LXXII-2023

ANALELE UNIVERSITĂȚII BUCUREŞTI

G E O G R A F I E

Volumul LXXII - 2 0 2 3

SUMAR • SOMMAIRE • CONTENTS

Scientific articles / Articles scientifiques / Articole științifice

https://doi.org/10.5719/aub-g/72.1

In Memoriam

Book Reviews / Comptes-rendus / Recenzii

Scientific life / Vie scientifique / Viața științifică

Doctoral theses / Thèses de doctorat / Teze de doctorat

https://doi.org/10.5719/aub-g/72.1/1

MATERNAL HEALTHCARE SEEKING BEHAVIOUR IN RURAL COMMUNITIES OF IDO-OSI LGA, EKITI STATE, NIGERIA

AFOLABI MONISOLA TUNDE [1] , PETER OLUWATOSIN OMOJOLA [1]

Abstract

This study assessed rural women's behaviour towards Antenatal and Postnatal Care in Ido-Osi Local Government Area of Ekiti State, Nigeria. It identified the type of health problems confronting them; examined their choice of healthcare; determined the factors influencing such choices and assessed factors associated with ANC and PNC service utilization. Primary data were generated through questionnaire administration among 399 respondents in three communities in a systematic way. Secondary data were obtained from Ido-osi LGA, textbooks and internet. Frequency-tables, percentages and ranking were employed to analyze the data. Findings revealed that 84% are married, 94% between 21 and 50years, 89.7% are gainfully employed and 81.4% earn less than N100,000/month. Vomiting is a common illness among pregnant women while dizziness is the sickness among those that gave birth in the last two years. Most of the sampled women consult female traditional birth attendance (92.2%), private health facility (89.7%) and government health facilities (83%). Reduced cost and proximity are the main determinants of caregiver. Socio-economic and Knowledge of pregnancy complications are the most significant factors that influence ANC and PNC service utilization respectively. The study recommends educating the rural women on the importance of modern health services before, during after child birth.
Keywords: child birth, child mortality, developing Countries, maternal mortality, pregnancy, rural areas and women.

1. Introduction

In most developing countries of the world, there is discrimination against women as a result of some sociocultural factors (Morrisson and

[1] University of Ilorin, Department of Geography & Environmental Management, e-mail: afolabi@unilorin.edu.ng

Jutting, 2005). Meanwhile there is an adage that says "no woman, no nation", meaning, women are nation builders (James, 2023). The World Health Organisation (WHO) (2023) however reported that in 2020 about 800 women die on daily basis from avertible causes related to pregnancy and childbirth worldwide. Maternal death has been defined as the death of a woman during the period of pregnancy or within 42 days of termination of pregnancy regardless of the duration and site of the pregnancy from causes as a result of its management only (WHO, 2018). Oestergaard *et. al* (2009) reported that over 50% of neonatal deaths worldwide occurred in five countries to include Pakistan, India, Nigeria, China and Democratic Republic of Congo. Health seeking behavior is one of the most crucial predictor of women's health. Latunji and Akinyemi (2018:52) assert that healthcare seeking behavior is "any action or inaction undertaken by individuals who perceive themselves to have a health problem or to be ill for the purpose of finding an appropriate remedy". Healthcare-seeking behaviour can be regarded as a person's plan of action to engaging (or not) with a particular health service.

Pregnancy is one of the most important events in the life of every woman and it is also a dynamic process in which a woman's risk status can change at any point in time (WHO, 2000). Hence, pregnant women can be said to be at risk of developing some health problems such as anemia, fever, malaria, excessive fatigue, diarrhea, reproductive tract infections, sexually transmitted infections, headache, backache and swelling cramps (Chamberlain, 2001). These problems may be as a result of either the pathological or physiological process or may also be as result of deficiencies in the normal body constituents. The health of women during pregnancy, childbirth and the postpartum period is what is known as maternal health while maternal health care services are antenatal care (ANC), delivery care and postnatal care (PNC) services.

To optimize the maternal health outcomes, the World Health Organisation recommends four antenatal care (ANC) visits, delivery in a health facility and three postnatal care (PNC) visits for women (WHO, 2014). In Nigeria, maternal mortality figure is high and varies from one geopolitical zone to another. The country alone accounts for almost 20 percent of global maternal mortality indicating one of the countries with the highest maternal deaths worldwide (Itodo *et al.,* 2021). In Northern

Nigeria, maternal mortality is high and a major health problem facing most communities in the region (Nigerian Tribune 08th March, 2020). For example, in rural Makwalla, Kaduna State, pregnant women need to cross a river before accessing the nearest health facility (Nigerian Tribune 08th March, 2020).

The World Health Organization (2019), reported that the MMR of Nigeria is 814 deaths (per 100,000 live births). In contrast to the lifetime risk in developed countries estimated at 1 in 4,900, the lifetime risk of a Nigerian woman dying during pregnancy, childbirth, postpartum or post-abortion is one in 22 (WHO, 2019). Despite the difficulties encountered in accessing health facilities, rural women in Nigeria still have at least one more child than the country's average of 5.7 children (NDHS, 2008). Healthcare-seeking behavior emerged as a way of tackling perceived ill health by taking corrective actions (Sreeramareddy *et al*., 2006). Hence, a woman's decision in seeking healthcare is a combination of her personal needs, social forces, actions of healthcare providers, and the location of services (Ferdous *et al*., 2013).

Unsuitable health seeking behavior has been linked to worse health outcomes, increased morbidity, mortality, and poorer health statistics in some rural areas of Nigeria (Atuyambe, 2008; Mwase, 2015). For instance, Onwujekwe *et al*., (2011) in their study reported that about 71 percent of rural pregnant women in Nigeria indicated inappropriate health seeking behavior during their illness episode while only 53 percent of urban dwellers reported inappropriate health seeking behavior during their last illness episodes. On yearly basis, a lot of Nigerian rural women are faced with pregnancy related complications attributed to haemorrhage, high blood pressure, obstructed labour, puerperal sepsis and unsafe abortions (Olatunji and Sule-Odu, 2001). It is therefore imperative to find out what could be responsible for these complications in women living in rural areas of Nigeria in spite of the fact that many studies relating to this have been carried out in Nigeria.

This study therefore seeks to unravel the behavioral pattern of pregnant women and women who gave birth in the last two years when seeking healthcare services using rural areas of Ido-osi local government area of Ekiti State as example. The study specifically identifies the pregnant women and women who gave birth in the last two years;

identifies the type of health problems confronting pregnant women/ those that gave birth in the last two years; examines their choice of place of healthcare; determines the factors influencing such choices and assess the factors associated with ANC and PNC services utilization.

2. Methods and Materials

2.1. Description to case study area

Ido-osi Local Government Area of Ekiti State, Nigeria is the study area for this research. The local government area is located in the northern part of the State between latitude $7^{0}45$ N and $7^{0}54''$ N of the equator and Longitude $5^{0}0''5$E and $5^{0}15'$E of the Greenwich Meridian (Figure 1). It is bounded in the North by Ilejemeje Local Government Area and Moba Local Government Area, in the East by Oye Local Government Area, in the West by Ijero Local Government and in the South by Irepodun/ Ifelodun Local Government Area (EkMI, 2017).

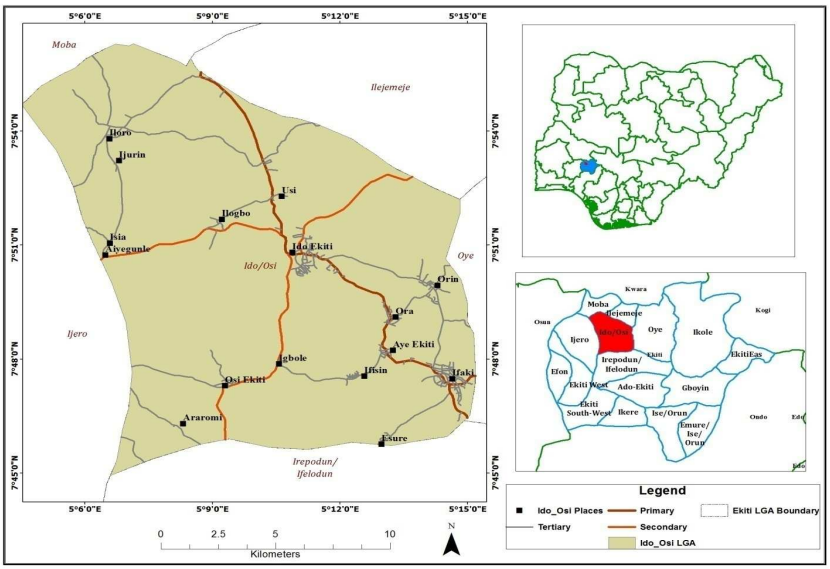


Figure 1. Ido-Osi LGA. Inserted maps show Ekiti State and Nigeria
(*Source:* Ekiti State Ministry of Information)

There are two seasons of rainy and dry seasons and temperature ranges between 32^0c and 35^0c. The relative humidity is high of about 85%. According to National Population Commission (2006), the local government area has about 159,114 people (EkMI, 2017). The people of this area are predominantly farmers with few cottage industries and civil servants.

The study was conducted in the rural districts of Ido-osi local government area of Ekiti State. Ido-osi local government consists of three (3) districts namely: Ido-Ekiti (Aiyetoro Ekiti, Igole Ekiti, Ilogbo Ekiti, Osi Ekiti and Usi Ekiti), Orin-Ekiti (Aeye Ekiti, Ifisin Ekiti, Ilogun, Odo-ora, Oke-ora and Ora-Ekiti) and Ifaki Ekiti (Igbira camp, Ipole, Obaji, Odo Oba-Aladesusi, Okalawa, Oke-Ese, Osi and Temigbola) districts.

2.2. Methods

The population of Ido-osi L.G.A in 2006 was 159,114 (Females 78,540 and male 81,461) as the only officially recognized record of population. To determine sample size and select respondents therefore, Yamane's formula was employed to obtain the required and appropriate sample size with the use of female population. Yamane's formula as expressed by Glenn (1992) is denoted by

$$n = \frac{N}{1 + N\,(e)\,2}$$

Where n= sample size
N = population size (78,540 for females)
e = error of sampling 0.05, Hence n is 399

A total of 399 women that are pregnant and who gave birth in the last 2 years were randomly selected for the study. Purposeful sampling technique was employed for the study since the study deals with rural women that are pregnant and those who gave birth in the last 2 years. The population of women in these villages could not be ascertained as there are no official records of it, copies of questionnaire were therefore distributed equally among respondents in the three villages. Since n is 399, therefore a total of 133 copies of questionnaire were administered on the target population per settlement.

A two-stage sampling procedure was employed as sampling technique. Firstly, the three districts were used as the sampling frame and a village was sampled from each district to make a total of three villages (Igole Ekiti, Ora Ekiti and Obaji) in all. Secondly, random sampling was employed to sample the target population. In this context, every household with a pregnant woman and who gave birth in the last 2years were sampled until a total of 399 is reached. Descriptive statistics such as the frequencies, simple percentages, tables and ranking were employed to analyze the generated data.

3. Results and Discussion

3.1. Socio-Demographic and Socio-Economic Characteristics of Sampled Rural Women

Table 1 reveals the socio-demographic and socio-economic characteristics of sampled rural women. From the table, majority (94%) are within the age bracket of 21-50years.

Table 1

Socio-demographic and socio-economic characteristics of respondents

Characteristics	Frequency (N = 399)	Percentage (%)	Cumulative Percentage (%)
a. Age (Years)			
10-20	24	6.0	6.0
21-30	113	28.3	34.3
31-40	239	59.9	94.2
41-50	23	5.8	100.0
b. Marital Status			
Single	16	4.0	4.0
Married	335	84.0	88.0
Separated	40	10.0	98.0
Widowed	08	2.0	100.0
c. Educational Status			
No Formal Education	11	2.8	2.8
Primary Education	31	7.8	10.5
Secondary Education	277	69.4	79.9

Tertiary Education	80	20.1	100.0
d. Primary Occupation			
Artisan	33	8.3	8.3
Civil Service	190	47.6	55.9
Farming	67	16.8	72.7
Trading	68	17.0	89.7
Unemployed	41	10.3	100.0
e. Income (₦)			
10,000-50,000	200	50.1	50.1
51,000-100,000	125	31.3	81.4
101,000-150,000	55	13.8	95.2
151,000-200,000	19	4.8	100.0

Source: Authors' Fieldwork, 2022

This is expected as it is the reproductive age of women. Also, 84% are married, 97.3% had formal education. This is similar to the study of Guihao, *et al.*, (2019) where they made the assertion that pregnant women who seek healthcare services in China are in their reproductive active ages, married and have good knowledge of healthcare services. Furthermore, 89.7% are gainfully employed, 81.4% earned less than N100,000/month, 97.2% has household size of less than 10 people. This is in tandem with Delwar (2020), when he confirmed that in Bangladesh, occupation and income capacity are significant factors to consider when pregnant women are seeking healthcare. For educational status of husband, 97.2% had formal education.

3.2. Health problems confronting pregnant women/those that gave birth in the last two years

Table 2 depicts types of health problems confronting pregnant rural women and those that gave birth in the last two years although they are not limited to these. From the table, 83.2% indicated vomiting as the major health problems confronting them. Confirming this, The Johns Hopkins Medicine (2022) highlighted morning sickness with vomiting and other discomforts during pregnancy as the health problems confronting pregnant rural women. Only those who gave birth in the last 2 years (N = 200) were later considered and dizziness was revealed by all of them

(100%) as the major health problem confronting them. This is in tandem with Hossain (2020)'s findings that women experience a range of conflicting and contrasting emotions during the postpartum period, these range from dizziness, intense feelings of joy and love for their new baby, to acute feelings of loneliness, low mood and depression. According to the respondents, the most common health challenge facing their babies is jaundice. This confirms a study by WHO (2021) on new born health.

Table 2

Health problems confronting pregnant women and those that gave birth in the last two years

Health Problems	Frequency (N = 399)	Percentage (%)
a. Health Problems experienced during pregnancy		
Fainting	179	44.9
High Blood Pressure	68	17.0
Malaise	196	49.1
Shortage of Blood	41	10.0
Headache	91	22.8
Malaria	199	49.9
Vomiting	332	83.2
Fever	135	33.8
Oodema	155	38.8
obstructed labour	41	10.0
Threatening Abortion	33	8.3
Haemorrhage	64	16.0
Puerperal sepsis	33	8.33
b. Health Problems being experienced after delivery	**Frequency (N = 200)**	**Percentage**
Breast Engorgement	64	32.0
Dizziness	200	100
Retained Placenta	124	62
Abdominal Pain	155	77.5
Bleeding after delivery	64	32
Virginal itching	41	20.5
Virginal discharge	41	20.5
High Blood Pressure	41	20.5

* Multiple Responses

Source: Authors' fieldwork, 2022

3.3. Choice of place of healthcare

Table 3 presents the distribution of respondents based on choice of ANC giver and factors affecting the choice. From the table, there were multiple responses, indicating these women do not limit themselves to only one healthcare provider but rather sought care from different healthcare providers. However, the main ones consulted include: female traditional birth attendance (92.2%), private health facility (89.7%), government health facilities (83%), and faith home (64.9%). This finding is against Adewoye *et al.,* (2013) where they discovered high patronage of government health facilities for antenatal care than any other caregiver. There is none of the respondents that do not seek one caregiver or another.

When factors/reasons for choice of healthcare provider were considered, there were multiple responses too and all of the respondents indicated that reduced cost (100%) and proximity (100%) are the main factors/reasons for choice of caregiver. This supports the study by Seljeskog *et al*., 2016 that economic reasons, quality of care, attitudes of caregiver were the main factors for choice of caregiver. Similarly, religious factor (81.5%), prolonged waiting time (66.2%), attitude and behavior of health workers (66.2%), and trust/experience (66.2%) were also considered before choosing their caregivers. The other reasons given for choices of health caregiver are husband/family decision (58.6%), type of services provided (55.9%), ease of payment (48.1%), affordability (47.6%), cultural practices (18%) and lack of information (7.8%).

As regards the frequency of antenatal care, 68.9% indicated more than three (3) times, 22.8% indicated 2-3times while 8.3% said they visited only once. For timing of the first ANC, 92.2% revealed first trimester. This contradicts Islam and Masud (2018)'findings that mothers received less than three (2.7 visits) ANC visits and only 6% receive the recommended eight or more ANC visits. About 22% of the mothers received all the prescribed basic items of ANC services. About one-fifth (21%) of the mothers never received ANC.

Table 3

Choice of ANC caregiver and factors affecting choice of caregiver

Variable	Frequency (N = 399)	Percentage (%)
a. Healthcare being sought during pregnancy		
Private Health Facility	358	89.7
Female traditional birth attendants	368	92.2
Faith Home	259	64.9
Government health facility	331	83.0
Islamic Cleric	132	33.1
Family	163	40.9
Herbalists	140	35.1
Pharmaceutical store	50	12.5
b. Factors/Reasons for choice of healthcare giver		
Reduced Cost	399	100.0
Proximity	399	100.0
Inadequate Human Resources in Health Facility	0	0.0
Poor Road Access	0	0.0
Lack of means of transport	0	0.0
Prolonged waiting time to see a doctor	264	66.2
Attitude and behavior of health workers	264	66.2
Lack of Information	31	7.8
Illiteracy	0	0.0
Cultural Practices	72	18.0
Husband Family Decision	234	58.6
Services Provided	223	55.9
Religious Factor	325	81.5
Ease of Payment	192	48.1
Trust/Experience	264	66.2
Affordability	190	47.6
Others	0	0.0

* Multiple Responses

Source: Authors' Field work, 2022

3.4. Choice of place of delivery and PNC utilization by Women

When the place of delivery by respondents was asked (Table 4), Out of the 200 women who delivered in the last two years, 61% said they delivered their babies in private hospitals, followed by traditional birth

attendants (TBAs) (17.5%). Very few used government facilities (13%) such as hospitals, clinic, maternity homes and primary healthcare board. This was validated by Osubor *et al*., 2006 who reported that private maternity center was the most preferred place for childbirth, followed by traditional birth attendants (TBAs) while government facility was preferred by only a few. Reasons for the low preference included irregularity of staff at work, poor quality of services, and high costs. As shown in Table 4, 3% indicated they deliver at faith home, 3% said at home and 2.5% indicated with herbalist. Table 4 further revealed where healthcare was sought after delivery by respondents. There were multiple responses as 100% said pharmaceutical shops, 79% indicated health facility, 65.5% said traditional birth attendants, 2.5% said Islamic cleric, 27.5% indicated family and 15.5% said herbalist.

Factors influencing choice of healthcare giver after delivery were sought. Table 4 revealed that reduced cost (100%), ease of payment (100%), trust/experience (100%) were the main factors considered by respondents. Similarly, 83% indicated distance from home, 79% said services provided, 74% said attitude and behavior of health workers, 58.5% and 53.5% said religious factor and waiting time to see a doctor respectively are the factors considered. Few (18%) respondents indicated cultural practices as the main factor considered before choice of caregiver after delivery. This is in line with the study by Aluko *et al*., (2020) which discovered that barriers to healthcare facilities delivery among women of childbearing age were mostly associated with factors surrounding income, accessible healthcare centre to deliver and education.

Table 4

Place of Delivery and utilization of PNC by Women

a. Place of delivery	**Frequency**	**Percentage**
Private Health Facility	122	61
Government facilities	26	13
Faith home	6	3
Traditional Birth attendants	35	17.5
Home	6	3
Herbalist	5	2.5
b. Where healthcare is sought after delivery		
Health Facility	158	79

Herbalist	31	15.5
Faith Home	0	0.0
Pharmaceutical Shops	200	100.0
Family	55	27.5
Islamic Cleric	5	2.5
Traditional Birth Attendants	131	65.5
Others	0	0.0
c. Factors influencing choice of PNC care giver		
Reduced cost	200	100.0
Distance from home	166	83
Inadequate Human Resources	0	0.0
Poor Road Access	0	0.0
Lack of means of transport	0	0.0
Waiting time to see a doctor	107	53.5
Attitude and Behavior of health worker	148	74
Lack of Information	0	0.0
Illiteracy	0	0.0
Cultural Practices	36	18
Services Provided	158	79
Religious Factor	117	58.5
Ease of payment	200	100.0
Trust /Experience	200	100.0
Others	0	0.0

* Multiple Responses

Source: Authors' fieldwork, 2022

3.5. Factors associated with ANC service utilization

Factors associated with antenatal care service utilization were examined. Table 5 presents these factors, socioeconomic factor was ranked as the most important with a mean value of 11.8 and this was closely followed by cultural factors with a mean value of 11.1. religious and Birth order of the last birth was ranked 3rd with each mean value of 9.4. Corroborating the work of Kifle (2017) that educational status of the women, birth order and knowledge about pregnancy complications were the major factors associated with maternal health care service seeking behavior in rural area of Ethiopia.

Table 5

Factors associated with antenatal care service utilization

Characteristics	SA (%)	A (%)	U (%)	D (%)	SD (%)	Mean ẍ	Rank
Educational Status	0 (0.0)	64 (16.0)	176 (44.1)	159 (39.8)	0 (0.0)	7.0	4th
Occupation	0 (0.0)	31 (7.8)	176 (44.1)	192 (48.1)	0 (0.0)	6.4	5th
Birth order of the last birth	135 (33.8)	31 (7.8)	74 (18.5)	159 (39.8)	0 (0.0)	9.4	3rd
Socioeconomic Factor	159 (39.8)	64 (16.0)	176 (44.1)	0 (0.0)	0 (0.0)	11.8	1st
Knowledge about pregnancy	0 (0.0)	64 (16.0)	176 (44.1)	159 (39.8)	0 (0.0)	7.0	4th
Cultural factor	159 (39.8)	31 (7.8)	176 (44.1)	33 (8.3)	0 (0.0)	11.1	2nd
Physical factor	0 (0.0)	0 (0.0)	209 (52.4)	159 (39.8)	0 (0.0)	5.8	6th
Religious factors	135 (33.8)	31 (7.8)	74 (18.5)	159 (39.8)	0 (0.0)	9.4	3rd

Source: Authors' fieldwork, 2022

3.6. Factors associated with post-natal care utilization

On factors associated with post-natal care utilization (Table 6), larger proportion of the respondents are aware of pregnancy complications and so make use of health facilities more after delivery as this factor ranks first.

Table 6

Factors associated with post-natal care utilization

Characteristics	SA (%)	A (%)	U (%)	D (%)	SD (%)	Mean ẍ	Rank
Religion	0 (0.0)	15 (7.5)	105 (52.5)	80 (39.5)	0 (0.0)	2.45	6th
Educational Status	0 (0.0)	16(7.5)	105(52.5)	79 (39.5)	0 (0.0)	3.08	3rd

Birth Order	16 (8)	15 (7.5)	90(45)	79 (39.5)	0 (0.0)	2.84	4th
Knowledge of pregnancy complications	147 (73.5)	32(16)	21 (10.5)	0 (0.0)	0 (0.0)	4.63	1st
Occupation	0 (0.0)	15(7.5)	104(52)	81 (40.5)	0 (0.0)	2.67	5th
Husband literacy	0 (0.0)	15(7.5)	105 (52.5)	80 (39.5)	0 (0.0)	2.45	6th
Women who gave birth in health facility	0 (0.0)	96(48)	104(52)	0 (0.0)	0 (0.0)	3.48	2nd

Source: Authors' Fieldwork, 2022

This is in tandem with Igboanusi *et al*., (2019), when they compared the factors affecting the utilization of post-natal care services in primary health care facilities in urban and rural settlement in Kaduna. In their investigation, pregnant women who are aware of the consequences of not seeking healthcare services in pregnancy attend post-natal clinic more both in urban and rural settlement of Kaduna State. The second most important factor respondents considered is the fact that large proportion of them gave birth in health facility (mean =3.48). This has given them prior knowledge of what post-natal care is all about. The third factor is the educational status with a mean value of 3.08.

4. Conclusion

From the foregoing, the study has critically assessed the mode at which pregnant women and women who gave birth in the last two years seek and respond to health care issues in Ido-Osi Local Government Area of Ekiti State, Nigeria. The study revealed the type of health problems challenging the pregnant women to include vomiting as the major health problems confronting them while dizziness is the major health problem confronting those that gave birth in the last two years. The most common health challenge facing their babies is jaundice. Reduced cost, ease of payment, and trust/experience were the main factors considered by respondents before seeking healthcare services.

The study further discovered that rural women do not limit themselves to only one health caregiver but rather sought care from different health caregivers. However, the main ones consulted include: female traditional birth attendance, private health facility, government health facilities, and faith home. Hence, pregnant rural women and those that have just given birth in the last two years should be encouraged and enlightened on the importance of using modern health facilities for antenatal, delivery and post-natal services. Government facilities should be subsidized for this group of people as women are very important in nation building.

REFERENCES

Adewoye, KR, Musa, IO Atoyebi, OA, Babatunde, OA, 2013, Knowledge and utilization of antenatal care services by women of child bearing age in Ilorin-East Local Government Area, North Central Nigeria. International Journal of Science and Technology, vol. 3, no 3, pp. 188-192.

Aluko, JO, Ademola, SA, Makanjuola, OJ, Umar, JO, Elusoji, CI, 2020, Factors influencing the choice of birthplace among women of childbearing age in selected health facilities in Saki West Local Government Area of Oyo State, Nigeria. Journal of Positive Psychology and Counselling, vol. 6, pp. 123-133. Rapid Communication Edition.

Atuyambe, LM, 2008, Adolescent motherhood in Uganda: Dilemmas, health seeking behaviour and coping responses. PhD Thesis, Makerere University, Kampala. http://diss.kib.ki.se/2008/978-91-7409-212-7/thesis.pdf

Chamberlane, G, 2001, Turnsbull Obsteristics. Churchill Livingstone. London; pp. 163-174. Retrieved 14th June 2022. From http://www.Churchhilllivingstone.com/turnbulls.obsteristics-ISBN-211211147677.

Delwar, H, 2020, Socio-economic status and maternal health seeking behavior: A comparative study between a rural site and urban community in Bangledesh. Journal of International women studies, vol. 21, no 6.

Ekiti State Ministry of Information, 2017, List of Firms in Ido-Osi LGA, Ekiti State.

Ferdous, F, Das, SK, Ahmed, S, Farzana, FD, Kaur, G, 2013, The impact of socioeconomic conditions and clinical characteristics on improving childhood care seeking behaviours for families for families living far from the health facility. *Science Journal of Public Health*, vol.1, pp. 69-76.

Glenn, I, 2003, Sampling Techniques, 2nd Edition. New York. John Wiley and Sons, Inc.

Guihao, L, Yunlian, X, Zhenhu, Q, Liuna, Y, Yunbin, Y, Quigshan, G, Xin, W, 2019, Healthcare-seeking behavior among pregnant women in the Chinese hierarchical medical system: a cross sectional study. International Journal for Equity in Health.

Hossain, D, 2020, Socioeconomic Status and Maternal Health-seeking Behavior: A Comparative Study between a Rural Site and an Urban Community in Bangladesh. Journal of International Women's Studies, vol. 21, no 6, pp. 122-134. Available at: https://vc.bridgew.edu/jiws/vol21/iss6/7.

Igboanusi, CJ, Nmadu, AG, Joshua, IA, Onoja-Alexander, MO, Olatubosun, B, 2020, Knowledge and attitude on neonatal jaundice among women of reproductive age group in rural community in northern Nigeria. Sahel Medical Journal, vol. 23, no 3, pp. 184-90. Available at https://www.smjonline.org/text.asp?2020/23/3/184/297454

Islam, MM, Masud, MS, 2018, Health care seeking behaviour during pregnancy, delivery and the postnatal period in Bangladesh: Assessing the compliance with WHO recommendations. Midwifery, vol. 63, pp. 8-16. pmid:29758443.

Itodo, DS, Olayemi, J, Lami, S, Misbahu, B, Nana-Hauwa S, Hope, AE, Bassey, W, Ibraheem, HM, 2021, Nigeria: Why Nigeria's Maternal Mortality Amongst Highest in the World. Daily Trust. All Africa.

James, S, 2023, Zulum Harps on Improved Social Welfare for Women to Tackle Poverty, Insecurity. This Day Newspaper, Nigeria. https://www.thisdaylive.com/index.php/2022/10/21/zulum-harps-on-improved-social-welfare-for-women-to-tackle-poverty-insecurity.

Kifle, D, Azale, T, Gelaw, YA, Melsew, YA, 2017, Maternal health care service seeking behaviors and associated factors among women in rural Haramaya District, Eastern Ethiopia: a triangulated community-based cross-sectional study. Reproductive Health. vol. 14, no 6. https:// doi.org/10.1186/s12978-016-0270-5.

Latunji, OO, Akinyemi, OO, 2018, Factors influencing health-seeking behaviour among civil servants in Ibadan, Nigeria Ann Ibadan Postgraduate Medicine, vol. 16, pp. 52-60.

Morrisson, C, Jütting, JP, 2005, 'Women's Discrimination in Developing Countries: A New Dataset for Better Policies', World Development, vol. 33, Issue 7, pp. 1065-1081.

National Population Commission (NPC) (2006): Population Census of the Federal Republic of Nigeria: Analytical Report of the National level, NPC, Abuja.

Nigeria Demographic and Health Survey (NDHS) 2008, Key Findings, National Population Commission, Abuja-Nigeria.

Nigerian Tribune, 2020, Kaduna Community Where Residents Cross River to Deliver Babies. www.tribuneonline.com.

Mwase, I, 2015, Social capital and household health seeking behavior for children in the context of urban neighbourhoods. The case of Khayelistha in Western Cape, South Africa: University of Town.

Oestergaard, MZ, Inoue, M, Yoshida, S, 2009, Neonatal mortality levels for 193 countries in 2009 with trends since 1990: a systematic analysis of progress, projections, and priorities. *PLoSMed* 2011; 8:e1001080. doi:10.1371/journal.pmed.1001080.

Olatunji, AO, Sule-Odu, AO, 2001, Maternal mortality at Sagamu, Nigeria – A ten-year review (1988-1997). Niger Postgrad Medical Journal, vol. 8, no 1, pp. 12-15.

Onwujekwe, O, Onoka, C, Uzochukwu, B, Hanson, K, 2011, Constraints to universal coverage: Inequalities in health service use and expenditures for different health conditions and providers. International journal for equity in health, vol. 10, no 1, p. 50.

Osubor, KM, Fatusi, AO, Chiwuzie, JC, 2006, Maternal Health-Seeking Behavior and Associated Factors in a Rural Nigerian Community. Maternal Child Health Journal, vol. 10, no 159. https://doi.org/10.1007/s10995-005-0037-z.

Seljeskog, L, Sundby, J, Chimango, J, 2006, Factors Influencing Women's Choice of Place of Delivery in Rural Malawi – An Explorative Study. African Journal of Reproductive Health, vol. 10, no 3, pp. 66-75. Published by Women's Health and Action Research Centre (WHARC).

Sreeramareddy, CT, Shankar, RP, Sreekumaran, BV, Subba, SH, Joshi, HS, Ramachandran, U, 2006, Care seeking behaviour for childhood illness – A questionnaire survey in western Nepal. BMC International Health Hum Rights. pp. 6-7.

The Johns Hopkins Medicine, 2022, 4 Common Pregnancy Complications. Health. https://www.hopkinsmedicine.org/health/conditions-and-diseases/staying-healthy-during-pregnancy/4-common-pregnancy-complications.

World Health Organization, 2000, Population reports: Issues in World Health Semesl; 9, Geneva. Retrieved 14th June, 2022. From http://www.who.org/population/reports/issuesinworldhealth/91476872115678.html.

World Health Organisation, 2014, Maternal Mortality – Factsheet. Availablefrom: http://apps.who.int/iris/bitstream/handle/10665/112318/WHO_RHR_14.06_eng.pdf;jsessionid=C9B41DE3F35BF6EE657F1B815CAADF66?sequence=1.

World Health Organization, 2016, Maternal mortality: fact sheet, 2016. Available: http://www.who.int/mediacentre/factsheets/fs348/en/ [Accessed 04 April 2022].

World Health Organization (2019). Trends in Maternal Mortality: 1990 to 2015: Estimates Developed by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. https://reliefweb.int/report/world/trends-maternal-mortality-1990-2015-estimates-who-unicef-unfpa-world-bank-group-and

World Health Organisation, 2021, Newborn Health. Key Facts. https://www.who.int/europe/news-room/fact-sheets/item/newborn-health.

World Health Organisation (2023). Maternal Mortality. Key Facts. https://www.who.int/news-room/fact-sheets/detail/maternal-mortality.

https://doi.org/10.5719/aub-g/72.1/2

SIMULATION OF FLOOD'S RISK USING GIS AND HEC-RAS IN THE LOWER VALLEY OF WADI EL KEBIR – TEBESSA, ALGERIA

KHEIREDDINE DJEDAIET[1], AZZEDINE GHACHI[1]

Abstract

Maximum daily precipitations play a crucial role in the occurrence of flood risk, particularly when combined with other natural and human factors, such as the geographical and morphological characteristics of the area, as seen in the case of Tebessa city. The city is situated below surrounding mountains, with the Wadi El Kebir valley passing through it to the north. This study aims to simulate the risk of flooding in Tebessa city. The approach involves utilizing GIS programs for DEM (Digital Elevation Model) analysis, extracting the study area, obtaining morphometric parameters and maps, and employing the Turraza, Sokolovsky, and Maillet-Gouthier equations to calculate the frequency of maximum daily flows for return periods of 10, 50, 100, and 200 years. Based on this, the flood volume is calculated. Finally, the HEC-RAS program is used to simulate flood risk in the Wadi El Kebir valley, and urban vulnerability maps are generated for Tebessa city for each return period.

Keywords: Watershed, Flood risk, HEC-RAS, Simulation, GIS, Tebessa, Return Periods.

I. Introduction

Floods are characterized by the temporary inundation of land by water beyond its usual boundaries and can occur in various environments, including small and large watersheds, estuaries, and coastal areas (Parker, Tapsell, McCarthy, 2007: 200). The study of flood risk is crucial due to the significant damage it can cause to buildings and urban infrastructure (Qi, Sun, Qi, 2010: 45), particularly in flat lowland cities

[1] Urban Technicals Management Institute, Salah Boubnider Constantine 3 University, Constantine, 25000, Algeria, e-mail: azzedine.ghachi@univ-constantine3.dz

with infrastructure and urbanization development (Abou Kheir, Abdallah, Khawlie, 2008: 240).

The city of Tebessa is traversed by the Wadi El Kebir Valley, intersecting important main roads, railways, and the city's airport to the north (DCU, 2016: 44). The rapid urban growth of the city has made its residents more vulnerable to flooding (Jha, Lamond, Bloch, 2011: 9). This study aims to simulate the flood risk in the city and identify areas threatened by flooding for different return periods.

GIS programs (Abou Kheir, Abdallah, Khawlie, 2008: 241) were used for hydrological analysis, leveraging the digital elevation model (DEM) to extract topographic characteristics (Izinyon, Ehiorob, Osadolor, 2011: 12) and drainage watershed networks' features (Zarcata, 2007). The Turraza, Sokolovski, and Maillet-Gouthier equations were then applied to calculate the frequency of maximum daily flows for return periods of 10, 50, 100, and 200 years. Using the HEC-RAS program developed by the US Army Hydrologic Engineering Corps (HEC-RAS, 2001: 11), flood risks were simulated for the city of Tebessa.

In conclusion, this study provides morphometric mapping of the watershed and urban vulnerability maps concerning the flood risk of Tebessa in the Wadi El Kebir watershed. In developed countries, flood prediction techniques (Erkek, A˘gıralio˘glu, 2013: 46) have significantly reduced loss of life and facilitated decision-making through structural measures such as dam construction and diversion channels, as well as non-structural measures like early flood warnings and mass evacuation (Yazdi, Salehi Neyshabouri, 2012: 45). This study is the first of its kind in the Tebessa region, and its findings can serve as a decision-making tool for city management.

Previous Studies

While flood risk studies have been conducted worldwide, there is a lack of research on flood risk simulation in the study area the Wadi El Kebir Valley in Tebessa. Some studies have shed light on flood risk in the city from different perspectives:

– Ali Hajla's Ph.D. thesis titled "Urban Planning and Sustainable Development in the City of Tebessa" in 2016 from the University of Mentouri Constantine includes a considerable amount of data, figures, and maps processed using GIS programs. The researcher addresses several topics, including flood risk and the human and material factors contributing to floods in the city. However, this Ph.D. Thesis primarily focuses on flood risk within the city limits.
– Jaber Mohamed El Tayeb's Ph.D. thesis titled "The Role of Geographic Information Systems in Urban Planning and Management: The City of Tebessa as a Model" in 2021 from Arabi Ben Mhidi University in Oum El Bouaghi highlights the role of GIS in urban planning and management for the city of Tebessa, touching upon flood risk among various other topics. However, it does not extensively cover the large watershed and flood risk, as it mainly focuses on the city's water network and the causes of flooding.

Thus, this study is the first of its kind to rely on rainfall data and GIS programs in simulate flood risk in the Wadi El Kebir Valley in Tebessa, providing a geographic database with various morphometric and urban vulnerability maps of the city.

Study Objectives

This study aims to:

- Study various morphometric characteristics of Wadi El Kebir. to establish a valuable geographic data, facilitating the study and simulate of flood hazards.
- Simulation flood risk in Wadi El Kebir and identify vulnerable areas for different return periods.

The Theoretical Approach

In the theoretical chapter, we will explore the most important scientific concepts and terms related to the subject of the study from various perspectives.

The Concept of Risk

The United States Geological Institute defined the term "risk" in 1984 as a state or event, either natural or human-induced, that leads to potential hazards to human life and property (Mohamed Sabry Mohsoub 1998: 36)

Definition of Natural Risks

Natural hazards can be defined as a collection of events that may cause significant or minor material and human losses, resulting from natural forces or variables. These disasters vary greatly in their geographical and temporal extent. Natural hazards are distinguished and classified based on two main elements: the source of the hazard and the vulnerability to the hazard (Dubois-M.1997: 264).

Definition of Floods

Floods occur when the water level in the normal flow path (the usual watercourse) rises to surpass it, leading to the overflow of water into the larger floodplain (flooded area) (Izambart, G. 2011: 11). It is also defined as a significant increase in water level in a river, lake, or coastal area (Versini 2009: 27).

Definition of Vulnerability

This concept evolved among specialized engineers, focusing on the resistance of buildings and existing infrastructure in urban areas to the physical forces exerted by natural phenomena such as floods, winds, and earth movements. During the 1980s and 1990s, this concept expanded to include social, economic, and environmental considerations of risk resistance in urban environments. Thus, urban vulnerability directly refers to elements in the environment exposed to potential risk, whether natural or human-induced (Morin, 2008: 9).

II. Material and methods

The research adopted a technical, analytical, and inductive method, which involves analyzing individual components to arrive at comprehensive solutions, i.e., a gradient in solving the problem and interpreting it to obtain final results.

• Data used in the research

Like any modern geographical study, this research utilized satellite imagery, specifically the digital elevation model (DEM) from the ASTER satellite (STRM) with a resolution of 30 meters. The satellite images were acquired on 20/08/2020. Additionally, the study relied on climatic data, including the maximum daily rainfall quantity from the rain station in the El Kebir watershed for the period (1983-2018). The following table presents essential data and spatial information for the station.

Table 1

Information about the rain station on which the study was based

Station	National numbering	X (km)	Y (km)	Z (m)	Average annual precipitation for the period	Period
Station - Tebessa_	120301	35.43 (991.9)	8.12 (247.2)	811 (890)	111.9	1983-2018

Source: National Agency of Water Resources, Ouargla

The study also employed the Geographic Information Systems (GIS) software version (ArcGIS 10.7.1) for analyzing the digital elevation model and flood risk modeling with the help of the HEC-RAS 5.3 software.

Furthermore, the morphometric analysis of the study relied on a set of morphometric indicators, as represented in the following table.

Table 2

A set of morphometric indicators

Title of transactions or equations	Transactions and their symbols
area of the watershed	A
Watershed perimeter	P
The length of the main tributary of the watershed	Lp
Global slope index	Ig
drainage density km/km2	Ds
Torrentiality coefficient	Ct
Runoff velocity	Rv

Additionally, three fundamental equations were used to calculate the maximum daily rainfall flow in the El Kebir watershed during different return periods, namely Sokolovsky, Turraza, and Maillet-Gouthier. The average flow was extracted to calculate the flood volume in the El Kebir valley for each period, contributing to the flood risk simulation.

III. Results and discussion

Study Area

Using the Geographic Information Systems software, we analyzed the Digital Elevation Model (DEM) and obtained maps of the study area for the El Kebir watershed, identified by the code 03, which is part of the larger Medjerda watershed (DWR, 2019: 8). The Medjerda watershed is cross-border, shared between Algeria and Tunisia, with a total area of 23,700 km², of which 7,600 km² are in Algerian territory. The sub-watershed of Wadi El Kebir is bordered to the northeast by the Mellegue watershed and to the west by the Wadi Meskiana watershed. The Wadi El Kebir sub-watershed covers a total area of 1555.9 km² (NAWR, 2018: 18). The El Kebir Valley runs through the city of Tebessa from the north, intersecting critical points such as the city's airport, national roads serving as the city's northern entrance, and neighborhoods in proximity, including Al-Arami, Al-Merja, Flouja, Bokaria Road, and the railway, among other significant facilities. Consequently, it poses a real threat to the city, especially considering that most of the city's urban expansion occurs northward near the valley. Fig 1 illustrates the location of the El Kebir watershed.

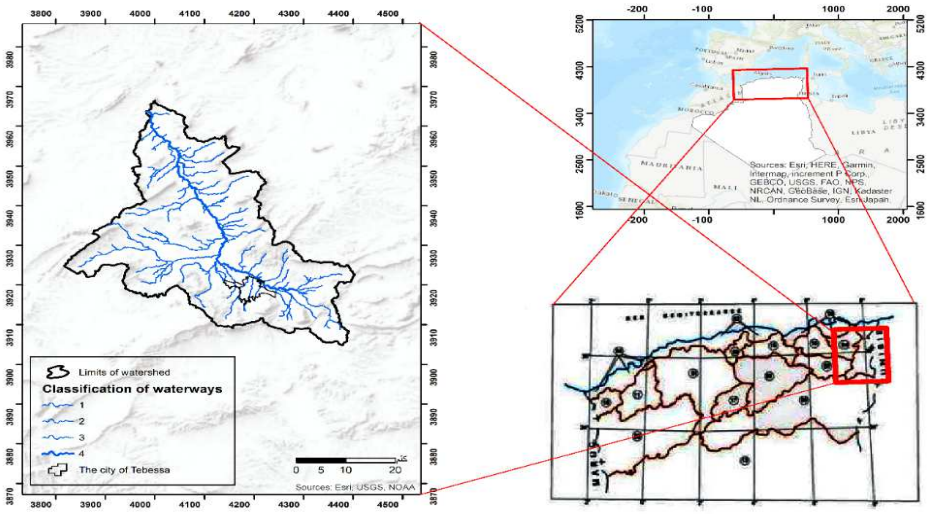


Fig. 1. Location of the watershed El Kebir

Hypsometric Analysis

Based on the Geographic Information Systems (ArcGIS) and the (DEM), the hypsometric analysis was conducted, and Fig 2 was obtained.

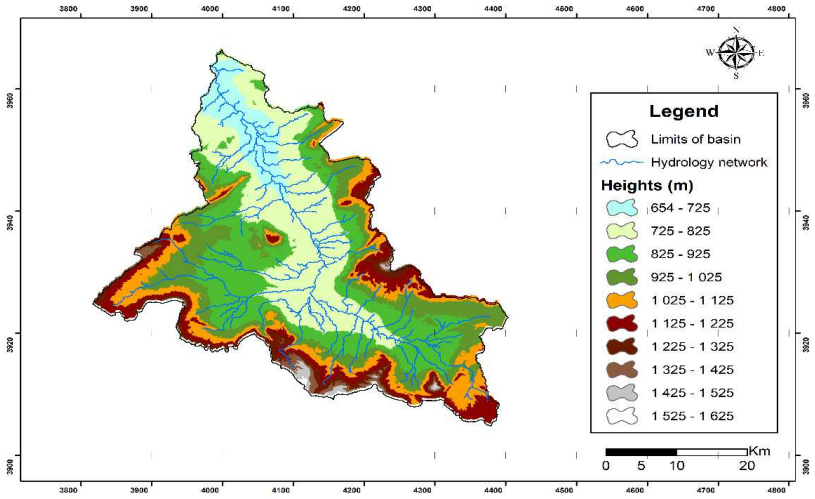


Fig. 2. Hydro network and hypsometric of the watershed El Kebir

Fig. 2 shows the hydro network and altimetry of the El Kebir watershed, where the maximum altitude in the watershed is 1625m in the upstream part, and the minimum altitude is 725m. The flow direction is from south to north, pouring into the main tributary.

Within the framework of the technical and analytical method used in this study, the hypsometric analysis was performed to study the relationship between heights and the watershed area, identifying the stages of watercourse growth within the watershed (Singh, 2000: 12). Fig. 3 presents the hypsometric curve of the El Kebir watershed.

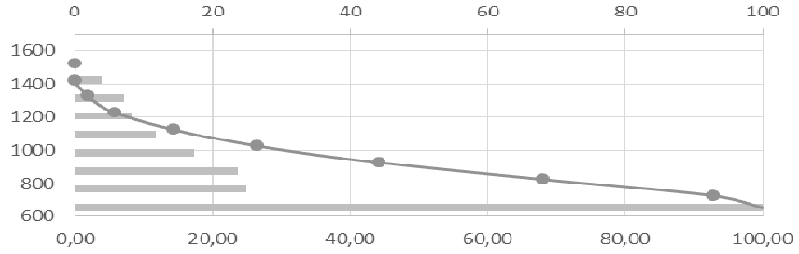


Fig. 3. The hypsometric curve of the watershed *El kebir*

The hypsometric curve of the El Kebir watershed demonstrates an inverse relationship between area and slopes. Smaller areas have steeper slopes and faster water flow, whereas larger areas have gentler slopes. Notably, the El Kebir watershed exhibits significant slopes, contributing to faster rainwater runoff, especially in urban areas, making it susceptible to flooding, particularly during heavy rainfall events in the city of Tebessa.

The Slope Index

To study the slope index of the Wadi El Kebir watershed, the digital elevation model (DEM) was analyzed using ArcGIS. The watershed was divided into three main parts, with seven categories of slopes, as shown in Fig4. From the relative circle in the figure, it is evident that the flat lands in the watershed constitute a significant portion compared to the moderately elevated and high lands, the city of Tebessa is situated between high lands and flat lands, making it more susceptible to flood risks.

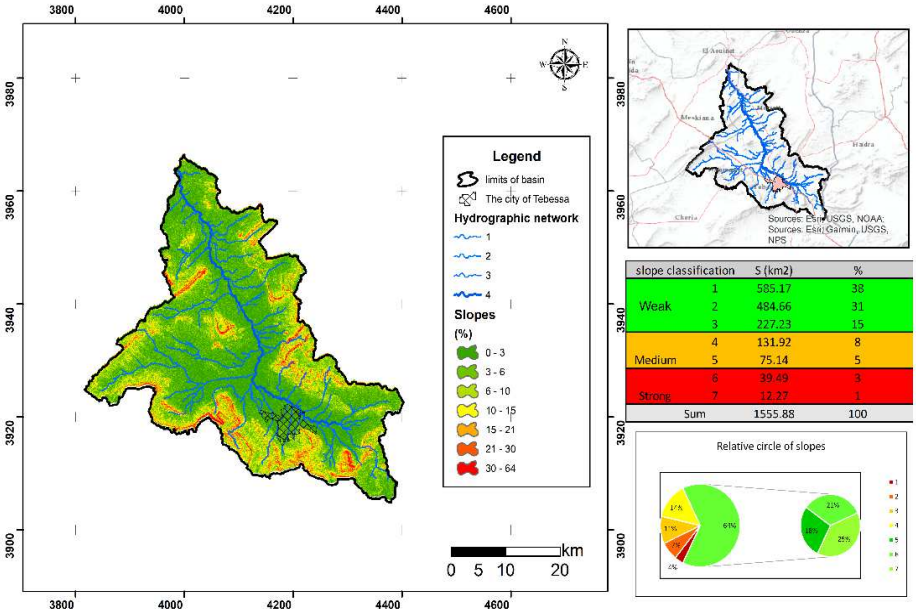


Fig. 4. The Slope Map of the watershed *El Kebir*

Various Morphometric Values

Based on the analysis of the DEM for the study area using Geographic Information System (GIS) software, various morphometric parameters were obtained, as illustrated in the following table:

Table 3

The morphometric characteristics of the watershed

Morphometric characteristics	A km^2	P km	LP km	Ds m/km	Ig m/km	Dd km/km^2	Ct	Tc	Rv km /h
Results	1555.9	276.62	74.09	188.12	52.63	0.40	20.12	0.02	3.70

From the above morphometric parameters, the Wadi El Kebir watershed exhibits considerable characteristics, with an area of approximately 1555.9 Km^2 and a main stream length of about 74.09 km. The time of concentration, estimated at 0.02 minutes, represents the time taken for raindrops to travel from the highest point to the lowest point in the watershed. This value indicates high vulnerability to flooding in the city, necessitating precautionary measures to mitigate flood risks.

Study of Drainage Density

To illustrate the danger of Wadi El Kebir to Tebessa, the drainage density was studied and modeled using GIS, based on the extracted data from the Strahler classification for the watershed network.

