Drought conditions and management strategies in Croatia

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RH covered annex included 4.UNCCD Convention to the area that was for millennia, more or less susceptible to erosion of soils, drought and desertification processes. As expected for South Eastern Europe (SEE), where territory of Croatia is located, according to 4-th IPCC Report more frequent warm and dry periods are expected in comparison with pre-industrial era especially during summer season.
It is evident from Table I-1 (Annex I) and Table II-1 (Annex II) at which a summary of monthly and yearly anomaly categorization have been represented for the last 12 years.

Most of 144 monthly air temperature anomaly cases i.e. 53 of them belong to warm category simultaneously for the whole territory of Croatia, 40 to warm and normal category, 24 to normal, 18 to cold and normal, 7 cold and only 2 cases when part of Croatia has been warm, part normal and the rest cold anomalies in comparison with the World Meteorological Organization (WMO) reference period 1961-1990. Most warm monthly categories are concentrate from April to August while the most cold categories are concentrated in September and February. Among of total 12 years considered 8 of them have been warm on the whole territory of Croatia, 3 warm and normal and only one i.e. for 2005 cold and normal. This distribution agrees with recent annual air temperature trend for Croatia.

Most of 144 monthly precipitation amount anomaly cases i.e. 47 of them belong to wet and normal category, 39 to dry and normal, 26 to normal, 14 belong to dry, 26 to normal and 6 to wet category simultaneously for the whole territory of Croatia, 12 cases when part of Croatia has been dry, in part normal and in part wet anomalies in comparison with the WMO reference period 1961-1990. Most dry monthly categories are concentrate in 2003 and 2011 as the driest years in the period considered.

Impact of drought have been particularly strong in Croatia in 2000, 2003, 2007, 2011 and 2012 (Figure 1). The strongest impact have been on small farmers due to the fact that the most of agricultural production in Croatia take place in small farms and makes only source of income for rural population.
One of the most vulnerable areas of the concentration of economic activities, particularly in rural and coastal karst areas, as a result of urban growth, industrial activities, food production, tourism development, etc. The Mediterranean karst areas, where erosion reached bedrock, are often affected by forest fires. Sociological development of social service industry that is leaving low income jobs in the primary production of food and hard to arable soils, the area is gradually moving from cultivated to uncultivated land. Degradation of the environment in food production in the continental part is also high, when emissions of highly intensive agricultural production and agglomeration of animals in limited space affects the environmental components. The impact of human industrial and agricultural production is associated with pressures on groundwater northwest parts of Croatia.

II

For international institutions MENP from RH delegated body for the legal implementation of the commitments of sustainable development in cooperation with the Fund Environmental Protection and Energy Efficiency and the Croatia Environmental Agency. Meteorological and Hydrological Service (MHS) is a very important and relevant institutions with the help CEA in the collection and processing of meteorological-hydrological data needed to guide policy monitoring drought on vulnerable segments of the development of society as a whole.

Operative drought monitoring and early warning system has been established by Meteorological and Hydrological Service (MHS) of Croatia. Recent period drought analysis have been published at MHS web site http://klima.hr/klima.php?id=SPI, including temperature and precipitation amounts. Rivers' discharges have been published at MHS web site http://hidro.hr/hidro.php?id=hidro&param=Podaci as well as at Croatian Waters (CW) web site http://www.voda.hr/Default.aspx?sec=821.

