An overview of general Land and Soil Water conditions in Bosnia and Herzegovina

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General Situation

Bosnia and Herzegovina emerged from the 1992-1995 war with an almost totally destroyed infrastructure (electric power, water supply, sanitation, transport, and other systems), ruined industry and collapsed economy. About 2 million people were turned into refugees and displaced persons. About two hundred thousand were killed. Many rural areas, due to the fact that they were not militarily defended, were turned into demographic deserts, while the housing and economic facilities were almost completely destroyed, landscape deforested, cities devastated and heavily damaged. More than two million landmines were planted throughout the country, thousands of tons of various kinds of waste (municipal, construction, medical, etc.) accumulated and are still waiting to be disposed of, thousands of hectares of forests were destroyed or cut, vast areas of high quality agricultural land and pastures were devastated or contaminated.

The current state structure of Bosnia and Herzegovina (BiH) is regulated by the Dayton Agreement. The country is composed of the Federation BiH (divided into 10 cantons), the Republic of Srpska (RS) and the District of Brčko as separate administrative units.

Physiographically BiH can be divided as follows:

- Flatland or lowland areas (up to 300 meters above sea level), 13.3%;
- Hilly area (300-500 meters above sea level), and Hilly-Mountainous area (500-700 meters above sea level), 26.3%;
- Mountainous area (above 700 meters above sea level), Mediterranean-Mountainous area (700-500 meters above sea level), 57.2%;
- Mediterranean area (below 500 meters above sea level), 5.2%.

Climate

Bosnia and Herzegovina is situated in the northern temperate belt, at equal distance from the Equator and the North Pole, thus the climate is not dominated by only one type of weather. There are neither dry seasons nor harsh and long winters. In terms of climate it can be divided into three divergent regions with more or less sharp boundaries or moderate transition zones:

- Northern region;
- Hilly mountain region;
- Southern region.

Temperature

Northern region, with temperate continental climate and average temperature in January from –0.2°C to 2.0°C, in July 20°C to 22°C.

Hilly-mountains region, with variations of continental, high-mountainous and alpine climate, average temperatures in January from –0.3°C to –7.4°C, in July 10.2°C to 21.2°C.
Southern region, with characteristics of Mediterranean climate, average temperatures in January being 2.3°C, in July 22.5°C to 25.7°C, and precipitation of about 2,000mm.

The varying climatic conditions in BIH offer wide possibilities to the agricultural production, both in terms of crop choice and cultivation of land farming, fruit-growing, vine-growing, vegetable growing and forage crops and in terms of livestock production.

Hydrological cycle

About 3,871,900ha (75.7%) of the BIH territory drains via the Sava River to the Black Sea, and 1,241,000ha, (24.3%) drains via the River Neretva to the Adriatic Sea. The boundary between these two catchments is obscured at the local level, especially in the south west, where rivers flow through karst areas.

The spatial variation of hydrological cycle (Figure 1.) is very characteristic for BIH. For instance, the mean annual precipitation in the southern region is 2.5 times larger than in northern region, and twice that in the central region. In the south, the mostly Mediterranean type precipitation is between 1,500 and 2,000mm of rain, potential evapotranspiration 900mm, actual evapotranspiration 600mm, potential water deficit or irrigation requirement 300mm and potential outflow or surplus from 900 to 1,400mm. It is interesting that the southern region has the most abundant precipitation, but also the highest water deficit, and highest water surplus in the absolute and relative sense.

The mean annual precipitation in central region of BIH is about 1,000mm, potential evapotranspiration 650mm, actual evapotranspiration 600mm, potential water deficit or irrigation requirement 50mm and potential outflow or surplus 400mm. This region has a much better water-balance than the southern region.

In the northern region of BIH mean annual precipitation is about 800mm, potential evapotranspiration 700mm, actual evapotranspiration 600mm, potential water deficit or irrigation requirement is 100mm and potential outflow or surplus 200mm. This region, with its continental climate characteristics, is more similar to the central than to the southern region regarding soil water cycle.

Land resources

The total area of BIH is 5.11 million ha, of which 50.3% is agricultural land (2,572,000ha) and 48.3% under forest.

