Assessment for basic demographic, health and public health profile

TRAP

Transboundary Air Pollution Health Index Development and Implementation

June, 2019

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1 INTRODUCTION

1.1 Project Overview

Information on real time air pollution levels is now more necessary than ever before. At present, air pollution is one of the most significant factors posing threat to the health of individuals worldwide. It is associated with a range of diseases, symptoms and conditions that impair health and quality of human life. According to the WHO, outdoor air pollution was responsible for the deaths of some 3.7 million people under the age 60 around the world in 2012 , representing 6.7% of the global disease burden while outdoor air pollution combined are among the largest risks to health worldwide. Apart from habitants air quality impacts natural environment and biodiversity. The main sources of air pollution at both countries are mainly caused by industrial activities, transportation and heating.

Air Pollution has been recognized as of the most pressing problems in both Greece and the Republic of North Macedonia, following the economic and social development of the two countries the sources of air pollution are mainly industrial activities, transport and central heating. The major challenges of transport in urban areas are the rising number of vehicles, their increased average age and traffic congestion. Air quality problems from industrial sources mainly concern areas with thermos-electrical power stations and industrial units located close to residential areas. Air quality is strongly influenced by pollutants trapped due to thermal inversions caused by from land local breezes and thermal internal boundary layers.

TRAP developed on the necessity for developing ICT applications in environmental protection, monitoring and management of the eligible areas. Environmental initiatives is a privileged field for developing cooperation in the cross-border area contributing significantly to economic and social development of the population and public health, therefore, the opportunity for mutual cooperation and understanding between public authorities, scientific institutions and residents of the area. The major challenge is the development of an integrated approach including air quality monitoring with providing health indicator for vulnerable groups of the population. TRAP project addresses a series of issues, such as:

- Identification of the emission sources and development of regional and CB emission for vulnerable groups of the population
- Assessment of each emission source
- Development of air quality plans
- Monitoring data, validation and analysis
- Basic demographic, health and public health profile
- Air quality and Health Indicators

Assessment for basic demographic, health and public health profile

- Joint CB comparative analysis
- Capacity Building at user level (Health and authority stakeholders)
- Air quality and health sensitization campaigns
- Protection of human health
- Citizen involvement
- Implementation of air quality directives

Partners aim to improve management and protection of areas in both countries by establishing air quality monitoring networks. The measurements of all station in areas involved in this project will create a system that will display real-time measurements through the internet. Moreover, epidemiological indicators and indicators of air quality, based on the effects of air pollution on human health, will be calculated and displayed on the web. The best way for someone to use an Air Pollution Health Indicator (APHI) is to regularly check the current index value, to pay attention to personal symptoms and self –calibrate to personal symptoms and self-calibrate to the report current APHI value. Therefore, the strategic objective of TRAP project is the creation of an ICT application integrating Air Quality Monitoring with Air Pollution Health Indicator) (APHI) in CB area.

The specific sub-objectives of the project are to:

- Develop and evaluate emission inventories at partner areas
- Assess the health risk related to air quality measurements
- Create integrated ICT tool including air quality information correlated to possible health impacts and providing emergency mechanism to policy makers and vulnerable groups
- Evaluate the CB conditions regarding air quality and transported pollution in CB areas
- Engage relevant stakeholders in order to inform them on the created tool operation and indexes
- Disseminate and communicate the project results to key stakeholders as well as to the general public and vulnerable groups

TRAP project results will positively affect and contribute to the programmes result indicator for ecosystems with improved protection status for the eligible areas of Florina, Bitola and Gevgelija where the monitoring stations will be placed. The innovative character of TRAP is served by its approach that favors the interaction and exchange of ideas as well as the knowledge diffusion and integration among the targeted stakeholders. Many of the projects activities will be jointly implemented creating unified framework for problem resolutions and providing added value to the CB area as a total. The expected results are focused on the development of an ICT tool for better air quality monitoring in CB area integrated with Air pollution Health Indicator.

2 MAIN CHARACTERISTICS OF THE TARGET AREA

2.1 Municipality of Gevgelija

Road Infrastructure

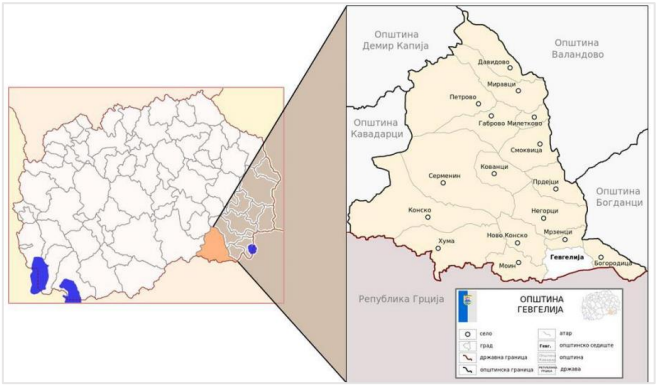
The **municipality of Gevgelija** is located in the southern part of the Republic of North Macedonia (RNM), at the border with the Republic of Greece, at an altitude of 64 m and on a space of 485 km^2. Throughout the territory of the municipality of Gevgelija, the primary axis of development passes through the Vardar valley in the north of the south and is part of the corridor 10. It is also very important the transboundary position of Gevgelija with Republic of Greece as well as possibilities for locating economic capacities that require higher transport of raw materials and products, where the Thessaloniki port represent important advantage.

Also, the railway transport built at 1873 is important transportation connection among Skopje and Thessaloniki. Besides, road transport, this railway plays important role at international railway transport of goods. Gevgelija has also short and quick access to 2 airports, the one in Thessaloniki at the 70 km distance and airport in Skopje at a distance of 155 km. The local road network is also on a satisfactory level. Total amount of roads is 65 km out of which 63% are asphalt covered. Road network is also good and all 17 villages are adequate connected and roads are in good conditions (Municipal Plan for waste management of Gevgelija, 2017-2022).

Favorable impact should have the newly foreseen future "horizontal" connection - from Bitola through Mariovo to Gevgelija, as a traffic route connecting the eastern and western parts of the RNM and which at the same time integrates the most important tourist areas (Gevgelija Municipality website, 2019).

The municipality of Gevgelija consists the city of Gevgelija and additional 16 rural settlements. The average population density in Gevgelija is 47 residents/km^2, in the Southeast Region is 63.3/km^2, compared to the average national population density 83.3/km^2. Total population according to the State Statistical Office (SSO) estimations for 2017 is 22,671 where 50.2% are female and 49.8 male (table 1). The average population age in this region is 39.6 years (RNM 39.0), while the average age where deaths occurred is 73.2 (RNM 73.1) (SSO. Regions of the Republic of Macedonia, 2018).

The Southeast Region where municipality of Gevgelija is located is characterized with the extensive hydrographic network, the great number of sunny days, the climate and the favorable pedologic conditions characterize the region as predominantly agricultural. The large-scale production of high-quality early vegetables, fruits and industrial crops enable the development of the canning and food processing industry, for which this region is renowned. In recent years, there has been an increasing trend in tourism, shown by the increased number of accommodation facilities, tourists and nights spent in the region. This is mostly due to the revitalization of the Dojran Lake and its exploitation for tourism.



Picture 1 *Geographical position of Municipality of Gevgelija*

Economic activities in Gevgelija

As one of the most geographical and cultural cross roads in Europe, Municipality of Gevgelija with centuries was center of production and trade especially with agricultural products and food, fruits, vegetables and high-quality wines. In 1995 industry and mining participated with 33% of the total value of the local economy, agriculture and fisheries 30%, civil construction 3,1%, trade with 24% and tourism and hospitality with 2,7%, forestry 2,7%, transport and communications with 0.9%, other processing and personal services with 1,8% and all other sectors 1,6%. In Gevgelija there are 4 industrial zones, Rakita, Delenica, Blokotehna and new economic zone TIRZ Gevgelija. In these economic zones are located 95% of the industrial capacities of the municipality, especially textile and food processing industries as well as industry for plastics (Municipal Plan for waste management of Gevgelija, 2017-2022).

Climate and Meteorological Characteristics

The mountain climate prevails only in the highest parts of the Kozuf Mountain. The total number of sunny hours per year is 2392 hours, which can be compared to several places near the Adriatic Sea and the Mediterranean in general. The average annual temperature in Gevgelija is 14.3 °C. The fastest month of the year is January with an average temperature of 3.2 °C, and the warmest is July with an average temperature of 25.7 °C. The average annual amount of precipitation is 745,2 mm^3. The precipitation schedules are not evenly distributed, the most in the autumn, and the least in the summer. The average number of days with snowfall is 8.3 days. The average humidity of the air is 71-72%, in winter 81-82%, and in summer it drops to 56%. The muds in the area of the municipality are rare. The average number of days with fog is 16.4. The fogs occur in autumn and winter months, and are most pronounced in December with 3.3 days. The most vivid are the winds Vardarec and the South. The Vardar is from the north and south from the southeast.

The maximum snow cover is less than 40 cm - only once is a snow cover of 80 cm. Most often, this region is characterized by small snowfall, short-term retention of snow cover and a very small share in the total amount of precipitation. The average number of days with snow cover is 8.3 days, but this number varies from 0-24 days. The average annual relative humidity of the air is 71% in Gevgelija.

With relatively low values of relative humidity in the air are the months of July and August when the average air humidity is between 57% and 59%. In the winter months it ranges from 75% to 81%. The total number of sunny hours, according to the data from the meteorological station Gevgelija, is 2371.0 hours with a maximum in July (326.0 hours) while the lowest number of sunny hours is in December (104.4 hours).

Local air circulation is more common in the warm part of the year, and the winds are slower and their occurrence is beneficial due to refreshment and constant aeration. It happens that the winds cause and damage especially in relation to vegetation. "Vardarec" blows with an average monthly speed of 4.5 - 7.2

m/s. This wind blows throughout the year mostly in January, February and December, but also occurs during July and August, and rarely in spring and winter. From time to time, this wind blows at high speed through the Gevgelija Valley.

In the winter months, wind decreases temperature, and in the summer it increases evaporation, that is, in the vegetative period, evaporation reaches 900 l/m^2, with a maximum in July of 150-200 l/m^2. The southern wind "Jugo" that blows at an average monthly speed of 2.1 m/s has a higher frequency in the summer and winter months; the wind comes from Kozuf Mountain, and the peak is in April and October.

The speed is lower in relation to the wind Vardarec and the average monthly wind speed is about 2.1 m/s, maximum up to 12.5 m/s; in the winter the wind increases the air temperature. The northwest wind is particularly pronounced in the summer and winter months; this wind also comes from Kozuf, with a maximum value in July and December, an average speed of 4.5 - 6.2 m/s and a maximum of 26.5 m/s.

The graph below shows the cloud, sunny and precipitation days (Figure 1).

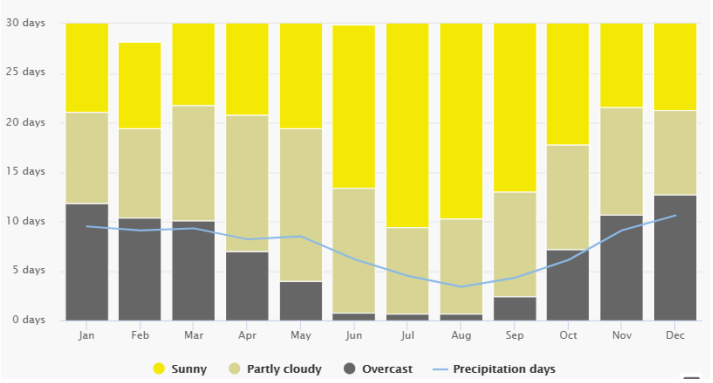


Figure 1. *Cloud, sunny and precipitation days based on 30 years of hourly weather model simulations*

Source: https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/gevgelija_north-macedonia_790744

The graph shows the monthly number of sunny, partly cloudy, overcast and precipitation days. Days with less than 20% cloud cover are considered as sunny, with 20-80% cloud cover as partly cloudy and with more than 80% as overcast.

The precipitation diagram for Gevgelija shows on how many days per month, certain precipitation amounts are reached (Figure 2).

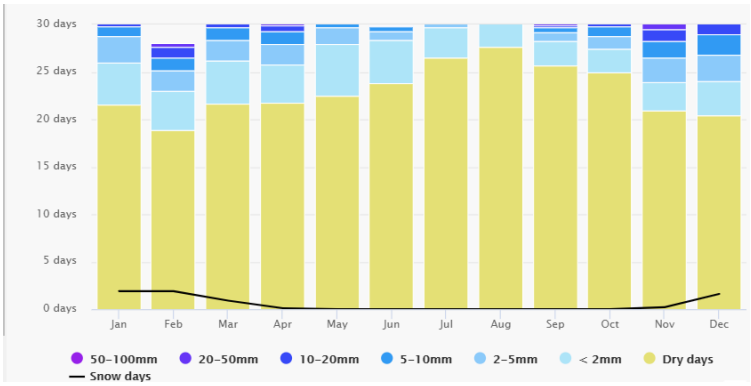


Figure 2. *Precipitation amounts for Gevgelija based on 30 years of hourly weather model simulations*

Source: https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/gevgelija_north-macedonia_790744

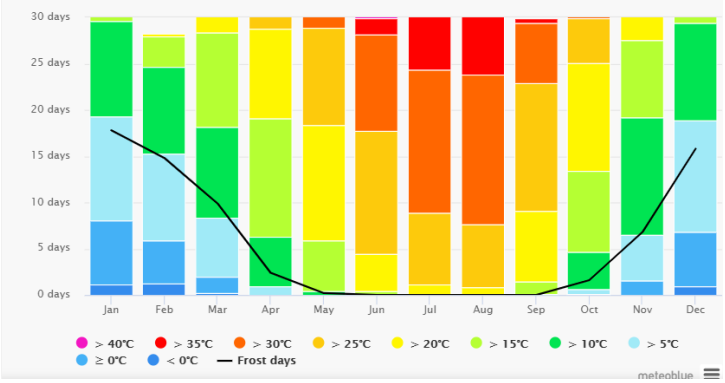


Figure 3. *Maximum temperature for Gevgelija based on 30 years of hourly weather model simulations*

Source: https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/gevgelija_north-macedonia_790744

The maximum temperature diagram for Gevgelija displays how many days per month reach certain temperatures (Figure 3).

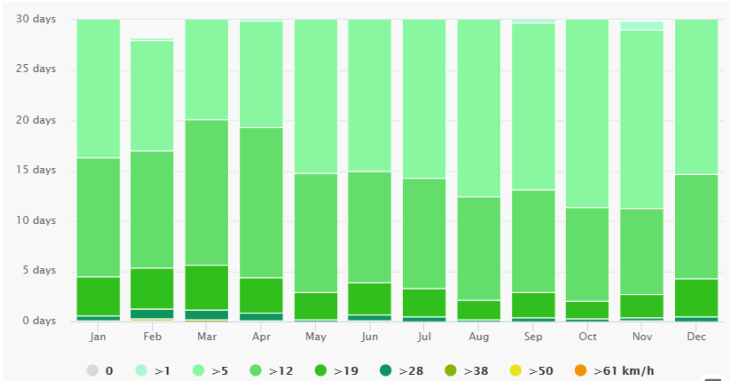


Figure 4. *Wind speed for Gevgelija based on 30 years of hourly weather model simulations*

Source: https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/gevgelija_north-macedonia_790744

The diagram for Gevgelija shows how many days within one month can be expected to reach certain wind speeds (Figure 4).

