global Forest...2010). In Ukraine, communal forests are area under collective farms.

However, a procedure for the demarcation of the lands has not yet been determined. Almost 0.4 million ha are not in any permanent use and are located on areas of reserve fund. These forests are not in good condition, due to the absence of thinning, protection against fires, pests and disease, and illegal logging. (Global Forest...2010)

In comparison with some other ex-Soviet republics (for example Russia and Latvia), reforms to the Ukrainian forest sector and administration have been modest. After the independence of Ukraine, the Ministry of Forestry was formed in 1991. Its functions remained principally the same in comparison with the former Ministry of Forestry of the Ukrainian SSR. The Ministry became the State Committee of Forestry in 1998. In 2000, the Committee was placed under the co-ordination of a newly created Ministry of Ecology and Natural Resources. However, the Committee has continued to be independent on matters related to forest management (Nordberg 2007).

The main tasks of the State Committee of Forestry are (State Forest...2012):

- to implement state policies for forest and hunting management, protection and conservation, sustainable forest management, regeneration of forest resources and game, and to improve the efficiency of forest and hunting management;
- to administer, regulate and control forest and hunting management;
- to develop and implement national, international and regional programmes for forest protection, productivity improvement, sustainable forest management and reforestation, management and the regeneration of game animals, development of hunting and forest management planning.

About two thirds of forest fund is managed by State Committee of Forestry (Table 2.1). Ministry of Agrarian Policy also manage quite a significant proportion of forest fund area.

The State Committee of Forestry carries out a normative function in forest and hunting management for all Ukrainian forests. The implementation and local administration are organised through regional state forest service enterprises (Table 2.2). The enterprises are usually located in small settlements and villages. The State Committee of Forestry manages about 380 enterprises and organisations, among them 294 are state forestry enterprises and specialised forest-hunting farms, 2 are national protected parks and 6 are nature reserves (UNECE 2002).

Forests which are administered by the Ministry of Agrarian Policy include those areas which are located in agricultural landscapes and have a critical importance for maintaining soil moisture levels and preventing wind erosion in arable lands. The management of those forests has been decentralised to a regional level. In 16 regions which have relatively more forest resources, agroforest enterprises undertake forest operations. In the remaining 9 oblasts, forests are managed through forestry departments within the main agricultural departments. Compared with forests managed by SFC, a bigger proportion of agricultural forests are categorised in Group I, where there are restrictions on commercial cutting (Ukraine: Forestry... 2006).

Table 2.1. Distribution of forest fund area between state departments (State Forest...2012).

Agency	Forest fund area	
	million ha	%
State Committee of Forestry	7.5	68
Ministry of Agrarian Policy and Food	1.8	17
Ministry of Defence	0.2	2
Ministry of Emergency Situations	0.2	2
Ministry of Infrastructure	0.1	1
Ministry of Environment and Natural Resources	0.1	1
Other	0.2	2
Reserve lands	0.7	7
Total	**10.8**	**100**

Table 2.2. Regional forest services in Ukraine (OULH = oblasne upravlinnya lisovoho ta myslyvskoho hospodarstva).

Region	Name of forest service	Website
Cherkasy	Cherkas'ke OULH	http://lis.ck.ua/
Chernihiv	Chernihivs'ke OULH	http://www.chernigivlis.com.ua/
Chernivitsi	Chernivets'ke OULH	http://www.cvoulg.cv.ukrtel.net/
Autonomous Republic of Crimea (including city of Sevastopol)	Respublikans'kyj komitet po lisovomu ta myslyvskomu hospodarstvu Avtonomnoi Respubliky Krym	http://www.comleshos.crimea-portal.gov.ua
Dnipropetrovsk	Dnipropetrovs'ke OULH	http://forest.dp.ukrtel.net/
Donetsk	Donets'ke OULH	http://www.les.dn.ua/
Ivano-Frankivsk	Ivano-Frankivs'ke OULH	http://www.forest.if.ua/
Kharkiv	Kharkivs'ke OULH	http://www.houlg.org.ua/
Kherson	Khersons'ke OULH	http://www.khersonlis.com.ua/
Khmelnytskyi	Khmel'nyts'ke OULH	http://www.kmlis.narod.ru/
Kiev (including city of Kiev)	Kyivs'ke OULH	http://www.kyivlis.org.ua/
Kirovohrad	Kirovohrads'ke OULH	http://www.lis.kr.ua/
Luhansk	Luhans'ke OULH	http://www.luglis.narod.ru/
Lviv	Lvivs'ke OULH	http://www.lvivlis.com.ua/
Mykolaiv	Mykolajivs'ke OULH	http://mikolaivlis.mk.ua/
Odessa	Odes'ke OULH	http://ulmg.odessa.gov.ua/
Poltava	Poltavs'ke OULH	http://upravles.com.ua/
Rivne	Rivnens'ke OULH	http://rivnelis.rv.ua/
Sumy	Sums'ke OULH	http://lis.sumy.ua/
Ternopil	Ternopil's'ke OULH	http://www.ternopillis.te.ua/
Vinnytsia	Vinnyts'ke OULH	http://wood.vn.ua/
Volyn	Volyns'ke OULH	http://voulg.org.ua/
Zakarpattia	Zakarpats'ke OULH	http://www.zakarpatlis.gov.ua/
Zaporizhia	Zaporiz'ke OULH	http://www.leshoz.zp.ua/
Zhytomyr	Zhytomyrs'ke OULH	http://lis.zhitomir.org/

2.2 Forest policy

In Ukraine, a separate Forest Policy has not been formulated. Instead, the Forest Code of Ukraine, which is the main legislative document in Ukrainian forest management, defines the role of Ukrainian forests (Nordberg 2007, Global Forest... 2010):

> Ukrainian forests are national assets whose designated functions, depending on their locations, have predominantly ecological (water protection, conservation, sanitation, recreation), aesthetic, educational and other uses, the use and exploitation of which are restricted and subject to State monitoring and protection.

Thus, non-wood values of forests have been given priority over their wood-producing function. This statement has already been mentioned in the Ukrainian forest code of 1979 (Polyakov & Teeter 2005). An important statement is also that local government bodies have influence upon the use of the forest resources on their territory (Nordberg 2007).

The Verkhovna Rada (Parliament of Ukraine) adopted the Law of Ukraine No. 3404-IV on the Amendments to the Forest Code of Ukraine introduced on 08.02.2006 which has been law since 31.03.2006. Now the process of developing the complexity of by-laws and regulations, which develop the main provisions of the Forest Code, is almost finished. Besides the Forest Code there are some other laws with a national scope that have an effect on forest management activities. Bearing in mind the aim of ensuring forest sector development, the Cabinet of Ministers of Ukraine (Document No. 208-p of 18.04.2006) approved Conception of Forestry Reforming and Developing. (Global Forest… 2010)

Conservation and regeneration of forests is regulated by the following Ukrainian laws (among others):

- Environmental Protection (25.06.1991 p. No. 1264-XII)
- Moratorium on Clear Cutting in Fir-beech Forests of the Carpathian Mountains (10.02.2000 p. No. 1436-III)
- National Ukrainian Program of National Ecological Network for 2000–2015 (21.09.2000 p. No. 1989-III)
- Nature-Reserve Fund in Ukraine (16.06.1992 p. No. 2456-XII).

The Ukrainian Land Code (25.10.2001 p. No. 2768-III) regulates land in relation to forest, flora and fauna management. It incorporates all the aspects of land use: territorial basis, natural and production resources, sustainable management and land protection, requirements of ecological safety, non-intervention in the activities of citizens, and legal entities and local communities related to their ownership, exploitation and land use, unless otherwise provided by the law. (State Forest...2012)

Ukraine has adopted several nature conservation programmes and legal documents directed towards biodiversity conservation. Among them are: Law on Econet (2004), Law on Red Data Book (2002), the series of Ministry of Environmental Protection Decrees on limits on the use of animal and plant species, Decree of the Cabinet of the Ministers on the Strategy for the Sustainable Development of the Carpathians (2006), Resolution of the Cabinet of the Ministers on the Cadastre of Plant Species (2006), Decree of the Cabinet of the Ministers on the Concept of the State Programme on Protected Areas until the Year 2020 (2006).

Ukraine ratified a number of selected treaties in the field of biodiversity conservation (European Landscape Convention (2005), African-Eurasian Waterbird Agreement (2002), Framework Convention on the Protection and Sustainable Development of the Carpathians (2004), Cartagena Protocol to CBD (2002), UN Convention on Combating Desertification (2002), The Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic Areas (2003). (Country Profile... 2010)

In Ukraine, forest management is organised on the basis the State Programme "Forests of Ukraine", approved by the Cabinet of Ministers in Resolution "State Programme: Forests of Ukraine 2010-2015", 16.09.09 No. 977. The programme defines the aims of forest management (State Forest...2012):

- to provide the industry with qualified managers and workers
- to improve the rational use of forest resources;
- to increase the percentage of forest cover to optimum levels in all natural zones (Table 2.3)
- to improve the productivity and quality of forests
- to enhance the nature-protective functions of forests, to conserve biological diversity
- to improve the resistance of forest ecosystems to negative factors and climate change
- to encourage the introduction of sustainable forest management
- to intensify the activities in protective afforestation and forest agro-melioration
- to develop regulative and legal bases in forest management and to harmonise them with the international principles of sustainable forest management
- to strengthen state control in the protection, conservation, exploitation and regeneration of forests
- to develop research and education in forestry
- to improve the social protection of forestry workers
- to promote international cooperation in the development of forestry industry
- to implement a recreation and tourism infrastructure
- to improve the efficiency of forestry management.

All activities are aimed at improving forest conditions and quality, ecological and protective functions, and forest productivity. The expected outcome of these activities is to finalise regulative and legal bases in forest conservation and regeneration, to develop the regulative system for sustainable forest management and forest resource exploitation, with a particular emphasis on the social, ecological and economic requirements. (State Forest...2012)

Table 2.3. Expected forestation and reforestation outputs from the implementation of the State Programme "Forests of Ukraine" (State Forest...2012).

Criteria	Unit	Year					
		2010	2011	2012	2013	2014	2015
Area of forestation	1,000 ha	28.7	52.3	62.4	83.5	95.1	107.7
Area of reforestation	1,000 ha	38.6	38.3	38.5	38.5	38.7	38.7

The expected outputs of the programme are an increase in forest covered areas of 0.5 million ha, in forest cover from 15.6% to 16.1%, and in growing stock by 16.7%. Along with the increase in forest harvesting activities, fulfilling the targets would improve the biological diversity in forests, have a positive influence at local, regional and global levels, and reduce land degradation and greenhouse gases in the atmosphere. Therefore it would mitigate global climate change (State Forest...2012).

The State Committee of Forestry is actively looking at international experiences in improving the management of forest resources. One of the possible directions is copying the model of managing state owned forests in Poland. Several reforms were carried out in 2010. The target of the reforms was to separate harvesting from other forest management operations in state forest management enterprises (similar to the approach in Russia in 2008).

Some of the former state forest management enterprises (leskhozes) were converted into private companies. The state subsidies were allocated to the newly established private forest management companies. The companies were responsible for the implementation of harvesting, forest regeneration, thinning and other forest management activities. The area and the scope of the activities were defined by State Committee of Forestry. As a result, in 2010 the share of the private forest management companies was 6% from the total state budget for forest management. In January–May 2010 around 53% of the wood was harvested by private SMEs. Consequently the wood prices in January-May 2010 reduced by 25%.

2.3 Forest industry policy

Despite its moderate forest resources, the forest industry in Ukraine has a fairly modest impact on a country level. A governmental target is to develop the forest industry sector. A Governmental Development Programme for the Wood Processing and Furniture Industry (2004–2011) was submitted at the end of 2004. The program includes proposals on several topics:

- modernisation of furniture manufacturing and wood processing
- establishment of new particleboard and medium density fibreboard (MDF) capacity
- research and development program (Ukraine: Forestry... 2006).

However, private sector investment in the wood industry may have been discouraged in some areas because of the inequalities in wood pricing between state forest enterprises and private enterprises. Other hindrances include:

- difficulty in arranging long term raw material supply contacts
- lack of clarity in relation to the procedures in obtaining cutting rights
- difficulty of accessing forest resource data for planning purposes
- changes in agreed contractual terms and conditions with different parties
- non-reimbursement of VAT on exports and ambiguity in taxation (Ukraine: Forestry... 2006).

Thus, improving the business environment so that beneficial private investment is possible is needed (Ukraine: Forestry... 2006).

3 Forest resources and their utilisation

3.1 Forest resources

In Ukraine, forests covers 9,705 million hectares, constituting 15.7% of the Ukrainian territory (Main Indicators... 2011a). The forest reserve area is 10.8 million hectares (State Forest...2012), including all forested areas and unforested areas which have been granted for forestry (Ukraine: Forestry... 2006).

Growing stock was 2,119 billion m³ in 2010. Thus, the average stock of forests was 218 m³ per ha. The amount of forests per inhabitant is modest, only 0.2 ha per person. Slightly more than half of the growing forest stock (1,172 billion m³) is available for management (Main Indicators... 2011a). Of the remaining growing stock there are restrictions in management caused by environmental and protection functions.

During the last 50 years, the area and volume of forests have been steadily increasing. During this period, the percentage of forest cover grew by approximately 50%, and the growing stock increased by 150% (Fig. 3.1). Governmental planning and strong reforestation and afforestation policies have prevented the overexploitation of Ukrainian forests. In forests managed by the State Committee of Forestry, the mean annual increment is equal to 4.0 m³ per hectare, and it varies from 5.0 m³ in the Carpathians to 2.5 m³ in the Steppe zone (State Forest...2012).

The forests of Ukraine are distributed very irregularly over the country (Map 7.1, Map 7.2) as a result of climatic conditions and anthropogenic impacts over a long period of time. There are several geographical zones: Polesia, Forest-steppe, Steppe, Carpathia and Crimea (Map 7.3), which differ greatly from each other. These areas have different forest growth conditions, and silvicultural methods and management. The largest forest territories are concentrated in the northern and western parts of the country, in the Polesia (mixed forests) zone and in the Ukrainian Carpathians (Fig. 3.2). On the other hand, the Crimea and Steppe regions have relatively low volumes. The Governmental target is to increase the forest area in all regions (Ukraine: Forestry... 2006).

