



International Journal of Engineering Science Invention (IJESI)

ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726

[www.ijesi.org](http://www.ijesi.org) |

# Journal IJESI

ISSN (Online) : 2319 - 6734

ISSN (Print) : 2319 - 6726

## Editorials Board Members

	<p><b>Name : Dr. Moinuddin Sarker</b> <b>Qualification :</b> PhD and Post Doctoral <b>Specialization :</b> Chemistry <b>Affiliation :</b> Natural State Research, Inc., USA <b>Experience :</b> 22 <b>Country :</b> USA <b>Paper Published :</b> 65</p>
	<p><b>Name : Dr. ahmed nabih zaki rashed</b> <b>Qualification :</b> Ph.D <b>Specialization :</b> Optics Comunications, Wireless Communications <b>Affiliation :</b> Dr. in MENOUFIA UNIVERSITY, Egypt <b>Experience :</b> 10 <b>Country :</b> Egypt <b>Paper Published :</b> 55</p>
	<p><b>Name : Dr. Lalan Kumar</b> <b>Qualification :</b> Ph.D <b>Specialization :</b> Scientist, I.T. <b>Affiliation :</b> Central Institute of Mining and Fuel Research (CIMFR), Dhanbad <b>Experience :</b> 25 <b>Country :</b> India <b>Paper Published :</b> 50</p>
	<p><b>Name : Dr. Nadhir Al-Ansari</b> <b>Qualification :</b> Ph.D <b>Specialization :</b> Å Civil, Environmental and Natural Resources Engineering <b>Affiliation :</b> Lulea University of Technology, Sweden <b>Experience :</b> 35 <b>Country :</b> Sweden <b>Paper Published :</b> 152</p>

# Journal IJESI

ISSN (Online) : 2319 - 6734

ISSN (Print) : 2319 - 6726

	<p><b>Name : Dr. Kolo, Stephen Sunday</b> <b>Qualification :</b> Ph.D <b>Specialization :</b> Civil Engineering <b>Affiliation :</b> FUT, Minna, Niger State, Nigeria <b>Experience :</b> 10 <b>Country :</b> Nigeria <b>Paper Published :</b> 07</p>
	<p><b>Name : Dr. Siddalingeshwara K. G</b> <b>Qualification :</b> Ph.D <b>Specialization :</b> EHS R&amp;D <b>Affiliation :</b> Gulbarga University <b>Experience :</b> 06 <b>Country :</b> India <b>Paper Published :</b> 25</p>
	<p><b>Name : Dr. M. Rizwan</b> <b>Qualification :</b> Ph.D <b>Specialization :</b> Electrical Engineering <b>Affiliation :</b> Delhi Technological University (Formaly Delhi College of Engineering) <b>Experience :</b> 10 <b>Country :</b> India <b>Paper Published :</b> 27</p>
	<p><b>Name : Dr. Vuda Sreenivasarao</b> <b>Qualification :</b> Ph.D <b>Specialization :</b> Computer Science <b>Affiliation :</b> Defence University college,Deberzeit,ETHIOPIA <b>Experience :</b> 13 <b>Country :</b> Ethopia <b>Paper Published :</b> 28</p>

# Journal IJESI

ISSN (Online) : 2319 - 6734

ISSN (Print) : 2319 - 6726

	<p><b>Name : Dr. Abdul Mutalib Leman</b></p> <p><b>Qualification :</b> Ph.D</p> <p><b>Specialization :</b> Mechanical Engineering</p> <p><b>Affiliation :</b> Universiti Tun Hussein Onn Malaysia</p> <p><b>Experience :</b> 10</p> <p><b>Country :</b> Malaysia</p> <p><b>Paper Published :</b> 75</p>
	<p><b>Name : Dr. Salawu .O.W</b></p> <p><b>Qualification :</b> Ph.D</p> <p><b>Specialization :</b> Inorganic Chemist</p> <p><b>Affiliation :</b> Federal University of Agriculture Makurdi , Benue State Nigeria</p> <p><b>Experience :</b> 03</p> <p><b>Country :</b> Nigeria</p> <p><b>Paper Published :</b> 17</p>
	<p><b>Name : Prof. Dr. GYV Victor</b></p> <p><b>Qualification :</b> PhD., CEng (UK)</p> <p><b>Specialization :</b> Environmental Engineering</p> <p><b>Affiliation :</b> AMET Maritime University</p> <p><b>Experience :</b> 22</p> <p><b>Country :</b> India</p> <p><b>Paper Published :</b> 20</p>

