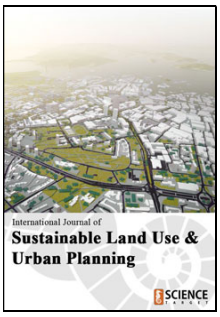
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Natural Heritage as a Structure for Urban Regeneration: Case of the El Harrach River

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Abstract. Discredited for a long time, the El Harrach River is extremely polluted today, exceeding by 30 times the accepted standards and by 400 times the WHO standards. Indeed, it crosses over its last nine kilometers to its outfall, an important urban and industrial zone. Nonetheless, the river pollution threatens the bay of Algiers.

Being a main part of the urban structure and the natural grid of the city, at 67km-long it starts in the Blida Atlas and flows into the Mediterranean in the middle of the Bay of Algiers. Relatively modest operations have been undertaken to try to absorb the pollution. Recently, the government launched rigorous decontamination work as a part of the new redevelopment plan of Algiers by 2029. The river is considered an important ecological axis and a natural regenerative of the urban structure.

This article analyses the strategy of reinstatement of this urban and natural microcosm through five segments as a green heritage and generator of the city of tomorrow, with a special focus on the impact of the river redevelopment on these different slices, in relation to the protection of ecosystems, channelling axis of urbanization, for the medium and the long terms.

Keywords. *water, pollution, urban, regeneration, evaluation, ecology*

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Introduction

The El Harrach River will undergo special treatment, which will lead to its promotion as the future center of the capital. The main river, 65 km long, rises in the foothills of Chréa (Blida). Before flowing into the sea, it crosses the province of Algiers, spanning 18.2 kilometers. El Harrach River faces two main issues: the pollution caused by household and industrial waste and flooding.

Along both sides of the river, new infrastructures will emerge. In addition to the pollution solutions, several public utility infrastructures will be built and completely alter the current landscape. The river area will become an attraction hub, open to all citizens from Algiers and others boundary regions.

All these achievements fit in the project of Algiers Bay. They will be located in the vicinity and all around the El Harrach River. Daewoo-Cosider Environment, an Algerian-South Korean company, is responsible for this project and has invested 38 billion dinars for a period of 42 months for its completion.

Research Background

The project is part of the global vision of the "Blue Plan", which covers projects linked to the supply of the city with drinking water, the reconquest of the coastline, the treatment of wastewater, and the problem of flooding and wasteland. Thus, the river clean-up project is the starting point for the implementation of this strategy around the development of the Bay of Algiers. This project is intended to treat the waters of the river through nearly 18.2 km, depuration of the sewage and wastewater, and construction of recreational areas on both sides of the river.

Oued El Harrach has always been characterized by bad smells. Although efforts have been made to alleviate some odours, residents have trouble visiting and use the first projects layouts. To

reduce them, the Jasmin project was implemented to temporarily neutralize odours in widespread open spaces. The system consists of applying a solid gel on bridges with high pedestrian traffic so that fogging of a liquid product over the deck of the Eastern highway. The final solution for the problem of Oued El Harrach will be the purification of the water.

Materials and Methods

Redefinition of the River: Major Operations

The three studies undertaken on the development of the river, of the master plan for its redevelopment, and development of the Bay of Algiers led to some conclusions: high exposure to flooding, pollution, and bad water quality; denaturing of banks, a riparian area unattractive and inaccessible. All this gives adverse the implication of citizens in the environment.

Water pollution control: Referring to the Mistuo Yoshida (2005) studies, the river contains lead, chlorine, zinc, and chromium in large quantities, which are released into the sea. The three sources of pollution (urban, industrial, and agricultural) have always prompted its management. Four industrial areas (Oued Smar, El Harrach, Gué de Constantine, and Ali Baba) with 473 units located on 740 ha, with 9% of the urbanized areas of the province of Algiers. In this area, only 30% are now connected to wastewater treatment plants.

In terms of reducing urban pollution, the actions concern the implementation of the first and second tranches of the purification station in Baraki, already operational since 2009. The reduction of industrial pollution, launched by the Ministry of Planning and Environment, included the completion of two stations of 100 000 Eq / h each that will deal with domestic and industrial wastewater.

Since December 2014, its capabilities for water treatment doubled from 150,000 m3/day to 300,000 m3/day. In addition, two treatment stations for industrial wastewater were launched in Baba Ali and the Semmar River.

Floods solution: The second problem refers to the river floods. Major flooding happened years ago at the rate of 2500 m3/second. This solution first requires recalibration and re-profiling of the river on 18.2 km. To combat flooding, both sides of the concrete walls will be raised to 9 meters high by 4 km at the city centre of El Harrach.



Figure 1: Pollution of the river

Enlargement of the river bed: This is the first recalibration of the river over 18 km to increase its width to 100 m and up to about 500 m in some places. The evacuation of the centennial flood was estimated at 2500 m3/second.