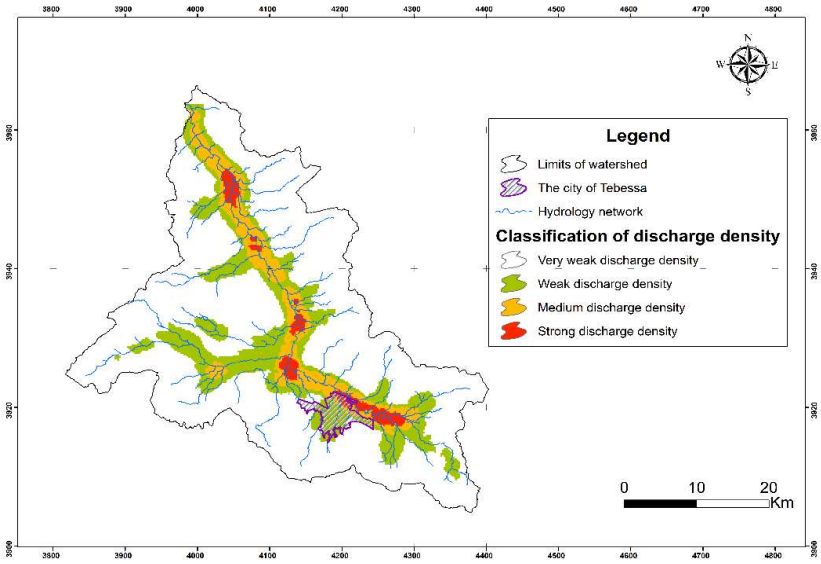


Fig. 5. Discharge density in watershed *El Kebir*

The drainage density map reveals that the highest drainage density, represented in red, is found in the main stream of the watershed, while the moderate and lowest densities are indicated by orange and green, respectively. Tebessa is located within these three areas, experiencing

high drainage density in the valley that cuts through the city, including the airport and northern neighborhoods. Consequently, the city is at risk of flooding at any time, emphasizing the need for necessary precautions. Therefore, the study proceeds to simulate the flood flow in the valley.

Study of Flood Flow

After identifying the morphometric characteristics of the study area and determining its vulnerability to flood risks, the study focuses on analyzing the flood flow in Wadi El Kebir and calculating the flood volume for various return periods in order to extract urban vulnerability maps for the city of Tebessa.

Study of the maximum daily flow (pd max)

Based on the meteorological data, specifically the maximum daily rainfall recorded between 1983 and 2018 at the rain gauge station in the watershed, the study focused on analyzing the values of maximum daily rainfall and calculating the frequency of precipitation events for further use in to study the flood flow in the watershed by applying the formulas Sokolovsky, Turraza, and Maillet-Gouthier, we calculated the average flow values for the periods 10, 50,100,200 years, as follows.

Formula Sokolovsky

$$Q_{max} = \frac{0.28.\, ptc.\, \alpha.A}{T_m}.F \qquad (1)$$

Where: ptc = the frequency of rain showers
α= Flood runoff coefficient for a given period
A= area of the watershed in km^2
$C_T = T_m$ = Concentration time
F = form coefficient of the flood hydro / F = 1.2.

Table 4

Flood flux in return periods according to the formula Sokolovsky

Return periods T years	10	50	100	200
Frequency %	90	95	98	99
Ptc mm	70.37	92.60	101	109.27
A	0.49	0.54	0.56	0.57
Qmax m ^{3}/a	1097.05	1443.62	1574.58	1703.50

Formula Turraza

$$Q_{maxp\%} = 0.278 \times C \times I_t \times A \quad (2)$$

Where: **C** = the surface runoff coefficient, which varies with the different return periods

I_t = The maximum density is in mm/h and the area of the watershed is in km^2

A = Area of watershed

Table 5

Flood flux in return periods according to the formula Turraza

Return periods T years	10	50	100	200
Frequency %	90	95	98	99
C	0.65	0.75	0.80	0.82
$I_t \frac{mm}{h}$	3.51	4.63	5.05	5.46
Q max m ^{3}/a	986.82	1501.97	1747.43	1936.54

Formula and Maillet-Gouthier

$$Q_{maxp\%} = 2K\log\left(1 + A.P_{moy}\right).\frac{A}{\sqrt{L}}\sqrt{1 + 4\log T - \log A} \quad (3)$$

Where: **K** and **a** = are constant coefficients which depend on the characteristics of the watershed
k = 1.3, a = 20, P_{moy} average annual precipitation mm
A = Area of the watershed in km²
L = The length of the main tributary is km
T = Return periods by years

Table 6

Flood flux in return periods according to the formula Maillet-Gauthier

Return periods T years	10	50	100	200
Frequency %	90	95	98	99
Q max m ³/a	1823.47	2875.5	3279.52	9463.5

Then we adopt a mean value of the frequency maxima:

Table 7

Mean values of flood fluxes for the different formulas applied

Formulas	Return periods T years			
	10	50	100	200
Turraza	986.82	1501.97	1747.43	1936.54
Sokolovsky	1097.05	1443.62	1574.58	1703.50
Maillet-Gouthier	1823.47	2875.5	3279.52	9463.5
Average Q max m ³/a	1302.44	1940.36	2200.51	4367.84

Through Table 7, which represents the average of the maximum values of daily rainfall flow for different applied equations in the watershed flow study during various return periods, we observe a gradual and significant increase in the maximum daily rainfall rate during each period, reaching its peak during a 200year return period, estimated at 4367.84 m³. Therefore, the city of Tebessa is always exposed to the risk of flooding. To further illustrate this, the flood volume in Wadi El Kebir will be calculated for each period to model the flood risk in the valley.

Volume flow in the watershed of valley El -Kebir

To obtain the maximum flood volume for a given frequency we apply the following equation:

$$V_{max(\%)} = \frac{Q_{max(\%)} \cdot C_t}{F} \quad (4)$$

Where: $Q_{max(\%)}$ = The max flood flow given frequency m³/A,
C_t = The Concentration times
F = The form coefficient of the flood hydro / F = 1.2

Table 8

Flood volume in the Oued El Kebir watershed for each return period

Formulas	Return periods T years			
	10	50	100	200
Frequency %	90	95	98	99
$Q_{max\%}$	1302.44	1940.36	2200.51	4367.84
C_t	20.12	20.12	20.12	20.12
F	1.2	1.2	1.2	1.2
$V_{max\%}$	21837.60	32533.40	36895.20	73234.11

From the table 8 illustrating the flood volume in Wadi El Kebir for each category, a substantial increase is observed at each stage, with the flood volume reaching 73234 m³ over 200 years. This accentuates the city's vulnerability to flood risks if appropriate protective measures are not implemented beforehand.

Flood Risk Simulation in Oued El Kebir

Based on this process and after conducting the hydrological and geometric analysis, the flood risk areas were identified and simulated over different return periods in the valley using HEC-RAS and Arc-GIS. A simulation of the flood in the watershed is shown in Figs 6, 7, 8, 9.

The maps in Fig 6,7,8,9 illustrate the vulnerability of Tebessa to flood risks during different return periods, where we note the following:

During the 10-year return period, the flood water covers an area of 7.17 km² of the watershed. The flood also affects parts of the city's airport and neighborhoods such as Flouja and Merja to the north, as well as National Roads 10 and 16, which are crucial entrances to the city from the north.

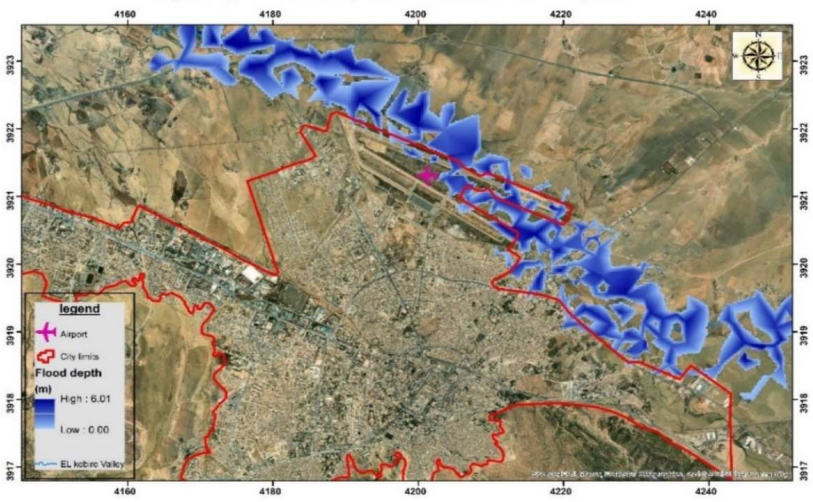


Fig. 6. Vulnerability to flooding risk. Flow = 10 years

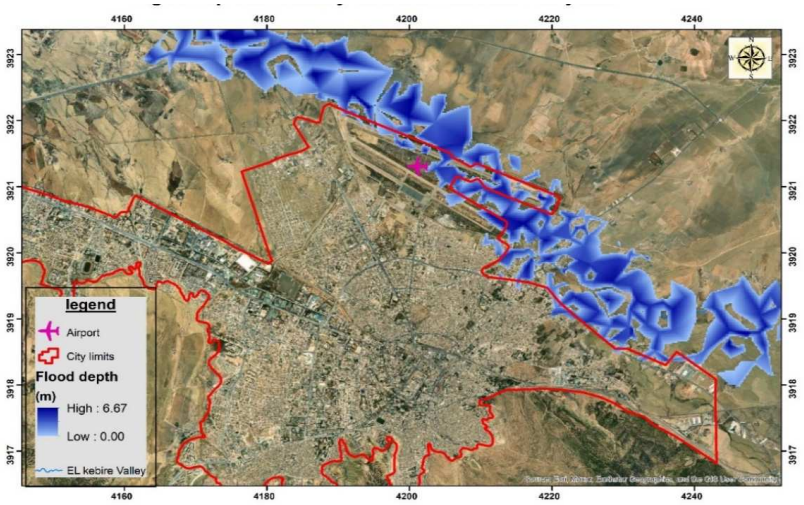


Fig. 7. Vulnerability to flooding risk. Flow = 50 years

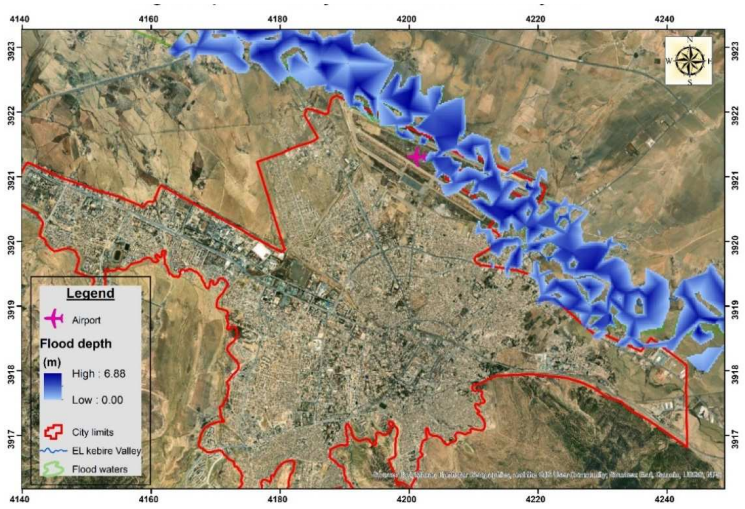


Fig. 8. Vulnerability to flooding risk. Flow = 100 years

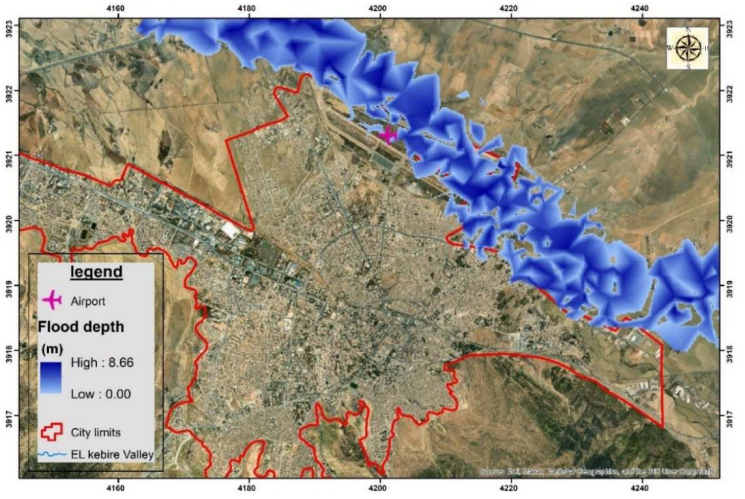


Fig. 9. Vulnerability to flooding risk. Flow = 200 years

During the 50-year return period, the floodwater covers an area of 8.37 km² of the watershed. The affected areas in the city increase significantly, including approximately 45% of the airport area, parts of the bypass road to the city, and the neighborhoods of Route Bekaria to the northeast.

During the 100-year return period, the floodwater covers an area of 8.69 km² of the watershed. The flooded areas expand further, encompassing

about 60% of the airport area, most of the neighborhoods to the north and northeast of the city, and the areas developed during this period, including the city's railway.

During the 200-year return period, which represents the maximum extent of floodwaters in the city, the floodwater covers an area of 11.05 km^2 of the watershed. Around 80% of the airport area and over 25% of the city area will be affected during this period. Therefore, it is essential to implement necessary measures to protect the city from flood risks.

Current Measures to Protect the City from Flood Risks

In recent years, the city has experienced repeated flood events, with the most severe one occurring in 2018, resulting in significant human and material losses. However, aside from occasional local clean-up campaigns in the subsidiary valleys that flow into Wadi El-Kebir and some awareness initiatives organized by local authorities, there is a lack of clear measures to protect the city from flood risks. Field visits to various local administrations, such as the Water Resources Directorate, the Municipality, and Civil Protection Services, revealed the absence of well-defined plans and scientific field studies that could guide necessary measures for flood protection. It is crucial to have such studies to enable local administrations to identify flood-prone areas and take adequate precautions to prevent disasters.

Recommendations and Proposals

To protect the city from flood risks and increase its resilience, the study has identified the following recommendations:

- Utilize the data from this study to develop flood risks prevention plans for the city to minimize its vulnerability to floods.
- Ensure adherence to urban development regulations and manage urban expansion to protect the city from future flood risks.
- Reconfigure Wadi El-Kebir, especially in planned expansion areas, while respecting safety distances to safeguard against flooding.

– Provide and expand a stormwater drainage system within the airport area to create a dedicated system to protect it from future flood risks.
– Maintain the infrastructure designed to protect against flood risk by regularly cleaning the stormwater drainage network in the city.
– Coordinate between different stakeholders in city management to collectively participate in flood risk protection policies.
– Establish an early warning system for flood risks in the city to facilitate the protection of properties and residents.

IV. Conclusions

This research focused on simulating flood risks in Tebessa for upcoming years. The study began by using Geographic Information Systems to analyze the DEM (Digital Elevation Model) to determine the watershed boundaries in the El Kebir Valley and study the shape of the watershed and the hydrographic network. A database was created for watersheds, represented by a set of coefficients and maps of natural and hydrological characteristics of large watersheds.

Then, a study of the flood flow in the watersheds was carried out by applying the formulas of Sokolovsky, Turazza, and Maillet Gauthier, and the average flow values were calculated over periods of 10, 50, 100, and 200 years.

In this study, maps of vulnerabilities were created, and areas exposed to floods were identified in Tebessa, after verifying the hydrological and engineering analysis. Utilizing the HEC-RAS program, flood risk areas were simulated, and maps were generated to depict the extent of floodwaters in the urban areas, considering different return periods as part of the city's expansion plan.

The study led to a set of general recommendations, aimed at utilizing this valuable data by local authorities to implement disaster management measures and develop a comprehensive strategy to safeguard the city from floods while considering its vulnerability due to its large area and growing population.

REFERENCES

Abou Kheir, R, Abdallah, C, Khawlie, M, (2008). «Assessment of soil erosion in the Mediterranean karst landscapes of Lebanon using remote sensing and GIS», Journal of Engineering Geology 99 (2008) 239-254, pp. 240, 246. https://www.researchgate.net/publication/223514376_Assessing_soil_erosion_in_Mediterranean_karst_landscapes_of_Lebanon_using_remote_sensing_and_GIS

Department of Construction and Urbanization. (2016). Report on the development and town planning of Tebessa,Department of construction and urbanization, p. 44.

Department of Water Resources of Tebessa (2019). Report on the watershed El kebir, Water Resources Department, p. 1-8.

Dubois-Maury, J, (1997). «Urban planning. Legal Tools and Urban Form». Annals of Geography, Volume 106, Number 598, p. 664. 4010_1997_num_106_598_20827_t1_0664_0000_2

Erkek, C, A˘Giralio˘glu, N, (2013). "Water resources Mühendislik ˘gi, Beta" Publishing House, Istanbul, Turkey p. 46.

Hec-Ras, (2001). Hec-Ras River Analysis System, User Manual, US Army Corps of Engineers, Institute for Water Resources, Hydrologic Engineering Center, USA.

Izambart, G, (2011). The contribution of the return of experience to understand vulnerability to floods. Master Master 1, University of Toulouse II, France.

Izinyoun, O, Ehiorobo Osadolor, C, Jacob, O, (2011). "Measures and Documentation for Flood and Erosion Monitoring and Control in Niger Delta States in Nigeria". FIG Work Week 2011 Bridging the Culture Gap, Marrakech, Morocco. https://www.fig.net/resources/proceedings/fig_proceedings/fig2011/papers/ts07e/ts07e_ehiorobo_izinyon_5126.pdf

Jha, A, Lamond, J, Bloch, R, Bhattachary, N, Lopez, A, Papa Christodoulou, N, Barker, R, (2011). "Cities and floods in the 21st century", World Bank, East Asia and Pacific Region, Transport, Energy and Sustainable Urban Development Unit. p. 9. https://documents1.worldbank.org/curated/en/612141468176682794/pdf/WPS5648.pdf

Muhammad, S,Muhammad, I, (1998). Book of Dangers and Natural Disasters, Event and Confrontation, Geographical Treatment, First Edition, 1998, Dar Al-Fikr Al-Arabi, Cairo.

Morin, M, (2008). Basic concepts in civil security. 9 pages / https://www.securitepubliqueue.gouv.qc.ca/fileadmin/Documents/securite_civile/publications/concepts_base/concepts_base.pd

National Agency for Water Resoures, Ourguel (2018). Weather Report, National Water Resources Agency Ouregula, Algeria.

Parker, D, Tapsell, S, Mc Carthy, S, (2007). «Improve the human benefits of flood warning, Natural hazards», Journal of the International Society for the Prevention and Mitigation of Natural Hazards, p. 200-209. https://www.researchgate.net/publication/226540243_Enhancing_the_human_benefits_of_flood_w

Qi, P, Sun, Z, Qi, H, (2010). Flood discharge and sediment transport potentials of the lower Yellow River and development of an efficient flood discharge channel. Yellow River Conservation Press, Hengzhou, China.

Shivaswamy, M, Ravikumar, A, Shivakumar, B, (2019). «Quantitative morphometric and hypsometric analysis using remote sensing and GIS techniques. Advanced Research in Engineering and Technology», International Journal of Advanced Research in Engineering and Technology,Volume 10, Issue4, p. 3-6. https://iaeme.com/MasterAdmin/Journal_uploads/IJARET/VOLUME_10_ISSUE_4/IJARET_10_04_001.pdf

Strahler, A, (1964). Applied hydrology, edited by chow, chow, V.T. McGraw-Hill, New York. http://ponce.sdsu.edu/Applied_Hydrology_Chow_1988.pdf

Singh, S, (2000). Geomorphology, Prayag Pustak Bhawan, Allahabad, India. https://www.worldcat.org/title/geomorphology/oclc/65222100

Yazid, J, Salehi Neyshabouri, S, (2012). «A simulation-based optimization model for flood management at the watershed scale », Journal Water resources management, vol. 26, p. 45, 69. https://link.springer.com/article/10.1007/s11269-012-0167-1

Versini, P, Gaume, E, (2009). « Distributed hydrometeorological simulations and forecast of road cuts in the Gard », Houille blanche. https://inria.hal.science/hal-00508789/

Yzarcata, H, (2007). Complete scientific book and guide to the GIS system (Aecview 9) First edition, Rayon for publishing and science, Damascene, Syria. https://library.iugaza.edu.ps/book_details.aspx?edition_no=140847

https://doi.org/10.5719/aub-g/72.1/3

DIGITALIZATION OF ROMANIAN PRE-UNIVERSITY EDUCATION IN CORONAVIRUS PANDEMIC CONDITIONS

RADU SĂGEATĂ[1], ANDREEA-LORETA CERCLEUX[2], ELENA BOGAN[2]

Abstract

The article analyzes the decisions regarding the implementation of the online education system in Romania as a result of the health crisis caused by Covid-19. The analysis was carried out in the period between the establishment of the state of emergency (March 2020) and the repeal of the state of alert (March 2022), during the first pandemic waves in Romania. General bibliographic resources, elements of the legislative framework and information from mass media were used. The conclusions highlight a lack of coherence in the management of educational activities during this period, embodied in the frequent change of criteria according to which the transition was made from educational activities with physical presence to those in the online system. This favored the intensification of the virus circulation during certain periods of the pandemic, contributed to widening social gaps between students and limited the usefulness of some investments in computer technology for students' access to online education.
Keywords: digitization, online education, pandemic, management of educational activities, Romania.

1. Background

The crisis caused by the new coronavirus pandemic has engendered new challenges, unprecedented in the last hundred years, in the economies and societies management around the world and in special conditions of health protection. Among these, an important role has the management of the educational process, which traditionally involves

[1] Romanian Academy, Institute of Geography, e-mail: rsageata@gmail.com
[2] University of Bucharest, Faculty of Geography, Department of Human and Economic Geography, e-mails: loreta.cercleux@geo.unibuc.ro; elena.bogan@geo.unibuc.ro

communities of children and young people who have to carry out their activities in best possible physical distance, as a basic premise for limiting the spread of the virus. In this context, in April 2020 was introduced for the first time in Romania the online education system, by Government Order, as a compromise solution, in order to avoid the freezing of the 2019-2020 school year, from the kindergarten level to the last year of high school.

Until that moment there was no reference in the Romanian legislation to online education, because in recent decades of Romanian society, and humanity in general, have not faced a health crisis of this magnitude.

2. Objectives

In this context, our paper aims to highlight the experience and the consequences of the forced digitalization of Romanian pre-university education dictated by the pandemic situation, in the conditions of inconsistent decision-making framework, next to insufficient endowment and training in this sense of the teachers and the school childrens.

The analysis was made during the first five pandemic waves in Romania, respectively from the establishment of the state of emergency (March 2020) until the abrogation of the state of alert (March 2022), a period in which both the health system and the education system in Romania have been managed through exceptional political-administrative decisions.

3. Methodology

The *methods* used consisted in the processing of theoretical background, in the analysis of the legislative framework, of the information flows in the mass media, as well as of the points of view of some specialists in the field.

Data analysis/Instrumentation

Bibliographical resources and legislative framework were processed, with official statistical data and the flows of information from the media (over 500 internet and media sources), the opinions of the main protagonists of the political-administrative decisions at the time, as well as those of various specialists in education and public health, based on which the authors outlined their own vision on the causes, dynamics and impact on the educational process of the analyzed phenomena in Romania during two years (march 2020, when the state of emergency was established – march 2022, when the state of epidemiological alert was abolished).

Key findings in relation to existing scientific literature:

- Digitalization and beyond: the effects of Covid-19 on post-pandemic educational policy and delivery in Europe and in Romania (Parysek, Mierzejewska, 2021; Uzzoli et al., 2021; Mocanu et al., 2021; Zancajo et al., 2022; Săgeată, 2022; Săgeată et al., 2023);
- Examining students' attitudes towards online education during Covid-19 pandemic (Sun et al., 2020; Edelhauser, Lupu-Dima, 2020 & 2021);
- The impact of digitalization on educational and administrative systems pre- and post- Covid-19 pandemic crisis (Cucoş, 2006; Ionescu et al., 2020; Paven & Banaduc, 2022).

4. Results

The crisis caused by the new coronavirus pandemic has engendered new challenges, among which management and digitalization of the educational process. In relation to the impact of the pandemic crisis on the educational process in Romania, we have identified several characteristic stages:

I. The first wave of the pandemic and preparations for an atypical school year: 2020-2021

Online education based on the cumulative incidence of infections (10 March – 12 June 2020)

Slow increase of infections under the partial lockdown imposed by a state of emergency (16 March – 15 May 2020), followed by a state of health alert. Under these conditions, the number of infections and deaths in Romania was relatively low compared to other European countries (Italy, Spain, France, UK etc.).

The schools were closed, and in order to avoid the freezing of the academic year, it was decided, by order issued by the Ministry of Education, for the first time in Romania, to transfer educational activities to the online system. The Romanian legislation did not make any reference to this education system, therefore both the teaching staff and the students had to adapt, as best they could, to the new challenges. In general, these challenges were determined by poor infrastructure and connectivity, especially in some rural areas, the lack of training of teachers and students in the use of online platforms.

For the smooth running of educational activities, especially in poor communities, 3,080,000 euros (equivalent to lei) were allocated from government sources for the purchase of electronic devices with internet connection in order to equip state pre-university education units. Later, the Government launched the procedure for the purchase of 250,000 tablets.

II. The beginning of the 2020-2021 school year

The characteristic of educational process: the premises for the return to the online education system (14 September – 5 November 2020)

The summer period, which coincided with the holidays, brought a gradual relaxation of the restrictions at the same time as crowds gathered in the resorts and tourist areas. Given the situation, the number of cases was on the rise, foreshadowing the second wave of the pandemic.

In this context, the decision on how to start the school year was decentralized from the central level to the level of local authorities, depending on the epidemiological situation in the respective school. In this sense, three scenarios were developed by the Ministries of Education and Health, depending on the incidence of infection per thousand inhabitants: green (which implied the participation of students in classes), yellow (in conditions of an average risk of infection, which implied the physical participation only of preschool, primary and secondary school students) and red (in which schools closed physically and classes were held exclusively online).

Another challenge faced by the Romanian educational system in the conditions of the transition of didactic activities to the online system was the lack of facilities granted to parents for home supervision of young students during the period when schools were closed. In order to avoid a budgetary effort in this regard, the yellow education scenario provided for the participation in educational activities with the physical presence of all students from the preschool and primary school cycles, these being considered, according to WHO statistics, to be the least affected by Sars- CoV-2 infection. A characteristic of the housing regime in Romania is the high density, in many situations up to three generations live in the same house (minors with parents and even grandparents). In this context, asymptomatic children or with mild symptoms of the disease were effective carriers of the virus to other family members who, due to their advanced age and possible comorbidities, could develop severe forms of the disease. This decision fueled the spread of the infection in the first month after the start of the school year.

III. The second wave of the pandemic

Generalization of the online education at national level by government decision (6 November 2020 – 7 February 2021)

The rapid increase in the number of infections in the context of the second wave of the pandemic again imposed, by government decision, the transition of all educational activities in Romania to the online

system. Applying this decision in a generalized way throughout the national territory, without taking into account the differences between large cities, there was an increased incidence of infections in conditions of overcrowded classes and rural areas with a smaller school population and with better physical distancing of students, created the conditions for widening social gaps between students, by limiting the access to educational resources of some students from disadvantaged areas and environments. In this context, the school dropout rate was clearly higher in such localities, where the education process could have continued in the classic system, with compliance with health protection norms. Despite all the efforts of local authorities to purchase devices for online education and to expand Internet networks, a large number of students from these areas and environments did not have access to online education (Figures 1-3).

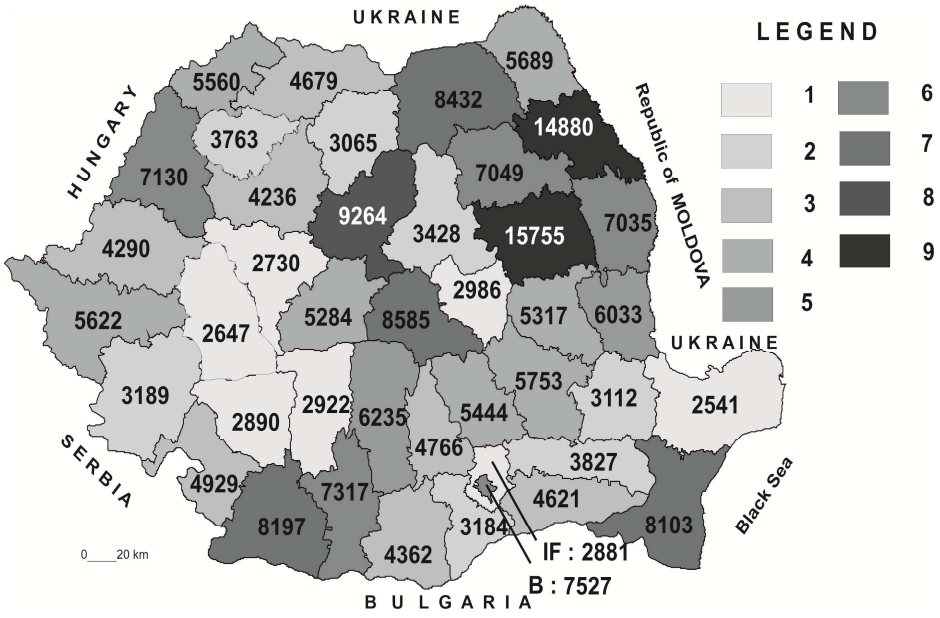


Figure 1. Students without online learning devices (December 15, 2020). **1.** 2001-3000, **2.** 3001-4000, **3.** 4001-5000, **4.** 5001-6000, **5.** 6001-7000, **6.** 7001-8000, **7.** 8001-9000, **8.** 9001-10000, **9.** over 10000

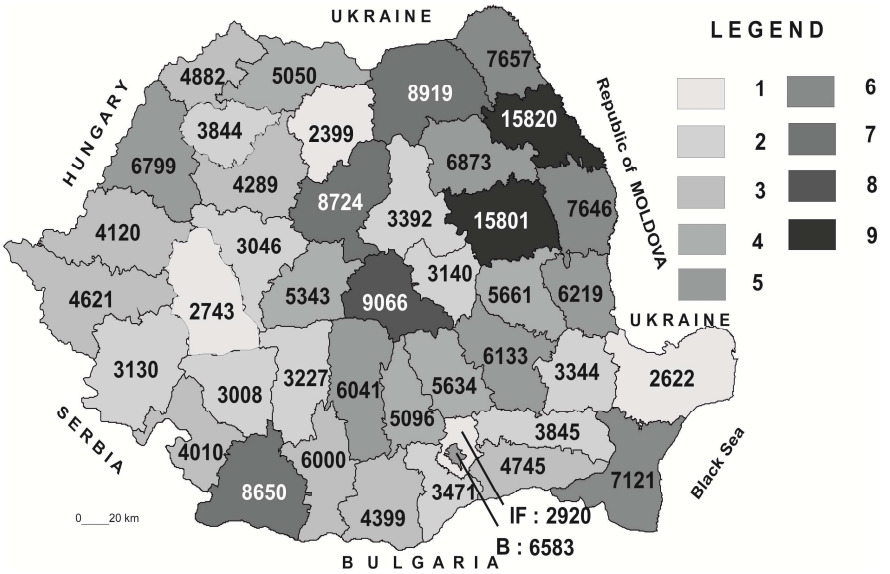


Figure 2. Students without internet access (December 15, 2020). **1.** 2001-3000, **2.** 3001-4000, **3.** 4001-5000, **4.** 5001-6000, **5.** 6001-7000, **6.** 7001-8000, **7.** 8001-9000, **8.** 9001-10000, **9.** over 10000

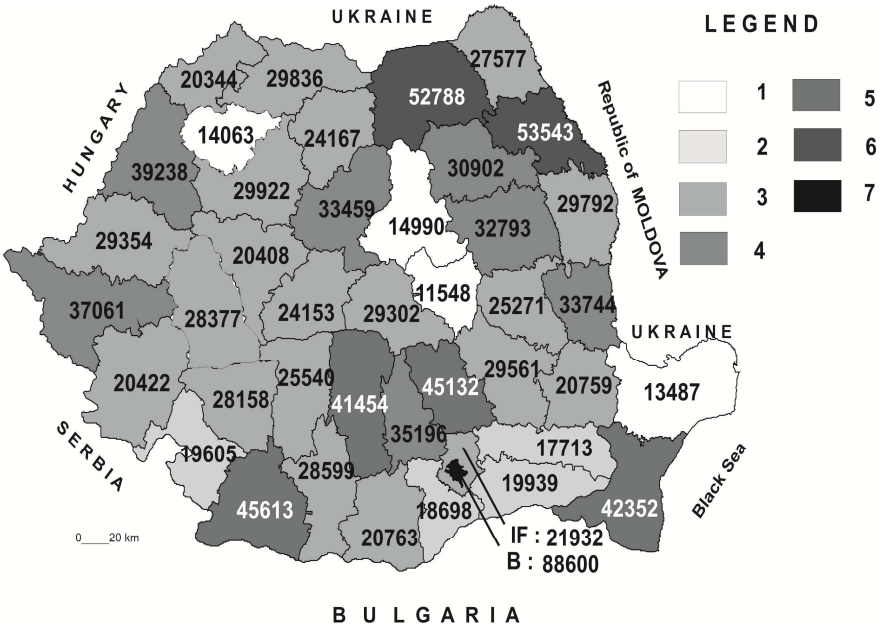


Figure 3. Students who only benefited of telephones for the educational process. **1.** 10000-15000, **2.** 15001-20000, **3.** 20001-30000, **4.** 30001-40000, **5.** 40001-50000, **6.** 50001-60000, **7.** over 80000

IV. Reducing the incidence and preparing for the reopening of schools

December 2020 – 7 February 2021

As a result of the restrictive measures enforced since October, the epidemiological trend had changed radically: official statistics showed a decrease in the daily number of infections and the rate per thousand inhabitants. Given the situation, the leadership of the Ministry of Education "still held major interest in opening schools", although experts estimated that in three months about 60% of new infections in Bucharest would be with the UK strain, and many parents did not want to send their children to school for fear of the new strain of coronavirus. In this context, three scenarios were (re)introduced: green – incidence below 1.5‰ inh., all schools are physically reopened; yellow – incidence between 1.5‰ and 3‰ inh. only kindergarten children, primary school students and students in the final grades (8th, 12th and 13th grade) start teaching activities in the traditional format) and red scenario – incidence between 3-6‰ inh. – only the kindergarten and primary school children start teaching activities in the traditional format. For an incidence of over 6‰, all students switch to online teaching activities. Just a few days before the reopening of schools, a complex set of measures regarding the organization of the activity in the educational institutions in conditions of epidemiological safety was communicated, by joint order of the Ministers of Education and Health.

V. The third wave of the pandemic

Vacation instead of online education (Mars – April 2021)

Starting from the second part of February 2021, but especially during the months of March and April 2021, there was a rapid increase in infections, corresponding to the third wave of the pandemic. Specific to this wave was the high incidence among young people and children, but also the high frequency of serious cases, which required hospitalization in intensive care units. Thus, just one month after the opening of schools, the number of infections among children had increased to over 150% compared to the moment of the resumption of face-to-face teaching activities.

In these conditions, despite the efforts to equip school units with online education devices, the new leadership of the Ministry of Education considered that online teaching generates structural losses that could only be recovered through physical presence education and, consequently, schools must be the last to be closed, exception if the epidemiological situation requires it. Thus, only one month after the re-establishment of educational scenarios (when the incidence threshold from which to switch to the online system had been increased from 3 to 6‰), this threshold was again modified by Order of the Minister, until the entry into quarantine of the locality, given the imminence of exceeding the incidence of 6‰ in the capital. In Romania, however, the declaration of quarantine in a locality was made by Order of the Department for Emergency Situations, the incidence of infections being only one of the criteria taken into account. A possible quarantine of a city of the size of Romania's capital (over 2 million inhabitants) would have imposed administrative measures difficult to manage efficiently. In addition, the application of this order generated strange situations: in Braşov, for example, after students had gone online at an incidence of 6‰, they returned to school at an incidence of over 7‰ because the city had not been quarantined, and in Timișoara once the quarantine was released, students returned to school at an incidence of 8.4‰ after entering at 6‰.

The trend of infections, continuously increasing, did not take into account the new demand of the leadership of the Ministry of Education to force education with physical presence regardless of the incidence of infections. Thus, it was forced to modify the structure of the school year by extending the Easter vacation and correspondingly the second semester courses, the argument being to avoid the peak of the pandemic, when schools will apply the online scenario anyway.

VI. The fourth wave of the pandemic

Online education according to the share of vaccinated staff in schools (15 September – 15 November 2021)

Despite the fact that in mid-July the lowest infection rate was registered since the beginning of the pandemic, the fourth wave of the pandemic had

become a certainty for Romania as well. Contrary to this epidemiological trend, the false confidence given to the population by the decrease in the incidence rate of infections and the lifting of most restrictions has caused the vaccination rate to decrease considerably. Two weeks after the start of the school year, there were already signs of an imminent crash of the healthcare system due to the large number of cases in this, the fourth wave of the pandemic.

In these conditions, of the rapid increase in the incidence of diseases and the exceeding of the critical threshold of 6‰ in Bucharest, at the level of the central authorities it was decided to decouple the functioning scenarios of schools from the incidence in the locality and to adopt decisions to suspend physical presence in relation to cases of illness confirmed at the level of the educational unit. The main arguments brought by the leadership of the Ministry of Education for avoiding the re-closing of educational units at the beginning of the school year were:

- lack of generalized connectivity (especially in rural areas and disadvantaged environments), an argument brought after almost three semesters in which online education was "experienced";
- lack of adequate connection speed (argument contested by the Romanian National Communications Authority, which claimed that the speeds required for the most popular online applications can be even 30 times lower);
- the lack of equipment available to connect to the Internet, despite the efforts made in this regard, as a result of their inequitable distribution;
- lack of digital content and digital catalog, insufficient training of teaching staff for online education (aspects highlighted after 18 months of the pandemic).

In the conditions in which the positive test rate had become enormous and the signals of an imminent blockage of the health system had already appeared due to the large number of serious cases in the fourth wave of the pandemic, at the level of the leadership of the Ministry of Education, it was decided, as in the third wave, to extend the holiday students to avoid the peak of the pandemic and the transition of educational activities online. The return of students to classes was to be done according to a criterion that was as original as it was arbitrary: the share of vaccinated staff in the educational unit. The students, who were the main vectors of transmission of the virus and were mostly unvaccinated,

were thus completely excluded from the authorities' calculations for establishing education scenarios. They wanted at any cost to stimulate the vaccination process in the context in which Romania had purchased a large amount of vaccine doses and the population's interest in vaccination had decreased considerably (Romania, along with Bulgaria, were the EU states with the lowest shares of the vaccinated population). This decision of the authorities contributed both to the intensification of the circulation of the virus, especially in schools in large cities, the most vulnerable from an epidemiological point of view, and to a widening of the gaps between students with access to technological resources and those from disadvantaged backgrounds, having exactly the opposite effect of what is declared at the governmental level.

VII. The fifth wave of the pandemic

Online education according to the occupancy rate of COVID-19 hospitals (January – February 2022)

After a considerable decrease in the incidence of infections in the months of November and December, Romania becoming one of the few "green areas" of the EU at the end of 2021, the fifth wave of the pandemic had begun to be felt strongly in this country as well, starting from the first days of 2022. The intensification of the circulation and the interactions between people as a result of the winter holidays considerably favored the circulation of the virus, in the conditions of a low vaccination rate and the challenge of the circulation restrictions imposed by the "green certificate".

The basic objectives set forth by the leadership of the Ministries of Health and Education were: 1) reducing the number of deaths, 2) avoiding the lockdown and 3) avoiding closing schools and moving educational activities in online. In this sense, a new decision of the National Committee for Emergency Situations was approved by which the suspension of educational activities with physical presence was conditioned by the degree of occupancy of the COVID hospitals. Thus, the transition to online courses at the level of pre-university education units was done when the occupancy rate of COVID beds at the county level reached 75% of the total, and the return to didactic activities with physical

presence was done when the occupancy rate of COVID hospitals was below 70%. Taking into account the lower degree of pathogenicity of the Omicron strain that generated the fifth wave of the pandemic, in no administrative unit were attained the conditions for moving educational activities in online, only isolated cases being registered, at class level, as a result of the illness teachers or a large number of students.

VIII. The repeal of the state of alert and the post-pandemic "new normality"

With the exit from the fifth wave of the pandemic and the decrease in the degree of pathogenicity of the virus and the intensification of anti-restriction protests, it was ordered, by government decision, the repeal of the state of alert and, implicitly, of all the restrictions adopted during the pandemic. These have taken on the character of recommendations, rarely respected at the level of society. Wearing a mask and quarantine in case of infection remained recommended in the classrooms.

The generalization of the presence of students in classes made that the tablets and laptops purchased for online teaching activity and which had reached the use of students exactly in the period when the decision-making trend became favorable to education with physical presence, no longer have users. In order to save this situation, the Ministry of Education has put into discussion a draft ordinance by which the devices purchased for online education can also be used in the context of the generalization of education with physical presence.

Conclusions

Centralized decisions alternated with decentralization at the local level, and the criteria in relation to which the transition was made from educational activities with physical presence to those in the online system varied according to the circumstances. If the first part of the pandemic period was characterized by the support of online education, efforts were made in this regard at the governmental level, in the last pandemic waves, after electronic devices for online education were

purchased, the ideological trend has changed radically, with attendance education being encouraged physical, even in the context of critical situations from a sanitary point of view.

The generalized implementation of online education, without taking into account the local peculiarities of the epidemic and the degree of equipment for online education and Internet connectivity, led to the accentuation of social gaps between students. On the other hand, however, in the disadvantaged environments where the local authorities have managed to successfully implement the online education system, it has contributed to reducing the school-home mobility of students. In Romania, at the beginning of the pandemic, on average, in each school, there were over 93 students and 8 teaching staff who commuted, the most critical situations from this point of view being registered at the level of poor communities in the east and south of the country, especially in the counties Botoşani and Vaslui, followed by Suceava, Neamț, Iasi, Bacău, Vrancea, Buzău, Dâmbovița and Mehedinți. In 6,713 schools in 2,600 localities (82% of the total), there were over 429,000 commuter students (World Bank, 2018).

The deficiencies of online education in the way it was implemented in Romania during the analysed period would be: 1) the lack of protocols, which allowed for an extremely permissive approach from both teachers and students, given that there was no coherent approach on the part of the authorities and minimal training; 2) relaxation of students and teachers, amid the lack of protocols, minimizing class duration and the amount of self, at-home study; 3) a poor/unstable internet connection; 4) the deficient provision of the necessary devices for the development of online learning; 5) the lacking training of teachers in the use of online devices and platforms; there was no unitary platform approved by the Ministry, everyone adapted as best they could, there were no courses for teachers to acquire the basic skills for using computer platforms; 6) the large number of students with whom a teacher is supposed to work; 7) the lack of an efficient and secure digital assessment platform (digital report); 8) the loss of interest of teachers in ensuring good quality education.

There is a need for a flexible, digitized, adaptable, quality education system and able to meet the challenges and generate change through: 1) Identifying mechanisms to reduce gap; 2) Equity in the use of digital

technologies; 3) Active involvement of all actors in the education process; and also avoidance of 4) Dysfunctions in the digitalized pre-university education in Romania; 5) Lack of predictability; 6) A heterogeneous school network, with a strong digital divide between schools; 7) Insufficiently developed digital skills for the efficient organization of the teaching process in the online environment; 8) Reduced access to technology and reduced internet connectivity; 9) The limited opportunities of families in providing support to the beneficiaries of education, children, to participate in online lessons.

REFERENCES

Banca Mondială 2018, Acordul de servicii de asistență tehnică pentru luarea unor decizii informative privind investițiile în infrastructură. Raportul pentru România privind condițiile şi alternativele de transport şcolar [World Bank 2018, Technical Assistance Services Agreement for Informed Decision Making on Infrastructure Investments. The report for Romania regarding school transport conditions and alternatives], https://www.infraed.ro/wp-content/uploads/2018/11/Analiza-privind-transport-alternativ-BM.rar

Cucoş, C., 2006, Informatizarea în educație. Aspecte ale virtualizării formării [Informatization in education. Aspects of training virtualization], Iaşi: Polirom.

Edelhauser, E., Lupu-Dima, L., 2020, Is Romania prepared for eLearning during the COVID-19 pandemic?, Sustainability, 12(13), 5438. https://doi.org/10.3390/su12135438

Edelhauser, E., Lupu-Dima, L., 2021, One year of online education in COVID-19 age, a challenge for the Romanian education system, International Journal of Environmental Research and Public Health, 18(15), 8129. https://doi.org/10.3390/ijerph18158129

Ionescu, C-A., Paschia, L., Gudănescu-Nicolau, N-L., Stănescu, S-G., Neacșu-Stănescu, V-M., Coman, D-M., Uzlău, M-C., 2020, Sustainability analysis of the e-learning education system during pandemic period – COVID-19 in Romania, Sustainability, 12(21), 9030. https://doi.org/10.3390/su12219030

Mocanu, I., Mitrică, B., Damian, N., Popovici, A., Persu, M., Grigorescu, I., Săgeată, R., 2021, Territorial characteristics of the vaccination process in Romania. Evidence at a local level, Proceedings of the Romanian Academy, Series B: Chemistry, Life Sciences and Geosciences, 23(1), 153-161.

Parysek, J-J., Mierzejewska, L., 2021, Spatio-temporal analysis of the development of the COVID-19 epidemic (pandemic) in Poland: First phase of development, Geographia Polonica, 94(3), 325-354. https://doi.org/10.7163/GPol.0208

Paven, A-E., Banaduc, G., 2022, The Impact of Digitalization on Educational and Administrative Systems, Acta Technica Napocensis. Series Applied Mathematics, Mechanics and Engineering, 65(1), 187-196.

Săgeată, R., 2022, Deciziile politico-administrative şi activitățile educaționale în pandemia de coronavirus (martie 2020 – martie 2022). Cazul României [Political-administrative decisions and educational activities in the coronavirus pandemic (March 2020 – March 2022). The case of Romania], Oradea: Creatio.

Săgeată, R., Geantă, N., Damian, N., Persu, M., 2023, Education during the COVID-19 Pandemic. The case of Romania's political-administrative decisions on education and health, European Review, 1-24. https://doi.org/10.1017/S1062798723000078

Sun, L., Tang, Y., Zou, W., 2020, Coronavirus pushes education online, Nature Materials, 19(687), https://doi.org/10.1038/s41563-020-0638-8

Uzzoli, A., Kovács, S-Z., Fábián, A., Páger, B., Szabó, T., 2021, Spatial Analysis of the COVID-19 Pandemic in Hungary: Changing Epidemic Waves in Time and Space, Region. The Journal of ERSA, 8(2), 147-165. https://org/10.18335/region.v8i2.343

Zancajo, A., Verger, A., Bolea, A., 2022, Digitalization and beyond: the effects of COVID-19 on post-pandemic educational policy and delivery in Europe, Policy and Society, 41(1), 111-128. https://doi.org/10.1093/polsoc/puab016

https://doi.org/10.5719/aub-g/72.1/4

BEYOND THE LITURGICAL. COMPLEMENTARY FUNCTIONS OF MONASTERIES FROM BUZĂU AND RÂMNICU SĂRAT COUNTIES, ROMANIA (16th-19th CENTURIES)

CEZAR BUTEREZ[1]

Abstract

In the Orthodox tradition, the liturgical function is by far the most important trait of any church, being often perceived either as the only one, or as the only one of importance. In reality, the churches perform also several other functions, which are much clearer and have played a bigger part in the case of monasteries. Throughout the Middle Ages, the monastic establishments have played a key role in developing culture and science and maintaining a good social climate. Most of the times, they were also used as icons of identity and legitimacy by their founders. This study aims to explore these secondary functions of social and ideological nature of the monastery churches from Buzău and Râmnicu Sărat Counties, between the 16th and 19th centuries. Based on their characteristics and connections to Romania's cultural and social history, we can assert that all the secondary functions of the monasteries are complementary to the liturgical one. Further historical-geographical research needs to be conducted in order to have a better understanding of the spatial dimension of these functions in different stages of Romanian history.

Dans la tradition Orthodoxe, la fonction liturgique est de loin le trait le plus important de toute l'église, étant souvent perçue soit comme le seul, ou comme le seul d'importance. En réalité, les églises exercent également plusieurs autres fonctions, qui sont beaucoup plus claires et qui ont joué un rôle plus important dans le cas des monastères. Tout au long du Moyen Age, les établissements monastiques ont joué un rôle clé dans le développement de la culture et la science et le maintien d'un bon climat social. La plupart du temps, ils ont également été utilisés comme des icônes de l'identité et de la légitimité par leurs fondateurs. Cette étude vise à explorer ces fonctions secondaires de nature sociale et idéologique des monastères dans les districts de Buzău et Râmnicu Sărat, entre le 16-eme et le 19-eme siècles. Basé sur leurs caractéristiques et leurs connexions à l'histoire culturelle et sociale de la Roumanie, nous pouvons affirmer que toutes les fonctions secondaires des monastères sont complémentaires à la fonction liturgique. De plus amples recherches de géographie historique doit être menée afin

[1] University of Bucharest, Faculty of Geography, e-mail: cezarb@geo.unibuc.ro

d'avoir une meilleure compréhension sur la dimension spatiale de ces fonctions dans les différents stades de l'histoire roumaine.
***Keywords**:* function, ideology, refuge, monasteries, Buzău, Râmnicu Sărat.