Category : Volume 7 - Issue 6 - Version - 2

Articles:



Modern Techniques used for Big Data Clustering:A Review

Sharon Susan Jacob || Prof. R.Vijayakumar File Size 330 KB

Paper Index : ANED  xxxxxxxxx



Screening for antimicrobial activity of some medicinal plants

R. P. Hongalamath || E. B. Sedamkar File Size 155 KB

Paper Index : ANED  xxxxxxxxx



Synthesis, Characterization, antimicrobial, anticancer and anti-hemolytic activity of Co (II), Ni (II) and Cu (II) complexes with 2-methoxy-6-(3-iminoquinolinyl methyl) phenol

S.N.Battin || A.H Manikshete || M.R. Asabe || D.J.Sathe File Size 0.98 MB

Paper Index : ANED  xxxxxxxxx



Finite Element Analysis of Optimization for Turning Parameters of Super Alloy Inconel 718

Peta.Anil Kumar || Ramesh Ganugapenta File Size 1.01 MB

Paper Index : ANED  xxxxxxxxx



Water Supply and Waterbornes Diseases in the Population of Za-Kpota Commune (Benin, West Africa)

Leocadie Odoulami || Brice S. Dansou || Nadege Kpoha File Size 555 KB

Paper Index : ANED  xxxxxxxxx



Influence des facteurs environnementaux sur la structure spatiale du peuplement roniers (Borassus aethiopum Mart.) de la savane, au Centre de la Cote d'Ivoire

Douffi Kouakou Guy-Casimir || Kone Moussa || Traore Amara Sidiki || Kouakou Amany Allegue Florentin || N'guessan Joachim File Size 1.58 MB

Paper Index : ANED  xxxxxxxxx



Challenges in Teaching and Learning for Visually Impaired

Dr. Saranjit Kaur File Size 174 KB

Paper Index : ANED  xxxxxxxxx



Deep Neural Networks Based Disease Detection in Family of Cashew Plants by Leaf Image Classification

Pravallika Rudraraju || Y.Vineela Sravya File Size 695 KB

Paper Index : ANED  xxxxxxxxx



### Data Embedding an Image Using DCT Compression

Sonali Bhujade || Prof.Muzaffar Khan

File Size

413 KB

Paper Index : **ANED**  xxxxxxxxx



### Design and Modification of Milling Fixture for Square Shank

Prof. Chetan E. Kolambe || Harshad Patil || Shubham  
Tiwari || Suraj Deshmukh || Sarim Shaikh

File Size

296 KB

Paper Index : **ANED**  xxxxxxxxx



### Data Integrity Verification In Cloud Database

Sangeetha D || Padma Priya M.K

File Size

206 KB

Paper Index : **ANED**  xxxxxxxxx



### Penta Band Inset-Fed Circular Microstrip Antenna For Wireless Communications

Ashwini C. Tengli || P. M. Hadalgi

File Size

583 KB

Paper Index : **ANED**  xxxxxxxxx



### Utilization of Basic oxygen furnace slag as aggregate in Bituminous mix

Vishwanath B J || Pavankumar N shirahatti || Grandhi Saravana kumar

File Size

344 KB

Paper Index : **ANED**  xxxxxxxxx



### Performance Analysis of Semantic Assisted Convolutional Neural Networks in Face Recognition

Kalyani D Sonawane || Dr.Sudhir D Sawarkar || Prof Archana Gulati

File Size

956 KB

## Water Supply and Waterbornes Diseases in the Population of Za-Kpota Commune (Benin, West Africa)

Léocadie Odoulami, Brice S. Dansou & Nadège Kpoha

Laboratoire Pierre PAGNEY, Climat, Eau, Eco système et Développement LACEEDE/DGAT/FLASH/  
Université d'Abomey-Calavi (UAC). 03BP: 1122 Cotonou, République du Bénin (Afrique de l'Ouest)  
Corresponding Author: Léocadie Odoulami

---

**Summary** :The population of the common Za-kpota is subjected to several difficulties bound at the access to the drinking water. This survey aims to identify and to analyze the problems of provision in drinking water and the risks on the human health in the township of Za-kpota. The data on the sources of provision in drinking water in the locality, the hydraulic infrastructures and the state of health of the populations of 2000 to 2012 have been collected then completed by information gotten by selected 198 households while taking into account the provision difficulties in water of consumption in the households. The analysis of the results gotten watch that 43 % of the investigation households consume the water of well, 47 % the water of cistern, 6 % the water of boring, 3% the water of the Soneb and 1% the water of marsh. However, the physic-chemical and bacteriological analyses of 11 samples of water of well and boring revealed that the physic-chemical and bacteriological parameters are superior to the norms admitted by Benin. The consumption of these waters exposes the health of the populations to the water illnesses as the gastroenteritis, the diarrheas, the affections dermatologic,... to fight against these water illnesses, the measures of sensitization of the populations for the adoption of the hygienic behaviors in the township of Za-kpota are to consider.