Total arable land in Bosnia and Herzegovina amounts to 1,585,000ha or 62%; in the Federation 765,000ha and in the RS 820,000ha. The ploughland area amounts to 1,018,000ha or 19.9% of the total land. There are about 0.59 hectares of agricultural land per capita, of which 0.36ha are fields and gardens.

The land quality classes in Bosnia and Herzegovina are given in Table 1. The best quality land (classes I to III) covers 14.0%, of the territory of Bosnia and Herzegovina, class IV land covers 17.9%, class V 16.7%, class VI 31.75% and classes VII and VIII 19.4% (data according to SZS).

Forty-five percent of agricultural land is hilly (300-700m a.s.l.), of medium quality and well suited to semi-intensive livestock production. Mountain areas (> 700m a.s.l.) account for a further 35 percent of agricultural land but high altitude, steep slopes and lower fertility soils limit the use of this land to livestock grazing during spring and summer. Less than 20 percent of agricultural land (half of all arable land) is suited to intensive agriculture, most of it in lowland river valleys. The land base for agriculture is thus very limited in both quantity and quality. Natural water resources are more abundant, with many unpolluted rivers and readily accessible groundwater. Despite this abundance of water only about 10,000ha (0.1 percent of arable land) was irrigated before the war, an area which could be increased significantly.

Despite the fact that the BIH territory is mainly mountainous, until now little has been done to improve water and soil conditions in the upland areas. Excessive deforestation, inappropriate conversion of grass land to arable land and uncontrolled cultivation of sloping terrain are degrading the land even in the valleys and lowland regions where soils are of good quality. The large sums invested in the protection of flat areas (river course direction, embankments, outfall drains, pumping stations) remain ineffective if soil and water conservation measures, both of an agricultural engineering and technical nature, are not undertaken in the hilly-mountainous uplands. Such measures would contribute to revitalising the mountainous area and would provide better protection for the lowlands.
Soils

The Basic Soil Map (BSM) Project was established in 1964 at the scale of 1:50,000 and implemented by Agropedology Institute from Sarajevo. For this purpose, the first Manual for field soil investigation was published. The BSM was developed on pedogenetic principles and lasted from 1966 to 1986. It was the largest pedological project in Bosnia and Herzegovina. Classification of soils is based on genetic-evolutionary principles, in which the type of soil was the basic unit of classification system. Map units including type, subtype, variety and even form. Morphological and lithological characteristics were the chief criteria. 1,176 different mapping units have been identified on the soil map of BIH. The total number of printed sheets is 116.

The soil map of BIH at scale 1:50,000 was made more than 20 years ago. Since then genetic-evolutionary classification has been through significant changes, which clearly can be seen from the terminology of the map units in the legend of the map.

There were two periods in development of the soil map, which differ from each other in inventory criteria, classification and methods. In the first period from 1963 to 1973, the national classification was based on genetic principles. In the second period 1973 to 1985, a new classification was adopted, which was influenced by international classifications, and this is readily apparent on soil maps made after 1973. In the second stage of mapping, application of modern methods were used such as telemetric research using aerial photography at various scales. At first, black and white photography was used, following by colour photography.
One of the very important tasks at the present time and in the future for the soil scientist will be to adapt the national classification to the FAO classification, and to carry out adjustments to the database of the BSM of BIH. Bosnia and Herzegovina is very rich in different types of soil whose characteristics very much derive from geology, morphology, climate conditions and other factors.

The flat or lowlands zone is found in the northern part of BIH and represents the most valuable land resource. There, the degree of development of primary food production is much higher than in the hilly-mountainous areas. The most common types of soil are: Stagnic Podzoluvisols, Fluvisols, Umbric Gleysols and Eutric Gleysols.

The hilly zone is more heterogeneous than the lowland zone in terms of soil. A considerable part of this zone has slopes above 13% and the processes of erosion are very marked. The erosion processes are further enhanced by inappropriate ways of farming, lack of water and soil conservation measures and preference being given to row crops (corn and potato) on such terrains. The most common types of soil are: Chromic Luvisols, Eutric Cambisols, Leptosols – Rendzic Leptosols and Vertisols.