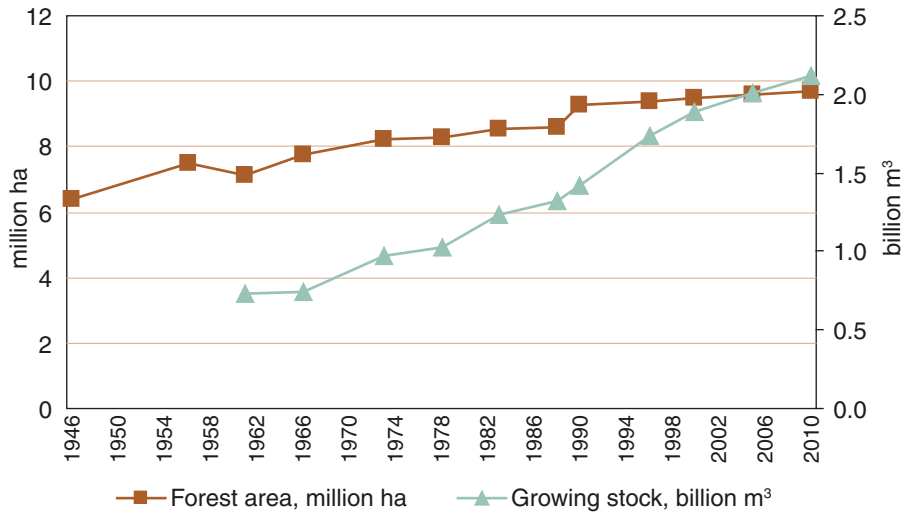


Figure 3.1. Dynamics of total area and volume of Ukrainian forests in 1946–2010 (Polyakov and Sydor 2006, State of… 2011).

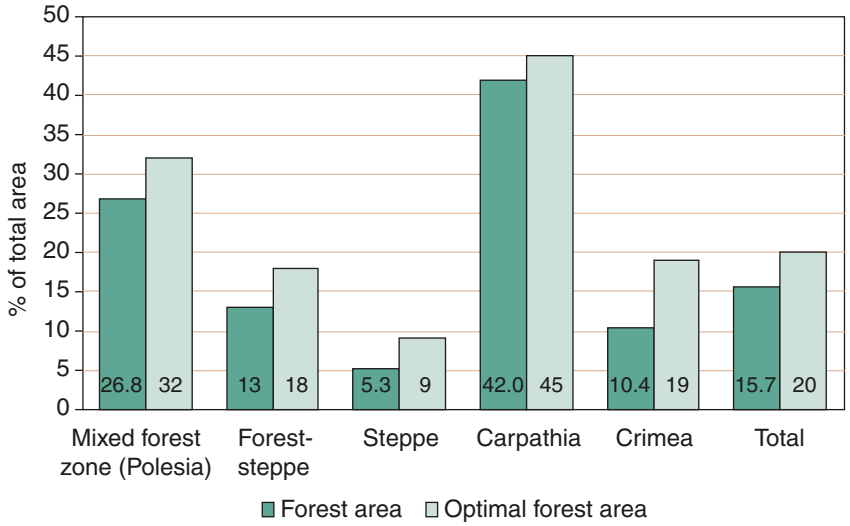


Figure 3.2. Forest area and optimal forest area of vegetation zones in Ukraine.

The average volume in different zones varies. The highest average volumes are in the Carpathian region, while the lowest volumes are in the Crimea and Steppe (Ukraine: Forestry... 2006).

Coniferous forests occupy almost half of the total forested area and more than half of the total growing stock. The most common coniferous species include pine (Pinus sylvestris), spruce (Picea abies) and silver fir (Abies alba). The most common hardwood species are European oak (Quercus robur) and common beech (Fagus sylvatica) (Table 3.1). Pine is dominant in Polesia and the northern part of the Steppe, oak in Forest-Steppe and the southern part of the Steppe, and spruce in Crimea and Carpathia.

Ukraine takes the 7th place in Europe for wood stock after Russia, Germany, Sweden, France, Poland and Finland. The annual net increment in Ukraine's forests was 20.9 million m³ in 2010 (Main Indicators... 2011a).

Table 3.1. Forest resources in forests managed by State Forest Agency of Ukraine (State Forest... 2009).

Species	Area 1,000 ha	% of total area	Growing stock million m^3	% of total growing stock
Ukraine	6,040	100	1,403	100
Pine	2,152	36	525	37
Spruce	500	8	167	12
Fir	95	2	29	2
Oak	1,703	28	330	24
Beech	531	9	171	12
Hornbeam	89	1	17	1
Ash	117	2	23	2
Birch	329	5	51	4
Aspen	33	1	7	0
Alder	255	4	42	3
Other	236	4	41	3

Table 3.2. Forested area by dominant species and age groups in forests managed by State Committee of Forestry of Ukraine (State Forest...2012).

Age class	Total		Coniferous		Hard deciduous		Soft deciduous	
	1,000 ha	%	1,000 ha	%	1,000 ha	%	1,000 ha	%
Young	1,360	23	838	62	427	31	95	7
Middle	2,811	47	1,206	43	1,319	47	286	10
Maturing	967	16	493	51	338	35	136	14
Mature	902	15	220	24	523	58	159	18

A significant proportion of Ukraine's forests are relatively young (Table 3.2). The largest share of the Ukrainian forests belong to the middle-aged group. Coniferous species have been preferred in reforestation during the last few decades which has led to their large proportion in the young age class.

A skewed age distribution has implications for the future wood supply. It will create undersupply and oversupply in the industry. This is partially caused by former afforestation patterns and technical norms which have only allowed final harvesting or regeneration felling when standing crops are mature or overmature (Ukraine: Forestry... 2006).

The distribution of forest resources by area in Ukrainian regions is presented in Map 7.4.

3.2 Forest classification

Ukrainian forests are classified in several classes (Ukraine: Forestry... 2006):

- group I forests (56%) which have primarily environmental and protection functions and a number of restrictions in management. These forests include
  - water protection (4%)
  - mainly erosion protection (30%)
  - sanitary or hygienic purposes (green zones and settlements) (19%)
  - special purpose forests (reserves, parks, etc.) (3%)
- group II forests (44%)
  - production forests (35%)
  - specially protected areas (9%).

Group I forests have a lot of management restrictions. In several subdivisions final fellings are prohibited, or there are other restrictions. One of the key issues in Ukrainian forestry is that unsuitable forest classifications and overly conservative harvesting levels impact negatively on good forest management (Ukraine: Forestry... 2006).

Between 1951 and 1990, the area of group I in Ukraine has more than doubled (Nordberg 2007). According to Nijnik (2002), the Ukraine National Academy of Science and the forest policy-makers have concentrated more on the ecological aspects of forestry than on the economic aspects. At the time of independence, Ukraine had among the largest protected forest territories in Europe

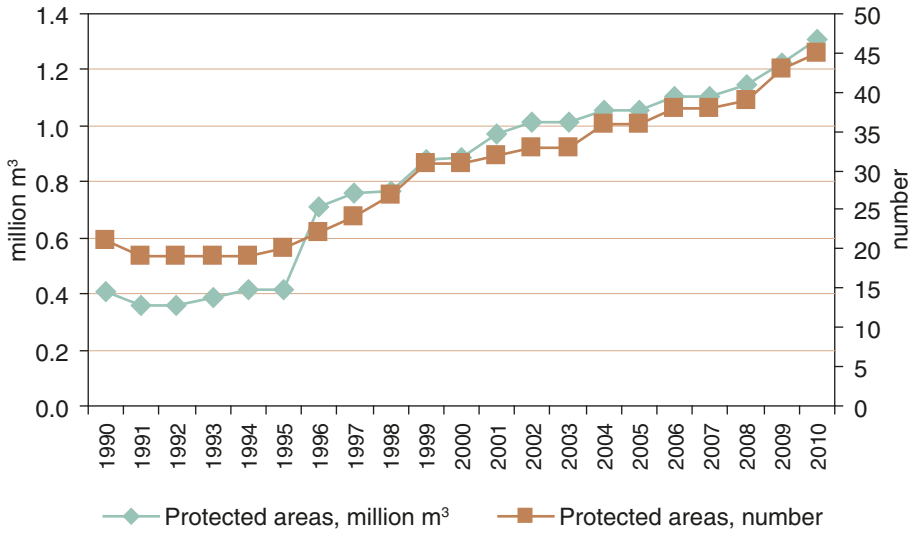


Figure 3.3. Development of area and number of protected areas (reserves and national nature parks) between 1990–2010 in Ukraine (Main indicators... 2011b).

(Bobko 1994). Still, protected forest land area is increasing (Nordberg 2007). The number and area of reserves and national nature parks is illustrated in Fig 3.3.

About 2 million hectares of degraded and abandoned arable land have been identified as being suitable for reforestation (Ukraine: Forestry... 2006).

The Chernobyl disaster significantly affected the Ukrainian forests. Radioactive fall-out covered some 3.5 million ha of forests, of which 157,000 have a high level caesium-137 (more than 555 kBq/m²) and cannot be exploited. In total 1.4 million ha have a lower pollution level (37–555 kBq/m²) and thus have restrictions on their management (Ukraine: Forestry... 2006).

The largest forest territories of radioactive contamination are situated in Zhytomyr (60%), Rivne (56%) and Kiev (52%) Oblasts (Map 7.5). In Volyn, Chernihiv, Cherkasy, Vinnytsia and Sumy Oblasts the proportion is near 20%. The State Committee of Forestry has organised a radiological service for controlling the radiation in timber (Buksha 2004). Contaminated areas of forest can release radionuclides, which creates a need for effective fire protection (Dusha-Gudym 2005).

3.3 Utilisation of forest resources

In Ukraine, the old model of state-owned forest management, harvesting and small-scale processing has remained (Nordberg 2007).

Forest management plans are prepared every ten years by Ukrdezhliproekt, based on a state monopoly. All forests that are managed by the State Forest Committee, Ministry of Environmental Protection, Ministry of Defence and Ministry of Emergency Situations have forest management plans.

A collective inventory of data is stored on a central database. The data is not geo-referenced which severely limits its use. Field measurements are also not usually statistically valid. Thus there is

no accurate and comprehensive data on forest resources. However, a new continuous inventory system has been introduced. Management and annual harvesting plans have a complicated annual approval procedure (Ukraine: Forestry... 2006).

The Ukrainian Forest code stipulates that the use of forests is performed in accordance with the procedure of the permanent or temporary use of forests. According to the law, the forests are granted into permanent use on the basis of decisions of executive power bodies or local self-government bodies.

All forests in state, municipal or private ownership can be the object of temporary use. Temporary use can be long-term for a term from 1 to 50 years, or short term for a term of up to 1 year. Forest management rights and responsibilities are transferred from the public administration to individuals or households through long-term leases or management agreements. Most timber harvesting is organised by state and private forest harvesting companies.

Roundwood is a major industrial forest product in the country. Annual harvesting is based on annual allowable cut (AAC). AAC is assessed during the forest inventory and planned for each forest enterprise and distinguished by tree species group. The actual harvesting amount usually equals 84–90% of the allowable volume of cutting. In general, the intensity of harvesting is substantially less than in other European countries (Lakyda et al. 2010).

In 2006–2008, Ukraine implemented several specific measures, including the preparation and approval of changes in legal acts, steps to form a transparent wood market (transfer to auction, stock trade), activation of work on forest certification, etc. (ENPI FLEG 2012)

During the 2000's, the AAC comprised from 5.2 to 5.7 million m^3 of commercial wood. Based on the current distribution of Ukrainian forests by age classes and number of activities planned by the government, it is expected that during the next decade, AAC will increase by 10–15% (Lakyda et al. 2010). There has not been any over-cut in Ukraine since 1965 (Gensiruk 1995). It is remarkable that AAC does not include thinnings.

As mentioned in chapter 3.2, Ukrainian forests are divided into two groups. In forests of the first group, wood harvesting is restricted and rotation ages are much longer than in the commercial forests of the second group.

In 2010, the total annual harvest of industrial roundwood comprised 18 million m^3. The development of harvesting is presented in Figure 3.4. In forests which are managed by the Ministry of Agrarian Policy, production is below average.

During the last few decades, the proportion of final fellings has been about 40–50% of total fellings. Other fellings are mainly sanitary fellings and thinnings (Dinamika objemov... 2011). The proportion of commercial thinning volumes fell during the 1990s, and have remained modest since then. This negatively affects wood growth and quality, and even fire hazards (Ukraine: Forestry... 2006).

In the 1950's about 50% of wood was harvested from the Carpathian natural zone in the western part of Ukrainian SSR. However, the proportion of Carpathia has decreased substantially during the years 1960–2000, and now cuttings in the natural zones of Polesia and the Forest Steppe constitute the majority of total cuttings (Popkov 2010).

The actual wood harvest by regions is presented in Figure 3.5. In Zhytomyr, Rivne, Kyiv, Chernihiv, Lviv and Zakarpattia Oblasts the total harvest volume exceeded one million m³. The relative proportion of other fellings is significant in regions with small amounts of total harvesting.

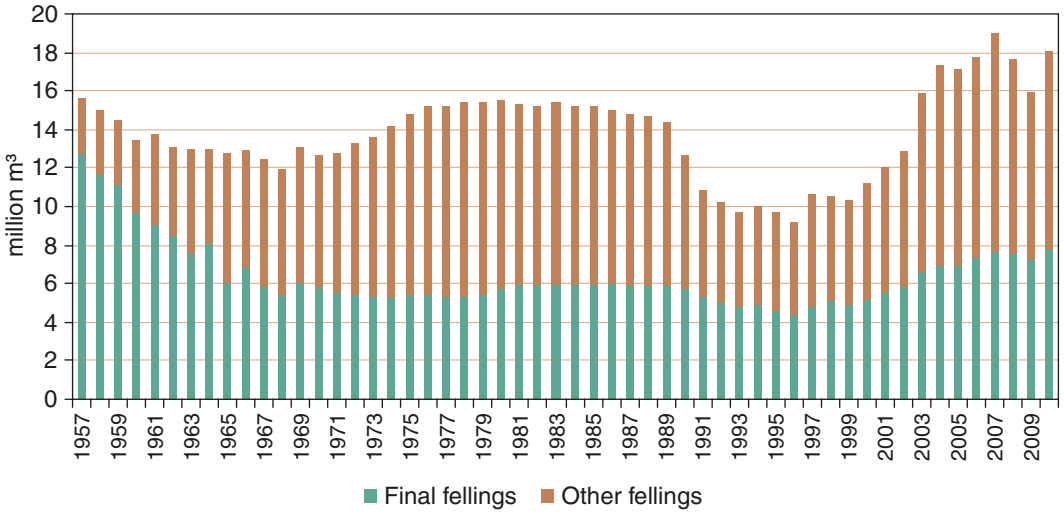


Fig. 3.4. Wood harvesting in Ukraine in 1957–2010 (Dinamika objemov… 2011, Main indicators… 2011b).

