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▶ **To cite this version:**

Taous Sahali, Abdel Majid Djenane. The problem of sewerage networks in Bejaia (Algeria). International Journal of Economic Performance - , ,2022 5 (2). hal-03905257

HAL Id: hal-03905257
https://cnrs.hal.science/hal-03905257

Submitted on 21 Dec 2022

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المجلة الدولية للأداء الاقتصادي
International journal of economic performance
ISSN: 2661-7161 EISSN:2716-9073
Publications are Open Access in this journal

The problem of sewerage networks in Bejaia (Algeria)

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Submitted:23/10/2022 Accepted:20/11/2022 Published:04/12/2022

Abstract:

The problem of the sewerage networks in Bejaia is due to the obsolescence of the equipment and the under-dimensioning of the networks. We have carried out a small study and show using the equations where the problem lies. to do so, we collected data from the various organizations. Changing the diameter of the sewer networks can solve the problems of overflow and the waste they generate, because rainwater carries garbage and debris, which then accumulates causing stagnation of water.

Key words: sustainable development; water resources; water pollution; the population explosion; sewerage networks.

JEL Classification Codes: Q1, Q25, Q53, Q56, Q59.

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Introduction:

Sustainable development, according to the WCED Commission, is development that meets the needs of the present without compromising the ability of future generations to meet theirs.

Keeping a clean planet is everyone's concern, so Algeria has adhered to several conventions: the Basel Convention in May 1998 with the aim of reducing the volume of hazardous waste, the Kyoto Protocol signed in April 1998 then approved in 2002, but only came into force in February 2005; this protocol aims to reduce GHG "greenhouse gases".

Following this, several laws have been introduced, in order to apply sustainable development.

One of the major challenges of sustainable development and the MDGs "millennium development goals" in terms of sanitation is to connect the population to sanitation networks and drinking water supply networks, but improved sanitation does not is not yet reached due to the rapid demographic development of Algeria; dilapidated networks, at least we see these malfunctions at the level of the wilaya of Bejaia. In addition, most of the networks are open to the sky, which is detrimental to public health through the appearance of respiratory and inflammatory diseases.

Where does the network problem come from? And how to fix it?

Is the paving of the canals a solution to put an end to the inconvenience?

The non-cooperation between sectors hinders the proper functioning and progress of the projects, added to this the difficult access to certain places or isolated dwellings making the realization of the projects impossible or even unrealizable.

Resizing the networks (modifying the slope and the diameter), will solve the dysfunctions of the sanitation networks.

The objective of this article is to find the gaps in order to fill them and find a solution to this problem.

To do this, we collected data from the organizations "ONA, department of the environment of the wilaya, department of water resources".

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Before starting the subject, we would like to present the study area.

1.Presentation of the wilaya of Bejaia:

The wilaya of Bejaia is a wilaya located in the north center of Algeria, it is organized into 19 dairates and 52 municipalities, its population is estimated at one million inhabitants.

It is bounded as follows: to the east by the wilaya of Jijel; to the west by the wilayas of Tizi Ouzou and Bouira; to the south by the wilayas of Bordj Bou Arreridj and Sétif; to the north by the Mediterranean Sea.

Consisting mainly of 04 industrial zones, and 23 activity zones.

The topographic map of the wilaya of Bejaia



Source: department of the environment of the wilaya

We speak about sanitation problems in the wilaya

2. Sanitation issues

Sanitation problems are at three levels:

- Pollution: following discharge of effluents into the natural environment;

- Risks of contamination: most of the networks are in the open air, which is detrimental to public health.

- Flooding: due to non-compliance with construction standards, and lack of network maintenance.

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Wastewater pollution harms environmental health, indeed the infiltration of these waters pollutes the groundwater and surface water also since these waters flow into the sea without any treatment. This phenomenon is related to pirate networks that do not respect the standards.

With regard to contamination, waste water, aggravate respiratory diseases as well as inflammatory diseases.

Network maintenance is one of the tasks of sustainable development the cost of maintenance varies from one network to another (length), and the extent of the failure. They are included in operating costs.

2.1. Center operating costs

Operating costs include staff costs estimated at 3,846,028.86 DA; maintenance costs estimated at 196,005.79 DA; operating costs 48,837.35 DA and therefore the total costs are 1,064,305.79 DA.

2.2. Lifting station operating costs

Staff costs estimated at 1,080,481.84 DA; energy costs 125,906.88 DA; maintenance costs 6 740DA.

The volume of wastewater discharged daily is 1150 Hm3. This must be treated before being released into the natural environment.