In the mountain zone the erosion processes are present also, although these lands are mostly covered by forests and grasslands. As for sown crops, rye, barley, oats and potato dominate. The most common types of soil are: Dystric Cambisols and Dystric Regosols which are predominantly present, followed by Leptosols – Rendzic Leptosols and Regosols.

The Mediterranean zone, with its warmer climatic conditions, can grow a wide variety of crops and support intensive farming, so that as well as traditional arable crops, early vegetables are also being cultivated for the local markets. Fruit-growing and vine-growing are also developed here, so that this region is also called the region of southern crops. The most common types of soil are: Lithic Leptosols, Regosols, Leptosols – Rendzic Leptosols, Chromic Cambisols, Fluvisols in the river valleys, Umbric and Eutric Gleysols in the karst fields. In the swamps, Histosols are often present and these are important environmentally.

In summary the main characteristics of soils in Bosnia and Herzegovina are:

- Acid soils occupy more than 1/3 of the land;
- Humus content is low;
- Content of the most important fertiliser nutrients is low;
- Soils are generally shallow;
- Excess water on about 14% of the territory;
- Inadequate concern for improvement of fertility;
- Individual land holdings are small and fragmented;
- Erosion is a problem particularly on sloping land.

**Land use change**

The recent conflicts in the 1990s have had a major effect on land cover and land use in Bosnia and Herzegovina. The movement and displacement of people caused significant changes in the distribution and pattern of population on the ground.

There was a large land use (LC/LU) change during the war years 1992-1995. This change has been primarily reflected in the area of abandoned land and deforestation.
Although before the war there was unused agricultural land in BIH because of migration of people from rural areas to towns and abroad, the amount of abandoned land greatly increased during the war. Economic considerations are another factor contributing to the increase of abandoned land. State farms leave significant areas of land uncultivated because they cannot sell agricultural produce profitably.

Significant deforestation occurred mainly during and after the war. Large areas of forest were cut and wood used as firewood as well as a source of funding for the war.

At present, it is estimated that 3,000 hectares of agricultural land are permanently lost to other land uses annually. It is often the most fertile and accessible cropland that is lost but there is no reliable record of these land use changes. Yet, the reliable and timely information on land cover and land use change is an essential part of sustainable land management. Given the limited availability of agricultural land in BIH, effective use of this land is essential for sector development.
Land-related constraints to sustainable agriculture

The land question in BIH can be looked at in four main ways:

- Considerable uncertainty over land rights, with obvious implications for investment;
- Fragmentation and small size of farm units (see table below);
- Poor or non-existent (some war-damaged) cadastral and legal registration systems;
- Mined land is a great risk for people. De-mining of the thousands of minefields may require many years to complete.

Whatever approach is adopted will be difficult. There is no common legal regime at BIH level for regulating land ownership. Entity laws do exist and regulate legal titles and registration of ownership over real estate, including land. Again however there are in practice three versions of real estate and land transaction legislation, one for the RS, and one for each “Canton” within the Federation. Fortunately the main principles of all three are similar because the legislation rests heavily on ex-Yugoslav laws.

Any sense that this relative uniformity is an advantage must be illusory however, given that these roughly similar laws are likely to be applied very differently and also manipulated in each Entity or Canton. Moreover, land information and survey records are archaic or were destroyed during the war.

Pre-war (1991) Indicators of Land Access and Fragmentation can be seen in Table 2.

The average size of a rural household farm in the BIH is about 3.0 hectares divided between 8 and 10 plots. Moreover, for better understanding of the land related constraints to the land resources, it is useful to have the insight into the ratio of different categories of land use per inhabitant in relation to altitude in the layout of the landscape of Bosnia and Herzegovina, (Table 3).

Land market activity has to be increased as a means of addressing the problem of small farm size and fragmentation. Leasing should be encouraged by developing legally recognised, standard lease contracts, which protect both lessee and lessor.

Institutional reforms include continued international community support for the process of updating and reconciling the land book and the land registry, and computerising land records; amendments to inheritance law to prevent further land fragmentation; and the establishment of Land Development Boards for land use projects that require cooperative action (drainage, irrigation and land consolidation programmes, and the management of communal grazing areas).