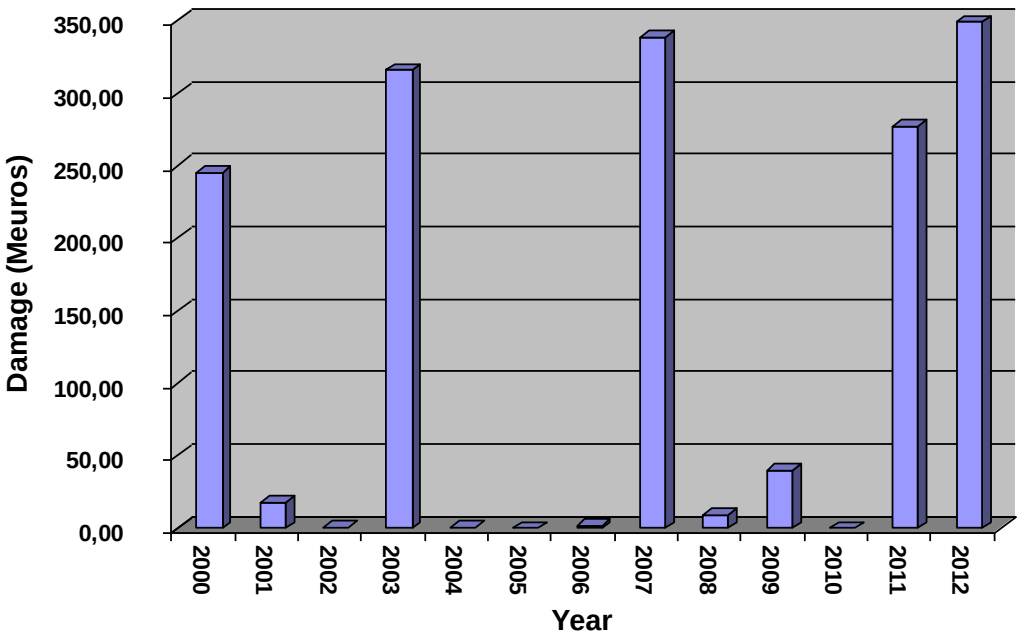

Figure 1 Damages (in M€) due to drought in Croatia during the period 2000–2012

Several international organizations (International Commission on Irrigation and Drainage, UN Convention to Combat Desertification and World Meteorological Organization) participated in shaping a proposal to establish DMCSEE (Drought Management Centre for SEE) in 2006 led by Agency for Environment of Slovenia (ARSO). A final proposal and application for the DMCSEE EU project was prepared in 2009 by a consortium, composed of representatives from national meteorological and hydrological services (e.g. MHS), the academic community (e.g. Faculty of Agriculture University of Zagreb) and ministries responsible for mitigation of impacts of drought and desertification (Ministry for Environmental and Natural Protection). The project partnership was assembled in a similar

manner – to cover drought monitoring and drought impacts. The main aim of DMCSEE Project is to improve drought preparedness (by performing risk assessment and establishing early warning system) and consequently help to reduce drought impacts. As a measure for drought mitigation is a national irrigation plan whose implementation requires significant investment.

III

Intensification of climate impacts on food production, Croatia faces different pressures on the safety of the food chain in terms of mycotoxin contamination and degradation of soil conditions - groundwater, etc.
Final version of the drought vulnerability map (Figure 2) is calculated from the category maps of slope, irradiation, coefficient of variation of precipitation, soil classes and the land cover classes. It has been calculated for the areas with vegetation.

Forests in the eastern Croatian classified “not vulnerable“ and “slightly vulnerable”. On the north-western inland area the woods are mainly “not vulnerable”, while the arable land and cultivated areas are “slightly vulnerable”. “Slightly vulnerable” are also the Istria peninsula and Lika region where only some smaller parts are in the classes “not vulnerable” (mixed forests) or “moderately vulnerable” (cultivated land or pastures). On the northern Adriatic coast vulnerability rises, and becomes “moderately vulnerable” (forests) and “vulnerable” (cultivated areas, sparse vegetation or shrub). On the middle Adriatic coast the “moderately vulnerable” are mostly transitional woodlands while grassland and cultivated areas are “vulnerable”. Some smaller areas can be also “strongly vulnerable”.

Inclusion map analysis of land use in relation to the drought, the vulnerability is focused on intensive agricultural areas of Eastern and Croatian karst areas.