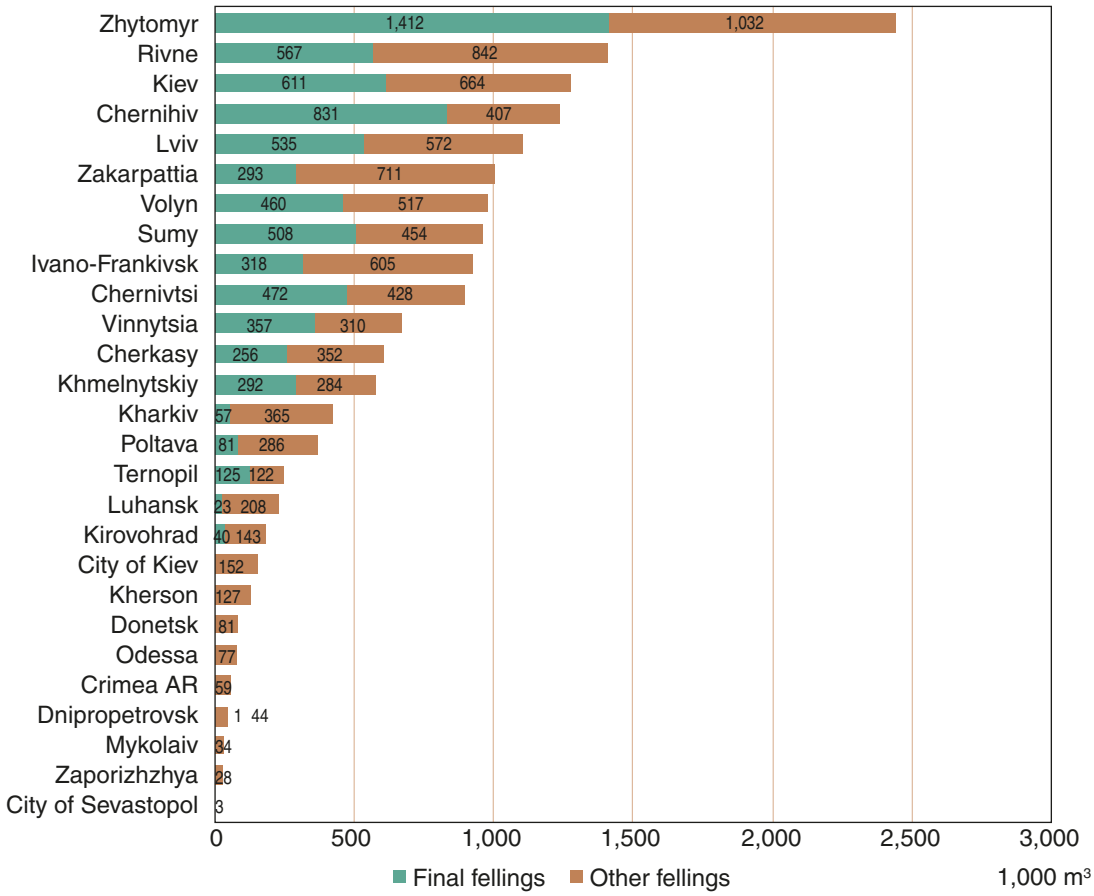


Fig. 3.5. Actual harvest in the regions of Ukraine in 2010 (Main indicators… 2011a).

Regional data of total harvesting, harvesting by area and harvesting by volume is presented in Maps 7.6, 7.7 and 7.8.

Harvested wood by tree species is illustrated in Fig. 3.6. Pine, oak, spruce and beech comprise in total more than two thirds of wood harvested. The main assortments of harvested wood from final felling are sawlogs, technical wood and firewood (Fig 3.7).

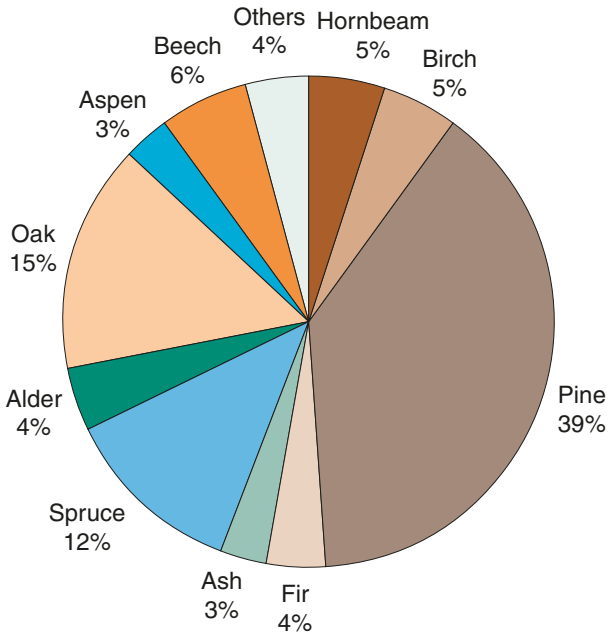


Fig. 3.6. Distribution of harvested wood by tree species (Energy potential… 2011).

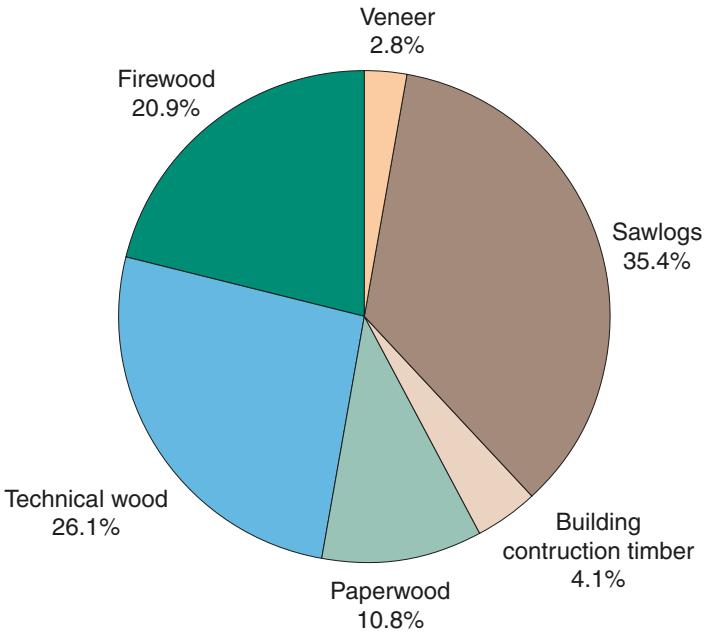


Fig. 3.7. Major assortments of wood harvested (Energy potential… 2011).

Logging work is mechanised in Ukraine. The harvesting machinery consists mainly of skidders with tracked or wheeled skidders for flat and sloped terrain. A few cable systems exist on steeper slopes (Ukraine: Forestry... 2006). Wood is primarily transported by wheel skidders made in Belarus (LT-157, MTZ-82L and MTZ 82.2) and Slovakia (LKT-81 and LKT-120), etc. Felling is usually carried out with chain saws (Lakyda et al. 2010). The State Committee of Forestry lacks the capacity for harvesting, and the equipment is usually inferior to the contractors'. There is an urgent need for new investment (Ukraine: Forestry... 2006).

Illegal logging has been acknowledged by key actors in Ukraine. However, the estimates of the volumes of illegal logging differ significantly. According to the State Committee of Forestry, the total volume of illegal logging in 2008 was about 20,000 m³. However, according to some expert estimations the average annual volume of illegal logging reaches 1.25 million m³ (Pavelko & Skrylnikov 2010).

3.4 Silviculture

Afforestation and reforestation are traditional in Ukraine from an environmental point of view. Success has been achieved in the growth of the Steppe forest as far back as the 18th century. However up until the 1920s, the efforts of the foresters concerning afforestation were isolated and episodic. The protection of land by means of tree-planting was considerably hampered by economic and social conditions. (Nijnik 2002)

The highest level of afforestation and forest regeneration was reached in 1951–1955. With time, the afforestation of marginal lands has become more difficult and expensive since the lands that were most suitable for tree-planting have been already afforested (Nijnik 2002).

During the 2000's, areas of reforestation increased (Fig. 3.8). In 2010, the total area of reforestation was 70,100 hectares.

Later, methods of logging operations moved away from clear-cutting and were partially replaced by selective and gradual cut, further reducing the area requiring tree-planting. Recently, tree-

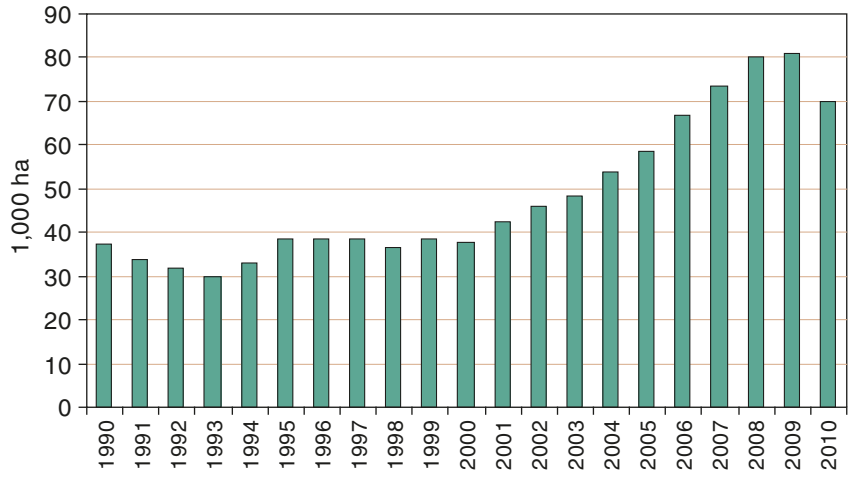


Fig. 3.8. Reforestation in Ukraine in 1990–2010 (Main indicators... 2011b).

planting activities have decreased further and the share of natural regeneration after wood harvesting has risen, especially in forestry zones where the conditions are favourable for natural forest renewal. Together with afforestation and reforestation, both artificial and natural, the creation of protective forest belts around fields, water basins, and industrial agglomerations and along roads is a recognised as a sustainable measure of rural policy.

Modest harvesting levels and the inappropriate classification of forests have impacted negatively on forest management. Less than 30% of the estimated annual growth is harvested. In addition, a high proportion of harvests are sanitary cuttings in which the quality of wood is poor. This has been explained, for example, by the following (Ukraine: Forestry... 2006):

- a significant area of the forest estate is classified as protection forest where commercial harvesting is restricted (there are limitations on almost 50% of the forest area)
- the potential sustainable area for harvesting is underestimated
- final and regeneration felling ages which are set by the technical norms are too high.

Over 1.2 million hectares of wooded hedges, including 0.5 million hectares of wooded lands around fields, have been created throughout the country to prevent soil destruction and to increase land productivity. These wooded areas protect 13 million hectares of arable land. Protective wooded areas in particular are helpful during periods with extreme weather conditions when forests save the soil and the harvests (Nijnik 2002).

Certification is organised according to the requirements of the Western European market. Accession of traditional importers of Ukrainian timber articles – in particular, Poland, Slovakia, and Hungary – to the European Union in May 2004 was a powerful incentive for developing forest certification in Ukraine. Correspondingly, demand for certified timber articles from these countries has grown significantly. Organisations, which recently passed certification procedures and received their certificates, include all state forestry enterprises subject to the State Committee of the Forestry of Ukraine located in Zakarpattia and Lviv Oblasts, as well as particular state forestry enterprises in Rivne, Zhytomyr, and Kiev Oblasts. Ukraine began its first activities in voluntary forest certification as a procedure, which evaluates correspondence between forestry management and sustainable development principles, back in 1999. (Timber industry...2007)

About 6 enterprises were certified according to the international FSC system between 2006–2010. According to the FSC Certificate Database (2011) the total area of certified forests is 823,764 ha which is managed by 6 organisations.

3.5 Forest roads

Ukrderzliprojet is responsible for all tasks related to the forest road network. Road building is usually carried out by private or state organisations. The total length of roads in the Ukrainian forests is 74,400 km according to statistical data. About 17,000 km is in common use. Thus, the density of the forest road network is 10.1 m/ha (7.8 m/ha on roads in common use) (Pryimachuk 2010).

The density of the road network differs in different parts of Ukraine. In mountainous areas the density is only 3.5–6 m/ha. More than half the forest roads are narrower than normative indexes require. 85% of forest roads are built without cover (Styranivskyi et al. 2009).

Road density is significantly lower compared with other countries with similar conditions. The existing road network is also in poor condition and a great proportion of it needs reconstruction. Forest road network deficiencies increase the cost of harvests and lengthen skidding distances. Therefore, it causes over-harvesting near the existing networks and under-harvesting in inaccessible areas and results in erosion in skidding routes (Ukraine: Forestry... 2006).

4 Forest industry

4.1 Development of forest sector

The forest industry forms 1.1% of the GDP in Ukraine. The forest sector plays an important role in rural areas with high unemployment by the provision of work and maintenance of rural communities (Ukraine: Forestry... 2006).

In the 1990s, the forest industry suffered a deep crisis, ownership changes, loss of supplies of cheap timber and traditional sales markets, inflation, as well as a lack of necessary investment. The wood industry's share in gross industrial GDP of the country decreased from 2.9% in 1990 to 1.7% in 1998, but later rose to 2.4% in 2000. (Timber industry...2007)

A significant proportion of the large-scale forest industry was closed in the mid 1990s, and recovery has been slow. The loss of cheap raw material, which was previously obtained from the Russian SSR caused major problems (Nordberg 2007). The industry's machinery was outdated and depreciated long ago. Investment flow into the industry made it possible to change negative tendencies for the better. Starting from 2000, production of commodities and provision of services started to grow steadily. Domestic and foreign investments and proceeds from exports are among the major sources of finance. In 2008, the global economic crisis heavily affected Ukraine. (Timber industry...2007)

Most of the forest industry has been privatised in Ukraine with the exception of small wood processing enterprises (Buksha et al. 2003). Northern and western regions of Ukraine, where significant forest resources are concentrated, gave the priority of development to wood working and the furniture industry (Timber industry...2007).

The key manufacturing areas are the production of paper and cardboard items (44% of the entire output), production of plywood, plates, panels, and veneer (19%). (Timber industry...2007)

4.2 Employment and location of industry

According to the Forestry sector note (Ukraine: Forestry... 2006) 350,000 people are employed by the forest sector and 260,000 of them work in the private sector. The estimated total employment contribution, which also includes indirect positions, is about 500,000.

In the forests of the State Committee of Forestry, about 80% of harvesting is conducted by State Forestry Enterprise workers. Only 5–10% of harvesting is by contractors which are hired by the Committee. A special characteristic of the Carpathian region is that standing trees may be sold (Ukraine: Forestry... 2006).