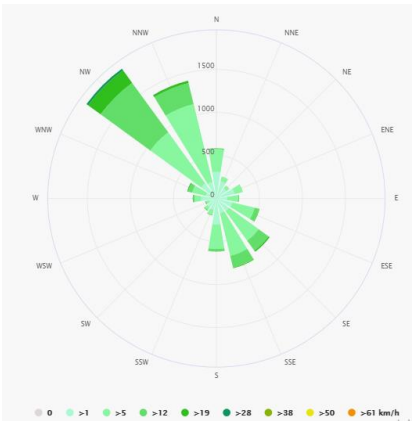


Figure 5. *Wind rose for Gevgelija based on 30 years of hourly weather model simulations*

The wind rose for Gevgelija shows how many hours per year the wind blows from the indicated direction (Figure 5).

Climate Change scenarios

According the climate change projections for the main climatic elements (temperature and precipitation) for the 21st century that have been made, i.e. for the periods 1996-2025 (marked 2025), 2021-2050 (marked 2050), 2050-2075 (marked 2075) and 2071-2100 (indicated by 2100), which are compared with 1961-1990, the largest increase in air temperature in the country by the end of the century is predicted for the summer period, accompanied by the most intense reduction of precipitation. In terms of precipitation, practically no changes are expected in the winter period, but a reduction in all other seasons is expected. An increase in average daily temperatures is expected in summer and a slight decrease in winter (MEPP. Third National Communication for Climate Change).

2.2 Environmental risks

1. Waste

Waste management, especially the part of its final disposal (landfilling), is one of the most pressing environmental problems in Macedonia. Although there have been attempts to solve non-hazardous solid waste in the South-East planning region on several occasions, there is still no concrete solution for the waste, nor can such a thing be expected in the near future. Landfilling is particularly a problem for the region, given that there is no sanitary landfill, and all the waste is left to the dumps and similar locations without or with very poor control of the impacts (Municipal Plan for waste management of Gevgelija, 2017-2022).

Some of those places for disposal are rated as high-risk for the environment. This is the case with the site for the disposal of municipal waste in the municipality of Gevgelija (existing non-sanitary and non-standard landfill) on the eastern part of the city, located on the very coast of Suva Reka (tributary of Vardar), where the waste is almost part of the riverbed, it is not uncommon to be carried in conditions of torrential waters.

The problem of landfilling of waste especially gained importance in the last period with the huge influx of refugees in that part of the country, when the daily quantities of collected waste increased significantly, and thus the problem of landfilling. The landfill itself is regarded as the second most risky non-sanitary landfill in Macedonia. The landfill is practically at the end of its useful life, ie the available space for disposal of additional waste at the current location, taking into account the current waste generation rate, is considered to be sufficient in less than a year.

Picture 2. *The nonstandard landfill in Gevgelija*

The daily production of municipal solid waste per capita according to the submitted data is 1,310 kg. Municipal waste management within the Municipality employs communal inspectors whose authority is to eliminate waste dumping in places that are not provided for that purpose.

The communal waste from the municipality of Gevgelija is collected by JPKD "Komunalec" - Gevgelija, in the city of Gevgelija and the settlements Smokvica, Prdejci, Negorci, Bogorodica, Miravci, Miletkovo, Davidovo, Mrzenci, Stojakovo, Moin, Novo Konsko, Konsko with weekend settlement "Smrdliva Water "as well as the camp for migrants. According to data from JPKD "KOMUNALEC", total municipal waste collected annually from the territory of the municipality of Gevgelija is 10141,69 tons.

JPKD "Komunalec"[1] carries out organized collection of waste to 15,497 inhabitants in the city of Gevgelija and 6,880 inhabitants in the settlements Smokvica, Prdejci, Negorci, Bogorodica, Miravci, Miletkovo, Davidovo, Mrzenci, Stojakovo, Moin, Novo Konsko, Konsko with weekend settlement "Smrdljiva Voda" as well as the camp for migrants. The remaining rural settlements in the Municipality do not receive services due to the eviction trend of the residents. Considering that approximately 500 inhabitants from the rural areas are not covered by organized waste collection, the Municipality and JPKD "Komunalec" in terms of service population cover 98.14% of the population.

The waste collected by the JPKD "Komunalec" Gevgelija, is carried to the landfill for industrial and communal waste, located near Suva Reka, and 1.5 km from the settlement. The waste in the city of Gevgelija is organized and carried out daily. Considering the fact that current municipal landfill is not compliant and is satisfying the needs for landfilling, the Municipality together with Japanese and Swiss support built new compliant temporary landfill located at Kozuf mountain near the village Novo Konsko. However, the landfill is still not operational due to the fact that there is no access road and landfilling is still not enabled. It is planned that very soon the road will be ready and new landfill will be used for landfilling the communal waste.

Generally, municipal waste does not carry out waste selection, i.e there is no system for selecting specific types of waste in accordance with the legal provisions. However, on the level of the city of Gevgelija, efforts are being made to start the implementation of the waste selection system. According to the project program for 2016, a selection of waste from natural persons was envisaged. Particularly organic and bio-degradable waste, and especially plastic, paper and cardboard. It was envisaged that organic and biodegradable waste should be placed in black bags, and paper and plastic in colorless (or by agreement in some other color) bags.

Illegal landfills

Considering the fact that in the Municipality of Gevgelija the servicing of the population with the services of the PUCD is 98,14%, the creation of illegal landfills is mainly due to the insufficiently developed awareness among the citizens. According to the analysis, additional reasons for the B are as follows:

- Low awareness of the population for environmental protection;
- existence of a large number of unused surfaces;

[1] JKPD Komunalec Gevgelija https://komunalecgevgelija.mk/

- Ineffective implementation of the legislation on the imposition of penalties by the relevant authorities.

The constant uncontrolled creation of illegal landfills has a major impact on human health, air quality, surface and groundwater, and land degradation. Among the problems that the Municipality faces is, of course, the problem of self-burning of illegal landfills, as well as inadequate citizens behavior who are usually burning the waste very often (Municipal Plan for waste management of Gevgelija, 2017-2022).

Due to the presence of an organic fraction of the fertilizer, methane is released under oxygen deficiency conditions. It is a gas that causes the greenhouse effect and with its incineration it releases CO_2, a gas that causes the greenhouse effect, but is of lesser intensity. The problem is due to the presence of plastic packaging, bags, etc., which by releasing release especially harmful (carcinogenic) substances - dioxins and furans.

The creation of illegal landfills in the Municipality is mainly related to the insufficient information of the citizens about the negative impacts that are due to inadequate waste handling, as well as because a large part of the population does not receive a waste collection service.

Table 1. *Review of illegal landfills – dumpsites*

	Name of the place where dumpsite is located	*Description (nearby river, road, river bed, etc.)*	*Type of waste*
1.	Bogorodica	The landfill is located nearby the border with Greece with capacity of 5000 m2.	Mixed waste (construction waste, plastics, glass)
2.	Negorci	Landfill is located 1 km from Negorci village with capacity of 5000 m^2	Mixed waste
3.	Dumpsites at different locations that are never cleaned	Nearby rivers and roads at all villages in the municipality	Mixed waste

Source: Municipal Plan for Waste Management in Gevgelija, 2017-2022

Quantities and type of generated waste

According to the data from Municipal plan for waste management, 10 141.69 tonnes of solid waste is collected on the territory of those settlements that receive waste collection and transportation service with a total number of served population - 22,377 inhabitants. According to the established norms obtained from the data on collected quantities of waste on an annual basis, the estimated quantities of generated waste in the municipality are 10333,41 tons/ year. Details in fractions are shown as percentages in the table below.

Table 2. *Waste fractions in percentages*

Component	***Percentage %***	***Component***	***Percentage %***
Organic	21,70	*Metal*	0,57
Waste from garden	13,14	*Non metal*	3,37
wood	1,51	*Electronic*	0,00
Paper and cardboard	18,68	*Batteries*	0,00

Plastic	17,74	*Accumulators*	0,00
Glass	1,20	*Hazardous waste*	3,09
Textile	5,57	*Construction waste*	2,88
Inert waste	5,35	*Leakages*	2,28
Hygienic	2,91		

Source: Municipal Plan for Waste Management in Gevgelija, 2017-2022

2. Utilization of energy and heating

Municipal buildings

For the supply of thermal energy, the buildings in the municipality use their own source of heating through their own boilers or wood stoves. Of the total of 25 facilities that have data in the database, 11 facilities have their own boilers that use extra light heating oil, 8 buildings use firewood while the other 7 facilities use electricity for heating the premises.

Table 3. *Review of municipal buildings in Gevgelija*

Sector	**Number of objects**	**Heating surface (m^2)**	**Annual energy consumption (KWh/год)**	**Annual specific energy consumption (kWh/m^2)**
Municipal administration	1	500	173 403,8	346,8
- Schools	13	17 913	2 123 224,2	118,5
- Kindergartens	5	5 118	1 219 455,4	238,3
Construction	1	317	48 877	154,2
Culture*	4	160	16 801	105,0
Fire brigade units	1	230	100 874	438,6
Street lightening		**/**	1 439 303,81	/
Total	**25**	**24.238**	**5 121 939,2**	**151.9**

Source: Energy Efficiency programme for Gevgelija

From the data available the total amount of light oil and wood for heating purposes of administrative buildings amounts to:

Table 4. *Quantity of heating sources used per year, 2013-2015*

Year	**Light oil, l/y**	**Wood m3/y**
2015	202.725,00	51,00
2014	151.828,00	58,80

2013	206.509,00	63,90

The amounts are given for all administrative buildings such as primary and secondary schools, municipal buildings, kindergartens, national theater, library, pioneer house, etc.

Generally, heating systems in buildings are relatively old and require renovation, and in some of them, replacement of certain components in them.

Industry

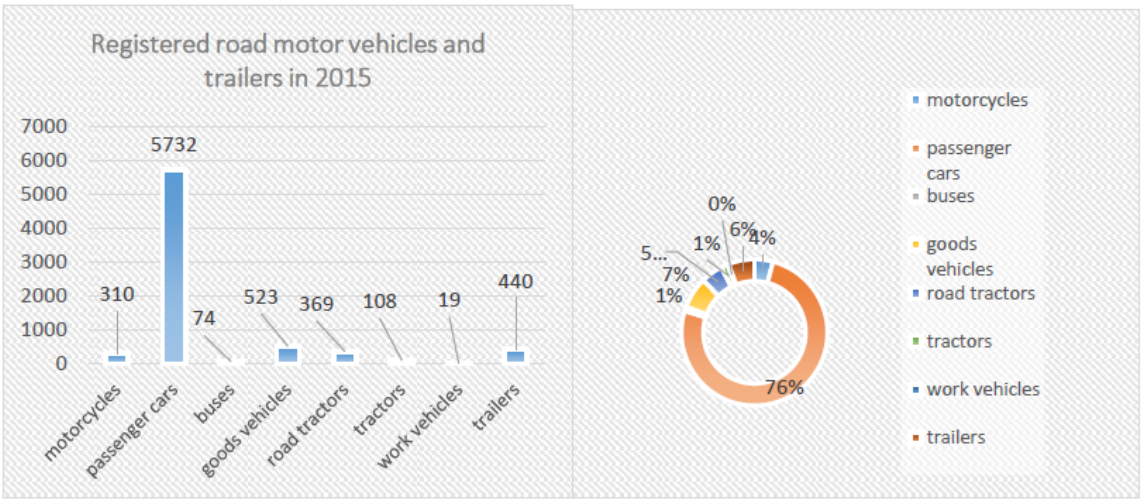
The industry is also very significant polluter, even though on the territory there are no heavy industries that contribute significantly towards the air pollution (Municipal Plan for waste management of Gevgelija, 2017-2022).

Within the municipality there is only 1 A-IPPC permit issued for Poultry farm, Veterinar Gevgelija.

There are seven B-IPPC permits issued by the Municipality: Concrete base "MANSARD" Gevgelija; Concrete base "INTER BETON" Gevgelija; Separation "ANSA GORAN" Miravci; Surface dig for diabase "INVICTA" Prdejci; Winery "RIGO IMPEKS" Gevgelija; Swine farm "VETERINAR" Gevgelija; Concrete base "Pelagonija Tiric" Gevgelija.

Registered road motor vehicles and trailers in 2015

According the State Statistic Office the number of registered vehicles is higher for passenger cars 76%, or 5732 out of 7575 total registered vehicles. Good vehicles are only 7% or 523 and trailers are 440 in total or 6%. All other types of vehicles are 5% or less than 400 in total registered in the town of Gevgelija. (State Statistical Office, Transport and other services, 2015)



2.3 Municipality of Bitola

The **municipality of Bitola** is settled in the the Pelagonia Region that is located in the south of the Republic of North Macedonia and comprises the Pelagonia basin and the Prespa Lake basin. The Pelagonia basin, which is the largest plain in the country, the Prespa Lake basin, the specific climate and the extensive hydrographic network are the basic preconditions for the agricultural development in the region. All of this makes this region the breadbasket of the country and the largest producer of tobacco, apples and

milk. At the same time, the largest coal deposits are located in this region, making it the country's largest producer of electricity.

Road Infrastructure

Bitola has good traffic connections with the neighboring and distant cities of the country and abroad, almost in all directions. Only 14 km is the state border with the Republic of Greece. As the most important traffic routes and bus communications to the north are:

- Bitola – Prilep (M-5)
- Bitola – Ohrid (M-5)
- Bitola – Lerin (E65 or M-5)

There is also railway Bitola – Prilep – Veles – Skopje and also international railway connection Bitola – Lerin. The local and regional road infrastructure is also very good: Bitola – Krusevo, Bitola – Demir Hisar, Bitola – Pelister, Bitola – Nize Pole, etc.

The **municipality of Bitola** comprises the city of Bitola and 65 villages that present 14% of the total population of the municipality. In the municipality of Bitola 788 persons live per km^2. The average population density in Pelagonia Region is 48.7/km^2 compared to the national average, 83.3/km^2. According to the SSO estimation for 2017, the total population of the Bitola municipality is 91,628 of which 50.9% are female and 49.1% male. The average population age in the Pelagonia Region is 41.1, while the average deaths age is 74.8 (SSO. Regions of the Republic of Macedonia, 2018).

***Picture 3**. Location of the Municipality of Bitola*

Climate characteristics

This region is located in the southern part of Macedonia at an altitude of 575-660 m. It is relatively close to the Aegean Sea which lies to the south about 150 km. The influence of the Mediterranean is very limited due to the barrier from the high mountains of the southern periphery of the Pelagonia Valley and its high altitude. The average annual air temperature in the area of Bitola (Bitola field) is 11.3 °C. The coldest month is January, with an average monthly temperature of -0.3 °C. The warmest month is July with an average monthly temperature of 21.6 °C.

The average annual precipitation is 598 mm. In certain years, the annual value varies from 359 mm to 818 mm. During the year, precipitation is unevenly distributed. The main maximum is in November, with an average monthly value of 72 mm or 12% of the average annual value. After the seasons, it is most desirable in autumn with an average seasonal value of 171 mm, and the least rain falls during the summer, with an average of 106 mm.

