The impact of human resources on water resources in Algeria, with existence of Industrial waste as a mediator variable during period 1970 to 2015

Pr. Souar Youcef[1], PhD. Abdelhakem Amina[2], PhD. Mahi Keltouma[3]

[1]Laboratory MIFMA, University Tahar Moulay, Saida 20000, Algeria, Syoucef12@yahoo.fr,

[2]Laboratory MCLDL, University Mustapha Istambouli, Mascara 29000, Algeria, abdelhakemamina@gmail.com,

[3]Laboratory MIFMA, University Tahar Moulay, Saida 20000, Algeria,

Abstract	**الملخص**
In this paper, we discuss the impact of human resources in water resources In Algeria, by the limited water resources especially groundwater in the medium and long term, that shall need to create a regulatory management of water resources in the zones and industrial parks with an emphasis on a management for moving water needs and save and protect it from pollution. From a theoretical point of view, there are good grounds for believing that human resources can play a polluting role for water resources. Right here, by entering industrial waste as a mediator variable in the study model, this will allow us to study the impact of	في هاته الورقة البحثية، نحن نناقش تأثير الموارد البشرية على الموارد المائية في الجزائر، فمع محدودية الموادر المائية خاصة الجوفية على المدى المتوسط والطويل وجب ضرورة خلق إدارة رقابية للموارد المائية في المناطق والمجمعات الصناعية مع التركيز على إدارة احتياجات المياه والمحافظة عليها وحمايتها من التلوث. تبعا للإطار النظري فللموارد البشرية دور في تلويث الثروة المائية. هنا بادخال المخلفات الصناعية كمتغير وسيطي في نموذج الدراسة، هذا سيسمح لنا بدراسة مدى تأثير الأنشطة الصناعية للموارد البشرية على الموارد المائية في الجزائر، وعليه يمكننا تحديد السبل الكفيلة لردعها. على هذا، نستخدم النمذجة الهيكلية (MIMIC – PLS) لدراسة أثر الانشطة الصناعية للموارد البشرية على الموارد المائية بوجود المخلفات الصناعية كمتغير وسيطي في الجزائر.

industrial activities for human resources on water resources in Algeria, thus, we can identify ways to deter it. At this, we will use the structural modeling (**MIMIC – PLS**) in order to calculate the impact of human resources in water resources in Algeria with the presence of industrial waste as a mediator variable.

Key Words: Human resources, Industrial waste, Water resources, Algeria.

JEL codes: $O_{15} – K_{32} – Q_{25}$

الكلمات المفتاحية: الموارد البشرية، المخلفات الصناعية، الموارد المائية، الجزائر.

JEL codes: $O_{15} – K_{32} – Q_{25}$

Introduction

The human is very important resource of the organization to get more powerful and develop itself to be standard and success one, but a number of forces continue to seriously affect our natural water resources (**Choup Theot Therith, 2009**). In the same context, a number of forces continue to seriously affect our natural water resources where many of these are primarily the result of human action and include ecosystem and landscape changes, sedimentation, pollution, over – abstraction and climate change (**UNESCO, 2017**). Through the MIMIC model, we will study the impact of human resources on water resources in Algeria with the existence of industrial waste as a mediator variable during the period from 1970 to 2015. For that end, the problematic of this study is as follows: "**What is the impact of the**

human resources on water resources with the existence of industrial waste as a mediator variable in Algeria during period from 1970 to 2015?"

1. Literature Review

1.1. *Human resources and water resources*

Just as water is essential to human development, human development is a key condition for sustainable management of water resources. Water is more and more recognized as a vital resource. (**Antonnius Bakkum**, **nd**) sees that the key role water plays in human development is well accepted. Human development however should also be considered as an important contributor to the adequate management of water resources. But (**UNESCO**, **2017**) believes that humans alter the water cycle by constructing dams and through water withdrawals. Climate change is expected to additionally affect water supply and demand. Here, model analyses of climate change and direct human impacts on the terrestrial water cycle are presented. The results indicte that the impact of man – made reservois and water withdrawals on the long – term global terrestrial water balances is small. However, in some river basins, impacts of human interventions are significant. In parts of Asia and United States, the effects of human's interventions exceed the impacts expected for moderate levels of global warming. From the table1, if all U.S. households installed water-saving features, water use would decrease by 30 percent, saving an estimated 5.4 billion gallons per day. This would result in dollar volume savings of $11.3 million per day or more than $4 billion per year (**Amy Vickers** , **2017**).