The number of wood working enterprises has grown from the beginning of 2000s, mostly due to small firms involved in timber sawing. Corporate or collective (including joint stock companies) and private ownership are the dominant forms, but joint ventures are also developing. One of the key tasks in the industry is to increase production of high value added wood products.

Many State Forest Enterprises have their own processing plants. The State Committee of Forestry is primarily self-funded by the sale of logs, non-timber forest products, game and processed wood products. The State gets additional tax returns with value added industries such as sawmilling, paper, and the board industry. Returns to the State could be multiplied by increasing harvesting, improving cost effectiveness in forest management and harvesting and increasing the development of the private sector in relation to value added industries (Ukraine: Forestry... 2006).

The largest volumes of timber production are attributed to the Kiev region (including the city of Kiev), Lvov, and Zakarpattia regions. Important factories are identified in Map 7.9.

4.3 Use of wood

Before independence, the annual harvesting level in Ukraine was 15 million m³. The total use of roundwood equivalent was 36–38 million m³. Hence, imports from Russia and Belarus were significant (Buksha et al. 2003). The current roundwood removals and foreign trade is presented in Fig. 4.1. According to official statistics, the level has recently been in the region of 17 million m³ per year. However, it has to be noticed that in some cases FAO statistics differ slightly from national statistics.

It is worth noting that a great proportion of roundwood removals is low-quality wood, which is used as firewood or for other purposes with low quality requirements. This is caused by the significant amount of sanitary cuttings where the quality is poor.

Often high-quality roundwood is exported, and lower-quality logs are processed by the State Forest Enterprises and semi-processed products as unprocessed sawnwood are exported (Ukraine: Forestry... 2006).

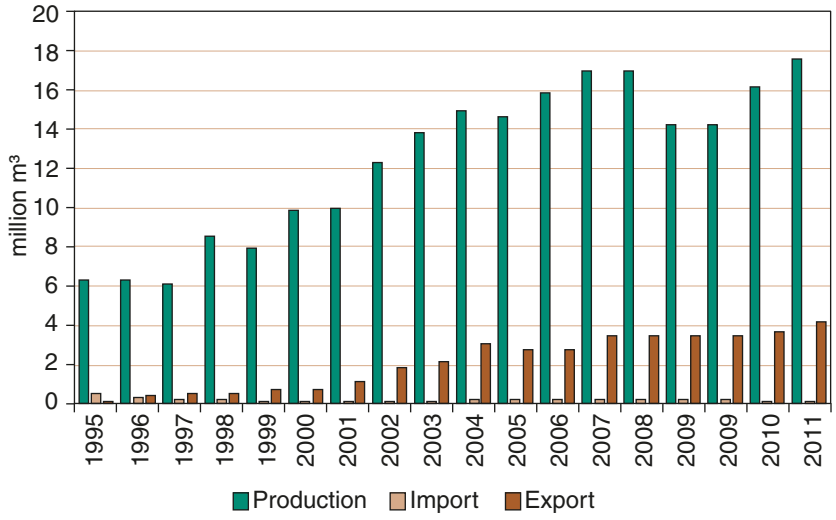


Fig. 4.1. Removals and foreign trade of roundwood in Ukraine (FAOSTAT 2011).

There is a great potential for increasing harvesting levels in Ukrainian forests by allowing sustainable silvicultural operations and lowering the final harvest ages. At the moment, less than 30% of the estimated gross annual growth is harvested. By increasing the harvest level to European average levels the annual harvest could be more than doubled (Ukraine: Forestry... 2006).

There is also potential for processing large quantities of small-diameter roundwood or for using it as bioenergy (Ukraine: Forestry... 2006).

During the 1990s, sawlog and sawnwood sales have been reorienting, especially within the EU and Turkey (Nordberg 2007). The strong decrease in domestic demand for low-quality wood for the pulp and board industry has been hard to compensate for. It has negatively influenced the possibilities of carrying out thinning, which creates problems for the profitability of future final fellings (Nordberg 2007).

The State Forest Enterprises have to pay a stumpage fee on harvested timber to the central government budget. The system was developed during the Soviet Union. The quantity of fee is related to the purpose of use of the wood and its quality (Ukraine: Forestry... 2006). In Ukraine, state forest enterprises have been both forest users and forest industry owner. Typically they have had one or more small sawmills and some production of upgraded products.

In 2010 around 300 companies were operating in the forest sector of Ukraine. The highest concentration of companies was in Kiev and Zakarpattia Oblasts. The largest customers of industrial wood are presented on Map 7.10.

4.4 Production trends, exports, imports

Since 2000, the forest industry of Ukraine has been developing steadily (Figs. 4.2–4.7). The main drivers for development were the export of processed timber and growth in the construction business. Ukraine is a net exporter of roundwood (Fig. 4.1), sawnwood (Fig. 4.2) and plywood (Fig. 4.3). The main export products (roundwood and sawnwood) are unprocessed or marginally processed, and hence there is a significant potential for further processing within the country.

Import and export of particle board are roughly balanced (Fig. 4.4). However, Ukraine is a net importer of fibreboard (Fig. 4.5). The domestic production of fibreboard decreased during the 2000s.

At the moment there is practically no domestic pulp production in Ukraine (Fig. 4.6). The annual import of pulp is more than 100,000 m³. Also the paper and paperboard industry production does not fulfil the domestic need (Fig. 4.7). Consequently, these products account for a great proportion of imports in the forest sector. Pulp and paper is imported mainly from the Russian Federation (Regional Workshop... 2010).

Consumption of forest products per capita is significantly below the European average. Collection of non-wood forest products is an important activity for the local population. Important non-wood forest products in Ukraine include resins, Christmas trees, wild fruits and berries, and birch sap (Regional Workshop... 2010).

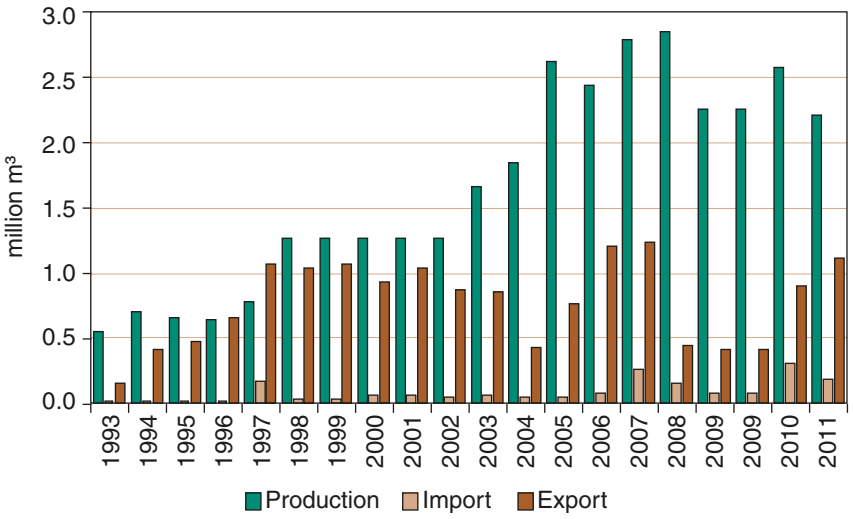


Fig. 4.2. Production trends, imports and exports of sawnwood (FAOSTAT 2012).

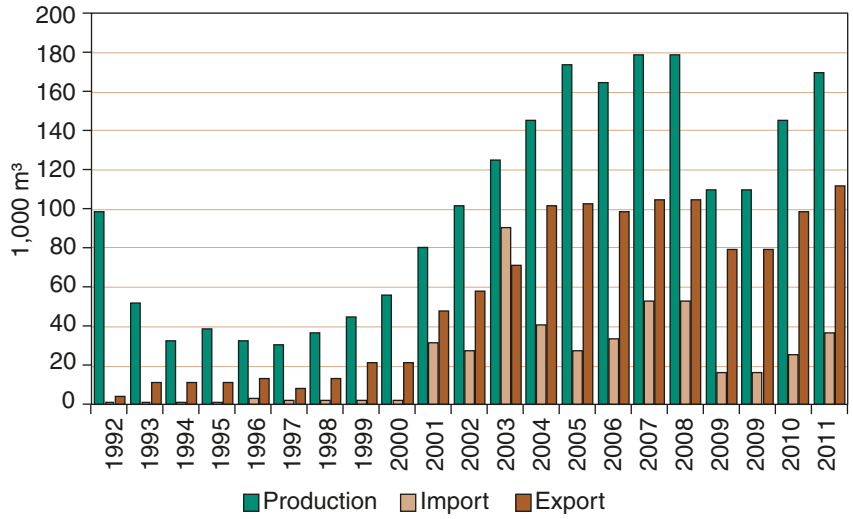


Fig. 4.3 Production trends, imports and exports of plywood (FAOSTAT 2012).

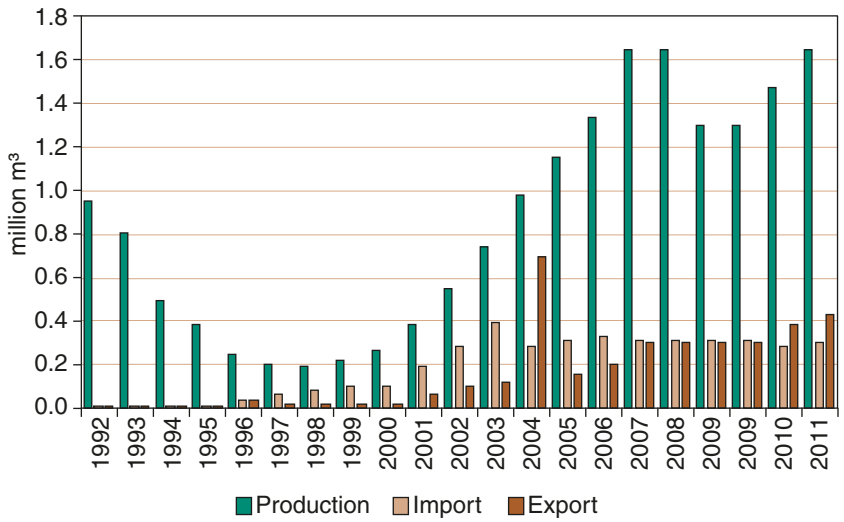


Fig. 4.4 Production trends, imports and exports of particle board (including OSB) (FAOSTAT 2012).

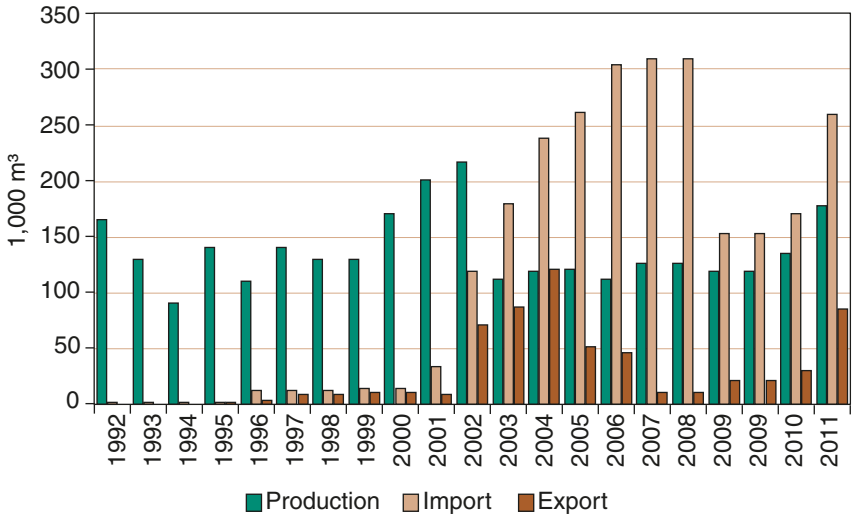


Fig. 4.5. Production trends, imports and exports of fibreboard (FAOSTAT 2012).

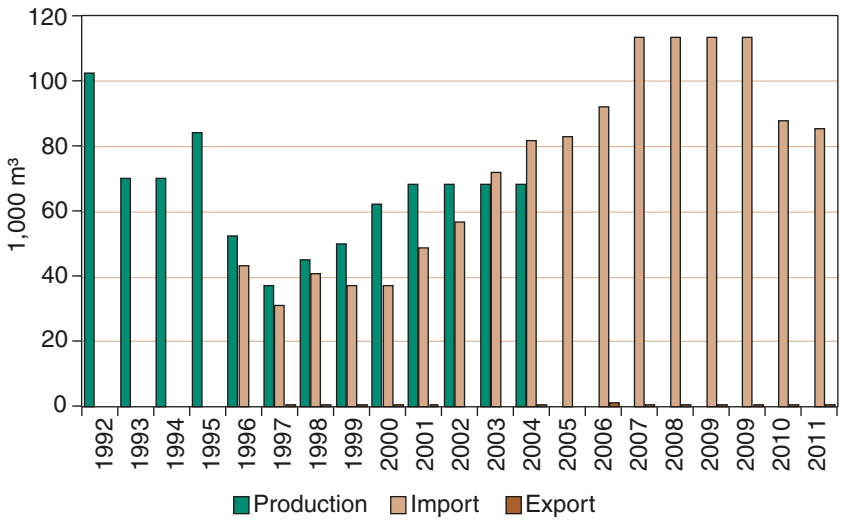


Fig. 4.6. Production trends, imports and exports of pulp (FAOSTAT 2012).

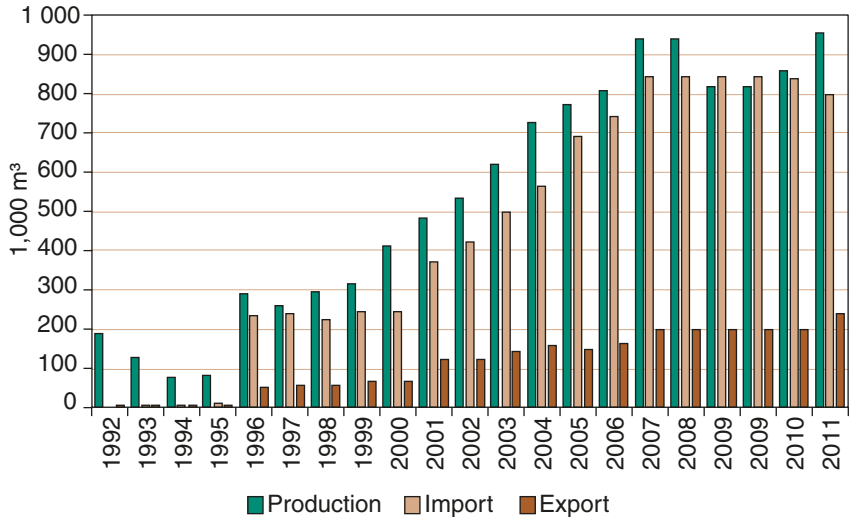


Fig. 4.7. Production trends, imports and exports of paper and paperboard (FAOSTAT 2012).