Rainfall in the Pelagonija valley is predominantly rain and snow and occur during the winter months. As an annual average, there are 34 to 36 days with snow cover. Pelagonia valley is characterized by high frequency of dry periods. During the year, dry periods are more intense in summer and autumn. Of the total number of drought periods, 61% are in these seasons and 39% in winter and spring. Summer droughts are 34%, autumn 27%, winter 23%, and spring 16%.

In the Pelagonia valley, winds from the north and south are dominant. In the Bitola field, the northern wind is dominant with an average annual frequency of 189 ‰, an average annual speed of 2.2 m/s and a maximum speed of 15.5 m/s (Local Environmental Action Plan for Bitola).

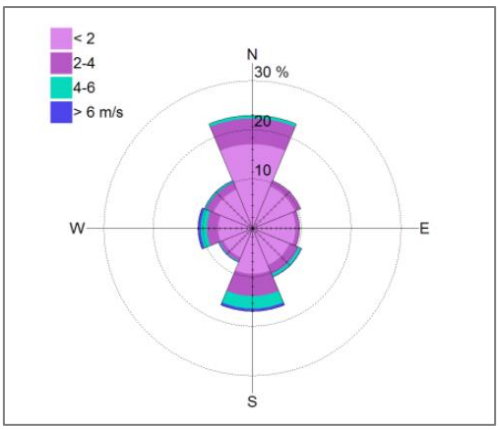


***Figure 6**. Wind rose for Bitola*

2.4 Environmental risks

1. Waste

The municipal waste on the territory of the Municipality of Bitola consists of waste from: households, waste from cleaning the streets and waste from the parks, commercial-institutional waste and waste generated by the industrial sector with a character similar to the household waste. The collection of waste is done by the city of Bitola and 16 villages (Dihovo, Trnovo, Magarevo, Dolno Orizari, Kravari, Logovardi, Bistrica, Lopatica, Nizhe field, Kukurechani, Zabeni, Bukovo, Lovci, Karamani, Krklino, Trn). There are 24500 physical persons (21614 physical persons from the city of Bitola and 2686 natural persons from the rural area) and 2850 legal entities (2744 legal entities from the city of Bitola and 106 legal entities from the rural areas) covered with the communal service for waste collection.

Quantities and types of waste

On the territory of Municipality of Bitola are evident the following types of waste:

- Communal waste – waste from households
- Commercial waste (industrial nonhazardous waste)
- Plastics
- Waste paper and cardboard
- Waste from electrical and electronic equipment
- Solid waste (demolition waste)

According the analysis of the PCE Komunalec Bitola done in 2015 in the period of 1 week in 4 seasons, average amounts of collected communal waste on the territory of Municipality of Bitola are 545 tones/week, or 28350 tones waste annually. The data are given at the Local Environmental Action Plan (LEAP) for Bitola prepared at 2016.

Table 5. *Types of waste in the Municipality of Bitola*

Types of waste	*Average*		
	Collective households	Individual households	Rural area
	%	%	%
Waste from garden	12.83	17.44	23.15
Biodegradable waste	32.06	30.93	25.16
Paper	7.70	5.50	6.40
Cardboard	4.92	4.11	4.28
Composite materials	2.41	2.78	1.68
Glass	11.37	6.98	5.65
Waste from packaging	0.88	0.53	1.22
Aluminum cans	0.75	1.25	0.44
PET	2.22	3.17	2.27
Plastics from packaging	1.71	1.07	1.08
Plastic bags	3.94	2.68	4.27
High dense plastic	2.29	1.32	0.91
Textile	3.36	2.98	6.69
Diapers	4.51	6.68	4.71
Construction waste	0.56	0.22	1.25
WEEE	0.02	0.01	0.14
Medical waste	0.01	0.00	0.00
Leather	0.32	0.33	0.20
Wood waste	0.12	0.18	1.43
Other types of waste	1.62	2.00	0.89
Elements <10mm	5.15	9.37	8.21

Landfilling of waste

Landfilling of municipal waste is carried out at the "Meglenci" landfill, located in near the mine "Suvodol" 13 km distance from the city of Bitola. The work of the landfill is carried out according to the Plan and the landfill of the landfill communal waste in the landfill "Meglentci" (2014-2019).

The landfill is carried out landfilling of municipal waste by surface method, and the given location is available with enough space to work on it for a period of 15 years or more. Average weekly quantities of

deposited waste amount to about 540 tons. Due to lack of scale, there is no measurement of the deposited waste.

Illegal landfills

On the territory of the Municipality of Bitola there are about 20 permanent locations where often municipal waste is left uncontrolled. These locations are regularly 2 times a year and are intervened in organized actions of the Municipality of Bitola with all public utility companies that own equipment for cleaning this type of waste (PCE Komunalec Bitola. Report 2018).

Identified problems

One of the main problems with municipal waste collection are collection efficiency of 90% at municipal level, Incomplete coverage on the territory of the Municipality of Bitola with service of municipal waste collection, not established integrated waste management system, not enough capacity for waste collection, non-compliant landfill, existing of many landfills where waste is illegally dumped, lack of environmental awareness at local population for proper waste management.

2. Industry

The most important stationary source of emission near Bitola is the thermal power plant REK "Bitola", which provides 70% of the electricity for the entire country. According to the emission permit documentation, the thermal power plant has three units (3 x 225 MW power) and uses local lignite as fuel. Annual emissions, according to the measurements carried out in 2007, are estimated at about 80,000 tones for SO2, 11,000 tons for NO_X and 11,000 tons of total suspended particles/dust, at the maximum power of the installation.

The share of each pollutant in the total annual emissions from REK Bitola is:

- The share of REK Bitola in the total annual emissions of SO_2 for 2010 from the large combustion installations in Macedonia is 44%.
- The share of REK "Bitola" in the total annual NOx emissions for 2010 from the large combustion installations in Macedonia is 45%.
- The share of dust emissions from REK Bitola is 44% of the total dust emissions from all large combustion installations[2]

Besides REK "Bitola", in industrial areas near Bitola are around twenty small and medium installations. In Bitola, another bigger installation is the sugar and yeast factory. This production line is quite old (approx fifty years) and has a heating plant for fuel oil used in the process production of lime from limestone rock. Lime is used in the process refining the sugar. In recent years this company does not operate at full capacity, according to market conditions, so its impact is less significant. Besides these two companies, air emissions emit two asphalt stations and one printing house.

3. Vehicles

According SSO, Publication for transport and other services, the highest percentage of vehicles in Bitola are passenger cars (86.5%).

[2] Local Environmental Action Plan for Bitola

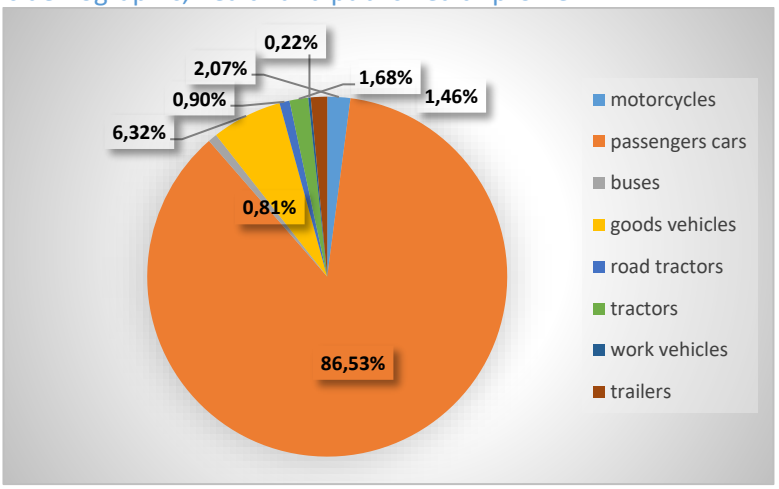


Figure 7. *Registered motor vehicles and trailers 2015*

Referring to the method included in the "EMEP/EEA Inventory Guidebook" emissions of polluting substances in the air - Road transport GB2009 (edition June 2010) "4, for NOx, PM_{10} and SOx there was an assessment of the emissions from traffic i.e. assessment of the contribution of the city traffic in Bitola in the total emissions of pollutants. Due to the availability of information on the fleet in Bitola, the assessment of emissions was made for public transport (buses), passenger vehicles, motorcycles and trucks that account for 98% of the total number of vehicles (LEAP for Bitola 2016).

The table 6 below shows the transport emissions for Bitola.

Table 6. Estimation of transport emissions for Bitola

	NOx (t/year)	**PM10 (t/year)**	**SO_X (t/year)**
Public transport	33	1.5	0.1
Passenger cars	125	3.1	0.7
Motorcycles	1	0.2	0.01
Freight vehicles	50	3.8	0.3
Total	208	8.7	1.1

In the Municipality of Bitola, the examination of buildings includes 39 buildings at the level of the municipality for which data are obtained and which objects are under the municipal administration. The total heating surface of all facilities is 48,591 m^2. The annual total energy consumption of all six sectors in 2007 was about 7,158 MWh and total energy costs of 37,578,367 denars.

The summary review of the cost of energy (electricity and heat) for municipal property in 2007 is shown in the following table 7 (LEAP for Bitola 2016).

Table 7*. Energy consumption at administrative buildings*

Sector	*Number of objects*	*Heating surface (m^2)*	*Annual consumption of electricity (MWh/y)*	*Average specific energy consumption kWh/m^2 year*

Administration	3	5.610	459.9	82
Education	28	36.802	3.619	98
Primary schools	25	20.056	1.965	98
Secondary schools	3	16.746	1.654	98
Social services	5	4.881	746	153
Culture	2	768	47	62
Municipal services	1	530	55	104
Street lightening	/	/	2.228	/
Total	**39**	**48.591**	**7.157**	**101**

Source: LEAP for Bitola. 2016

3 DEMOGRAPHY

Basic demographic indicators show slight differences in the population distribution in the selected cities versus country level (table 1 and table 2). Differences particularly in vital statistic is evident (table 3).

Table 8. *Age distribution of the population*

2017	Bitola			Gevgelija			North Macedonia		
	total	male	female	total	male	female	total	male	female
0-14	13362	6955	6407	3256	1668	1588	341983	176700	165283
15-64	63371	31664	31707	15677	7952	7725	1449869	736469	713400
65+	14895	6395	8500	3738	1673	2065	283449	126114	157335
TOTAL	91628	45014	46614	22671	11293	11378	2075301	1039283	1036018
fraction (%)		**49.1**	**50.9**		**49.8**	**50.2**		**50.1**	**49.9**

Source: MakStat DB, State Statistical Office 2018.

Table 9. *Fraction of young population and elderly*

% of total population	Bitola	Gevgelija	North Macedonia
0-14	14.6	14.4	16.5
15-64	69.2	69.2	69.9
65+	16.3	16.5	13.7

Source: MakStat DB, State Statistical Office 2018.

The highest share of young population (0-14 years) is registered at country level (16.5%), while there are no significant differences between Bitola (14.6%) and Gevgelija (14.4%). Opposite situation is registered in terms of the fraction of the population over 65, whereas the country mean as a fraction of total

population is 13.7%, 16.3% and 16.5% in Bitola and Gevgelija is registered accordingly (table 2). The highest proportion of old population (65+) is observed in the Pelagonia Region where the Bitola municipality belongs to (16.2%), while the lowest one in the Polog Region (9.3%). The indicators of the average age of the population also confirm this situation (see Introduction session).

Infant mortality rate in the Southeast Region is 6.4, in Pelagonia Region 6.1, compared to the national average that is higher than those two regions (9.2).

Graphically, the age structure divided by five-year age groups is presented bellow (Figure 1-3).

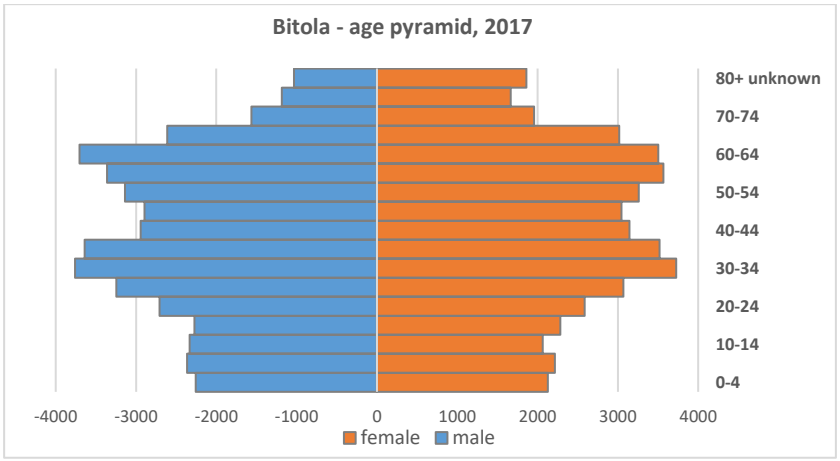


Figure 8. *Population of Bitola as at December 2017, according to five-year age groups, by sex*

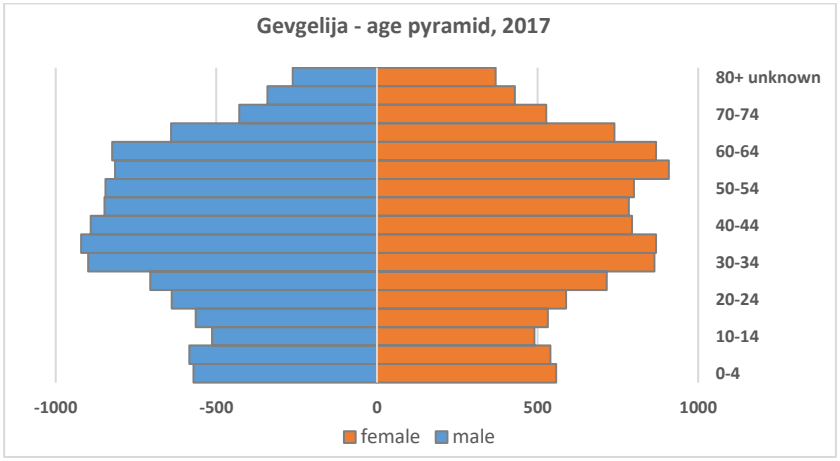


Figure 9. *Population of Gevgelija as at December 2017, according to five-year age groups, by sex*

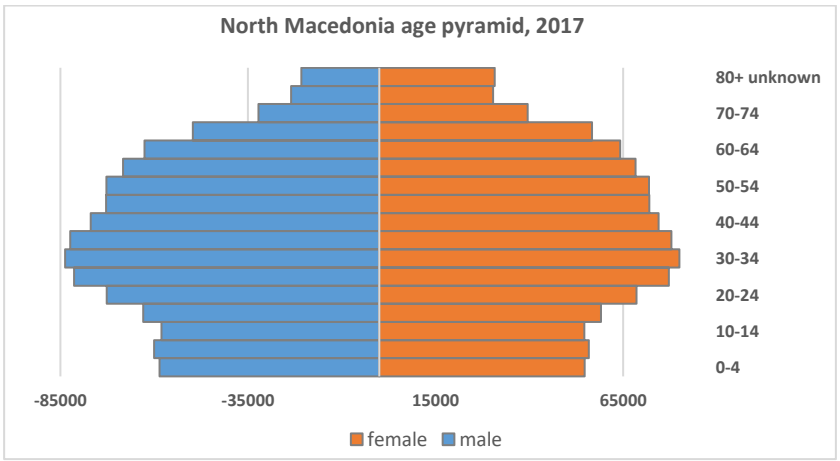


Figure 10. *Population of RNM as at December 2017, according to five-year age groups, by sex*

Vital Index

Differences are significant in the vital statistic expressed as a ***Vital Index***[3] in the observed cities, as a result of unfavorable age structure and the low fertility. Consequently, the number of deaths exceeds the number of live births in Bitola and Gevgelija in the analyzed ten-year period. Still, there is positive Vital Index in the R.N. Macedonia (table 3, Figure 4).