Minefields are still one of the main constraints to the development of rural areas in BIH. Large tracts of strategically important agricultural land and forest areas remained mined after the war and therefore cannot be used. De-mining of the thousands of minefields may require many years to complete. Estimates do suggest that at current rates of de-mining, it might take several generations before rural areas are again safe.

The de-mining of agricultural land will be accelerated by establishing an administrative unit to: identify and prioritise land for de-mining, obtain requisite donor finance, and coordinate and monitor de-mining.

Table 2: Indicators of Land Access and Fragmentation

<table>
<thead>
<tr>
<th>Farm size in ha</th>
<th>Number of Farms</th>
<th>Percentage of Total Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 1</td>
<td>180,673</td>
<td>33.93</td>
</tr>
<tr>
<td>1 - 3</td>
<td>178,138</td>
<td>33.45</td>
</tr>
<tr>
<td>3 - 5</td>
<td>86,272</td>
<td>16.20</td>
</tr>
<tr>
<td>5 - 8</td>
<td>56,115</td>
<td>10.54</td>
</tr>
<tr>
<td>8 - 10</td>
<td>16,661</td>
<td>3.13</td>
</tr>
<tr>
<td>More than 10</td>
<td>14,669</td>
<td>2.75</td>
</tr>
<tr>
<td>Total</td>
<td>532,528</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source: Statistic Bulletin (1991)
Table 3: Different categories of land use per inhabitant

<table>
<thead>
<tr>
<th>Ratio of land use</th>
<th>Height above see level in BIH</th>
<th>in m</th>
<th>in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ploughed fields and gardens</td>
<td>0.23</td>
<td>0 – 200</td>
<td>14.2</td>
</tr>
<tr>
<td>Total plough able land</td>
<td>0.36</td>
<td>200 – 500</td>
<td>29.0</td>
</tr>
<tr>
<td>Total agricultural land</td>
<td>0.59</td>
<td>500 – 1,000</td>
<td>32.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,000 – 1,500</td>
<td>20.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,500 – 2,000</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More than 2,000</td>
<td>0.1</td>
</tr>
<tr>
<td>TOTAL:</td>
<td></td>
<td></td>
<td>100.0</td>
</tr>
</tbody>
</table>

1Precise population data is still lacking. Current estimates of total population range from 3.6 million (World Bank), to 3.7 million (Reconstruction and Return Task Force - RRTF).

Figure 3: Minefields information

Current de-mining costs range from US$2-7/m² depending on terrain, density of vegetation, residual metal content in the ground, and the number of land mines discovered.
Following the guidelines and programmes developed by the Reconstruction and Return Task Force (RRTF), the resettlement of rural land will be supported by ensuring that the returnees, re-locating families and residents in resettlement areas have full access to available credit and extension facilities.

A clear agricultural policy response to the tragic problem of land mines in rural areas has yet to be developed. It is estimated that there are 17,000 mine fields and some 750,000 land mines remaining in BIH. More then 250,000ha of arable land is rendered inaccessible because of mines. As urban areas and infrastructure have priority for current de-mining activities, only 330ha of agricultural land had been demined by the end of 2001.

Mines are a great hazard to people that walk on afflicted areas for carrying out agricultural work or felling of trees. Indirectly, minefields are the cause of fires, spreading of weeds, erosion processes and other forms of degradation, directly related to plant production.

De-mining is therefore critically important not just from the human rights perspective, but is also as a pre-condition for long-term development and environmental protection.

**Overview: society's response to amelioration**

Ongoing efforts to make inventories and assess the land resource base in BIH are clearly enlarging the knowledge base that will serve as a foundation for decision making on future land use. Bosnia and Herzegovina presents a diversified resource base offering opportunities for both quantitative and qualitative improvement of the agricultural production.

Recent legislation and policy intentions reflect a real concern to preserve land resources. Recommendations to train municipal authorities in the application of ‘ISO 14000 - Environmental Management Systems for Municipalities’ are underlining the genuineness of these pre-occupations. Actual discussions within local governments on priorities to de-mine agricultural land, and on the identification of ‘virgin’ land, i.e. not polluted, for promoting biological agriculture are other indicators of support for preservation planning.