Bank protection: Seven projects are being undertaken to protect the river banks. These consist of the construction of three filtering gardens. The banks will be protected from erosion by planting 30,000 trees and 120,000 shrubs.

Navigable river: The other action to be taken is the lowering of the river bed by 6 km. The stream will be relatively navigable. A pumping

station with a capacity of 90,000 m3/day will be established to ensure a smooth flow even in the absence of rain. Access will be allowed for small leisure crafts.

Improving the quality of water: The control and monitoring of water quality will be provided by four automatic monitoring stations and an integrated centre for this purpose. Known for its cyclical moods, the El Harrach River will have a forecasting and warning system for floods consisting of sophisticated equipment including a gauge, a video, a speaker, a rain gauge, a data logger connected by Internet to a control centre, and a warning system for floods.

Phytopurification: In order to improve the water quality and thus create new sites for wildlife, ponds with natural lagoons are lined with plants to reduce pollution. The sanitary flow will be supported by the construction of pumping stations. The objective is to improve the water quality and thus create new sites for fauna and flora. Along the 18 km, there are three planned filter gardens, for about 193 m2 each, also called Korean gardens.

Urban Planning Strategy: The Layout of the River into Five Segments

Once completed, all the achievements in the program will make the El Harrach River the center of Algiers Bay with the implementation of several structural projects, including the Great Mosque of Algiers, the Africa Museum, the Baraki Stadium, and Central Station. The El Harrach River will offer recreational development, sports, and leisure for the population. There will be walkways and 19 bridges to allow people to move from one bank to another. The development will include the creation of six football fields, four basketball courts, three swimming pools, and 40 km of track cycling that will span the river.

The mouth: Three batches in the first phase concern the development of the mouth, the realization of two arms inside the sea, dredging the bed of the river, and a dam enclosure of 6 Ha.

Industry Zone: A dozen abandoned factories will be affected by expropriation operations. These are mainly car parks, garages, and small unused workshops. The advantage for this project is that over 95% of factories belong to the public sector.



Figure 2: The mouth projects



Figure 3: Suburban and rural projects

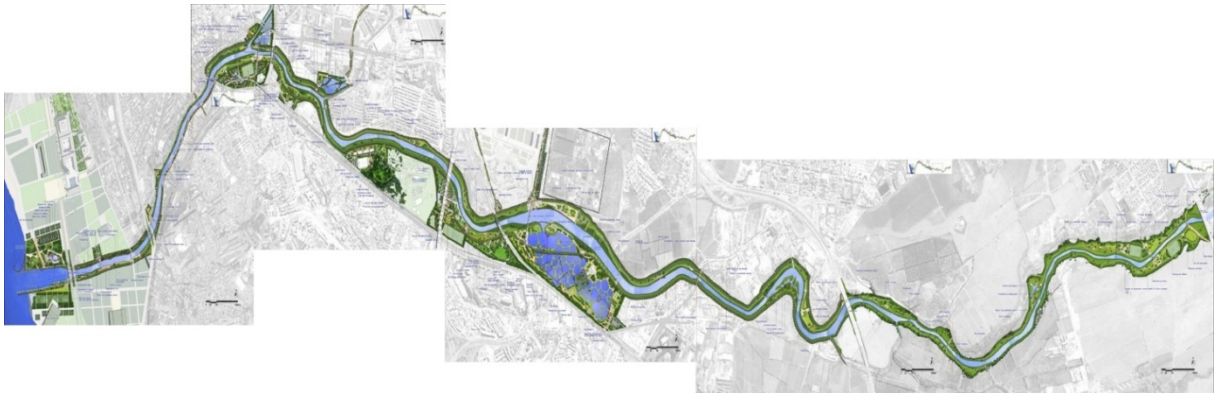


Figure 4: The river project through the capital

Housing areas (urban): The expropriation will touch the slum Remli (Gué de Constantine), one of the largest in the capital. There are approximately 3000 huts, according to the 2007 census, over 2 km. Because the social impact of the project is important, support of the population is necessary.

The suburban area: Suburban areas will benefit from parks and leisure stations, dedicated to people living near the river and also for weekend visitors, as natural preserved stations.

Agricultural lands: The rural zones will be preserved and will supply water from the river. This is a sustainable method of reinvestment which will save natural resources for labours.

Evaluation of the Project

To assess the sustainability of the project, we use the Bernese Compass Sustainable Development tools, referring the project to a series of predefined indicators grouped under three dimensions of sustainable development (environment, economy, and society).