**Keywords**: Bénin, Za-kpota commune, water supplied, water pollution, waterborne disease

---

Date of Submission: 25-05-2018

Date of acceptance: 11-06-2018

---

### I. Introduction

Nowadays, thousands of people in the world don't have access always to the drinking water. The water illnesses stay one of the main preoccupations of the sanitary security in the world (Kpanou, 2007). Of this fact, the mastery of the water quality should be a priority in all countries in order to protect the health of the populations (Hilhorst and al., 2008) because the illnesses only diarrhoeic caused in the world about 24 millions death every year and was classified thus to the sixth rank of the mortality reasons. This illnesses diarrhoeic is undue largely by the use of no treated water and to the lack of hygiene (OMS, 2004).

The situation of provision in drinking water is preoccupying to Benin and especially in out-of-town environment. More of 50 % of Beninese living in semi-urban environment don't arrange a drinking water (Hilhorst and al, 2008). This situation is bound to the variability pluviometric (Boko, 1988) and to the quality of the consumption waters. This variability pluviometric appears by an important change of the rhythm middle pluviometric and by a mobility of the maxima pluviometric (Houdénou, 1999). These conditions don't facilitate provision in drinking water of the populations. The township of Za-kpota is not in margin of these provision difficulties in drinking water.

The objective of this survey is to identify and to analyze the problems of provision in drinking water and the quality of the consumption waters in the township of Za-kpota. This township is situated between 7° 05'24 " and 7° 21'57 " of the north latitude on the one hand and between 2° 03'54 " and 2° 21'57 " longitude is (figure 1).



Also, investigatings in real environment have been led in 198 households on the 87076 households of the township. The 198 households have been selected in eight districts that the township counts. The cards of questionnaires have been used to collect the information in these selected households.

The individual interviews and the focuses groups have been achieved with the Method Accelerated from Research Participative (MARP). In the same way of people resources (eight politico authorities - administrative, three agents of health, an agent of the water service and a civil servant of the SONEB) have been interrogated with the help of maintenance guides. The investigatings in real environment as well as the documentary research done drove below to the results.

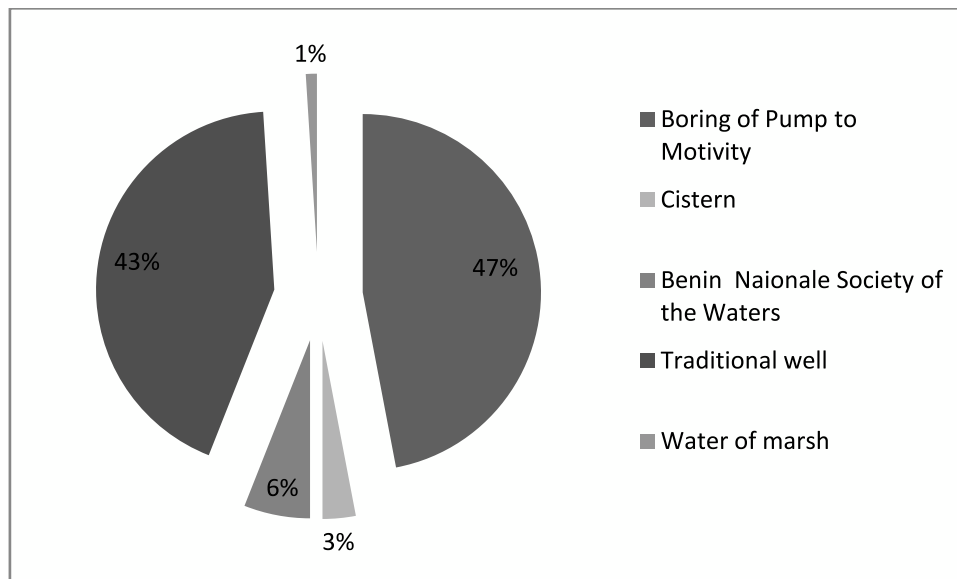
### III. Main results

#### 3.1. Sources of provision water in the township of Za-kpota

The township of Za-kpota enjoys a climate subequatorial characterized by two rainy seasons alternated by two dry seasons.