**International support**

The FAO ‘Agricultural Sector Strategy Project’ (TCP/BIH/7821) was finalised in 1999 with the publication of a comprehensive medium-term strategy paper for the agricultural sector in BIH. The global objective of the strategy recognises the importance of optimising land use and preserving the natural resources base.

The Land Resources Inventory Project (GCP/BIH/002/TTA) was carried out from 2000 to 2002. The activities covered the entire territory of BIH. The development of a land use management model based on the Agro-Ecological Zoning (AEZ) methodology is a major achievement. The project is still active at a lower level with the main task to establish sustainable land use methodology in the three municipalities of BIH.

GTZ (German Cooperation) is presently involved in some pilot cadastral projects, addressing among other things the issue of land registration procedures. The major aim here is to build a modern cadastre that responds to the present needs of the country. In some pilot areas, new procedures to deal with the privatisation of state enterprises, including the land resources are being tested.

The United Nations Development Programme (UNDP) implements the Local Action Programme in the Brčko District (BLAP), hence gaining important experience in area-based development. With the technical assistance of FAO, this programme has also supported the Department of

**Other constraints to sustainable agriculture**

Land and water conservation are the major environmental issues for land use policy. There is a strong awareness of this imperative in F Bosnia and Herzegovina presents a diversified resource base offering opportunities for both quantitative and qualitative improvement of the agricultural production.

The cost of recovering these areas is probably prohibitive. Much more can be done to restore the remaining 258,500ha that has suffered a combination of erosion and fertility loss as a result of poor management. Guidance on management techniques such as deep ploughing, green manuring, liming and crop rotations would assist this restoration.

The United Nations Development Programme (UNDP) implements the Local Action Programme in the Brčko District (BLAP), hence gaining important experience in area-based development. With the technical assistance of FAO, this programme has also supported the Department of
Agriculture and Forestry with the preparation of a plan for the future use of the ‘PD Posavina’ state farm based on the optimal land use.

Through its Agricultural Strategy and Programming Unit (ASPU), the European Union supports policy and legislation development for a number of land-related issues. It is instrumental in the revision of the legislation on land restitution. Furthermore, many national and international NGOs are working in BIH in the sectors of agriculture and sustainable use of land resources.

**Conclusions**

The basic goals for the short term in soil use and management in Bosnia and Herzegovina are:

- Institutional strengthening in the domain of management, protection and use of land resources;
- Reduction of soil degradation.

**Measures** necessary for achieving these goals, e.g:

- Preparation of a unique strategy (policy) for the protection of soil at the national level;
- Preparation of a unique law on soil (protection, use and management), based on planned policy;
- Inventory of the current balance of soil in Bosnia and Herzegovina for the needs of strategic planning;
- Determination of the level of contamination in order to provide conditions for organic food production (institutional building of soil contamination monitoring procedures);
- Increase in fertility of intensively used soils with a soil fertility monitoring system;
- Establishment of a state or entity level agency or institute that would be in charge of the implementation of soil management and protection policy;
- Determination of the current and potential erosion of soil in Bosnia and Herzegovina and determination of protection measures (preparation of erosion and landslide maps);
- Classification of soil for sustainable management and use in agriculture and forestry;
- Determination of the quality of soil in order to outline priorities;
- Establishment of a systematic monitoring of soil, first within the Aple-Adria association, and then later within the European integration processes;
- Preparation of other soil maps in order to provide for better space management and increasing food and raw-material production;
- Establishment of a unique land information system (ZIS);
- Revitalisation of ‘technogene deserts’ of mines and thermal power plants;
- Raising the education level of the population on the importance of soil for sustainable development and future benefit of future generations;
- Preparation of programmes for activation of unused lands and changing limited areas on inclined terrains into orchards and forests in order to prevent erosion;
- Reform of the land registry and cadastral records.
Further Reading

Vlahinić, M., (1999): Agrohydrological views on the state, use and contamination of water resources in BIH. 6th Workshop on water protection and sustainable development. World water day, Neum.
1999: FAO Agricultural Strategy (draft), Entities Ministry for Agriculture.