1. Introduction

The default and main function of all churches is, without any doubt, that of worship. In the Orthodox Church, this is all the more true (McGuckin 2010). At its heart stands the Divine Liturgy, which is the one sacrament that represents the very being of the Church itself (Plămădeală 2004). In a community, the parish church plays a key role, since it is intimately woven into the lives of generations (Maguire 2004). Yet, the churches of monasteries and sketes are different from parish ones. Beyond their principal function, they were created to meet the needs of monastic communities – isolation, self-administration and lesser connections with other social groups. Furthermore, all these lead to an aggregation of several other functions, depending on the social status of the founders (Pușcașu 2001). It is important to note that higher class people such as princes or boyars have almost always preferred to build monasteries instead of parish churches. This is partly due to the fact that the act of founding is thought to be an extension of the religious experience (Radosav 1997). Formulations that are found in church inscriptions, charters, books of worship and diptychs confirm that the first and most important aspiration of the founders is to seek the salvation of their souls. The choice of founding a monastery as opposed to a parish church is based on the larger availability that monks have to prayer.

2. Social and ideological functions

Monasteries and sketes are symbols of cultural identity and from this perspective, they invite to an active interpretation of the landscape as a product of human continuity (Tilley 1994, Maguire 2004). Furthermore, they are (or should be) one of the few elements of stability that evoke timeless values in the ever-changing landscapes. The higher the social

position of the founder, the more representative nature was acquired by his foundation. This became more evident with the spread of coenobitic life. The very presence and activeness of the coenobitic monasteries built by princes or boyars were actually the primary means by which the representatives of the secular power and the Orthodox Church enhanced their prestige. The princely foundations were very few compared to other regions of Wallachia (Lupu 2011), yet because of this, a series of ideological particularities can be ascertained. First of all, the princes made their foundations in such a way that they would become emblems of power and control similar to the Wallachian monasteries of Cozia, Argeș, Dealu and Arnota. Saint George monastery, founded by either Mihnea Turcitul or Mihai Viteazul (Mândricel 2006, Lupu 2011) and Pinu monastery, restored by Matei Basarab, both had the obvious goal of establishing themselves as polarizing centers of spirituality and culture in the area of Ivănețu massif, where the monastic life was thriving in the 16-17 centuries.

In a charter issued approximately half a century after the rebuilding of Pinu, when Matei Basarab replaced the old wooden church with a brick one, there is a passage which points out that the new foundation was supposed to act as "*mother to all the little sketes from around*"[2].

The boyar foundations, which were the most numerous in the region, had different fates. Those of the low-ranking squires did not have the sufficient resources to gain an important amount of prestige, yet they managed to create links to the local peasantry, who in some cases, agreed and supported those kinds of initiatives. Before 1767, the chancellor Mihai Vernescu and his wife, Maria, asked the peasants of Cârlomănești for their consent in the idea "*of building a small skete on the valley of Ulmeasa*", which they agreed "*so that we have alms too*"[3].

In other cases, the boyars helped in the rebuilding and repairing of monasteries and sketes. Thus, after the new church of Găvanele was destroyed because of the 1802 earthquake, several boyars including Dimitrie and Costache Ghica contributed substantially to the erection of a new building (Filitti 1932, Mândricel 2006, Lupu 2011). There are also quite a few situations where the founders were also boyars (Cucuiata,

---

2 *S.A.N.I.C.*, fond Episcopia Buzău, pach. XCII bis/10, undated draft.

3 S*.A.N.I.C.*, fond Episcopia Buzău, ms. 172, f. 334v.

Domirești, Lapoș, Micșani, Mircești, Valea Produlesei etc.), yet we know almost nothing about their existence and way of life, which seems to point out that their social and ideological role was at most a local one.

A different discussion must be carried out for the foundations of the greater boyar families. They have always bore in an active manner the mark of foundation and they permanently strove to emphasize it through various ways. The Cândești boyars, a lineage with hardy roots in the Buzău region, have acquired over time a great political and economic power, whose peak was roughly in the second half of the 17th century (Lecca 1911). The great constable Radu rebuilt Bradu monastery, which was finished in 1641 (Vasilescu 1937); his brother the clucer Negoiță began before 1659, the construction of Ungurei monastery (Ionașcu 1936a), and in 1694, prince Constantin Brâncoveanu entrusted Negoiță's nephew, the great stolnik Mihalcea, with Pinu monastery[4] (*Figure 1*). Yet by far, the most important foundation achievement was the rebuilding of the Cetățuia or Berca monastery, initiated by the same Mihalcea and finished in 1694[5] (Cocora 1963). Its church stands out from several points of view. First of all, it was included on Constantin Cantacuzino's map from 1700, being registered with its founder's actual name – *Micalcia*, and has been copied almost unalterably on most of the cartographic representations of Wallachia in the 18th century. During the church's construction, a certain Stoica Oaleș supervised a team of craftsmen which included a shingler from Brașov (Iorga 1905), and the frescoes were executed by the famous painter of the Cantacuzino family, Pârvu Mutu[6]. There are no documents that speak about the ideological role of the monastery, but it can be inferred from the way in which its position was described by visitors. Above Berca village, "*pornind de la câteva căsuțe* […] *un mare părete de lut se ridică deasupra văii; pe vârful lui se vede o*

---

4 *S.A.N.I.C.*, fond Episcopia Buzău, pach. XCII bis/10, undated draft

5 The church's inscription which is still kept today, does not mention anything about an earlier construction. Yet we know that the monastery existed earlier; In 1762, an old lady named Alba, together with her children and other relatives, sold en estate at Pleșcoiul de Jos to *Mihalcea Cândescu*, Drăghici and *Berca* monastery (*S.A.N.I.C.*, fond Episcopia Buzău, XX/1). It is possible that the Cândescu boyars had older ties with the monastic settlement from Berca.

6 He made an autoportrait there.

biserică veche, lângă o lungă perdea de zid ruinat" (starting with a few small houses […] a great clay wall rises above the valley; on its peak, you can see an old church, next to a long curtain of ruined walls) (Iorga 1939: 398). The monastery "*singuratecă, este așezată pe un deal care domină împrejurimile*" (is situated all by itself on a hill which dominates its surroundings) (*Figure 2*) (Chițulescu 1944: 69). Indeed, its location, on top of a promontory, similar to a fortification, makes it visible from afar, transforming it into one of the key elements of the Buzău valley cultural landscape.

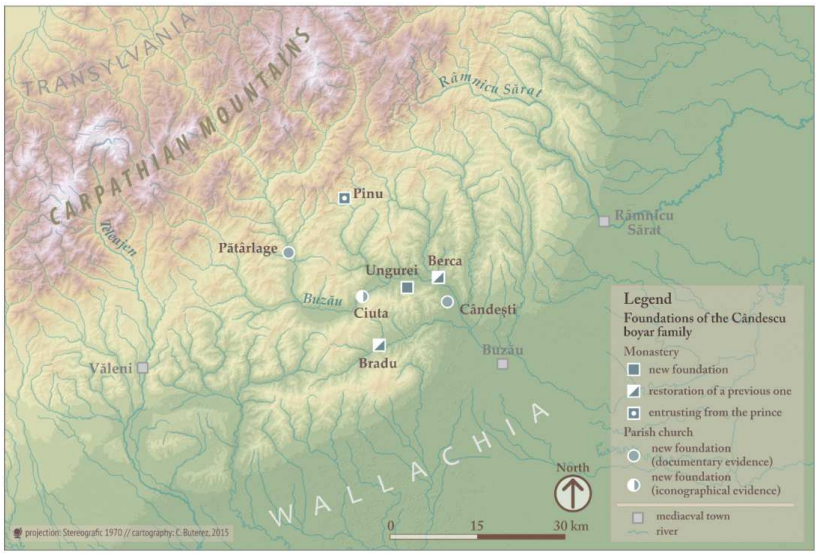


Figure 1. The foundations of the Cândescu family (17th-18th Centuries) (*Cartography:* C. Buterez, 2015)

Figure 2. Berca monastery, seen from the Buzău river valley (*Photo:* I. Voinescu, cca 1908 ; *Source:* Chițulescu, 1944, p. 70)

Apart from the direct relationships with their founders, the monasteries were the main centres of creation and dispersion of the mediaeval culture. Not coincidentally, the first Wallachian schools for teaching reading and writing have initially functioned inside monasteries and bishoprics.

In a document from June 25, 1625, at the establishment of Menedic's estate boundaries, one of the witnesses was "*Uriil clisiiarul, care au învățat carte în mănăstire la Minidic*" (Uriil the verger, who learned at Menedic monastery)[7]. In 1643, in a similar act, a certain hieromonk Teodosie signed as a witness; he acknowledged that "*am fost la sfânta mănăstire grămătic cu Teofan egumen, în zilele lui Pătru Voevod și la Mihnea Voievod*" (I was a teacher at the holy monastery, with Teofan the hegoumen, in the days of princes Pătru and Mihnea)[8]. From another writing, dated in 1793 we find out that "*la acest locaș Găvanul era nacealnic și starețu părintile schimonah Dionisie*" (the leader, teacher and hegoumen of the holy place named Găvanul, was father Dionisie)[9]. At Grăjdana, in 1801, there was a "*dăscălaș pentru ajutor(ul) biserici(i) și pentru învățătura copiilor*" (teacher who helped the church and for the children's education) (Ionașcu 1936b), and at Berca, the metochion of the Buzău Diocese, the bishop brought the school for teachers, candidates for priesthood (Iorgulescu 1901). A certain Grigore Dițescu left in 1851 a short note in which he confessed that "*am intrat la anul 1850 aprilie 29 la învățătură în școala episcopii Buzău, care este așezată la sfânta mănăstire Berca*" (I entered on the 29th of April 1850, to learn in the school of the Buzău Diocese, which is located at the holy monastery of Berca) (Constantinescu 1941: 388). Also, in the years of the 1859 Union, there were at least four private monastery schools – at Cislău, Saint George, Nifon and Rătești (*Figure 3*) (Mândricel 2000).

---

7 *D.I.R.*, veacul XVII, vol. B., Țara Românească, vol. IV (1620-1625), doc. 550, pp. 530-531.

8 *S.A.N.I.C.*, fond Episcopia Buzău, XXXVII/11. The princes in question are Petru Cercel and Mihnea the 3rd, which demonstrates that the school was active near the end of the 16th century.

9 *Biblioteca Academiei Române*, Cabinetul Manuscrise și Carte rară, ms. rom. 3169.

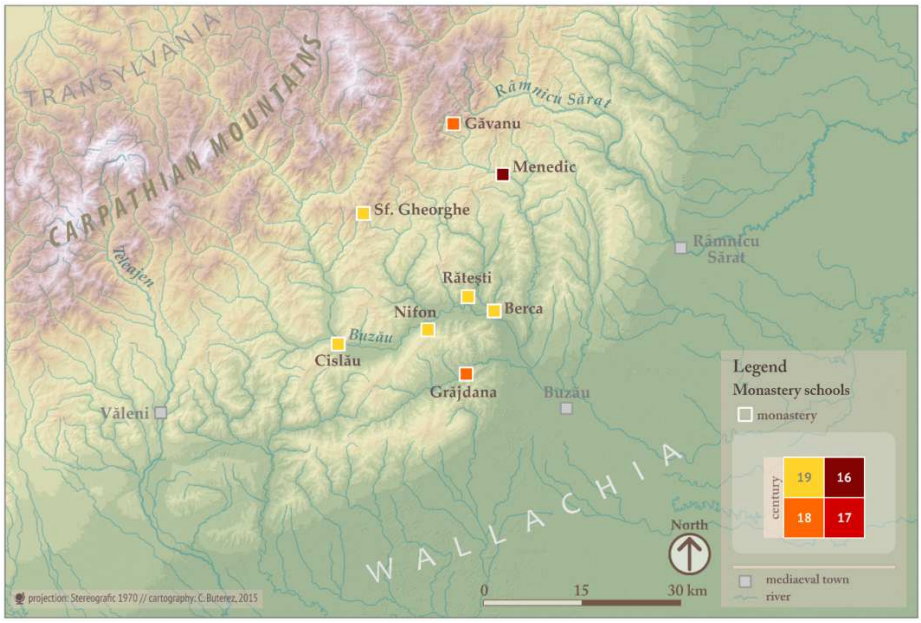


Figure 3. Monastery schools documented between the 16th-19th centuries (*Cartography*: C. Buterez, 2015)

Wallachian monks were also preoccupied with copying manuscripts containing patristic literature. This was especially necessary because of the need for liturgical books since the number of typographies was quite small across the entire country. Later on, the copy work was replaced by the actual writing of original texts, particularly philokalic ones (Cocora 1987). The most important copy and translation centre was Poiana Mărului monastery, where the monks were supervised by the hegoumen Vasile, the hiero-schemamonk, "*un predicator al culturii și reformei bisericești*" (a preacher of culture and church reformation) (Iorga 1901: 391). Several monks, schemamonks, and hierodeacons copied some of the writings of saints Vasile, Grigore and Macarie (Cocora 1987). Poiana Mărului had a great cultural influence on other monasteries such as Găvanu, Dălhăuți and Valea Neagră, where the concern for manuscript copying was assumed by a large number of monks.

3. Refuge function

Isolation was characteristic for the monastic life in the Buzău and Râmnicu Sărat region; because of it, some monasteries and sketes which were more secluded than other, became places of refuge, wandering and even exile. The same usage was also common for the rock-hewn settlements. Regarding their origin, the local folklore emanates a unique explanation – that of refuge in times of invasions. In an answer to Hasdeu's enquiry, it is said that "*sunt foarte vechi și la început au fost locuite de tătari prigoniți. Mai în urmă, când din unii din oameni mai bătrâni țin minte, ele au fost locuite de câte un pustnic de unde și-au tras și numele…*" (they are very old and were, at the beginning, inhabited by persecuted Tartars. Closer to our days, when some of our old people still remember, they were inhabited by hermits who also gave their names to them)[10]. The reconstruction of Pinu monastery, by Matei Basarab, has a similar explanation in local tradition – "*În acel loc, scăpându-se de furia turcilor, a zidit acea mănăstire*" (In that place, where he got rid of the Turks' anger, he had built that monastery)[11]. We can suspect that the constant Ottoman and Tatar threats were among the factors that determined a nearly endless swing of population, between the settlements and the more isolated areas – mountains and forests – where it occupied (and maybe also dug) the rock-cut chambers and other small natural shelters.

There are very few documentary mentions of refugees hiding in monasteries and sketes before the 19th century (*Figure 4*). Thereby, Bradu monastery, whose thick stone walls did not only defend the church, was in 1689, the chosen place of shelter by lady Marica, the wife of prince Constantin Brâncoveanu, during general Heisler's foray into Wallachia[12] (Bilciurescu 1890, Del Chiaro 1929).

---

[10] *Biblioteca Academiei Române,* Cabinetul Manuscrise și Carte rară, ms. rom. 3437, f. 43.

[11] *Biblioteca Academiei Române,* Cabinetul Manuscrise și Carte rară, ms. rom. 224, f. 302.

[12] According to some researchers, Bradu monastery was also Mihai Viteazul's camp site from 1597 Cocora, G. 1986. *Pentru libertate și unitate. Studii, articole și documente de istorie buzoiană,* București, Editura Litera..

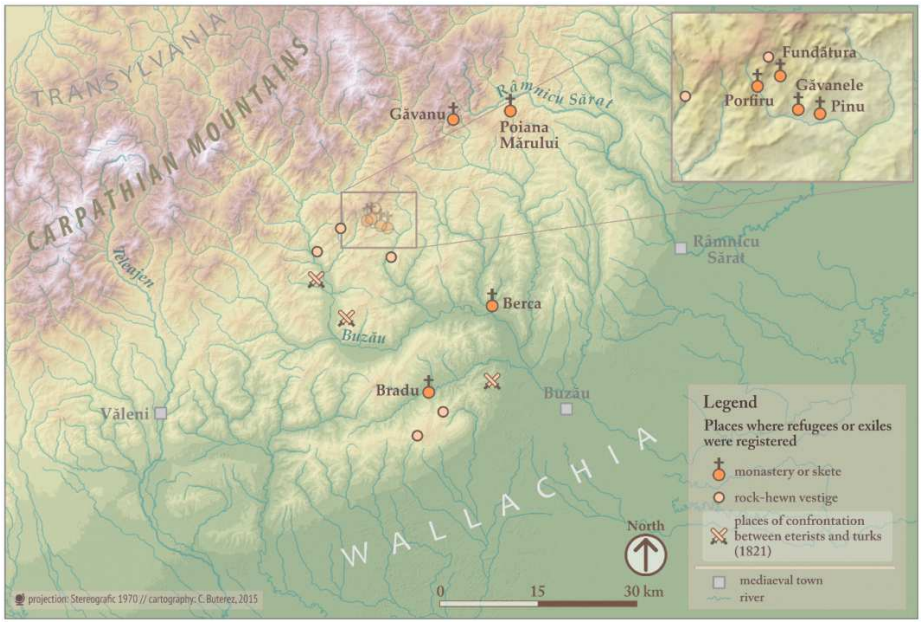


Figure 4. The monasteries and rock-hewn vestiges were refugees or exiles were registered (*Cartography*: C. Buterez, 2015)

In the 19th century, the ethnic and political instabilities from the Balkans, caused by nationalist movements, gave rise to a large number of Ottoman raids and further conflicts with the Russians. This greatly affected Wallachia, as we know from a series of documents. Thus, in 1802, the Turks crossed the river Olt and attacked Cleanov, Târgu-Jiu and Ocnele Mari, where "*pă toți negutătorii i-au jăfuit și pă mulți din creștini au tăiat*" (they robbed all the merchants and killed many Christians). The prince, together with the metropolitan bishop, the bishop of Buzău and several boyars fled to Brașov, and "*toate satele s-au băjenit și umblau toți din loc în loc, făr' de niciun căpătâiu*" (all the villagers ran to take refuge and everybody was wandering around without any aim). All of these were written on a Homiliary by "*Ioan logofăt din sud Meh(edin)ți, fiind băjen(a)ri la satul Buda*" (Ioan the chancellor from Mehedinți County, being a refugee in the village of Buda) (Săndulescu-Verna 1938: 821).

On a Gospel Book from the 17th century, a certain hierodeacon named Ilarion wrote that:

> "*la 1804 fiind răzmeriță moscalii cu turcii* […], *s-au întâmplat de au venit (i)eșit turcii brăileni și au venit la Buzău unde au făcut mari stricăciuni, tă(i)eri, robii. Iar eu, scăpând în Episcopie cu nasul tăiat, am venit aici la Pin*" (in 1804, during the war between the Russian and the Turks […] as it happened, the Turks from Brăila came to Buzău where they made a lot of damage, killings and took captives. And I managed to escape from the bishopric with my nose cut off, and I came here to Pinu)[13].

The eruption of the revolutionary movements in 1821 had powerful effects in the counties of Buzău and Râmnicu Sărat. The general confusion caused by the eterists' actions led to the disbandment of many villages. The extent of the population movement was so large, that the entire town of Buzău became empty at one point (Vrapciu 1973). Many boyars ran to more isolated areas and some of them took refuge inside monasteries and sketes. A larger group, which included Nica Mușceleanu, former landowner at Merei and judge in Buzău, found shelter at Fundătura, yet they were caught and killed (Nicolescu and Petcu 1999). The same scenario took place at Găvanu skete, where many boyars with their families came to hide (Pelimon 1864). With the help of some informers, the Turks managed to pick up their trail and to find them, "*iar pe Paharnicul Costache Hrisoscoleu* […] *l-au jertfit îndată cu săbiile, și pe iconomul schitului și pe doi Țigani de acolo, și, năvălind înăuntru la schit, au luat toate calabalâcurile băjeniilor*" (and the cup-bearer Costache Hrisoscoleu […] they immediately killed him with the swords along with the skete's treasurer and two gypsies, and rushing inside, they took all the refugees' possessions), burning down the church (Iorga 1921: 88).

In 1821, one group of runaways took refuge in Bradu monastery "*de unde fiind alungat de-o poteră, a fost zdrobit pe apa Nișcovului*" (where it was driven out by a posse and was eventually crushed on the Nișcov valley (*Figure 5*) (Cojocaru 1926: 5). At Cârnu, the monastery church suffered significant damage after a fight between the eterists and the Turks[14] (Constantinescu 1924), and the Berca monastery welcomed some Greek

---

[13] *Biblioteca Academiei Române,* Cabinetul Manuscrise și Carte rară, C.R.V. 42, f. 156.

[14] According to tradition, similar battles have been fought on Panduru hill, Cetățeaua near Pătârlage and Malul Burcheștilor, near Tega. Iorgulescu, B. 1892. *Dicționar geografic, statistic, economic și istoric al județului Buzău,* București, Stabilimentul Grafic I.V. Socecu..

boyars as refugees (Iorgulescu 1892). To avoid being captured by the Turks, other boyars found shelter in some rock-hewn vestiges like *Malul cu Gaură* and *Casa Hoților* (Iorgulescu 1892, Ștefan and Drâmbocianu 1980).

Figure 5. The former Bradu monastery seen from the main gate
(Unknown author, published in *Muguri*, 1929)

Next to the above-mentioned monasteries, some clues like traces of defensive structures and old hiding places seem to indicate that similar functions can't be excluded for Menedic, Barbu and Dedulești, yet with a single notable exception from 1848 (Cocora 1987), we lack clear documentary evidence.

A special case is the exile of poet Cezar Bolliac at Poiana Mărului, in 1841, because of his meddling in the Filipescu conspiracy. Despite the fact that Bolliac "*respira aer curat de munte*" (was breathing fresh mountain air) and "*un cucernic călugăr rus îi citea în toate diminețile molitfele sfântului Vasilie*" (each morning, a Russian monk would read to him Saint Basil's molitvae) (Ghica 1914: 372), he described his stay in a gloomy way:

> "*Vrând să-ți spun ce am pățit / Din cauza ciocoimii, vrând să-ți spun că-s surghiunit / În Camtceatka Rumâniei* […] *unde cer să vezi nu poți* / […] *Unde șoimul și vulturul se scald vara în nămeți*" (I want to tell you what happened / Because of the up-starts, I wanted to tell you that I'm in exile / In Romania's Kamchatka […] where you cannot see the sky […] where, during summer, the hawk and the eagle bathe in snowdrifts) (Bolliac 1915: 161).

Conclusions

In this paper we presented a different view on the monasteries, well beyond their default liturgical function. Like any other kind of settlement, they too possess complementary functions such as social and ideological ones, but also act as places of refuge and exile, yet all of them have a strong cultural-geographical dimension. The amplitude of their social influence reflects the status of their founders, who, in case of a great economic and political power, also left their mark in an ideological manner, giving birth to unique cultural landscapes. The monasteries of Aninoasa, Berca, Bradu, Dedulești, Pinu and Vintilă Vodă are among the best examples of higher rank foundations which became representative for the power acquired by local boyars and their connections with the princely authority. Apart from also being cultural and learning centres, the first to promote and spread the use of written Romanian language for other people than social elites, the monasteries stood as places of refuge in times of great trials. Yet this is only documented for the troubled times of the 19th century, when the nationalist movements and numerous uprisings forced the Ottoman Empire to suppress fast any potential threats that came from within. The population fled almost all the times, and one of the favourite hiding destinations were the more secluded monasteries, not few in the Buzău and Râmnicu Sărat regions. In spite of the isolation, in most cases, the refugees got killed or wounded, since the Turks compensated their little geographic knowledge with scouts and informers which denounced the concealed groups.

The secondary functions of monasteries need to be further explored by historical-geographical studies, which can better highlight their spatial dimension and establish some trends or further specificities for different stages of Romanian history. Such work can complement in a new and exciting way the general picture that we have so far about the monastic life and its geographical aspects.

REFERENCES

Bilciurescu, C., 1890, *Monastirile și bisericile din România,* București, Tipografia Cărților Bisericești.

Bolliac, C., 1915, *Meditații și poezii,* București, Minerva.

Chițulescu, T., 1944, Biserica fostei mănăstiri Berca, in *Buletinul Comisiunii Monumentelor Istorice,* XXXVII, pp. 69-76.

Cocora, G., 1963, Biserica de la Berca, monument de artă brâncovenească, in *Glasul Bisericii,* nr. 5-6, pp. 515-534.

Cocora, G., 1986, *Pentru libertate și unitate. Studii, articole și documente de istorie buzoiană,* București, Editura Litera.

Cocora, G., 1987, *Mănăstiri din Eparhia Buzăului: vetre de cultură și trăire românească,* Buzău, Editura Episcopiei Buzăului.

Cojocaru, V., 1926, Mănăstirea Bradu (Tisău), in *Muguri*, an V, nr. 7-9, pp. 1-5.

Constantinescu, N.A., 1924, Biserici și mănăstiri din județul Buzău, in *Buletinul Comisiunii Monumentelor Istorice,* an XVII, fasc. 41, pp. 188-191.

Constantinescu, N.A., 1941, Biserici și mănăstiri din jud. Buzău. Partea II-a, in *Îngerul,* an XIII, nr. 5-6, pp. 367-392.

Del Chiaro, A.-M., 1929, *Revoluțiile Valahiei (după textul reeditat de N. Iorga),* Iași, Viața Românească.

Filitti, I.C., 1932, Biserici și ctitori, in *Biserica Ortodoxă Română,* an L, pp. 118-134.

Ghica, I., 1914, *Scrieri,* volumul III (ediție îngrijită de Petre Haneș), București, Institutul de Arte Grafice și Editură Minerva.

Ionașcu, I., 1936a, Mănăstirea Izvorani, ctitoria episcopului Luca (1583-1604), in *Îngerul,* an XVIII, pp. 31-93.

Ionașcu, I., 1936b, *Un fost metoh al Pantelimonului: Schitul Grăjdana (Buzău),* Buzău.

Iorga, N., 1901, *Istoria literaturii române în secolul al XVIII-lea (1688-1821).* Vol. II, București, Institutul de Arte Grafice și Editura Minerva.

Iorga, N., 1905, *Brașovul și romînii,* București, Stabilimentul grafic I. V. SOCECU.

Iorga, N., 1921, *Izvoarele contemporane asupra mișcării lui Tudor Vladimirescu,* București, Librăriile „Cartea Românească" și Pavel Suru.

Iorga, N., 1939, *România cum era până la 1918. I. România „Munteană",* București.

Iorgulescu, B., 1892, *Dicționar geografic, statistic, economic și istoric al județului Buzău,* București, Stabilimentul Grafic I. V. Socecu.

Iorgulescu, B., 1901, Istoria picturii în Țara Românească. Pitarul Nicolae Teodorescu și Școala de Pictură din Buzău (1831), in *Literatură și Artă Română,* an 5, pp. 221-227.

Lecca, O.G., 1911, *Genealogia a 100 de case din Țara-Românească și Moldova,* București.

Lupu, E., 2011, *Ctitori și ctitorii la Curbura Carpaților în veacurile XIV-XVIII,* Iași, Doxologia.

Maguire, M., 2004, Churches and Symbolic Power in the Irish Landscape, in *Landscapes,* vol. 5, nr. 2, pp. 91-114.

Mândricel, I., 2000, *Izvoare din adâncuri. Începuturile învățământului buzoian la sate,* Buzău, Casa Corpului Didactic.

Mândricel, I., 2006, *Chemarea clopotelor scufundate,* Buzău, Editura Vega.

McGuckin, J.A., 2010, *The Orthodox Church: An introduction to its history, doctrine, and spiritual culture,* Malden – Oxford, Blackwell.

Nicolescu, V, Petcu, G., 1999, *Buzău – Râmnicu Sărat: Oameni de ieri, oameni de azi,* Buzău, Alpha MDN.

Pelimon, A., 1864, *Catastrofa întâmplată boerilor în muntele Găvanul – 1821,* București, Editura Fundațiunei I.V. Socec.

Plămădeală, A., 2004, *Tradiție și libertate în spiritualitatea ortodoxă,* Alba Iulia, Reîntregirea.

Pușcașu, V.M., 2001, *Actul de ctitorire ca fenomen istoric în Țara Românească și Moldova până la sfârșitul secolului al XVIII-lea,* București, Vremea.

Radosav, D., 1997, *Sentimentul religios la români. O perspectivă istorică (sec. XVII-XX),* Cluj-Napoca, Editura Dacia.

Săndulescu-Verna, C., 1938, Biserica din Buda-Cislău. *Îngerul*, pp. 819-821.

Ştefan, C., Drâmbocianu, V., 1980. "Repertoriul vestigiilor rupestre din Munții Buzăului", in Ștefan C. (ed.), *Vestigiile rupestre din Munții Buzăului,* Buzău, Arhivele Statului Buzău, pp. 44 -65.

Tilley, C., 1994, *A phenomenology of landscape: places, paths, and monuments,* Oxford, Berg.

Vasilescu, A, 1937, M-rea Bradu de pe Nișcov, in *Biserica Ortodoxă Română,* LV, nr. 1-2, pp. 60-89.

Vrapciu, N., 1973, Ecouri buzoiene la mișcarea revoluționară din anul 1821, in *Studii și cercetări de istorie buzoiană,* vol. I, pp. 77-83

https://doi.org/10.5719/aub-g/72.1/5

COMPLIANT *VERSUS* NON-COMPLIANT PRACTICES IN THE POULTRY SECTOR AND THE INFLUENCE OF DISCREPANCIES ON THE QUALITY OF LIFE. CASE STUDY – POULTRY FARM SC AVICOM SA, VASLUI COUNTY

FELICIA BENCIU[1], GABRIELA TAULESCU[1], ELENA BOGAN[2], ANDREEA-LORETA CERCLEUX[2], LILIANA BUJOR[3]

Abstract

This paper briefly presents some theoretical approaches regarding the compliant and non-compliant practices in the poultry sector, and the case study: Poultry farm SC AVICOM SA in Vaslui County. The purpose of this paper is to assess the changes to the air environment factor, caused by the pollutants originating from the zootechnical activities of an integrated poultry facility of SC AVICOM SA poultry farm in Vaslui County. The status of current environmental problems for air is presented from the perspective of the analysis of pollution management methods, approached at a general level.

This study focuses on air pollution caused by the activity of zootechnical branch, presenting current issues related to the activity of intensive poultry rearing. The study deals with the analysis of the evolution of odorous pollutants generated by this activity, the impact on the environment generated by the emission and concentration of ammonia NH3. The conclusions include recommendations for the application of BAT rules to reduce ammonia emissions and protect air quality.

Keywards: poultry farm, pollutants, air quality, poultry manure.

1. Introduction

This paper details the analysis of the evolution of pollutants generated by the poultry activity – with special regard to the environmental factor –

[1] Ecological University of Bucharest, Faculty of Ecology and Environmental Protection, e-mail: felidumitru@yahoo.com;

[2] University of Bucharest, Faculty of Geography, e-mails: elena.bogan@geo.unibuc.ro; loreta.cercleux@geo.unibuc.ro;

[3] Environmental Consultant, e-mail: lilianabujor@yahoo.com.

air, the monitoring methods and methods to reduce emissions, impact of the activity on environment and people, while also proposing solutions to improve air quality, by applying BAT rules. Defined as "a form of orientation and organization of the complex activity of environmental protection, called to establish the strategies, methods and means used in the actions carried out on a national and international level, to prevent and control pollution, to improve environmental conditions", the environmental policy tries to reconcile economic and social development with environmental protection (Lupan E., 2009).

Along with the great scientific advances, the amount and nature of residues has fundamentally changed. In the last decades, the process of degradation of the environmental factors on our planet has had an increasingly worrying evolution, the amount of pollutants reaching figures that exceed the most pessimistic estimates, and solving the pollution issue has become a complex problem of correcting the errors that cause it. Human activities, whether industrial or agricultural, have the greatest impact on the environment, all abiotic and biotic environmental factors being affected due to air, water, soil pollution, respectively through the generation of waste or overexploitation of natural resources. Along with the other environment components, atmospheric air is vital to nature, including organisms and humans. However, the development of human society led and leads to pressure on this environmental component, the impact on the air and its quality always being profoundly negative. In addition to urbanization and the development of transport, the branches of industry and agriculture cause emissions with high concentrations of polluting substances into the atmosphere. These emissions have harmful effects on the health of all living organisms. In this sense, the field of ecology focuses on studying the relationships established between the biotic part and the environment, with an emphasis on the protection of atmospheric air, as its pollution causes negative consequences both on local and global scale (Copacinschi Gh., et al., 2015).

While the organoleptic pollutants resulting, in general, from the industrial activity do not cause discomfort to human settlements in the immediate vicinity of the sites (provided the distances imposed by the legislation are observed), the emissions/odors from livestock farms,

respectively from poultry farms, are easily noticeable. Some of the emissions resulting from the poultry rearing activity are non-polluting, such as water vapor or carbon dioxide (CO_2) from breathing, or those from the decomposition of manure. Others, on the other hand, have a negative impact on the environment, including abiotic factors: ammonia NH_3, nitrous oxide N_2O, dust (Benciu F., 2009).

In 2017, in the United Kingdom of Great Britain, at the University of Cambridge, a group of specialists carried out an analysis on poultry rearing, Growth Curve Analyzes in Poultry Science, through which it was highlighted that the pattern of growth and modification of the body of poultry per unit of time are influenced by genotype and environment. The research results were grouped on three levels: determining the most suitable growth model, comparing the development of poultry vs. groups of experimental poultry and development of a growth curve based on estimates of genetic growth parameters (Narniç D., Narniç Ö., Aygün A., 2017).

Pollution generated by this poultry sector finds its solution can be solved by applying the best available techniques and practices regarding feeding, rearing poultry and managing manure, as well as the wider use of conventional energy saving technologies by using biogas generators. (Benciu F., 2010) In this context, on an international level, numerous specialist studies have been carried out regarding the assessment of the impact of pesticides on human health and ecosystems. For the present study, is relevant the work of Swiss specialists of EPFL – Swiss Federal Institute of Technology, Institute of Ecosystems Management, CECOS, CH-1005 Lausanne, Switzwerland, who found that by applying the best environmental management practices, it can be avoided the transmission of agricultural toxicity caused by pollution of environmental factors on the human body. The paper describes a method of assessing the pollutant circuit by which is determined the harmful impact on the air environmental factor, on ecosystems and implicitly on human health (Margni M., et al., 2002).

It is also worth noting the specialist works from the Islamic Republic of Iran developed within the framework of university research on the application of new methods (the DRASTIC Model) to identify the vulnerability of groundwater and underground water table to nitrate pollution from the agricultural areas of northern Iran. Specialists refer to the fact that, for a more accurate assessment, the values of DRASTIC

parameters that reflect the potential for aquifer pollution must be related to the DRASTIC index. This correlation (Pearson Correlation) is applied to identify the relationship between the index and pollution measured at each observation point, finally being able to get more accurate assessments of the risk of nitrate pollution from agricultural sources (Javadi S., et al., 2010).

2. Methodology

In the current understanding of scientific research, detailed studies found that the analysis of the knowledge of a phenomenon that constitutes a case study should follow several stages of the research, such as: to demonstrate in what form the knowledge of established objective is available; to establish the methods of critical analysis of knowledge of the phenomenon; to formulate and present the minimum conditions necessary to carry out critical analysis and to demonstrate by which specific methods this investigation is carried out (Iordache V., 2006).

In this research, we complied with the methodology and stages of drawing up case studies with environmental impact. In a first stage, the purpose of research was established, the knowledge of our goal and its identification on site. The official sources for obtaining public information and statistical data were selected from relevant institutions. Also, we developed the necessary documentation for carrying out field work: maps, laptop, Toolpack field distance measuring device with a measuring capacity of 10000 m and a tolerance of 5 mm/m. The information was collected by gathering an appropriate number of data, sufficient for the relevance of the study. In the next stage, we compiled and processed the numerical data, drew up the graphic part and finally, we created the material. For the graphic representation, we used a modeling program made available to the public by the United States Environmental Agency: Screen Model – Lakes Environmental Software, which provides a pollutant concentration estimation method for ammonia emissions to air. The research was completed by obtaining the results, establishing the conclusions and suggestions regarding the improvement of the air quality. For immediate results, we recommended to apply the best practices available for air, agreed by national and European legislative norms for air quality management.

3. Case study: SC AVICOM S.A. Poultry Farm, Vaslui County

The SC AVICOM SA poultry farm is located in the suburbs of Muntenii de Jos, in the southeast of Vaslui city, on the left bank of the Vasluieț river - a tributary of Bârlad river (Figure 1). The poultry farm's business activity is the rearing of meat birds (NACE code 0147 Poultry rearing) for consumption through the "ground" raising method and is the oldest of the poultry farms in Vaslui County.

Figure 1. Geographical location of the study area
(*Source:* Google Earth, 2020 https://www.google.ro/intl/ro/earth/)

Geographical features. The relief on which the site is located is typical of a smooth plateau, with well-developed terraces along the main Bârlad and Vasluieț watercourses (Ienenicz M., 2005). The local hydrographic network formed three terrace levels: the upper terrace of 70-80 m, the middle terrace of 40-50 m and the lower terrace of 10-20 m. The slopes are smooth, and the interfluves have small slopes that stimulate swamping and clogging of lands, especially in the areas of water convergence (Pișota I., Zaharia L., 2001-2002).

The climate is transitional temperate-continental with continental patches of aridity, where the circulation of air masses is mostly from the southeast. Depending on the speed and direction of the wind, they are of particular importance in the atmospheric dispersion of noxious substances and pollutants originating from human activities (Bordei-Ion E., Taulescu G., 2008).

The zonal soils are specific to the low plateau and plain relief that are part of the mollisol and clay loam classes, and the azonal soils belong to the alluvial soils, widely distributed in the meadow. The natural vegetation is typical of the steppe and silvosteppe, but it has mostly been replaced by agricultural crops or removed by the expansion of urban development (Radu Al. T., 2003).

Ecological features. The purpose of study Compliant practices *versus* non-compliant practices in the poultry sector and the influence of the discrepancies for the quality of life is related to the fact that the dispersion of polluting substances in the atmosphere is influenced by the geographical characteristics of the location of SC AVICOM SA poultry farm in Vaslui County. The concentration of pollutants is influenced by meteorological factors such as: wind speed, direction of movement of air masses, temperature and precipitation, and their variation during a day or from one day to another leads to short or long-term variations in their concentration and their persistence in air (Benciu F., 2010).

In Romania, the concentration of atmospheric pollutants is monitored by the National Air Quality Monitoring Network (R.N.M.C.A.). The study area is within the scope of the automatic air quality monitoring station VS1, which is part of the R.N.M.C.A. As a type, it is an urban base station providing field coverage up to a distance of 5 km. The VS1 station is located in the central-southern part of the Vaslui city, and the SC AVICOM SA poultry farm is located 1.6 km from it in the southeastern part.

According to public information from the County Report on Environment Condition in Vaslui County 2020, carried out by the Vaslui Environmental Protection Agency, animal farms (livestock and poultry) fall under the scope of Directive 2010/75/EU on industrial emissions, known as the IED Directive to which the animal farms that are inventoried in the E-PRTR (European Pollutant Release and Transfer Register – refers to the water environmental factor) are also added.

In the technological flow of SC AVICOM SA poultry farm, the sheds with various population/raising/depopulation purposes have an important role in ensuring an environment conducive to the optimal development of poultry. The main role is to comply with sanitary rules and maintain cleanliness. The sheds are permanently sanitized at each end of the poultry raising cycle, the process consisting in the mechanical

removal of the previously dry bedding (consisting of sawdust, sunflower stalks, animal droppings); and the substances used as disinfectants must be approved by the competent institutions regarding toxicity and environmental impact. The sanitization procedure of the halls must observe the sequence of execution stages: wash the walls and floors with a turbo jet with a concentrated solution of 3% sodium hydroxide, rinse with water and ventilation. Disinfection is done with substances with virucidal, bactericidal and fungicidal action, after which the halls are closed for a period of 6 to 10 days, followed by their ventilation. The following raw materials of a polluting nature are needed for the activity of raising broiler chickens at the poultry farm in Vaslui County: combined feed, vitamins, vaccines, medicines. Depending on the population capacity of the poultry farm, the quantities of raw materials are variable. The waste water from the sanitation of the premises during the sanitary vacuum period is discharged through sewerage networks and directed to the city's sewage treatment plant.

The SC AVICOM SA poultry farm in Vaslui County uses entirely the water and sewerage network in the area, the waste water being purified in the municipal treatment plant according to NTPA001/2002 and NTPA002/2002 standards; thus complying with the provisions of GD no. 352 of April 21, 2005 for the approval of certain rules regarding the conditions for discharging waste water into the aquatic environment (completion and amendment of GD no. 188/2002) published in the Official Gazette no. 398 of May 11, 2005.

In the production flow of the SC AVICOM SA poultry farm, the management of animal waste falls under the final procedures, Figure 2. The site has a storage platform for manure from the chicken rearing sector. This construction is concreted, waterproofed, and provided with a drain through which the leachate is directed to the concrete waste water storage basin. From here, the manure can be taken over and used (along with cattle manure and cereal stillage) in the local biogas production process.

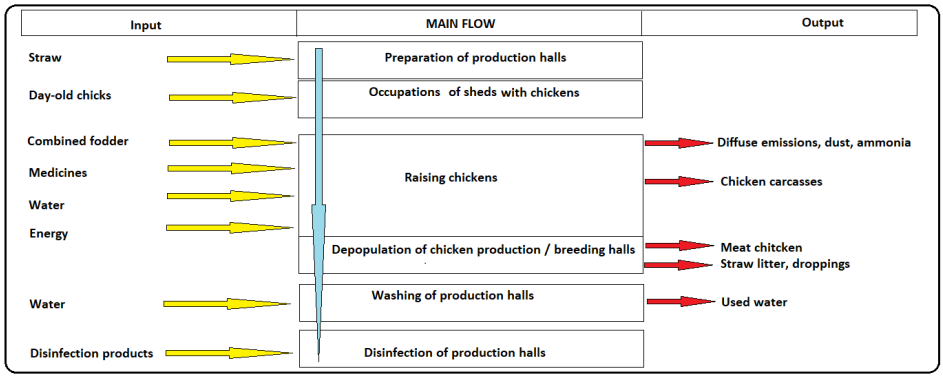


Figure 2. Technological flow diagram for SC AVICOM SA Poultry Farm, Vaslui County

4. The impact on the environmental factor – air generated by the Poultry Farm SC AVICOM SA, Vaslui County

According to the legislation in force, intensive poultry facilities with more than 40,000 places have the obligation to protect the quality of environmental factors by complying with Law no. 278/2013 on industrial emissions, published in the Official Gazette no. 671 of November 1, 2013, whose purpose is the prevention and integrated control of pollution resulting from industrial activities. This document establishes the conditions for the prevention or, if it is not possible, for the reduction of emissions to air, water and soil, as well as for the prevention of the generation of animal waste, so as to achieve a high level of environmental protection. Operators that carry out activities of this type will only operate after obtaining the Integrated Environmental Permit from the relevant institutions.

Air quality

The internal activities of agricultural farms are generating sources of pollutants and odors in the atmospheric air. They fall under pollutant emissions and immissions as follows:

A **–** Non-directed point sources identified by: the ventilation system of poultry rearing halls that cause emissions of burnt gases, ammonia (NH_3), non-methane organic compounds and dust; fugitive emissions from the leachate storage basin and from the waste platform containing ammonia, non-methane organic compounds; vehicle traffic on the premises of the farm that generates exhaust gases containing carbon monoxide (CO) and carbon dioxide (CO_2), nitrogen oxides (NO_x).

The broiler chickens are raised on the ground at the SC AVICOM SA with adequate ventilation and frequent sanitation, which has led to a decrease in the level of pollutants generated in the atmosphere. Ammonia and non-methane VOC result from both the metabolic growth reaction of the birds and their droppings. Ammonia and dust emissions discharged with the ventilation systems equipped with exhaust fans are below the limits imposed by the regulations in force. By humidity control, fermentation of manure in the hall is reduced. The noxious emission exhaust systems in the hall are located at height and due to the location in an open area, a dilution of the emitted pollutants is achieved.

Odors from the leachate storage basin and the manure platform

The odor is a local problem of discomfort, which is generated by stationary sources such as: storage basins, technological waste water, household water and the storage platform. The intensity of the odors is due to the fugitive emissions of ammonia NH3 and non-methane volatile organic compounds. The storage of manure on the concrete platform is a source of emissions of ammonia and other foul-smelling components. Emissions from manure storage depend on their chemical composition, as a result of diet and feeding level applied, climatic conditions – temperature, ambient, precipitation, as well as the nature of the feed composition. The animal waste storage platform is located within the premises of the poultry farm and is set up in compliance with the technical conditions to avoid soil, subsoil and water table pollution in the farm area.

Starting from the premise that of the four parameters monitored between 2013 and 2018: ammonia, non-methane VOC, PM_{10} and $PM_{2.5}$, the highest values of release into the atmosphere are of ammonia NH_3

(Figure 3). This study focused on the detailed research of this parameter. In parallel, it is stated that the odors generated by ammonia were periodic and persistent.

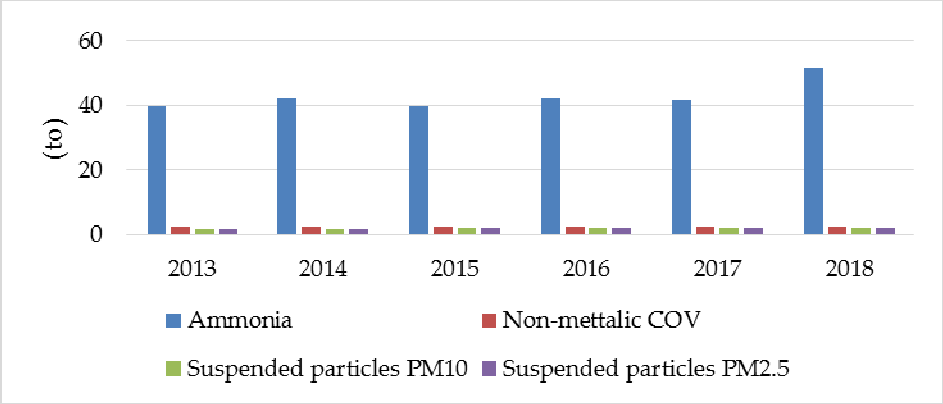


Figure 3. Annual evolution of NH_3, VOC, $PM_{10}/PM_{2.5}$ pollutant emissions (*Source:* primary data of SC AVICOM SA Poultry Farm, Vaslui County)

The above diagram shows that the evolution of the quantity of ammonia has increased, exceeding 40 tons/year in the period 2013-2017, so that in 2018 the quantity exceeds 50 tons/year.

The calculation of ammonia emissions resulting from the poultry rearing activity was carried out during the Local Emission Inventory stage carried out by the environmental authority of Vaslui County. There were used the indicators of emission factors provided by the EMEP/EEA Air Pollutant Emission Inventory Guidebook, with the changes made in 2013 and 2016. According to the European Pollutant Emission Register and the Local Emission Inventory the amount of pollutants released by the SC AVICOM SA poultry farm in the period 2013-2018 had the following evolution (Table 1):

Table 1

Amount of pollutants generated by SC AVICOM SA Poultry Farm, Vaslui County

Pollutant released t/year	2013	2014	2015	2016	2017	2018
Broiler chicken population	2.033.715	2.164.614	2.035.600	2.148.440	2.137.650	2.044.464
NH_3	39,8	42,3	39,8	42,0	41,8	51,8
Non-methane VOC	2,34	2,49	2,34	2,47	2,45	2,35
PM_{10} dust	1,6	1,7	2,1	2,2	2,2	2,1
$PM_{2,5}$ dust	1,6	1,7	2,1	2,2	2,2	2,1

Source: primary data of SC AVICOM SA Poultry Farm, Vaslui County

B – Directed point sources. The thermal plant of the administrative pavilion of the SC AVICOM SA poultry farm operates on the basis of methane gas and generates burnt gases such as: carbon monoxide, nitrogen oxides, sulfur dioxide, dust. Following the observations made on the directed emissions from this plant, they were considered to be insignificant emissions. The permitted limit values for pollutant emissions from the combustion of natural gas, respectively those resulting from the biogas production facility through anaerobic fermentation are established by Order no. 462/1993 for the approval of the Technical Conditions regarding the protection of the atmosphere and the Methodological Norms regarding the determination of emissions of atmospheric pollutants generated by stationary sources, as presented in Table 2.

Operator is obliged to monitor annually the emissions from the biogas production facility through the anaerobic fermentation of waste. Starting with the start-up year of the installation - 2014 and up to 2018 (Table 3), the values obtained in the monitoring activity fell below the allowed limit value provided by Order no. 462/1993 for the approval of the Technical Conditions regarding the protection of the atmosphere and Methodological norms regarding the determination of atmospheric pollutant emissions produced by stationary sources (Figure 4).

Table 2

Limit values allowed for pollutant emissions from natural gas combustion

Emission	Source description	Pollutant	Order 462/1993 (mg/cbm)	Evacuation
Permissible	Thermal plant – methane gas	Dust	5	Evacuation chimney
		CO	100	
		NO_x	350	
		SO_2	35	
Directed		Dust	5	Evacuation chimney
		CO	100	
		NO_x	350	
		H_2S	5	

Source: Order no. 462/1993 for the approval of the Technical Conditions regarding the protection of the atmosphere and the Methodological Norms regarding the determination of the emissions of atmospheric pollutants produced by stationary sources

Table 3

Emissions from the biogas production facility (2014-2018)

Year	CO (mg/cbm)	NOx (mg/cbm)	SO_2* (mg/cbm)	Dust (mg/cbm)	H_2S* (mg/cbm)
2014	29	133	<0,26	2,3	<0,01
2015	29	135	<0,26	2,5	<0,01
2016	27	142	<0,26	2,4	<0,01
2017	28	138	<0,26	2,5	<0,01
2018	29	133	<0,26	2,5	<0,01

Source: primary data of SC AVICOM SA Poultry Farm, Vaslui County

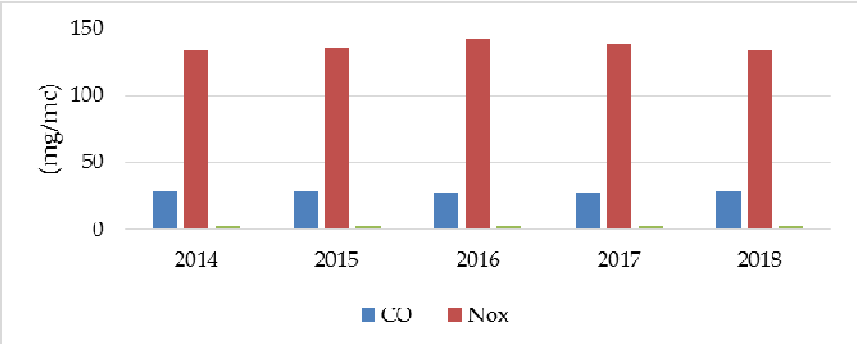


Figure 4. Annual evolution of pollutant emissions NH_3, VOC_s, PM_s at the cogeneration plant (*Source:* primary data of SC AVICOM SA Poultry Farm, Vaslui County)

It is apparent that for all monitored parameters, the values of pollutant emission concentrations remained constant during the period 2014-2018 and fell below the maximum limit allowed by law.

