Land-Use and Forestry sector of Ukraine in climate change context

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- Advanced Field-Map technology for field data collection and carbon sequestration
General background information: Ukraine

- Area - 603,500 km²
- Population - 46,299,862 (July 2007 est.)
- Over 100 nationalities and ethnic groups (of which 73% are Ukrainian).
- Climate - temperate continental (excluding of subtropical climate on the Crimean South Coast)
- 5 different eco-zones - Mixed forests, Forest-Steppe, Steppe, Carpathians and Crimea Mountains.
- A big difference in condition of forests growth between different eco-zones
Forestry background information: Ukraine

- Total area of forest lands - 10.8 mln. ha
- Forests covered area - 9.4 mln. ha
- Per cent of forest covered lands - 16.4% (in Steppe zone - lower then 5%, Forest Steppe - 16%), Mixed forests - 30% and Carpathians - around 70%)
- Coniferous forests - 42%, hardwood forests - 43%, 15% - softwood broadleaves and shrubs
- Average growing stock - 186 m3 / ha
- Average change of stock - 3.8 m3 / ha
- Total growing stock - 1.7 billion m3

Source: SFCU-2007
Forestry background information: Ukraine

- Forest cover in Ukraine is one of the lowest in Europe, at 16.4 percent, compared with 38.1 percent for Europe as a whole (UN-ECE/FAO, 2000).
- Forest in Ukraine plays a key role for biodiversity conservation, soil and watershed protection and climate change mitigation.
- Ukraine occupies 8th place among European countries on forest area and it’s forests very important for carbon absorbers for all European region. Forest phytomass in Ukraine contents nearly 7% of carbon stock in European forests. Some amount of carbon is accumulated in forest soils (it’s expected this amount is considerable in Ukraine taking into account the high humus content in soils).
Forests ownership

State Committee of Forestry 68%

Ministry of Agricultural Policy 24%

Ministry of Defense 2%

Ministry of Emergencies 2%

Ministry of Environmental 1%

Others 3%

Source: SFCU-2007
Percent of forest land by administrative region
Mean age of forest stands (years).
Mean standing volume in cubic meters per hectare of forest land
Research activity in forestry sector: URIFFM – the main forestry research organization in Ukraine

- Established in 1929
- Supervised by State Committee of Forestry of Ukraine and National Academy of Science of Ukraine
- The country wide network of research stations
- Member of International Union of Forest Research Organizations (IUFRO, since 1996) and European Forest Institute (EFI, since 2000)
URIFFM research network

Мережа науково-дослідних організацій Держкомплієсгоспу України

1. УкрНДІЛГА
2. Поліський філіал УкрНДІЛГА
3. Степовий філіал УкрНДІЛГА
4. Київська ЛНДС
5. Вінницька ЛНДС
6. Новгород-Сіверська ЛНДС
7. Маріупольська ЛНДС
8. Луганська АЛНДС
9. Червоноармійська ЛНДС
10. Кримська ГЛНДС
11. УкрНДІгріліс
12. Карпатська ЛНДС
Forest Monitoring & Certification Laboratory

- **CO-ORDINATION OF FOREST MONITORING ACTIVITY IN UKRAINE, DEVELOPMENT OF METHODS FOR MONITORING HEALTH, PRODUCTIVITY AND BIODIVERSITY OF UKRAINIAN FOREST** – scientific accompanying of national system of forest monitoring on the base of harmonized methods with international programs of UN/ECE ICP Forest (www.icp-forests.org) and USA Forest Health Monitoring Program - FHM (www.rfl.psw.fs.fed.us/pubs/psw-gtr-164/fulltext/buksha/buksha.html).

- **FORESTS AND CLIMATE CHANGES INVESTIGATION** – carbon cycle in forest and absorption of greenhouse gases, investigation of forest vulnerability and assessment of adaptations to climate changes, development of react strategy of forest sector in climate change conditions. Preparation proposals for Joint Implementation Projects for Carbon Sequestration in Ukrainian Forest Sector under Kyoto protocol (www.zef.de/zef_englisch/publikation/publist_neu/publist_ecosystem_functioning.htm).

- **MODELLING, SCENARIO ANALYSIS AND FORECASTING OF FOREST RESOURCES DYNAMICS** under anthropogenic changes of environment (air pollution and climate change), assessment of risk for different scenarios of forest management (www.efi.fi/projects/sceforma).

- **ADVANCED TECHNOLOGIES USAGE AND DEVELOPMENT FOR IMPROVING OF FORESTRY INFORMATION SYSTEM** – scientific support for usage of field GIS, RS and GPS technology in forestry and nature protection (www.techinles.org.ua).