The structure of export is presented in Figs. 4.8–4.13. It is worth noting that in the statistics for several products the sum of combined export to all countries was not equivalent to the total export quantity reported. The proportions are scaled so that the sum is 100%. Thus, a very critical examination of the following figures is needed.

The chief export countries for roundwood in 2010 were Turkey, Romania and Slovakia (FAOSTAT 2012). The amount of exported roundwood is decreasing as a result of government policy (Regional Workshop.. 2010). Ukraine has been an important supplier of pulpwood to Europe.

The main export directions of sawnwood timber from Ukraine were Italy, Germany and Turkey in 2010. For particleboard, the main export countries were Poland, Romania and Hungary, for plywood the Netherlands, Turkey and Germany, and for fibreboard it was Vietnam and Romania. For paper and paperboard, Russia is by far the principal export partner for Ukraine (FAOSTAT 2012).

The production and consumption of wood products are expected to grow in Eastern Europe. With lower domestic prices compared with Poland and Hungary, Ukraine is well positioned to compete with other countries in the region and benefit from market growth in the east. This also creates possibilities to increase penetration on higher value markets in Western Europe (Ukraine: Forestry... 2006). Most of Ukraine's imports of wood and wood products come from Russia (FAOSTAT 2012).

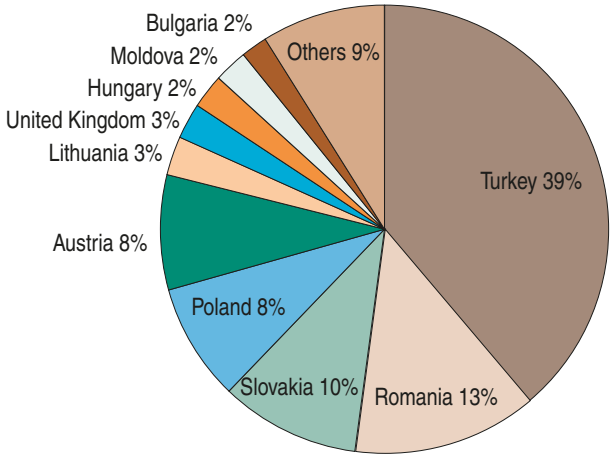


Fig. 4.8. Industrial roundwood export according to country in 2010 (FAOSTAT 2012).

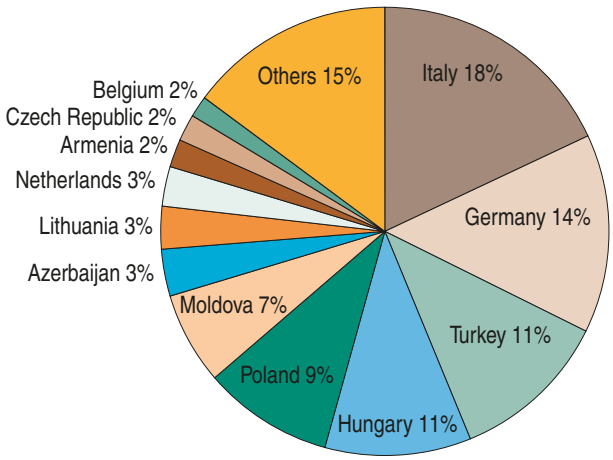


Fig. 4.9. Sawnwood export according to country in 2010 (FAOSTAT 2012).

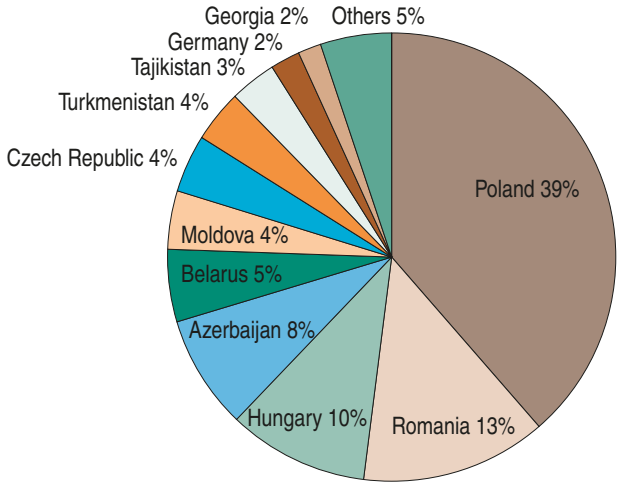


Fig. 4.10. Particle board export according to country in 2010 (FAOSTAT 2012).

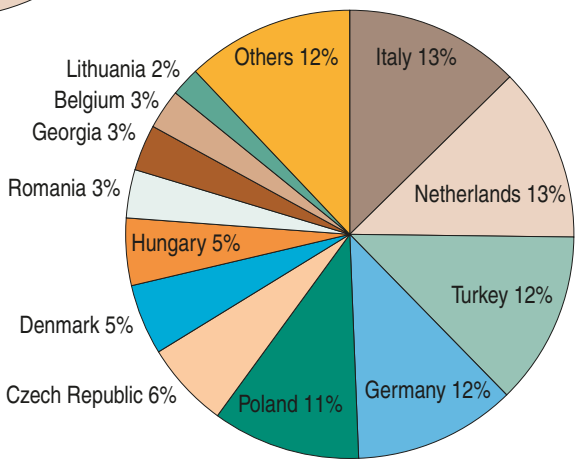


Fig. 4.11. Plywood export according to country in 2010 (FAOSTAT 2012).

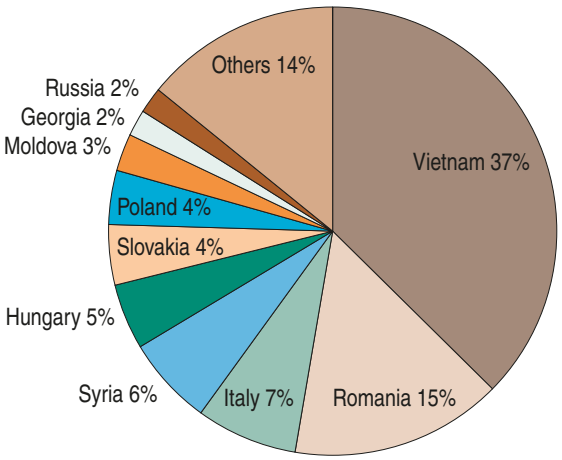


Fig. 4.12. Fibreboard export according to country in 2010 (FAOSTAT 2012).

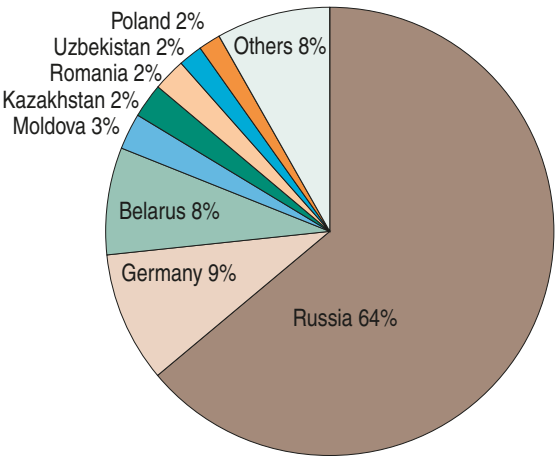


Fig. 4.13. Paper and paperboard export according to country in 2010 (FAOSTAT 2012).

5 Forest education and research

5.1 Forest education

In Ukraine, higher education is divided into four levels:

- level I – vocational schools
- level II – technical secondary schools and colleges
- level III and IV – universities, academies, institutes and conservatories.

The training of forest specialists is in four-levels respectively (junior specialist, bachelor degree, specialist's and master degree) (Ukrainian's National... 2008).

Short training courses and the retraining of forestry workers is organised in "forest schools" (Table 5.1). Education at level I is organised in forest colleges which carry out the education of junior specialists (Table 5.2).

In Berezne Forest College there has also been some practice in preparation towards the bachelor degree (level II) (Regional Workshop... 2010). From the colleges and technical schools a total of about 1,600 students graduate annually. In addition, each year about 1,200 forestry senior workers and specialists take supplementary education at the Ukrainian State Forestry Staff Training Centre "Ukrcentrkadrylis" (State Forest...2012). In addition to these, the training of junior specialists in forestry is carried out at other colleges and in one institute, which are under authority of other ministries and departments (Table 5.3) (Global Forest... 2010).

There is only one institute which provides education to level III (Table 5.4). Level IV education is provided in universities. Four universities provide education in forestry (Table 5.5).

Table 5.1. Forest schools in Ukraine (State Forest...2012).

Name	Location	Subordination	Website
Berezne Forest School Березнівська лісна школа	Berezne, Rivne Oblast	State Committee of Forestry	–
Chornolis Forest School Чорноліська лісна школа	Vodyane, Kirovohrad Oblast	State Committee of Forestry	–

Table 5.2. Forest colleges and technical colleges (State Forest...2012, Global Forest... 2010).

Name	Location	Subordination	Field	Website
Shatsk Forest College Шацький лісовий коледж	Shatsk, Volyn Oblast	State Committee of Forestry	Forestry	–
Berezne Forestry College Березнівський лісовий коледж	Berezne, Rivne Oblast	State Committee of Forestry	Forestry Business accounting	http://www.blk.org.ua/
Storozhynets Forest College Сторожинецький лісовий коледж	Storozhynets, Chernivitsi Oblast	State Committee of Forestry	Forestry Business accounting	http://www.liskoleg.ipsys.net/
Kremenets Technical Forest College Кременецький лісотехнічний коледж	Kremenets, Ternopil Oblast	State Committee of Forestry	Forestry Operation and maintenance of forestry equipment	http://klk-kremenets.at.ua/
Malyn Technical Forest College Малинський лісотехнічний коледж	Malyn, Zhytomyr Oblast	State Committee of Forestry	Forestry Forest harvesting Hauling Operation and maintenance of forestry equipment Business accounting	http://mltk.org.ua/
Lubny Technical Forest College Лубенський лісотехнічний коледж	Lubny, Poltava Oblast	State Committee of Forestry	Forestry Business accounting Agronomy	http://www.llk.org.ua/
Chughuevo-Babchans'k Forest College Чугуєво-Бабчанський лісний коледж	Kharkiv Oblast	State Committee of Forestry	Forestry Operation and maintenance of forestry equipment Business accounting Hunting management	–
Velykoanadol'sk Forest College Великоанадольський лісовий коледж	Donetsk Oblast	State Committee of Forestry	Forestry Operation and maintenance of forestry equipment	http://www.valk.hut2.ru/

Table 5.3. Colleges and instituties which carry out education for forestry under subordination of other ministries and departments (Global Forest… 2010).

Name	Location	Subordination	Website
Prikarpatskiy Forest College Прикарпатський лісогосподарський коледж	Bolekhiz, Ivano-Frankivsk Oblast	Local administration	http://forestcollege.if.ua/
Vinnytsia Transport College Вінницький транспортний коледж	Vinnytsia, Vinnytsia Oblast	Ministry of Transport	http://vtk.vinnica.ua/zaoch.html
Boyarka College of Ecology and Natural resources Боярський коледж екології і природних ресурсів	Boyarka, Kiev Oblast	Cabinet of ministers of Ukraine (in the structure of National Agrarian University)	http://boyarkacollege.org.ua/
Berezhany Agrotechnical Institute Бережанський агротехнічний інститут	Berezhany, Ternopil Oblast	Cabinet of ministers of Ukraine (in the structure of National Agrarian University)	http://www.bati.ber.te.ua/
Horodyshche Agrarian College Городищенський коледж Уманського державного аграрного університету	Horodyshche, Cherkasy Oblast	Ministry of Agrarian Policy	http://mrada.hmarka.net/Koledsw.shtml
Zakarpatskiy Forest College Закарпатський лісотехнічний коледж	Zakarpattia Oblast	Ministry of Education and Science (in the structure of National Forest Engineering University of Ukraine)	http://woody.at.ua/
Lviv Technological college Технічний коледж Національного університету “Львівська політехніка”	Lviv, Lviv Oblast	Ministry of Education and Science (in the structure of National Forest Engineering University of Ukraine)	http://techcol.com.ua/

Table 5.4. III level education on forestry (Global Forest… 2010).

Name	Location	Subordination	Website
Nadluchanskiy Institute Надслучанський інститут	Berezne, Rivne Oblast	Private ownership	

Table 5.5. University education in forestry.

Name	Location	Subordination	Website
National Ukrainian University of Forestry Engineering	Lviv, Lviv Oblast	Ministry of Education and Science	http://www.forest.lviv.ua/
National University of Life and Environmental Sciences of Ukraine	Kiev, Kiev Obast	Ministry of Education and Science	http://nubip.edu.ua
Kharkiv National Agricultural University named after V.V. Dokuchaev	Kharkiv, Kharkiv Oblast	Ministry of Education and Science	http://www.knau.kharkov.ua/
Zhytomyr National Agroecological University	Zhytomyr, Zhytomyr Oblast	Ministry of Education and Science	http://www.znau.edu.ua/

5.2 Forest research

There are two scientific institutions in Ukraine which have concentrated on forestry research (Table 5.6).

The Ukrainian Research Institute of Forestry and Forest Melioration (URIF&FM) is the leading forestry research centre in Ukraine. The Ukrainian Mountain Forestry Research Institute (UMFRI) is a research centre which carries out research related to forest management in mountainous areas (Global Forest... 2010).

URIF&FM has a Steppe division in Kherson and a Polesia division in Zhytomyr. It also has 7 forest research stations: in Vinnytsa, Kiev, Krasnotrostyatets, Crimea, Luhansk, Mariupol and Novgorod-Siverskiy (Global Forest... 2010).

UMFRI conducts research in the mountainous Carpathian region (in Ivano-Frankivsk, Zakarpattia, Lviv and Chernivtsi Oblasts). The institute has a research and experimental base in Mukacheve, control station in Ternopil and also hydro-stations (Global Forest... 2010).

In 2004, by the joint decision of the National Academy of Science and the State Committee of Forestry, URIF&FM and UMFRI have been in dual subordination. The National Academy of Science is answerable for research and methodology and the State Committee of Forestry answers for both financial and economic activities and for research and methodology (Global Forest... 2010).

Table 5.6. Forest research institutes in Ukraine (Global Forest… 2010).