The impact of noxious emissions and odors on neighboring areas, mostly residential areas, depends on several factors, such as: the way in which the operator manages the metabolic and fermentation processes of waste from birds; distance to receivers; the circulation of air masses through the direction, frequency and speed of the wind. It is obvious that weather phenomena cannot be controlled by humans, and the dispersion of unpleasant odors in the atmosphere can reach significant distances, causing discomfort when crossing inhabited areas. However, compliance with the conditions imposed by the best techniques available in the field (BAT Norms for maintaining air quality) can lead to minimizing the impact of unpleasant odors on sensitive receptors. The application of BAT rules aims to reduce the emissions generating disturbing odors through sustained actions such as: implement an adequate nutritional regimen in the birds' feed, the appropriate management of droppings eliminated by birds, transport of animal droppings in accordance with the local and daily weather conditions, so that they do not increase the dispersion of pollutants in the atmosphere.

Also, *pollutant immissions* (transfer of pollutants into the atmosphere to a receptor) must fall within the maximum limits allowed according to Law no. 104/2011 on the quality of the surrounding air for the pollutants CO, SO_2, NO_x, suspended dust, and STAS 12574 /87 regarding air quality conditions in protected areas for the indicator ammonia NH_3 and hydrogen sulphide H_2S, both sets of values being presented in Table 4.

Operator has the obligation to monitor the immissions from the poultry farm site and to draw up annual reports on the monitoring of the immissions. For the year 2019, pollutant immission values were recorded in the area of incidence of the cogeneration plant, at the boundary of the site, in the area of the flare of the biogas plant and in the area of the nearest sensitive receptors for the pollutants: carbon monoxide CO, NO_x, dioxide of sulfur SO_2, dust, hydrogen sulphide H_2S and ammonia NH_3 (Table 5, Figure 5).

Table 4

Legislative conditions regarding air quality in protected areas

	STAS 12574/1987		Legea nr.104/2011		
	Pollutant	**Short-term average value (30 min) mg/cbm**	**Pollutant**	**Hourly limit value**	**Daily limit value**
Sensitive receptor area	CO	6,0	NO_2	200µg/m^3	-
	NOx	0,3	SO_2	350µg/m^3	125 µg/m^3
	SO_2	0,75	CO	-	10 mg/m^3
	Dust	0,5	-	-	-
	H_2S	0,015	-	-	-
	NH_3	0,3	-	-	-

Source: Extract from STAS 12574/1997 regarding the conditions for protecting the air in protected areas and Law no. 104/2011 regarding the quality of the surrounding air for pollutants CO, SO_2, NO_x, suspended dust

Table 5

Emissions from the site of SC AVICOM SA Poultry Farm in 2019

	Pollutant	**Short-term average value (30 min) mg/m2 according to STAS 12574/1987**	**Measured value (2019) mg/cbm**
At the boundary of the site, the area of the biogas plant flare (approx. 4 m of flare)	CO	6,0	4,12
	NO_x	0,3	0,26
	SO_2	0,75	0,18
	Dust	0,5	0,16
	H_2S	0,015	0,010
	NH_3	0,3	0,11
Area of the nearest sensitive receptors	CO	6,0	1,8
	NO_x	0,3	0,19
	SO_2	0,75	0,22
	Dust	0,5	0,042
	H_2S	0,015	0,008
	NH_3	0,3	0,12

Source: primary data of SC AVICOM SA Poultry Farm, Vaslui County

As can be seen, the recorded values are below the limit values allowed according to regulations in force (STAS 12574/1997 regarding the conditions for air protection in protected areas).

The poultry rearing facility at the integrated level of the poultry farm with a population of more than 40,000 broiler chickens falls under the scope of Law no. 278/2013 regarding industrial emissions. In this sense, the provisions imposed by Commission Implementing Decision (EU) 2017/302 of 15 February 2017 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for the intensive rearing of poultry or pigs.

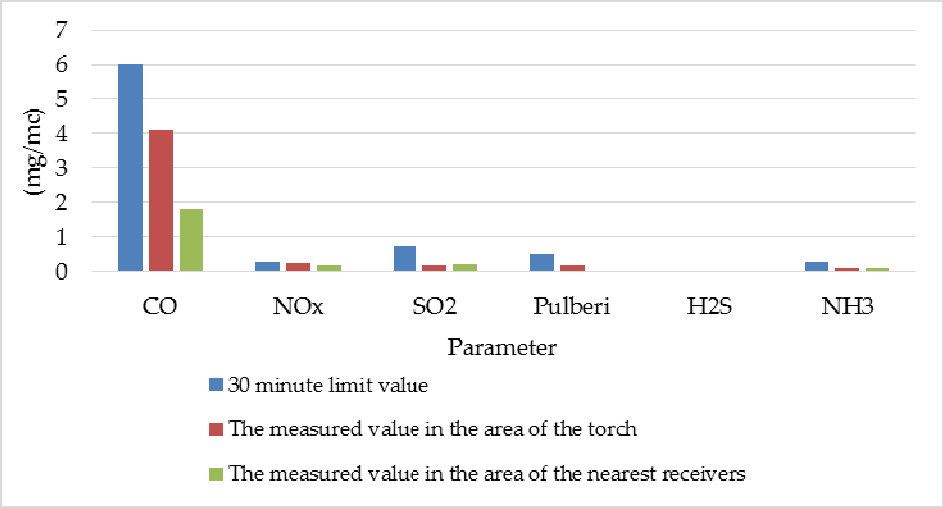


Figure 5. Values of pollutant emissions in the incidence area of the cogeneration plant, 2019 (*Source:* primary data of SC AVICOM SA Poultry Farm, Vaslui County)

The BAT norms and conclusions detail the techniques by which odor-generating immissions are reduced, details also observed by the operator: frequent removal of animal droppings; the use of forced ventilation in shelters; use of an adequate nutritional regimen; keeping the bedding dry thanks to the forced ventilation and the heating system; manure management depending on the weather conditions. Failure to comply with these rules does not ensure favorable conditions for minimizing emissions and may lead to emissions of pollutants that exceed the

normal values provided by law, respectively may cause discomfort to the population in the neighboring residential areas.

The case study refers to such an incident that occurred in November 2019. Due to bad weather conditions for the transport of manure to the platform of the cogeneration plant, the city of Vaslui faced the discomfort generated by a persistent odor for a period of 2 consecutive days. Thus, on November 28 and 29, the weather conditions were unfavorable compared to the previous days, November 23-27, namely: the temperature was higher for this period of the year, reaching +10.5°C, the atmospheric humidity reached the maximum threshold of 100%, the direction of movement of the air masses was towards the south and southeast towards the inhabited area, the wind speed had very low values, close to atmospheric calm (0 m/s). As a result of these topoclimatic characteristics, the dispersion of odors generated by the concentration of ammonia was not achieved efficiently, it persisted for more than 48 hours in the entire residential area. Figure 6 shows the values recorded at the sampling point of the Environmental Protection Agency in Vaslui County for the period 23-29 November 2019, including the interval in which the discomfort generated by the persistent smell of Ammonia NH_3 was recorded (Figure 6).

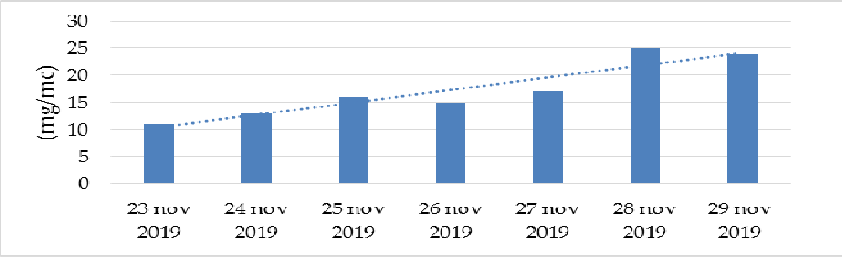


Figure 6. Daily evolution of ammonia (NH_3) emissions between November 23 and 29, 2019 (*Source:* primary data of SC AVICOM SA Poultry Farm, Vaslui County)

As can be seen from the graphic representation, the toxic emission values fall within the limit established by STAS 12574/87, the maximum being recorded on 28.11.2019, namely: 0.025 mg/m^2, the daily limit being 0.1 mg/m^2. However, inhabitants of the city of Vaslui noticed the discomfort produced by the smell of ammonia NH_3, which is also

perceived at lower concentrations in the air, due to the unfavorable local weather conditions for the dispersion of pestilential odors in the atmosphere.

To quantify the extent of the impact and establish its negative effects on the Vaslui population, a modeling program made available to the public by the United States Environmental Agency, we used LAKES ENVIRONMENTAL SOFTWARE – SCREEN MODEL. It provides an easy-to-use method for estimating the concentration of air pollutants. The mathematical modeling of the dispersion of pollutants in the residential area of the city of Vaslui consists in the processing of information and statistical data, such as: the establishment of geographical-topographical characteristics (relief), the area where the site is located in relation to the monitoring point, the processing of pollutant concentrations depending on the nature of the source, the values local meteorological parameters.

The modeling parameters were established following field observations:

- Geographical features of the relief – the flat surface, with the appearance of a wide plain with altitudes not exceeding 100 m, the direction of topographic inclination is from north to south, with a very low slope;
- Area where the site is located in relation to the monitoring point of the A.P.M. Vaslui – 2300/2400 m (animal manure platform of the poultry farm).

The data entered for modeling through the SCREEN MODEL program were:

- platform size: surface = 5642 m, Length = 91m, width = 62 m;
- ammonia emission factor according to CORINAIR 2016: 0.22 kg/capita/year;
- average number of chickens per year: 181,000 heads;
- ammonia emission in g/m^2/s required by the program: 0.000224 g/m^2/s, calculated as follows:
  - an emission factor x number of chickens: 0.22 kg manure/capita/ year x 181,000 capita = 39800 kg/year on the manure platform of 5642 sqm;
  - emissions per second required by the program are: 39800 kg: (365x24x3600 s) = 0.00126 kg/s, i.e.: 1.26 g/s per platform;
  - emissions per second per square meter required by the program are: 1.26 g/s: 5642 sqm = 0.000224 gNH_3g/sqm/s;

– prevailing wind direction: 170 degrees (according to the data recorded by the automatic air quality monitoring station, urban background SV1 Vaslui).

In Table 6, the first columns show the ammonia concentrations measured at the cogeneration facility of the poultry farm, compared to the distance up to which the unpleasant odors persisted, and the last two columns show the values of the maximum concentrations allowed by STAS 12574/1987 regarding the conditions air quality in protected areas and the alert threshold values according to the legislative norms in force (Order no. 756/1997 for the approval of the regulation on the assessment of environmental pollution) for the ammonia NH_3 concentration.

Table 6

Inclusion of ammonia (NH_3) concentration in the limit values allowed by the legislation in force

No.	Distance (metres)	Modeled concentration (mg/cbm)	Maximum allowed concentration according to STAS 12574/1987 regarding air quality conditions in protected areas	Alert threshold according to Order no. 756/1997 for the approval of the regulation regarding the assessment of environmental pollution
1.	200	1,0060	**0,100**	**0,070**
2.	300	0,5597		
3.	400	0,3568		
4.	500	0,2499		
5.	600	0,1868		
6.	700	0,1462		
7.	800	0,1186		
8.	900	0,0987		
9.	1000	0,0839		
10.	1100	0,0727		
11.	1200	0,0637		
12.	1300	0,0566		
13.	1400	0,0507		
14.	1500	0,0459		
15.	1600	0,0418		
16.	1700	0,0383		
17.	1800	0,0353		
18.	1900	0,0328		

19.	2000	0,0305		
20.	2100	0,0285		
21.	2200	0,0267		
22.	2300	0,0251		
23.	2400	0,0237		
24.	2500	0,0224		
25.	2600	0,0213		

Source: primary data of SC AVICOM SA Poultry Farm, Vaslui County

The result of SCREEN MODEL modeling is shown in the graph in Figure 7, which shows how the curve of ammonia concentration *versus* distance decreases as we move away from the point of emission/ immission.

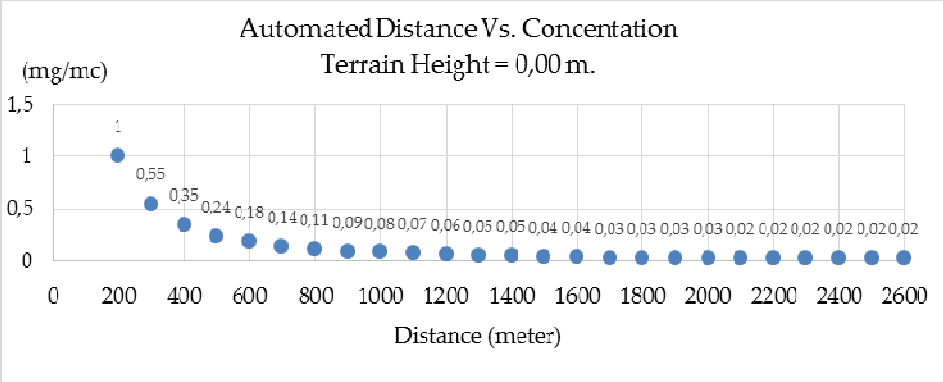


Figure 7. Variation of Ammonia NH3 concentration in relation to distance, according to the SCREEN MODEL program

Interpretation of the diagram was made according to Order no. 756 of 1997 for the approval of the Regulation on the assessment of environmental pollution, as amended, Article 13*): "b) the alert thresholds for the concentrations of pollutants in atmospheric emissions and in the ambient air are set at 70% from the intervention thresholds of the same pollutants, taking into account the relevant time period in which these concentrations must be measured."

Analysis results

Further to observing the situation on site, we concluded that the entire area is connected to the sewage network, and the residential owners do not raise domestic animals (birds, pigs or cattle), so there are no emissions of pollutants/smells additional to those from the farm.

Further to reviewing the statistical data processing, we noted that the limit value allowed for the concentration of ammonia NH_3 in the air, for a long period (24 hours), according to STAS 12574/1987, is 0.1 mg/m^3. The alert threshold established by Order no. 756/1997 for the approval of the regulation regarding the assessment of environmental pollution is 0.070 mg/cbm and it can be seen that it was exceeded in the distance range of 1100-1000 m by 0.0027 mg/cbm. If we refer to the alert threshold, as defined in Order no. 756/1997, it is exceeded starting from the distance of 1000 m, where the value is 0.0839 mg/cbm, compared to the alert threshold which is in relation to the permitted limit concentration of 0.070 mg/cbm. Thus, it can be appreciated that the value of the maximum allowed concentration is not exceeded outside the sanitary protection zone of the farm of 1000 m. The highest values of the concentration of NH3 from the generating source were recorded at distances of 300 m (0.5597 mg/cbm), 400 m (0.3568 mg/cbm) and 500 m (0.2499 mg/cbm), and as the distances increased, the NH_3 concentration values decreased. It can be seen from the table that the highest value of the concentration of NH_3 was 1.0060 mg/cbm recorded at the shortest distance of 200 m, however, most notifications regarding the persistence of odors were made by the population to the local authorities in the habitable area of distances from 300 and 400 m. Figure 8 shows the allowed limit values and the measured alert threshold values, according to the legislative norms in force for SC Avicom SA Poultry Farm.

The provisions of Art. 4 of Order no. 756/1997 as amended and supplemented, show what are the operators' obligations regarding the alert thresholds, namely: "... a) warn the relevant authorities about the existence, in a certain situation, of a pollution potential in air, water or soil; b) when the concentration of one or more pollutants exceeds an alert threshold .... the relevant authorities will request and monitor the implementation of measures to reduce the concentrations of pollutants

from emissions/discharges..." Under these conditions, the competent authority in applying sanctions considered that the poultry farm, not observing the meteorological conditions for the management of droppings on the operating platform (mandatory condition so that the odor has as little impact as possible on the population) can be punished as an offense.

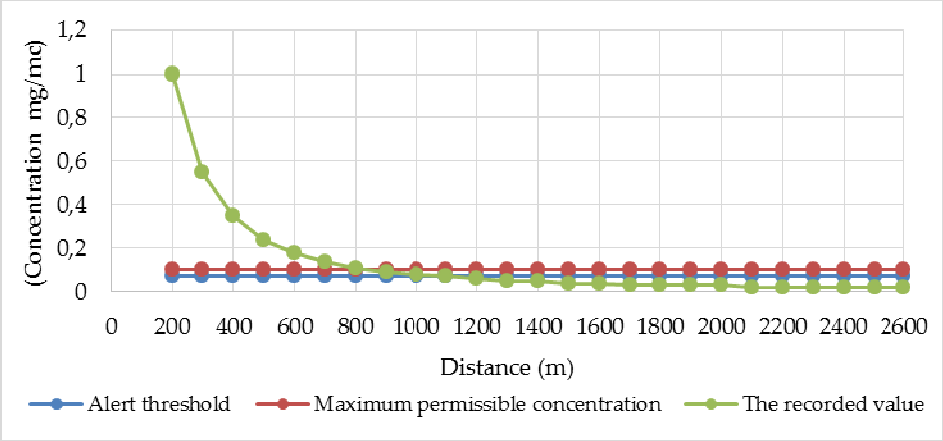


Figure 8. Variation of ammonia concentration (NH_3) in relation to distance (m)

Further to searching the history of the agricultural farm, we found that another pollution event occurred in 2017, in approximately the same unfavorable weather conditions, which is similar to the one in 2019 that is the subject of this study. Thus, it can be appreciated that the information provided by the results of modeling by SCREEN MODEL program of the dispersion of ammonia NH_3 concentration in relation to the distance, justifies the values acquired by measurement at the monitoring point from the Vaslui Environmental Protection Agency.

Results of the study

Demonstrated that in the area of Vaslui city, favorable weather conditions may occur periodically for the accumulation of persistent toxic emissions/ odors such as ammonia. Their smell can become increasingly accentuated against the background of a topoclimate that prevents effective

dispersion in the atmosphere and can lead to the discomfort caused to the population in the immediate vicinity of the poultry farm. As a result, strict compliance with the legal norms in force regarding the management of organic waste of animal origin within the SC Avicom SA Poultry Farm in Vaslui County, becomes very important for human health.

The study aims to emphasize the importance of complying with the rules for pollution prevention and to reduce pollution by applying the best available techniques (BAT) provided by Directive 2010/75/EU on industrial emissions and fully transposed into the Romanian environmental legislation.

Adherence to the best available techniques BAT – considered in the study as COMPLIANT PRACTICES refers to the management of manure storage and the management of storage platform. Observations on site proved that this construction complies with BAT rules: the manure is taken from the technological halls on conveyor belts and transported to the basins related to the biogas production facility. The manure storage platform ensures a sufficiently large capacity for depositing the manure until it is spread on the soil or converted into green electricity. The construction is bi-compartmentalized, waterproofed, provided with a ledge with H=2.5 m and a collector base for collecting the leachate. It is specified that poultry droppings are used for the ecological production of electricity and thermal energy, in the biogas facilities in the immediate vicinity of the poultry farm. The use of manure in the biogas plant leads to their ecological management, in compliance with the provisions of the European Union and the Kyoto Protocol on atmospheric protection.

Failure to comply with the European BAT rules – considered in the paper as NON-COMPLIANT PRACTICES does not ensure the necessary conditions to minimize emissions into the atmosphere and may generate emissions of pollutants above the normal values provided by law (allowed limit values), causing discomfort to the population of neighboring residential areas. In the technological process of the biogas plant, the manure is dried as follows, depending on the weather conditions: in the warm period of the year, the manure is dried by adduction of hot air from outside, and in the cold period, the manure is dried by using heated air from the premises of the sheds coming from the biological heat of birds. The manure resulting from the poultry rearing process is discharged into the

biogas station, and the resulting sludge is spread over the agricultural land. The periods when it is allowed to spread animal manure on the soil depends on the local climatic conditions and the type of crops.

The BAT conclusions for the maintenance of air quality detail the techniques to reduce the ammonia NH_3 emissions by a poultry farm, which generate an unpleasant and persistent odor. These details are also provided in the Integrated Environmental Permit issued in 2016 in order to relicense the operation of the SC AVICOM SA poultry farm in Vaslui County, which is valid for 10 years. During this time, the operator has the obligation to comply with the technological process regarding: frequent evacuation of animal droppings; use of forced ventilation in shelters; use of an adequate nutritional regimen; keep the bedding dry thanks to the forced ventilation and the heating system; manure management depending on weather conditions.

Conclusions and recommendations

If Company implements the measures imposed by the Poultry Farm Management Program of SC AVICOM SA, regarding the facilities, the way of organizing the technological flow and related activities, the business activity of the poultry farm should not be a local or regional polluter for the environment and neighboring areas.

The negative impact on inhabited areas depends on several factors, such as: the way in which the operator manages the processing of poultry droppings; distance from receivers or residential areas; wind direction and speed. It is obvious that the manifestation and evolution of meteorological parameters cannot be controlled, but compliance with the rules imposed by the best techniques available in the field (BAT rules) can be successfully managed by complying with the provisions of the Management Plan and Company's Action Plan. These reference documents provide for the measures and actions by which odor-generating emissions and immissions can be reduced through the proper management of droppings, their transport according to meteorological conditions, so that the local accumulation of toxic emissions and odors is not increased. On the contrary, the handling of significant amounts of manure in

optimal climatic conditions leads to the dispersion of pollutants in the atmosphere on air currents, ensuring the minimization of the impact of odors on human receptors.

This study demonstrated that the SC Avicom SA poultry farm in Vaslui County can be a polluter for the environment and for people regarding the air quality factor, as long as the legislation specified by the Integrated Environmental Permit is not observed. In case of air pollution through the persistence of odor, the degree of damage decreases with the distance. Diagram in Figure 8 Variation of ammonia (NH_3) concentration in relation to distance (m) shows how the value of the maximum allowed concentration for ammonia is not exceeded outside the sanitary protection zone of 1000 m of the objective. In order to avoid unpleasant situations generated by foul odors, it is mandatory that, in the case of erecting constructions, the distances of the sanitary protection zone of the farm are observed, and the buildings are located outside it.

The proposed ***recommendations*** can prevent the problems observed in the case study, being achievable in the short, medium or long term:

- Permanently comply with phytosanitary rules in chicken rearing halls; in the site area, pollutant emissions must fall within the limits allowed according to Law 104/2011 on ambient air quality for pollutants CO, SO_2, NO_x, suspended dust and STAS 12574/87 on air quality conditions in protected areas for the indicator ammonia (NH_3) and hydrogen sulfide (H_2S).
- Comply with the rules of managing waste and prohibit its discharge in places other than those specially arranged;
- Plan activities for picking up droppings from the specially arranged platform and comply with the Code of Good Agricultural Practices in the activity of spreading droppings;
- Monitor the technological processes of processing the droppings resulting from the poultry rearing process;
- Permanently monitor emissions, immissions and odors coming from the farm site in order not to exceed the limit values allowed by law;
- Create a forest curtain with dendrological species with a high capacity to absorb atmospheric pollutants (linden, poplar, elm) around the poultry farm to reduce the concentration of persistent unpleasant odors in the atmosphere;

– Carry out open demonstrations organized by relevant institutions through which the population is informed about the importance of complying with the legislation when expanding constructions in the bordering areas of cities located near economic objectives considered potential polluting sources. It is also necessary for the population to accept that by complying with the measures imposed by the issued Construction Permits, the future buildings or households are placed under sanitary protection and are outside the man-made risk areas. These communication sessions can be organized by the relevant local authorities such as: townships – represented by employees of the Urban Planning and Territorial Planning Office, County Council and Local Councils represented by councilors and with the support of environmental consultants of the County Environmental Protection Agency Vaslui, and other local or regional decision-makers.

In this sense and according to the Order of the Ministry of the Environment no. 598/June 20, 2018 regarding the approval of the lists of municipalities drawn up as a result of being included in the management regimes of areas in the areas and agglomerations provided for in Annex no. 2 to Law no. 104/2011 regarding the quality of the surrounding air, published in the Official Gazette no. 549 of July 2, 2018, at the County level, an Air Quality Maintenance Plan for Vaslui County 2018-2022 was drawn up, which aims to ensure increased efficiency regarding the air quality improvement process and maintaining the concentration of pollutants below the limit values provided by legislation.

REFERENCES

Benciu, F. 2009, Environmental Chemistry. University course, Ecological University of Bucharest, Faculty of Ecology and Environmental Protection.

Benciu, F. 2010, Global Biogeophysical Cycles. IFR Course, Ecological University of Bucharest, Faculty of Ecology and Environmental Protection.

Bordei-Ion, E., Taulescu, G. 2008, Problems of meteorology and climatology for ecologists, Printech Publishing House, Bucharest.

Copacinschi, Gh., Mârza, V., Ciobanu, Z., Veleva, A., 2015, Sources of atmospheric air pollution, Scientific Information Magazine, Environment Section, No.3 (21) June, 2005, pp. 39-44.

Ienenicz, M. 2005, Geography of Romania. Little encyclopedia, Corinth Publishing House, Bucharest.

Iordache, V. 2006, Practical works of ecology, University of Bucharest, Faculty of Biology, accessed at http://www.multidimension.ro/ecologie/LP.pdf

Javadi, S., Kavehkar, N., Mousavizadeh, M.H., Mohammadi, K. 2010, Modification of DRASTIC MODEL to Map Groundwater Vulnerability to Pollution Using Nitrate Measurements in Agricultural Areas, Journal of Agricultural Science and Technology, Tarbiat Modares University Press, Volume 13, Issue 2, 13(2), pp. 239-249.

Lupan, E. 2009, Treaty on the right to environmental protection, C.H. Beck Publishing House, Bucharest, p. 19.

Margni, M., Rossier, D., Crettaz, P., Jolliet, O. 2002, Life cycle impact assesment of pesticides on human healt and ecosystems, Agriculture, Ecosystems & Environment, Vol. 93, Issues 1-3, December 2002, pp. 379-392.

Narinç, D., Narinc, Ö., Aygün, A. 2017, Growth Curve Analyses In Poultry Science, Published online by Cambridge University Press: 02 March 2017, World's Poultry Science Journal, Volume 73, Issue 2, June 2017, pp. 395-408.

Pișota, I., Zaharia, L. 2002, Hydrology, Bucharest University Publishing House.

Radu, Al.T. 2003, Pedology. Part I – General notions, University of Agronomic Sciences and Veterinary Medicine. Center for Distance Education Studies, Bucharest/

*** Integrated Environmental Permit, 2016, Economic Operator SC Avicom SA Vaslui, Muntenii de Jos, Vaslui County Environmental Protection Agency, Ministry of Environment, Water and Forests, National Environmental Protection Agency: http://www.anpm.ro/documents/29689/3839226/Draft+SC+AVICOM+SA+Muntenii+de+Jos-instalatie+biogaz.pdf/7afb9e0c-9371-414a-ab19-9316a436cfd7

*** County report on the environment condition in Vaslui County, 2019, developed in 2020, Vaslui County Environmental Protection Agency: http://apmvs.anpm.ro/documents/29689/46312698/APM+Vaslui_Raport+judetean+privind+starea+mediului+-+2019.pdf/91d8ad86-1c3c-4bfb-b3db-2dde3640956d

*** Report on the environment condition in Vaslui County, 2020, developed in 2021, Vaslui County Environmental Protection Agency: http://apmvs-old.anpm.ro/upload/201618_APM%20Vaslui%20-%20Raport%20judetean%20privind%20starea%20mediului%20-%202020.pdf

*** European Organisation for the Safety of Air Navigation, Eurocontrol method for estimating aviation fuel burnt and emission. EMEP/EEA air pollutant emission inventory guidebook 2016, DOCUMENT IDENTIFIER: N/A, Edition Number: 1.0, Edition Date: 2016/06/29, Status: Released Issue, Intended for: General Public, Category: EUROCONTROL Specification accessed at: https://www.eurocontrol.int/sites/default/files/2019-03/emep-eea-air-pollution-emission-inventory-method-v1.0.pdf

Source websites

https://caen.ro/caen/0147-cresterea-pasarilor
https://www.google.ro/intl/ro/earth/

https://www.avi-vest.ro/wp-content/uploads/2020/07/Autorizatia_integrata_de_mediu_ferma_Tamaseu-1.pdf
https://eur-lex.europa.eu/legal-content/RO/TXT/PDF/?uri=CELEX:32017D0302&from=EN
http://www.anpm.ro/documents/14011/34547034/STAS+12574.pdf/edc7ed15-e971-4604-8c57-a25ade67c3d3
https://legislatie.just.ro/Public/DetaliiDocument/13572
https://eur-lex.europa.eu/legal-content/RO/TXT/HTML/?uri=LEGISSUM:ev0027&from=RO
https://eippcb.jrc.ec.europa.eu/about
https://www.eurocontrol.int/sites/default/files/2019-03/emep-eea-air-pollution-emission-inventory-method-v1.0.pdf

https://doi.org/10.5719/aub-g/72.1/6

LE RÔLE DES PAYSAGES GÉOMORPHOLOGIQUES DANS LA PERSONNALISATION DE LA DIVERSITÉ DU TERRITOIRE ET DES ALÉAS GÉOSPATIAUX

FLORINA GRECU[1], MANEL YAKHLEFOUNE[2], GABRIEL COSMIN ILIE[1], MIHAELA VERGA[1]

Résumé

La recherche complexe d'une surface de terrain a eu le long du temps différents noms qui surprennent quand même le spécifique scientifique à un moment donné (landschaft, paysage, géosystème, environnement, espace, territoire, unités géospatiales). Le paysage est intégré au territoire et dépend de sa genèse, de son évolution et de sa dynamique. La relation entre le relief, paysage et géosite constitue une prémisse du développement durable des unités territoriales / unités géospatiales.

L'objectif principal est de mettre en évidence le rôle des paysages dans la personnalisation du territoire/ des unités territoriales dans les relations relief-paysage-territoire. Les exemples d'analyse proviennent des territoires de basse altitude de la Roumanie : plaines (Câmpia Română), plateau (Podişul Dobrogei de Sud) et dans le basin-versant d'Oued Rhumel (Algérie). Dans les plaines, les paysages sont donnés par évolution paléogéographique, et dans les unités de plateau par la dynamique du relief ; dans les deux situations, des paysages urbains et des paysages ruraux apparaissent. En Algérie, la diversification des paysages est donnée par la ville de Constantine et son Rhumel. Constantine occupait des positions stratégiques dans l'est de l'Algérie. Elle constituait une station relais entre le Tell et les hautes plaines, un carrefour entre la mer et le Sahara, et le Rocher de Constantine constituait un socle foncier privilégié sur lequel s'édifièrent la première ville.

La recherche intégrée du territoire par méthode multi- et interdisciplinaire, montre que les résultats prévus dépendent de la qualité partiale des investigations. Ce type d'analyse est très important pour des rations pratiques. La notion du territoire est un élément fondamental pour la compréhension du phénomène d'aléa et pour le développement durable.

Mots-clés : paysage, territoire, aléas géospatiaux, relief, Constantine, Plaine Roumaine.

---

[1] Université de Bucarest, Faculté de Géographie, 1 Bd. N. Bălcescu, sector 1, 010041 Bucarest, Roumanie, e-mails: grecu@geo.unibuc.ro; gabriel.ilie@drd.unibuc.ro; mihaela.verga@geo.unibuc.ro

[2] Université Constantine 3, IGTU, Algérie, e-mail: manel.yakhlefoune@univ-constantine3.dz

1. Introduction

La géomorphologie est l'une des différentes disciplines qui étudient le paysage comme objet de recherche scientifique. Les paysages naturels sont une ressource de valorisation pour les sciences de la Terre. Ils décrivent, de facon multiple, comment le temps et les mouvements de notre Terre sont inscrits dans l'espace **(**Reynard and Pralong, 2004).

La géographie actuelle est le résultat d'une succession de paléogéographies : l'espace actuel des reliefs, montagnes, et des paysages est un raccourci gigantesque à travers des temps et des espaces disparus (Marthaler, 2002).

L'objectif principal est de mettre en évidence le rôle des paysages dans la personnalisation du territoire/ des unités territoriales, le critère de base étant le relief ; qui guide aussi les relations secours-paysage-territoire. Ce type d'interdépendance est difficile à réaliser dans les régions au relief plat, généralement des plaines (comme la plaine de la Romana) ou dans les régions où la forte densité de population remet en cause les paysages urbains ou ruraux (comme la ville de Constantine et son Rhumel) caractérisé par une topographie très accidentée, marquée par une juxtaposition de plateaux, de collines coupées d'Oueds, de dépressions, d'escarpements et de ruptures brutales de pentes donnant ainsi un site hétérogène et une diversification des paysages. Dans les deux situations, des analyses multicritères et interdisciplinaires sont nécessaires à la connaissance fine des valeurs paysagères requises. Dans les études de cas, nous nous appuyons sur les résultats de nos recherches précédentes (Grecu et al., 2012 ; Grecu et al., 2021 ; Yakhlefoune et al., 2021 ; Ilie, Grecu, 2023, Verga 2000 ; voir bibliographie) et sur des recherches et observations de terrain récentes.

2. Le paysage et les unités géospatiales. Considérations générales

La géomorphologie considère le paysage comme l'objet central de la géographie (Reynard, 2005), le sens qui lui est donné est celui d'un « espace contenu par le regard » (Zăvoianu, Alexandrescu, 1994) et une expression de la relation entre l'homme et la nature (Reynard, 2005).

L'élément principal de la définition des paysages réside dans les différences existant dans les caractéristiques environnementales d'un territoire (Grecu et al., 2019a), qui sont déterminées par la position géographique. Les processus localisés créent des structures territoriales adaptées aux conditions environnementales générales et définissent des paysages géographiques physionomiquement et fonctionnellement (Băcănaru, Velcea, 2006), sans coïncider complètement avec les unités taxonomiques spatiales. Une unité taxonomique, une région ou une zone cela signifie plus qu'un paysage, mais l'analyse doit commencer par le paysage (Mihăilescu, 1970), en diversifiant la typologie et la hiérarchisation de certains aspects territoriaux.

Un aspect de la diversification des paysages, de leur typologie, est l'usage du terme « terroir », qui ne se confond pas avec territoire. Le terme a été introduit par les géographes français pour désigner la relation entre l'homme et le territoire utilisé pour différentes cultures (terroir agricole/paysage végétal) (Biancotti et al., 2003). La recherche actuelle continue les différends sur le contenu du terme, cependant, étant accepté et utilisé dans le cas de la viticulture comme "terroir/s viticol/es".

Le caractère applicatif des paysages, au service de la société, nécessite d'abord leur identification et leur analyse systémique. Ce type d'approche a conduit dans le cas des paysages fluviaux au concept de culture fluviale, une gestion responsable des paysages fluviaux, de la culture des relations entre les gens et les rivières (Wantzen, 2023).

L'étude des paysages en Roumanie, et dans tout le monde, est étroitement liée au développement de la géographie. Dans la première moitié du siècle dernier, l'accent était mis sur la description scientifique du paysage (Vâlsan, 1929 ; Mihăilescu, 1968). Par la suite, dans la seconde moitié du siècle dernier, le paysage est abordé comme un système dans la conception écologique, étant considéré comme un géo-écosystème (Bertrand, 1968; Mihăilescu, 1970; Troll, 1970; Tudoran, 1983). Les préoccupations ont porté sur la définition du contenu scientifique du paysage (Ielenicz, 1995; Verga, 2000; Drăguț, 2000; Dincă, 2005), la classification selon des critères génétiques ou spatiaux (Popova-Cucu, Muică 1989; Pătroescu et al., 2000; Verga, 2008), avec des résultats remarquables, présentés dans divers travaux (Marin, 2002; Pătru-Stupariu, 2011; Vijulie, 2010), thèses de doctorat récentes).

3. Relation relief-géosite-paysage géomorphologique

L'élément de référence dans l'analyse de chaque géosite est l'établissement de la valeur scientifique, révélée par le processus d'évaluation. Une attention particulière doit être portée au fait qu'à l'instar des méthodes visant à évaluer la valeur scientifique, et des démarches orientées vers la protection ou la valorisation d'un géosite ou d'un géomorphosite (Fig. 1) ; l'analyse nécessite une bonne connaissance du cadre régional, l'implication des acteurs sociaux, facteurs économiques, culturels, politiques, écologiques et autres éléments qui présentant une spécificité locale.

Une gestion efficace du géosite nécessite en grande partie certaines données qui ne font pas partie de son propre contexte scientifique, étant mises en évidence par l'analyse de valeurs supplémentaires. Par exemple, dans l'analyse du risque de dégradation des géosites, les informations sur la protection juridique seront pertinentes, et dans la mise en évidence du potentiel touristique, l'accessibilité, les points d'observation, la structure du géosite ou la pertinence artistique du paysage jouent un rôle important.

Le paysage géomorphologique est une zone de terre modelée de manière dynamique par des facteurs environnementaux, dans laquelle les formes résultant de l'action des processus géomorphologiques ont une importance scientifique particulière (Grecu, 2017). Certains éléments particuliers du paysage, modifiés par des processus géomorphologiques/ d'aléas, peuvent être définis comme des géosites (Fig. 2).

Le caractère subjectif de la perception de l'évaluateur est déterminé par :

- éléments environnementaux ne sont pas totalement intégrés ;

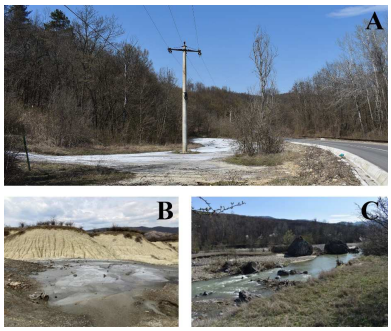


Fig. 1. Exemples de paysages - géosite avec haute valeur esthétique, situés dans la vallée de la rivière Buzău : **A.** La réserve *Le sel de Buzău* ; **B.** Chaudières (volcans de boue) de Berca ; **C.** Réserve *Blocs calcaires de Bădila*

– Un nombre élevé de points d'observation doit également s'accompagner d'une absence d'obstacles ;
– La nature du géosite peut influencer le rôle que jouent les points d'observation et les obstacles.
– Un petit géosite ponctuel in situ peut être beaucoup plus difficile à voir qu'un géosite moyen/grand entouré de quelques obstacles.

La structure du géosite évalue le rôle du géosite par rapport au paysage en termes de contraste, de topographie et de structure spatiale (Iosif, 2014). Les paysages qui offrent une riche palette de couleurs, ainsi que ceux qui présentent un développement vertical imposant ou des éléments bien individualisés, sont plus attrayants visuellement que ceux qui sont petits ou monotones (Iosif, 2014).

L'importance artistique est difficile à interpréter, car les valeurs artistiques ne peuvent être jugées uniquement en termes d'appartenance ou d'influence territoriale (Fig. 2, 3).

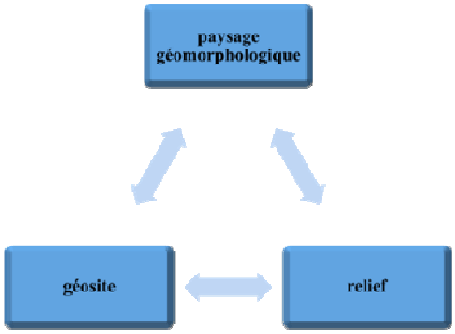


Fig. 2. Interrelations entre paysage géomorphologique, géosite et relief

Fig. 3. Paysage – géosite d'importance artistique (notamment scientifique), situé dans la vallée de la rivière Buzău a Păltineni

Le potentiel artistique d'un géosite doit être évalué en fonction de sa nature artistique, de son interprétabilité, de la présence de contrastes dans le paysage qui peuvent être des sources d'inspiration en littérature, en beaux-arts, etc. par leur aspect extérieur.

Certaines caractéristiques physiques d'un paysage peuvent être pertinentes sur le plan artistique même si leur valeur première est scientifique et que leur popularité auprès du grand public est faible (Fig. 3).

La combinaison de caractéristiques esthétiques particulières du paysage peut influencer le potentiel d'interprétation et constituer un facteur important dans les décisions des consommateurs de produits touristiques.

4. Étude de cas

4.1. Les facteurs d'apparition et de délimitation des unités territoriales/ paysages en Dobroudja du Sud sont : relief, géosites et paysages (Fig. 4)

A. Unité Danube (S-O)

– Principal élément morphologique : les vallées

– Paysage présentant des caractéristiques particulières : profil en U, lits lisses, pentes calcaires presque verticales (vallée de Canaraua Fetii, vallée d'Urluia), pentes avec arcs, cheminées, surplombs, niches, grottes.

B. Unité interne (centre)

– La présence des plateaux inter-fluviaux les plus étendus, à caractère tabulaire (plateau de Cobadin) (Fig 4), avec un réseau hydrographique peu développé ;

– Le relief karstique est bien individualisé (dolines, poteaux à Merenim Amzacea, Negu Voda ; vallées de canyons secs à Mangalia, Albești ; grotte Movile).

C. Unité marine/littorale

– Faire la transition du domaine continental au domaine marin ;

– Le relief est représenté par des falaises et des plaines littorales, des baies limaniques (Agigea, Techiorghiol), des lagunes (Comorova, Mangaliei), des formes d'accumulation de type cordon littoral.

D. Unité du nord en Dobroudja du Sud

– Relief développé sur une couverture de lœss, caractérisé par la dynamique des formes développées (vallée de Carasu – dépression morphologique et tectonique)

– Présente des sites (points fossilifères) qui sont des témoins de l'état géologique et paléogéographique de la Dobroudja méridionale.

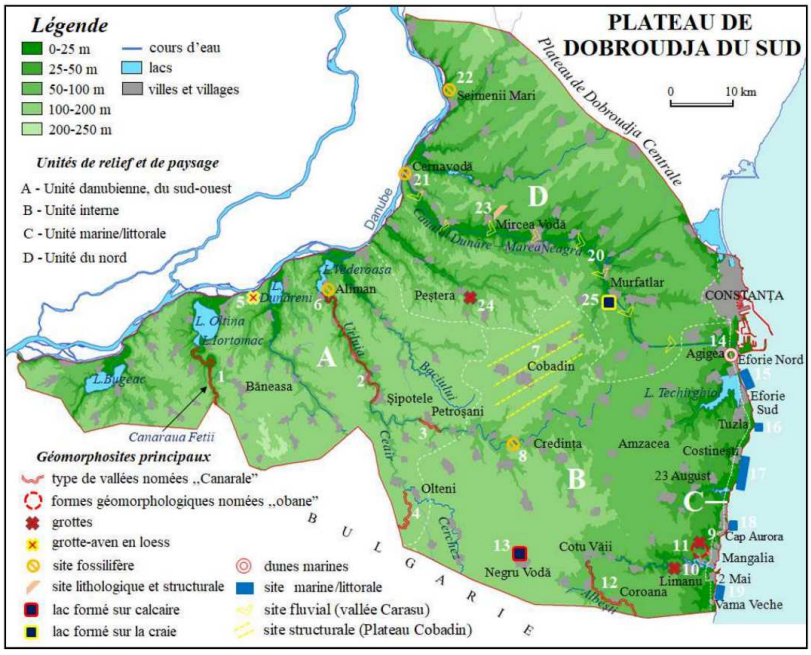


Fig. 4. Plateau de Dobroudja du Sud : relief-geosite-unités de territoire (Grecu et al., 2019a)

4.2. Les facteurs d'apparition et de délimitation des unités territoriales/ paysages en Plaine Roumaine

A. Facteur géologique : localisation dans une zone de plate-forme : socle rocheux cristallin (plate-forme Moesic) recouvert d'un riche dépôt sédimentaire. Paysages d'ordre I (résultant de l'évolution géologique) :

– Le paysage de la plaine d'Olténie

– Le paysage du secteur central de la Plaine Roumaine

– Paysage du secteur Est

B. Facteur de relief : caractérisé par une grande variété génétique et une grande complexité des formes de relief. Paysages d'ordre II (types génétiques de plaines) (Fig. 5) :

– Plaines au pied des montagnes
– Plaines de glacis subcarpathiques
– Plaines de terrasse
– Plaines de subsidence
– Plaines fluvio-lacustres (tabulaires)

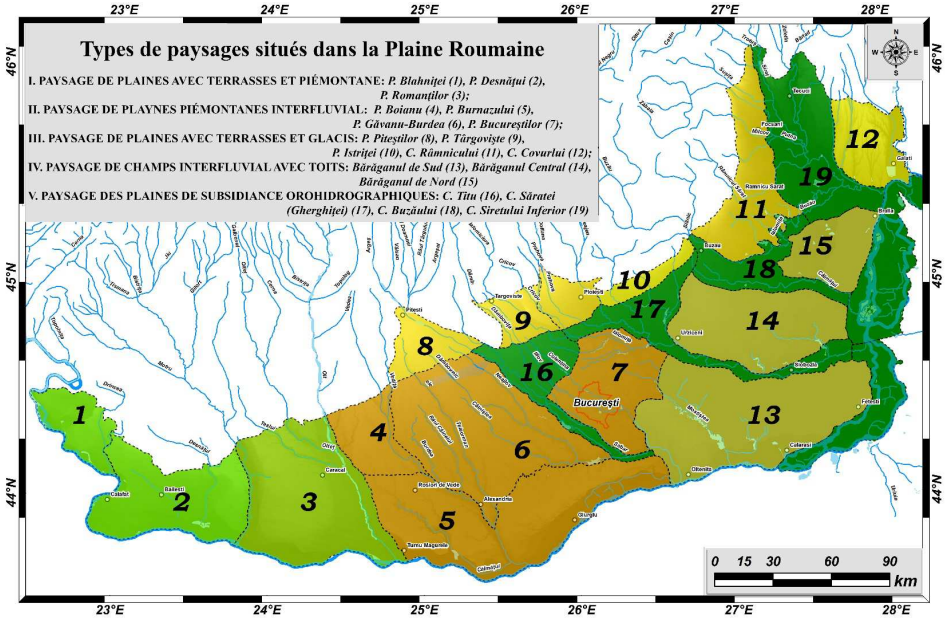


Fig. 5. Types de paysages dans la Plaine Roumaine
(essai de carte, F.Grecu, C. Ilie)

Paysages d'ordre III : micro-dépressions d'affaissement de lœss (Plaine de Burnas, Mostiștea, Bărăganul Ialomiței).

C. Facteur réseau hydrographique : les unités orogéniques nord et sud ont influencé le régime hydrogéologique par le type de dépôts accumulés et par la position et le débit relativement élevé de la nappe phréatique. Paysages d'ordre II : plaines inondables et des vallées (Vedea, Neajlov, Moștiștea).

4.3. Diversification des paysages (exemple de la ville de Constantine et son Rhumel, Algérie)

Constantine occupait des positions stratégiques dans l'est de l'Algérie (Camuset et al., 2007). Elle constituait une station relais entre le Tell et les hautes plaines, un carrefour entre la mer et le Sahara, et le Rocher de Constantine constituait un socle foncier privilégié sur lequel s'édifièrent la première ville (Aidat, 2017).

L'établissement du réseau hydrographique du bassin versant d'Oued Rhumel se fait à partir d'une topographie qui existait au Pliocène. À la fin du Pliocène, des mouvements tectoniques ont donné au Tell son volume montagneux. Ces mouvements sont à l'origine de la reprise du creusement des rivières qui ont pu inciser des vallées et des gorges profondes. La ville s'est développée d'abord sur un site défensif, sous forme d'un rocher fermé par des gorges et des escarpements. La ville de Constantine a été construite sur un relief très escarpé et accidenté du Tell Constantinois. Elle se trouve à une altitude de 649 mètres sur un plateau rocheux qui se présente d'un escarpement calcaire, ce qui lui donne un paysage spécifique dans le monde, c'est pourquoi elle est nommée la ville du vieux rocher (Fig 6).

Fig. 6. Paysage de la ville de Constantine construite sur le Rocher (un bloc de calcaire)

La structure urbaine de la ville est influencée par des éléments naturels tels que le réseau hydrographique, le relief, la présence du rocher et le type du couvert végétal.

Oued Rhumel est le principal cours d'eau de la ville de Constantine, il est considéré aussi comme l'élément identitaire de la ville, une ligne de repère fondamentale pour l'orientation et la perception urbaine. Le Rhumel, très encaissé, constitue un rempart naturel ceinturant la ville sur trois côtés. Pareil au bracelet qui entoure le bras, un fleuve grondant le fond d'un ravin inaccessible, enserre le Rocher qui supporte Constantine. Il défend cette ville, comme les « monts escarpés protégeant le nid du corbeau » (Marion, 1957). Le Rhumel n'apparaît pas comme un simple cours d'eau pour la ville de Constantine, c'est aussi un repère urbanistique fort et imposant, un élément de mémoire et de reconnaissance pour les habitants. Il s'est surimposé sur plusieurs séquences, différentes les unes par rapport aux autres, non seulement sur le plan spatial mais aussi paysager (Aidat, 2017).