Table 10. *The Vital Index trend for the period 2007-2017*

	Bitola			*Gevgelija*			*North Macedonia*		
	live births	deaths	Vital Index	live births	deaths	Vital Index	live births	deaths	Vital Index
2017	844	1216	**69**	234	260	**90**	21754	20318	**107**
2016	903	1146	**79**	241	278	**87**	23002	20421	**113**
2015	915	1226	**75**	237	284	**83**	23075	20461	**113**
2014	919	1172	**78**	213	242	**88**	23596	19718	**120**
2013	844	1154	**73**	212	251	**84**	23138	19208	**120**
2012	881	1262	**70**	202	261	**77**	23568	20134	**117**
2011	880	1177	**75**	183	244	**75**	22770	19465	**117**
2010	976	1171	**83**	235	246	**96**	24296	19113	**127**
2009	989	1134	**87**	265	243	**109**	23684	19060	**124**
2008	920	1172	**78**	242	226	**107**	22945	18982	**121**
2007	918	1278	**72**	204	233	**88**	22688	19594	**116**

Source: MakStat DB, State Statistical Office 2018.

Differences between the number of deaths and live births by cities for analyzed ten-year period is presented in the figures 4-7.

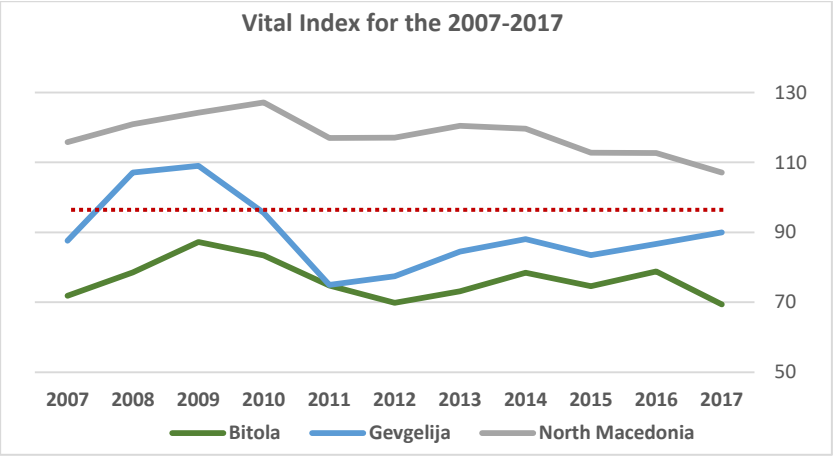


Figure 11. *Vital index for the period 2007-2017*

With a ten-year average of 76 live births per 100 deaths, municipality of Bitola is facing a serious negative trend of the population natural growth. The ratio and value of Vital Index in the municipality of Gevgelija

[3] ***Vital Index (VI)*** is the ratio of live births to deaths within a population during a given time. It shows how many live births are born per 100 deaths. The larger is the *VI*, the greater is population. Vital Index is a direct measure of survival value. If *VI* is greater than 100, the population is not only surviving but growing.
https://www.jstor.org/stable/84531?seq=1#metadata_info_tab_contents

is bellow 100, with an average of 90 live births per 100 deaths in the analyzed period, compared to the national average which has a positive value (118 per 100 deaths).

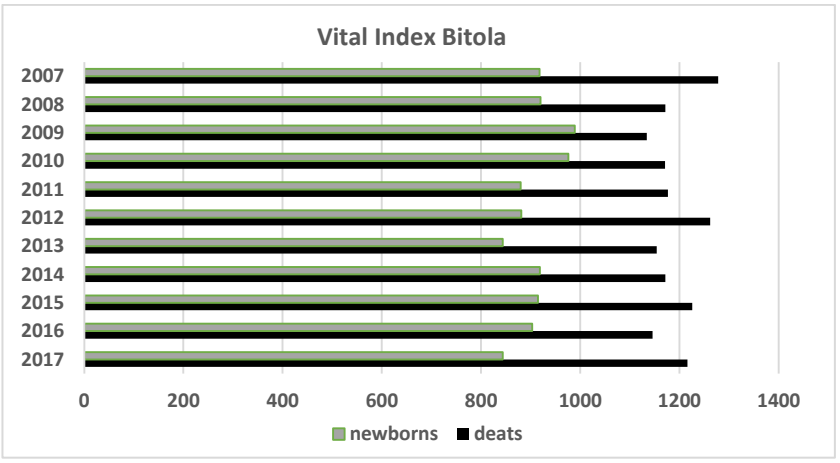


Figure 12. *Vital index for the period 2007-2017 in the Bitola municipality*

The positive value of the Vital Index is registered only in Gevgelija in the 2008-2009, where the number of life births has exceeded the number of deaths (Figure 6).

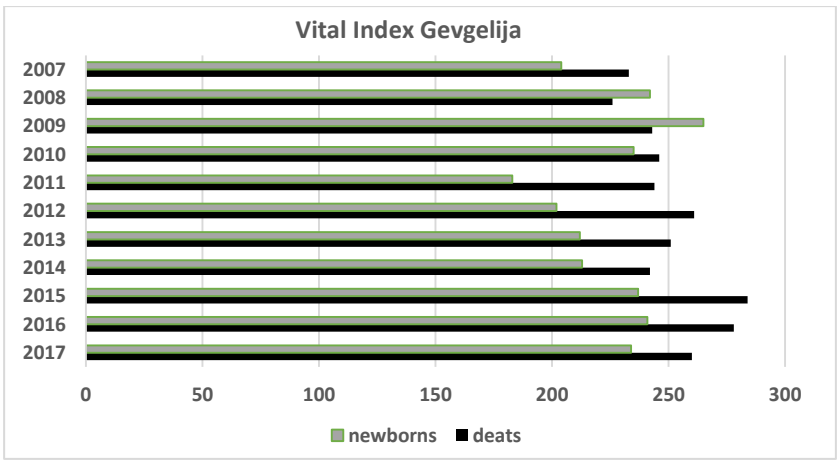


Figure 13. *Vital index for the period 2007-2017 in the Gevgelija municipality*

The national Vital Index constantly has a positive value and trend during ten-year period (Figure 7).

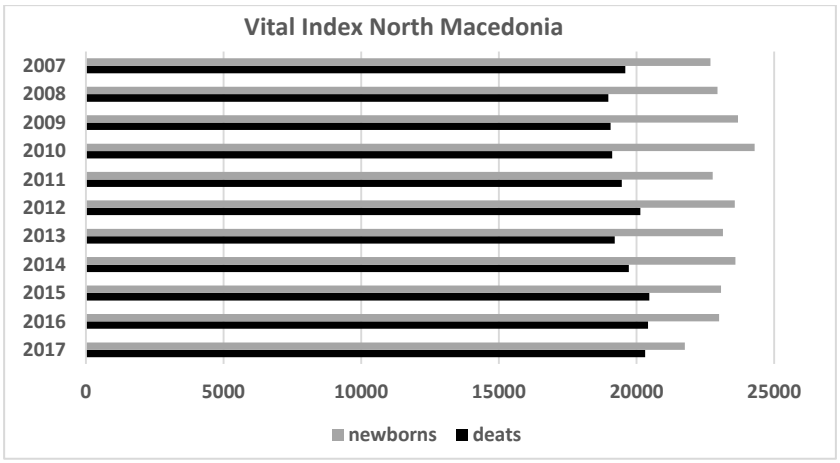


Figure 14. *National Vital index for the period 2007-2017*

Life expectancy at birth

According to the EUROSTAT, average *Life Expectancy at birth* in the Republic of North Macedonia 2017 is 76.0, in female 77.9 while male can expect to live 74.1 years, that shows a gender gap od 3.8 years (EU-28 average gender gap is 5.4) (EUROSTAT. Mortality and life expectancy statistics, 2019).

Life expectancy at birth rose rapidly during the last century due to a number of factors, including reductions in infant mortality, rising living standards, improved lifestyles and better education, as well as advances in healthcare and medicine.

Households

Although outdated, the only available data on *the number of households* in the selected cities are from the last conducted Census in 2002, where the number of households in municipality of Gevgelija is 7221, with an average of 3.2 members per households. In municipality od Bitola, 28,942 households have been registered in 2002, with an average member of 3.3 per household (SSO, Census 2002).

The percentage of the *households that used computer and internet* in the Southeast Region in 2017 is 71%, in Pelagonia 70% that present a higher fraction compared to the national average in terms of use of computers (67%), but lower in terms of use of internet (national average 74%).

4 SOCIOECONOMIC INDICATORS

A higher *gross domestic product per capita* compared to the average of the Republic of North Macedonia was recorded in the Skopje Region with an index of 143.3, the Southeast Region with an index of 116.9 and the Vardar Region with an index of 108.0. All other regions had gross domestic product per capita below the average of the Republic of Macedonia. If GDP is expressed in denars per capita, the national GDP in 2015 is 269,996; in the Southeast Region 315,717 and Pelagonia Region 260,855 denars.

Households - recipients of social financial benefits aged 18+ (per 1000 population) in Pelagonia Region is 18.5 (2017) and it is higher than in Southeast Region - 12.0 and the national average of 15.8 per 1,000 populations (SSO. Regions of the Republic of Macedonia, 2018).

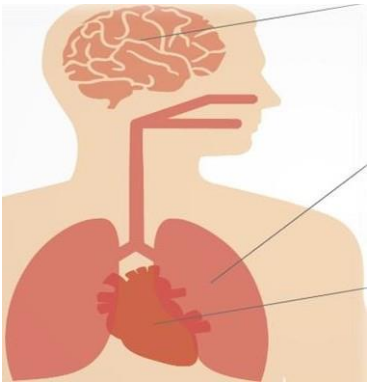
Employment and unemployment rate

Employment and unemployment rates of the population at the regional level show fluctuations (differences) in relation to the total rates at the country level. Employment rate in the Pelagonia Region is 54.2 while in Southeast Region is higher 59.7. Actually, Southeast Region had the highest employment rate in 2017 compared to the other planning regions (RSM average is 44.1). Unemployment rate is 16.3 and 12.0 accordingly, compared to the national unemployment rate - 22.4. In both regions, the rate of unemployed urban population is higher than in rural population, and regarding to the sex, the rate is higher in the women population (SSO. Regions of the Republic of Macedonia, 2018).

Fraction of illiterates

The percentage of illiterates in Gevgelija is lower in comparison to Bitola (0.8% compared to 2.6%, data from the Census 2002).

Assessment of basic health profile in Gevgelija and Bitola Municipality



5 MORBIDITY

Hospital admissions from the diseases of interest (cardiovascular diseases, respiratory diseases or particular conditions such as exacerbation of asthma, or frequent asthma attacks or wheezing in children), are good indicators for the air quality, but as well for the burden of the health systems during the air pollution episodes.

The electronic health system for aggregation of this data in RNM (so called "Moj termin") has been established in 2015. It collects information from the public health care institutions at secondary and tertiary level, but limited to the institutions that have contracts with the Health Insurance Fund (HIF). Since 2016, some private health care institutions that provide package of services covered by HIF, have been included in "Moj termin" as well.

In this analysis we covered three-year period starting from 1st January 2016 to 31 December 2018, for the city of Gevgelija and Bitola, then compared to the national average. In order to assess the burden of the health system, we analyzed *hospital admissions, unique (repetitive) according to the diagnosis*.

Table 11. *Hospital admissions from circulatory diseases, all ages for 2016-2018*

Circulatory diseases, I00-I99	Bitola		Gevgelija		RNM	
	#	Mb rate/10,000	#	Mb rate/10,000	#	Mb rate/10,000
2016	2004	218.7	353	155.7	33887	163.3
2017	1855	202.4	356	157.0	34335	165.4
2018	1803	196.8	370	163.2	35066	169.0
ПРОСЕК	**1887**	**206.0**	**360**	**158.6**	**34429**	**165.9**

Source: E-health Directorate. Ministry of Health, 2019

Bitola has the highest rate of hospital admissions per 10,000 (206), with an annual average of 1887 people being hospitalized from the *circulatory diseases*. The rate is lowest in Gevgelija where is registered 159 per 10,000 populations (Table 12). As expected, the rate is highest in the age group 30 and over (where the registered rate is 302/10,000 in Bitola; 226 in Gevgelija and the national average 260/10,000).

In terms of the burden from *respiratory diseases*, annually 1058 people are hospitalized annually in Bitola (the lowest rate registered, 116/10,000), and 363 in Gevgelija (160/10,000). The both cities have lower rate compared to the national average of 164 per 10,000 populations.

Table 12. *Hospital admissions from respiratory diseases, all ages for 2016-2018*

Respiratory diseases, J00-J99	Bitola		Gevgelija		RNM	
	#	Mb стапка /10,000	#	Mb стапка /10,000	#	Mb стапка /10,000
2016	1279	139.6	319	140.7	36413	175.5

2017	999	109.0	373	164.5	32395	156.1
2018	897	97.9	398	175.6	33127	159.6
ПРОСЕК	**1058**	**115.5**	**363**	**160.3**	**33978**	**163.7**

Source: E-health Directorate. Ministry of Health, 2019

As is presented in figure 11, the higher number of hospital admissions are registered in the cold season (from December to March-April).

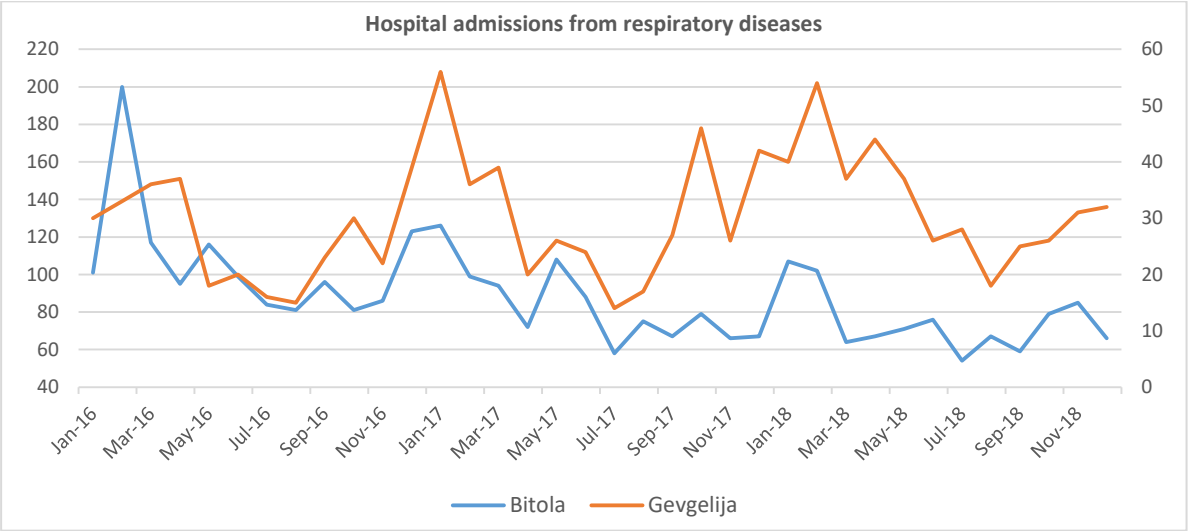


Figure 15. *Seasonal variation of the hospital admissions (HA) from the respiratory diseases for the period 2016-2018. On the left (primary) y-axis are presented HA in Bitola; on the right (y-secondary) axis, HA in Gevgelija*

Source: E-healthDirectorate. Ministry of Health, 2019

The number of hospitalizations from the respiratory diseases is distributed mainly in the age group 0-6, where very high rate is registered in Gevgelija (438/10,000), while in Bitola the rate is 91/10,000. The national average is 333/10,000 population. This significant differences and variations in the rate could be explained if we have the complete data from private health care institutions included in this analysis. In the other age groups (7-14 and 30 and over), the rate is high as well (80; 230 and 253/10,000 and 136; 144 and 151/10,000 in the 30+).