- **SCIENTIFIC SUPPORT FOR DEVELOPMENT OF FOREST CERTIFICATION IN UKRAINE** – development of national criterions, indicators and standards for forest certification on the base on principles of sustainable forest management.

Assessment of Ukrainian forests in the climate change context

• USA-Ukraine scientific cooperation in frame of Countries Study Program (1994-1996)
• Vorobjov climates classification model
• Vulnerability assessment
• Scenario analysis
• Mitigation activity and adaptation strategy
Vorobjov climates classification model (by forest types)

• Vorobjov classification relates climate conditions with type of forest - type of forest that grows at a plain site on a primary relief with undisturbed soils indicates forest type of the climate and such type of forest called as zonal type of forest. There are many other types of forest in this climate, but their variability depends of relief, soil and water conditions. For example, zonal type of forest in the Ukrainian steppe is dry grud.

• Two climatic indices are used to describe forest type of climate. These are heat index $T$ and humidity index $W$. Heat index is year sum of mean monthly temperatures for months with positive mean monthly temperature. Vorobjov climate humidity index is $W = \frac{R}{T} - 0,0286 \times T$, where $R$ is sum of precipitation values for months with positive mean monthly temperature.

• Scales of variables $W$ and $T$ are forming a grid of Vorobjov climates. Grades on $T$ scale are equal to $20^0C$ and grades on $W$ scale are equal to 1,4. Each cell has own code, that formed of digit corresponding to humidity index on $W$ scale, and letter corresponding to heat index on $T$ scale (e.g. 1d, 2e).
Scale of humidity index W of the Vorobjov classification

<table>
<thead>
<tr>
<th>Index</th>
<th>Range</th>
<th>Name for humidity index</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>-6.4 .. -5.0</td>
<td>Ultra dry</td>
</tr>
<tr>
<td>-2</td>
<td>-5.1 .. -3.6</td>
<td>Extremely dry</td>
</tr>
<tr>
<td>-1</td>
<td>-3.7 .. -2.2</td>
<td>Particularly dry</td>
</tr>
<tr>
<td>0</td>
<td>-2.3 .. -0.8</td>
<td>Very dry</td>
</tr>
<tr>
<td>1</td>
<td>-0.9 .. 0.6</td>
<td>Dry</td>
</tr>
<tr>
<td>2</td>
<td>0.7 .. 2.0</td>
<td>Fresh</td>
</tr>
<tr>
<td>3</td>
<td>2.1 .. 3.4</td>
<td>Moist</td>
</tr>
<tr>
<td>4</td>
<td>3.5 .. 4.8</td>
<td>Damp</td>
</tr>
<tr>
<td>5</td>
<td>4.9 .. 6.2</td>
<td>Wet</td>
</tr>
</tbody>
</table>
## Scale of heat index T of the Vorobjov classification

<table>
<thead>
<tr>
<th>Index</th>
<th>Range</th>
<th>Name of corresponding forest type or non-forest zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>24-44</td>
<td>Bor (original name in Russian)</td>
</tr>
<tr>
<td>b</td>
<td>45-64</td>
<td>Subor (original name in Russian)</td>
</tr>
<tr>
<td>c</td>
<td>65-84</td>
<td>Sugrud (original name in Russian)</td>
</tr>
<tr>
<td>d</td>
<td>85-104</td>
<td>Grud (original name in Russian)</td>
</tr>
<tr>
<td>e</td>
<td>105-124</td>
<td>Steppe</td>
</tr>
<tr>
<td>f</td>
<td>125-144</td>
<td>Dry steppe</td>
</tr>
<tr>
<td>g</td>
<td>145-164</td>
<td>Semidesert</td>
</tr>
<tr>
<td>h</td>
<td>165-184</td>
<td>Deserts</td>
</tr>
</tbody>
</table>
Correspondence of Vorobjov climates classification and Holdridge model
Vorobjov's climates by mean monthly precipitations and temperatures for last 30 year's
Vorobjov's climates. GISS scenario.
Vorobjov's climates. UK89 scenario.
Current and potential area
Relative changes in size of the forest income under different scenarios of climate changes

![Bar chart showing conditional forest profit change in percentage under different scenarios.](chart.png)
Scenario analysis of forestry sustainability in changing environmental (EU SCEFORMA project)
EFISCEN matrix model
Results of SCEFORMA project

- Results of SCEFORMA project (Schelhaas M.J., Buksha I.F., Cerny M. et. all, 2004) show Ukrainian forest fund dynamics for different forest management regimes in conditions of environmental changes.