La vallée de Oued Rhumel est caractérisée par des altitudes qui varient de 170 m à 750 m, On observe plusieurs anomalies géomorphologiques au cours de cette vallée, ce qui témoigne de la complexité géomorphologique de la zone étudiée.

La vallée du Rhumel présente plusieurs sinuosités, Oued Rhumel traverse les hautes plaines constantinoises suivant une direction Nord-Est/Sud-Ouest, il conflue avec Oued Boumerzouag à Constantine et traverse les gorges profondes de la région en gardant une orientation générale Nord-Est/ Sud-Ouest. Au cours de sa traversée des gorges profondes de Constantine, Oued Rhumel change soudainement de direction pour se diriger vers le NW-SE **(**Bouedja, 2010), et continue de dessiner une série de sinuosité jusqu'à son arrivée au barrage de Beni Haroun (Fig. 7, 8).

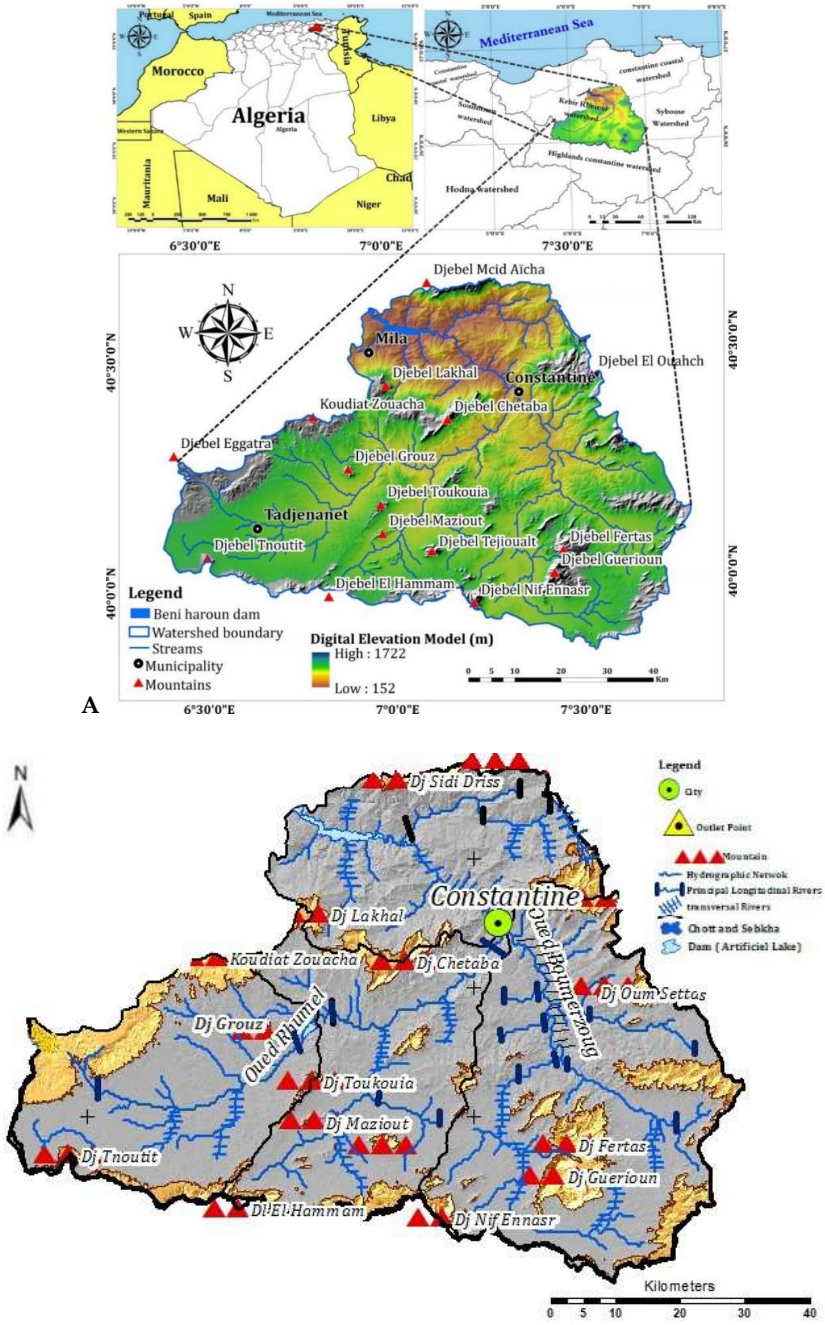


Fig. 7. Bassin-versant 'Oued Rhumel : **A.** Situation géographique hypsometrie ; **B.** Le réseau morphohydrographique (Manel Yakhlefoune)

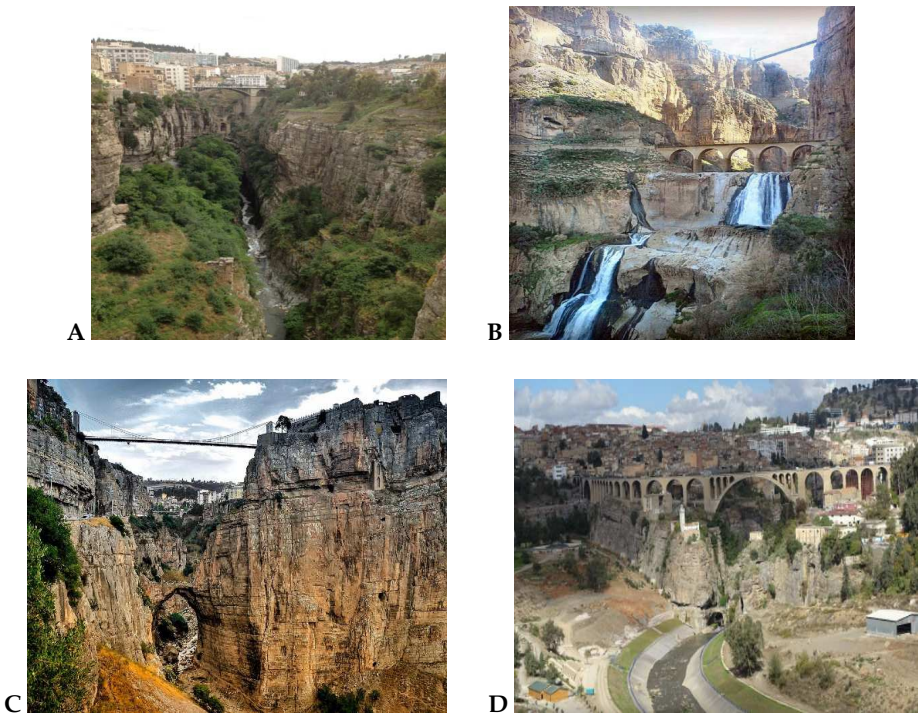


Fig. 8. Vue des gorges du Rhumel à la ville de Constantine

A. paysage de la vallée de Rhumel : Oued Rhumel pénétrant le rocher de Constantine

B. Les cascades d'Oued Rhumel sous le pont des chutes qui relie la rive droite à la rive gauche du Rhumel, une structure plus modeste enjambe le Rhumel à la hauteur des cascades à la sortie nord des gorges. Ce dernier marque également l'aboutissement du chemin des touristes, lequel, à partir du pont du Diable parcours les gorges sur toutes leur longueur.

C. les gorges du Rhumel sous L'arche naturelle traversées en dessous du pont suspendu de Sidi M'Cid qui relie la ville de Constantine au centre hospitalo-universitaire. Il domine les gorges de 175 mètres et permet une vue exceptionnelle sur une partie de la ville jusqu'à la vallée de Hamma Bouziane.

D. les gorges du Rhumel franchit par le pont de Sidi Rached à 105 mètres de hauteur, qui a été construit en 1912, il est considéré comme le plus long pont de pierre au monde.

L'eau est un élément fondamental du paysage, un enjeu puissant et fédérateur. La mise en valeur de ce patrimoine, en faisant de l'Oued une forte composante du paysage urbain, donne à la ville un cadre plus attrayant et contribue à l'amélioration de la qualité de son environnement sans négliger les retombées économiques et touristiques.

Constantine et son Rhumel constituent un paysage diversifié – d'ordre I – suivant la topographie des lieux et la typologie d'habitat. Par la dynamique des rivière (Rhumel et des affluents) ont générés d'autre paysages – d'ordre II et III - avec de multiples facettes au sein de la ville : des berges douces, vertes, sableuses, des berges occupées par des vergers, habitées par des quartiers spontanés, par une zone industrielle, des gorges profondes et étroites qui s'élargissent parfois, des cascades. La population, par son activité, a occupé, et transformé des paysages naturels et a développé un paysage urbain complexe. Donc, les paysages naturels sont subordonnés au paysage urbain. La vallée d'Oued Rummel constitue l'élément le plus spécifique et significatif de la géographie de la ville de Constantine (Fig. 8).

5. Fonctionnalité des paysages – paysages naturels et paysages dérivés

La qualité fonctionnelle du paysage est définie par le caractère dynamique des relations de conditionnement établies entre ses composantes (Verga et al., 2021). L'intervention anthropique a conduit à des changements importants dans la dynamique des éléments environnementaux, dans le régime de drainage des rivières, ainsi que dans la dynamique des systèmes morpho-hydrographiques. Les paysages caractéristiques résultaient, notamment, de l'interaction entre les éléments hydriques (réseau fluvial) et les éléments morphologiques (champs interfluviaux).

La fonctionnalité des paysages découle de leur capacité à fournir des ressources (matérielles, culturelles ou autres) au profit de la société. Le regroupement de paysages le plus utilisé selon le critère de fonctionnalité (Mac, 1990) comprend deux grandes catégories : les paysages naturels et les paysages humanisés (cultivés, anthropisés, dérivés, construits).

Dans la plaine roumaine, où l'espace géographique n'a cessé de changer sous l'influence transformatrice de l'homme, les unités paysagères

ont été intégrées en deux catégories générales : les paysages anthropiques, prédominants, et les paysages surnaturels, à caractère isolé. L'évaluation spatiale des typologies paysagères s'est appuyée sur l'analyse de l'utilisation des terres (Fig. 9), pour identifier la structure biotique et pédologique et, implicitement, les changements imposés par les activités anthropiques. Celles-ci sont réduites à diverses catégories d'usage : terres cultivées, agglomérations, associations herbeuses de pâturages et prairies, forêts et arbustes, exploitations et carrières, routes et autres moyens de communication, plans d'eau.

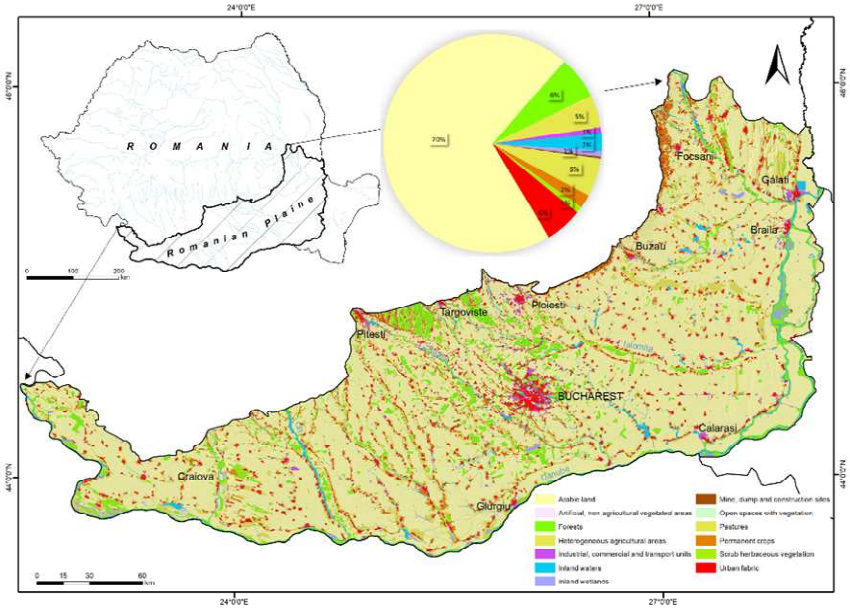


Fig. 9. Plaine Roumaine – utilisation des terres
(*Source* : Agence européenne pour l'environnement, Corine Land Cover ; Grecu et. al, 2019b)

Les paysages anthropiques sont spécifiques à la plaine roumaine en raison de l'intensité et de la continuité de l'habitation (environ 7 millions d'habitants). Selon le type d'habitat, les paysages ruraux et urbains ont été individualisés. Le réseau de peuplement de la plaine roumaine se compose de plus de 2300 villages, organisés en plus de 650 communes et 56 villes de différentes tailles, ce qui signifie qu'un village rural peut être trouvé tous les 20-25 km2 et une ville peut être trouvée à moins de 950 km² (Posea et al., 2005). La répartition spatiale et leur niveau de développement des

peuplements sont inégaux dans la plaine (Fig. 9). Les agglomérations les plus vastes et les plus complexes se développent près des grands fleuves ou de certains grands axes de circulation qui traversent la plaine (Bucarest, Ploiesti, Buzau, Brăila, Galați, Slobozia, etc.) ou dans l'espace de complémentarité à la frontière avec les unités vallonnées du nord (Craiova, Pitesti, Slatina). L'expansion territoriale a été réalisée par la fusion des villages voisins, résultant en des colonies polynucléaires ou des colonies allongées, qui s'étendent sur des kilomètres entiers. Dans les champs interfluviaux, les établissements sont plus petits, avec des formes rectangulaires régulières.

Bien que le nombre de villes ait presque doublé au siècle dernier, les paysages ruraux restent prédominants dans les plaines. La vocation agricole de la plaine roumaine est attestée par la manière dont la terre a été utilisée au fil du temps. L'extension de la zone agricole (où les zones arables ont la fonction principale) a été obtenue en réduisant les zones forestières (dans la plaine d'Olténie, la plaine de Teleorman, la plaine de Ialomița) et celles avec des prairies naturelles (à Burnas, Bărăgan et les prairies/alluviale plaine des grandes rivières). L'inversion des rapports entre la forêt et la surface cultivée, à travers l'expansion rapide des terres agricoles, s'est manifestement produite au cours des deux derniers siècles, ce qui a conduit à la multiplication des paysages anthropiques (Dumitrașcu, 2006).

L'amplification continue et soutenue des interventions de l'élément humain dans la plaine roumaine, souligne, au fil du temps, la qualité multifonctionnelle de cet espace, le paysage actuel étant le résultat de l'exploitation, plus ou moins rationnelle, de son potentiel écologique et biologique.

6. Conclusions

– La méthodologie de recherches des paysages est importance pour le développement économique et social durable**.**

– Les fonctions ainsi définies permettent une utilisation pour des bénéfices matériels, culturels ou autres, ce qui signifie un haut degré d'implication, non dirigé par le facteur anthropique.

– Le regroupement des paysages le plus largement utilisé sur la base du critère de fonctionnalité comprend deux grandes classes : les paysages naturels et les paysages humanisés (culturalisés, anthropisés, dérivés, construits, urbains, ruraux etc).

– Le paysage peut être utilisé comme outil de planification pour assurer une meilleure cohérence dans l'aménagement des sites urbains

RÉFÉRENCES BIBLIOGRAPHIQUES

Aidat, A. (2017), Typologie de rapports entre la ville de Constantine et son Rhumel-Boumerzoug, these de magistere, Université Mentouri Constantine, 180.

Băcănaru, I., Velcea, I. (2006), *Zona şi mediul geografic*, Editura ULB,Sibiu, 327 p.

Bertrand, G. (1968), *Paysage et géographie physique globale*. Révue géographique et des Pyrénées et du Sud-Ouest 49:249-272.

Biancotti, A., Pambianchi, G., Pioletti, A.M. (2003), *Spaces, environments and landscapes of terroirs*, World in Progress BEM, Milano, 168 p.

Bouedja, F., (2010), Tectonique actuelle et récente et risque sismique de la région de Constantine. These de magistere. Université Ferhat Abbas Setif, p. 154.

Camuset, A., Djao- Rakitine, I., Mondesert, M. (2007), Constantine, ville paysage, DPLG. 140 p., Atelier pédagogique 2003-04, Ecole nationale supérieure du paysage de Versailles. https://doi.org/10.4000/insaniyat.3919

Dincă, I. (2005), *Peisajele geografice ale Terrei. Teoria peisajului*. Editura Universității din Oradea.

Drăguț, L. (2000), *Geografia peisajului*. Editura Presa Universitară Clujeană, Cluj Napoca.

Dumitrașcu, M. (2006), *Modificări ale peisajului în Câmpia Olteniei*. Editura Academiei, București.

Grecu, F. (2010), *Geografia câmpiilor României*. Editura Universității din București, București.

Grecu, F. (2017), *Interconditionality geomorphosites and natural hazards*, in Sorocovschi, V. (ed.) , Riscuri şi catastrophe, an XVI, vol. 20, nr. 1/2017, Cluj Napoca, p. 41-52.

Grecu, F., Zaharia, L., Ghiță, C., Comănescu, L., Cîrciumaru, E., Albu, M. (2012), *Sisteme hidrogeomorfologice din Câmpia Română*. Hazard – Vulnerabilitate – Risc. Editura Universității București.

Grecu, F., Rădulescu, C., Comănescu, L. (2019a), *Relief, paysage, géomorphosite dans le Plateau de Dobroudja du Sud (Roumanie)*. 2019. 5-24. 10.5719/AUB-G/68.1/1.

Grecu, F., Ioana-Toroimac, G., Săndulache, I., Verga, M., Carablaisă, S., Dobre, R., Ghiță-Petre, C., Teodor, M. (2019b), *Landforms and landscape variety in the Romanian Plain. Identification and typology*, Simpozionul Național de Geomorfologie, Timişoara, 23-26 mai 2019.

Grecu, F., Ioana-Toroimac, G., Osaci-Costache, G., Zaharia, L., Cocos, O, Hachemi, K., Salajan, L. (2021), *Dynamics of Islands and Danube River Channel Along Vedea-Călăraşi Sector (1856-2019): Hydrogeomorphological Approach*, in The Lower Danube River. Earth and Environmental Sciences Library. Springer, DOI:10.1007/978-3-031-03865-5-2.

Ielenicz, M. (1995), *Contribuții la teoria peisajului*, Terra, an XXXVI-XXXVII.

Ilie, G.C., Grecu, F. (2023), *Analysis of the Scientific Importance and Vulnerability of the Sarea lui Buzău Geosite Within the Buzău Land UNESCO Global Geopark, Romania*. Geoheritage 15, 35 (2023). https://doi.org/10.1007/s12371-023-00806-z.

Iosif, D. (2014), *La fiche d'évaluation des géosites. Un exemple exhaustif utilisé sur des sites roumains*. Cinq Continents 4 (10) 158-180.

Mac, I. (1990), *Peisajul geografic. Conținut și semnificație științifică*. Terra 1-4:8-11.

Marin, I. (coord.) (2002), *Gestiunea durabilă a peisajelor geografice prin organizare şi amenajare teritorială*, Ed. ArsDocendi, Bucureşti.

Marion, A. (1957), *L'Epopée des Gorges du Rhumel Constantinoises*, Edition Dépêche de Constantine.

Marthaler M. (2002), Le Cervin est-il africain ? Une histoire géologique entre les Alpes et notre planète, Le Mont sur Lausanne, Editions LEP (Loisirs et Pédagogie).

Mihăilescu, V. (1968), *Geografie teoretică. Principii fundamentale. Orientare generală în științele geografice*. Editura Academiei, București.

Mihăilescu, V. (1970), *Geografie, ecologie, regiune geografică, ecosistem, Studii şi cercetări de geologie, geofizică, geografie*, Seria Geografie, t. 14, nr. 2.

Pătroescu, M., Toma, S., Sasaki, L., Apostol, G. (2000), *Priorities in the rehabilitation and renaturation of rural landscape of the Roumaninan Plain, southern Romaniainan*. Analele Universității din București, Geografie XLIX.

Pătru-Stupariu, I. (2011), *Peisaj și gestiune durabilă a teritoriului*. Editura Universității din București, București.

Popova-Cucu, A., Muică, C. (1989), *Premises and criteria for the classification of landscape types in Romania*. Landscape classification. Institute of Geography, Slovak Akademy of Sciences, Bratislava.

Posea, Gr., Iordan, I., Zavoianu, I. (2005), *Câmpia Română. Geografia României V (Câmpia Română, Dunărea, Podișul Dobrogei, Litoralul românesc al Mării Negre și Platforma continentală)*. Institutul de Geografie al Academiei Române. Editura Academiei Române, București.

Reynard, E., Pralong, J.P. (2004), Paysages géomorphologiques, Compte-rendu du séminaire de 3ème cycle CUSO 2003, Lausanne, Institut de Géographie, Travaux et Recherches N° 27, 270 p.

Reynard, E. (2005), *Geomorphosites et paysages*, Geomorphologie: relief, processus, environnment, 2:181-188.

Troll, C. (1970), *Landschaftsokologie (Gcoecology) and bioecologie. Eine Terminologische Studie.* Révue roumaine de Géologie, Géophysique et Géographie, Géographie, XXXIII.

Tudoran, P. (1983), *Țara Zarandului. Studiu geoecologic*. Editura Academiei, București.

Vâlsan, G. (1929), *Elementul spațial în descrierea geografică*. Lucrările Institutului de Geografie al Universității din Cluj, IV, Cluj Napoca.

Verga, M. (2000), *Dinamica peisajului geografic din bazinul hidrografic Bicaz*. Comunicări de Geografie IV: 547-557, București.

Verga, M. (2008), *Studiul fizico-geografic al bazinului hidrografic Bicaz. Diversitatea și analiza peisajelor*. Rezumatul tezei de doctorat, București.

Verga M., Andra-Topârceanu A., Marin A. (2021), *Vulnerabilități teritoriale evidențiate prin modificări ale peisajului geografic în bazinul hidrografic Bicaz*, The International Workshop Natural and Anthropic Risk, 4th edition, 08-10th November 2019 – Orșova, Romania,

in Florina Grecu (Ed) Lucrari si rapoarte de cercetare vol. V, Editura Universitatii din Bucuresti, p. 48-54, ISBN: ISSN 1844-7260.

Vijulie, I. (2010), *Dinamica peisajului rural în Câmpia Boianului*. Editura Universităţii din Bucureşti.

Wantzen, K.M. (2023), *River Culture: Living with the River, Loving the River, Taking Care of the River*, Blue Papers 2023 (Vol. 2, No. 1), 58-65 10.58981/bluepapers.2023.1.06.

Yakhlefoun, M., Benabbas, C., Grecu, F. (2021), *Evaluation du risque d'érosion des sols par approche USLE/SIG dans le bassin versant deOued Endja (Nort-Est Algérie),* Seminaire international sur l'ingenierie de la construction des villes (Architecture, Génie Civil, Hydraulique, Travaux Publiques, Urbanisme), Université d'Oran, DOI: 10.13140/RG.2.2.23176.75528.

Yakhlefoun, M., Benabbas, C., Grecu, F., Belkendil, A., Kharchi, T-E. (2022), *Vulnérabilité au risque d'érosion hydrique par processus d'analyse multicritères hiérarchique (AHP) couplé avec les systèmes d'information géographiques (SIG) dans une région semi-aride cas du bassin versant d'oued Endja (nord-est Algérie*), resume in vol VII^{ème} Colloque de l'Association francophone de Géographie physique (AFGP) « Dynamiques géosystémiques – défis actuels et futurs » Iasi, Roumanie, 14 - 16 octobre 2022.

Zăvoianu, I., Alexandrescu, M. (1994), Preocupări legate de studiul peisajului. Revista geografică, Anul L. Academia Română 1:78-85, București.

https://doi.org/10.5719/aub-g/72.1/7

ROMANIAN EMIGRANTS FOR UNIVERSITY STUDIES IN THE 18TH CENTURY UNTIL THE FIRST HALF OF THE 19TH CENTURY

ANTONIO SASU[1]

Abstract

The process of emigration for studies abroad, was neither simple nor accessible to all those interested. 18th century Romanian graduates went to study where Romania had „open gates", in cities under which Romania was suzerain, or at least had bilateral relations. The Romanian emigrants left for a certain period and generally followed the same specializations that they followed in their country. It was an emigration model that brought the graduate a certain social status, on his return to the country he offered the possibility of access to a public position (Vasilescu and Roman, 2016).

The 18th century saw profound political and administrative changes. From the Austro-Hungarian Empire (18th century), emigrants are heading to Paris and Berlin in these centuries. The 19th century brings changes in the wishes of emigrants. The model has changed significantly: we are talking about emigrants who choose something else compared to what was chosen in the last century, for example (Paris, Berlin, Budapest or Bern). Times change and so do people. The young graduates, who emigrated in the 18th century, spent an average of over 5 years studying, and then in the 19th century, the period spent in studies increases by another 4 years. The graduate emigrant changes not only his direction but also his time abroad in his studies.

Thus, in the 18th century, 60% of graduates choose Vienna and Rome as their destination. In the 19th century, they choose Paris as their destination, in a percentage of 55.55%.
Keywards: emigration, destination, time, graduate, study, centuries.

1. Introduction

The 18th century was called "The Century of Lights", a century that brought light and culture. During that period there was fierce competition

[1] PhD student, University of Bucharest, Faculty of Geography, e-mail: antoniosasu@yahoo.com

between the great powers, over the occupation areas and the spheres of influence manifested on the territories of Wallachia, Moldova and Transylvania. Transylvania has been occupied by the Habsburgs since 1687-1688. Leopoldine's diploma (1691) was imposed, which was the same as a contract between the Transylvanians and the Habsburg Empire regime.

There were riots against the political regime, riots made by Romanian intellectuals. Following these riots and with the help of intellectuals educated abroad, the High School of Blaj (1754) is born, giving rise to new generations of intellectuals (Sasu, 2023).

During this period, a Phanariot leadership was imposed in Wallachia (1716-1821), as well as in Moldova (1711-1821). In all the Romanian provinces there were no universities where these intellectuals could study. Through the reform of Empress Maria Theresa and Emperor Joseph II, people enjoy new benefits (1740-1790): people learn to trade, settle in cities, they only need to be tied to the glie[2]. These benefits bring freedom of movement; with the help of Romanian intellectuals (Gregore Maior, Petru Pavel Aaron) the Holy Varvara Seminar is established in Vienna, so Romanians from Transylvania abroad can also study.

For those who did not emigrate to enjoy the benefits of Grigore Major in Vienna, he brings books from Vienna to Blaj, thus creating the Transylvanian School, from here going to other high schools personalities such as Petru Maior, Samuil Micu and others.

In Wallachia, it was desired to give up the Phanariot reign and to install a Romanian gentleman, this being done with the help of intellectuals, who addressed France, Austria or Russia (which happened in 1829, Wallachia and Moldova entering under Russian protectorate and benefiting from organic regulations, which also brought the organization of the university environment).

Romanian emigrants chose mostly destinations from the Austro-Hungarian Empire, following mainly humanistic studies in the field of philosophy and theology; in the 19th century, destinations in the French area are chosen.

The periods spent also varied according to the needs of each graduate. Some spent more on education, others spent less. Some followed several

---

[2] *Glie* = archaic word meaning the binding of people to the owned field

study programs, specializing in several fields, others studied only to obtain a degree; the contexts were particular for each of the graduates.

2. Research methodology

The methodology used to obtain the data was as follows: the periods spent by graduates from abroad were calculated (after studying their biographies), the calculation method consisting in calculating the time of departure from the native country for studies and the time of their return to the country. These ages have been added and divided by the number of graduates, resulting in an average. In terms of destinations, they were extracted from the biographies of graduates (the great intellectuals of the centuries studied) and the graphics were drawn up with these destinations.

The mentioned personalities are those for which information was found (Pall, 1997; Nastasă, 2006), but there are certainly others.

The tables were drawn up with these data, comparing the differences between the time spent studying in these centuries and the destinations they have chosen in these centuries. The tables were made using Microsoft Office (Microsoft Word) and graphics using Microsoft Office (Microsoft Excel).

3. Results and discussion

In the 18th century, when the Romanian space was under the regime of Phanariot gentlemen, under the leadership of Austria-Hungary, 60% (see figure 1) among graduates who chose to study (see table no.1), chose the Austro-Hungarian Empire as a destination, choosing to study in Vienna, 20% in Slovakia and 20% in Constantinople, with the mention for the latter, that it was chosen by the graduates from Wallachia (this being under Ottoman suzerainty).

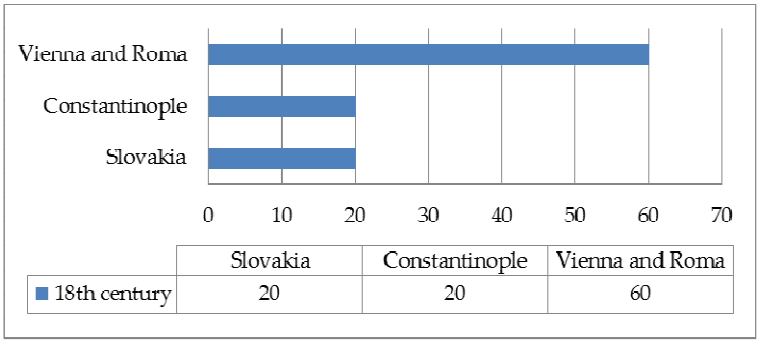


Figure 1. Destinations chosen by 18th century graduates (%)
(*Source:* processed data)

Table 1

Names of graduates, specialization and destination chosen (18th century)

Names of graduates	Specialization in Romania	Specialization abroad	Destinations chosen
Ioan Micu Klein	Philosophy	Theology	Slovakia
Dimitrie Cantemir	Languages foreign	Languages foreign and theology	Constantinople
Samuil Micu	Theology	Mathematics and theology	Vienna
Ioan Budai-Deleanu	Theology	Languages foreign and theology	Vienna
Petru Maior	Theology	Theology and law	Vienna and Roma

Source: processed data

Most graduates (see figure 2) of this century left because they did not have universities to study in Romania and these destinations outside the borders have been a very good source of development for these graduates. They studied the same specializations that they followed in the country, they practically wanted to develop more; not only that, some of them even followed several specializations. 20% of them choose Constantinople as their destination (only for oriental studies), they practically wanted to know as many languages as possible, to use them in the political life of the time.

For example, the Moldavian lord and the famous geographer, Dimitrie Cantemir, who emigrated to study at the Gate (Turkey today),

knew twelve foreign languages. They were not limited to a bit, they were often self-taught, but they also had information about all areas; 20% choose philosophy in Slovakia.

Graduates spent an average of 5 years and 6 months studying (see figure 2).

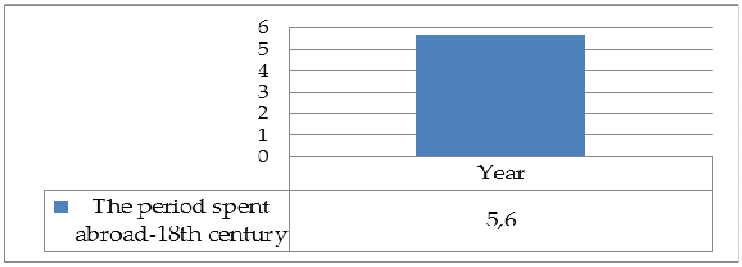


Figure 2. The period spent abroad – 18th century
(*Source:* processed data)

During the 19th century, emigrant graduates (see figure 3, 4 and 5) change their destination. At the end of the Phanariot reigns (1821-1822), the great powers try to regroup. Russia imposes its protectorate on Wallachia and Moldova through the agreements of the White Fortress (1826) and from Adrianople (1829). During this period, national emancipation (social and political) was desired. The Organic Regulations have contributed to this. Among the articles of organic regulations are details regarding the education system, which is structured on 4 levels: primary, humanities, complementary and higher.

Here that Romanian graduates could study in their country, but did not have the necessary logistical basis, the first university being built four decades later -October 26, 1860 (Sasu, 2023; Ianoș et al., 2010; Ianoș et al., 2014).

As a result of the ideas of the French Revolution entering the country, the liberal spirit includes the enlightened minds of Transylvania, Wallachia and Moldova. Graduates emigrate mainly to Paris, Berlin, Bern, Rome and, to a lesser extent, Vienna. Here, as the political context and relations between states change, emigrants change their direction of emigration. Emigrants from this period were also attracted by the greatness of Paris at that time, by the life of the salon and by the benefits of urban

infrastructure. 55.55% of the emigrant graduates choose Paris as their study destination, compared to 60% of the 18th century who chose Vienna. In the 19th century, only 11% still choose Vienna, a difference of 49% (see figure 3).

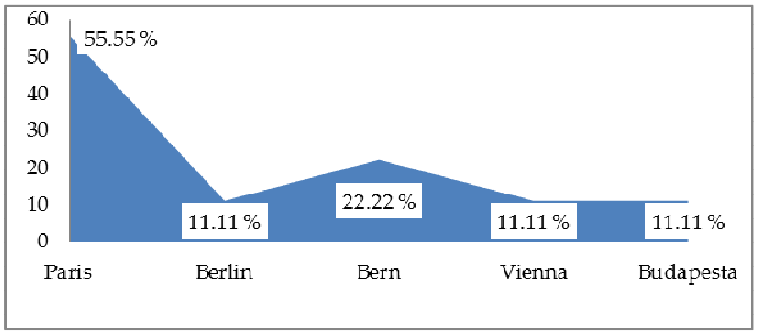


Figure 3. Destinations chosen by 19th century graduates (%)
(*Source:* processed data)

In figure 4 are represented the Romanian intellectuals, participants in the revolution of 1848 in Wallachia (19th century). They emigrate at 29 years and 2 months (average age) and spend 11.4 years in studies.

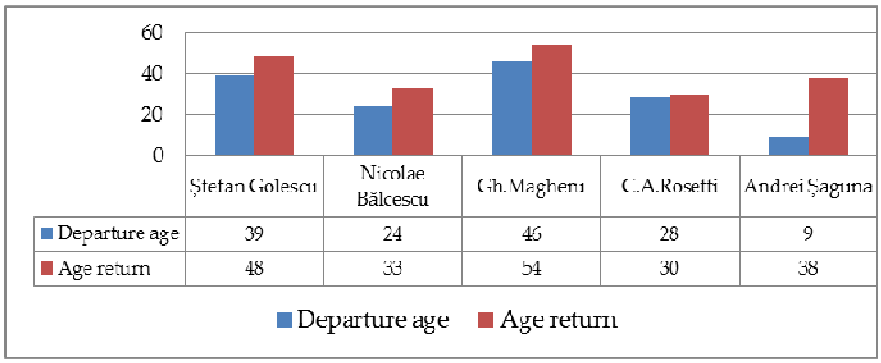


Figure 4. Graduated emigrants in the 19th century (Revolution of 1848 – Romania)
(*Source:* processed data)

Figure 5 represents Romanian intellectuals from Moldova, emigrants, revolutionaries (from 1848) from the 19th century. They emigrate at 13 years and 7 months (mean age) and spend 7 years and 7 months in studies.

The age difference between the intellectuals from Wallachia and Moldova is given by particular cases. It is not necessarily a constant dynamic of the migration of intellectuals from that period.

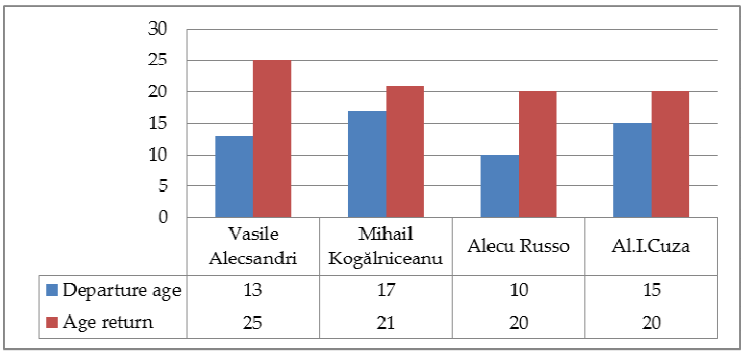


Figure 5. Emigrants graduates in the 19th century (Revolution of 1848 – Moldova)
(*Source:* processed data)

As it can be seen in Table 2, most graduates study the same specializations as they studied in their country. In practice, they specialize much more.

Table 2

Names of graduates, specialization and destination chosen (19th century)

Names of graduates	Specialization in Romania	Specialization abroad	Destinations chosen
Ștefan Golescu	Military studies	Military studies	Bern
Nicolae Bălcescu	Languages foreign	Languages foreign	Paris
Gh.Magheru	Political studies	Political studies	Vienna
C.A Rosetti	Political studies	Political studies	Vienna
Andrei Șaguna	Theology studies	Theology studies	Budapest
Vasile Alecsandri	Languages foreign	Languages foreign	Paris
Mihail Kogălniceanu	History studies	History studies	Paris and Berlin
Alecu Russo	Languages foreign	Languages foreign	Bern
Alexandru Ioan Cuza	Law studies	Law studies	Paris

Source: processed data

Regarding the period spent in studies, we can observe from the following data (see figure no. 4) that Romanian emigrants spent on average 9 years and 6 months in studies.

In the 18th century, Romanian graduates emigrants mostly choose Vienna as a destination for studies and spend an average of 9.6 years there (see figure 6). In the 19th century, graduates emigrants choose Paris as a destination for studies.

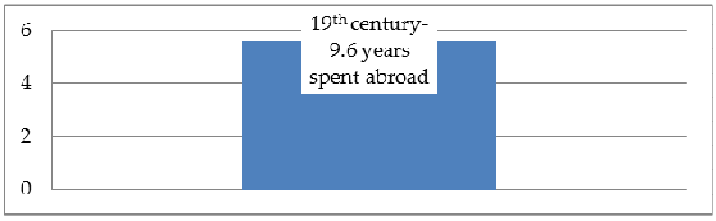


Figure 6. The period spent abroad – 19th century
(*Source:* processed data)

Over the years, the Romanian graduate of that period spends more on cross-border studies. The Romanian graduate becomes more and more prepared and willing to spend more time studying across the border. The graduate's behavior is different, following generations that change their vision of studies.

It can be seen how in the 18th century, graduates choose destinations such as Vienna, Slovakia and Constantinople, and in the 19th century they choose destinations in Western Europe: Paris, Berlin and Bern (see figure 7). It can be also noticed a change of direction in the behavior of graduates: in the 18th century they choose more destinations in Central Europe, while in the 19th century they choose destinations in Western Europe.

If in the 18th century, the emigrant graduate thought he could study elsewhere, but have to live and die in your homeland, as it turns out from what Ioan Ionchentie Micu-Klein says: "You can really rise only in the country of the homeland" (Pall, 1997). In the 19th century we meet the concept that you must be "something" and that something must be concentrated in an academic degree in Paris (Simion, 1988).

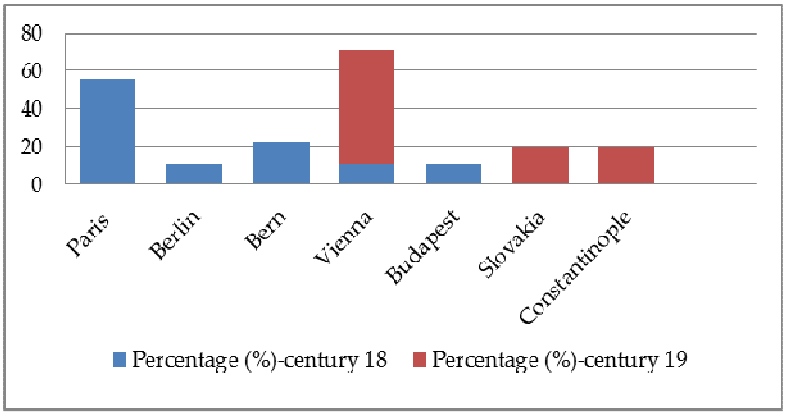


Figure 7. The difference between the destinations chosen by the Romanian emigrant (differences between the 18th century and the first half of the 19th century) (*Source:* processed data)

In comparison, in terms of periods spent in studies abroad, between the 18th and 19th centuries (the first half of it) there is a difference of 4 years in terms of time spent in studies (see figure 8).

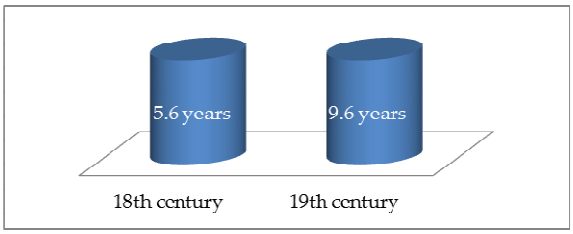


Figure 8. Differences between the periods spent in studies by the graduated Romanian emigrant (difference between the 18th and 19th centuries) (*Source:* processed data)

4. Conclusion

The period of the 18th and 19th centuries was a lack of technology. During this period there were no data on the phenomenon of migration for studies of graduates. The phenomenon was presented in the literature as a brain drain (Anghel et al., 2009; Ștefănescu, 1982).

The first census in Tara Romaneasca (1838) did not contain data on this phenomenon, nor did the following (to the present), so there are certain limitations of the study. Data collection was performed using biographies of intellectuals from the 18th and 19th centuries.

REFERENCES

Anghel, R.G., Horváth, I., Bădescu, G., 2009, Sociologia migrației. Teorii şi studii de caz româneşti, Iași, Editura Polirom.

Pall, F., 1997, Inocentie Micu-Klein, Exile in Rome 1745-1768, vol I-II, Fundația Culturală Română, Cluj-Napoca.

Ianoș, I. (coordonator), 2010, Inserția teritorială a universităților din România, Cercleux A-L. – co-autor 1.2, 1.3, 5.1, 5.2, 7.3, 8.3, Editura Universitară, București, 342 p.

Ianoș, I. (coordonator), 2014, Reforma curriculară și piața forței de muncă pentru domeniul Geografie, Cercleux Andreea-Loreta – co-autor capitolele I, VI și IX, Editura Universitară, București, p. 8-17, 118-132, 148-153.

Nastasă, L., 2006, Itinerarii spre lumea savantă. Tinerii din spațiul românesc la studii în străinătate (1864-1944), Editura Limes, Cluj-Napoca.

Ștefănescu, P., 1982, Brain-drain. Exodul creierelor, Editura Politică, București.

Sasu, A., 2023, The emigration of Romanian graduates for studies in different historical periods (from the period of the Phanariot reigns to the First World War, 18th-19th century), vol. 10, p. 185-192.

Simion, S., 1988, Printre scriitori și artiști, Editura Minerva, București.

Vasilescu, M.D., Roman, M., 2016, Explaining the Migration Intentions Of Romanian Youth: Are Teenegers Different?, Romanian Statistical Review nr. 4/2016.

https://doi.org/10.5719/aub-g/72.1/8

DYNAMIQUE SPATIO-TEMPORELLE DE L'ÉTAT DE VITALITÉ DU COUVERT VÉGÉTAL AVEC L'INDICE NDVI DANS LA COMMUNE RURALE DE KOUKA, AU NORD-OUEST DU BURKINA FASO

JACQUES KONKOBO[1], YÉLÉZOUOMIN STÉPHANE CORENTIN SOMÉ[2]

Résumé

L'évaluation et le suivi des changements de la végétation (couverture du sol en plante) permettent de clarifier l'état, la santé et la qualité des ressources végétales. Pour apprécier la vitalité de la végétation d'un espace géographique donné, l'indice NDVI est utilisé. L'objectif de cette étude est d'analyser la dynamique spatio-temporelle de l'état de vitalité du couvert végétal avec l'indice NDVI dans la commune rurale de Kouka, au Burkina Faso. La démarche méthodologique est basée sur une revue de littérature, l'acquisition des images satellites suivi de leur traitement et le calcul de l'indice NDVI. Les images Landsat 7 de 2000 et 2010 et de Landsat 8 de 2020 ont été utilisées. Les outils sont constitués par le logiciel QGIS 3.16 qui a été utilisé pour le traitement des images satellites, ArcGIS 10.8 pour l'élaboration des cartes, Word et Excel 2016 sont utilisés respectivement pour la rédaction et l'élaboration des graphiques. L'analyse des résultats révèle qu'entre 2000 et 2020, il ressort dans l'ensemble que les faibles valeurs du NDVI, ont connu une hausse au détriment des fortes valeurs. Les valeurs des « très faibles » et « faibles » sont respectivement passées de 18,49 % et 20,88 % en 2000 à 19,48 % et 28,68 % en 2020 tandis que les valeurs « fortes » et « très fortes » ont varié de 23,76 % et 9,18 en 2000 à 16,38 % et 7,75 % respectivement en 2020. Cette dynamique régressive de la vitalité de l'état du couvert végétal est fortement liée aux besoins croissant en bois d'énergie d'une population de plus en plus croissante et surtout l'importante expansion territoriale agricole.
Mots clés : Burkina Faso, Commune rurale de Kouka, dynamique, NDVI, couvert végétal.

1. Introduction

Le suivi des ressources naturelles dans les régions aride et semi-aride de l'Afrique subsaharienne s'est imposé comme une priorité pour les décideurs

[1] Université Norbert Zongo, e-mail : konkobojacques@ymail.com
[2] Université Norbert Zongo, e-mail : some_y@yahoo.fr.

politiques comme pour les scientifiques depuis la période des sécheresses des années 1970 et 1980 (Sylla et *al*., 2019, p. 6675). Cette période de déficit hydrique combinée aux stratégies adaptatives de survie des populations locales, ont causé une dégradation et une surexploitation des écosystèmes déjà fragiles notamment les domaines des savanes. Cependant, pour Da et *al*., (2008, p. 306), si la sécheresse et les activités des hommes semblent être les principales causes, les mécanismes qui aboutissent à ce phénomène sont loin d'être connus et nécessitent encore beaucoup d'investigations. La commune rurale de Kouka n'est pas en reste de cette dégradation environnementale. En effet, cette dégradation est liée à l'extension des surfaces cultivées due aux défrichements et aux divagations des animaux. Cette situation engendre des perturbations parfois profondes des systèmes écologiques. Le phénomène se manifeste par des modifications de la structure du paysage, de la végétation et est donc préjudiciable aux conditions de vie des populations rurales et à l'économie locale.

Au cours de ces dernières décennies, les activités humaines en particulier l'agriculture ont conduit à la transformation progressive d'une très grande partie de la surface terrestre (Ballo et *al*., 2016, p.92). L'expansion territoriale agricole a été importante, de même que la croissance démographique. Gérer les ressources naturelles de manière rationnelle pour assurer une production durable, telle est le défi des agriculteurs du Burkina Faso en général et en particulier ceux de la commune rurale de Kouka.

La dégradation du couvert végétal résulte d'une dynamique régressive de la végétation initiale. Cette dégradation du couvert végétal peut être analysée par l'indice NDVI. L'Indice Différentiel Normalisé de Végétation (IDNV) ou NDVI en anglais Normalized difference végétation index, est utilisé pour évaluer le degré de dégradation du couvert végétal. Plusieurs auteurs l'on utilisé dans la littérature : Philippon et *al* (2008), Leceuyer, (2012), Tankoano, (2012), Ouoba, 2013, Trabi, (2013), Gansaonre et *al*, 2020 etc.). Cet indice fournit des valeurs estimées de « l'intensité de vert » du couvert végétal, résultant de l'analyse de données satellitaires. La démarche part du principe que le NDVI soit un indicateur de la santé végétale, dans la mesure où une dégradation de la végétation d'un écosystème, ou une diminution de l'intensité de vert se traduiraient par une diminution de la valeur du NDVI. Avec le NDVI, il est aussi possible

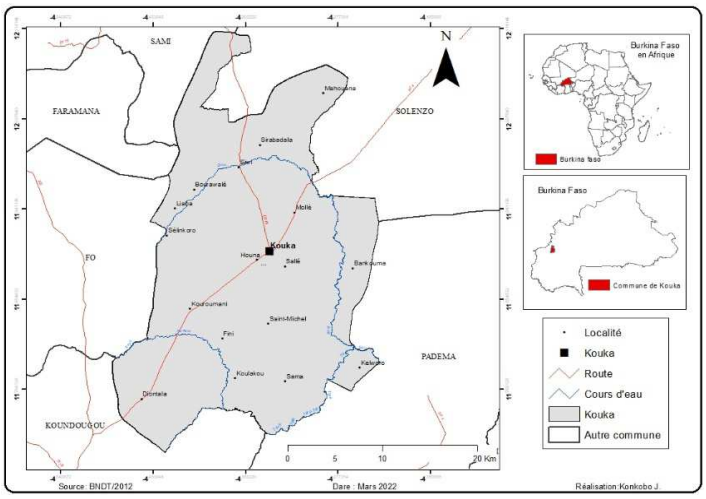
de suivre l'évolution du processus de dégradation. De ce fait, l'objectif de cette étude est d'analyser la dynamique spatio-temporelle de l'état de vitalité du couvert végétal avec l'indice NDVI dans la commune rurale de Kouka, au Burkina Faso.

2. Matériel et méthodes

Cette partie présente le milieu d'étude, les données, les outils utilisés et les méthodes de traitement des données recueillies.

2.1. Présentation de la zone d'étude

Kouka est une Commune rurale située dans la partie Sud de la province des Banwa qui fait partie de la région de la Boucle du Mouhoun au nord-ouest du Burkina Faso. D'après la Base Nationale de Données Topographiques (BNDT), elle est encadrée entre les parallèles 11°42'01'' et 12°7'30'' de Latitude Nord et les méridiens 4°14' et 4°30' de Longitude Ouest (Carte n° 1). La commune s'étend sur une superficie d'environ 700 km² soit 11,76% du territoire provincial (5954 km²) et 2,03% de la Région (34497 km²).