Table1. Individual use of Water

Type of Use	*Gallons Per Capita*	*Percentage of Total Daily Use*
Showers	8.8	19.5%
Clothers Washers	10.0	22.1%
Toilets	8.2	18.0%
Dishwashers	0.7	1.5%
Baths	1.2	2.7%
Leaks	4.0	8.8%
Faucets	10.8	23.9%
Other Domestic Uses	1.6	3.4%

Human have a long used air, and land and water resources as 'sinks' into which we dispose of the waste we generate. These disposal practices leave most wastes inadequately treated, thereby causing pollution (for example: acid rain impact on water resources). The sources of pollution that impact our water resources can develop a different scales (local – regional – global) but can generally according to nine types (**UNESCO, 2006**). In fact, (**Koichi Fuji, nd**) sees that the effects of human activities on natural water quality is discussed by looking back at the history of water pollution in japan, and here the source of pollutants in a natural water body can be divided into two groups: those from natural sources (such as soils, forests, etc.) and artificial sources, namely human activity, and by looking back on the history of water pollution, it is easy to understand that the expansion of human activity is the main

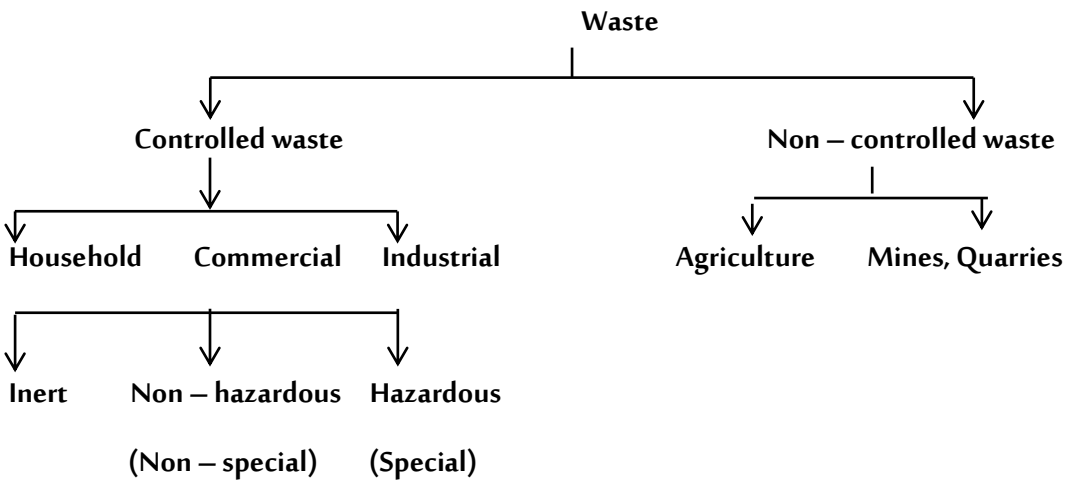
reason for water pollution. Historically and in point view of (**Koichi Fuji, nd**) water pollution problems occurred even before the industrial revolution, one of the early records of river water pollution in Japan was the outflow of pit water from Ashio Copper Mines into the Watarase River during the late nineteenth century, with the growth of industrial activities, the volume of wastewater flowing into rivers increased, bringing serious water pollution problems in various areas of Japan. In this context, the water pollution also began to affect human health, the Minamata disease incident is one of the most famous examples in the world of damage to people's health as a result of water pollution.