- Most reasonable is multifunctional management regime which will provide implementation of natural oriented forestry, optimization of thinning regimes. In this case the total felling level will increase by steps to 22.1 mln.m3 per year; increment will slowly decrease from 5.2 to 4.2 m3/ha/year mainly due to ageing of the forest.
Forest age class distribution under different scenarios (2002-2050)
The main activities in forest sector for the assessment, prevention and/or mitigation of negative climate change consequences are:

- to improve National forest monitoring system and establish of National Forest Inventory;
- to assess the vulnerability of forests and to develop the strategy for the adaptation of forest ecosystems to climate change;
- to develop the strategy and activity plan for forest sector to mitigate the influence of climate change on forest ecosystems;
- to set up the preconditions for the realization of joint implementation projects in forestry, targeted to the reduction of emissions and the increasing of GHGs absorption;
- to develop and to implement the National Plan of activities for forest sector on the base of adaptation strategy and mitigation of climate change influence.
Ukraine’s national inventory of greenhouse gas sources and sinks 1990 to 2005

<table>
<thead>
<tr>
<th>GHGs without LULUCF, in Gg CO2 equivalent</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1990 (base year)</td>
<td>923,844</td>
</tr>
<tr>
<td>2005 (latest reported year)</td>
<td>418,923</td>
</tr>
<tr>
<td>Change from base year to latest reported year (%)</td>
<td>- 54.7</td>
</tr>
</tbody>
</table>
GG sequestration in forestry, (cadastre 2006)
Data Source for forest carbon accounting

- State forest accounting on 01.01.1996 and for state forests on 01.01.2002.
- Database “Forest Fund” for state forests, but only general information for another user or owner.
- Experimental data on forest biomass allocation.
Data Source for forest carbon accounting (cont.)

- Data on dead wood - data on forest inventory and forest monitoring
- Harvest and management – forest statistics
- Concept for annual updates – database and actualisation
- Allometric data are available for main tree species and Natural zones
Ukrainian National Environmental Investment Agency – authorized state player in the climate change topics (created in 2007)

The aims of National Environmental Investment Agency of Ukraine are:

- Raising the level of environmental efficiency of the Ukrainian economy;
- Creation of a transparent infrastructure of the ecology market and mechanisms for regulating the levels of anthropogenic impact on the environment in Ukraine;
- Harmonization of the ecology market of Ukraine with the global markets;
- Fulfilling obligations under the UNFCCC and Kyoto Protocol;
- Participation in the Kyoto Protocol flexible mechanisms.
Selection of activities under Article 3.4 of the Kyoto Protocol

- Ukraine selects Forest Management as activity under article 3.4, but does not elect Cropland Management, Grazing Land Management and Revegetation towards meeting its commitment.
- Forest Management is determined as “a system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner”.

Odesa, 23-27.08.08
Reforestation and afforestation projects

- Ukraine now can only participate in the JI project to the track II modalities and regulation, country would be able soon to fully meet the KP requirements for access to simplified modalities of Track I;
- The area of Ukrainian forests should be increased. 2.3 million ha of degraded and polluted land of which 1 million is suitable for forestry projects. International collaboration in the frames of the KP may accelerate reforestation in Ukraine;
- The results of the “Ukraine Reforestation Biocarbon Fund Project” show the potential carbon sequestration of Chernobyl area - about 6.3 tCO$_2$e/ha/year. Polissya region has a great potential for scaling up forestry activities under JI;
- Possible for Ukraine to sell the surplus AAUs to other Annex I parties of the KP (1.8 billion of tonnes of CO$_2$e in the first commitment period). Green Investment Schemes (GIS) represent a way of promoting the environmental efficacy of transactions.
# Areas Requiring Conversion from Arable Land to Forest Lands or Meadows*

<table>
<thead>
<tr>
<th>Zone</th>
<th>Area, thou. ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steppe</td>
<td>4147</td>
</tr>
<tr>
<td>Forest-steppe</td>
<td>3090</td>
</tr>
<tr>
<td>Polissya and Carpathians</td>
<td>1392</td>
</tr>
<tr>
<td><strong>Total for Ukraine</strong></td>
<td><strong>8629</strong></td>
</tr>
</tbody>
</table>

*Source: State of land resources of Ukraine: problems and possible solution, Ukrainian Agrarian Academy, 2001*
Calculating emission reduction credits in forestry projects

- Carbon estimation in living biomass;
- Carbon estimation in soil;
- Carbon estimation in dead organic matter.
Area of new forest in Ukraine

Afforestation area

Thous. ha

Years


Odesa, 23-27.08.08
JI/GIS projects implementation scheme in UA*

*according to Cabinet Ministry of Ukraine decree No 718 from 20/08/2008
JI/GIS projects implementation Scheme in UA LU/Forestry

National level:
- Ministry of Environment
- State Committee of Forestry
- National Environmental Investment Agency