Carte n° 1. Localisation de la commune de Kouka au Burkina Faso

Elle subit l'influence du climat soudano-sahélien selon le découpage thermo-climatique du Burkina Faso avec une pluviométrie moyenne annuelle de 842,60 mn pour la période 1990-2020, selon les données météorologiques de la station synoptique de Dédougou. La pluviométrie est sous l'influence du Front intertropical (FIT) dont la fluctuation du Sud vers le Nord et du Nord vers le Sud caractérise les deux saisons (sèche et pluvieuse). Le découpage de l'année en saisons au Burkina Faso se caractérise par l'alternance d'une saison sèche dont la longueur varie de huit mois au nord à six mois au sud et d'une saison humide de mi-avril à mi-octobre au sud, de juin à septembre au nord (Figure n° 1).

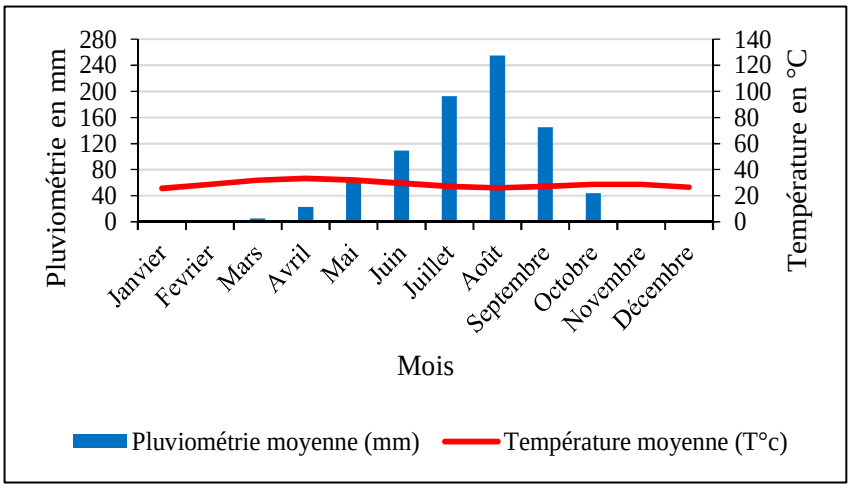


Figure n° 1. Digramme pluviothermique
(*Source des données :* station synoptique de Dédougou, 2021)

La nature des sols est le reflet des facteurs géomorphologiques (plateau gréseux, glacis, bas-fond), de la nature du substrat d'altération (grès, Schiste) et du climat. Quatre classes distinctes de sols sont rencontrées dans la commune de Kouka : les sols minéraux bruts, les sols ferrugineux ou sols à sesquioxydes, les sols peu évolués et les sols hydromorphes (carte n° 2). Tous ces types de sols connaissent un fort niveau de dégradation. Les causes sont généralement liées aux actions conjuguées de l'homme, des animaux, des facteurs climatiques et de la topographie du milieu. La surexploitation des champs, le surpâturage,

les défrichements sont donc à l'origine d'une érosion hydrique intense des hautes terres (plateau).

Selon les résultats définitifs du Recensement Général de la Population et de l'Habitat (RGPH) du Burkina Faso de 2006 et de 2019, la population de cette commune est passées de 59118 habitants à 73717 en 2019. Sa densité qui était de 47,16 habitants au Km^2 en 2006 est allée à 105,31 habitants au Km^2 en 2019.L'agriculture qui est la principale activité socioéconomique de cette localité, occupe environ 90 % de la population active (Plan de Développement Communal Kouka, 2021, p. 34). Le système de production agricole est de type familial basé sur un mode de production extensif. C'est une agriculture de subsistance, principalement pluviale, centrée sur la production céréalière, maraîchère et de rente. L'élevage est la deuxième activité socioéconomique de la commune après l'agriculture. De type traditionnel, l'alimentation du bétail est faite en grande partie, à partir du pâturage naturel. Les principales espèces élevées sont : les bovins, les caprins, les ovins, et la volaille. On rencontre principalement trois systèmes d'élevage dans la commune de Kouka : l'élevage extensif, l'élevage semi intensif et l'élevage transhumant.

2.2. Matériels : données et outils

Les images satellitaires constituent un outil important dans la cartographie de l'occupation du sol ainsi que dans la planification et la gestion des ressources naturelles. Elles sont descriptives et apportent une information spatiale et spectrale, permettant la caractérisation des objets dans une large bande spectrale (Hadraoui, 2013, p. 29). Les différentes analyses de cette étude proviennent de l'exploitation de trois images satellitaires Landsat couvrant la zone d'étude. Il s'agit d'images de type TM (Thematics mapper) et ETM+ (Enhanced Thematic Mapper Plus), de résolution 30 m. Les années 2000, 2010 et 2020 et les images satellites Landsat correspondant ont été donc retenues. Le tableau n°1 montre les caractéristiques des images retenues.

Tableau 1

Caractéristiques des images Landsat utilisées

Type d'image	Date	Résolution spatiale	Path	Row	Source
Landsat 7	19 février 2000	30 m	197	52	http://earthexplorer.usgs.gov/.
Landsat 7	4 février 2010	30 m	197	52	http://earthexplorer.usgs.gov/.
Landsat 8	14 mars 2020	30 m	197	52	http://earthexplorer.usgs.gov/.

Ces images ont été géoréférencées dans le système de projection UTM zone 30N avec ellipsoïde de référence WGS 84. Les outils sont constitués par le logiciel ENVI 4.5 qui a été utilisé pour le traitement des images satellites Landsat 7 et 8, du logiciel SIG ArcGIS 10.3 pour l'élaboration des cartes de la distribution spatiale de l'indice NDVI. Word et Excel 2016 ont été respectivement utilisés pour la rédaction et l'élaboration des graphiques.

2.3. Méthodes de traitements et d'analyses

Pour connaitre l'évolution du processus de dégradation du couvert végétal, trois images espacées dans le temps ont été choisies afin d'avoir trois états et de pouvoir déduire une tendance de façon claire et précise. Les années 2000, 2010 et 2020 et les images satellites Landsat correspondant ont été donc retenues. Après la rétention des images satellites, elles ont été ensuite traitées et analysées dans un système de logiciels SIG : QGIS 3.16 et Argis 10.8. Pour la création des images, l'association des bandes spectrales (Rouge, vert et bleu) est faite. L'utilisation du rouge pour le canal 3, le vert pour le canal 2 et le bleu pour le canal 1, une image avec la couleur naturelle des différents objets (la végétation en vert, l'eau en bleu foncé, les routes en gris…) est obtenue. Par contre, l'utilisation du canal 5 pour le rouge, le canal 4 pour le vert et le canal 3 pour le bleu, la végétation est mise en évidence. Celle-ci sera de couleur verte. Plus le vert est foncé, plus la végétation réalise de la photosynthèse. Si le sol est nu, le pixel correspondant apparait en rose. Les zones bâties sont de couleur rouge,

les cultures annuelles en jaune. Le tableau n° 2 montre les caractéristiques des canaux Landsat TM & ETM+.

Tableau 2

Caractéristiques des canaux Landsat TM&ETM+.

Capteurs	Gamme de bandes (µm)	Localisation spectrale	Résolution spatiale (m)	Application principale
TM & ETM+	BI : 0,45-0,52	Bleu	30×30	Pénétration des plans d'eau, cartographie des eaux territoriales
	B2 : 0,52-0,60	Vert	30×30	Distinction de la végétation, évaluation de la vigueur et identification des différents types de cultures
	B3 : 0,63-0,69	Rouge	30×30	Absorption de la chlorophylle, et différenciation des espèces végétales
	B4 : 0,76-0,90	Proche IR	30×30	Détermination des types de végétation et surveillance de la vigueur et de la biomasse, définition des limites des plans d'eau
	B5 : 1,55-1,75	Moyen IR	30×30	Indicateurs de végétation et d'humidité du sol utilisés pour la différenciation de la neige et des nuages
	B6 : 10,4-12,5	IR thermique	TM 120x120 ETM+ 60x60	Analyse des contraintes de végétation, distinction de l'humidité du sol et cartographie thermique
	B7 : 2,08-2,35	Moyen IR	30×30	Identification des types de roches et de minéraux, cartographie thermale et mesure de l'humidité du sol et de la végétation
	P : 0,50-0,90 pour ETM	Visible et proche IR	15x15	Image à la résolution plus élevée

Source : Wu, 2003, http://landsat.gsfc.nasa.gov/images/

De ce fait, la composition colorée 4-3-2 a été faite pour les images Landsat 7 et celle 5-4-3 a été faite pour les images Landsat 8. Ces deux compositions colorées ont été utilisées à cause des bandes infra-rouge et proche-infrarouge qui permettent une bonne réflectance de la végétation. Après le rehaussement des images, la classification Maximum Likelihood ou maximum de vraisemblance a été utilisée. Pour la poste classification, l'algorithme Majority/Minority Analysis est utilisé. En outre, il y a eu l'étape de la vectorisation. Les vecteurs sont exportés en fichiers de forme vers un logiciel de cartographie en l'occurrence Arc Gis 10.3 pour peaufiner et réaliser les différentes cartes montrant la répartition spatiale de l'indice NDVI.

Le NDVI est une combinaison des bandes spectrales du Rouge (R) et du Proche Infrarouge (PIR). Le calcul de l'indice se fait selon la formule suivante : NDVI = (PIR – R) / (PIR + R). Les valeurs du NDVI sont comprises entre –1 et +1, les valeurs négatives correspondant aux surfaces autres que les couverts végétaux, comme la neige, l'eau ou les nuages pour lesquels la réflectance dans le rouge est supérieure à celle du proche infrarouge. Pour les sols nus et les roches, les réflectances étant à peu près du même ordre de grandeur dans le rouge et le proche infrarouge, le NDVI présente des valeurs proches de 0. Les formations végétales quant à elles, ont des valeurs de NDVI positives, généralement comprises entre 0,1 et 0,7. Les valeurs les plus élevées correspondant aux couverts les plus denses. Les très faibles valeurs de l'indice NDVI (0,1 et inférieures) correspondent aux surfaces stériles de roche, de sable ou de neige. Les Valeurs modérées représentent des zones arbustives et de prairies (0,2 à 0,3), alors que les valeurs élevées indiquent des forêts tropicales humides (0,6 à 0,8) (Trabi, 2013).

Pour ce présent travail, les valeurs négatives correspondent à de la déforestation ou à une disparition de la végétation, à l'eau, au sol nu. Les valeurs positives correspondent à de la végétation nouvelle ou qui a repoussé, la savane arbustive, la savane arborée et la forêt-galerie. L'analyse de la dynamique de l'indice de végétation NDVI, dans cette étude, vise à comprendre les variations spatiotemporelles de la végétation dans l'espace et dans le temps de la commune de Kouka ainsi que la dynamique du couvert végétal. Pour des raisons pratiques liées à l'approche méthodologique adoptée dans cette présente étude, 5 classes sont identifiées comme le montre le tableau n° 3:

Tableau 3

Appréciation du NDVI et dégradation de la végétation

Valeur du NDVI	Appréciation du NDVI	Appréciation du niveau de dégradation de la végétation
-0,01 à 0,12	Très faible	Sol en dégradation (Très fort)
0,12 à 0,15	Faible	Végétation dégradée (Fort)
0,15 à 0,17	Moyen	Végétation en dégradation (Moyen)
0,17 à 0,21	Fort	Végétation en stabilisation (Faible)
0,21 à 0,37	Très fort	Végétation en croissance (Très faible)

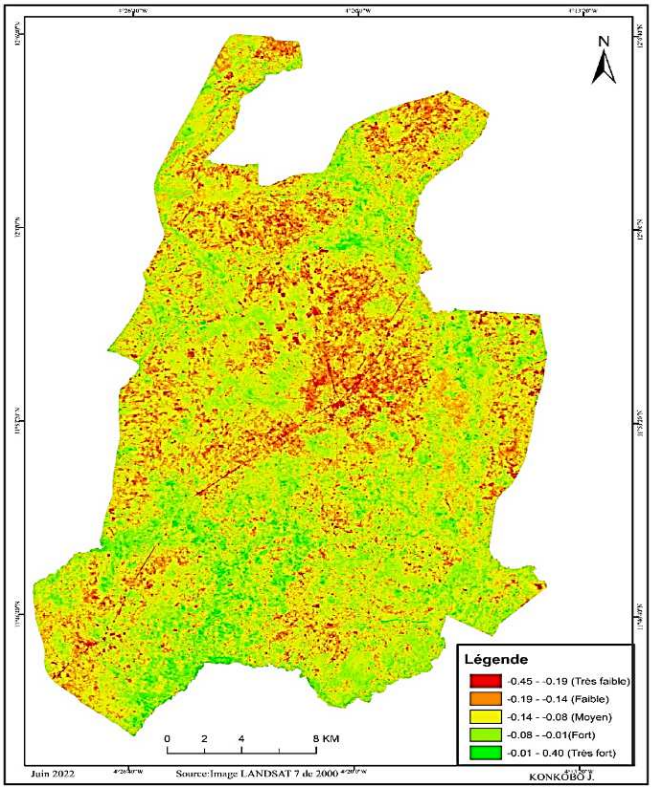
3. Résultats

Les résultats de l'étude mettent en évidence la dynamique spatiotemporelle de l'état de vitalité du couvert végétal entre les années 2000, 2010 et 2020.

3.1. État de vitalité du couvert végétal en 2000

La carte n° 2 ci-dessous montre la représentation spatiale de la vitalité du couvert végétal de la commune de Kouka durant l'année 2000.

La carte n° 2 permet de constater qu'au cours de l'année 2000, les « fortes (*en couleur vert clair*) » et les « très fortes (*en couleur vert foncé*) » valeurs de l'indice NDVI étaient les plus importantes, car elles occupaient le Sud, le Centre-Sud, le Sud-Ouest, le Sud-Est, l'Ouest et une partie du Nord-Est de la commune. Les « très faible (*en couleur rouge foncé*) » et « faibles (*en couleur rouge clair*) » valeurs sont localisées au Centre (Village de Kouka, chef-lieu de la commune), au Nord, à l'Ouest et Sud-Ouest. La Figure n° 2 montre les états de la vitalité de la végétation en fonction des valeurs de l'indice NDVI. En l'an 2000, c'est la valeur moyenne du NDVI qui est dominant avec 27,66 % d'occupation de l'espace communal. Elle est suivie par la valeur de l'indice faible qui couvrait 20,88 % du territoire communal et celle de l'indice très faible (18,49 %). Viennent enfin les valeurs fortes (23,76 %) et très fortes (9,18 %).



Carte n° 2. Représentation spatiale de la vitalité de la végétation de 2000

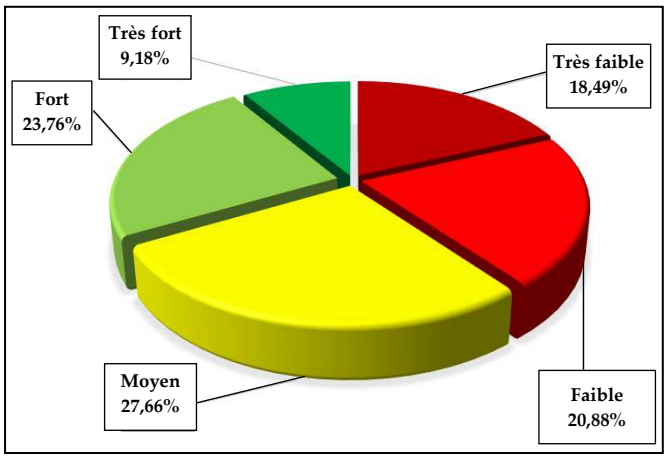
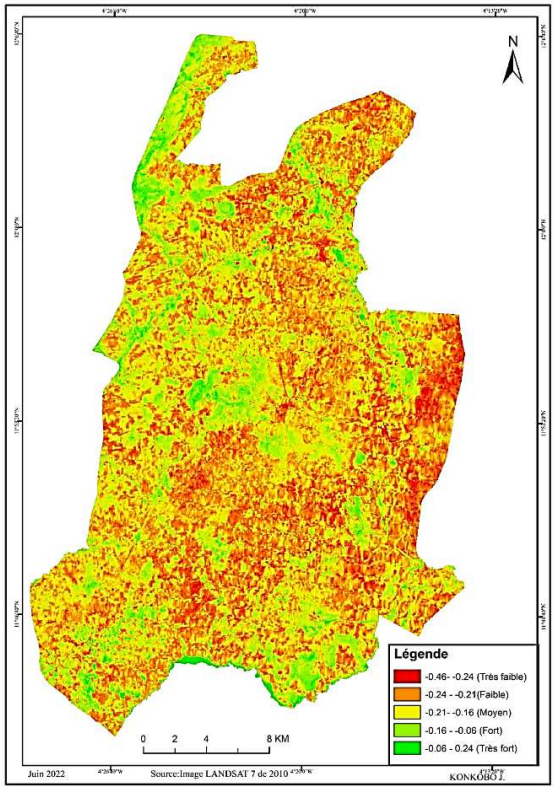


Figure n° 2. État de la vitalité de la végétation de l'année 2000
(*Source :* image Landsat 7 de 2000)

3.2. État de vitalité de la végétation en 2010

La carte n° 3 ci-dessous montre la représentation spatiale de la vitalité du couvert végétal de la commune de Kouka durant l'année 2010.



Carte n° 3. Représentation spatiale de la vitalité de la végétation de 2010

Contrairement à l'an 2000, les fortes et les très fortes valeurs de l'indice NDVI ne sont plus dominantes. Elles sont devenues des ilots, localisées de façon ponctuelle à travers le territoire communal. C'est principalement le long des cours d'eau (au Sud, au Nord-Est) que les très fortes et fortes valeurs du NDVI sont observées. Cependant, il y a au Nord et au Centre, des portions de terre où il y a une forte valeur du NDVI). En effet, la portion Nord constitue la limite de la commune où les chaines de collines sont dominantes et ne sont pas colonisées pour

des activités agricoles, d'où le maintien de la végétation. La Figure n° 3 présente les états de vitalité de la végétation durant l'année 2010.

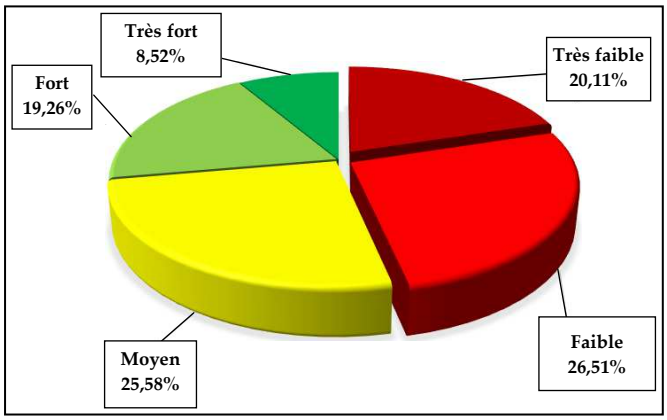


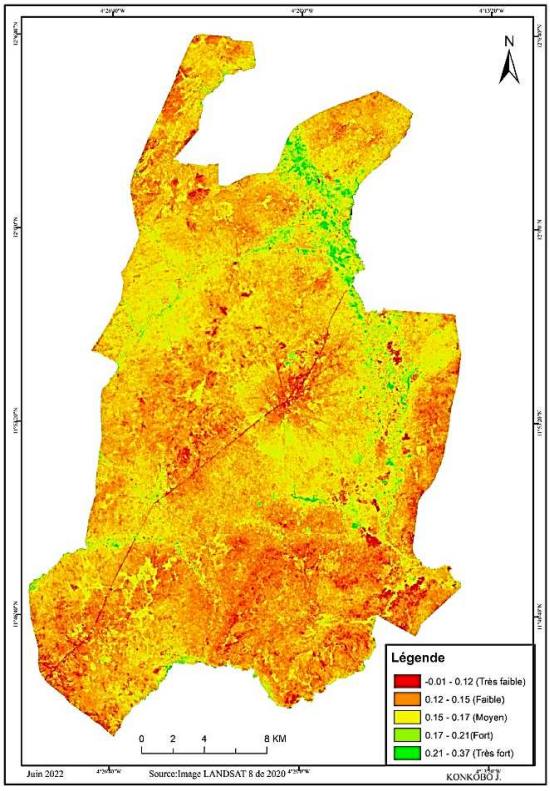
Figure n° 3. État de la vitalité du couvert végétal de l'année 2010
(*Source :* image Landsat 7 de 2010)

En l'an 2010, c'est la valeur faible du NDVI qui est dominant avec 26,51 %. Elle est suivie par la valeur de l'indice moyen qui couvrait 25,58 % du territoire communal et celle de l'indice très faible (20,11 %). Viennent enfin les valeurs fortes (19,26 %) et très fortes (8,52 %). Entre 2000 et 2010, les faibles et très faibles valeurs du NDVI ont connu une hausse en termes de couverture territoriale. L'indice très faible est de 18,49 % en 2000 à 20,11 % en 2010. L'indice faible, quant à lui, est passé de 20,88 % à 26,51 %. Au même moment, les indices moyens, forts et très forts ont connu une diminution de leur superficie. L'indice moyen occupe désormais 25,58 % contre 27,66 % en 2000. Quant aux indices très forts et forts, ils sont passés respectivement de 9,18 %, 23,76 % en 2000 à 8,52 et 19,26 % en 2010. La végétation a donc connu une dégradation importante.

3.3. État de vitalité de la végétation en 2020

La carte n° 4 ci-dessous montre la représentation spatiale de la vitalité du couvert végétal de la commune de Kouka durant l'année 2020. Le territoire communal a totalement changé de physionomie en termes de couverture

végétale par rapport aux années 2000 et 2010. En 2020, ce sont le rouge (indice faible et très faible) et le jaune (indice moyen) qui dominent le paysage communal. Les indices forts et très forts (en vert) sont seulement localisés le long des cours d'eau dans la partie Est et Nord-Est de la commune.



Carte n° 4. Représentation spatiale de la vitalité du couvert végétal de 2020

En termes de statistiques des états de vitalité de la végétation, la proportion de couvertures végétale faible vient en première position avec 28,63 % (figure n° 4). Cette proportion est suivie par celles de couverture végétale moyenne et très faible avec respectivement 27,75 % et 19, 48 %. Enfin, les proportions de couvertures végétales fortes et très fortes occupent respectivement 16,38 % et 7,75 %.

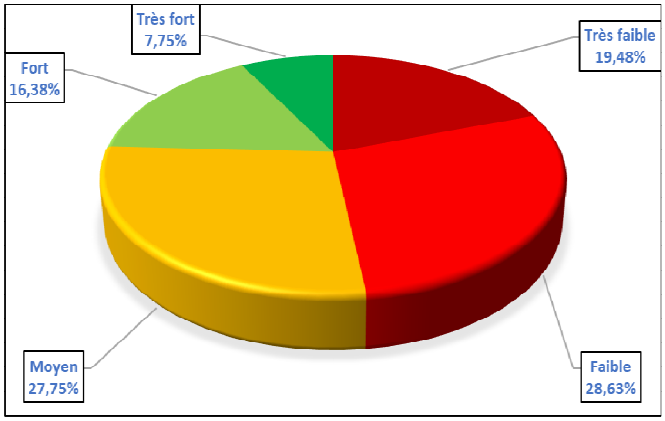


Figure n° 4. État de la vitalité de la végétation de l'année 2020.
Source : image Landsat 8 de 2020

Entre les années 2000, 2010 et 2020, il ressort dans l'ensemble que les faibles valeurs du NDVI, ont connu une hausse au détriment des fortes valeurs. En effet, les valeurs des « très faibles » et « faibles » sont respectivement passées de 18,49 % et 20,88 % en 2000 à 19,48 % et 28,68 % en 2020 tandis que les valeurs « fortes » et « très fortes » ont varié de 23,76 % et 9,18 en 2000 à 16,38 % et 7,75 % respectivement en 2020. La figure n°5 montre les proportions de la couverture végétale en termes de superficie de l'évolution des valeurs des indices de NDVI entre 2000, 2010 et 2020.

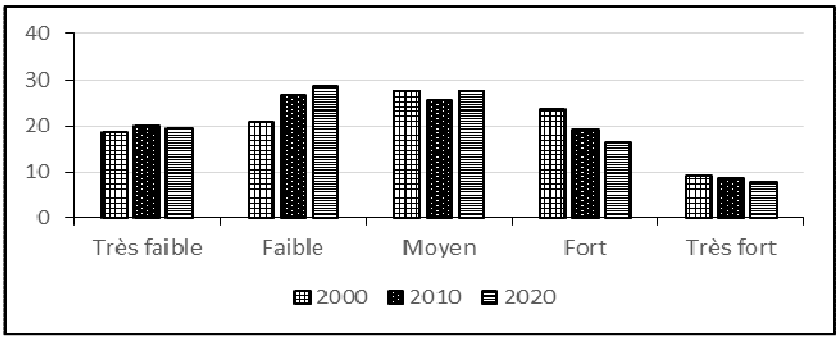


Figure n° 5. L'évolution de la couverture végétale en superficie selon les valeurs des indices de NDVI de 2000, 2010 et 2020
(*Source :* image Landsat 7 de 2000 et 2010, image Landsat 8 de 2020)

Le tableau n° 4 recapitule l'interprétation du graphique, c'est-à-dire la valeur de l'indice de NDVI sur la vitalité du couvert végétal entre les années 2000, 2010 et 2020.

Tableau 4

Appréciation de la valeur de NDVI par rapport au niveau de dégradation de la végétation

Valeur NDVI	Appréciation du niveau de dégradation de la végétation
Très faible	Sol en dégradation (Très fort)
Faible	Végétation dégradée (Fort)
Moyen	Végétation en dégradation (Moyen)
Fort	Dégradation faible
Très fort	Végétation en croissance (dégradation très faible)

4. Discussion

La dégradation du couvert végétal naturel, considérée comme une perte de productivité végétale (réduction de la biomasse), constitue une préoccupation environnementale. La superficie occupée par les formations végétales a connu une baisse de 14242,983 ha entre 1998 et 2018 soit 712,14915 ha/an (Konkobo, 2019, p.78). Cette dynamique régressive du couvert végétal réduit donc la capacité de renouvellement de la matière organique du sol et est à l'origine de la dégradation biologique des terres dans la commune rurale de Kouka. Plusieurs facteurs expliquent cette dynamique régressive de la végétation. En effet, si les actions de l'homme semblent être les plus indexées à l'origine de la dégradation de la couverture végétale, il n'en est pas moins que les conditions climatiques les exacerbent. Les résultats de cette étude montrent que les actions de l'homme sont des facteurs de dégradation importants. Ces actions se traduisent, à travers les défrichements agricoles, la dégradation de la couverture végétale pour l'énergie, utilisation du bois pour la cuisine, l'artisanat (préparation du dolo, fixation des hangars). Ce sont ces besoins en terres de culture et bois de chauffe qui expliquent les tendances négatives du NDVI.

Avec l'avènement des séries temporelles d'images satellite et le MODIS NDVI, l'analyse des modifications de la couverture végétale s'est accélérée en Afrique de l'Ouest d'une manière générale, et au Burkina Faso en particulier à travers l'analyse des tendances (Solly et *al*.,

2021, p. 2). Pour ces auteurs, les analyses diachroniques fournissent les données les plus appropriées pour analyser la tendance des changements liés aux phénomènes naturels et humains. Grâce à l'indice de végétation par différence normalisée (NDVI), la télédétection permet de détection la dégradation et la régénération biologique des terres. Cet indice fournit des informations sur la capacité photosynthétique des couverts végétaux, la teneur en eau des feuilles, l'humidité des sols, la qualité phytosanitaire, la productivité primaire, la biomasse, etc. Il permet de détecter, par des changements de productivité de la végétation, des changements de couvert végétal. La couverture de végétation est l'indicateur le plus courant de l'état des terres. Par conséquent, les modifications de la quantité, de la qualité et de la distribution de la végétation peuvent indiquer des changements de la capacité des écosystèmes à soutenir les communautés, en termes de ressources et de services environnementaux constatent Yengoh et *al*., (2011, p. 27 & 40). Cependant, selon ces auteurs, lors de l'examen de la dégradation des terres, la simple présence d'une tendance négative du NDVI n'indique pas nécessairement une manifestation de la dégradation. Plusieurs facteurs peuvent contribuer aux tendances négatives du NDVI. Par exemple, dans les écosystèmes agricoles, la modification du type de culture peut contribuer à une tendance négative, sans forcément signifier une dégradation des terres.

Dans la commune rurale de Kouka, les conditions naturelles favorables ont fait de cette localité, une commune de colonisation agricole qui accueille des immigrés composés essentiellement de Moose et de Samo. L'arrivée massive des colons agricoles a engendré la création des villages et hameaux de cultures qui ont participé à la dynamique d'occupation des terres dans la localité (Paré et Tallet, 1999, p. 87). L'extension des superficies agricoles au détriment des formations naturelles explique l'état de surface actuel dans la commune. Pour Idani et *al*, (2021, p.494), la superficie occupée par les formations végétales a connu une baisse de 14242,983 ha entre 1998 et 2018 soit 712,14915 ha/an.

5. Conclusion

L'Indice Différentiel Normalisé de Végétation (IDNV) ou NDVI en anglais Normalized difference végétation index, est utilisé pour évaluer

le degré de dégradation du couvert végétal. La démarche part du principe que le NDVI soit un indicateur de la santé végétale, dans la mesure où une dégradation de la végétation d'un écosystème, ou une diminution de l'intensité de vert se traduiraient par une diminution de la valeur du NDVI. L'analyse de la dynamique de l'indice de végétation NDVI, dans cette étude, vise à comprendre les variations spatiotemporelles de la végétation dans l'espace de la commune de Kouka ainsi que la dynamique du couvert végétal. De ce qui précède, il ressort que le couvert végétal a connu une forte dégradation entre 2000 et 2020 dans la commune rurale de Kouka. L'augmentation des superficies des espaces agricoles et la consommation des populations en bois d'énergie sont à l'origine de la hausse des fréquences des valeurs de l'indice « faible » du NDVI et de la baisse de celles des valeurs de l'indice « fort ». Pour bien comprendre la dynamique spatiotemporelle de l'état de la vitalité du couvert, il faudrait que d'autres études s'attachent à la caractérisation des facteurs de dégradation de la végétation dans la commune rurale de Kouka.

RÉFÉRENCES BIBLIOGRAPHIQUES

BALLO, A, TRAORE, S.S., COULIBALY, B., 2016, « Pressions Anthropiques Et Dynamique D'occupation Des Terres Dans le Terroir De Ziguéna, Zone Cotonnière Du Mali », *European Scientific Journal*, vol. 12, No. 5, p. 90-99.

BALLOT, C.SA., MAWUSSI, G., ATAKPAMA, W., et *al.*, 2016, « Caractérisation physico-chimique des sols en vue de l'amélioration de la productivité du manioc dans la région de Damara au centre-sud de Centrafrique », in *Agronomie Africaine 28* (1), p. 9-23, Bases Nationales de Données Topographiques (BNDT, 2012).

DA, D.E.C., 2008, « Impact des techniques de conservation des eaux et des sols sur le rendement du sorgho au centre-nord du Burkina Faso », in *Cahiers d'Outre-Mer*, n° 241-242, Bordeaux, p. 99-110.

El HADRAOUI, Y., 2013, *Étude diachronique de l'occupation du sol et de modélisation des processus érosifs du bassin versant du Bouregreg (Maroc) à partir des données de l'Observation de la Terre*, Mémoire en Sciences de l'ingénieur, École Supérieure Des Géomètres et Topographes, 89 p.

GANSAONRE, R.N., ZOUNGRANA, B.J.-B., YANOGO, P.I., 2018, « Dynamique du couvert végétal à la périphérie du parc W/Burkina Faso », Belgeo, en ligne, disponible à http://journals.openedition.org/belgeo/40786.

IDANI, T.F., KONKOBO, J., DA, D E.C., 2021, « Dynamique d'occupation des terres entre 1998 et 2018 à Kouka (BURKINA FASO)», in *Géovision,* Numéro spécial 005, p. 487-497.

KONKOBO, J., 2019, *Les facteurs physiques influençant la production céréalière dans la commune rurale de Kouka (Province des Banwa*, Master de recherche en Géographie, Université JOSEPH KI-ZERBO, 105 p.

LECUYER, C., 2012, *Evolution de la désertification en Afrique de l'ouest*, IRD, rapport de stage de Master 1, 101 p.

OUOBA, A.P., 2013, *Changements climatiques, dynamique de la végétation, et perceptions paysannes dans le Sahel burkinabé ;* thèse de Doctorat unique de Géographie, Université de Ouagadougou, 305 p.

PARE, L., TALLET, B., 1999, « D'un espace ouvert à un espace saturé : dynamique foncière et démographique dans le département de Kouka (Burkina Faso », in *Espace, population, société*, p. 83-92.

PHILIPPON, N., MARTINY, N., CAMBERLIN, P., RICHARD, Y., 2008, « Impact des précipitations sur l'activité photosynthétique de la végétation en Afrique semi-aride sub-saharienne », in *Climat et végétation*, p. 77-90.

RGPH, 2006 (Recensement Général de la Population et de l'habitation du Burkina), 2008, *Résultats définitifs*, INSD, Ouagadougou, 52 p.

RGPH, 2019 (Recensement Général de la Population et de l'Habitation), 2021, *Résultats définitifs*, INSD, Ouagadougou, 69 p.

SOLLY, B., El HADJI BALLA, D., SY, O., JARJU, A.M., SANE, T., 2020, « Détection des zones de dégradation et de régénération de la couverture végétale dans le sud du Sénégal a travers l'analyse des tendances de séries temporelles MODIS NDVI et des changements d'occupation des sols à partir d'images landsat ». in *Revue Française de Photogrammétrie et de Télédétection, Société Française de Photogrammétrie et de Télédétection, AFRIQUE, 223,* p. 1-15.

SYLLA, D., BA, T., DIALLO, M.D., MBAYE, T., DIALLO, A., PEIRY, J.L., GUISSÉ, A., 2019, « Dynamique de l'occupation du sol de la commune de Téssékéré de 1984 à 2015 (Ferlo Nord, Sénégal) », in *Journal of Animal & Plant Sciences*, Vol.40 (3), p. 6674-6689.

TANKOANO, B., 2012, *Suivi diachronique de la couverture ligneuse dans la forêt classée de Koulbi à l'aide de la télédétection et des systèmes d'information géographique (SIG)*, diplôme d'ingénieur développement rural option: Eaux et Forêts, université Polytechnique de BOBO-DIOULASSO (UPB), 94 p.

TRABI, Z.A., 2013, *Etude de l'impact des activités anthropiques et de la variabilité climatique sur la végétation et les usages des sols, par utilisation de la télédétection et des statistiques agricoles, sur le bassin versant du Bouregreg (Maroc)*, Thèse de Doctorat en Géographie Physique, Université Félix Houphouët Boigny d'Abidjan, 192 p.

YENGOH, G.T., HICHLER, T., TCHUINTE, A., 2021, « Ressource agro-climatiques et défis de la production alimentaire au Cameroun », in Geocarto international, p. 251-273.

https://doi.org/10.5719/aub-g/72.1/9

ANALYSIS OF THE TOURIST ATTRACTIVENESS OF URBAN SETTLEMENTS IN MEHEDINȚI COUNTY

ANA-MARIA ROANGHEȘ –MUREANU[1], AMALIA MIHAELA OGLINDOIU[2]

Abstract

The position of Mehedinți County in the southwestern part of Romania, on the left bank of the Danube at its exit from the gorge, together with the territorial planning actions, contributed to the socio-economic evolution of the regional territorial system.

As far as the tourist activity is concerned, it is focused on the exploitation of some resources, through actions and tourist products, which is done through the infrastructure created for this purpose, namely the infrastructure of accommodation, public food, transport and leisure, with the aim of attracting as many tourists as possible.

The aim of the study is the analysis of the existing tourist potential correlated with the thorough examination of the tourist market, carried out through a series of qualitative and quantitative methods with the help of which the evolution of the tourist circulation and the accommodation capacity in operation is highlighted. The calculation of some economic indicators, as well as some tourist indicators, is noteworthy as the methods used. The main results of the study reflect the diversity of types of tourist resources in the urban centers of Mehedinți County, with Drobeta Turnu Severin standing out in particular.
Keywords: built cultural heritage, geomorphosites, Danube Gorge, cultural tourism, cruise tourism, tourist traffic.

1. Introduction

Tourism is a complex activity, which raises a multitude of problems, being positioned at the intersection of several economic branches and sectors (Bădiță, 2013: 58), involving both man and nature (Cuvelier, 1998), being

[1] Faculty of Geography, University of Bucharest, e-mail: ana_mureanu@yahoo.com
[2] Faculty of Geography, University of Bucharest, e-mail: mihaelaoglindoiu@yahoo.com

a consequence of the increase in the human standard of living (Muntele, Iațu, 2006: 15).

The term tourism dates back to the 20th century (Tuns Bode, 2012), although the first record was made at the beginning of the 19th century when the use of this term referred to people who traveled (Pegge, 1814).

An exact definition of tourism is practically impossible to establish, considering the multiple economic and psycho-social implications. In a technical approach, Pearce (1993: 17) defined tourism as "a set of relationships and phenomena resulting from the travel and temporary stay of people, especially for relaxation and recreation".

Tourism activity is a complex activity that uses a series of indicators with the help of which the elements of tourism potential existing at the level of the area are highlighted. On the other hand, the area of influence of the cities does not coincide with their administrative limits, being wider (as is the case of Drobeta-Turnu Severin municipality) or narrower depending on the size and importance of the urban settlement at the regional level.

The peripheral position of the existing urban settlements in the studied region offers the possibility of polarization of the entire territory, but the stronger influence of the urban center of regional development, Drobeta-Turnu Severin, is felt. The urban phenomenon is one of the most characteristic features of contemporary civilization (Beaujeau-Garnier, 1971: 13). The growth of cities has intensified in recent decades, with increases both in the population and in tourists (highlighted by the increase in existing tourist indicators). The recreational facilities available both in and around cities are many and varied.

Due to the geographical position, Mehedinți's urban centers constitute a strong pole of attractiveness, represented by the elements of natural potential (the diversity of the relief, the existence of a climate that presents particularities of the sub-Mediterranean climate) and human tourist resources (historical, architectural buildings, memorial houses).

From a tourist point of view, Drobeta-Turnu Severin has a great historical value, being known since ancient times for being a European city with complex functions (Petculescu, 2013: 84). It should be noted that tourism is an important element for a locality, involving 3 distinct domains: economy, society and space (Băbăț, 2022: 108), aiming to create

jobs, accumulate income and create a balance of payment adjustment (Muntele, Iațu, 2003). Although the benefits of tourism are greater than the costs involved, the final goal is to fulfill a series of steps, such as: preserving the authenticity of the elements of natural and anthropic potential within local communities, satisfying the demands of the tourist and penetrating the product on the tourist market (Costencu, Cristescu, 2008: 87).

In this article, the authors set out to analyze the natural and cultural-historical tourist potential of the urban centers in Mehedinți County, as well as the evolution of tourist traffic and accommodation capacity in operation, in the period 2001-2021.

Mehedinți County benefits from a remarkable anthropogenic tourism potential, the existing urban settlements at its level attracting a considerable number of tourists. An important role is also occupied by the natural factor which, through its support function for the anthropic element, becomes a strong point in local tourism development.

The purpose of this paper is to present the main objectives/ elements of existing natural and anthropic potential, and how the development of tourism can contribute to the development of Mehedinți urban settlements. To achieve this goal, the study focused on a number of methods such as the investigation method, the observation method, the interpretation method and the graphic method.

2. General presentation of the area

Administrative organization

The position of Mehedinți county at the level of the Southwest Oltenia development region (in the southwestern part of Romania, on the left bank of the Danube at its exit from the gorge), together with the anthropic component, have contributed to the evolution of the regional territorial system.

From an organizational point of view, Mehedinți County is made up of 2 municipalities (Drobeta Turnu Severin and Orșova), 3 cities

(Strehaia, Vânju Mare and Baia de Aramă), 61 communes and 344 villages (see Fig. 1).

Fig. 1. The delimitation of Mehedinți County at the level of Romania
(*Source:* Oglindoiu et. colab. 2018)

The defining features of the natural component highlight the relationship between the natural and the human element, based on the influence of the particularities of the natural elements (relief, climate, hydrography, natural resources) and the way in which they contributed to human development and evolution, over time highlighting the human pressure on the environment determined by the main activities carried out in the occupied space.

The natural factor has a special role through its support function for the anthropic element, through its role as a barrier both for climatic factors, but also for historical, economic and social factors. Also, the relief can influence, through the nature of the rocks or the exposure of the slopes, the other natural elements: climatic factors, the spread of biogeographic areas, the orientation of the hydrographic network, all of which further contribute to the determination of the way of land use, to industrial development through the exploitation and processing of natural resources, outlining the functions of the analyzed territorial system. Depending on

these factors, the first human settlements in Țara Severinului (the Country of Severin) became individualized and later developed.

3. Methodology

The research methodology used to carry out this study took into account 2 categories of main methods: the research method and the statistical method. Within the research method, the study focused on the observation of existing phenomena in the field, the analysis and description of elements of tourist potential and bibliographic documentation, by identifying the main works written in accordance with the chosen theme.

Regarding the statistical method, a series of data provided by the National Institute of Statistics and the Ministry of Culture were used, data that were graphically and cartographically interpreted during the study.

4. Results

4.1. Urban settlements in Mehedinți County

The factors that influence the humanization of the territory are: settlement and accessibility, relief, climate, hydrography, soils (natural factors), age of residence and continuity of residence (historical factors), economic development (economic factors) (Oglindoiu, et al., 2021: 87-88).

Currently, from the point of view of the urban-rural division, of the county's total of 410 localities, 1.2% are actually urban, and 98.8% are rural. The population of the county is approximately 277,994 inhabitants, the percentage of the urban population being equal to that of the rural population (50%).

4.2. Economic activities

Mehedinți County has had since ancient times a rich commercial activity, of naval transports, especially those of goods, being advantaged by its

geographical position, opening to the Danube. Regarding road transport, they have a network of 1856 km, of which 374 km are national and European roads (Mehedinți County Monograph). Post and telecommunications have their beginnings in 1862 (Braghină, 2000) gaining momentum in recent years. Commercial and public services designed to meet the growing demands of the population have seen an important development in recent years.

From an economic point of view, the county has important production capacities in the field of shipbuilding, wagons, wood processing, manufacturing of inorganic products, manufacturing of wooden furniture, pulp and paper, textiles, food industry, capacities for coal extraction and electricity production (hydro and thermal) (Mehedinți County Monograph).

After 1999, the economic condition of the northern county system registered a slight improvement, but not enough to lead to substantial changes in the population's standard of living.

At the level of 2020, the number of commercial companies existing at the level of urban settlements (2455 economic agents) registers a percentage of over 70% of the total existing at the level of Mehedinți county (3366 economic agents) (see Fig. 2).

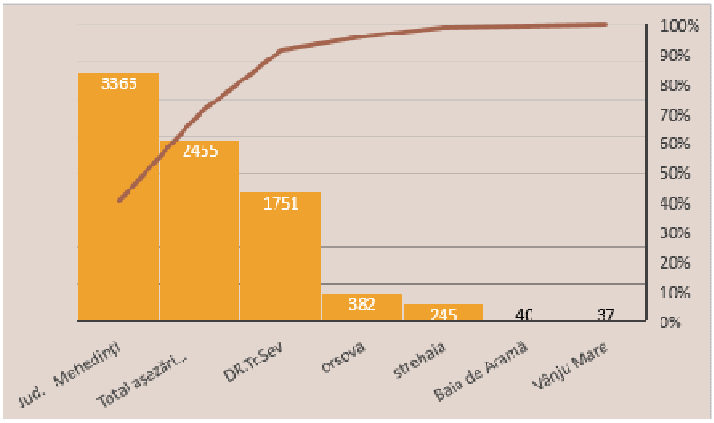


Fig. 2. Number of urban commercial companies
in relation to the companies in Mehedinți county (2020)
(*Source:* processed INS data)

Regarding the number of employees at the level of urban settlements, it represents over 80% of the total number of existing employees at the

county level (see Fig. 3). For their part, the number of employees in tourism had an increasing evolution until the level of 2019, followed by a pronounced decrease due to the pandemic situation (5 %) (see Fig. 4).

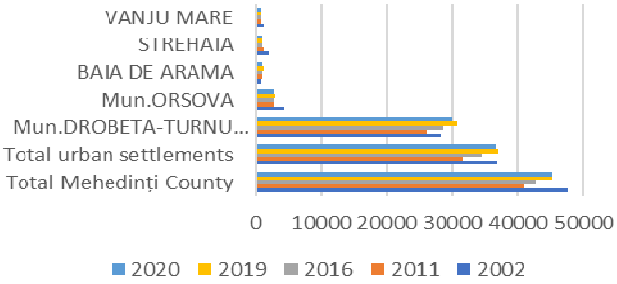


Fig. 3. The evolution of the number of employees at the level of urban settlements (*Source:* processed INS data)

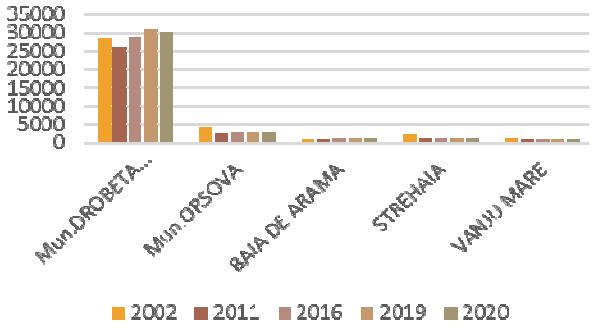


Fig. 4. The evolution of the number of employees in tourism at the level of urban settlements (*Source:* processed INS data)

4.2. Analysis of the tourist potential of urban settlements in Mehedinți county

Being crossed by the Danube in the south-southwest part, Mehedinti county is very rich both in landscapes and natural places of extraordinary beauty (on its territory there are 2 national natural parks), as well as in cultural-historical objectives represented of the ruins of Roman forts and medieval fortresses that are still visible today.

Thus, it can be appreciated that the natural tourist potential within Mehedinți county is made up of natural elements that are introduced within the tourist circuits, to which is added the diversity of elements of anthropic tourist potential (archaeological vestiges, historical monuments, architecture, art, ethnography, economy, constructions with touristic value) (Oglindoiu, 2018: 70).

An important role is also played by their positioning (urban settlements) in the southern border area of Romania, but also in the geographical and touristic area of the Iron Gates Natural Park where they are present as representative values both economically and politically (Ilovan, Merciu, 2021: 45), but also as fundamental values of human existence and specific elements of tourist attraction (Drăguleasa, 2022: 153). The Iron Gates Natural Park is an important area for geoconservation in Romania, having a geological heritage among the richest in the Southern Carpathians (Grecu, 2014: 178). The tourist attractiveness is also given by the presence of geosites in this area, there are approaches regarding the accessibility of tourists to them, accessibility influenced by positioning near the main access roads (Grecu, 2014: 180).

Regarding the cultural activity in Mehedinți County, the analysis of human resources highlights the presence of a cultural-historical potential (archaeological sites, architectural monuments, monuments of technical popularity, museums, traditional cuisine) (Boengiu, 2012: 237). Thus, an important landmark is the "Theodor Costescu" Cultural Palace in Drobeta-Turnu Severin, and also the museums (Museum of the Iron Gates region, "Gheorghe Rădulescu Motru" Memorial House, Eșelnița Parish Museum) and monuments etc. Among the existing archaeological remains is the Archaeological Complex of Drobeta-Turnu Severin, which includes the ruins of the Roman fort, the ruins of Trajan's bridge, the tower of Justinian (6th century), the ruins of the medieval fortress. Other archaeological remains are the ruins of Ada Kaleh, displaced from the island Ada Kaleh on the island of Șimian, in order to build the reservoir Porțile de Fier I (Mehedinți County Monograph).

The statistical data available at the Ministry of Culture highlighted the presence on the surface of Mehedinți's urban settlements (at the level of 2015), over 200 historical monuments out of a total of 570 monuments at the county level. As a typology, 3 categories of historical monuments can be mentioned: archaeological monuments, architectural monuments and commemorative monuments.

According to statistical data, Drobeta-Turnu Severin municipality is numerically different from the other urban centers, due to the multitude of historical monuments listed on the List of Historical Monuments declared cultural heritage objectives. Towards the end of the Mesolithic era and the beginning of the Neolithic, the Cladovei Scaffolding culture appears with bone tools for agriculture and fishing (8570-7700 BC) (Ieva, Vișan, 1994: 7-8). The Cladovei Scaffolding archaeological site with the oldest stable settlement (approx. 10000-7500 years) in Romania and possibly in Europe (the archaeological materials discovered demonstrate ancient and continuous habitation: rectangular-shaped houses with hearths for heating and preparing food, over 100 burial tombs - skeletons with great heights (such a skeleton is at the Museum of the Iron Gates region) (Boroneanț, Boroneanț, 2009: 15-34).

Due to the construction of the Iron Gates hydropower plants, the site was heavily affected, a large part of it being destroyed, some of the artefacts found in the site are exhibited at the museum. The most important are the remains of the Roman Drobeta Camp (the first stone fortress built in Dacia by the Emperor Trajan, a defense construction and an important military and political center) whose image can be found on Trajan's Column (Tudor, 1965: 10; Tudor, 1978: 274-276), Traian's Bridge (built in only three years (103-105) according to the plans of the architect Apollodorus from Damascus (Drâmbă, 2003: 363, Tudor, 1979: 35-47) – the most daring engineering work of Roman antiquity, the Drobeta thermal baths, the ruins of the Roman amphitheater (it is carved on Trajan's Column), the Severin Medieval Fortress etc. These vestiges have undergone restoration processes as a result of the implementation of some projects with European funds. From the category of architectural monuments (civil, administrative, cultural and industrial buildings and structures of large dimensions, symbols of national identity, which over time also acquired the function of tourist attractions) that are in a large proportion in Drobeta Turnu Severin we mention: neoclassical style constructions (Commercial Bank Headquarters, "Theodor Costescu" House – Traian Street etc.), neo-Romanian style buildings (Former Paid Polyclinic, "Daia Alexandru" House, Dialysis Center, "Taxe și impozite" Department, etc.), buildings with the *Little Paris* style architecture (Moșneanu Adrian House, Iancu Saidac House, etc.), in Romanian style (Pogany House) (see Table 1).