1.3. *Waste industrial and water resources*

(**Abdulrzzak Alturkmani, p. 01**) Stated that the wastewater from industries varies so greatly in both flow and pollutional strength, so it is impossible to assign fixed values to their constituents. In general, industrial wastewaters may contain suspended, colloidal and dissolved (mineral and organic) solids. In addition, they may be either excessively acid or alkaline and may contain high or low concentrations of colored matter. These wastes may contain inert, organic or toxic materials and possibly pathogenic bacteria. These wastes may be discharged into the sewer system provided they have no adverse effect on treatment efficiency or undesirable effects on the sewer system (**Abdulrzzak Alturkmani**). In the same context, **(Jihan Khalid Abdel Karim Ali, 2004**) sees that the waste can be categorized into controlled and

non – controlled waste. (Figure1) the controlled waste includes among others hazardous and non – hazardous waste as explained bellow:

Figure1. The waste classification system



Source: Jihan Khalid Abdel Karim, 2004, the impact of industrial waste on human and natural resources: a case study of Khartoum, P. 40.

2. Evolution of the study variables in Algeria

In Algeria, human activities create waste; it is the way these wastes are handled, stored, collected and disposed of, which can pose risks to the environment and to public health, and the management of solid waste is an important concern in developing and emergency conditions (**Marianna Garfi, nd, p. 01**). On other hand, local sources in developing countries including urban growth, transportation systems,

industrialization, and lack of awareness and shortage of institutional capabilities all contributed to the relatively low air and water quality and weak control, about 8.5 million tons of municipal wastes are generated in Algeria every year, more than 90 percent of which originates in the northern part of the country, and the municipalities are responsible for waste management collection (**Mohamed El Raey, 2000, p. 37**). However, most of the waste is presently disposed of in open dumps (a recent survey conducted by the Ministry of Land Use Planning and Environment showed that there are 2,100 illegal dumps nationwide, 360 of which are located in the 40 most important cities) (**Mohamed El Raey, 2000, p. 37**).

In same context, in Algeria the exploitation of water resources is great. This is mainly due to the growing needs associated with the population growth, accelerated development of economic activities, including irrigated agriculture, industry and the lack of awareness of the population about environmental protection. All these factors lead to an imbalance of the ecosystem and generate pollutants that can affect the physicochemical and biological quality of aquatic receptors (**Soumya Boussaha, 2016, p. 505**).

In Algeria also, the risks of industrial waste that the population faces especially health hazards, where there have been reported outbreaks of disease due to the combined effects of lack of: waste treatment, fresh water, and waste collection and disposal capacity. Emission into the atmosphere of noxious gases and fumes from smoldering landfills has reportedly generated respiratory diseases, and inappropriate

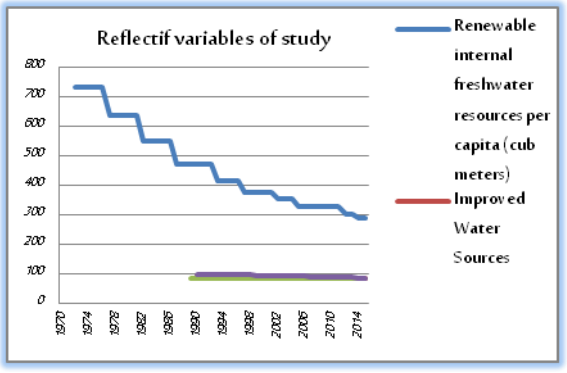
handling of waste by municipal staff and illegal scavengers has also led to skin diseases and other ailments. In addition, contamination of surface and groundwater due to improper landfill design and operation has been reported, as well as illegal dumping of waste in wadis and forests (**Mohamed El Raey, 2000, p. 37**).

In same context, in Algeria the exploitation of water resources is great. This is mainly due to the growing needs associated with the population growth, accelerated development of economic activities, including irrigated agriculture, industry and the lack of awareness of the population about environmental protection. All these factors lead to an imbalance of the ecosystem and generate pollutants that can affect the physicochemical and biological quality of aquatic receptors (**Soumya Boussaha, 2016, p. 505**).

