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Socio-Economic Impact of Floods in Suceava County in June – August, 2010

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ABSTRACT

Following the floods from the period considered, serious damage occurred in all Suceava regions. The county's infrastructure was seriously affected, resulting in significant material losses. The most important fact is that the floods from June – August 2010, have killed a total of 10 people.

1. INTRODUCTION

The county of Suceava is one of the most affected by floods in the last decade. Along the natural causes of floods lately, land management is another important aspect to be considered when talking about extreme phenomena. The human factor and its daily routine add to the causes of floods, and are considered the most important elements when it comes to risk assessment. Indirect economic damages consist of effects that are temporary or permanent flooding of the interruption of production processes, the delays in delivering products and even products by reducing exports. The impact is greater, especially in poorer communities. Reconstruction measures are closely related to the populations' economic situation of the affected area. The following study concentrates on presenting the element of one of the major floods, namely the flood from June – August 2010, and the way it was perceived by the locals and its socio-economical impact on a long term basis.

2. OVERVIEW OF SUCEAVA COUNTY

The administrative county of Suceava is located in the North, unfolding between 24° 57' - 26° 40' East longitude and 47° 4' 33" - 47° 57' 31" North longitude,

bordered on the North by Ukraine, South of Mureş County, East of Botosani and the Western counties of Maramureş, Bistriţa-Năsăud. This county includes 5 municipalities, 11 towns and 96 communes. The total area is 855,350 ha (3.6% of Romania, the second county in size) of which:

- 349,502 ha agricultural land 40.8%;
- 434,815 ha Forest 50.6%;
- the living area 778.28 ha.

The total percentage of county area, occupied by rivers, is 0.65%.

3. THE GEOGRAPHICAL SETTING

Suceava county territory consists of two main relief units:

a). *The mountainous region* consists of massive and complex groups of peaks separated by deep valley corridors and depression areas: the Suhard and Călimani, Bistriţa-Griţescu Pietrosu Broşteni, Obcina Mestecăniş massifs, Giumalău Rarău, Obcina Feredeului, Obcina Mare massifs, the Stănişoara Mountains, the Dorna Depression, the Vatra Dornei – Câmpulung Moldovenesc and Gura Humorului depression corridors.

Between the set of massifs, the Călimani massif stands out, being the highest and most imposing

volcanic mountain (2,102 m Pietrosu Peak) in our country and it presents a distinguished relief, consisting of very sharp peaks, curious residual plateaus, large debris fields, deep valleys with radial arrangement from the volcanic cone.

b). *The plateau region.* The Moldavian Plateau, down an average of 200 m from the lowest Eastern mountain peaks, consists of structural plates, with slopes with landslide micro relief, asymmetric valleys, erosive depressions, morphological valley corridors. The relief subunits, components of the plateau region, are Marginea-Ciungi piedmont hills, the Rădăuți Depression, the Suceava-Fălticeni Plateau, the Dragomirna Plateau, the Linei Depression, Baia piedmont plain (located along the extra-mountainous valley of Moldova), the Siret Valley corridor. The piedmont Marginea-Ciungi is the highest and most fragmented subunit of relief. The lowest altitude with smooth relief, sometimes terraces, is the Siret valley corridor, the Baia Depression and Rădăuți piedmont plain. The architecture of the county has as a main

characteristic the succession from west to east of four structural zones, distributed as follows: the volcanic area, the Cristalo-Mesozoic area, the flysch area and the platform area. The first three areas make up the mountainous region and the last forms the plateau unit.

In the composition of the Cristalo-Mesozoic area, between well metamorphosed crystalline schists, the flysch area, occupied mostly by the Obcinile Bucovinei units, consists of strongly folded packets of sandstones, marls, clays, conglomerates and shale. The platform area, situated in the East of the county, consists of quasi horizontal layers, at the composition of which, participate in general soft rocks, such as: sandstone, sand, gravel, clay and loess deposits.

3.1. The hydrographic and hydrological network

The hydrographic network of the Suceava County total 3,092 km. The hydrographic network's density is of 0.361 km river/km² areas, high value of the national average.

Table 1. The main rivers that cross county and their length within the county of Suceava.

River	River length in Romania (km)	Length in Suceava county (km)	% of the total length in Suceava County
Siret	559	148	26.47
Suceava	173	170	98.6
Somuzu Mare	51	51	100.00
Molodova	213	149	69.95
Bistrița	283	131	46.29
Dorna	46	46	100.00
Total	1,325	695	52.45

The total size of water bodies in the county is 5,542.63 ha, representing 0.65% of total county area, of which 5056.622 ha are rivers and 486.008 ha lakes.

All the rivers in the county of Suceava are tributaries of the Siret River, due to the general configuration of the relief. The largest amounts of water are transported by the rivers whose basins are located in mountainous region. The most extensive river basin is the basin of the Moldova River, which drains through its tributaries, over 33% of the county, as follows: Bistrița (about 30% of the surface) and Suceava (26.6%). Stagnant waters consist of small natural lakes and artificial lakes designed for complex purposes: industrial and drinking water supplies, flood protection, fishing, etc. The largest anthropogenic accumulations are the six lakes along the Șomuzu Mare River. The county's ground waters are quartered in the deposits of some Cristalo-Mesozoic structures, by flysch, in Miocene deposits and especially in Quaternary alluvial formations.