Table 1

The situation of existing historical monuments at the level of urban settlements in Mehedinți County

	Archeological monuments	Architectonical monuments	Commemorative monuments
Drobeta Turnu Severin	20	50	100
Orşova	-	2	-
Baia de Aramă	1	3	5
Strehaia	5	3	4
Vânju Mare	5	-	1

Source: Data calculated by the authors according to the List of Historical Monuments in Mehedinți County, 2015.

The emblematic buildings of the city can be noted such as: the Art Museum – the most beautiful monument of civil architecture in Drobeta in an eclectic style with baroque elements (Sabetay House), the "Theodor Costescu" Palace (the work of the architect Grigore Cerchez, based on the Venetian model, in the Ionic style , has inside a cinema, a theater hall and a festival hall, the "I.G. Bibicescu" Library, on the building are two eagle-eyed, winged griffins with lion claws) (Butnariu, 2012:179-181), Traian National College Building, National Bank of Romania Building (Bibescu House), "Radu Negru" Hall, Iron Gates Museum (neo-Romanian style, which originally functioned as a boarding school of Traian High School), Water Castle, "Saint George" Episcopal Cathedral, Grecescu Church, Assumption Church (Maioreasa), Vodița Monastery, Askenaza Synagogue. To which are added numerous commemorative monuments (Monument to the Heroes of the First World War, Bust of King Decebal, Bust of Emperor Trajan, etc.) (see Fig. 5, 6 and 7).

Fig. 5. Theodor Costescu Palace
(*Source:* personal archive, 2022)

Fig. 6. Porțile de Fier Museum
(*Source:* personal archive, 2022)

Fig. 7. Bibescu House
(*Source:* personal archive, 2022)

At the opposite pole is the city of Orșova which, due to the construction of the dam on the Danube, lost forever an important part of its culture, the old Orșova is under the waters of the Danube. Among the architectural monuments, the Roman Catholic Cathedral in Orșova built between 1972-1976, according to the plans of the architect Horst Fackelmann, the "Saint Nicholas" Orthodox Church, to which the "Saint Ana" Monastery – orthodox monastic settlement, could be added, stand out. foundation of the interwar journalist Pamfil Șeicaru, an objective extremely visited by tourists due to the panorama offered.

In the other urban settlements of the county, there are a small number of historical monuments, but they have great cultural significance, let's mention the following: Strehaia - Strehaia Monastery, the cellars of the royal palace, the Holy Trinity Church; Tudor Vladimirescu's monument, Vasilescu House from Baia de Aramă, Baia de Aramă Monastery; Vânju Mare-Bucura archaeological site, Novac's furrow from Orevița Mare, Cetății Hill archaeological site from Orevița Mare.

The existence of diversified natural tourist potential and the multitude and variety of historical monuments in Drobeta Turnu Severin make the types of tourism practiced here diverse. It can be observed an increased interest of tourists for the historical-cultural objectives highlighted by the increasing number of visitors to the Iron Gates Museum, the Medieval Citadel, the Water Castle (Arts), which makes us rate cultural tourism as the better individualized.

In general, those who visit the city practice weekend and transit tourism. It can be observed, however, that cruise tourism has gained new impulses by the introduction of boats with foreign tourists in the Drobeta port in the cruise circuits from Germany. The Vodița Monastery, along with

the Strehaia Monastery and "Saint Ana" Monastery, are sights visited by tourists who come to this area, so we can say that another type of tourism practiced is the religious one (see Table 2).

Table 2

Distribution of frequented forms of tourism at the level of Mehedinți urban settlements

Municipality / town's name	Cultural tourism	Cruise tourism	Religious tourism	Geo-tourism	Weekend tourism
Drobeta Turnu Severin	+++	++	++	++	+++
Orşova	+	++	+++	++	+++
Baia de Aramă	+		+	+++	+
Strehaia			++		
Vânju Mare					

Source: Data calculated by the authors

In Baia de Aramă, geotourism presents the greatest interest for tourists who come to this area. Despite several cultural-historical objectives, religious tourism is practiced in Strehaia, but there are no accommodation structures here, so the city is only transited by tourists who make a stop to visit the Strehaia Monastery. Vânju Mare has no tourist potential. An opportunity would be to introduce it into a circuit of Oltenia vineyards and wineries.

Tourist traffic

The evolution of tourist traffic is manifested under the influence of a complex of factors, some essential, others with a reduced and less significant influence. As such, in the analysis of the connections we will use non-parametric correlation models, in which the determining factor will be the accommodation capacity in operation, and the dependent factors will be total tourist arrivals and total overnight stays.

The analysis of the existing accommodation capacity at the level of Mehedinți urban settlements highlights a preponderance of units at the level of Drobeta Turnu Severin Municipality, followed by Orșova and Baia de Aramă. As an evolution, the curves are predominantly increasing, a significant increase can be observed at the level of 2019, followed by a stagnation until 2019 and an increase again in 2021 (see Fig. 8).

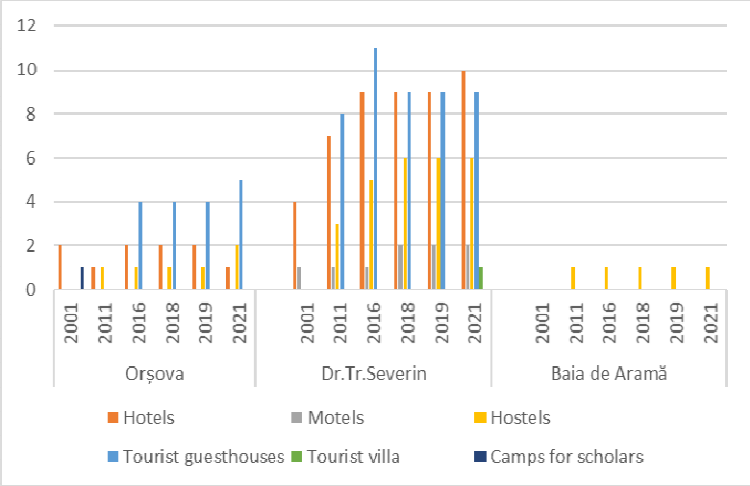


Fig. 8. The evolution of accommodation capacity
at the level of Mehedinti urban settlements (2001-2021)
(*Source:* processed INS data)

From the point of view of the distribution by types of structures, there is an upward trend in the value curves for all types of existing accommodation units at the level of the area, the highest percentage being occupied by structures of the tourist boarding house type, followed by hotels and hostels (see Fig. 9).

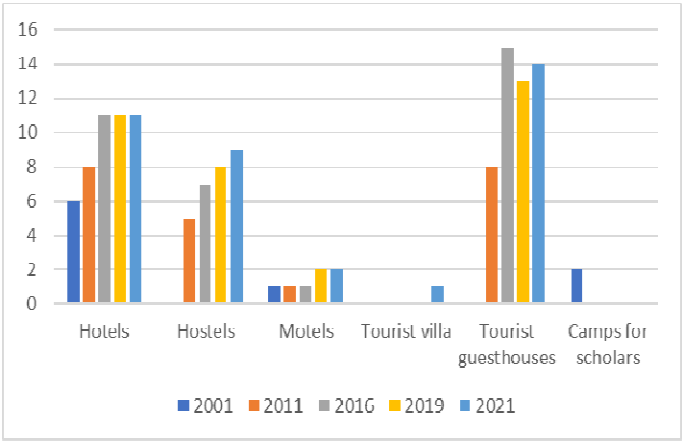


Fig. 9. Distribution of accommodation capacity by types of units (2001-2021)
(*Source:* processed INS data)

Evolution of the number of arrivals and overnight stays in accommodation units

The number of arrivals in accommodation units at the level of urban settlements registered a significant increase until 2019, when a continuous decrease is recorded (by approximately 25% of the capacity), a phenomenon due to the pandemic conditions existing at that time.

From the point of view of no. of overnight stays in accommodation units, an increasing trend can be noted at the level of urban settlements until 2016, followed by sharp decreases (the difference between 2019 and 2020 being 40% of capacity) (see Fig. 10).

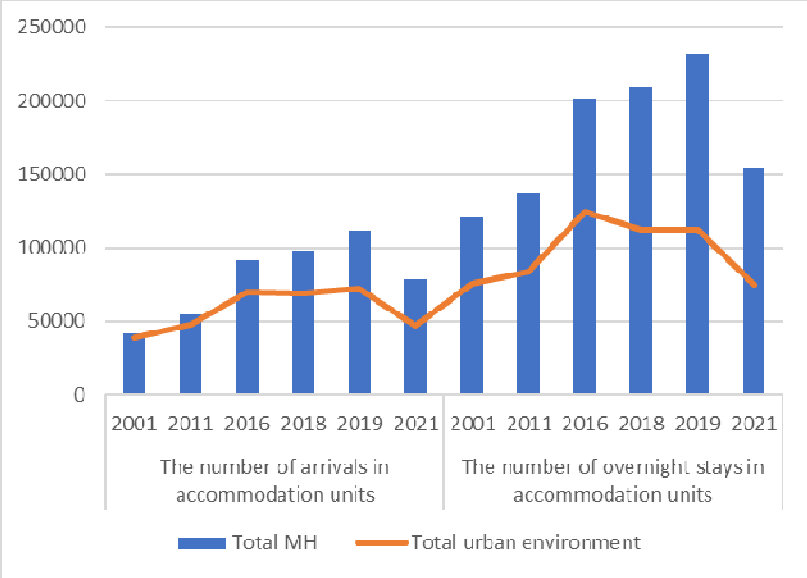


Fig. 10. The evolution of the number of arrivals and overnight stays at the level of urban settlements in Mehedinți County (2001-2021).
Source: processed INS data

On the other hand, it can be noted that the evolution of the number of tourists during the period 2001-2021 marks an upward trend. The minimum value of 39196 tourists is recorded in 2001, and the maximum value being recorded in 2019 by 72609 tourists. In 2021, there is a sharp decrease compared to 2019 in the number of tourists, reaching 47,372

tourists. A possible cause can be the pandemic situation that marked the entire tourist activity.

In terms of overnight stays, the lowest value is recorded in 2001, followed by an increase to the level of 124,699 tourists (at the level of 2016) and then a decrease to the level of 2021 when the values reached 74,565 tourists.

Index of the use of accommodation places in urban settlements in Mehedinți County

The index or coefficient of use of the tourist accommodation capacity represents an indicator that helps to assess the efficiency of the exploitation of accommodation spaces. The indicator shows the percentage of the existing accommodation capacity that has actually been used (see Fig. 11).

At the level of the area, the trend of this indicator is downward, the accommodation capacity being effectively used at a percentage below 15%.

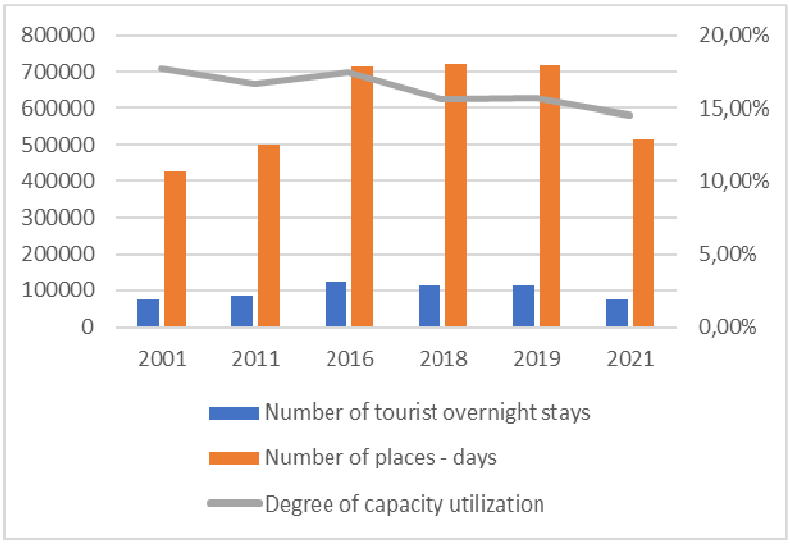


Fig. 11. The index of use of accommodation places at the level of urban settlements in Mehedinți County (2001-2021)
(*Source:* processed INS data)

Average length of stay in urban settlements in Mehedinți County

The indicator shows the average length of stay (days) of tourists in accommodation spaces and thus reflects the ability of the destination to retain tourists in a certain area. At the level of the area, this indicator registers decreasing values, the average length of stay being at the level of 2020 from 1.57 days (see Fig. 12).

Regarding the analysis of tourist circulation in the urban settlements of Mehedinți County, a pronounced seasonality is noted, with a peak period overlapping the period between the months of July and September, the month of August registering the highest value of tourist visits (see Fig. 13).

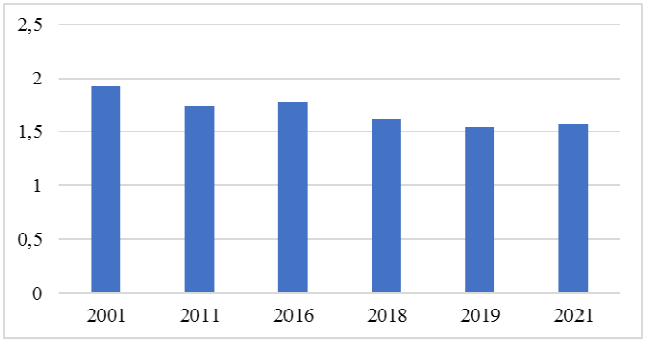


Fig. 12. Average length of stay in urban settlements in Mehedinți County (2001-2021) (*Source:* processed INS data)

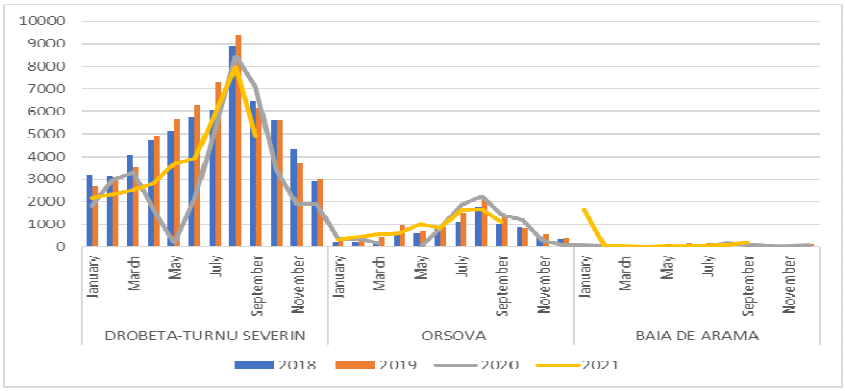


Fig. 13. Seasonality of tourist traffic in urban settlements in Mehedinți County (*Source:* processed INS data)

Starting from 2020, although the same trend of values is maintained, the circulation has decreased quite a lot, something that can be observed through the analysis the number of arrivals and overnight stays analyzed and presented previously.

Overall, the analysis of statistical data on the development of tourism shows that tourist traffic is increasing, although there is a contradiction between the upward trend of tourist flows and the delay in large-scale tourist infrastructure, with the predominant type of accommodation being guesthouses and hotels.

Conclusions

The urban settlements in Mehedinți County benefit from a diverse, natural and anthropogenic tourism potential, a potential that should be exploited through the continuous development of sustainable tourism, by increasing the economic level, as well as reducing or even eliminating the pollution caused by these activities. The identification and launch of nature-oriented tourist products could represent a means of attracting a growing number of tourists, from all segments, ensuring an increase in the average length of overnight stay.

As a first conclusion of the analysis carried out, we can highlight the need to capitalize on all existing opportunities at the present time, to ensure an increase in the share of tourism at the level of urban settlements in Mehedinți.

Based on the interpretation of the statistical data, it was possible to demonstrate the existence of an accommodation capacity necessary for the development of tourism and the satisfaction of the interest shown by tourists for the analyzed area. Although in the first part of the analyzed period the values are increasing, the pandemic period generated downward developments in all these indicators.

As a general conclusion, the authors consider it necessary and useful to develop some plans and strategies for the development of the tourism sector at the county level, which would better value the existing potential. It is necessary a real promotion of the area by participating in tourism fairs, especially at the national level, but also internationally, the

organization of events in various fields with attractiveness for tourists, the capitalization of existing European funds for the realization of projects with a direct or indirect impact on tourism. The pandemic has affected the tourism sector so much that it has profoundly changed the business models of the entire system. It is necessary that they adapt to the new needs of tourists, with increased attention to health, safety and their desire to seek outdoor travel to rediscover nature, authenticity, traditions and beauty.

REFERENCES

Băbăț, Andrei-Florin, Pavel, Sorin, 2022, *Tourism development in the borderlands of Romania: A Case Study of the Danube Gorge-Iron Gates,* in Questiones Geographicale no 41(4), p. 107-125.

Bădiță, Amalia, 2013, *Approaches to the analysis and evaluation of urban tourism system within urban destinations*, în Journal of Tourism – studes and research in tourism, "Stefan cel Mare" University of Suceava, România, vol. 16(16), p. 58-66.

Beaujeau-Garnier, Jacqueline, Chabot, Georges, (1971), Geografia urbană, Bucureşti, Editura Ştiințifică.

Boengiu, Valentina, 2012, *Evoluation of tourism resorurces in the Iron Gates Natural Park in order to identify the potential of tourism development,* in Analele Universității din Oradea, Seria Geografie, Year XXII, no. 2/2012 (December), p. 234-240.

Boroneanț, A., Boroneanț, V., Schela, Cladovei, 1965-1968. După 40 de ani, în Rev. Studii de preistorie, nr. 6/2009, București, Editura Renaissance, p. 15-34.

Braghină, C., 2000, Așezările umane din dealurile piemontane dintre Motru și Gilort, București, Editura Tehnică.

Butnariu, M., 2012, Monografia municipiului Drobeta Turnu Severin, Editura Prier.

Conea, I., 1937, Geografia satului românesc – așezare, formă, structură, Sociologie Românească, Anul II, Nr. 2-3, februarie-martie, p. 179-181.

Costencu, Mirela, Cristescu, Ilie, 2008, *Cultural tourism product,* Analele Universității din Oradea, Seria Științe Economice, vol. 17 (2), p. 87-91.

Cuvelier, P., 1998, *Anciennes et nouvelles formes de titourisme,* Paris, Editura Harmattan, France.

Drăguleasa, Ionuț-Adrian, 2022, *Tourism in protected natural areas. Case study: Iron Gates Nature Park,* in International Scientific Journal Theoretical & Apllied Science, Issue: 1, vol. 105, p. 153-163.

Drâmbă, O., 2003, Istoria culturii și civilizației, vol. II, București, Editura Saeculum, p. 35-47.

Grecu, Florin, Iosif, Daniel, 2014, *The geosites from Danube Defile in Romania. The vulnerability to touristic activities*, in GeoJournal of Tourism and Geosites, Year VII, no. 2, vol. 14, November 2014, p. 178-184.

Erdeli, G., 1992, Podișul Mehedinți. Geografie umană, București, Editura Metropol.

Ianoș, Ioan, 1987, Orașele și reoganizarea spațiului geografic, București, Editura Academiei RSR.

Ieva, N., Vișan, O., 1994, Mehedinți, timp și istorie, Dr. Tr. Severin, Editura Hermes.
Ilovan, Oana-Ramona, Merciu, Florentina-Cristina, 2021, *Building Visual Intertextuality and Territorial Identitiees for the Romanian Danubian Settlements during Socialism,* in Journal of Settlements and Spatial Planning, Issue no. 7 (2021), p. 15-50.
Muntele, I., Iațu, C., 2006, *Geografia turismului. Concepte, metode şi forme fr manifestare spațio-temporală,* Iaşi, Editura Sedcom Libris.
Oglindoiu, Amalia Mihaela, 2010, *Podișul Piemontan al Bălăciței. Geografia așezărilor rurale*, Craiova, Editura Aius Printed.
Oglindoiu, Amalia Mihaela, Carablaisă, S., Roanghes-Mureanu, Ana-Maria, 2018, Municipiul Orșova Elemente de geografie fizică și umană, Craiova, Editura Aius.
Oglindoiu, Amalia Mihaela, Roanghes-Mureanu, Ana-Maria, 2021, *Curent aspects of the population dynamic in the municipality of Orșova, Romania, Revista Centrului de Cercetare – Degradarea Terenurilor și Dinanamică Geomorfologică (DTDG),* vol. V, p. 87-95.
Pegge, S., 1814, *Anecdotes of the English Language*, London, J. Nichols Son and Bentley.
Petculescu, Mirabela, 2013, *Landmarks of historical development in Drobeta-Turnu Severin,* in Review of Historical Geography and Toponomastics, vol. III, no. 15-16, p. 83-93.
Tudor, D., 1965, Drobeta, București, Editura Meridiane.
Tudor, D., 1978, Oltenia romană, București, Editura Academiei, ed. IV.
Tudor, D., 1979, Itinerare arheologice și istorice oltene, București, Editura Sport-Turism.
Vert, C., 2000, *Geografia populației și așezărilor umane,* Timișoara, Imprimeria Mirton.
*** Monografia județului Mehedinți
*** www.insse.ro
*** https://patrimoniu.gov.ro/images/lmi-2015/LMI-MH.pdf

https://doi.org/10.5719/aub-g/72.1/10

CHARACTERISTIC FEATURE OF THE FLOOD VULNERABILITY IN URBAN AREAS. CASE OF SKIKDA CITY (NORTH EAST ALGERIA)

AZZEDINE GHACHI[1], FOUDIL KHALED[1], KHEIREDDINE DJEDAIET[1], OUALID MEDDOUR[1]

Abstract

Floods are incredibly dangerous and disruptive, and flooding is on the rise around the globe due to climate change. For these reasons, flood management will be one of the top challenges for communities around the world for the next half-century and beyond. This study is based on the knowledge of extreme hydrological mechanisms and a strong urban growth. It constitutes a first step towards a better management of the flood risk, in particular by the proposals materialized by documents in the form of cartographic tools as decision support. In this article, we'll provide a sky-high view of the configuration of the flood risk management solution through a new scientific approach by hydroclimate analysis. The study relied on the maximum daily rainfall data over an observation period of 47 years (1970-2017). The statistical treatment of the Maximum daily rainfall and short duration showers highlights the frequency values characterizing the intensity of rainfall representative of the study area. The peak flows were evaluated using the rational method and the Sokolovski flood hydrograph method. The objective of this study is to assess the flood risk in the city of Skikda by comparing the hazard and vulnerability and to propose cartographic tools to assist decision-making.
Keywords: Watershed, Peak flow, Flooding, Maximum rainfall, Risk, Skikda, Vulnerabilit.

1. Introduction

Today, floods are the first natural risk, they have at their origin meteorological-hydrological events that, because of their stochastic nature, are very difficult

[1] Constantine 3 University Salah Boubnider, Algeria, e-mails: azzedine.ghachi@univ-constantine3.dz, foudil.khaled@univ-constantine3.dz, khiereddine.djedaiet@univ-constantine3.dz, oualid.meddour@univ-constantine3.dz.

to predict in terms of their return period and their intensity. They are all the more feared when they occur in cities, where there is a high concentration of human activities. Floods represent more than 80% of the world's natural disasters between 1996 and 2006 and were responsible for about 500,000 deaths and $600 billion in economic losses. In fact, they are the most spectacular natural disasters that produce the most damage (Klijn, 2008). As a result, economic activities are severely disrupted and the costs to society become exorbitant, hence the need to anticipate and prevent the return of these disasters. Algeria is classified at the plantar scale in the orange zone by more than 60 floods during the period 1974-2003. 2,470 floods have occurred internationally over the past 20 years (1989 and 2009). 147,457 people lost their lives and damage was estimated at US$ 372.5 billion (according to EM-DAT). Many cities in Algeria are confronted to the phenomena of floods that occur recurrently, thus constituting a major constraint for economic and social development. Climate change often intensified by aggravating factors (accelerated urbanization, occupation of flood-prone areas, sealing, deforestation, fires, failure of rainwater networks, etc.) have largely contributed to modifying the hydrological response of hydrographic systems, thus favoring the extent of anarchic runoff. Numerous works carried out to understand the functioning of hydrological systems and the anthropization of natural landscapes Ghachi, 2015; Oberlin, 1993; Behloul, 2009; Benjamin, 2004) deduce an increase in runoff and drainage caused by the transformation of undeveloped natural land into urban waterproofed land. On the other hand, cities have always practiced stormwater drainage and the protection against flood. What offers the particularity of the urban area is the active presence of the anthropogenic factor which by its activities, by the density of its constructions etc. increases the vulnerability of certain factors, including the population. As a result, the passage from the hazard stage to risk stage increases more quickly in time and space (Grecu, 2011). Another peculiarity is the pluri- and interdisciplinary nature of the genetic type of risks because in most cases risks, so-called natural, also have anthropogenic causes (Grecu, 2018). The flooding problem has given rise to numerous works on the assessment and management of flood risks in urban areas (Ghachi, 2015; Khaled and Amireche, 2021, Grelo, 2001). The empirical approach is to

relate the characteristics extracted from flow chronicles to the geomorphological, hydrological and climatological characteristics of watersheds (Bishop and Church, 1992; Cemagref, 1986; Dingman, 1981; Liebscher, 1972). The models resulting from this approach are presented either in cartographic or mathematical form. For consistency, the same method was used and validated during modeling work at daily time steps (Perrin, 2000; Perrin et al., 2001, 2003), monthly and annually was adopted. The extreme economic importance of flood studies is largely explained by geographical considerations: areas of high urban concentrations are very often near rivers; the richest agricultural land is generally in the lower valleys (Laborde, 2000; Bujan, Veliz, Manzanares, 2004.). The stated objective is to manage risks in order to eliminate any possibility of disaster. However, the exceptional rainfall events recorded in recent years (Constantine, Skikda, Annaba, Bab el Oued, Ghardaïa, Bechar, Sidi Bel Abbes) have highlighted the importance to be given to the risk of flooding and to seek the natural and anthropic causes in order to limit losses. It is not to stop a flood but to reduce the risk and minimize the cost of damage. It has been estimated that in developing countries, more than 40% of the urban population is threatened directly or indirectly by natural phenomena likely to cause damage to people and property (Khaled and Amireche, 2021). This context corresponds well to what is observed, for example, in the agglomeration of Skikda where a strong demographic growth. The last decades have led to a rapid expansion of the city, resulting in the urbanization of areas exposed to flooding. The objective of this study is to assess the flood risk in the city of Skikda by comparing the hazard and vulnerability and to propose cartographic tools to assist decision-making.

Study area setting

The study area located in the humid Mediterranean zone between 6°54' and 36°35' N (Fig.1) Skikda is characterized by a rugged site surrounded to the north by the sea, to the south by land with high agricultural value, to the west by an accentuated orography and to the east by a large industrial zone.

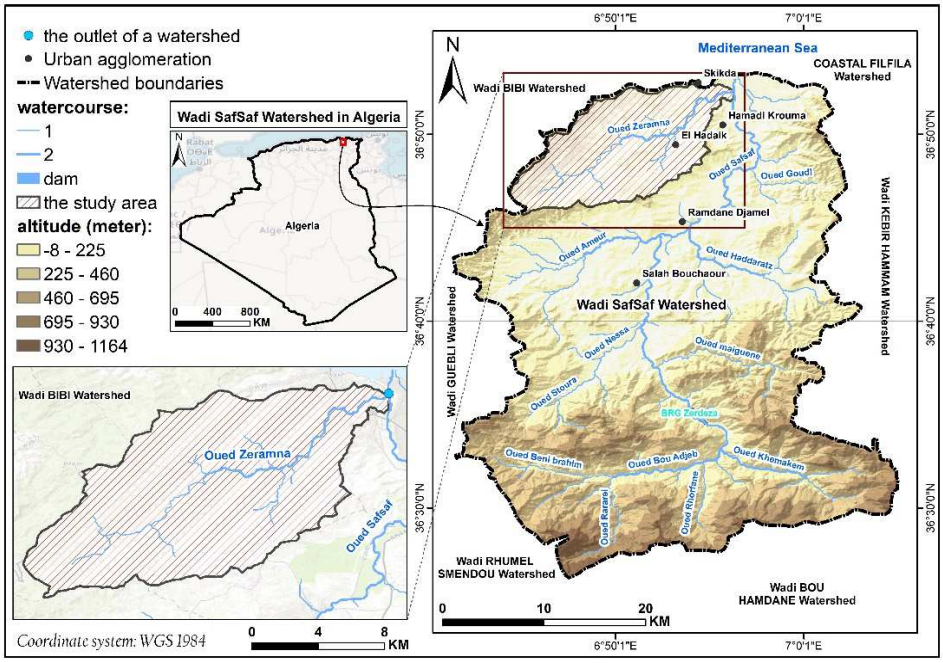


Figure 1. Situation of the semi-urban watershed studied

Due to its central location, the Algerian North East is subject to heavy rains, which generally occur between September and May. The damage to property is growing, in recent years in connection with the urbanization of flood-prone areas where the drainage systems are non-existent. The city has long been sheltered from rising waters because installed on the heights (city of Bouabaz, downtown, Brothers Bouhadja etc.). However, the urban growth difficult to control in recent decades has led to the use of flooding areas for construction purposes. This situation can only worsen in the coming years if there is no consideration of the flood risk in the current development plan. The choice of watersheds as a framework for the study was guided by the hydrological approach in order to evaluate the maximum flows of floods generating overflows without losing sight of the complex interaction between urbanization and the flood hazard.

2. Data and methods

The morphometric characteristics of the watersheds (wadi Saf-saf 03) and the data of maximum daily precipitation as well as rainfall (Skikda rain gauge), used in the determination of the flood flows, constitute the basis of this study. The statistical processing of the series of maximum daily rains (Pj max) using the Skikda pluviograph (code 03 08 01) with an observation period of 47 years (1970-2017) is considered to be representative of the study area.

– ***Morphometric parametric***

Morphometric parameters allow a better understanding of the reaction of the watersheds to hydropluviometric events. They present a relatively dense hydrographic network with steep to medium slopes, known for its rapid transmission of floods downstream during intense rainfall events.

– ***Maximum daily rainfall and showers.***

The study of maximum daily rainfall and rainfall intensity and their impacts on urban concentrations, reveal an increasing importance for the study of flood control projects. Expressed most often as Intensity-Duration-Frequency curves, they represent the probable maximum values of the related showers at different time intervals and provide useful values for the evaluation of extreme flows. The statistical treatment of the series of maximum daily rainfall at the Skikda rain gauge (code 03 08 01) with an observation period of 47 years (1970-2017) is considered representative of the study area.

– ***Calculation of the peak flow and the flood hydrograph Rational method***

The rational method is the most used empirical model in the world. It is based on the idea that the maximum runoff at the outlet of a watershed is obtained when the entire area of the watershed contributes to the flow.

– ***Calculating the intensity of rainfall***

The intensity of rainfall I(tc,T), observed during an equal time of concentration (TC) of watershed was evaluated using the relationship established for the Skikda region.

$$H(Tc, T) = Pjmax(T) \cdot (tc/24)^{0.38}$$

In which: H (Tc, T): Height of precipitated water during a time equal to the time of concentration of the watershed in hour.
T: return period of the value calculated in years.
Pjmax (T): maximum daily rainfall of the same frequency T.

When the area is expressed in Km^2, the rain intensity in mm/h and the flow rate in m^3/s the rational method takes the form:

$$Q(t) = 0.278\ C\ I(tc,T)\ A$$

In which: Q(T): flow of the flood of frequency (T).
I(tc, T): rain intensity (mm/h) of frequency (T).
Tc: concentration time of the watershed.
A: Area of the watershed in Km^2.
C: runoff coefficient related to soil characteristics (slope, permeability, vegetation cover).

The layout of the Zeramna wadi

The flood vulnerability map was based on the DTM of the Skikda region. The use of the DTM in the ARC GIS software allowed to produce the contour lines and the hydrographic network (Fig. 2).

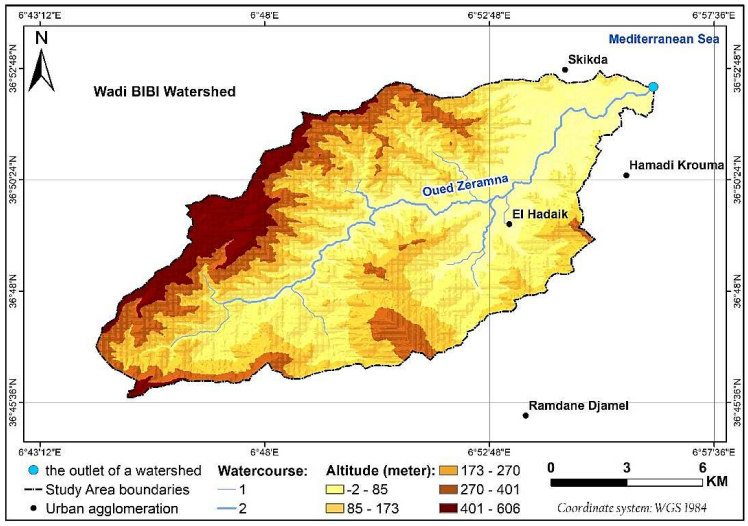


Figure 2. Hypsometric map watershed Wadi Zeramna

From the topographic map and the hydrographic network, the Zeramna wadi was traced using the HEC-GEO RAS tool in the software. ARC GIS. HEC-GEO RAS is the link between these two software.

3. Results

The Pj max series fits the Gumbel law correctly and gives the frequency values with the respective recurrence period summarized in Table 1.

Table 1

Maximum daily frequency rainfall values (mm) at the Skikda rain gauge

Return period T (year)	Frequency (F)	Gumbel's reduced variable	Rain height (mm)
2	0,5	0,37	50
5	0,8	1,5	72
10	0,9	2,25	87
20	0,95	2,97	101
50	0,98	3,902	119
100	0,99	4,6	133

Source: ANRH data. Processed and prepared by Ghachi, 2018

The short duration rainfall is obtained from the Pj max. according to the study of Body K.1981.According to the formula of Montanari and based on ANRH (National water resources agency) data, the relationship Intensity- Duration- Frequency (IDF) is of the form:

$$P_t = Pj\ max\% \ (t/24)^b$$

For the Skikda region, the climatic exponent b = 0.38 Table 2. summarizes the hourly intensities in mm/h for the different time steps and the respective return periods.

Table 2

Maximum average intensities (mm/h) for various time intervals Δt as a function of their return time T

Return period T (year)	Reference intervals Δt (in minutes)					
	15mn	**30mn**	**1h**	**2h**	**3h**	**6h**
2	35	23	15	10	7,5	5
10	61	40	26	17	13	8,5
50	84	55	36	23	18	12
100	94	61	40	26	20	13

Source: ANRH, ONA of Skikda + Personal contribution 2019

The Intensity-Duration-Frequency curves at the above-mentioned rain gauge were established. These curves make it possible to estimate the frequencies of exceedance F and return period T of the observed rainfall events generating flows from their durations and their intensities by graphic interpolation (Fig. 3), essential in the field of evacuation of the flows of protection project against floods.

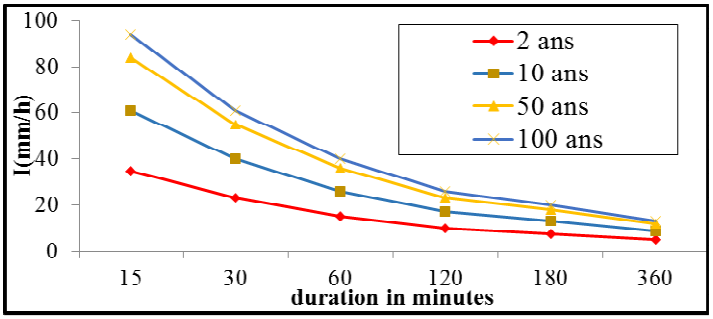


Figure 3. Intensity-Duration-Frequency (IDF) curves at the Skikda rain gauge

3.1. Generated flood flows

The catchment areas draining the outskirts of the city of Skikda and its extension area are characterized by rapid floods accentuated by anarchic urbanization whose consequences can be catastrophic. Table 3 summarizes the frequency intensity values calculated for different times of concentration (TC).

Table 3

Determination of rainfall intensity I (tc, T) in the watersheds studied

T(years)	Frequency	Pjmax(T)/mn	H(tc,T)/mn	I(tc,T)mn/h
Watershed of oued El Ouahch (Tc= 160mn)				
10	0,10	87	37,7	14,2
20	0,05	101	43,8	16,4
50	0,02	119	51,6	19,4
100	0,01	133	57,6	21,6
Watershed of oued Beni Malek (Tc=103mn)				
10	0,10	87	29,8	21
20	0,05	101	34,3	24
50	0,02	119	40,5	28,3
100	0,01	133	45,2	31,6
Watershed of oued Zeramna (Tc= 435mn)				
10	0,10	70	44,2	6,2
20	0,05	74	46,6	6,5
50	0,02	80	50,4	7
100	0,01	83	52,3	7,3

The maximum flows calculated for the return periods 10, 20, 50 and 100 are summarized in Table 4.

Table 4

Frequency flood flow in m³/s (rational method)

Watershed	Return period (T in years)			
	10	**20**	**50**	**100**
Oued El Ouahch	8,9	10,2	12	13,4
Oued Beni Malek	10	11,5	13,6	15,2
Oued Zeramna	79	83	89,2	93

Source: A.Ghachi. 2019

The rational method remains very sensitive to the choice of the runoff coefficient. The latter seems to reflect the specificity of the basins studied which are lithologically impermeable. Added to this, an accelerated urbanization thus favoring the runoff more solicited in the calculations of urban networks where the artificial impermeabilization of the grounds is very obvious. The values of the peak flows obtained by the latter can characterize the flood hydrograph and evaluate the volume (V) produced. In the absence of flood hydrographs actually observed on the watercourses of wadis El Ouahch, Beni Malek and Zeramna, we used the method proposed by Sokolovski (1968), for the construction of flood hydrographs. This approach gives satisfactory results in the case of small watersheds. This author gives the flood hydrograph the shape of a curve, formed by two parabolas joined at the top of the flood hydrograph the shape of a curve, whose equations are the following: Synthetic flood hydrograph method (SOKOLOVSKI, 1968). Equation of the rise curve:

$$Q(t) = Qmax\ (t/tm)^m \text{ in } m3/s$$

Where: Q(t): flow at time t in hours after the beginning of the flood (m $^{3/s}$).
Qmax: maximum flood flow ($^{m3/s}$)
tm: time of rise of the flood in hours; the author recommends for the small basins tm=tc.
m: exponent of the parabola, m=2 (for small basins).

Equation of the recession curve:

$$Q(t) = Qmax.\ (td\text{-}t'\ /td)^n \text{ in } m3/s$$

Where: Q(t`): flow at time t` in hours, after the peak of the flood (m3/s).
td: duration of the recession in hours, td = 2tm according to the author.
n: exponent of the parabola, for small watersheds the author recommends n=3.

The plot of the hydrograph allows to estimate the characteristics of the flood: shape, volume, rise time, t base time: Figures 4, 5, 6m illustrate correctly the flood hydrographs obtained in the watershed.

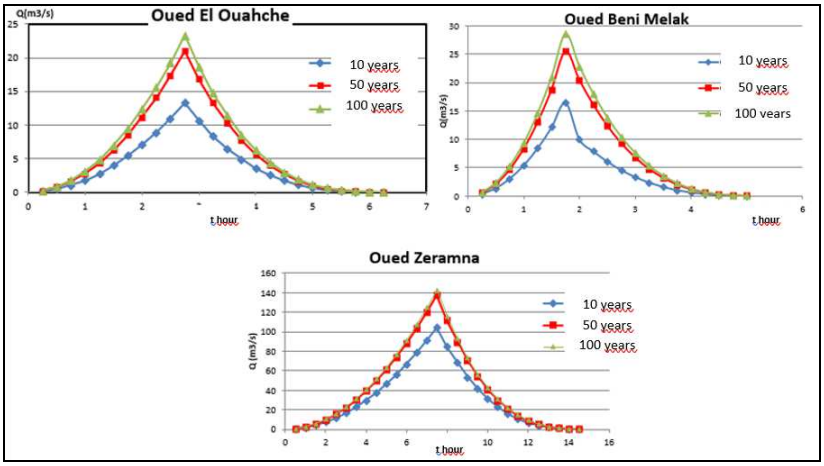


Figure. 4, 5, 6. Synthetic hydrographs of Oued El Ouahch, Oued Beni Malek and Oued Zeramna

The maximum flood volumes for a given frequency were calculated from the following relationship:

$$\mathbf{Vmax.\ (\%) = Qmax(\%).\ Tc/f\ (m^3)}$$

Where: Qmax. (%): maximum flood flow for a given frequency (m3/s)
Tc: concentration time (sec).
f: shape coefficient of the flood hydrograph, f = 1,2

Table 5

Values of flows and volumes of frequency flood adopted

Return period (year)	Frequency of overrun (%)	Peak throughput (m3/s)	Flood volume (Hm3)
Watershed of Oued El Ouahch			
10	10	10,25	0,084
50	2	13,95	0,115
100	1	15,55	0,128
Watershed of Oued Beni Malek			
10	10	12,5	0,065
50	2	17,25	0,090
100	1	19	0,099
Watershed of Oued Zeramna			
10	10	63	1,370
50	2	68	1,479
100	1	72	1,566

Source: Ghachi Azzedine 2019

3.2. Characteristics and floods genesis in the city of Skikda

Flooding by urban runoff. It occurs when the evacuation networks are no longer sufficient to absorb the volumes of rainwater generated, mainly due to runoff from new urbanized areas (Impermeabilized) upstream. **The flooding by overflow of** the Oued Zeramna. It is by far the main supplier because it is the collector of the urban sub-basins (O. El Ouahch and O. Beni Malek). It participates in 80% of the city's flooding. On the basis of the calculated frequent flows of the latter, an attempt to establish a map of vulnerability to flooding has been drafted for this city.

Numerical simulation of the flood of the Wadi Zeramna

The 100-year flood flow of Wadi Zeramna was used for the numerical simulation of the flood from the HEC-RAS software.

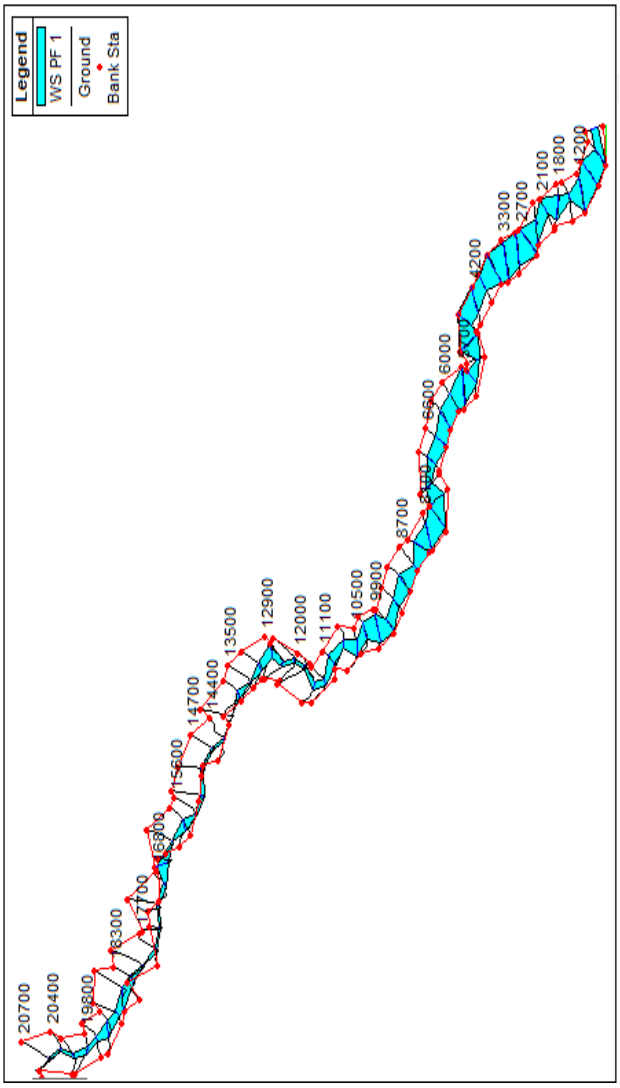


Figure 7. Numerical simulation of the centennial flood of the Wadi Zeramna

The latter is a simulation software of hydraulics in canals and wadis. Figure 7. Shows the result of the numerical simulation of the hundred-year flood of the Zeramna wadi for a flow of 93 m $^{3/s}$. In the same way, the operation was carried out for the ten-year and fifty-year floods (Fig. 8, 9, 10). The flood vulnerability map is created by exporting the HEC-RAS file to ARC-GIS software, which determines the slope and the flooded areas.

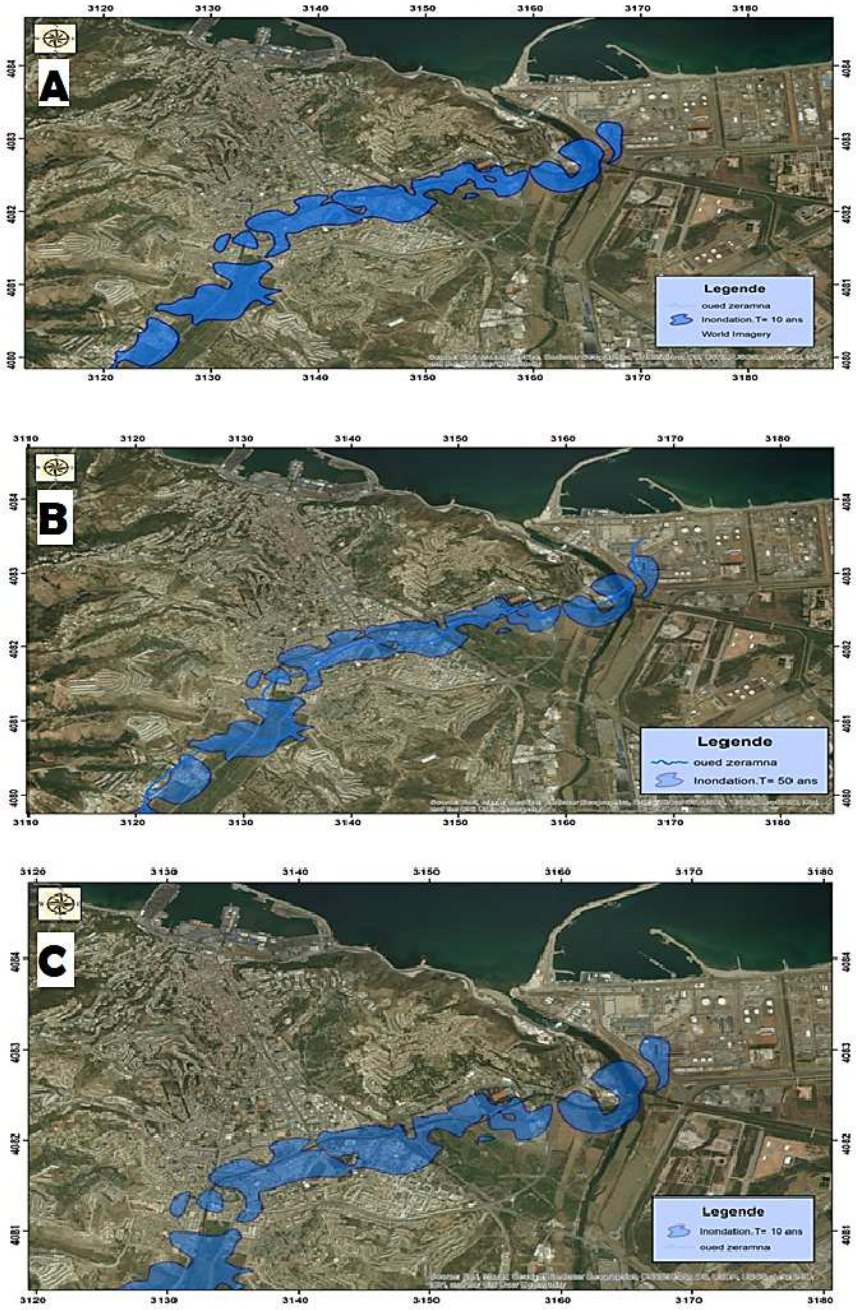


Figure. 8. Flood vulnerability map: A. Flood vulnerability map, Flood = 100 years; B. Flood vulnerability map, Flood = 50 years; C. Flood vulnerability map, Flood = 10 years

The maps show the flood zones for each return period. The decennial, 50-year and 100-year frequency floods correspond to flows of 79m^3/s, 89m^3/s and 93m^3/s. They submerge respectively surfaces of 3.72 Km^2, 3.89Km^2 and 3.92Km^2. In addition, Table 6 provides a historical overview of successive floods and an inventory of the damage incurred. It appears from this table that the main floods that affected the city of Skikda are mainly due to intense rainfall that generated maximum flows sometimes exceptional.

Table. 6

Historical overview of the floods and their impacts on the city of Skikda

Date	Recorded rainfall (mm)	Damage assessment
November 1957	173 mm in 24 h	Flooding of areas: El Hadaek – Skikda center – agricultural land Zeramna — height of submersion reached = 0.8 to 1m at the former Aerodrome.
January 1958	Exceptional rain 223 mm in 72h	The affected areas are the same as those of 1957.
February 1984	Heavy rains of 153 mm Water level reached at wadi Zeramna = 6.3 m	174 houses demolished – 500 families affected – heavily damaged agricultural land.
December 1984	111 mm in less than 24 hours	11 deaths – damaged basic infrastructure – collapsed buildings – 400 ha of agricultural land submerged – damage estimated at more than 5 billion at the time.
December 1990	92 mm in less than 15h	Overflow of the wadi Zeramna – flooding of the low-lying areas of the city.
November 2004	126 mm recorded on the eve of Eid El Fitr from 13 to 14 Nov.	Oued Zeramna overflow – Saf-saf wadi overflow – 100 homeless families – 219 affected families – 13 schools were closed.
February 2011	100 mm recorded between 2 and 3 Feb.	Overflow of wadi Zeramna – Flooding of cities: Merdj Dib – August 20th –saker brothers – El Adjour – Salah Boulekeroua.