In Algeria also, the risks of industrial waste that the population faces especially health hazards, where there have been reported outbreaks of disease due to the combined effects of lack of: waste treatment, fresh water, and waste collection and disposal capacity. Emission into the atmosphere of noxious gases and fumes from smoldering landfills has reportedly generated respiratory diseases, and inappropriate handling of waste by municipal staff and illegal scavengers has also led to skin diseases and other ailments. In addition, contamination of surface and groundwater due to improper landfill design and operation has been reported, as well as illegal dumping of waste in wadis and forests (**Mohamed El Raey, 2000, p. 37**).

The past focus on development of publicly owned and operated heavy industries (e.g., chemical and metallurgical), often close to fragile ecosystems and population centers, has created serious risks to environmental quality, human health and the quality of life. The intensive and heavily subsidized use of energy sources such as diesel and leaded gasoline, the lack of enforceable industrial pollution control and the lack of proper management of solid and hazardous waste, are exacerbating factors. Poor vulnerable groups are particularly affected, as well as the country's cultural and archaeological heritage and coastal resources (**Mohamed El Raey, 2000, p. 37**).

Figure2 represents the evolution of the study variables in Algeria during period 1970 to 2015:



Source : Renewable Internal Freshwater Resources per capita.

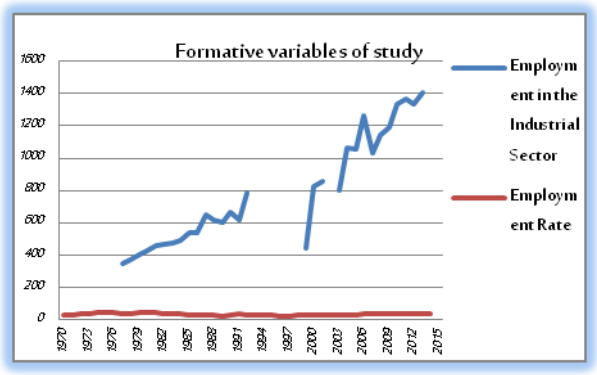
Improved Water Source (% of population total).

Improved Water Source, rural.

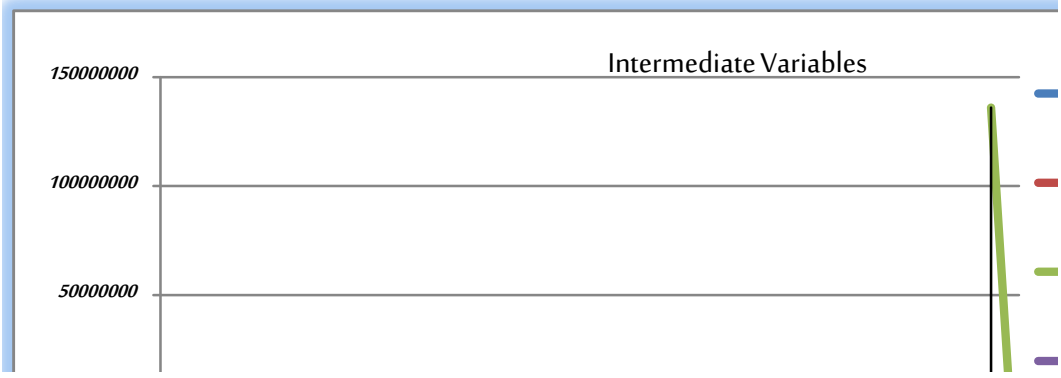
Improved Water Source, urban.

http://data.worldbank.org/indicator/EG.USE.CRNW.ZS?location

Figure2. The evolution of the study variables in Algeria (1970 – 2015)



Source : Directory of finance laws in Algeria (1962 to 2009). Employment in the industrial secto UNCTAD STATA. (**2016**). Employment rate in Algeria **1970** to **2014**. http://Unctad_stat.unctad.org.