3.2. Local weather conditions

Due to its geographical position the Suceava County's climate is temperate, with continental

character. The climate is mainly influenced by the presence of the Atlantic and Continental anticyclone masses. Due to the fact that the county's relief is diversified, including areas of plateaus and hills, and low and high mountainous areas (with altitudes of about 225 m at Dolhasca up to 2,210 m in the Călimani Mountains) a climate range clearly stands out (a plateau temperate continental climate and a mountainous one) as well as a detailed top climate differentiation.

The climate's continental character is revealed by extreme air temperatures at Suceava, oscillating between 38.6° C in summer (17/08/1952) and -31.0° C (20/02/1954) in winter, resulting an amplitude of 69.6° C. The average annual air temperatures vary between 7 – 8° C in the plateau area, 4-6° C in the lower mountainous and 0-2° C in the mountains. The average multi-annual rainfall quantity varies between 550mm and 940 mm depending on the height of relief. The temperature regime is characterized by average values of between 8.0° C in the plateau area (values increasing from North to South) and 0.0° C in high mountain area, the values decreasing with the altitude. Wind speed shows the highest values on the prevailing directions, presenting a maximum in winter and a minimum in summer. The prevailing wind direction is NW-SE.

3.3. The demographic structure of the Suceava county

The human resources of a region are measured in terms of the total number of population of a country. A review of human resources, according to modern methodological principles, must begin with a description of the existing demographic situation, the main demographic phenomena, based on information available in statistical form.

The Suceava County numbers 708,109 inhabitants (01.01.2010). If the average population of a county in Romania is of 511,000 inhabitants, then the Suceava County is situated in the large counties.

The population's distribution is 303,501 (42.86%) people in urban areas and 404,608 (57.14%) people in rural areas. The population's density, in the Suceava County, was of 82.8/sq km registered at 01.01.2010.

The number of population represents the result of the interaction of two major movements: the natural movement, characterized in turn by developments in birth and mortality, and the population's migratory movement.

In the division between urban and rural areas in 2004, to January 1, the number of people in urban areas was of 235,947 persons, and in 2010, January 1, there were 303,501 people. In rural areas, on 01.01.2004 there were 469,608 people and on 01.01.2010 only 404,608 persons. In the Suceava county we can see a shift of population from rural areas to urban ones (see table 2).

Table 2. Demographic structure at 01.01.2010.

Gender	Area of residence	2004	2010
Total	Urban	235,947	303,501
	Rural	469,608	404,608
Male	Urban	113,587	147,069
	Rural	235,163	202,822
Female	Urban	122,360	156,432
	Rural	234,445	201,786

The number of people of the county grew by 2,554 people compared to 2004.

4. HYDROMETEOROLOGICAL PHENOMENA EVOLUTION

The region of Suceava is one of the areas most affected by floods; several objectives were flooded following heavy rains in 2010.

In many areas of the county, particularly those in the mountainous area, torrential rains have blocked roads and railways. Several river flows, recorded increases, over the share of risk and flooded important areas of land, the torrents carried off logs and stones, which blocked or clogged traffic.

Some churches were flooded due to heavy rains, along with other institutions and dozens of homes were affected by torrential rains.

More localities, both in the mountainous and neighboring areas of the city of Suceava were affected by floods. In the mountains there were problems in several areas of county roads, among the affected area being the Nisipitu village of the Ulma commune and several localities in the Brodina commune.

The Suceava River's waters overflow the water bed and washed a larger portion of the road.

During the duration of the event, the flow of hydro meteorological information functioned properly. Rainfall warnings, hydro warnings (Hyavert) and other posts were taken by the hydrological stations, validated by the service hydrologist and sent to SGA Suceava. Dispatch messages were collected and disseminated in the territory according to the information flow.

The evolution of the hydro-weather was continuously monitored taking about bands and hydrometric stations in Suceava SGA management to ensure operational information flow.

The County Committee for emergency situations, local emergency committees in the affected areas and the Inspectorate for Emergency Situations Bucovina, of Suceava County, has been alerted.

5. LOCAL MEASURES BEFORE, DURING AND POST – FLOOD

Preventive measures:

- due to dangerous weather phenomena, registered between 27.06.2010 - 07.03.2010, which determined the increases in flow growth on watercourses of the Suceava county, the county's prefect ordered all owners of water accumulations in the county, by order 282/03.07.2010, to lower the water level to the minimum volume. Notifications were done by Water Management System of Suceava;

- alerting operational personnel from Suceava SGA for intervention if necessary taking action SJ;

- the verification of equipments and transportation, as well as the existing flood protection materials in SJ stocks.

Operational measures:

- the flood wave propagation was monitored. The calculation of the flow travel time, based on which the evacuation of the town's population was ordered;

- the work of SGA administration Suceava interventions were made on their own equipments, with assistance from representatives of SGA Suceava.