Regional level:
- Regional (Oblast) Forest Administration

Local level:
- State Forestry Enterprises (Local Forest Administration)
  - Field Technicians
  - Local Community NGO’s
  - Field Monitors, Auditors

Projects:
- Projects Developers
- Projects Auditors
- Project
  - Project
  - Project
Forest monitoring activity in Ukraine (international context)

- Since 1989 - in cooperation with UN/ECE pan-European Program of ICP Forests
- Since 1995 - in cooperation with Forest Health Monitoring (FHM) program, developed by USA Forest Service, U.S. Department of Agriculture and U.S. Environmental Protection Agency
- The main principle of monitoring is multilevel survey system, which provides equilibrium between expenditures on monitoring and self-descriptiveness of obtained data
- Simple extensive estimations of forest condition are carried out at the level 1 plots according to ICP Forests Manual (defoliation, discoloration, DBH, damage etc.)
- Intensive monitoring for level 2 plots carried out assessment of 200 parameters according to FHM Manual at the sparse net of plots (site condition, growth regeneration, crown condition classification, damage and catastrophic mortality, PAR, vegetation structure, soils, lichen communities etc.)
Pine defoliation, %

5%  45%  75%
Oak defoliation, %

0%

45%

70%

Odesa, 23-27.08.08
Forest Monitoring under Technology of USA International Program FHM

- Has been implemented by URIFFM from 1995
- 120 permanent plots were established in the territory of 7 north-east oblasts of Ukraine
- Observations are carried out under the 4-year cycle
- Statistical design of plots grid, possibility for dense and random plotting of the grid
- Special field equipment to determine biometric indicators of forest vegetation and FAR
- Capability of direct determination of dynamics of carbon accumulation (accurate determination of forest plant biomass, instrumental assessment of FAR and leaf area indices)
Grid of Permanent Forest Monitoring Plots by FHM Technology

Natural zones:
- Polissya
- Forest steppe
- North steppe
Assessment of Dynamics of Forest Vegetation Biomass under FHM Technology

• determination of biometric indicators of all trees (diameter >12.7 cm) on the plots with fixed area;
• measurement of biometric parameters of understory vegetation (saplings, undergrowth, lianas, ground vegetation layer, fallen trees, etc.);
• special sub-program of monitoring soils, fall and litterfall;
• PAR measurements
Assessment of Soil Carbon Sequestration

• obtaining of data on humus horizon (thickness, density and content of organic substance);

• calculation of carbon stock in the upper soil layer (to a depth of 1 m);

• assessment of change in carbon content with preserving lands for agricultural use (comparative scenario);

• assessment of change in carbon content in case of afforestation.
Assessment on the monitoring plot: forest health, productivity, biodiversity, carbon sequestrations etc.
Forest monitoring grid (2007)
Forest monitoring condition, 2006
Certification of carbon sequestration in forests and certification of SFM

- Forests certification plays the important role in the practical implementation of sustainable forest management. SFM concept is important as far as Ukraine was selected forest management as an activity on article 3.4 of Kyoto protocol.
- The SFM approaches are aimed to achieve environmentally responsible, socially beneficial and economically viable forest management. There are following activity for SFM will be applicable for Ukraine: using close to nature forestry technology, increasing of selective harvesting instead of clear cutting, spreading of natural reforestation, improving of forest road, ecologically sound wood transportation etc.
- Sustainable forest management (SFM) can give not only carbon sequestration benefits but broad spectrum of others ecological and social benefits.
Advanced Field-Map technology for field data collection and carbon sequestration

- Data collection in field and data processing
- Mobile field GIS
- Direct support of GPS
- Continuous georeferencing
- Field navigation
- Laser equipment, high-precision mensuration
- Compatibility with lot of software's
Field-Map (mobile GIS)

- GPS
- Laser rangefinder + electronic compass + electronic inclinometer
- Electronic calliper
- PC running MS Windows 95/98/NT/2000/XP

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Mensuration by Field-Map: area, single trees, stands, shrubs, understory vegetation etc.
Print screen from field PC: using of remote sensing data in field work
Navigation in field by Field-Map
Mapping by Field-Map (mobile GIS)
Building of ecological forest profile by Fild-Map

Odesa, 23-27.08.08

- Смерека
- Ялиця
- Сосна звичайна
- Модрина європейська
- Бук лісовий
- Граб звичайний
- підріст
Stem and branches mensuration by Field-Map
Field-Map Stem Profiler: Modeling of stem profile
Data processing in Field-Map Inventory Analyst
Usage data from Field-Map

Results of carbon inventory

Forestry data

Odesa, 23-27.08.08
Thank you for your attention!

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