To do this, it must go through the STEP treatment plants.

Bejaia has 5 WWTPs spread over the following municipalities: Akbou, Aokas, Soul El Tenine, Bejaia; Sid Ali lebher.

That of Bejaia has a capacity of 80,000 inhabitants equivalent (ONA of Bejaia), with a flow of 9,600m3/d1.

The cost of rehabilitating WWTPs is estimated at 11,361.72 DA; they also contain personnel costs 386 359.8 DA, energy costs 67 736.92 DA, maintenance costs 11 361.92 DA operating costs 109.6 DA the total cost is 465 568.04 DA.

3. The institutions involved in the rehabilitation of sewerage networks

- DHW (department of hydraulics of the wilaya): responsible for carrying out major hydraulic projects;

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- ONA (national sanitation office): its main mission is the management and maintenance of sanitation networks;

APC (communal popular assembly): in charge of carrying out small hydraulic projects;

- The Public Works Department: intervenes to solve problems related to sanitation.

4. Waste water discharge points (ONA of Bejaia)

The municipality of Bejaia has more than fifty discharge points distributed as follows:

- discharges from the upper town: flow directly into the port.

- Discharges from the plain: flow into Salamon and Danous wadis.

- The discharges of Ighil Ouazzoug and Ihaddaden: flow into the wadis Seghir 1 and Seghir 2.

- The rejections of Sidi Ali Lebher: is an outlet.

We will show you in the table below the wadis where these waters flow.

There are 15 wadis spread all over the territory of the city of Bejaia.

Most of the discharge points are in the open, which harms public health and the environment

Table n°1: The oued of the city of Bejaia

Name of oued	Place of the oued
Oued Segouili	Northeast of Bejaia
Oued Ibouhathman	Center Bejaia
Oued N'Dfali	Northeast of Bejaia
Oued Seghir1	Center of Bejaia
Oued Seghir2	south west of Bejaia
Oued Salomon	East of Bejaia
Oued Tizi Imehdienne	South of Bejaia
Oued Laâmrache	South east of Bejaia
Oued Ain Skhoun	Center of Bejaia
Oued Boukhiama	Center of Bejaia
Oued Taghzout	Center of Bejaia
Oued N'savone	South of Bejaia
Oued Ouchaalal	Northeast of Bejaia
Oued Danous	At the back port
Oued Romaine	North east of Bejaia

Source: Made by ourselves from the sanitation master plan

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5.The state of the sanitation networks in the municipality of Bejaia

The sanitation and drinking water supply collectors are shown in the table below:

Table n°2 collectors of sewerage and drinking water supply networks

networks		Adduction water supply				sanitation	
municipality of Bejaia	population	adduction	distribution	total	rate (%)	manifold (ML/s)	rate (%)
	182 602	356481	424492	780973	97%	381190	95%

source: Bejaia environment department

The connection rate to the DWS and sanitation networks are 97% and 95% respectively. The length of the sanitation networks is 408,452 m, the collector collects 381,190 ml/s. the failure of these networks is observed day by day because of the topography of Bejaia which has an almost zero slope, which prevents the water from evacuating easily.

Indeed, we always notice road overflows as soon as a precipitation falls on the region which freezes the circulation, blocks the access to certain places, to remedy it, it is necessary to carry out sanitation networks according to the standards , and study the flow velocity, the slope, the rejected flow in order to avoid any malfunction.

Network sizing: in order to size them, we need to know the flow of water discharged, for this we need the quantity of water consumed.

All the water consumed is not discharged into the network, the water discharged represents only 70 to 80% of the water consumed (discharge coefficient).

Before calculating the quantity of this flow, we will show in a table the supply of drinking water in the municipality.

The statistics obtained dated 2018 for lack of recent study according to the direction of the environment.

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Table n°3: Water supply in the municipality of Bejaia

Water supply municipality	Type of infrastructure	théoritical Capacity m³/D	Actual Production m³/D	Utilisation		
				Drinking water supply	industry	agriculture
Bejaia	Barrage Source drilling well	81834 30000 53397 4061	120000 19000 22119 4061	100% 100% 100% 100%		
	Mobilised water Underground water hm³	Affectation: drink	Affectation: industry	Origine of source	Dotation L/H/D Drinking water	
	23,40	100	----	B+S+F+P	200	

Source: Bejaia environment department

The water supply is 200l/h/d, this water comes from different sources: drilling; well, dam, spring.