It benefits to the total of 8 months of rain on 12 the year (Kpoha, 2014). The yearly rains varying between 719,7 mm and 1397 mm per year. These rainy months facilitate the refill annually in water of the soil of the township of Za-kpota. Indeed, the sedimentary cover met in the zone is constituted by the formations of the Continental Terminal in which one generally meets some clay brunettes, beige, greenish that deepened itself quickly from the North to the South (earth of rod); sometimes a rest of shell lateritic and the formations of thin white sands to coarse, change clayey-sandy-gritty red continental and pink facies with some benches sandy.

In spite of the nature of the soil of the township of Za-kpota, this one has a hydraulic potentiality (resources in water underground and resources in water of surface) for the food in water of the populations. The accession to this hydraulic potentiality by the populations makes itself by the wells and the boring or by the collection. Therefore, different sources of water are used in the township of Za-kpota. It is about the drinking water of the SONEB, the waters of the boring and wells (figure 2).



**Figure 2: Sources of provision in water in the township of Za-kpota**

Source: Works of land, October 2013

The figure 2 shows different sources of provision in water in the common Za-kpota. Among the households of investigation, 47 % get a stock in water of cistern, 3 % in drinking water of the SONEB, 6% in water of Pump Boring to Motivity, 43% to the traditional well, and 1 % to the water of marsh. The photos 1 and 2 illustrates some sources of water in the township of Za-kpota.



**Photo 1:** Collection of water of well in the precinct of Koguédé Photo, catch by Kpoha, January 2013



**Photo 2 :** Collection of water of pump boring to motivity (FPM) in Za-tanta Photo, catch by Kpoha, January 2013

The photo 1 and 2 shows the collection of waters respectively by the members of the households in a well to big diameter in Koguédé and to a boring of pump to motivity in Za-tanta. Hygiene stays precarious to the immediate surroundings of these works of hydraulics. Besides, these waters are collected in smutty and non protected containers. These conditions mortgage the quality of these collected waters and consumed in the households of the township of Za-kpota.

Next to these constraints, there are the constraints bound to the management of water.

### **3.2. Constraints bound to the management of water in the township of Za-kpota**

To the number of the insufficiencies of the management of resources in water, it is necessary to mention the carelessness of the local authorities in the protection and the maintenance of the hydraulic works and the bad practices of hygiene of the residents of the surface waters (photo 3).



**Photo 3:** Laundry makes in the Hla river in the district of Allahé Photo, catch by Kpoha, January 2013

The photo 3 shows the lifting of the linens on the outskirts of the Hla river in the precinct of Allahé. The practice of these domestic activities on the outskirts of the courses compromises the quality of these rivers. This situation is due to the bad management of resources in water in the township of Za-kpota. Indeed, in the township of Za-kpota, several facilities of drinking water are not functional (table V). The reasons that justify this state of dysfunction are the frequent breakdowns on the works or their momentary abandonment or their closing.

**Table I :** Synthesis of the different points of water recorded in the Township of Za-kpota to December 31, 2010

District	Population	Needs in EPE	Total EPE Equipped	Total EPE functional	Number of functional works by type				Total AEV	Total PE A	Total EPE of BF and Rails in breakdown	FPM in breakdown	PM in breakdown
					FP M	P M	Nb BF	PEA					
<b>ALL AHE</b>	8196	33	40	40	39	1					0		
<b>ASS ALI N</b>	9939	40	10	9	5			1		1	0	1	
<b>HOU NGO MEY</b>	10341	41	17	13	4	1		2		2	0	3	1
<b>KPA KPA ME</b>	12175	49	18	18	7	1	5		1		0		
<b>KPO ZOU N</b>	16879	68	34	32	6		13		2		0	2	
<b>ZA-KPO TA</b>	20176	81	35	33	13		8	1	1	1	0	2	
<b>ZA-TAN TA</b>	18926	76	21	20	4		8		1		0	1	
<b>ZEK O</b>	6757	27	6	6	1	1		1		1	0		
<b>Total :</b>	103389	414	181	181	79	4	34	5	5	5	0	9	1

Source : DG-Water, 2011

BF = Boundary-mark Fountain, PEA = Autonomous water Station, PE = Point of water, 1PE give water to 250 inhabitants, 1EPE=1PE, AEV.; Adduction of water Villager, FPM = 1 PE, PM = 1 PE, AEV = Nb BF, 1 BF = 2 PE, PEA = 4 PE,

EPE = Equivalent Not of water, FCP = Boring Against Well, SA = Arranged Source, FPM = Boring of Pump to Motivity; Modern PM-Well

It evident from the table that the total number in EPE equipped represents about a third of the need in EPE without taking into account the breakdown rate. It shows the real difficulties of the population to get a stock in drinking water. The number of hydraulic works is therefore only very insufficient and satisfied a small part of the needs of the population. In these conditions, the populations move toward the doubtful sources of water of quality.