Source: Combustible Renewables and Waste (% of total energy). http://data.worldbank.org/indicator/.
Gross Heat Content Biomass and Waste Electric Power (Btu Per Kilowatt-hour) / http://knoema.fr/EIAIES2014Aug/.
Solid urban industrial waste. http://knoema.fr/atlas/Alg%C3%A9rie/D%C3%A9chets-urbains-solides-ramass%C3%A9s.
Sanitati

Algeria is now facing serious problems of industrial pollution. The national industrial park is old and dilapidated, frequently inefficient and polluting, it should also be noted that the process of industrialization took place under conditions that did not take account of ecological imperatives. Pollution from untreated industrial wastewater, atmospheric emissions, and the generation of special wastes (which are inadequately managed) pose serious threats to the quality of ecosystems (**Cherif Rahmani, 2002, p. 53**).

- **Industrial wastewater in Algeria**: It is estimated that industrial enterprises generate more than 220 million m3 of wastewater annually, 55,000 tons of BOD5, 135,000 tons of suspended matter, and 8,000 tons of nitrogenous matter. Such as domestic wastewater, industrial effluents contribute significantly to the pollution of watercourses and dams. This is the case for the Beni Bahdel, Bakhada, Lekhal and Hamam Grouz dams. It is the same for the wadis of Tafna, Seybouse, Soumam, Cheliff and Mekerra (**Cherif Rahmani, 2002, p. 53**).

- **Special Waste in Algeria**: The production of special waste is of the order of 180,000 tons / year thus distributed: 9,500 t of biodegradable waste; 6,500 t of organic waste; 48,000 t of inorganic waste and 55,000 t of low toxic waste. This waste is mainly produced in the **wilayas** of Annaba (36%), Médéa (16%), Tlemcen (15%) and Oran (14%) (**Cherif Rahmani, 2002, p. 54**). In the case of used oils, 140,000 tons of oils are sold annually by NAFTAL. Only 8% are recovered for recycling abroad. Waste oils that

are discharged to service stations as well as wild rubbish are an important environmental problem. Other special wastes are:

- Wastes related to care activities: 125,000 t / year of which 33,000 t were considered toxic and 22,000 t as infectious;
- Agrochemical waste (pesticides, obsolete insecticides) which constitute a stock of 2,200 tons;
- Asbestos waste that is estimated at 7,000 t / year (**Cherif Rahmani, 2002, p. 54**).

3. Methodology

In our research and by using **MIMIC** model we are trying study the impact of human resources on water resources with the existence of industrial waste as a mediator variable in Algeria during period from 1970 to 2015. This model contains 10 variables of which: 02 explicative variables for human resources, and 04 explicative variables for industrial waste, and 04 reflective variables for water resources.

Since it is difficult to measure directly both of: Human Resources – Industrial Waste – Water Resources, it has developed a tool are capable of monitoring those variables called **'Latent Variables'** allows modeling both: Human Resources – Industrial Waste – Water Resources as a variables unobservable (**Chaib Bounoua**, **2009**). Our model of Structural Equations (**MIMIC – PLS**) it consists of two parts: the measurement model and the structural model. Mathematically, we can express the equations that

define both: Water Resources (model outputs) – Human Resources (Model inputs) – Industrial Waste (intermediate variable) as follows:

$$\eta_t = \gamma' x_t + \varepsilon_t \qquad (1)$$

Where, Π indicated latent variable, γ transactions those are estimated and ε the extent of the error.

On the other, the latent variable contributes to identifying indicators that can be observed which are symbolizing by (Y_1, Y_2, Y_3) where it can be expressed in the pro formula:

$$Y_t = \lambda \eta_t + \xi_t \quad (2)$$

Where, λ transactions those are estimated and ξ the extent of the error.