The estimation of domestic wastewater flows requires the average daily consumption which corresponds to the product of the average daily allocation by the number of consumers: Qmoyj=KrDn/86400 in english it's Q avgd

Qpt=Kp×Qavgj

Qavgd: average daily quantity l/d

Kr: rejection coefficient according to the habits of the population it represents 80% of drinking water consumption

D: daily allocation

N: number of inhabitants

Qpt: peak quantity

Thereby:

Qavgd=KrDn/86400 (AMIROUCHE S and AIT HAMOU S, 2017, p40.)

=(0.8×200×182602)/86400

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= 338.152 l/s

The peak coefficient Kp is 3 if Qd<2.8l/s…….(1)

Kp4=1.5+2.5/√Qavg if Kp>2.8l/s…….(2)

In our case we will take equation number (2) so Kp= 1.63 l/s

Now we will calculate the peak flow

Qpt= Kp×Qavgd

= 553.2 l/s

We have the average daily quantity 338.152 l/s or 338,152 ml/s

And the peak quantity 553.2 l/s or 553,200 ml/s

The self-cleaning speed is 0.6 m / s we will check if our networks meet this condition.

Q= k I1/2 r8/3π 2-2/3……(MESSAOUD(M.A) and MEZERAI K ,2018,pp6.7)

This formula is intended for full-section circular networks.

Q: flow in m3/s

K: roughness coefficient 70

I: the slope of the network ≈ 3 at the head of the network and 2 near the outlet

r: network radius

Q = 70. (2.10-3)1/2. (0.1)8/3.π2-2/3

Q = 0.013347766m3/s

Q = 13.34 l/s.

We are now going to check if these networks respect the self-cleaning condition which is 0.6m/s.

For this we will calculate the velocity of the waste water, by applying the following formula:

V= D/S (D flow m3/s and S section of the water m2) (http://www.infociment.fr consulted on June 14, 2019).

V = 4D/π d2 d diameter m

V= 4(0.0133477966) / π (0.2)2

V= 0.42 m/s

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The calculated speed is lower than the speed necessary for self-cleaning of the networks.

This condition is not met, which causes the overflow of the networks and the floods therefore a malfunction of the sewerage networks.

In order to remedy this, it is necessary to take into account the design of the networks, this information must be known by all the agents involved in the construction of these infrastructures.

Let's try to find a diameter that will allow the easy flow of effluents and reach the self-cleaning condition.

We have the following equation:

$$V=\frac{4D}{\pi d^2}=\frac{4D}{\pi(0,2)^2}$$

To reach speed V= 0.6

We will find the rate D

$$D=\frac{0,6\pi d^2}{4}$$

D= 18.85m3

If the flow is 18.85 m3 then the diameter must widen to calculate it we will use the Manning Strickler equation (http://scribd.com consulted on November 2022)

$$Q= k\, I^{1/2}\, r^{8/3}\pi\, 2^{-2/3}$$

$$r8/3=\frac{Q}{70\times(2\times10^{-3})^{-1/2}\pi(2)^{-2/3}}$$

r= 1.518m.

To ensure the self-cleaning speed, the radius must be 1.518 m instead of 0.1 m.

Indeed, the design of sewer networks is characterized by:

"Physical constraints subordinated to the relief of the land, the connections of buildings and the dependence on other networks,

- hydraulic data, nature of the effluent, flow, characteristics of the sections;

- technical provisions that require the most economical solutions" (Amirouche S. and AIT HAMOU S, 2017, p.45)

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6.Analysis of results

The problem of sanitation networks comes from their under-dimensioning; indeed, for a collector which collects only 381,190 ml/s, will not support a quantity of 553,200 ml/s. The amount collected is greater than the amount that the collectors can support, which damages the pipes, causing leaks and foul odors that harm the environment and public health.

Added to this, the stagnation of water in the pipes, due in particular to the low flow which does not allow the water to circulate (almost zero slope) in certain places. The flow required to reach the self-cleaning speed in the current condition of the networks is 18.85 m3, whereas it is currently 0.01334 m3.

To ensure the easy and rapid flow of effluents, the radius of the networks must be reviewed. It should be 1.518 m instead of 0.1 m.

The resizing of the networks is more than necessary.

Conclusion:

Changing the diameter of the sewer networks can solve the problems of overflow and the waste they generate, because rainwater carries garbage and debris, which then accumulates causing stagnation of water. Paving the canals in this case is not a solution for open-air networks, because it prevents self-cleaning operations from being carried out. In addition, the sizing of the pipes must take into account the self-cleaning of the deposits, taking into account the flow velocity and the slope.

Studying the slope downstream and upstream of the network before their construction will allow the easy flow of effluents.

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