### 3.3. Quality of waters used in the households of the township of Za-kpota

#### 3.3.1. Physico-chemical features of the water samples in the township of Za-kpota

The waters of boring and the wells of the township of Za-kpota are for most exposed to the pollution. However, they are collected and are used in the households. The II picture presents the results of the physico-chemical analyses of the water samples appropriated in the township of Za-kpota.

#### - Physical features

The results of the analysis of the main physical parameters measured in the different samples of water appropriated are presented in the table II.

**Table II:** Results of the physical analyses on the samples of water in Za-kpota

N°	District	Alkalinity CaCO <sub>3</sub> (en mg/L)	Conductivity (µs/cm)	Color (uc)	Total toughness (mg/L)	Temperature (°C)	Turbidity (FTU)	PH	DTS (mg/L)
	<u>WHO norm</u>	500	400	15	500	25	5	6,5<pH<8,5	500
	<u>Beninese norm</u>	500	400	15	500	25	5	6,5<pH<8,5	-
I	<u>Allahé</u>	40	51	423	18	25,5	69	6,14	30
II	<u>Houngomey</u>	30	38	78	14	25,5	20	6,39	
III	<u>Kpakpamè</u>	55	69	184	52	26	25	7,01	30
IV	<u>Tanta</u>	40	46	-	20	25	-	6,11	18
V	<u>Za-kpota</u>	50	53	-	16	26,4	-	6,74	22

Source: Results of the analyses to DG-Water, 2013

The analysis of the table II shows that:

- the samples n° 1, 2, and 3 appropriated in the precincts present values of color measure the norms above (15uc) ;
- the quasi-totality of the samples presents the temperatures being located beyond the admitted norms (25°C) ;
- the samples n° 1, 2, and 3 present rates of turbidity beyond 5 FTU (norms);
- three (3) samples out of the five (5) analyzed present the pH inferior to 6,5. Waters consumed in the township are to close to 60% acidic;

On the set of the samples, one only (20%) respects the norms of potability on a physical level. It says that on a physical level the waters of well and boring consumed in the township of Za-kpota are not drinkable.

**- Chemical features**

The results of the analysis of the main chemical parameters (organic and of the metallic traces) measured in the different samples of water appropriated are consigned in the table III.

**Table III:** Results of chemical analyses on the samples of water in Za-kpota

N°	Distri ct	Ca2+ (mg/L)	Cl- (m g/ L)	F- (mg/ L)	Fe_ Tota l (mg/ L)	HCO3 - (mg/L )	I- (mg/ L)	Mg2+( mg/L)	NH 4+ (mg/ L)	NO2 - (mg/ L)	NO3- (mg/L)	PO4 3- (mg/ L)	SO42 - (mg/L )
WHO norm		100	250	1,5	0,2	-	-	0,05	0,5	3	50	5	250
Beninese norm		100	250	1,5	0,3	-	-	5	0,5	3,2	50	5	500
1	Allah é	5,01	11,66	0,15	0,49	19	0,5	1,95	0,645	0,0232	20,24	2,3	-
2	Houngomey	4,01	7,1	-	0,22	12,2	0,17	0,73	0,2193	-	2,2	0,06	2
3	Kpakpamè	5,21	10,97	-	0,25	50,7	-	11,16	1,34	-	1706,	0,5	6
4	Tanta	5,01	11,66	-	0,08	19,3	0,31	3,243	-	0,0693	15,44	2,57	-
5	Za-kpota	20,34	30,4	0,35	1,38	18,30	0,12	-	0,2322	2,32	15,84	1,28	10

Source: Results of the analyses to DG-Water, 2013

The table III shows that all samples present the values respecting the Beninese norms with regard to the contents in calcium, chlorides, fluorides, bicarbonate, iodine, nitrate, nitrite, phosphate and sulphate ; 40 % of the samples present contents made of total iron outside of the values fixed by the Beninese legislation and finally 80 % of the samples present some contents in magnesium and ammonium in conformity with the norms in force.