Analysis of the current status and developmental needs show that Croatia possesses sufficient quantities of water for its own needs and that water resources, in terms of their quality and quantity are not a restricting factor of economic development. Lack of water is possible during the summer months in dry years and most usually effect agricultural production because irrigation, as agro technical measure mostly is not used in agricultural production on small farms.

Problems with water supply are possible in parts of Croatia where public water supply does not existing. In the state of droughts, as it was last year, problems with public water supply were present on Istrian peninsula. In that case county authorities declared limitation of I. degree for usage of water from public water supply.

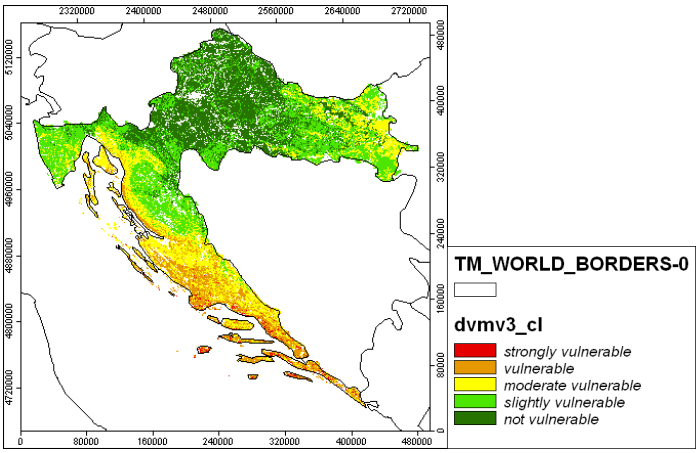

Figure 2 Categorical drought vulnerability map for the areas covered with vegetation. It is calculated from the category maps of slope, irradiation, coefficient of variation of precipitation, soil type and land cover type (Source: http://meteo.hr/DMCSEE/).

The drought most often has been affecting rural population especially small family farms, and reducing already law incomes from agricultural production. Recovery of agricultural damage due to drought is based on the Declaration of Natural Disaster and then by financial aid from the governmental found. Depend on proportion Natural Disaster can be declared for the part of the country by the municipality/county authorities or for the whole country territory by the Government. Based on the assessment of crop damage local authorities allocate approved financial resources from governmental found among farmers affected by droughts, as measure of mitigation of the drought effect. On same way droughts are a common occurrence, and the damage they cause to agriculture is estimated at billions of kunas. At the same time, irrigation of agricultural land is insufficient and uses a negligible part of the water potential. Due to Census of Agriculture for 2003 in Croatia were irrigated 9.264 hectares or 0.86 percent of exploited agricultural land. Having in mind the natural potential of the Republic of Croatia – the quality of soil and rich water resources with a favorable climate – it is clear that irrigation is not performed according to the actual potential, significance and needs.

IV

Special effect on CO2 emissions, the groundwater level has the energy sector and industrial production.

The impact of construction and industry on the ground and the groundwater level is of significant interest to Croatia. Particularly in terms of maintaining the function of soil and groundwater at the baseline and establishing the legal basis for actions of remediation integrated environment from industrial pollution. Development environment from industrial pollution primarily involves strengthening institutional capacity for sustainable development for the implementation of IPPC - IED 5 regional centers. The basis of this project establishment of centers in the implementation of the IPPC Directive and Closed cycle of pollution control and billing harmful emission allowances, creating a legal framework for greenfield investments.

Sustainable use of natural resources of the river near the building, the energy sector is also important to maintain buoyancy in order to divert vehicles and reduce harmful emissions into the air, as well as maintaining the appropriate level of underground water available for use by the civil sector, etc. Special attention is focused on the application of sustainable soil use of natural resources, waterways and prescribed environmental impact assessment guidelines - Platinum manual.