Through this historical overview of floods, it appears that the hydrological risk was not sufficiently taken into consideration in the elaboration of successive urban developments since the city continued to develop on land of great flooding, thus causing a limitation to the infiltration capacity by accentuating the vulnerability factor.

4. Discussion

The «flood» phenomenon is widespread in Algeria. High vulnerability has been found in a wide range of countries where flooding remains one of the most dangerous and frequent disasters. (Khaled and Amireche, 2021). It is defined as the realization of a risk resulting from the concomitance of a hydrological hazard, and a vulnerability (land use and urbanization). Certainly, urbanization and flooding; a complex interaction. The natural vulnerability of the site, aggravated by inappropriate modes of urbanization, occupying wadi beds, added to the lack of protection, were then considered as the main causes of this event. (Daoud, 2010). Given the growing hydrometeorological risk such as flooding, scientists, politicians and managers have made it a priority. And the large number of works carried out in recent years in each of these disciplines attests to this. However, This requires interdisciplinary and intersectoral work whose main actors are the hydrologists, planners and managers of the city. (Khaled and Amireche, 2021). The study of natural hazards in Algeria has become an indispensable action in the management of urban spaces, Consideration of the various phenomena is currently providing an important basis for the development of regulatory arrangements for the prediction of natural hazards, in particular, ground movements, floods, etc. (Amireche and Benabas, 2010). It should be noted that new settlements and development in flood-prone areas contribute to densifying the already urbanized territories rather than expanding them, which increases vulnerability. Indeed, we can see that the majority of the victims of floods are inhabitants of cities, a large part of which are located near the rivers (Khaled and Amireche, 2021).

In recent decades, the Skikda population has been increasingly exposed to natural hazards such as flooding, which have caused damage to populations and their environments. The perception of the security of people and goods is constantly evolving and efforts to protect populations and economic issues are becoming more than necessary. The choice of the study area is based on the presence of the human stake downstream of the river for this, we chose Wadi Zeramna, which is among the largest rivers of Algeria and presents a very dense hydrographic network. Strong urbanization is present along the river, practically in its part swallows, made in a random way, and sometimes, without management or respect for the tools of planning and urban planning. Add to this the high frequency of historical events that occurred in this region, where there were almost ten floods in the past century.

This study has been made within the cities management and prevention from the risks of floods, it treats the taking into consideration the risks of space layouts, decreasing the vulnerability as well as determining of the risky areas, actually, making a studies model about risks (floods),in the watershed of " Wadi Zeramna " requires to study the parameters of the hydrogeology, the hydroclimatology and the morphology, an alternation between these aspects and the state of the urban management in the site will allow to make the zoning map of risks. Within these two approaches it is possible to distinguish different sensitivities: retrospectives constructed by the feedback of experiences, prospective aimed at the realization of diagnostics or risk scenario, diachronic or even dynamic studying the temporal evolution of vulnerability (Provitolo, 2002). The study of flood vulnerability of the city of Skikda illustrates the physical characteristics, hydropluviometric flooding and its human and economic issues. The extreme rains which are at the origin of the flood hazard have been used for the passage to the rain of short duration. From the Montanari formula, the probable maximum average intensities related to different time intervals were estimated at the level of the studied semi-urban catchment areas. Frequential peak flows were determined. The two empirical models used for the evaluation of the frequency peak flood discharge give relatively close results. The establishment of the synthetic hydrograph of Sokolovski flood of the Wadi Zeramna allowed to characterize the shape of the flood and its volume. The frequency contribution of the flood (T= 10; 50 and 100 years) is respectively estimated at 1.64 hm3; 1.77 hm3 and 1.88hm3. Based on the probable frequency values, a flood vulnerability mapping test was performed using the HEC-GEO RAS tool in ARC-GIS software. The 100-year, 50-year and 10-year flood discharge of wad Zeramna was used for the numerical simulation of the flood. The established maps show the floodable areas for different return periods on Google Earth image. The surfaces submerged by water are about 4 Km^2. This study based on the knowledge of extreme hydrological mechanisms and a strong urban growth, cannot solve alone the problem of flooding in Skikda. On the other hand, it constitutes a first step towards a better management of the flood risk, in particular by the proposals materialized by documents in the form of cartographic tools for decision support.

5. Conclusion

If the work of a hydrologist is summed up in the search for the distribution of rains in space and during time, the work of a city manager consists of an interpretation of the data in order to arrive at a theoretical and applied design aimed at the management of urban flood risk through well-defined tools and methods. Through this modest work, we have demonstrated that the cartography produced by the climate and hydrogeomorphological analysis makes it possible to have a global and homogeneous vision of flood fields on all the sectors treated by pointing to a first level, the areas most vulnerable to existing buildings and equipment. However, the information provided remains essentially qualitative, even if supplemented, where available, by historical data. In addition, to fully exploit the advantages of the management approach that we have followed, we need a cross-cutting approach for the integration of different levels and disciplines: urban planning, urban risks, hydrology, planning and mapping. The joint action of all these actors is necessary to implement concerted actions of integrated management of watersheds, covering its upstream and downstream part. Finally, as part of this research, we presented a tool to help authorities and deciders understand urban vulnerabilities to flooding. The purpose of which is to promote exchange, and to establish a language shared by actors and scientists to seek a consensus that can foster the construction of local resilience and allow an urban development integrating risk, an essential factor of sustainability.

REFERENCES

Amireche, Hamza, Benabas, Chaouki, 2010, « Ville et risque naturel en Algérie » in : le 1er séminaire international Euro-méditerranéen « aménagement du territoire, gestion des risque et sécurité civile, Batna le 27 au 29 avril 2010.

Behlouli, L., 2009, « Les risques majeurs liés à l'eau », Agence Nationale des Ressources Hydrauliques (ANRH). *Revue Géographique de l'Est*, vol.53, Gestion du risque et sécurité civile.

Benjamin, G., 2004, Prédétermination des débits de crue des petits bassins versants torrentiels, Thèse de doctorat.

Bishop, G.D, Church, M.R., 1992, « Automated approaches for regional runoff mapping in the northeastern United States". *J. Hydrol.*, 138, 361-383.

Bujan, C.M., Véliz, J., Manzanares, B., 2004, Hydrologie appliqué, procédures méthodologiques pour l'exécution d'études des retenues collinaires et petits barrages, Agence Nationale des Barrage Unité retenue collinaire, Algérie. Ed. Tecnica Hidraulica SA. 103 p.

Cemagref, 1986, Guide méthodologique en vue d'une estimation du « module » d'un cours d'eau. Rapport technique, 10 p.

Daoud, Abdelkarim, 2010, « Vulnérabilité urbaine face au risque d'inondation, Cas de l'agglomération de Sfax (Tunisie méridionale) in : 1er séminaire international Euro-méditerranéen « Aménagement du territoire, gestion des risque et sécurité civile, Batna le 27 au 29 avril 2010.

Dingman, S.L., 1981, « Elevation: a major influence on the hydrology of New Hampshire and Vermont, USA". *Hydrol. Sci. Bull.*, 26, 399-413.

EM-DAT : La base de données internationale en catastrophes. OFDA-CRED – www.emdat.be – Université Catholique de Louvain-Bruxelles-Belgique.

Ghachi, Azzedine, 2015, Vulnérabilité et risque inondation. Cas de la ville de Skikda. 5éme colloque international Eau et Climat : Regards croisés Nord-sud. Université Mentouri 24-25 nov. 2015.

Grecu, Florina, 2011, « Concernant la notion de risque naturel urbain, Analele Universitatii Bucuresti », *Seria Geografie LX*, 105-116.

Grecu, Florina, 2018, « Problématiques générales et particulières dans l'étude des risques urbains ». *Cinq Continents 8* (17): 5-22.

Grelo, F., 2001, Le risque inondation et la prise de décision publique CEMAGREF.

Khaled, Foudil, Amireche, Hamza, 2021, «Villes algériennes et risques d'inondation : intérêt d'élaboration des PPRI cas de Ghardaïa et Bejaïa», in Lucrări şi rapoarte de cercetare, vol. V, Editura Universității din București – Bucharest University.

Klijn, T., 2008, « Flash flood warning based on rainfall thresholds and soil moisture conditions", Journal of Hydrology p. 120-121.

Laborde, J.P., 2000, Eléments d'hydrologie de surface, Ed. 2000, CNRS, Univ. Nice-Sofia Antipolis, France, 98 p.

Liebscher, H., 1972, "A method for runoff mappin from precipitation and air temperature data". *World Water Balance*, p. 115-121.

Oberlin, G, Gautier, J.N., Chastan, B., Farissier, P., Givone, P., 1993, « Une méthode globale pour la gestion des zones inondables » : Le programme « inondabilité » du *CEMAGREF. Sécheresse*, vol. 4, 3, p. 171-176.

Perrin, C.C., Andréassian, Michel, Andréassian, V., 2001, "Does a large number of parameters enhance model performance?", *J. Hydrol.*, 242, 275-301.

Perrin, C.C., Andréassian, Michel, Andréassian, V., 2003, Improvement of a parsimonious model for streamflow simulation. *J. Hydrol.*, 279, 275-289.

Provitolo, D., 2002, Risque urbain, catastrophe et villes méditerranéennes, Thèse de l'Université de Nice-Sophia Antipolis, 365 p.

In Memoriam

https://doi.org/10.5719/aub-g/72.1/11

LE PROFESSEUR GRIGORE POSEA
15 OCTOBRE 1928, NEHOIASU – 23 FEVRIER 2023, BUCAREST

Enseignant de plus de 60 générations d'étudiants et de doctorants, guidé par la sagesse d'un labeur exemplaire et particulier dans le domaine scientifique, Grigore Posea est décédé à l'âge de 94 ans. « La sagesse et le travail acharné » sont des attributs qui ne l'ont pas quitté jusqu'aux derniers jours de sa vie.

Le Professeur Grigore Posea nous a inculqué l'amour et la passion pour la recherche géomorphologique et géographique, le respect de la vérité scientifique, la conviction que ce n'est que par un travail acharné que nous pouvons obtenir des performances.

À travers tout ce que Grigore Posea a créé, il a indéniablement contribué au progrès des connaissances en général, mais surtout aux connaissances géographiques et géomorphologiques, obtenues à la fois par le développement de concepts et/ou de théories antérieurs, et surtout par des recherches directes, propres ou même uniquement à travers

l'énonciation des idées, fondement de débats et de thèmes de recherche pour les autres générations. Toute l'activité scientifique et didactique du Professeur est soutenue par la création scientifique matérialisée dans plus de 500 ouvrages et contrats de recherche, avec des contributions exceptionnelles dans tous les domaines de la géomorphologie, ainsi que dans d'autres domaines de la géographie, certains étroitement liés au relief, à la pensée et à l'histoire géographiques, à l'environnement ou au tourisme.

Par conséquent, le monde scientifique géographique l'a positionné à plusieurs reprises comme un leader à la tête de la Société de Géographie, de l'Association des Géomorphologues de Roumanie, à la tête de la Faculté et du Département de Géomorphologie.

Étudiant de l'Université de Bucarest, Faculté de Géologie – Géographie (1948-1952), il a complété ses études par le doctorat à l'Université de Cluj, sous la direction exigeante du Professeur Tiberiu Morariu, membre correspondant de l'Académie Roumaine, obtenant le titre de Docteur en Géographie en 1958 avec la thèse *Ţara Lăpuşului* (*Le pays de Lăpuş*), publiée en 1962, à une époque où de nombreuses personnes tentent d'apprendre l'alphabet scientifique. Aujourd'hui encore, l'ouvrage constitue un modèle d'élaboration et une source d'inspiration et de documentation pour les études géomorphologiques en Transylvanie ou dans d'autres unités territoriales. La multitude et la variété thématique des recherches sur le relief de la Roumanie ont constitué le matériel de base pour la synthèse sur le relief de la Roumanie, d'abord un volume en collaboration (*Le Relief de la Roumanie*), puis un volume de la création scientifique du Professeur Grigore Posea (*Géomorphologie de la Roumanie*, Editura Fundaţiei România de Mâine – Editions de la Fondation Roumanie de Demain, 2002). Ainsi, le Professeur pose les bases de la géomorphologie régionale qu'il impose comme exemplaire et comme priorité au niveau national, parallèlement aux travaux de recherche et de théorie géomorphologique, développés au sein des cours, comme le travail *Géomorphologie* (Gr. Posea, M. Grigore, N. Popescu, M. Ielenicz, Ediţia Didactică şi Pedagogică – Edition Didactique et Pédagogique, Bucarest, 1976).

À partir de ces brèves idées de commémoration, on suppose qu'on s'assume une certaine responsabilité en présentant, même abrégée, la contribution d'une grande personnalité comme celle du Professeur Grigore Posea à la continuité et au progrès de l'école géographique

roumaine, notamment celle de géomorphologie. Nous n'avons pas proposé un débat dans ce sens, même si, en tant que doctorant du Professeur, j'ai le devoir moral de réaliser cette intention à l'avenir, avec quelques-uns parmi plus de 20 docteurs actifs du Professeur.

Dans un autre ordre d'idées, révélant très brièvement le rôle créateur des réalisations scientifiques du Professeur Posea, je mentionnerai une caractéristique essentielle, celle d'avoir trouvé son inspiration dans le relief de la Roumanie et d'avoir façonné sa pensée géomorphologique dans une relation de feed-back avec le territoire du pays. Nous pensons ne pas nous tromper en affirmant que dans ce sens notre Professeur a réalisé des performances absolues, situation bénéfique pour ceux qui l'ont suivi, apprenant, quelques-uns directement, à travers la collaboration scientifique dans l'élaboration de certains ouvrages, d'autres moins directement, à travers les livres, les conseils et les encouragements généreusement transmis chaque fois que nous étions en difficulté dans le processus de création.

Le Professeur n'est plus parmi nous, mais il reste le MODÈLE de vie dans et pour la science auquel nous pouvons faire appel à travers ses travaux scientifiques. Nous vous remercions.

Adieu, Professeur, sur le long chemin de l'immortalité éternelle.

FLORINA GRECU[1]

[1] Professeur des universités, Département de Géomorphologie, Pédologie et Géomatique, Faculté de Géographie, Université de Bucarest, e-mail : grecu@geo.unibuc.ro

Book Reviews / Comptes-rendus / Recenzii

https://doi.org/10.5719/aub-g/72.1/12

VLADAN HRUSKA (Ed.), 2022, *Industrial past, creative future? Perspectives of industrial heritage from Podkrusnohori*, Univerzita J.E. Purkyně v Ústí nad Labem, Přirodovědcká fakulta, 51 p.

The book intitled „Industrial past, creative future? Perspectives of the industrial heritage from Podkrusnohori" aims to analyze the industrial heritage located of the Ore Mountains foothills, a heavily urbanized old industrial area, located in the north-western part of Czech Republic, between the towns of Klášterec nad Ohří and Děčín, as well its role played in the redevelopment process of the region.

In the first part of the book, the editor examines the deindustrialization process of the region selected as case study, highlighting the negative effects generated in the post-socialist period (after 1989) economically (the closure of numerous industrial units) and socially (unemployment), as well as identifying the valuable industrial heritage assets. The contribution of editor and the team he coordinated for in-depth analysis of industrial heritage from the perspective of its appropiate reuse than can contribute to the economic revitalization of the region is noteworthy. Thus, the importance of the geographic approach is highlighted by referring to the multiple changes generated by the deindustrialization process and the need to identify viable solutions for the development of a territory in economic decline by valorization of industrial heritage.

The second part of the book was built on the mixed-method approach exploring the values and perception of local communities and other stakeholders regarding industrial heritage, especially since the state of conservation of several industrial monuments is strongly damaged. Applying semi-structured interviews to different local actors allowed the authors to identify four main discourses in relation to how society members perceive industrial heritage: idyllic, pragmatic, problematizing,

and revitalisation discourse. Also, the authors highlighted the importance of the way of presenting the industrial heritage from the case study area in the media. The authors underlined that the media mainly analyzed the problematic cases and accidents related to various industrial branches and the adaptive reuse of industrial monuments with the aim of preserving their historical value was less addressed.

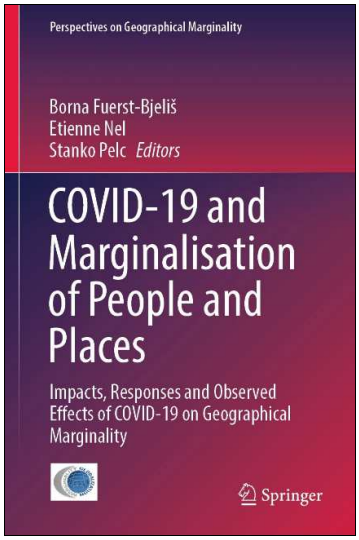
The special contribution of the collective of authors can be found in the third part of the book, where they examine and validate new creative approaches in the revitalization process of the industrial heritage assets located in the old industrial region of Ore Mountains in the Czech Republic. Thus, it is offered as an example, the involvement of students from the Faculty of Art and Design at the University J.E. Purkyně in Ústí nad Labem in the newly creative representation of the industrial heritage that they perceive as a source of inspiraton for stimulating the development of tourism, improving the public spaces or proposing the reuse of industrial buildings to host creative industries.

FLORENTINA-CRISTINA MERCIU[1]

[1] Lecturer dr., Faculty of Geography, University of Bucharest, e-mail: cristina.merciu@geo.unibuc.ro

https://doi.org/10.5719/aub-g/72.1/13

BORNA, FUERST-BJELIŠ, ETIENNE, NEL, STANKO, PELC (Editors), 2022, *COVID-19 and Marginalisation of People and Places. Impacts, Responses and Observed Effects of COVID-19 on Geographical Marginality*, Springer, Cham, 238 p.



The present volume is part of the "Perspectives on Geographical Marginality" series, stemming from the International Geographical Union, "Commission on Globalization, Marginalization and Regional and Local Response". It adds to the series a current and relevant topic in the context of the COVID-19 pandemic and its immediate and long-term implications.

Overlapping the specifics of this IGU commission, the volume offers a vast geographical picture of the effects of the COVID-19 pandemic. On the one hand, it presents a wide range of individual case studies, reffering to countries with very different development trajectories: Switzerland (Chapter 4), Argentina (Chapter 5), Romania (Chapters 6 and 12), Malaysia

(Chapter 7), Mexico (Chapter 8), New Zealand (Chapter 10), Croatia (Chapter 11), Portugal (Chapter 13), Mozambique (Chapter 14), Vietnam (Chapter 15). On the other hand, four contributions deal with international comparisons: Chapter 3, centered on the cultural differentiation of responses to the COVID-19 pandemic between European countries, and chapters 2, 9 and 16 presenting various comparisons on a global scale. Moreover, the geographical scales approached in case studies are also diverse, ranging from local – neighbourhoods, communities or specific tourist destinations (Chapters 4, 5, 8, 10, 11, 13, 14) and sub-national (Chapters 6, 12) to national approaches (Chapters 7, 15). Even if in some individual chapters the spatial/territorial approach could have been better articulated, the work as a whole has a deep geographical character.

The coverage of a wide range of effects of the pandemic is also remarkable. Thus, the two chapters that open and close the volume (2 and 16) present holistic approaches, discussing the effects of the pandemic on sustainable development at the international level, respectively drawing relevant conclusions and perspectives for the future, starting from the conclusions of the studies collected in the entire volume. The chapters included in the second part fall into themes subsumed into the social sphere. Chapter 3 explains the differences between European states' policy against COVID through the lens of the dominant cultural model in these states. Chapters 4 and 5 – emphasize the unequal effects of the pandemic on the quality of education and the related marginalization processes, through case studies from Switzerland and Argentina respectively. Chapter 7 captures the negative effects on some disadvantaged professional categories in Malaysia (migrant workers and materially deprived population), while chapter 6 (concerning civil society initiatives in Romania aimed at reducing the effects of the COVID-19 pandemic) and chapter 8 (concerning the impact and response of some communities of fishermen from Yucatan, Mexico) present optimistic perspectives, focused on the resilience of communities and the prevention/reduction of marginalization processes induced by the pandemic. Part 4 includes 5 chapters that address the economic impact on the tourism sector. Here, all chapters focus on the difficulties faced by peripheral, marginal tourism destinations, which, as argued in Chapter 9, are the most affected by the pandemic internationally. There is also no lack of approaches highlighting the opportunities that

the pandemic has opened for a reinvention of some peripheral tourist destinations (the case of Croatia, chapter 11 and the case of the city of Porto, chapter 13). Part 4 presents the effects of marginalization in an international geopolitical context, through two case studies that highlight intra-country development inequalities: Mozambique (Chapter 14) and Vietnam (Chapter 15).

Concerning the research design, the chapters also present great diversity. In some chapters, the discourse on the pandemic and marginalization is found in the introduction and conclusions, but it is not convincingly supported by results or a solid argumentation in the main body of the chapter. Also, some methodologies are presented briefly and some statements are not clearly argued from a scientific point of view. Despite these minor methodological shortcomings, the reflections offered in all chapters are pertinent and lead to interesting conclusions, with relevant policy implications both for reducing marginalization processes in general and for preparing the response to future unforeseen events. Moreover, the work can represent a good source of methodological inspiration, especially for young researchers; a wide range of research methods and tools are used in the same volume: descriptive statistics, indexes, interviews, systematic observations, content analysis, questionnaire – used separately or in different combinations that strengthen the scientific approach.

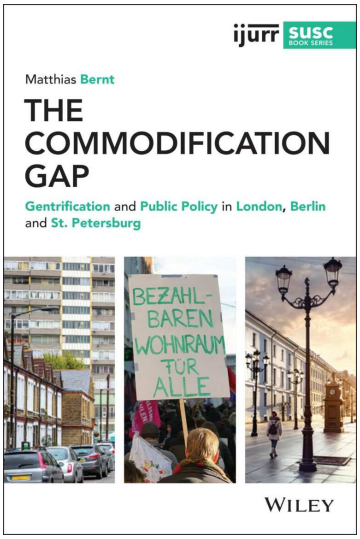
In conclusion, the volume is of maximum interest both to the academic audience and to different stakeholders in the various sectors that are covered, representing an extremely rich and diverse review of the complex and multiple effects of the pandemic on territories.

EMA CORODESCU-ROȘCA[1]

[1] Assistant lecturer PhD, Faculty of Geography and Geology, Alexandru Ioan Cuza University of Iași, e-mail: ema.corodescu@uaic.ro

https://doi.org/10.5719/aub-g/72.1/14

MATTHIAS BERNT, 2022, *The commodification gap. Gentrification and Public Policy in London, Berlin and St. Petersburg*, Wiley, Hoboken, NJ, xiii+258 p.



Positive transformations in cities, such as investment in disadvantaged areas, are happening all over the world. This phenomenon is called gentrification, and the scientific literature on it is very rich, because of the controversies that accompany it. *The commodification gap. Gentrification and Public Policy in London, Berlin and St. Petersburg* is an excellent book that combines theoretical and empirical emphasis, the objective also targeted by the book series of which this book is a part – the IJURR (International Journal of Urban and Regional Research) Studies in Urban and Social Change Book Series, which "shares IJURR's commitments to critical, global and politically relevant analyses of our urban worlds" (p. xi). Books in this series "bring forward innovative

theoretical approaches and present rigorous empirical work, deepening understandings of urbanization processes, but also advancing critical insights in support of political action and change" (p. xi) and focus on issues such as comparative urbanism, diversity, difference and neighbourhood change, environmental sustainability, financialisation and gentrification, international migration, and so on.

In his book, Bernt wants to suggest a different perspective on gentrification, recognising its condition as a universal phenomenon "that reflects general conditions set by capitalist land and housing markets" (p. 3), yet at the same time, "it is only made possible through specific institutional constellations" (p. 3), arguing that it is at the same time economically and politically determined: it rests on historically specific entanglements of markets and states, expressed in multiple combinations of what Bernt calls commodification and decommodification; their analysis is central in this book.

In the introductory chapter, Bernt explains his approach and defines the key terms of decommodification and commodification and their relation to the economic processes, in the complicated context where housing "is produced for the purpose of being sold as a commodity in the market", and, at the same time, it is "an essential human need" (p. 3): "Commodification happens when the social use of housing is subordinated to its economic value. When housing is commodified, it can be treated as an investment and can be purchased, sold, mortgaged, securitised and traded in markets. Decommodification occurs when exactly the opposite is taking place" (p. 3), when "the provision of housing is rendered as a right and/or when a person can maintain accommodation without reliance on the market, or when the conditions in the markets make it impossible to trade housing or invest in it, the commodity status is loosened and housing becomes decommodified" (p. 3).

The "commodification gap" is a concept designed by Bernt, meant to reconcile investors and locals: it considers that the achievement of gentrification is related to a certain degree of limitation of the decommodification that allows for satisfactory rates of return on investment in housing. The author considers this concept useful when comparing gentrification across varied contexts, given the fact that "the general dynamics of commodification are universal in capitalist societies,

whereas the ways in which markets are embedded into societies and the variations in which social rights are perceived, negotiated and legislated are not" (p. 4). It proves its usefulness in this book, in which three case studies from different housing systems are compared.

The content of the book is organized into seven chapters. The first chapter, *Introduction*, begins with a very interesting focus on Prenzlauer Berg, a neighbourhood in East Berlin, which in the late 1990s experienced rapid changes: "After decades of decay, more and more of its dilapidated residential buildings were bought up by investors, renovated and rented out with considerable price increases" (p. 1), followed by many changes, including the economic activity and the composition of the population; this example is used to describe "gentrification", a phenomenon which occurs in developed and also in developing countries.

The second chapter discusses the rent-gap thesis formulated by Marxist geographer Neil Smith in 1979, which is one of the best-known theoretical arguments about gentrification: it states that gentrification is a structural product of capitalist land and housing markets. Bernt highlights the conceptual limits of this theory: "It suffers from an oversimplified perspective on the way markets work. It can, therefore, make a convincing general argument about the general economy of gentrification, but is of very limited use for understanding its political preconditions" (p. 48), because "gentrification cannot be isolated from the context in which it takes place" (p. 48).

The third chapter shifts the focus from the theoretical critique to the empirical analysis "to examine how reinvestment and displacement have been intermingled with state action in three different countries and cities over time" (p. 57). It is also the most extensive chapter of the book and explains how different institutional configurations have determined different commodification gaps, and enabled or restricted gentrification. The focus is on the national scale: the two main characteristics of the British housing system are "the conjunction of tenure and sociospatial segregation and the complex ways in which the relationship between the two has changed over time" (p. 57); the two main characteristics of the German housing system are "its form as a rental system (instead of one designed around owner-occupation) and the long continuities that have determined its recent shaping (p. 77); in the Soviet system, housing "was

a reward given to those seen as deserving by the state. Housing allocation was an administrative procedure, not a market issue" (p 99). The detailed Table 3.6 ("Commodification gaps in the UK, Germany and Russia", pp. 132-133) is very useful: it presents a concise overview of the three housing systems and their commodification gaps.

The next three chapters present gentrification in three neighorhoods from the three housing systems: Barnsbury (chapter 4), as an example of the British housing system; Prenzlauer Berg (chapter 5), as an example of the German housing system; and St Petersburg (chapter 6), as a case study from the Russian housing system. First, Barnsbury, "one the birthplaces of gentrification in the UK" (p. 139), is an interesting case study because the area has undergone gentrification over a very long time: the history of urban upgrading dates back half a century, so the impact of changing economic and political environments can be studied over a long period. In this case, "gentrification is not only an outcome of a difference between actual and potential ground rent, but both the emergence of this gap, its geography, the way it operated and the opportunities to profit from it have fundamentally altered throughout the last five decades" (p. 153). Second, within Germany, Prenzlauer Berg is widely known and is usually seen as a showcase example of gentrification: "Journalists have even used the term *Prenzlauerbergisierung* (Prenzlauerbergisation) when trying to describe urban changes elsewhere" (p. 157); the area experienced considerable neglect under East German state, but, in the 25 years following the fall of the wall, the neighbourhood has experienced a total renewal and massive population exchange. In this case, "state intervention has been considerably downsized and the market gained more control" (p. 174), but, at the same time, "the role of the state seems much more ambivalent here. If a complex back and forth of regulations with regard to housing provision, allocation and pricing is already typical for Germany, this is particularly the case for Prenzlauer Berg" (p. 174). Third, St Petersburg is a very interesting case study on gentrification in an Eastern European society: "The term gentrification has only very recently entered Russian vocabulary and in most situations, Russians would use it in a way similar to terms like improvement or beautification" (p. 181). Bernt highlights that gentrification has not yet become a major issue for most Russian inner

cities, but "it has proceeded in the form of suburbanization and the construction of new elite housing and gated communities" (p. 182). Gentrification here has specific forms. For example, despite heritage regulations, the demolition of existing buildings (rarely possible in theory), is a recurrent phenomenon: "It has been reported that more than 1300 architectural monuments, nominally under state protection, have either been demolished or were 'in the phase of active destruction' in 2012" (p. 187). The chapter describes the three major dynamics of gentrification in St Petersburg: "the regeneration of existing residential buildings, the piecemeal construction of elite new housing, and the dissolution of *kommunalki* apartments" (p. 183).

The last chapter, titled as the book is, *The Commodification Gap*, contains concluding remarks, an overview of the concepts discussed, and a succinct comparison of the three case studies: "Gentrification follows very different dynamics in the three cases examined, resulting in different temporalities, spatial patterns and political issues connected to this form of urban change" (p. 210). In this sense, also useful is figure Figure 7.1 (p. 215), which sketches the interplay of universal and particular factors in bringing about gentrification.

Finally, despite the technical language used, the case studies, the relevant images, and the tables help considerably to understand the message of the book, even for a non-specialist. This text could be ended with a conclusive idea from the book: "There is no silver bullet for unmaking gentrification and change will not be achieved through a one-size-fits-all approach. What is needed then, is not abstract anti-capitalism and Manichean utopias, but a better understanding of the political forces that can make alternatives to gentrification possible" (p. 220).

GABRIEL CAMARĂ[1]

[1] Lecturer PhD, Faculty of Geography and Geology, "Alexandru Ioan Cuza" University of Iași, e-mail: gabriel.camara@uaic.ro

https://doi.org/10.5719/aub-g/72.1/15

IGU COMMISSION ON MARGINALIZATION, GLOBALIZATION, AND REGIONAL AND LOCAL RESPONSES, VIRTUAL CONFERENCE CLUJ-NAPOCA (ROMANIA), 9-10 AUGUST 2021

The annual Conference of the Geographical International Union (IGU) – Commission on Marginalization, Globalization, and Regional and Local Responses, had been postponed from 2020 to 2021 and was held online via Zoom in partnership with the Centre for Regional Geography of Babeş-Bolyai University, from Cluj-Napoca, Romania. The head of the organizing committee was Assoc. Prof. Raularian Rusu, and the local organizing team including Assoc. Prof. Titus Man, Dr. Ana-Maria Pop, Dr. Lelia Papp and Dr. Gheorghe Hognogi, all of Babeş-Bolyai University, Cluj-Napoca, Romania.

The theme of the Conference was *Bridging Regional Responses to Marginalization and Disparities in a Globalized World*. Considering the special situation of the COVID-19 pandemic, the conference opened with a panel session focusing on marginality issues provoked by the pandemic: *The global impact of COVID-19 pandemic and local responses*. Among the speakers in this panel were Prof. Etienne Nel (University of Otago, New Zealand), Prof. Dolores Sánchez-Aguilera (Universitat de Barcelona, Spain), Prof. Paulo Nossa and Prof. Anabela Mota-Pinto (Universidade de Coimbra, Portugal), which presented the influence on pandemics on peripheral, tourism-dependent regions in New Zealand, on marginality in the Ramblas, Barcelona, and the diffusion of Covid-19 in Lichinga, Northern Mozambique.

Afterward, an additional 16 papers on a variety of topics were presented in five sessions:

1. Opportunities and challenges in the rural area
2. Gendered and cultural inequalities and vulnerabilities
3. Economic and social inequalities and disparities in the globalized world
4. Land use management and change in marginal areas
5. Ways out of marginality. Accessibility, mobility and urban development

Most of the presentations to these sessions were made by the members of the organizing committee and other Romanian speakers, such as Prof. Corneliu Iațu and Dr. Marinela Istrate (Alexandru Ioan Cuza University of Iași, Romania), Prof. József Benedek and Assoc. Prof. Ibolya Török (Babeş-Bolyai University, Romania), but presentations by professors and researchers from other countries were also made, such as Prof. Steve Déry (Université Laval, Canada), Prof. Jamalunlaili Abdullah (UiTM Shah Alam, Malaysia), Dr. Chhabi Lal Chidi (Tribhuvan University, Nepal), Prof. Hugo Capellá Miternique (Universitat de les Illes Balears, Spain), Prof. Walter Leimgruber (University of Fribourg, Switzerland).

The topics were diverse, as well as the location of the study areas: rural proofing (Finland), population dynamics and agricultural land abandonment, population growth and land use change (Nepal), accessibility and marginality of settlements, farming activities and labeling agricultural and food products, smart transportation, gendered vulnerability and energy poverty, Three Seas Initiative, the spatial dimension of income inequality, women's involvement in political life, the evolution of impervious surfaces (Romania); and general topics: the solitude, reducing the inequalities, education as a way out of marginality.

GABRIEL CAMARĂ[1]

[1] Lecturer PhD, Faculty of Geography and Geology, "Alexandru Ioan Cuza" University of Iași, e-mail: gabriel.camara@uaic.ro

https://doi.org/10.5719/aub-g/72.1/16

ANNUAL CONFERENCE OF THE FACULTY OF GEOGRAPHY, *GEOGRAPHICAL PERSPECTIVES ON GLOBAL CHANGES*, 18-19 NOVEMBER 2022, BUCHAREST, ROMANIA

On November 18-19, 2022, the Department of Meteorology and Hydrology of the Faculty of Geography of the University of Bucharest held the international conference "Geographical Perspectives on Global Changes".

The conference was opened with speeches made by Prof. Dr. Marian Preda, rector of the University of Bucharest, Prof. Dr. Alexandru Nedelea, dean of the Faculty of Geography, and As. Prof. Dr. Adrian Tișcovschi, director of the Department of Meteorology and Hydrology. The opening was followed by a ceremony during which the title of Professor Honoris Causa of the University of Bucharest was awarded to Prof. Dr. William S. Keeton, Rubenstein School of Environment & Natural Resources, Vermont University, USA.

The event brought together national and international professors and researchers, and covered a wide range of topics mainly focused on human society, which is already experiencing climate change, a change that is much faster than those recorded in the Earth's geological history, before the Anthropocene. In this setting, professors and scientific researchers, together with master and doctoral students, presented their ideas and geographical studies on the impact climate has on natural and human systems, while highlighting the importance of generating and transferring scientific knowledge, as rapidly and efficiently as possible, so that society can plan ahead and ensure a sustainable socio-economic development, given the new status quo.

Moreover, for first-year students of the "Simion Mehedinți" Doctoral School, a special communications session was held – "My thesis in three minutes". The enthusiasm and commitment shown by the BSc, MSc and PhD students who attended this scientific event confirms the interest young people have in geography, in their training, and in the way earth sciences are perceived by the geographical community.

The 81 communications tackled various topics such as climate change, landscape transformations, geomorphic, demographic and social processes, as well as trends in teaching geography. Interventions were made by specialists from both Romanian (Bucharest, Iasi, Cluj Napoca, Brașov, Ploiești, Constanța, Târgoviște, Suceava) and international (Vermont, Vienna, Krakow, Oslo, M'sila) university centers. All presentations impressed with their variety, quality, originality, and the modern methods used (GIS, remote sensing, statistics, modeling, etc.).

Conference sessions were grouped around the following main themes:

- Monitoring the weather and climate to reduce their impacts and effects
- Water – Society – Environment
- Applied geomorphology
- GIS, remote sensing and geotechnology
- Challenges of Environment and Human Dimension
- Recent Dynamics and Challenges of Territorial, Economic and Social Processes
- Teaching Geography between tradition and modernity
- Research challenges in a changing world – PhD Students Scientific Session.

ADRIAN TIȘCOVSCHI[1]

[1] Associate Professor PhD, Director of the Department of Meteorology and Hydrology, Faculty of Geography, University of Bucharest, e-mail: adrian.tiscovschi@unibuc.ro

https://doi.org/10.5719/aub-g/72.1/17

LE 9ÈME RENCONTRE ALGÉRO-ROUMAINE SÉMINAIRE INTERNATIONAL *VULNÉRABILITÉ, PRÉVENTION, ADAPTATION ET RÉSILIENCE DES TERRITOIRES*, UNIVERSITÉ CONSTANTINE 3, CENTRE NATIONAL DE RECHERCHE EN AMÉNAGEMENT DU TERRITOIRE CRAT, ALGÉRIE, 20-21 MAI 2023

Ce séminaire organisé à l'occasion du 9ème rencontre Algéro-Roumaine sur « Les ressources en eau, risques naturels et aménagement des territoires » a eu pour objectif principal la compréhension de l'état de vulnérabilité des territoires urbains, y compris de la population face aux catastrophes naturelles et anthropiques. Cette question en appelle trois autres sous-jacentes : i) Les systèmes de gouvernance de nos villes favorisent-ils l'adoption de stratégies résilientes de développement ? ii) Les outils de prévisions et d'analyse sont-ils à la portée des décideurs et des citoyens ? iii) Notre système de formation (à tous les niveaux) prépare-t-il le citoyen à faire face aux risques et aux situations « hors normes », en un mot à former une société résiliente ?

La session a marqué 17 ans de collaboration ininterrompue entre l'Université de Bucarest et l'Université de Constantine (organisée depuis 2013 en trois grandes universités, chacune avec un profil caractéristique : l'Université Constantine 1, l'Université Constantine 2 et l'Université Constantine 3) – voir l'article *La coopération roumaino-algérienne en science Géographique à l'Université de Bucarest (15 années de réalisations 2006-2021*, auteurs Florina Grecu et Abdelkader Abdellaoui, https://doi.org/10.5719/aub-g/70.1/10). L'affiliation d'autres universités de Roumanie pour une collaboration à long terme est un souhait de perspective.

L'événement, qui s'est déroulé au siège de l'IGTU (Institut de Gestion des Techniques Urbaines), a été ouvert par le chancelier de l'Université Constantine 3, le directeur de l'IGTU, Dr. BRAGDI Salim, ainsi que le

président du séminaire, Dr GHACHI Azzedine, et le co-président du séminaire, Pr. BENABBAS Chaouki (directeur de CRAT).

Grâce à des communications scientifiques d'un haut niveau scientifique, la manifestation s'est distinguée par une large participation internationale, notamment des pays francophones, le grand nombre de présentations (plus de 80 dans plusieurs sections), la haute qualité des débats, une assistance technique remarquable et une application sur le terrain.

La session peut être considérée comme une école exemplaire pour la participation des jeunes. Une synthèse, des bilans et des recommandations ont été présentées à la fin du séminaire par le Coordonnateur du séminaire, Mr. KHALED Foudil.

En tant que participant, j'apprécie à la fois la qualité exceptionnelle du séminaire, modèle pour les futures rencontres, ainsi que l'esprit de collégialité et d'amitié qui s'est dégagé tout au long de notre séjour à Constantine.

FLORINA GRECU[1]

[1] Professeur des universités, Faculté de Géographie, Université de Bucarest, e-mail : grecu@geo.unibuc.ro

https://doi.org/10.5719/aub-g/72.1/18

CONGRÈS DE FONDATION DE L'ASSOCIATION INTERNATIONALE DE GÉOGRAPHIE FRANCOPHONE (AIGF), RABAT, MAROC, 13-15 JUIN 2023

Prévu initialement en 2020 mais retardé en raison de la pandémie de covid-19, le Congrès de fondation de l'Association internationale de géographie francophone (AIGF) a été tenu à Rabat du 13 au 15 juin 2023. Le but de l'AIGF est de faire rayonner la géographie francophone à travers le monde. Elle regroupe des géographes et des spécialistes de disciplines connexes qui, quelle que soit leur nationalité, utilisent ou veulent utiliser le français dans une part notable de leur activité scientifique. Plus spécifiquement, cette association a comme objectifs d'organiser des activités (congrès, séminaires, excursions, expositions, etc.) pour animer la vie scientifique des géographes francophones de toute provenance ou nationalité et pour développer la géographie francophone à l'échelle internationale. Elle tiendra également sur une base régulière des réunions, dont une assemblée générale annuelle, pour assurer la bonne gestion et le développement de son organisation.

Ayant comme thème « La géographie francophone au défi du monde contemporain », le congrès a réuni 136 personnes inscrites sous différents statuts provenant de 21 pays d'Afrique centrale, de l'Ouest et du Nord, d'Europe orientale et occidentale et l'Amérique du Sud et du Nord.

Les trois jours ont été rythmés par trois moments, celui des échanges scientifiques, de l'assemblée générale constitutive de l'association et enfin de l'excursion. Le premier moment a été composé de 18 séances autour de 9 axes thématiques faisant suite à un appel qui a enregistré 110 communications. Le deuxième temps a été l'assemblée générale qui a porté sur l'adoption des statuts de la nouvelle association, la composition du conseil scientifique et des commissions thématiques ainsi que l'élection de ses officiers. Une excursion post-congrès d'un jour sur le Moyen Atlas a permis aux participants de s'imprégner des enjeux d'aménagement qui se posent aujourd'hui au Maroc.

Bureau de l'AIGF :

- *Président d'honneur* : Professeur des universités Vincent BERDOULAY, Université du Pau et des Pays de l'Adour (France)
- *Président* : Professeur assimilé Papa SAKHO, Université Cheikh Anta Diop de Dakar (Sénégal)
- *Vice-présidents* : Professeur des universités Guy MERCIER, Université de Laval (Canada) et Professeur des universités Clémence DITENGO, Université Marien Ngouabi (Congo)
- *Secrétaire générale* : Maître de conférences HDR Andreea-Loreta CERCLEUX, Université de Bucarest (Roumanie)
- *Trésorier* : Professeur des universités Paolo MOLINARI, Università Cattolica del Sacro Cuore, Milano (Italie)

PAPA SAKHO[1]

[1] Professeur assimilé, Université Cheikh Anta Diop de Dakar, e-mail : papa.sakho@ucad.edu.sn

https://doi.org/10.5719/aub-g/72.1/19

TEZE DE DOCTORAT
SUSȚINUTE ÎN PERIOADA 1 DECEMBRIE 2022 – 30 SEPTEMBRIE 2023

Nr. crt.	Numele și prenumele doctorandului	Profesor coordonator	Titlul tezei de doctorat	Data susținerii publice
1.	BĂRBĂRIE C. Manuela Raluca	Prof. univ. dr. Cristian BRAGHINĂ	Zona transfrontalieră Dobrogea de Sud – Cadrilater. Identitate, competitivitate, potențial turistic. Perspective de dezvoltare	15.12.2022
2.	MANOLACHE (TUDORACHE) A. Andreea Violeta	Prof. univ. dr. Nicoleta IONAC	Variabilitatea regimului hidro-meteorologic în bazinul hidrografic al Râului Trotuș	02.03.2023
3.	MUSTĂȚEA Mihai	Prof. univ. dr. Ileana PĂTRU-STUPARIU	Investigarea fragmentării și conectivității peisajelor. Studiu de caz sectorul montan al Văii Prahovei între Sinaia și Predeal	29.03.2023
4.	PĂUNESCU C. George Cosmin	Prof. univ. dr. Laura COMĂNESCU	Evaluarea componentelor mediului geografic pentru dezvoltarea infrastructurii de transport rutier. Studiu de caz: sectorul de autostradă Tg. Secuiesc – Onești	07.04.2023
5.	MUSCALU Ioana Monica	Prof. univ. dr. Alexandru NEDELEA	Studiul degradărilor de teren în arealul lacului de acumulare Izvorul Muntelui	30.05.2023
6.	PÂNZARU Mariana Diana Rodica	Prof. univ. dr. Cristian IOJĂ	Evaluarea potențialului de aplicare a soluțiilor verzi în orașele din România	26.06.2023
7.	POPA G. Ana Maria	Prof. univ. dr. Cristian IOJĂ	Metode de evaluare a durabilității orașelor din România	24.07.2023

8.	GHERSIN (TOMA) I. Florentina	Prof. univ. dr. Alexandru NEDELEA	Învățarea vizibilă în didactica Geografiei. Abordări practice privind formarea competențelor specifice la conținuturile despre hidrosferă	19.09.2023

OANA PUIA [1]

[1] PhD, Faculty of Geography, University of Bucharest, e-mail: oana.puia@g.unibuc.ro

THE ANNALS OF THE UNIVERSITY OF BUCHAREST
GEOGRAPHY

NOTES FOR CONTRIBUTORS

The authors of the articles and book reviews are requested to observe the following publication guidelines:

- The articles can be edited in English and French.
- The articles should be submitted electronically (by e-mail or CD) in a WORD format (formats .doc or .rtf).
- The articles should contain the author's full name and affiliation, along with the author's e-mail address.
- The articles should contain an abstract (10-15 lines), followed by 5-7 Keywords (***Palatino Linotype*** 9, single spaced).
- All the articles and book reviews must be edited using diacritical marks; if there are special Fonts, these should also be sent.
- The page format: paper A4 (no Letter, Executive, A5 etc.).
- The page margins: top – 5,75 cm; bottom – 5 cm; left and right – 4,25 cm; header – 4,75 cm; footer – 1,25 cm.
- The articles submitted for publication must be typed single spaced, in ***Palatino Linotype*** 11.
- The title of the article should be centered, bold, all capitals (***Palatino Linotype***, 11).
- The author's name (bold capitals) should be centered, under the title (***Palatino Linotype*** 9).
- The abstract (with the translated title, if the article is written in other language than English; ***Palatino Linotype*** 9, single spaced) precedes the text of the article; the Keywords (***Palatino Linotype*** 9, bold) follow the abstract and they are preceded by the word Keywords (in italics+bold).

• The notes should be indicated by superscript numbers in the text and typed at the bottom of the page (single spaced, ***Palatino Linotype*** 9).

• The references or the quotations sources should be indicated in the text, following the format: (Author year:(space)page) − (Pop 2001: 32); (Pop/Ionescu 2001: 32).

• The abbreviations or abbreviated titles (RRL, tome L, nos 3-4, p. 216) can be used in the papers; they will be included completely in the listed references at the end of the article, as it follows: RRG – *Revue Roumaine de Géographie*, tome L, nos 3-4, 2005.

• The references should observe the following styles:

1. **Books** *Basic Format:* Author, A. (B.B. Author, C.C. Author), Year of publication, *Title of Work,* Location, Publisher.

   Ielenicz, Mihai, 2004, *Geomorfologie generală*, București, Editura Universității din București.

2. **Edited Books** *Basic Format:* Author, A.A. (B.B. Author, C.C. Author)(ed./eds.), Year of publication, *Title of Work*, Location, Publisher (only the name of the first editor inverted).

   Piacente, S., G. Poli (eds.), 2007, *La memoria della Terra, la terra della memoria*, Bologna, Edizioni L'Inchiostroblu.

3. **Articles or Chapters in Edited Book** *Basic Format:*

   Raper, Jordan, 1992, "Spatial Data Exploration Using Hypertext Techniques", in D.A. Ondaatje (ed.), *Proceedings of the 2nd European Conference on Geographical Information Systems*,Utrecht, Egis Fondation Press, pp. 47-94.

4. **Articles in Journals** *Basic Format:* Author, A.A. (B.B. Author), Year of publication, "Title of the article", in *Title of Periodical*, volume number (issue number), pages.

   Hilal, A., 2016, « L'espace littoral marocain entre pressions du présent et exigences de l'avenir, cas du littoral d'Essaouira », in *Cinq Continents*, vol. 6, nr. 13, pp. 79-100.

All the bibliographical references should appear in the final bibliography.

All the papers will be peer-reviewed by a committee of specialists in Geography and Environmental Science. Depending on the degree of interdisciplinarity of the document, specialists in other fields of research are also consulted.

The first version of the articles should be submitted to the e-mail address: loreta.cercleux@geo.unibuc.ro

ACREDITARE

ANALELE UNIVERSITĂȚII BUCUREŞTI. Seria Geografie. An LXXII
[https://doi.org/10.5719/aub-g/72.1]

Scientific articles* / *Articles scientifiques* / *Articole științifice

Book Reviews/ Comptes-rendus / Recenzii

Scientific Life / Vie scientifique / Viața științifică

PAPA SAKHO, Congrès de Fondation de l'Association Internationale de Géographie Francophone (AIGF), 13-15 juin 2023, Rabat, Maroc
[https://doi.org/10.5719/aub-g/72.1/18]

Doctoral Theses / Thèses de doctorat / Teze de doctorat

OANA PUIA, Teze de doctorat susținute în perioada 1 Decembrie 2022 – 30 Septembrie 2023
[https://doi.org/10.5719/aub-g/72.1/19]

EDITURA UNIVERSITĂȚII DIN BUCUREȘTI
BUCHAREST UNIVERSITY PRESS

tipografia.unibuc@unibuc.ro

Bd. Iuliu Maniu 1-3, Complex LEU
tel: 0799 210 566

Tiparul s-a executat la Tipografia
Editurii Universității din Bucureşti – Bucharest University Press (EUB – BUP)