This tool based on profile strengths / weaknesses not only indicates the project's optimization potential but also provides general assessment of the sustainable development perspectives. Each indicator is rated on a five-point scale: important or low effects for hiding or promoting sustainable development. The tables below show the evaluation:

Table 1

Evaluation of the environmental dimension according to thematic fields (Extract from the sustainability evaluation)

Environment Indicators	Strategy effects	Eval
Water management	Purification the reuse of waste water	+
Water quality	Clean-up of water	+
Land waste	Reinvestment of brownfields and bank's wasteland	+
Land quality	Purification of land through revegetation	+
Waste of raw material		O
Waste of recyclable raw material	Mainly water	+
Quality of materials		O
Biology diversity	Improvement of regional planning, protection and restoration of ecosystems	+
Natural space	The natural aspect of the river will change according to new width and depth. Concreting the banks	-
Air quality	Purification of air, decrease of carbon	+
Climate		O
Energy consummation	The project does not plan the use of renewable energy sources. The permanent control and purification of water will need the use of energy	-
Energy quality		+

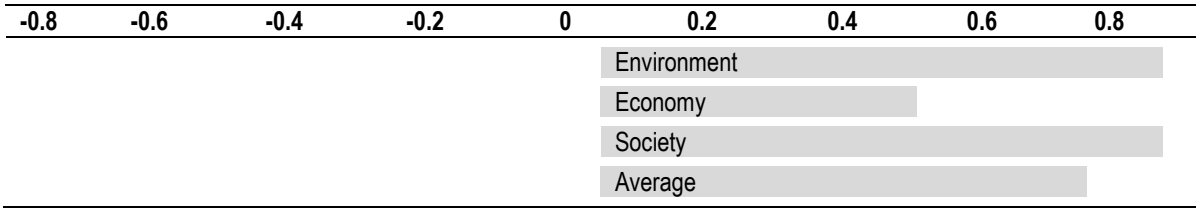
Table 2

Sustainability evaluation of the project using Bernese compass for sustanable development

Profile of strengths and weaknesses				Hiding sustainable development		Promoting sustainable development		
Dimensions	**Avge**	**Indicators**	**Avge**	**-2**	**-1**	**0**	**+1**	**+2**
Environment	0.78	Water management	+2					
		Water quality	+1.5					
		Land waste	+1.75					
		Land quality	+1					
		Waste of raw material	0					
		Waste of recyclable raw material	+1					
		Quality of materials	0					
		Biology diversity	+1.75					
		Natural space	-0.5					
		Air quality	+1.5					
		Climate	0					
		Energy consummation	-1					
		Energy quality	+1					
Economy	0.42	Income	+1					
		Living cost	0					
		Work places	+1.5					
		New investments	+1					
		Business assets investments	0					
		Economic advancement	+1					
		Truth of costs	0					
		Resources efficiency	+0.5					
		Economic structure	+0.5					
		Tax burden	-0.5					
		Public finances	0					
		Know-how	+0.5					
		Innovations	0					
Society	0.76	Landscape quality	+1.25					
		Housing quality	+1					
		Good and services offers	0					
		Mobility	+1.5					
		Health	+1.75					
		Security	0					
		Participation	-0.5					
		Integration	+1					
		Community	+0.5					
		Incomes repartition	0					
		Chances equality	+1.25					
		Supra regional solidarity	+1					
		Training	+0.5					
		Culture and leisure	+1.5					

Table 3.

Evaluation of sustainability of the project (averages)



Results and Discussion

The project of reinstatement of the river has a high sustainable impact on the city. The ecological planning is mainly based on the redefinition of the river and has a relevant impact on the ecological dimension with an average of 0.78 and will promote socialization through the opening of the city for citizens. This will generate a better quality of life for inhabitants, increased work opportunities, and provide a leisure hub. The project is less important to the economy because of its first vocation related to ecological dimension. However, other economic activities related to the exploitation of spaces will be generated progressively. There are tendencies to go towards the improvement of living conditions and the living environment of citizens. Initially, priority was given to water. Today, it is served 24 hours in Algiers. We pass to the improvement of the environment, and the draft of the river development. These results should be slightly offset by measures promoting renewable energy.

Future Perspectives

The rehabilitation of the river will give a new image to the east region of Algiers and neighbouring municipalities. Currently, the development work on the left bank of the river of 5 hectares is completed. For now, rehabilitation operations concern only the 18.2 kilometers of the river located within the administrative boundaries of the wilaya of Algiers while its total length is 67 km. The remaining 50 km of the river, up to its source Hammam Melouane (Blida), will be the subject of future studies.

Considered as the future centre of the capital, the river is similarly related to blue plan projects that are focused on creating an attractive waterfront, eliminating the polluted landscape, and enhancing the blue resource planning to provide opportunities to reuse water for the green areas among others.

Conclusion

As shown, this megaproject will probably solve the problem of the iconic river of Algiers, which has become the source of many nuisances and at the same time is an important part of the famous strategic plan of the capital. Revising PDAU for the development of the Algiers Bay through thirty relocation operations is a huge development that will fit into the urban space design for an ecological city. A Mediterranean metropolis is on the horizon for 2029.

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