V

In October 2005 the Government of the Republic of Croatia adopted strategy of present and future development of irrigation in Croatia, aimed at improving the management of natural resources, organization of agricultural infrastructure, and market economy of agricultural products under the title of the *National Project of Irrigation and Management of Agricultural Land and Water in the Republic of Croatia* – NAPNAV.

Since than six existing irrigation systems have been totally or partially repaired (3.800 ha), five new systems were built (1.200 ha) and total irrigable land are increased to around 15.000 ha at 2012.y. of 65.000 ha on which is planed to be constructed irrigation systems until 2020. It is expected that the measures of systematic organization of infrastructure in agriculture, consolidation of agricultural land and introduction of irrigation and new technologies of production shall result in a more efficient and stabile agricultural production.

In September 2011.y. The Croatian Government has adopted a strategic guidance for the development of green economy. According to the Strategy for Sustainable Development of the Republic of Croatia there are eight challenges for sustainable development activities in specific areas: climate change, food, marine and coastal areas and the environment, water, biodiversity, forestry, etc.

Due to the improvement of competitiveness of production, it is almost bound to increase the level of irrigated agricultural land in a sustainable manner.

Described the context of" zero tolerance" of industrial production in the degradation of the environment, creates an effective legislative framework implementing the conclusions of the Conference Rio +20 and the Millennium Development Goals with clear operational action programs of all stakeholders from agriculture, civil society, research, etc.

Cross compliance - Soil management in accordance with the recommendations of sustainable development has enormous economic and social importance, particularly with respect to economic growth, biodiversity, addressing climate change, improving water availability, environmental protection, agriculture and security of the food chain (environmental certification), eradication of poverty and the empowerment of women.

The important food sector Croatian launched initial activities promoted information on good agricultural practice. Developed guidelines for agriculture and application of environmental measures in practice, 2008 could not cover the full recommendations of sustainable development related to environmental protection.

These efforts have not achieved the expected results and Croatia must make further efforts in terms of connectivity and strengthening institutional capacity for sustainable

development Fund Environmental Protection and Energy Efficiency, Croatian Environmental Agencies and the Ministry of Environment and Nature Protection, based on positive recommendations Convention UNCCD, UNFCCC, LRTAP, UNECE that legislation from the field of sustainable development.

VI

Sustainable development is a very precise balance as the application of pesticides, fertilizer and water use in line with the laws to protect the air, on what is important to the country several times to increase the institutional capacity of the legislative acts of the institutions of environmental protection. One of the key tools in the management of environmental soil and increasing soil organic matter is the continued development of the law for organic (organic) farming. Croatia is an organic agricultural production affected 32,000 ha or 1.5% of arable land.

The primary interest of the state to strengthen environmental institutions in enhancing understanding of the needs of the implementation of an effective legal system, nominated sustainable development and the transfer of the legal provisions on the masses by publishing guidelines for sustainable development for individual sectors of production.

The impact of drought on deforestation, forest soils, reducing damage to the primary production of food, loss of soil organic matter, water temperature, soil and socio-economic indicators, it is necessary at the national level to connect with the recommendations of sustainable development, connecting strategic coordination of several Convention.

In order to implement the Law of sustainable development in practice, the institutions of the Fund of Environmental Protection and Energy Efficiency systematized data from CEA used as a liberal system of financial interventions for the implementation of environmental protection measures.

Very complex IT programs for soil and agricultural land data on the soil will be used to monitor deforestation, the level of soil organic matter, soil contamination levels, the correlation with the individual user, laboratory analyzes, soil remediation, land registry, cadastre, etc. The process of strengthening environmental institutions special Croatian attention must be focused on the activities of integrating all existing data into one - a database with the possibility of rapid issuance of certified data on the state of the environment and the realization - polluter pays principle.

Precisely because of the sustainable use of rural areas is intended to put into operation the development of neglected areas with the use of agro environmental measures, including maximum development potential to meet their own needs for food. Food produced in rural areas because of the security of the food chain and export options must comply with international environmental standards Global GAP, ISO, etc.