2.1. ***Classification of study model variables***

From Table 1 and given the needs of our problematic, causal variables of **Human Resources** as an independent variable in the study model, and the causal variables of **Industrial Waste** as an intermediate variable in the study model, in addition to variables reflective of **Water Resources** as a dependent variable in the standard model appear as follows:

Table1. Classification of study model variables

Independent Variables	*Intermediate Variables*	*Dependent Variables*
X_{11} : Employment in the Industrial Sector **X_{12} : Employment Rate**	X_{21} : Combustible Renewable and Waste **X_{22}**: Gross Heat Content Biomass and Waste Electric Power **X_{23}** : Solid Industrial Waste Picked up **X_{24}** : Sanitation - Total Population - Proportion of total population with other unimproved sanitation facilities	**Y_1**: Improved Water Sources (% of population with access) **Y_2**: Renewable internal freshwater resources per capita (cub meters) Y_3:Improved Water Source, rural (% of rural population with access) **Y_4**:Improved Water Source, urban (% of total population with access)

Source: Prepared by the researchers based on previous studies.

periods in this study is 46 years. The table also shows the standard deviation as well greater value and smallest value.

Table2. Statistical analysis of the study variables

Variables	*Obs*	*Mean*	*Std.Dev*	*Min*	*Max*
IWS	46	88.358	1.9772	83.6	91.8
RIFR	46	465.084	139.0570	288.9	731.6
IWS_R	46	83.600	0.8006	81.8	85.0
IWS_U	46	91.612	3.2325	84.3	97.4
CRW	46	0.122	0.0613	0.0	0.2
GHCBW	46	10205.758	22.1130	9516.0	10520.0
SIWP	46	28212140.000	17968560.8719	5200.0	136000000.0
SPU	46	2.385	0.4750	1.0	3.0
EIS	46	755.758	291.7679	245.0	1407.0
ER	46	34.7244	5.56989	25.00	45.50

Source: Presented by Researchers Using Stata V13 Output.

Latent Variable	*Measurement Variable*	*Saturation coefficient*	*Probability (P)*
Human Resources	EIS	0.704	P<0.001
	ER	0.704	P<0.001
Industrial Waste	CRW	-0.855	P<0.001
	GHCBW	0.159	P=0.127
	SIWP	0.433	P<0.001
	SPU	0.845	P<0.001
Water Resources	IWS	0.991	P<0.001
	RIFR	0.385	P=0.002
	IWS_R	0.992	P<0.001
	IWS_U	0.993	P<0.001

Source: Presented by Researchers Using WarpPLSv.5.0 (n=46).

2.2.3. Model quality indicators

From Table4, it is noted that the ten tests to measure the quality of the indicators and the validity of the model are all significant depending on WarpPLSv.5.0 output.

Table4. Model fit and quality indices

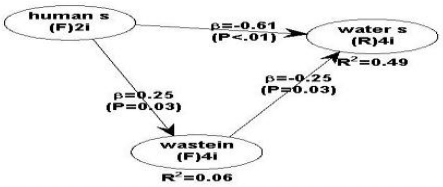
Indice	*Value*	*Probability*
Average Path Coefficient (APC)	0.294	P= 0.008
Average R – squared (ARS)	0.280	P=0.01
Average adjusted R- squared (AARS)	0.251	P=0.016
Average block VIF	1.219	VIF ≤ 3.3
Average full collinearity VIF (AFVIF)	1.450	AVIF≤ 3.3
Tenenhaus GoF (GoF)	0.373	GoF≥0.36
Sympson's paradox ratio (SPR)	1.000	SPR= 1
R-squared contribution ratio (RSCR)	1.000	RSCR=1
Statistical suppression ratio (SSR)	1.000	SSR≥0.7
Nonlinear bivariate causality direction ratio (NLBCDR)	0.750	NLBCDR≥0.7

Source: Presented by Researchers Using WarpPLSv.5.0 (n=46).

2.2.4. *Structural Evaluation of the Study Model*

After doing the process of building the proposed theoretical model in this study, we tried by relying on the **MIMIC** Model (**PLS**) to clarify the relationship between the different variables of the study. (Figure3).