6 MORTALITY

All-cause natural mortality

The vast scientific literature on the health impact of air pollution includes numerous epidemiological, clinical and toxicological studies. Studies have been systematically documented wide a range of harmful health effects starting from respiratory symptoms to mortality from cardiorespiratory diseases and lung cancer. Numerous epidemiological studies have been conducted in order to quantify disease burden due to exposure to polluted ambient air since 1952 and "The Great smog" in London, where an increase in cardiovascular mortality was observed, as well as diseases of the respiratory system.

For the purposes of the TRAP Project, we analyzed vital statistic in total population in both municipalities - Gevgelija and Bitola, analyzing all deaths where death occurred in the period of interest (January 1 2015 to 31 December 2017). Monthly mortality data was provided from the State Statistical Office (SSO), coded according to ICD-10, disegrageted by age and sex. All-cause natural mortality is analyzed *(All-cause mortality ICD-10 code A00-Y89, excluding external causes of death V01-Y89)* and presented bellow (Figure 8-10).

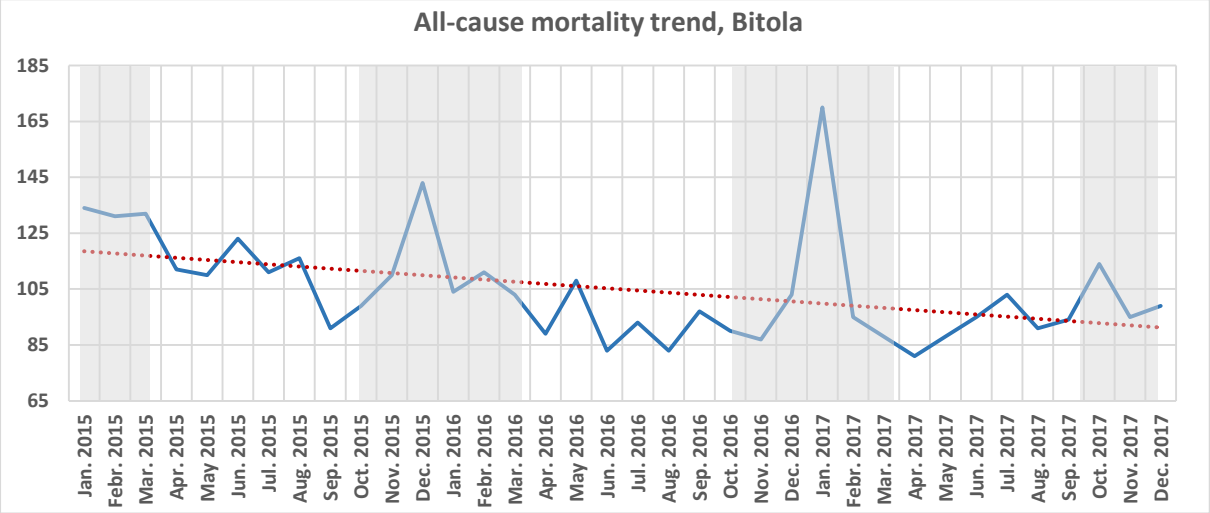


Figure 16. All-cause mortality trend, seasonal variations, all age groups for the three-year period, Bitola. Dark backgrounds (gray) marks the cold season (October-March) and the light background warm season (April-September)

Source: SSO. 2018

The mortality trend in analyzed municipalities is decreasing slightly including at national level. The highest pick in mortality is registered in January 2017 not only in selected cities in this Project, but in most of the cities analyzed for some other purposes, probably due to the severely low ambient temperature registered in that period (Figure 8-10).

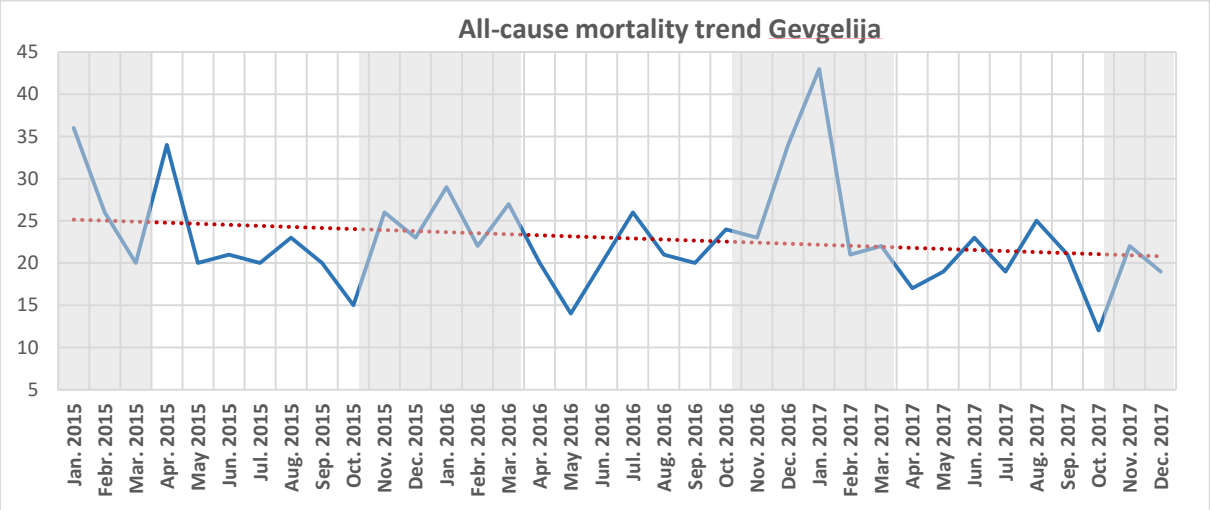


Figure 17. *All-cause mortality trend, seasonal variations all age groups for the three-year period, Gevgelija. Dark backgrounds (gray) mark the cold season (October-March) and the light background warm season (April-September)*

Source: SSO. 2018

Average *all-cause mortality rate* per 10,000 for analyzed three-year period is highest in Bitola (135.0/10,000); in Gevgelija the rate is 117.2, compared to the national average 96.0 (table 4-5). Annually, 1237 have died in Bitola from all causes of deaths (including metabolic, life styles factors and environmental and occupational), in Gevgelija the annual average is 266 deaths (table 4).

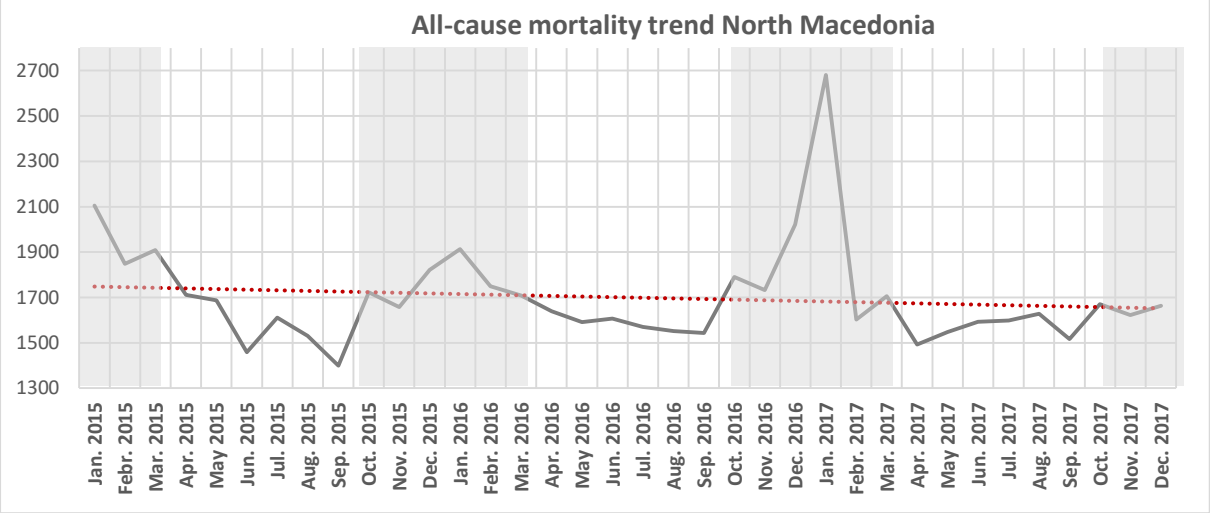


Figure 18. *All-cause mortality trend, seasonal variations all age groups for the three-year period, RN Macedonia. Dark backgrounds (gray) mark the cold season (October-March) and the light background warm season (April-September)*

Source: SSO. 2018

Table 13. *All-cause mortality (excluding external), all age groups for three-year period*

All-cause	Bitola			Gevgelija			RNM		
Mt	total	male	female	total	male	female	total	male	female
2015	1396	711	685	273	151	122	19948	10192	9756
2016	1127	554	573	266	128	138	19924	10368	9556
2017	1189	613	576	258	127	131	19897	10238	9659
Average	**1237**	**626**	**611**	**266**	**135**	**130**	**19923**	**10266**	**9657**

Source: SSO. 2018

Table 14. *All-cause (excluding external) mortality rate, all age groups for three-year period*

All-cause Mt	Bitola			Gevgelija			RNM		
rate/10,000	total	male	female	total	male	female	total	male	female
2015	152.4	158.0	147.0	120.4	133.7	107.2	96.1	98.1	94.2
2016	123.0	123.1	122.9	117.3	113.3	121.3	96.0	99.8	92.2
2017	129.8	136.2	123.6	113.8	112.5	115.1	95.9	98.5	93.2
Average	**135.0**	**139.1**	**131.1**	**117.2**	**119.8**	**114.5**	**96.0**	**98.8**	**93.2**

Source: SSO. 2018

Specific mortality

Due to the strong scientific evidence of association based on numerous implemented impact assessments of particulate air pollution, *specific mortality* is also analyzed: *diseases of the circulatory system (I00-I99)* including ischemic heart disease (I20-I25) and cerebrovascular diseases (I60-I69); as well as mortality from *respiratory diseases (J00-J99)* and *malignant neoplasms of the larynx, trachea and lungs (C32-C34)*.

In terms of the mortality of the circulatory diseases, the rate in Gevgelija is higher than in Bitola and RNM (69.8/10,000, and 55.7 and 54.6 per 10,000 populations accordingly) (table 7).

Table 15. *Cardiovascular and cerebrovascular mortality, all age groups for three-year period*

Mt circulatory system, I00-I99	Bitola			Gevgelija			RNM		
	total	male	female	total	male	female	total	male	female
2015	557	262	295	151	81	70	11939	5714	6225
2016	452	208	244	168	77	91	10912	5364	5548
2017	522	244	278	156	76	80	11172	5364	5808
Average	**510**	**238**	**272**	**158**	**78**	**80**	**11341**	**5480**	**5860**

Source: SSO. 2018

In both analyzed municipalities as well as at national level, the rate is predominantly higher in female population than in male (table 6-7). Regarding the age, the mortality rate is predominantly higher in the age group 65 and over (291/10,000 in Bitola; 362 in Gevgelija and national average 338 per 10,000 population). Compared to the other age groups, the rate is getting high in population aged 30-64 (the rate in Bitola is 16/10,000; Gevgelija 19 and RSM 17 per 10,000 population).

Table 16*. Cardiovascular and cerebrovascular mortality rate, all age groups for three-year period*

Mt circulatory system, I00-I99/10,000	Bitola			Gevgelija			RNM		
	total	male	female	total	male	female	total	male	female
2015	60.8	58.2	63.3	66.6	71.7	61.5	57.5	55.0	60.1
2016	49.3	46.2	52.3	74.1	68.2	80.0	52.6	51.6	53.6
2017	57.0	54.2	59.6	68.8	67.3	70.3	53.8	51.6	56.1
Average	**55.7**	**52.9**	**58.4**	**69.8**	**69.1**	**70.6**	**54.6**	**52.7**	**56.6**

Source: SSO. 2018

The mortality rate from respiratory diseases in general is lower compared to mortality from circulatory diseases, but higher in male population, especially in the age group 65 and over. The highest rate for all ages is registered in Gevgelija (5.7 per 10,000), and the lowest in Bitola (2.0/10,000) (table 8-9).

Table 17*. Respiratory mortality, all age groups for three-year period*

Respiratory Mt, J00-J99	Bitola			Gevgelija			RNM		
	total	male	female	total	male	female	total	male	female
2015	15	9	6	18	10	8	761	446	315
2016	17	11	6	6	2	4	846	517	329
2017	22	14	8	15	9	6	852	534	318
Average	**18**	**11**	**7**	**13**	**7**	**6**	**820**	**499**	**321**

Source: SSO. 2018

***Table 18**. Respiratory mortality rate, all age groups for three-year period*

Respiratory Mt, J00-J99/10,000	Bitola			Gevgelija			RNM		
	total	male	female	total	male	female	total	male	female
2015	1.6	2.0	1.3	7.9	8.9	7.0	3.7	4.3	3.0
2016	1.9	2.4	1.3	2.6	1.8	3.5	4.1	5.0	3.2
2017	2.4	3.1	1.7	6.6	8.0	5.3	4.1	5.1	3.1
Average	**2.0**	**2.5**	**1.4**	**5.7**	**6.2**	**5.3**	**3.9**	**4.8**	**3.1**

Source: SSO. 2018

Bearing in mind that International Agency for Research on Cancer (IARC) in 2013 classified the polluted air and the mixture of pollutants including pollution with PM (particulate matter) as human carcinogen (Group 1) (IARC Press Release N0 221; IARC Monograph 2016), it is expected that the impact of polluted air with PM in the country on the occurrence of malignant neoplasms of the respiratory system and it's mortality will be significant.

***Table 19.** Lung cancer mortality, all age groups for three-year period*

Lung cancer Mt, C32-C34	Bitola			Gevgelija			RNM		
	total	male	female	total	male	female	total	male	female
2015	36	30	6	10	8	2	930	755	175
2016	47	39	8	18	12	6	995	779	216
2017	46	37	9	21	15	6	884	681	203
Average	**43**	**35**	**8**	**16**	**12**	**5**	**936**	**738**	**198**

Source: SSO. 2018

In the analyzed three-year period the highest mortality rate from lung cancer is registered in Gevgelija (7.2/10,000), while in Bitola the mortality rate is closer to the national mortality rate (4.7 compared to the national average 4.5 per 10,000 population).

In most of the cases, the gender ratio in terms of lung cancer mortality is 4:1 or 5:1 (male/female) as is registered in Bitola and the national level. This ratio is 2:1 in the Gevgelija Municipality. Lack of study for individual/behavioral health risks in the selected cities (smoking habits of the population), is a limitation factor for the study (table 11).