Name	Location	Subordination	Website
Ukrainian Research Institute of Forestry and Forest Melioration named after G.N. Vysotsky Український науково-дослідний інститут лісового господарства і агролісомеліорації ім. Г.М.Висоцького	Kharkiv, Kharkiv Oblast	National Academy of Science, State Committee of Forestry	http://uriffm.org.ua/
Ukrainian Research Institute of Mountain Forestry named after P.S. Pasternak Український науково-дослідний інститут гірського лісівництва ім. П.С.Пастернака	Ivano-Frankivsk, Ivano-Frankivsk Oblast	National Academy of Science, State Committee of Forestry	–

6 Energy wood potential

6.1 Energy consumption and bioenergy targets

Ukraine is one of the most energy intensive countries. In 2010, the primary energy consumption was 5.31 EJ (Business Monitor... 2011a). Gas was the dominant fuel, accounting for 37% of the primary energy demand, followed by coal at 32%, nuclear energy at 17% and oil at 13% (Business Monitor... 2011b).

Energy production from biomass forms about 38 PJ/year, which is only 0.65% of the total primary energy consumption. The majority of bioenergy is produced from wood residues. Biomass usage, mainly for heating purposes, is relatively common in rural areas, and in many villages biomass-fired boilers have been installed for small district heating systems (Geletukha 2008). Ukraine has a plenty of energy intensive industries, especially in the eastern part of the country, and energy-efficiency is poor.

Ukraine is dependent on imported energy. Despite having oil, gas, coal and shale gas and bioenergy reserves, it is only able to cover 47–49% of its energy needs and is dependent on Russia for energy resources (Patronyk & Zhovka 2010).

There are several sources of bioenergy in Ukraine. The main possibilities include agriculture residues (straw, energy crops, etc.), wood residues and byproducts and biogas production (Lakyda et al. 2010). Due to the large areas of arable land, primary agricultural residues have a much higher potential compared with the other sources of bioenergy (Lakyda et al. 2010).

The Energy Committee of Ukrainian parliament has coordinated the energy strategy of Ukraine including the selection of renewable energy sources. According to the strategy which was accepted by the Parliament in 2006, the targeted utilisation of renewable energy sources is 276 PJ (4.7% of primary energy consumption [PEC]) in 2010 and 1.030 EJ (17.5% of PEC) in 2030. The target for biomass is 79 PJ (1.35% of PEC) in 2010 and 272 PJ (4.6% of PEC) in 2030 (ESCOB, 2007). This is a modest proportion related to the strategic targets of many European countries (Elbersen & Waarts 2009).

However, increasing the proportion of bioenergy sources in Ukraine would only slightly improve the self-sufficiency of the energy sector. There are several factors which support these efforts. Ukraine has tried to reduce dependency on the Russian energy source of natural gas. Also, Ukraine's nuclear power plants are ageing which increases the need for new investment in energy.

A certain legislative framework related to forest biomass usage has already been created. In 2009, the law "Alternative types of fuel" was approved in parliament. This law provides the legislative basis and economic incentives for the implementation of modern technology for forest biomass usage for energy purposes. The Cabinet of Ministries also allocated grants (25 million hryvnias, approximately 2.5 million euros) for the procurement of technologies for harvesting and utilising wood residues as pellets and transporting them to municipal or regional heating plants (Lakyda et al. 2010).

However, in the absence of notable investment in alternative markets for small wood processing, bioenergy could provide the potential for small wood (Ukraine: Forestry... 2006). Estimates indicate that the current level of potential energy from wood is significant and annual use could be increased by 10–15 times. There is practically no pulp production in Ukraine. Because of this,

the demand for low-quality and small-diameter wood, which accounts for a great proportion of total roundwood removal, is small.

The demand for biofuels and heatings plants may grow in the near future, because subsidies in gas prices are ending which enhances the competitiveness of alternative energy sources. This is supported by the aging heating plants requiring modernisation in the country. The modernisation programmes of outdated heating plants and investment programmes for producing alternative energy sources has been on the political agenda. In Ivano-Frankivsk Oblast the European Bank for Reconstruction and Development (EBRD) finances investments in communal bioenergy heating plants. In Sumy Oblast there is an ongoing programme in which gas is substituted with wood briquettes. The use of wood chips is insignificant in Ukraine.

Peat is used to some extent as an energy source. However, the significance of peat is lower than, for example, in Finland or Belarus. There are about 500 peat extraction sites in the country. About 80% of peat is used as fuel. Peatlands are located in the northern part of the country.

6.2 Theoretical and potential energy wood usage

Based on the calculations of Lakyda et al. (2010), and taking into account the growing stock in 2010 (2.119 billion m³), the total energy content in forest biomass is approximately 27 EJ. In totally 22 EJ of this is aboveground wood. The technical and economic potential is much smaller compared with the theoretical amount. The theoretical and technical potential of wood for bioenergy (according to Lakyda et al. (2011)) is presented in Table 6.1.

In another report (Biomass Potential... 2007) the potential proportion of wood energy estimated would be only half of this, 40 PJ. The main reason for different numbers seems to be the differences in estimation of the potential of stemwood in bioenergy.

There are major differences in the potential of different regions in Ukraine (Table 6.2). Technical and theoretical bionenergy potential in different regions are illustrated in Map 7.11.

The greatest technical potential for wood energy is in areas with plenty of forests, such as Zhytomyr, Zakarpattia, Lviv, Kiev and Chernihiv Oblasts. In these areas there are the economic possibilities of substituting old heating plants with new bioenergy heating plants. According to Lakyda et al. (2010), in some areas such as Zakarpattia Oblast, firewood has already become significant especially in rural areas. Alternatively, in the Eastern part of the country, in areas such as Dnipropetrovsk, Donetsk and Zaporizhzhya Oblasts, there is only a very marginal potential for

Table 6.1. Theoretical and technical potential of different types of wood fuels in Ukraine (Lakyda et al. 2011).

Type of forest biomass*	Theoretical potential, PJ	Technical potential, PJ	Technical/theoretical potential, %
Stemwood	263.7	50.0	18.9
Primary forest residues	28.7	22.6	78.9
Secondary forest residues	19.8	16.5	83.2
Total	312.2	89.1	28.5

* The primary forest residues contain wood harvest residues and the secondary forest residues wood processing residues.

Table 6.2. Potential use of wood energy and its proportion of total energy consumption in Ukrainian regions in 2008. (Lakyda et al. 2011). Cities of Kiev and Sevastopol are not separately examined.

Oblast	Theoretical potential of wood energy, PJ	Technical potential of wood energy, PJ	Technical/theoretical potential, %
Cherkasy	10.0	3.0	30.4
Chernihiv	23.5	5.9	25.0
Chernivtsi	11.1	4.8	42.9
Crimea AR	4.3	0.7	17.1
Dnipropetrovsk	2.4	0.6	27.1
Donetsk	2.4	0.7	26.9
Ivano-Frankivsk	23.6	5.2	21.9
Kharkiv	12.2	3.7	30.5
Kherson	2.9	2.1	72.5
Khmelnytskyi	9.8	3.1	31.6
Kiev	18.2	6.8	37.5
Kirovohrad	3.0	1.2	38.9
Luhansk	6.3	1.9	30.0
Lviv	24.6	6.9	28.2
Mikolayiv	1.1	0.4	41.9
Odessa	3.4	1.2	36.7
Poltava	6.1	1.7	28.0
Rivne	26.5	4.4	16.6
Sumy	16.3	4.8	29.6
Ternopil	6.7	1.6	23.5
Vinnytsia	10.4	3.2	30.4
Volyn	21.5	3.9	18.2
Zakarpattia	28.9	9.0	31.3
Zaporizhia	0.6	0.3	54.4
Zhytomyr	36.8	12.0	32.5
Total	**312.2**	**89.1**	**28.5**

wood energy. The location of the potential large heating plants is presented in Map 7.12 and small heating plants in Map 7.13.

However, in many areas, the lack of large-scale wood processing industry does not provide economically feasible volumes of forest residues which can be accumulated profitably. Only a few wood processing enterprises annually process 25,000 m³ timber or more, which makes the delivery of wood residues difficult. The usage of wood energy is also highly correlated with the economic picture. In 2009, the sales of wood pellets decreased by 30% due to the lack of sawdust from the furniture sector and sawmills. A lack of forest road network and machinery also complicates the utilisation of wood energy (Lakyda et al. 2010). The problems related to the forest road network especially hinders the utilisation of bioenergy in Zakarpattia Oblast where plenty of resources are located (Lakyda et al. 2011). Also, old harvesting equipment hinders the use of logging residues.

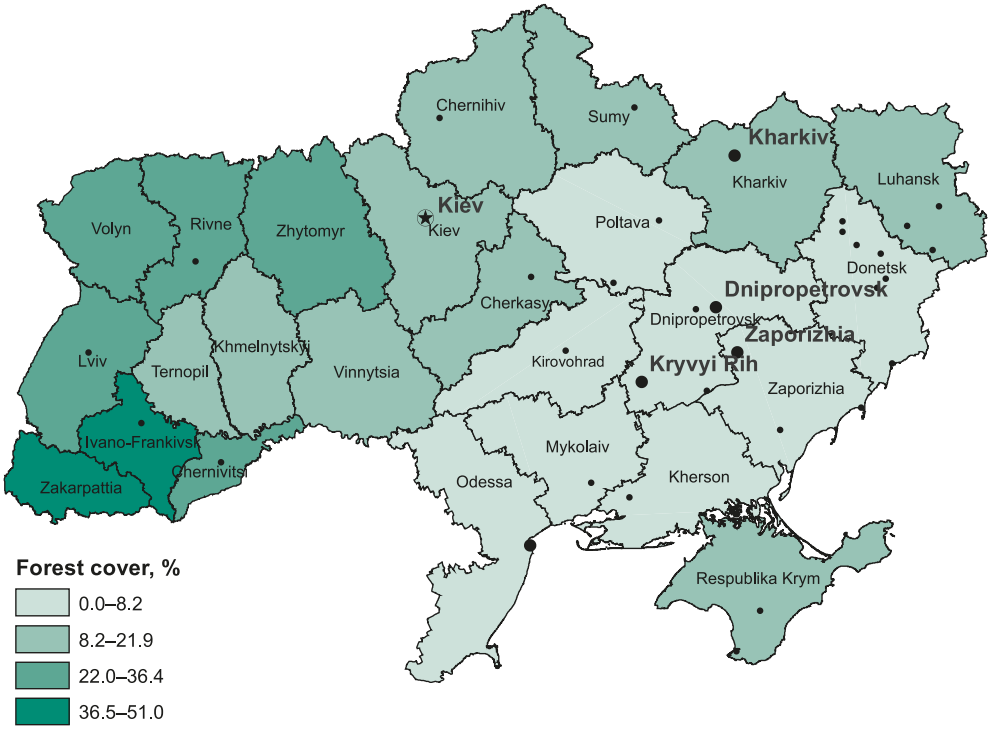
Taking into consideration the age distribution of forests in Ukraine, during the next 10 years the share of mature stands will substantially increase. This will also lead to an increasing availability of forest biomass for energy (Lakyda et al. 2011).

The total pellet production in Ukraine was 370,000 tonnes in 2009. Altogether 87% of it was exported, and the main markets are Poland, Germany and the Baltic countries. Sunflower husks

is the major raw material, and only 16% of pellet production (59,000 tonnes) was made from wood residuals. The total potential amount of available forest resources for pellet production is 5 million m³ which is needed for 900,000 tonnes of pellet. Taking into account the demand from board mills during the next 10 years, the potential production is 600,000 tonnes (Lakyda et al. 2010). The low domestic consumption of pellets is the result of a reluctance to invest in high-cost equipment in households and enterprises.

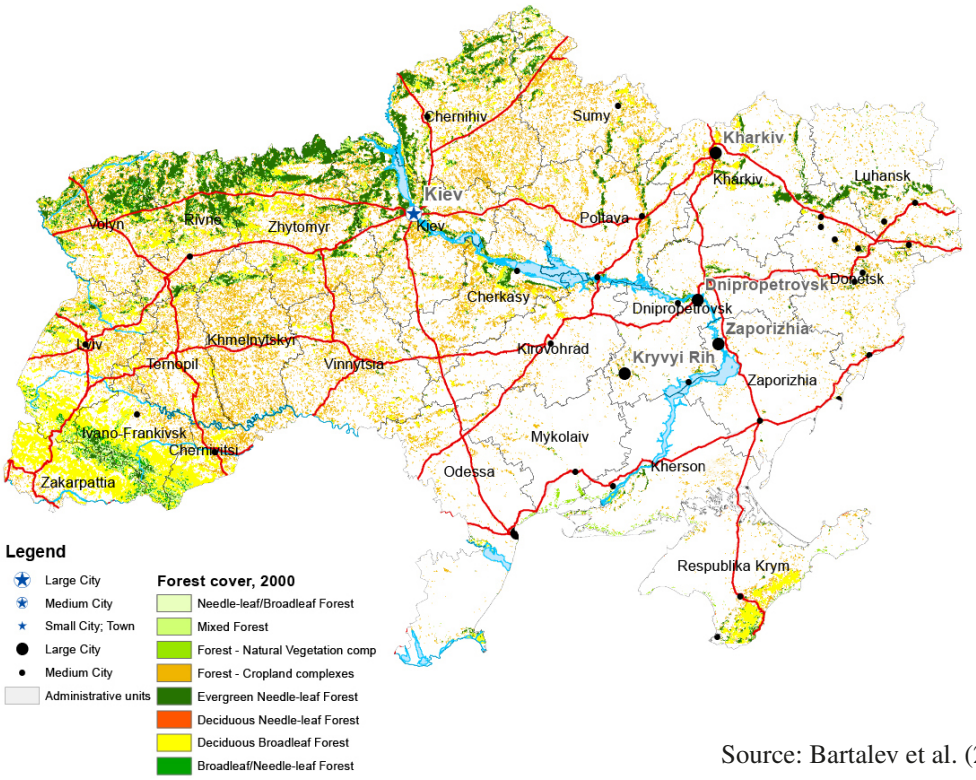
7 Maps

7.1 Distribution of forest land by administrative districts



Data source: State Statistics Service of Ukraine, 2010, http://www.ukrstat.gov.ua/