Figure3. The structural model of the relationship between human resources and water resources



Source: Presented by Researchers Using WarpPLSv.5.0 (n=46).

2.2.4.1. *Direct Impact of the study variables*

From Figure3, it is noted that:

1. The existence of a significative negative impact of the human resources on water resources in Algeria and estimated at (-0.61) during the period from 1970 to 2015, explained the nature of the negative relationship between the human resources and the water resources. This is illustrated by a study of (**Mohamad Ali Fulazzaky, 2014**) the increased demands for water and land in Indonesia as a consequence of the population growth and economic development has reportedly have been accelerated from the year to year, the spatial and temporal variability of human induced hydrological changes in a river basin could after affect quality and quantity of water.
2. The existence of a significative positive impact of the human resources on industrial waste in Algeria and estimated at (0.25) during the period from 1970 to 2015, explained the nature of the positive relationship between the human

resources and the industrial waste, this was confirmed by (**Kahn Danielle J, nd, p. 02**) in developing countries, the informal sector is normally not monitored and it employs a very large proportion of the workforce, which can result in widespread exposure to any hazardous materials that are used. Socioeconomic issues, on the other hand, contribute to low awareness of hazardous waste issues and to the general inability to afford adequate waste management, and many of these countries do not have the trained specialists or technical knowledge necessary to assess information concerning hazardous wastes and their handling.

3. The existence of a significative negative impact of the industrial waste on water resources in Algeria and estimated at (-0.25) during the period from 1970 to 2015, explained the nature of the negative relationship between the industrial waste and water resources. According to the study by (**Saroj Gywali, 2012, p. 109**), industrialization is considered the cornerstone of development strategies due to its significant contribution to the economic growth and human welfare, but it carries inevitable costs and problems in terms of pollution of the air and water resources. So, industrial waste is the most common source of water pollution in the present day and it increases yearly due to the fact that industries are increasing because most countries are getting industrialized (**Saroj Gywali, 2012, p. 109**). Industrial waste-water originates from the wet nature of industries which require large quantities of water for processing and disposal of wastes. Most industries are therefore, located near water sources. In Algeria, (**Boukelia Taqiy Eddine, 2012, p. 04**) study shows that the hazardous waste which includes waste oil, waste solvents, ash, cinder, and other wastes with hazardous nature (such as flammability, explosiveness, and causticity)

generated amounts to 325,100 tons/year. The quantities of waste in stock and awaiting a disposal solution amount to 2,008,500 tons, which are generated by four principal sectors: hydrocarbons (34%), chemistry, rubber and plastic (23%), metallurgy (16%), and mines (13%). Compared to textile (4%) as well as paper and cellulose cement and drifts, food and mechanics produce less than 2%, and the eastern regions hold the palm for the production of ISW in Algeria, with the wilayas of Annaba and Skikda which are characterized by a high proportion of waste generated and in stock (the petrochemical, transportation, and hydrocarbons industries of these regions). The western region is in the second position, because the industrial area of Arzew is the largest generator of waste with 65,760 T/year only for its refinery, followed by the industrial area of Ghazaouet with 18,500 T/year. The central region is characterized by the high production of lead waste (manufacture of battery and refinery).

2.2.4.2. *Indirect impact of the study variables*

From Figure3, it is noted that the existence of an indirect negative impact effect significative for the human resources on water resources, with the existence of industrial waste as a variable mediator in Algeria during period from 1970 to 2015. The negative nature of the relationship between the human resources and the water resources with existence of industrial waste as a variable mediator shows the reality of environmental and climatic disaster resulting from industrial human activity subconscious (industrial waste non - recycle). It is through study by (**Abd Alla Gad, 2011, p. 02**) the human activities affect both water quality and quantity. It leads to a change of land use and land cover, which changes the water balance and usually changes the relative importance of processes that control water quality. Furthermore,

most human activities generate wastes ranging from gases to concentrated radioactive materials. In addition, Acid mine drainage, industrial effluent, and atmospheric emissions of sculpture and nitrogen oxides are largely responsible for the acidification of surface waters.