Table 20. Lung cancer mortality rate, all age groups for three-year period

Lung cancer Mt, C32-C34/10,000	Bitola			Gevgelija			RNM		
	total	male	female	total	male	female	total	male	female
2015	3.9	6.7	1.3	4.4	7.1	1.8	4.5	7.3	1.7
2016	5.1	8.7	1.7	7.9	10.6	5.3	4.8	7.5	2.1
2017	5.0	8.2	1.9	9.3	13.3	5.3	4.3	6.6	2.0
Average	**4.7**	**7.8**	**1.6**	**7.2**	**10.3**	**4.1**	**4.5**	**7.1**	**1.9**

Source: SSO. 2018

7 IDENTIFICATION OF MAIN STAKEHOLDERS

Following desk research and consultations with the Project beneficiaries, a long list of stakeholders is created. The identified stakeholders are based on:

- Their importance for the project topic and the manner they are affected from project implementation;
- Their involvement at creating environmental and health policy;
- Their involvement at implementation of the legislation at national and local level.

Detailed information on description of the role and responsibilities of identified stakeholders, list of the identified ones are enclosed in the Annex 1.

8 AIR QUALITY

Republic of North Macedonia is a signatory of the Agreement for Stabilization and Association with European Union, that poses obligation to transpose the national legislation to agreement with the EU legislation (among others) on air quality and emissions. The European Union directives are transposed to the national legislation. The main laws are the Law on Environment and the Law on Ambient Air Quality.

Air pollution in the country is a cause of serious concern as the limit values set for protection of human health, especially for particulate matter, are exceeded significantly. Several sources and causes of the severe air quality problems are identified and may vary within and between cities. *Household heating* with wood during the winter period causes severe air quality problems in densely populated residential areas as major part of the households in the country still use wood as the primary source of heating. *Road traffic* is also a source of air pollution in urban locations, due to high volumes of traffic and partially old and poorly maintained vehicle fleet. *Energy production* and *industry* can have local impacts to the air quality, especially in the vicinities of old industrial installations lacking modern emission reduction systems. Furthermore, *development of densely built urban areas* including *decrease of green areas* in cities can affect the formation of pollution (MoEPP. Macedonian Air Quality Assessment Report for the period 2005-2015).

Characteristics of the monitoring stations in Bitola municipality

The national automatic AQ monitoring network comprised 17 monitoring station. In 2018 the new monitoring stations have been establsished, one mobile located in the Skopje municipality - Butel, Gostivar and Strumica. $PM_{2.5}$ started to be monitored in the monitoring stations Bitola 2, Kumanovo and Tetovo.

Considering that Bitola is a larger urban area in the state and an industrial city, in order to monitor the ambient air quality, two automatic monitoring stations for air quality has been set up in January 2004.

Bitola 1 monitoring station is located on the outskirts of the city close to small industries producing food and beverages. The main source of pollution in Bitola is the power plant REK Bitola, which is located 13 kilometers east of the station Bitola 1. The station stationed at the very entrance of the city, in the yard of the Hydrometeorological Service (UHMR) monitors industrial pollution. (Picture 1).

The *Bitola 2 station* is located in the courtyard of the administrative buildings. The nearest local road and parking lot is located at a distance of 2-3 meters, but the nearest main road is at a distance of 45 meters. Dotted emission sources are located on the southern side of the city at a distance of 0.5-2 kilometers from the station. MEIC (Picture 2).

Pollutant substances are measured in both stations: O_3, NO_2, SO_2, CO and PM_{10}. $PM_{2.5}$ are measured since 2018 in Bitola 2 station only.

Picture 4. Monitoring station Bitola 1

Picture 5. Monitoring station Bitola 2

The coordinates of the location of the AQ monitoring stations are presented in the table 14.

Table 21. Location of the AQ monitoring station in Bitola

Station	Coordinates		
	Longitude	Latitude	Altitude (m)
Bitola 1 (UHMR)	21^{0}21'23''	41^{0}02'24	586
Bitola 2 (Strezevo)	21^{0}20'12''	41^{0}01'49	600

Source: Macedonian Environment Information Center (MEIC), MoEPP. Monthly Reports on AQ

PM_{10} and $PM_{2.5}$ annual concentrations

Particulate matters (PM) are one of the most common pollutants in the air. The term particulate matter in a general is a mixture of particles (solid and liquid) suspended in the air with a wide range of size and chemical composition. $PM_{2.5}$ are fine particles with a diameter of up to 2.5 µm, while PM_{10} are particles with a diameter of up to 10 µm (MoEPP. Annual Report on Air Quality 2017).

PM particles (especially $PM_{2.5}$) are in the main focus of the experts due to their evidence-based impact on health and characteristic to penetrate deeply in the respiratory system, reaching to the alveoli. The registered adverse health effects of particulate air pollution include premature deaths, increase in hospital admissions and visit to emergency centers, increased medication use, absenteeism from work and schools etc.

In order to present the trend of the PM during a longer period, annual mean concentrations are presented for five-year period (table 15).

Table 22. Annual mean concentrations of PM10 in some selected cities, for five-year period

	PM_{10} annual mean concentration (µg/m^3)					
	2014	**2015**	**2016**	**2017**	**2018**	**mean**
RNM	69.5	68.7	58.6	56.4	49.1	***60.5***
Kocani	47.0	49.5	43.7	41.2	40.0	***44.3***
Kavadarci	80.4	56.1	46.5	47.7	55.2	***57.2***
Kicevo	76.6	79.2	60.1	47.7	44.5	***61.6***
Tetovo	133.8	147.2	96.8	58.1	50.1	***97.2***
Bitola	56.3	59.8	52.7	53.2	46.7	***53.7***
Skopje	68.7	66.6	66.4	67.4	57.0	***65.2***

*Annual EU Limit value of PM_{10} = 40 **(µg/m^3)**

Source: Macedonian Environment Information Center (MEIC), MoEPP. 2019

The trend is decreasing slightly, that is more evident in almost all cities in 2018, probably due to favorable meteorological conditions in that year. Still, the annual mean concentrations are greater than EU limit values in all presented cities and the national average as well.

Since the concentration of $PM_{2.5}$ particles used to be monitored routinly only at two monitoring stations from the national AQ monitoring network (Center and Karposh in Skopje) until 2017, in accordance with international literature, above all with the findings of the HRAPIE study (Health Risks from Air Pollution in Europe), a formula for the determination of $PM_{2.5}$ particles is used as a fraction of the total mass of the registered PM_{10} particles, where:

(*Equation 1. $PM_{2.5}/PM_{10}$ ratio*)

$$PM_{2.5} = 0.65\ x\ PM_{10}$$

The annual mean concentration of $PM_{2.5}$ (estimated or measured) is presented in table 16. In terms of the quality of data of the measured concentration, in 2018 monitoring station Tetovo had the highest percent of continuity and it was operational 97% the days of the year; Centar and Karpos in Skopje 92% and 73%, while Bitola 2 monitoring station 84% of the days.

Table 23. *Estimations of the annual mean concentrations of $PM_{2.5}$ in some selected cities, for five-year period. e (estimation); with blue are marked concentrations based on the measurements*

$PM_{2.5}$ annual mean concentration (µg/m³)						
	2014	**2015**	**2016**	**2017**	**2018**	**просек**
RNM[e]	45.2	44.7	38.1	36.7	31.9	**39.3**
Kocani[e]	30.5	32.2	28.4	26.8	26.0	**28.8**
Kavadarci[e]	52.3	36.4	30.2	31.0	35.9	**37.2**
Kicevo[e]	49.8	51.5	39.0	31.0	28.9	**40.0**
Tetovo[e]	87.0	95.7	62.9	37.8	40.8	**64.8**
Bitola[e]	36.6	38.9	34.3	34.6	32.3	**35.3**
Skopje	44.7	43.3	42.7	43.8	37.0	**42.3**

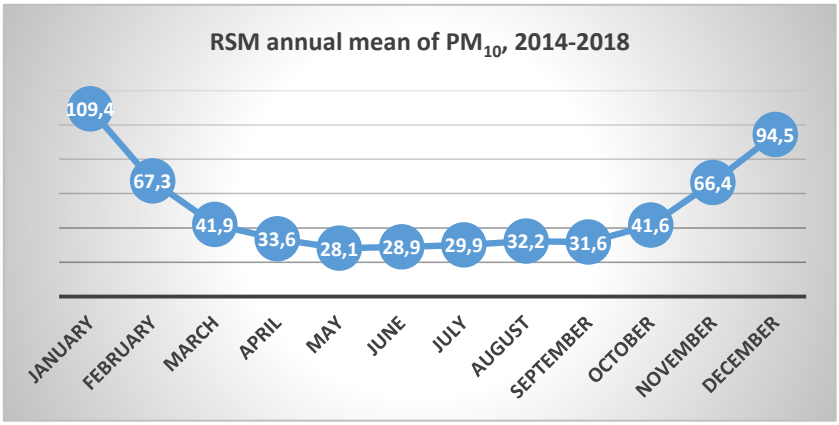
*Annual EU Limit Value (LV) of $PM_{2.5}$ = 25 (µg/m³); WHO LV = 10 (µg/m³)

Source: Macedonian Environment Information Center (MEIC), MoEPP. 2019

Exceedance of the annual mean concentration of $PM_{2.5}$ above EU and World Health Organization (WHO) Air Quality Standards for particulate matter ($PM_{2.5}$ and PM_{10}) is registered in all selected cities including the national average, that gives reasons for seriouse public health concern and priority (table 16).

Seasonal variation of the polutant concentration is expected. The highest concentrations of the PM_{10} are registered in the cold months, mainly starting from November to March (Table 17). Also during the summer concentration levels are relatively high, likely due to direct local emissions, photochemical particle formation from precursor gases, regionally dispersed particulates from forest and land fires and also background aerosols (MoEPP. Macedonian Air Quality Assessment Report for the period 2005-2015).

***Table 24**. Seasonal variation of the pollutant concentration for five-year period, a country mean*



Source: Macedonian Environment Information Center (MEIC), MoEPP. 2019

Ozone (O_3)

Unlike other pollutants, ozone levels are generally higher in rural areas. This is because in urban stations and stations that monitor traffic pollution, in the immediate vicinity of which there are sources of nitrogen oxides, the ozone is depleted by a titration reaction with freshly emitted nitrogen monoxide. In general, the highest concentrations of ozone are registered in the rural measuring points, lower in urban locations, and the lowest at the measuring points where traffic is the dominant source (MoEPP. Annual Report 2017).

Maximum daily 8-hours average ozone concentrations are presented for two-year period from the monitoring station Bitola 1 and 2, and the national average that presents mean from 13 monitoring station (2017) and 16 monitoring station in 2018.

***Table 25.** Maximum daily 8-hours average ozone concentrations for period 2017-2018*

O_3 (mg/m³)				
	2017		2018	
	Bitola (1 and 2)	RSM	Bitola (1 and 2)	RSM
January	43.3	37.9	27.4	26.3
February	45.4	30.0	41.0	32.4
March	64.5	48.0	55.7	41.4
April	66.3	51.6	60.7	49.3
May	70.7	49.7	59.1	54.2
June	69.9	51.1	64.6	54.8
July	74.3	62.0	67.6	64.8
August	78.0	60.6	59.5	60.6
September	59.5	48.1	65.3	64.2
October	42.7	35.8	42.7	42.6
November	29.4	23.9	25.1	25.3
December	36.1	27.7	24.2	24.5

Average	**56.7**	**43.9**	**49.4**	**45.0**

*Target value for protection of the human health = 120 (mg/m^3), it must not be exceeded in more than 25 days in a calendar year with an average value measured over a period of three years

Source: Macedonian Environment Information Center (MEIC), MoEPP. 2019

The target value for protection of the human health has not been exceeded in the analyzed period. But the emergence of high concentrations in large urban areas, is because the formation of ozone occurs at a time when there is high solar radiation and high temperature. Also, ozone concentrations increase with increasing altitude.

On average the ozone levels in cities are relatively low due to the presence of other pollutants that consume the ozone from the air. However, as typical for these latitudes, short term ozone episodes are usual. Number of these episode days have decreased during the past ten years (MoEPP. Macedonian Air Quality Assessment Report for the period 2005-2015). Exceedances of long-term ozone targets in our country are due to the geographical location in the southern part of Europe, which is characterized by a large number of sunny days during the summer period (MoEPP. Annual Reports).

Other pollutants (SO_2, NO_2 and CO)

Sulphur dioxide (SO_2) is a major precursor to particulate matter, associated with adverse health effects, and effects on the entire ecosystem (deforestation, acidification of the water and soil). The main anthropogenic source is burning of sulphur-containing fossil fuels for domestic heating, power generation or motor vechicles.

Nitrogen dioxide is mainly formed from oxidation of nitrogen monoxide (NO). These two gases together are known as nitrogen oxides (NOx). Nitrogen dioxide is the main source of nitrate aerosols, which form particulates ($PM_{2.5}$ and PM_{10}) and in the presence of ultraviolet light, ozone (O_3). NO_2 can have adverse effects on ecosystems, as it can beside of its acidifying effects act as a nutrient. However, excess deposition of reactive nitrogen in ecosystems may cause eutrophication (nutrient oversupply) (MoEPP. Macedonian Air Quality Assessment Report for the period 2005-2015). Main sources of NO_2 are combustion processes (heating, power generation, fuel combustion in vehicles' engines).

Carbon monoxide (CO) is an air pollutant that is formed by combustion processes such as residential heating by solid fuels and road traffic particularly in poor combustion conditions.

Table 26. *Annual mean concentrations od SO_2, NO_2 and CO for 2017-2018*

monitoring station	**SO_2**		**NO_2**		**CO**	
	annual mean ($\mu g/m^3$)	data coverage	annual mean ($\mu g/m^3$)	data coverage	annual mean (mg/m^3)	data coverage
Bitola 1	3.68	70%	9.93	56% (2018 data only)	0.4	36%
Bitola 2	3.19	85%	24.0	88%	0.7	93%
RNM	2.22		21.5		0.7	
Limit value	125 $\mu g/m^3$/one day		200 $\mu g/m^3$/one hour; 40 $\mu g/m^3$/calendar year		Max. daily 8th hour mean 10 mg/m^3	

Source: Macedonian Environment Information Center (MEIC), MoEPP. 2019

9 MATERIALS AND METHODS

Aiming to assess the burden of diseases attributable to air pollution in the regions of interest, Health Impact Assessment - the counterfactual approach has been applied, using environmental data for population exposure of $PM_{2.5}$ as input data for the calculations, obtained from the State Air Quality Monitoring network of Ministry of Environment and Physical Planning (MoEPP). Considering the fact that the AQ Monitoring system is still not established in the region of Gevgelija, the full methodological approach described below will be applied to the city of Bitola.

Since the health impact of polluted air was assessed through the mortality as a main health outcome, demographic data and data for all-cause mortality and specific mortality were obtained from the State Statistical Office. $PM_{2.5}$ particles are selected as a main stressors of concern, due to increasing trends in the last few years and serious exceedance of the EU and WHO limit values, as well as due to a huge body of scientific evidence for the adverse health effects of this pollutant.