Post-Flood Measures:

- the inventory of all critical points at this time in the work of defense and action to remedy them;

- repair works to establish the emergency hydraulic construction, that affected the administration - to restore the line of defense;

- participation in assessing damages in the action of management and report summaries.

Significant amounts of rainfall were reported in the following hydrometric stations:

Tabel 3. Measurements of the amount of precipitations.

Significant amounts of rainfall were reported in these hydrometric stations:	Date	Amount of precipitation measured (l/sq m)	Accumulated on 17.08-02.07.2010 (l/sq m)
SH Siret	23.06.2010	56.7	270.1
SH Zvoriștea	23.06.2010	48.1	248.6
SH Huțan	22.06.2010	45.6	138.4
SH Lespezi	22.06.2010	41.6	122.9
SH Brodina	30.06.2010	46.3	272.9
SH Țibeni	28.08.2010	74.5	260.0
SH Ițcani	22.03.2010	86.4	179.1
SH Horodnic	30.06.2010	58.7	268.0
SH Părâuți	28.06.2010	80.1	198.7
SH Dolhești	26.08.2010	39.9	134.1
SH Fundu Moldovei	30.08.2010	36.3	159.2
SH Câmpulung Moldovenesc	22.06.2010	47.1	217.9
SH Prisaca Dornei	22.06.2010	55.4	233.8
SH Gura Humorului	22.06.2010	35.3	169.5
SH Lunguleț	22.06.2010	42.9	250.6
SH Dragoș	29.06.2010	50.5	206.9
SH Stulpicani	29.06.2010	40.9	191.2
SH Bogdănești	22.06.2010	36.9	141.7
SH Sucevița	29.06.2010	65.4	241.6
SH Putna	29.06.2010	56.2	280.7
SH Solca	28.06.2010	45.9	236.6

The hydrometric stations which have reached and exceeded rates of attention are:

SH Siret (Siret River - H=425 cm, Q=1125mc/s - 29.06.2010 hour 13, +75 cm over R.L)
 SH Zvoriștea (Siret River - H=602 cm, Q=1000 mc/s - 29.06.2010 time 23, +102 cm over R.L)
 SH Huțani (Siret River - H=588 cm, Q=815 mc/s - 30.06.2010 time 1, +138 cm over R.L)
 SH Lespezi (Siret River - H=662 cm, Q=2049 mc/s - 01.07.2010 time 05, +62 cm over R.L)
 SH Brodina (Suceava River - H=384 cm, Q=336 mc/s - 29.06.2010 time 16, +24 cm over R.L)
 SH Țibeni (Suceava River - H=376 cm, Q=973 mc/s - 29.06.2010 time 08, +26 cm over R.L)
 SH Ițcani (Suceava River - H= 670 cm, Q= 1055 mc/s - 30.06.2010 time 20, + 26 cm over R.L)
 SH Fundu Moldovei (Moldova River - H=190 cm, Q=106mc/s - 30.06. time 16, +4 ocm over R.L)
 SH Prisaca Dornei (Moldova River - H=325cm, Q=222mc/s - 28.06. time 24, +25 cm over R.L)
 SH Gura Humorului (Moldova River - H=251cm, Q=630 mc/s - 30.06. time 18, +51 ocm over R.L)
 SH Lunguleț (Moldovița River - H=255 cm, Q=126mc/s - 30.06.2010 time 14, +5 cm over R.L)
 SH Ursoaia (Suha River - H=375cm, Q=368 mc/s - 30.06.2010 time 16, +125 cm over R.L)
 SH Dragoș (Moldovița River - H=283 cm, Q=238mc/s - 28.06.2010 time 23, +33 cm over R.L)
 SH Stulpicani (Suha River - H=105 cm, Q=47,6mc/s - 28.06.2010 time 22. +5 cm over R.L)

The negative social effects consist mainly of loss of life and their subsequent consequences on the lives of human communities and society in general.

During floods, ample discharge of population panic is developed, that leads to negative psychological effects. If protection measures are not taken the required care, floods can lead to onset of disease. Following these floods serious damage occurred in all Suceava regions.

The county's infrastructure was seriously affected, resulting in significant material losses. The most important fact is that the floods from June – August 2010, have killed a total of 10 people.

6. CONCLUSIONS AND ASSESSMENTS

The floods of August 2010, affected in the basin of Suceava, a total of over 108 locations, their effects being estimated at a total value of 405,607,336

Lei. In terms of effects on geomorphology, floods caused the county bed and banks erosion in an area of 38.85 km and there were clogging of river beds and erosion on an area of 176,651 km. They also triggered landslides on an area of over 53.1 km. Including damage to property and infrastructure the overflowing of rivers damaged up to 894 bridges and footbridges, over 1153.194 km street network, 596 km of electrical networks, 0.388 km of gas supply network and 13,294 wells. The worse affected county roads were DJ 208 S and DJ 209 D, of which the verges were damaged, the asphalt blanking, the roads' flagging, and the DJ 174 county road, with damaged embankments and clogging.

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