4. FINDINGS

From using MIMIC model, we found that:

- The human resources have a direct and negative effect on water resources in Algeria.
- The human resources effect positively and directly industrial waste in Algeria.
- Industrial waste effects negatively and directly the water resources in Algeria
- With the existence of industrial waste as an intermediate factor, the human resources effect positively and indirectly water resources.
- This study has shown the reality of environmental and climatic disaster in Algeria during period from 1970 to 2015 resulting from industrial human activity subconscious.
- There must be a large – scale government action to reduction this human activities that affect water quality and quantity.

5. Conclusion

This study has attempted to show how the size of the disaster produced by human activities on water resources and represented in industrial waste. Through our analysis of study results and using the **MIMIC** model, it is shown that the human resources have a negative impact on water resources in Algeria during period of study (1970 to 2015), because Algeria was not interested seriously in creating a control committee to reduce those unconscious activities. In the same context, even with existence of laws on environmental protection especially water resources, these laws

alone are not enough to deter these environmental pests produced by human activities in industrial field. For that, the government should not only drafting the protection of ecosystems legislative laws but ensure full implementations of its.

References

Abd Alla Gad, A.-Z. R. (2011). Negative impacts of man - made activities on water quality, Egypte. Conference of integrated water resources managemen in the Mediterranean (p. 02). Agadir, Moroco: National Authority for Remote Sensing and Space Sciences .

Abdulrzzak Alturkmani. (n.d.). Industrial Wastewater. Environmental Engineering Website Manager, 01.

Amy Vickers . (2017, 04 28). Water Use Statistics. (American Water Works Association) Retrieved from Drink Top: http://www.drinktap.org/water-info/water-conservation/water-use-statistics.aspx

Antonnius Bakkum, M. (nd). Human Development and Water. II, 01.

Boukelia Taqiy Eddine, M. (2012). Solid waste as renewable source of energy: current and future possibility in Algeria. International Journal of energy and environmental engineering, 04.

Chaib Bounoua, F. Z. (2009). L'économie informelle en Algérie: analyse de l'évaluation du phénoméne et évaluation macroéconomioque (1990 - 2009). Les cahiers du Cread N°11, 37.

Cherif Rahmani. (2002). Plan National d'Actions pour l'Environnement et de Développement Durable (PNAE - DD). Algérie: Ministére de l'Aménagement du térritoire et de l'environnement.

Choup Theot Therith. (2009). The importance of HRM. MBA - BIT - DPA, 02.

Jihan Khalid Abdel Karim Ali. (2004). The impact of industrial waste on human and natural resources: a case study of khartoum - North Industrial Area. Desertification and desert Cultivation Institute.

Kahn Danielle J, K. M. (nd). Hazardous wastes issues in developing countries. Encyclopedia of life support systems (EOLSS), 02.

Koichi Fuji, H.-Y. (nd). Effects of human acivities on water quality. Encyclopedia of life support systems (EOLSS), II, 01.

Marianna Garfi, A. (nd). Waste dispodal in Developing countries and emergency situations - The case of Saharawi refugees camps. DICMA - University of Bologna, 01.

Mohamed El Raey. (2000). Air quality and atmospheric pollution in the Arab Region. Joint technical secretariat of the council of Arab Ministers responsible for the environment, Economic and Social Commission for Western Asia. Regional Office for West Asia: League of Arab States.

Saroj Gywali, K. C. (2012). Effects of industrial waste disposal on the surface water quality of U - tapa river, Thailand. International conference on environment science and engieering. 32, p. 109. Singapoore: LASCIP Press.

Soumya Boussaha, A. (2016). Quantitative evaluation of phosphorus dissolved in the water of Bounamoussa river (North Eastern Algeria). Journal of chemical and pharmaceutical research, 08(02), 505.

UNESCO. (2017). Waste water: the untapped resource. The united nations world water development report 2017.