HIAs (Health Impact Assessment) generally apply concentration-response functions based on risk estimates from the existing epidemiological studies. These functions are used aiming to correlate exposure estimated by air pollution assessment and the scenarios for air quality changes to a population at risk and its baseline health status (Fann et al. 2011). In order to assess the contribution of the particulate air pollution as a growing public health concern on the mortality, we have applied the methodology in which population exposure data and relative risk (RR) for selected health outcomes derived from epidemiological studies are used to calculate Population Attributable Fraction (PAF) (Hänninen 2014). This epidemiological concept - *PAF* assess "the proportional reduction in the outcome incidence if all risk factors of interest were simultaneously eliminated from the target population"

The PAF calculation is shown in the following formula:

(*Equation 2*)

$$PAF = \frac{f\ x\ (RR - 1)}{f\ x\ (RR - 1) + 1}$$

where f is the fraction of the population exposed, obtained from the SSO population estimations for 2017, and relative risk (RR) for selected health outcome derived from the epidemiological studies.

Whilst epidemiologists often study the risk of a disease in the presence of exposure compared to risk of a disease in the absence of exposure, in health impact assessment on the other hand often asks how many excess cases of disease will occur in a population of a certain size due to exposure at a given exposure level (Hertz-Picciotto 1995). The health impact of PM refers to the proportion of ill health that is attributable to the PM concentration observed in a given city or population. This is the amount of mortality and disease that would be prevented if PM were totally removed, which is an (unrealistic) counterfactual scenario of zero exposure (Martuzzi 2006).

To calculate the number of *attributable extra deaths*, the estimated mortality at no exposure (PM concentrations of 0.0 μg/m^3 - cut-off value), a hypothetical scenario (counterfactual scenario 1), is deducted from the observed mortality at observed exposure levels. This scenario has been applied in the EBD study in six European countries, where no threshold was used and levels were compared to

a scenario in which air pollution levels is reduced down to zero (Hänninen 2014). In order to estimate the potential *health gain* of reducing the exposure to PM, and/or to assess the benefit of the potential reduction strategies and actions in the future, we set up two other exposure scenarios. The observed mortality rate associated with the current exposure of suspended $PM_{2.5}$ in ambient air will be compared with the estimated mortality rate for exposure to concentrations corresponding to EU limit values (25 µg/m^3 $PM_{2.5}$, from Directive 2008/50/EC) and WHO target value (10 µg/m^3 $PM_{2.5}$ in WHO Air Quality Guideline - WHO AQG) - counterfactual scenario 2 and 3.

Aiming to assess the burden of diseases due to particulate air pollution and most importantly to assess the health benefits from implementation of effective and consistent measures and policies that would reduce the concentration of the stressors to the EU limit values (EU LV), we have applied a second method for assessing disease burden using a YLL (*Years of Life Lost*) as a selected metrics for quantification of the disease burden (WHO Methods and data sources 2017).

This method and metrics was firstly developed in the 1980s by WHO and other HIA studies, the data for the YLL due to premature mortality are obtained from the WHO Global Health Estimates (WHO GHE, 2016) data base. The environmental data for population exposure of $PM_{2.5}$ are obtained from state air quality monitoring network runned by MoEPP, and relevant Concentration-response Functions (CRFs) have been applied.

Data collection and period of analysis: The study period is three years (2015-2017).

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ANNEX 1.IDENTIFICATION OF STAKEHOLDERS

1.1 List of identified stakeholders

Following desk research and consultations with the Project beneficiaries, a long list of stakeholders is created. The identified stakeholders are based on:

- Their importance for the project topic and the manner they are affected from project implementation,
- Their involvement at creating environmental and health policy,
- Their involvement at implementation of the legislation at national and local level.

Table 1. *List of identified stakeholders*

Categories	***Name of Stakeholders***
Stakeholders directly involved at environment (air quality) and public health management, policy creating and decision making	➢ Macedonian Environmental Informative Center (MEIC) ➢ Ministry of Environment and Physical Planning ➢ Ministry of Health ➢ Institute for Public Health ➢ Center for Public Health Bitola ➢ Center for Public Health Veles, Regional Office Gevgelija
Stakeholders with limited involvement	➢ Municipality of Bitola ➢ Municipality of Gevgelija ➢ Center for South East Planning Region ➢ Center for Pelagonia Planning Region ➢ General Hospital Bitola ➢ General Hospital Gevgelija
Stakeholders with private interests	➢ Local industries ➢ NGOs ➢ Academia
General public	➢ Local population, general public

1.2 Description of each stakeholder's role and responsibilities regarding TRAP Project

Table 2. *Stakeholders' role and responsibility regarding TRAP Project*

STAKEHOLDER	CATEGORY	ROLE
Macedonian Environmental Informative Center (MEIC)	Stakeholders directly involved at environment (air quality) management, policy creating and decision making	Macedonian Environmental Informative Center (MEIC) is department within MoEPP. MEIC is main beneficiary and at the same time representing the MoEPP as project partner at TRAP Project. Their role in the project is to secure successful implementation of the project especially regarding working packages 3 and 4. MEIC is also responsible for engaging, supervision and quality assurance of the activities related to: ➢ Conducting survey for emissions for households heating and development of air quality plan, ➢ Preparation of technical specification of monitoring equipment and preparation of tender procedure for procurement of monitoring equipment, ➢ Procurement of monitoring equipment for air quality measurements: 1 (one) air quality monitoring station in Gevgelija, Upgrading of the air quality monitoring station in Bitola ➢ Analysis of the filters in the accredited chemical laboratory, ➢ Preparation of design of the promotional materials and preparation for printing
Ministry of Environment and Physical Planning	Stakeholders directly involved at environment (air quality) management, policy creating and decision making	Ministry of Environment and Physical Planning is project beneficiary No. 5 responsible for project implementation as well as securing on time implementation of activities assigned to PP5. The Ministry is main beneficiary of the TRAP project and shall be regularly informed and involved at all project activities.
Institute for Public Health (IPH)	Stakeholders directly involved at public health management, policy creating and decision making	Institute for Public Health is not project partner at TRAP project but is going to be involved as monitoring and advisory institution. Representatives from Institute are going to be consulted during preparation and implementation of the WP 5. The main activity of the Institute of Public Health of the Republic's health care is prevention through monitoring, researching and studying of health condition, the causes and spread of communicable and non-communicable diseases of social and medical importance, the impact of environmental factors and taking measures for protection and promotion of health.
Ministry of Health (MoH)	Stakeholders directly involved at public health management, policy creating and decision making	Ministry of Health is main policy creator in the country in regards to health care, public health i.e. covering all health topics on national level. The Ministry is not involved directly in the project implementation, but considering the fact that one of the main aims of the project is health, the role of this Ministry is inevitable. MoH should be informed about activities related to WP 5, sensitization activities from WP 6 and in some situations if necessary, it shall be consulted during implementation of these project activities.
Center for Public Health (CPH)	Stakeholders directly involved at public health	CPH doesn't have any direct responsibilities regarding TRAP project but is identified as important stakeholder in regards to public health especially with its branch offices in Gevgelija and Bitola

STAKEHOLDER	CATEGORY	ROLE
	management, policy creating and decision making	
Municipality of Bitola	Stakeholders with limited involvement	Municipality of Bitola is the location where the TRAP activities should take place. This municipality is one of the beneficiaries of the project. For this municipality the following activities are going to be conducted: - Upgrading of the existing equipment for monitoring of the ambient air quality in Bitola, - Preparing Plan for ambient air quality for Bitola - Conducting training for relevant local authorities from Bitola - Conducting health sensitization campaign
Municipality of Gevgelija	Stakeholders with limited involvement	Municipality of Gevgelija is the location where the TRAP activities should take place. This municipality is one of the beneficiaries of the project. For this municipality the following activities are going to be conducted: - Supply of equipment for monitoring of the ambient air quality in Bitola, - Preparing Emission Inventory for Gevgelija and whole Southeast region - Conducting training for relevant local authorities from Gevgelija - Conducting health sensitization campaign
Center for South East Planning Region	Stakeholders with limited involvement	Center for South East Planning Region is not part of the TRAP project but is identified as important stakeholder considering the environmental issues in this region
Center for Pelagonia Planning Region	Stakeholders with limited involvement	Center for Pelagonia Planning Region is not part of the TRAP project but is identified as important stakeholder considering the environmental issues in this region
General Hospital Bitola	Stakeholders with limited involvement	The General Hospital in Bitola, as well as other health care centers from the town are not part of the TRAP project but are important for implementation of activities under WP5.
General Hospital Gevgelija	Stakeholders with limited involvement	The General Hospital in Gevgelija, as well as other health care centers from the town are not part of the TRAP project but are important for implementation of activities under WP5.
Local industries	Stakeholders with private interests	Local industries are important stakeholders for the TRAP project. They are significantly contributing to the Ambient Air Quality in Gevgelija and especially in Bitola.
NGOs	Stakeholders with private interests	NGOs working in the environmental sector are included in all the decision making process related to environmental legislation. The below NGOs are representing the non-governmental sector working in the area of environmental protection and health: • Bitola NGOs (Sfera Bitola, ED Molika, Geosfera, Slou Fud, Za nas se raboti, • Gevgelija NGOs (Foundation Apolonia, Poddrska)
Academia	Stakeholders with private interests	Academic sector is also important especially for conducting scientific pressure, building capacities or increasing awareness about particular issues on national or local level. In Gevgelija there is a Faculty on Business and Tourism

STAKEHOLDER	CATEGORY	ROLE
		Management, and this faculty is not covering the respected topics of the project. The Faculty in Bitola is more relevant and is going to be involved at TRAP Project activities.
Local population, general public	General public	Local population and general public are also one of the most important stakeholders. They are both contributing to the air pollution and health impact, and are also affected by ambient air quality. Therefore, they are going to be significantly involved at implementation of the TRAP Project activities.

Table 27. Stakeholders' role and responsibility regarding TRAP Project

1.3 Description of each stakeholder's role and responsibilities regarding legislation for environment and health

Table 3. *Stakeholders' role and responsibility regarding environment and health legislation*

STAKEHOLDER	CATEGORY	ROLE REGARDING ENVIRONMENTAL LEGISLATION (LAW ON AIR QUALITY and LAW ON ENVIRONMENT)	ROLE REGARDING HEALTH LEGISLATION
Macedonian Environmental Informative Center (MEIC)	Stakeholders directly involved at environment (air quality)	Responsible for monitoring of the Ambient Air Quality. Within MEIC are functioning 4 units: Unit for ambient air quality, Unit for analytics and reporting, Unit for cadastre and modelling, Unit for Information Technology. Under the Law on Environment, the Centre collects all information on the state of the environment from self-monitoring of different institutions and other sources, as well as from its own monitoring and makes them available to the public through its electronic information system (via WEB Site of MOEPP) and adequate information materials, such as: brochures, reports, etc. In this way, MEIC provides central archives of data on all environmental media and it can be used by all interested working on subject matters related to environment protection in the Republic of Macedonia. Under the Law on AAQ, MEIC is responsible for: - preparing of the annual programme for monitoring of the AAQ - Prepare and maintain the cadastre on air pollutants	This stakeholder doesn't have responsibilities under the legislation on health
Ministry of Environment and Physical Planning	Stakeholders directly involved	Responsible for implementation of Legislation on Ambient Air Quality According the Law on AAQ MoEPP is:	This stakeholder doesn't have responsibilities under the legislation on health

STAKEHOLDER	CATEGORY	ROLE REGARDING ENVIRONMENTAL LEGISLATION (LAW ON AIR QUALITY and LAW ON ENVIRONMENT)	ROLE REGARDING HEALTH LEGISLATION
	at environment (air quality)	- Responsible for prescribing the content and manner for preparation of Plan for air quality - Responsible for prescribing the criteria, methods and procedures for assessment of the ambient air quality - Responsible for prescribing the ELV from stationary sources - Responsible for prescribing the content and manner for preparation of short-term action plan - Responsible for adoption of the annual programme for monitoring of the AAQ - Defining the conditions for conducting the monitoring of the AAQ <u>Responsibilities under the LoAAQ[4] include:</u> • participation in determining zones and agglomerations of priority importance (defined as such in the National Plan for Ambient Air Quality Protection depending on the degree of exceedance of the quality limit values and depending on the danger posed to human health) • participation in preparing the Plan for ambient air quality improvement • participation in preparing Short term action plan for protection of ambient air ; • cooperating with state administrative bodies, scientific and expert organisations including legal entities and natural persons who are owners/users of installations that are pollution sources; • taking measures to inform the public and providing access to information and participation in the preparation and adoption of the planning documents; • annual reporting on the implementation of the planning documents adopted and publishing of the planning documents; • reporting on other measures for ambient air quality management	

[4] Consolidated version of 04.05.2015 (Official Gazette of RM no. 67/04, 92/07, 35/10, 47/11, 59/12. 163/13 and 10/15)

STAKEHOLDER	CATEGORY	ROLE REGARDING ENVIRONMENTAL LEGISLATION (LAW ON AIR QUALITY and LAW ON ENVIRONMENT)	ROLE REGARDING HEALTH LEGISLATION
		as well as measures and activities aimed at improving the general situation on the territory of the LSGU that were implemented in the last year and planned activities for the next year; • establishing local monitoring (optional) and reporting; • monitoring of air emission from B-Installations and proposing measures to B- installations to prevent or mitigate air emissions ; • providing financing for protection and improvement of air quality i.e. for preparation and implementation of the Plan for ambient air quality improvement and the Short term action plan for ambient air protection, for implementation of activities in the priority zones and agglomerations and for other measures being undertaken based on LAAQ as well as for local monitoring networks; • informing the public about the measures taken and each exceeding of the threshold of alert; • inspection over the enforcement is performed by authorized environmental inspectors; • random control over emissions from mobile sources of pollution is performed by authorized environmental inspectors in cooperation with competent body for determining technical preparedness of mobile sources of pollution.	
Institute for Public Health	Stakeholders directly involved at public health management, policy creating and decision making	The role of IPH in the water management system is related to the monitoring of drinking water and surface waters. The activity of the Institute is defined in the Law on Health Care and comprises of: • collection, processing and analysis of data, • organization and planning of health care, research and monitoring of hygiene and other conditions for the protection of air, food products, drinking water, wastewater and solid waste materials, • participation in preventive sanitary supervision over construction and other facilities, • monitoring and implementation of active measures to protect the population from infectious and other diseases, • conducting reference laboratory analysis,	The activity of IPH is defined in the Law on Public Health. Main activities of IPH are collection, processing and analysis of data, organization and planning of health care, research and monitoring of hygiene and other conditions for the protection of air, food products, general items use, drinking water, wastewater and solid waste materials, participation in preventive sanitary supervision.