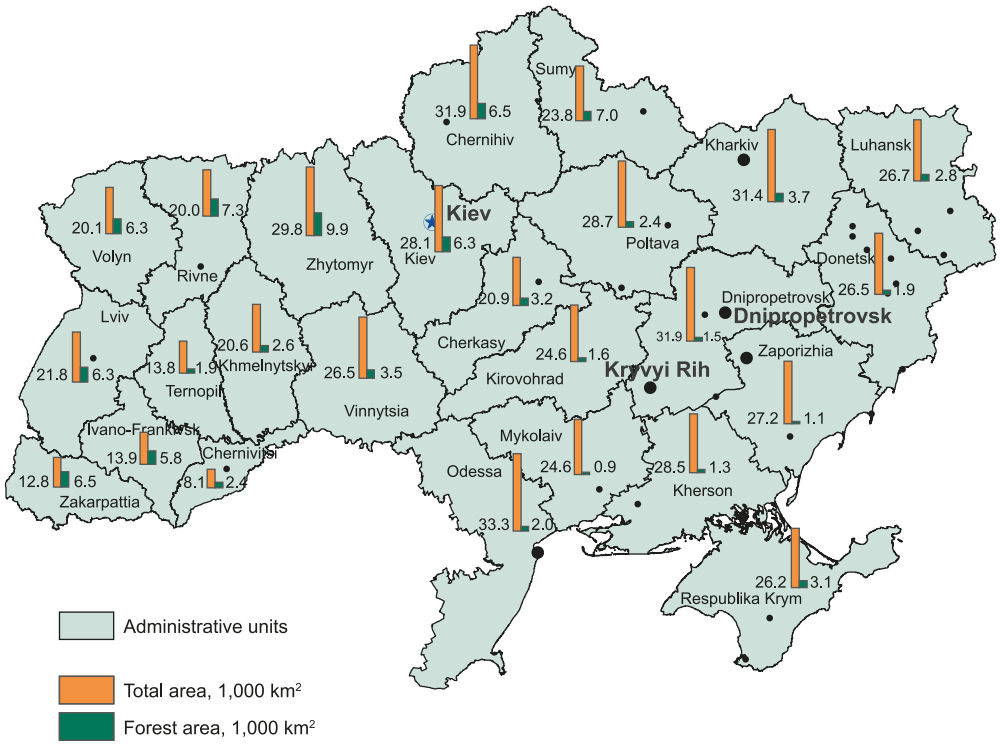
7.2 Forest cover structure from remote sensing data



Source: Bartalev et al. (2003)

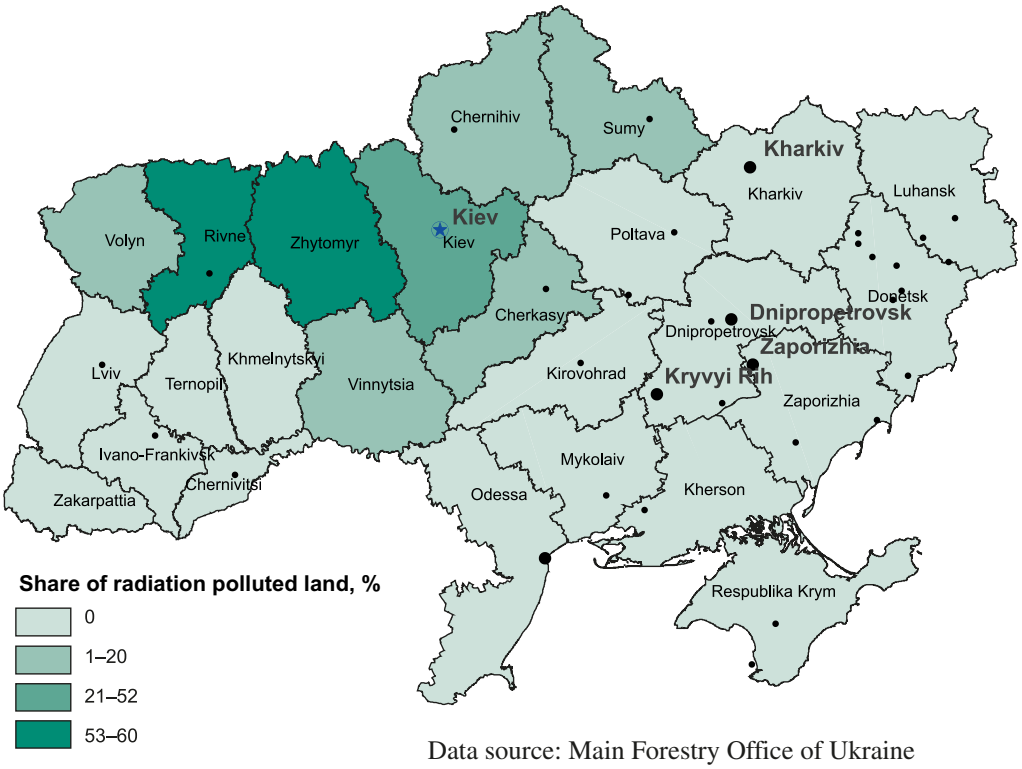
7.3 Natural vegetation zones

7.4 Forest area



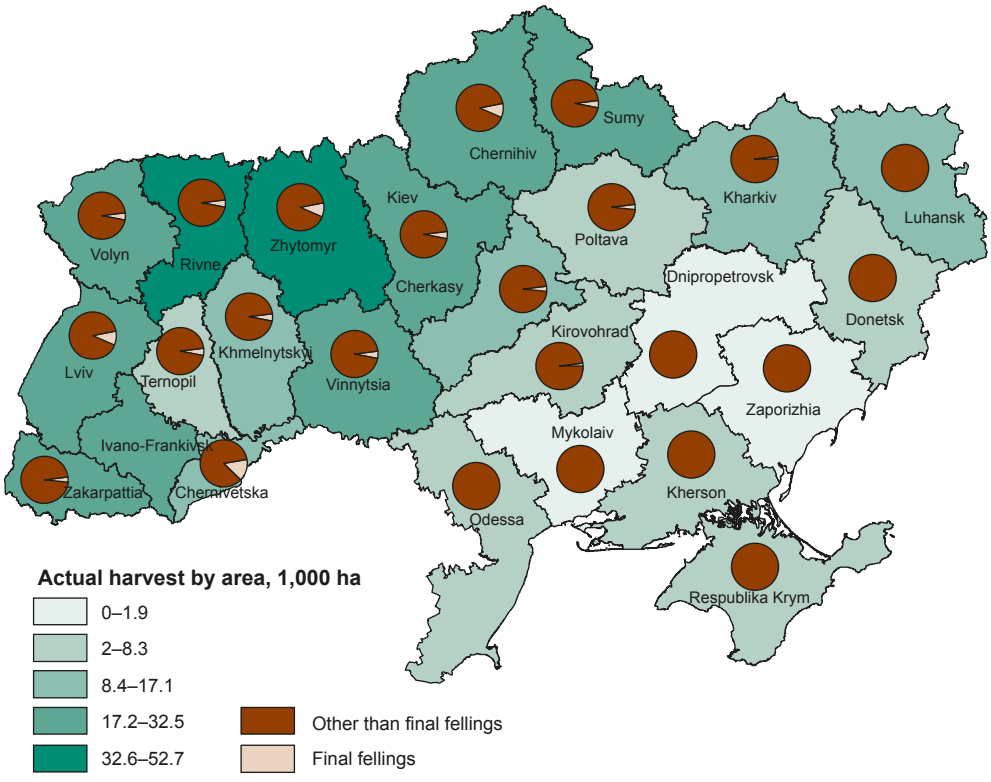
Data source: State Statistics Service of Ukraine, 2010, http://www.ukrstat.gov.ua/

7.5 Location of forests affected by radiation fallout



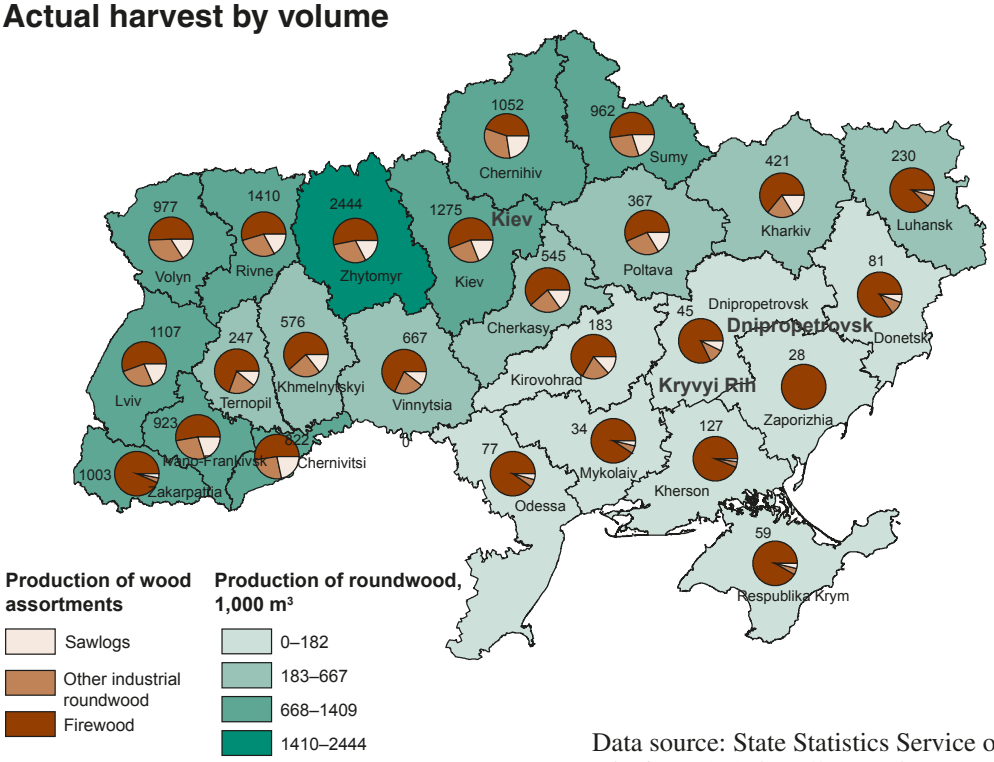
Data source: Main Forestry Office of Ukraine
http://dklg.kmu.gov.ua/forest/control/en/publish/article?art_id=33221&cat_id=33188

7.6 Actual harvest by area



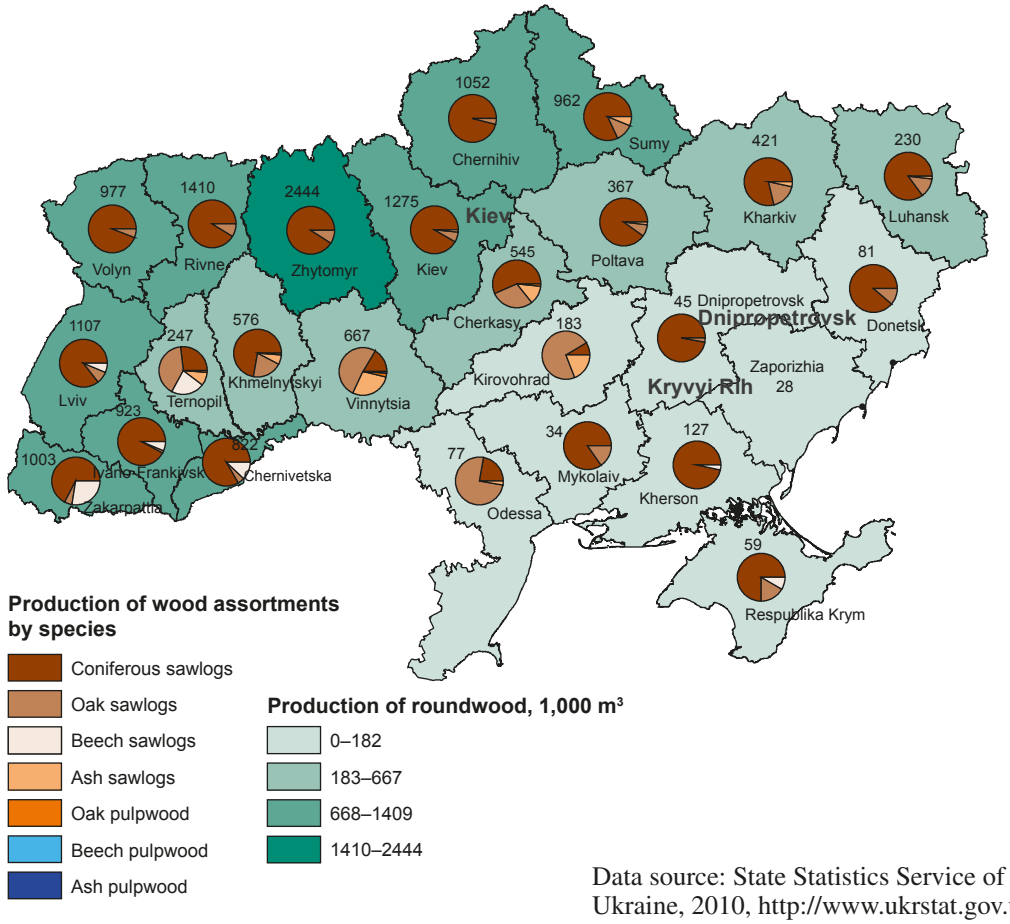
Data source: State Statistics Service of Ukraine, 2010, http://www.ukrstat.gov.ua/

7.7 Actual harvest by volume



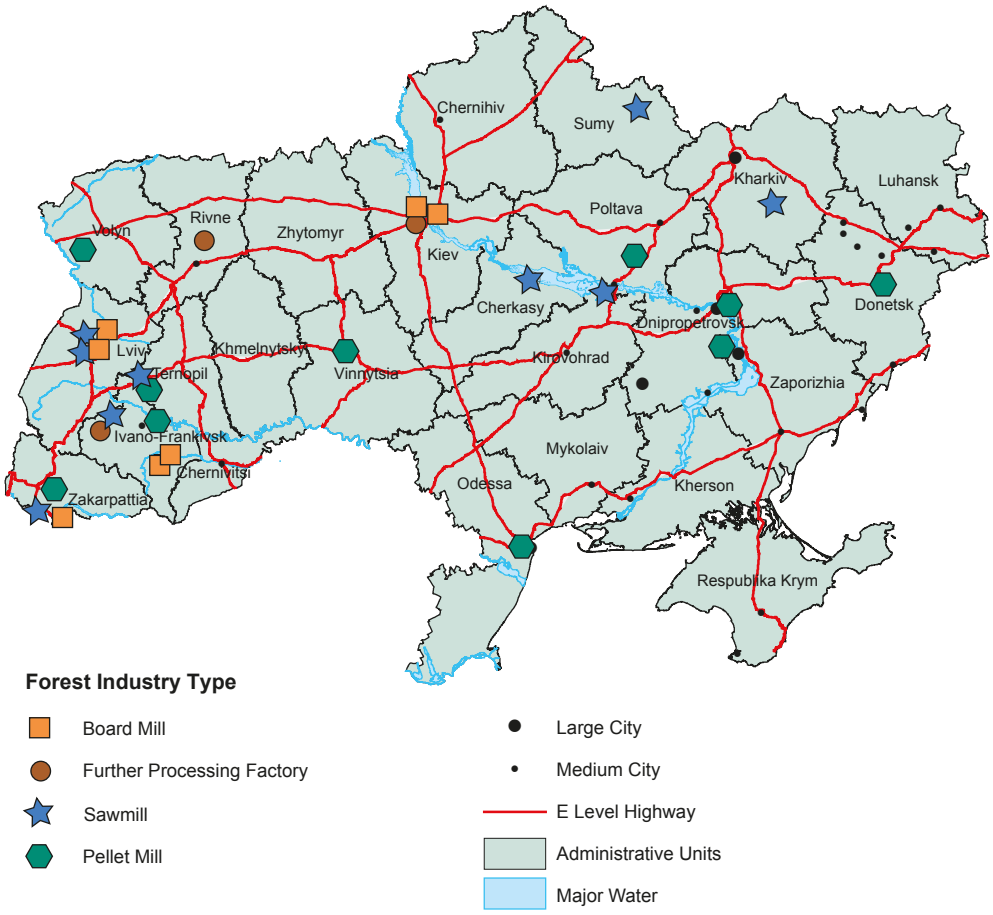
Data source: State Statistics Service of Ukraine, 2010, http://www.ukrstat.gov.ua/