STAKEHOLDER	CATEGORY	ROLE REGARDING ENVIRONMENTAL LEGISLATION (LAW ON AIR QUALITY and LAW ON ENVIRONMENT)	ROLE REGARDING HEALTH LEGISLATION
		• establishing and implementing measures to disasters, and accident emergencies, etc. Throughout the country there are 10 Centres for Public Health with laboratories; these centres are separate and administratively independent from the Institute; however, the Institute performs expert supervision on their activity and monitors the implementation of the Programme for Public Health required under the Law on Health Care.	
Ministry of Health	Stakeholders directly involved at public health management, policy creating and decision making	<u>According to the LoAAQ:</u> • prescribing criteria for ambient air quality, ELVs from stationary sources as well as deviations from the ELVs; • assessment of the health risk associated with the ambient air; • methodology for evaluating; • prescribing the content and proposing the National ambient air quality plan to the GoRMK; • preparing the content and short term action plans; • informing the public about the measures taken and each exceeding of the threshold of alert; • monitoring methodologies and selection criteria for location of the measuring points for all sources of pollution; • prescribing other measures for protection from mobile sources.	Ministry of Health (MoH) is responsible authority for creating policy and decision making in the field regarding health care, public health and is public authority responsible for implementation of the whole legislation for health.
Center for Public Health (CPH)	Stakeholders directly involved at public health management, policy creating and decision making	This stakeholder doesn't have responsibilities under the legislation on environment	Center for Public Health is established with the Law amending the Law on health protection, from May 29th, 2009. Pursuing the Law on health protection, the Center for public health-Skopje monitors, investigates, and examines the health condition of the population, the reasons of its appearance and the spreading of the contagious and other diseases that are of a great socio-medical importance, as well as the influence of the ecological factors on health.

STAKEHOLDER	CATEGORY	ROLE REGARDING ENVIRONMENTAL LEGISLATION (LAW ON AIR QUALITY and LAW ON ENVIRONMENT)	ROLE REGARDING HEALTH LEGISLATION
			It proposes and undertakes measures to protect and promote the health of the people within the whole territory of the district of Skopje city and other towns from the country.
Municipality of Bitola	Stakeholders with limited involvement	Many local industries have to obtain environmental permits before they are allowed to operate, in many cases such permits have to be obtained from an LSGU. Business operators must comply with a number of requirements in their respective areas of business activity in order to be permitted to operate: • Prepare and submit the applications to receive permits, respectively to satisfy the requirements for receiving the permit; • Self-monitoring, submission of measurement data to LSGUs except for B-installation that are located in protected areas and report to MoEPP; • Maintain records of the facilities and submitted them to the MoEPP/EA and the MoAFWE; • inform the MoEPP about threats to the environment from their operations, inform users in cases of force majeure when services are temporary restricted or forbidden; • measurements of different media done by accredited laboratories, keeping records of the measurements and reporting to LSGUs except for B-installation that are located in protected areas and report to MoEPP.	Implementation of the legislation on health at local level
Municipality of Gevgelija	Stakeholders with limited involvement	Many local industries have to obtain environmental permits before they are allowed to operate, in many cases such permits have to be obtained from an LSGU. Business operators must comply with a number of requirements in their respective areas of business activity in order to be permitted to operate: • Prepare and submit the applications to receive permits, respectively to satisfy the requirements for receiving the permit; • Self-monitoring, submission of measurement data to LSGUs except for B-installation that are located in protected areas and	

STAKEHOLDER	CATEGORY	ROLE REGARDING ENVIRONMENTAL LEGISLATION (LAW ON AIR QUALITY and LAW ON ENVIRONMENT)	ROLE REGARDING HEALTH LEGISLATION
		report to MoEPP; • Maintain records of the facilities and submitted them to the MoEPP/EA and the MoAFWE; • inform the MoEPP about threats to the environment from their operations, inform users in cases of force majeure when services are temporary restricted or forbidden; • measurements of different media done by accredited laboratories, keeping records of the measurements and reporting to LSGUs except for B-installation that are located in protected areas and report to MoEPP.	Implementation of the legislation on health at local level
Center for South East Planning Region	Stakeholders with limited involvement	The Center has not particular obligations regarding environmental legislation. The only work regarding environmental legislation is promoting the concept of environmental protection as integral part of regional development.	This stakeholder doesn't have responsibilities under the legislation on health
Center for Pelagonia Planning Region	Stakeholders with limited involvement	The Center has not particular obligations regarding environmental legislation. The only work regarding environmental legislation is promoting the concept of environmental protection as integral part of regional development.	This stakeholder doesn't have responsibilities under the legislation on health
General Hospital Bitola	Stakeholders with limited involvement	The hospital has no obligations under the legislation on environment	To follow and implement the legislation on health
General Hospital Gevgelija	Stakeholders with limited involvement	The hospital has no obligations under the legislation on environment	To follow and implement the legislation on health
Local industries	Stakeholders with private interests	Many local industries have to obtain environmental permits before they are allowed to operate, in many cases such permits have to be obtained from an LSGU. Business operators must comply with a number of requirements in their respective areas of business activity in order to be permitted to operate: • Prepare and submit the applications to receive permits, respectively to satisfy the requirements for receiving the permit; • Self-monitoring, submission of measurement data to LSGUs except for B-installation that are located in protected areas and	This stakeholder doesn't have responsibilities under the legislation on health

STAKEHOLDER	CATEGORY	ROLE REGARDING ENVIRONMENTAL LEGISLATION (LAW ON AIR QUALITY and LAW ON ENVIRONMENT)	ROLE REGARDING HEALTH LEGISLATION
		report to MoEPP; • Maintain records of the facilities and submitted them to the MoEPP/EA and the MoAFWE; • inform the MoEPP about threats to the environment from their operations, inform users in cases of force majeure when services are temporary restricted or forbidden; • measurements of different media done by accredited laboratories, keeping records of the measurements and reporting to LSGUs except for B-installation that are located in protected areas and report to MoEPP.	
NGOs	Stakeholders with private interests	This stakeholder doesn't have responsibilities under the legislation on environment	This stakeholder doesn't have responsibilities under the legislation on health
Academia	Stakeholders with private interests	This stakeholder doesn't have responsibilities under the legislation on environment	This stakeholder doesn't have responsibilities under the legislation on health
Local population, general public	General public	The General Public are an important stakeholder who must be involved in decision making in environmental permitting and during the development of environmental plans. The general public is an important stakeholder in the environmental management, in terms of general awareness and behaviour change. Raising awareness of the local population regarding their inclusion in the decision making process in the areas of air and water quality, nature protection, industrial pollution, environmental noise and waste is very important issue for implementation of environmental legislation.	This stakeholder doesn't have responsibilities under the legislation on health. However, the General Public are an important stakeholder who must be involved in decision making in health policies on local and national level. So far there is no evidence of involvement nor any type of activism directly oriented towards public health, health care, etc.

ANNEX 2 Identification of main stakeholders

In continuation to the stakeholder analysis, identification of stakeholders important for project implementation was conducted. The identification was performed under the criteria set to asses the relevance and priority of the stakeholders.

The criteria under which the selection was conducted are the following:

- The stakeholder has obligation under the TRAP Project
- The stakeholder has obligation under the environmental/health legislation
- The stakeholder is/might be, directly affected from project implementation
- The stakeholder is interested to be part of the project implementation

Based on the desk research and the various consultations carried out, a qualitative assessment regarding awareness of environmental legislation relevant to local level was performed for each category of stakeholders. The conclusions are presented in the table below.

Each stakeholder is evaluated with scores from 1 to 5, where 1 is the lowest and 5 the highest.

Table 4. *List of priority stakeholders*

STAKEHOLDER	Has obligation under the TRAP Project	The stakeholder has obligation under the environmental/health legislation	The stakeholder is/might be, directly affected from project implementation	The stakeholder is interested to be part of the project implementation	Total
Macedonian Environmental Informative Center (MEIC)	5	5	5	5	20
Ministry of Environment and Physical Planning	5	5	5	5	20
Institute for Public Health (IPH)	4	5	5	5	19
Ministry of Health (MoH)	1	5	4	2	12
Center for Public Health (CPH)	1	3	4	2	10
Municipality of Bitola	1	4	4	3	12
Municipality of Gevgelija	1	4	4	3	12
Center for South East Planning Region	1	3	3	3	10
Center for Pelagonia Planning Region	1	3	3	3	10
General Hospital Bitola	1	2	2	2	7
General Hospital Gevgelija	1	2	2	2	7
Local industries	1	3	3	2	9
NGOs	2	1	3	3	9
Local Initiatives for AiR Quality	2	1	3	3	9
Academia	2	1	3	3	9
Local population, general public	2	3	4	3	12

ANNEX 3. STAKEHOLDERS' PRIORITIZING

Priority stakeholders

The purpose of prioritizing stakeholders is to form priority groups of stakeholders which will be given different consideration and involvement at project implementation. Following on the quantitative assessment under criteria 1 to 5, an overall score is calculated for each stakeholder. Based on the overall score, three priority groups were identified as set out in the table below.

Table 5. *List of type of stakeholders according the scoring*

Priority	Score	Role/Type of Stakeholders
1	15-20	Key stakeholders
2	10-14	Necessary actors
3	1-9	Stakeholders with less direct role

Table 5. *Prioritization of stakeholders*

Key stakeholders	***Stakeholder***	***Scores***
Necessary actors	MEIC	20
	MoEPP	20
	IPH	19
	Ministry of Health (MoH)	12
	Center for Public Health (CPH)	10
	Municipality of Bitola	12
	Municipality of Gevgelija	12
	Center for South East Planning Region	10
	Center for Pelagonia Planning Region	10
Stakeholders with less direct role	Local population, general public	12
	Local industries	9
	NGOs	9
	Academia	9
	General hospital Gevgelija	7
	General Hospital Bitola	7

ANNEX 4. MINUTES OF THE STAKEHOLDER MEETING, GEVGELIJA, THUESDAY 18.6.2019

The stakeholder meeting took place on Tuesday 18.06.2019 in Gevgelija at Motel Vardar. The meeting was attended by all relevant stakeholders connected directly or indirectly with the issue of environment and health and responsible for creating the local policy at these sectors. The list of all stakeholders is given as Annex 1.

The representative from Center for Climate Change, Mrs. Bojana Stanojevska Pecurovska opened the meeting and presented the project and activities that are going to be implemented in the country , specifically in Gevgelija and Bitola. Afterwards, in parallel with a discussion regarding the importance of the air pollution problem and accordingly the health impact on global and national level, the representatives from Institute of Public Health presented the demographic, socio-economic, environmental and health profile of the population in the Municipality of Gevgelija including the structure of the main causes for morbidity and mortality focusing at environmental and health risks.

Following the presentations, the participants had a chance to discuss the current situation with air pollution in Gevgelija, different environmental risks, causes that contribute as well as what needs to be done in order improving the public health and the life quality in the municipality.

Main conclusions

As one of the main environmental and health issue in the town are air pollution especially during the winter period which predominantly is caused by the heating process , the increase of transport in the city and its contribution towards the air pollution. Also, the improper waste selection and disposal is a big problem which can be solved among others with setting up private public partnership (PPP) due to the insufficient capacity of the PCE to collect and manage the current waste.

The low level of awareness was also mentioned including the need of more efficient promotion and education for environmental protection and sustainable development . Previously the drinking water quality and safety was an issue, but now it seems to be solved with the construction of the new water supply system.

In general, the conclusion was that the life quality in the town is on satisfactory level and none of the representatives identified the environmental issues as possible direct cause for health problems among the population. However, a straightforward strategy for local sustainable development including environmental priorities is inevitable as soon as possible having into consideration that all local strategies are currently expired and municipality is not working at strategic planning at the moment.

The detailed statements from relevant representatives are given below:

Dr. Marija Peneva from CPH Veles, regional office Gevgelija said that so far the risks from the air pollution are assessed through the descriptive method only, monitoring the trend of respiratory morbidity in preschool children and pupils. The Public Health Center is reporting annually to the Ministry of Health and the Institute of Public Health. Their findings trough the years state that

morbidity rate is much higher in the urban area than the rural. It is important to mention that there could be a lot of biases in the health statistics, following the frequent misclassifications in the morbidity reporting.

Mr. Aco Ristovski from Apollonia Foundation said that Gevgelija population has very high level of environmental awareness lately. But it is important everyone to act in reducing the air pollution and to take their own part of the responsibility. The foundation where he works is organizing regular outdoor events and activities with pupils from primary school where they have a chance to discuss the environmental protection. Still, that is not sufficient number of children covered by the Apolonia Foundation Programed (40 children), so the other similar organizations and institutions should be more active because there is a need to spread that idea at the age when the attitudes and behaviors are still in the process of ongoing developing. Therefore, education is very important and is a field where we all must regularly work.

The municipal environmental inspector Mr. Mite Krecev tackled the main environmental local problem in his discussion, saying that the current air quality is not at satisfactory level. During the winter period 60-70% of the residents are using wood as primary source for heating, out of which 10-15% coal and 10-15% pine trees which are polluting the air. The vehicles, especially the higher number due to the visitors from neighboring countries are also polluting. The current dumpsite must be closed immediately, and the new one to be in function as soon as possible. He thinks also that education of the population about waste selection is very important but as well to provide appropriate conditions and infrastructure for that activity. Gevgelija started with selection partially but it is still not satisfactory. Mr Krecev arouse the problem with the lack of human resources for inspection within the local government as well as the problem that one inspector is responsible for the surveillance of all present environmental risk factors starting from the inspection to the development of the local policies.

Mrs. Vera Ljateva, the state environmental inspector said that there are a lot of dumpsites which contribute to the air pollution. Therefore, much higher fines should be executed for citizens that don't dispose the waste properly, especially at the rural areas. Mrs Ljateva stressed out the problem of the lack of a separate environmental department in the Municipality of Gevgelija beside the frequently repeated recommendation by the State Environmental Inspectorate.

Mr. Risto Atanasovski, representative from **FLORIT Foundation,** said that life quality in Gevgelija is satisfactory. The main environmental problem according to him is the current dumpsite and he stressed out the importance the new landfill to be operational as quick as possible. The population in Gevgelija is referring to European cities and is striving to reach the European standards that's why is very important to have straightforward strategy and to define what the city wants to achieve. He thinks that all involved parties are acting confusingly and uncoordinated so far posing various priorities that are based mostly on their perceptions. Thus, he suggests real time environmental monitoring to be established. Introducing the air quality monitoring station in the municipality of Gevgelija is a good start in this direction.

Mr. Zoran Zumrov, the Director of the PCE Komunalec Gevgelija said that although the city of Gevgelija has a new communal landfill according to the standards and requirements, it is still not operational because the road access to the landfill is not enabled yet. The Municipality of Gevgelija is

doing efforts to construct the road and bring electricity supply. He thinks that the current dumpsite is nonstandard and contribute largely to the air pollution. According to Mr Zumrov, it is very important to develop and establish National Strategy on waste selection accompanied with educational and promotional activities among the general population. Regarding the drinking water quality, the problem with contaminated drinking water (with arsenic) has been solved starting from the beginning of this year, and all citizens now use safe drinking water (except population from the village of Moin, approximately 300 citizens). But the public communal enterprise which operates with the water supply system is still working on accession of the Moin residents to the safe water supply hopefully to the end of this year.

Dr. Peneva added that this company should also take the care of the rural water supply systems, their regular maintenance and disinfection in order to provide constantly safe drinking water.

Mr. Toni Nikolov a representative from the Municipality of Gevgelija said that though the Municipality administration is not doing regular activities at raising awareness they have many activities for improving the environmental condition in the municipality.

The industry representative Mr. Zoran Gjurov said that even symbolically, his company contributes to the environmental protection with the recycling the plastic waste, but still he thinks that campaign for raising the public awareness for waste selection is more than important. They had many attempts to select the waste but unsuccessful. Therefore, he suggests Public Private Partnership could be a solution for waste management. The PCE has no capacity to collect the selected waste.

At the end **Mr. Aco Ristovski** from Apollonia said that it is very important the strategy to be implemented by the local government and legislation enforcement to be in place regularly.

The meeting ended up at 12h with lunch, and during the lunch the participants had a chance to continue the fruitful discussion.