7.8 Actual harvest by volume, wood assortments and species

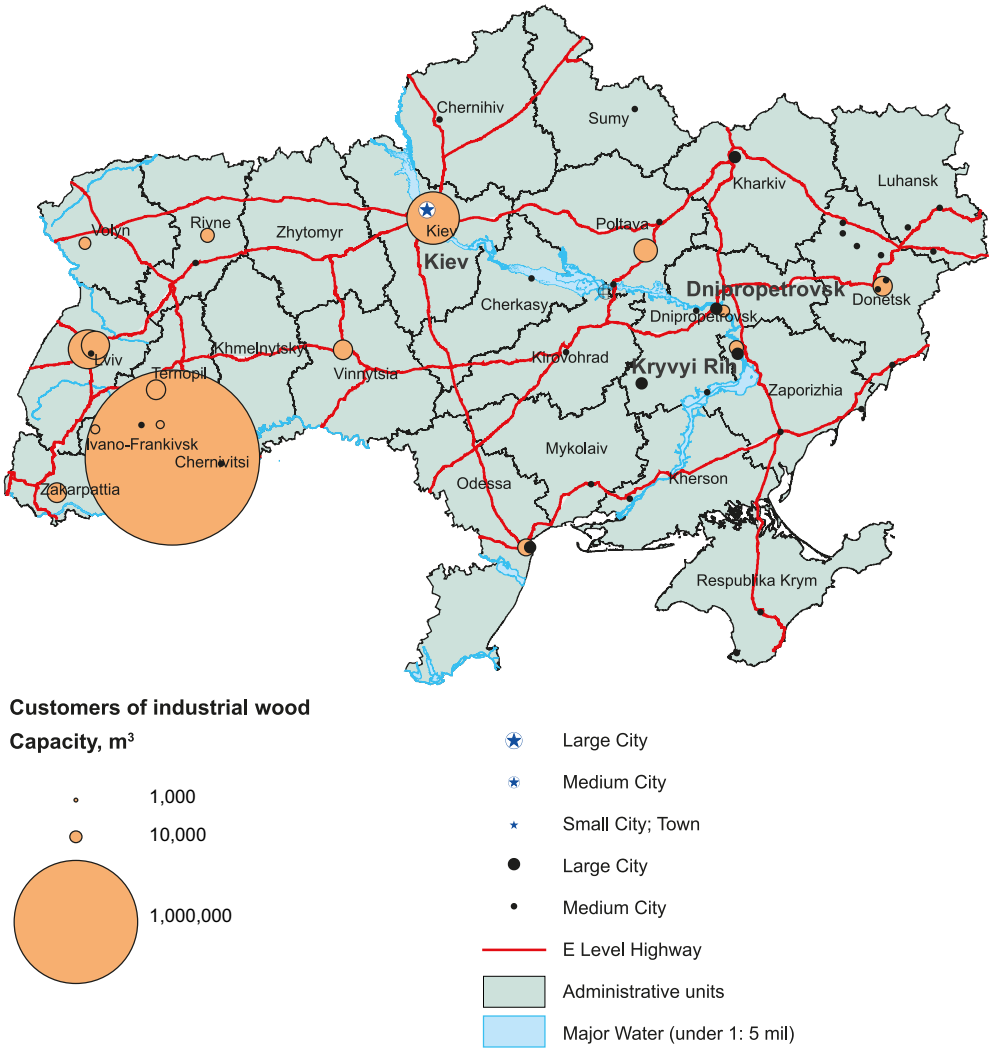


Data source: State Statistics Service of Ukraine, 2010, http://www.ukrstat.gov.ua/

7.9 Forest industry

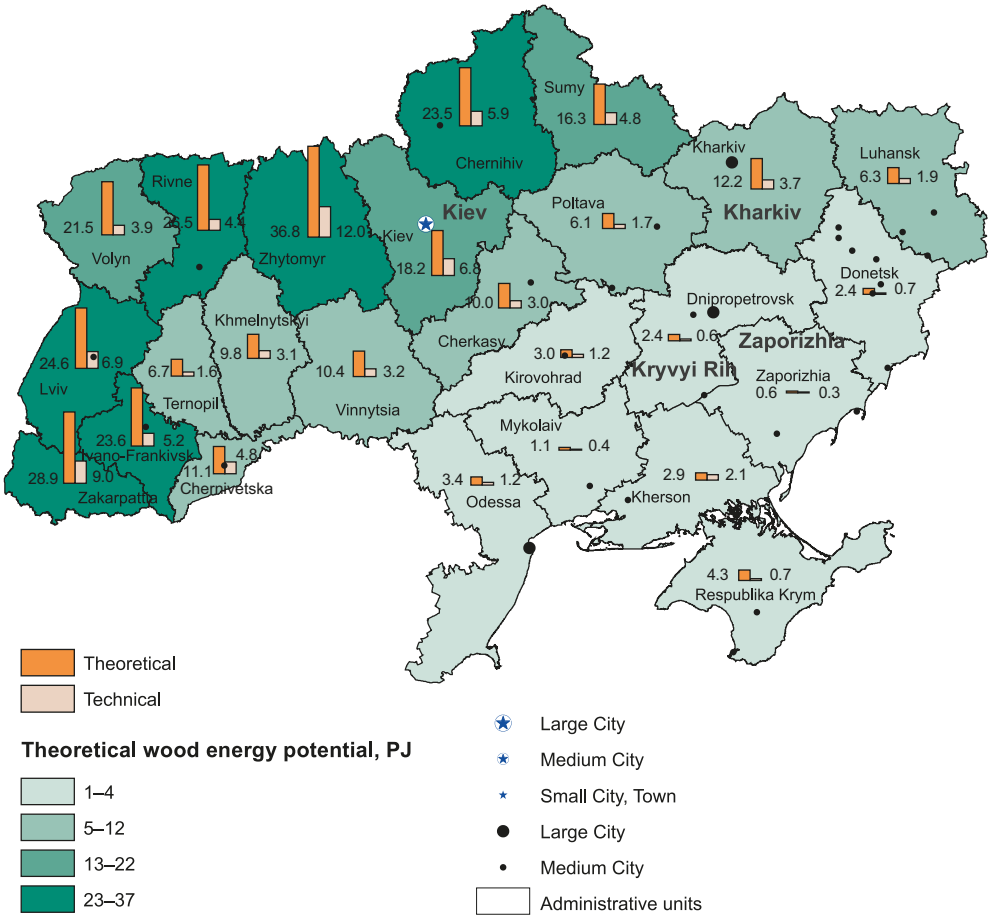


7.10 Customers of industrial wood



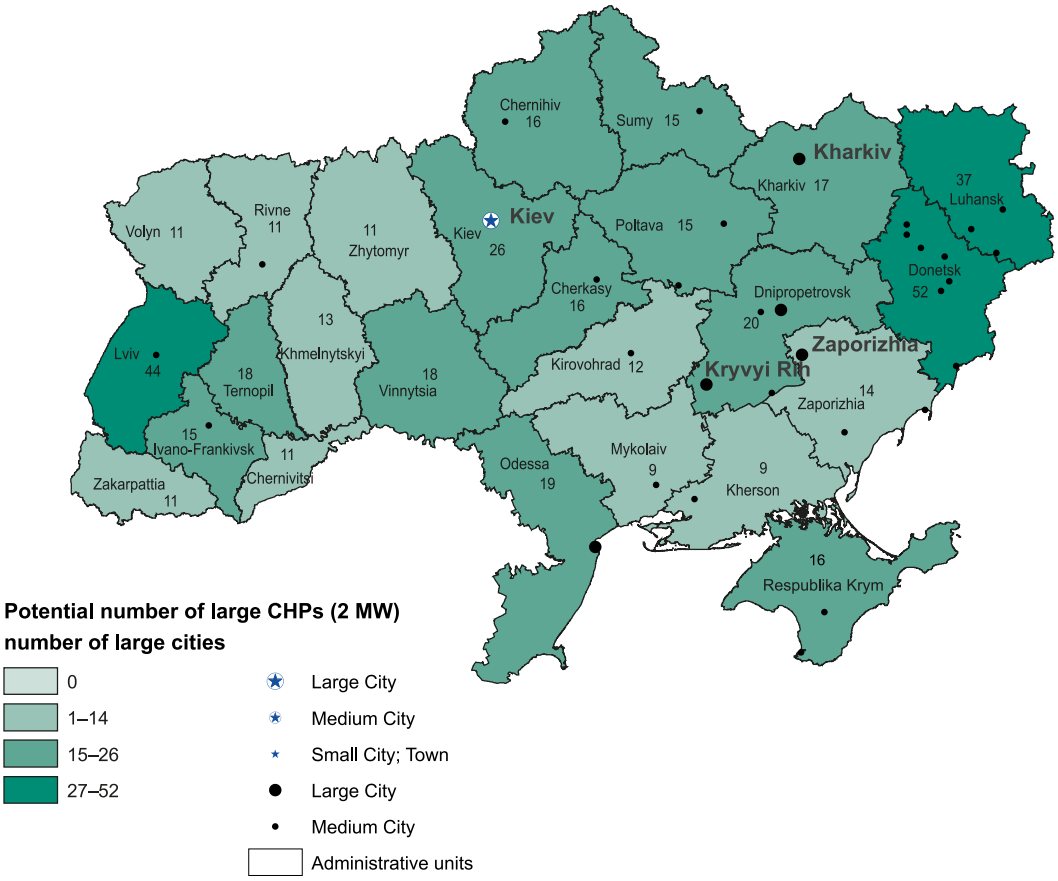
Source: Companies' information (October 2010)

7.11 Energy wood potential



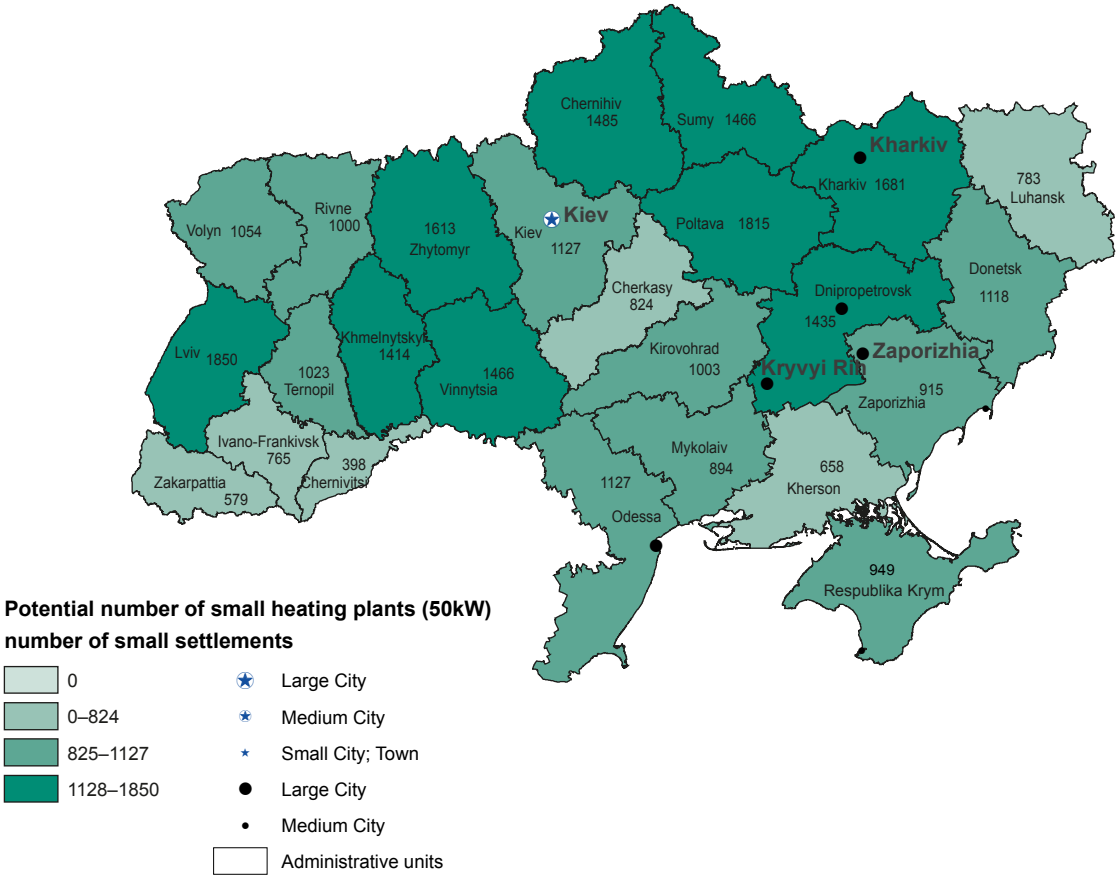
Source: Lakyda et al. (2010)

7.12 Potential number of large CHPs (2 MW), 456 cities



Data source: State Statistics Committee of Ukraine, http://www.ukrstat.gov.ua

7.13 Potential number of small heating plants (50 kW), 28,442 small settlements



Data source: Main Forestry Office of Ukraine, http://dklg.kmu.gov.ua/forest/control/en/publish/article?art_id=33221&cat_id=33188

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