On a chemical level, the risk of pollution would be located a lot more on the content made of total iron of the waters of well in the township of Za-kpota. It is necessary to note that the presence of iron in excess in the water of consumption entails in the organism the lesion of the organs whose liver is the first to store and when his/her/its capacity of storage would be exhausted, it continuous and accumulate in the heart, the hypophysis, pancreas, intestine, etc. These lesions can drag the individual's death thereafter (Kpoha, 2014). These physico-chemical analyses have been completed by the bacteriological analyses.

**3.2.2. Bacteriological features of the water samples in the township of Za-kpota**

The results of the bacteriological analyses are consigned in the IV picture.

**Table IV:** Results of the bacteriological analyses of the water samples in Za-kpota

Parameters	District					Beninese norm
	I	II	III	IV	V	
Total Coliformes	20	08	15	12	09	6-11 cfu/ml
Fecal Coliformes	1	-	-	-	-	<1cfu/100

Source : DG-Water and investigation of land 2012

The table IV shows that all samples of water don't contain any fecal coliformes practically. But the number of total coliformes passes the one advisable by instructions of quality of the WHO for a water of drink. The presence of these bacteria in waters reveals a fecal pollution of human or animal origin. One deduces to some therefore that the risk of pollution is located a lot more on the chemical parameters of waters in the township.

Of these results, one can conclude that the waters that the population uses are chemically drinkable and mineralized weakly but of doubtful hygienic qualities of the point of bacteriological view. The figure 3 shows the evolution of the water illnesses of 2000 to 2012 in the township of Za-kpota.

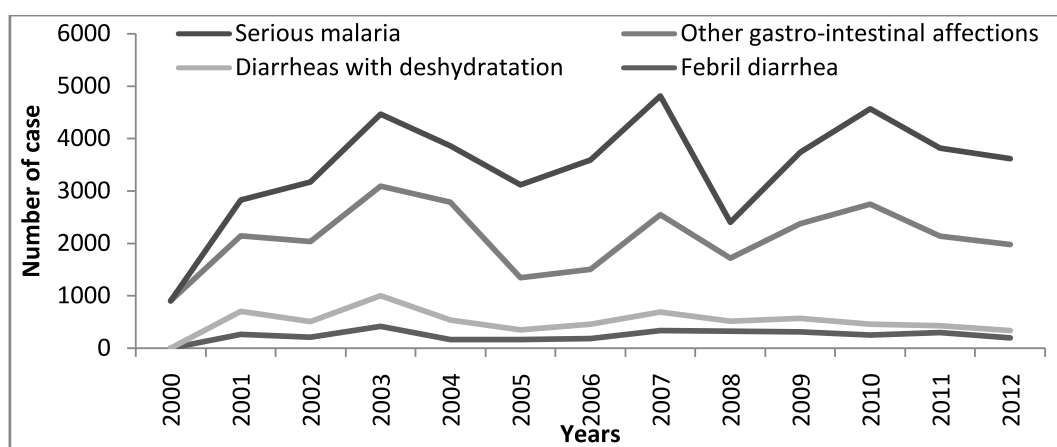


Figure 3: Illnesses bound to water in the commune of Za-kpota

Source: Local Health center, Za-kpota October 2012

The analysis of the figure 3 shows that among the illnesses of water origin, the malaria presents the most elevated rate. These results confirm those of Akpotrossou (2010) that identifies like source of water illnesses, the waters of traditional wells and the waters of surfaces (river, creek, stream). But for Odoulami (1999), the insufficiency of the drinking water and the weakness of the household incomes drive these last to consume the waters of doubtful quality, what entails problems of health. These results corroborate those of Fagnon (2003) and of Bossou (2001). It is important to do periodic analyses to follow the quality of the consumption waters in the township in order to warn the contamination of the consumption waters and to preserve the health of the populations in the township of Za-kpota.

#### IV. Conclusion

To the term of this survey, it is necessary to keep that the problems of provision in drinking water in the township of Za-kpota concern the insufficiency of the hydraulic works and the breakdowns of hydraulic facilities, the accessibility to the points of drinking water and the quality of water. The physico-chemical and bacteriological analyses of the water samples appropriated showed that the main sources of water of the populations are unfit to the consumption according to the Beninese norms.

Therefore, measures in view of the backing of the provision facilities in drinking water in the township of Za-kpota deserve to be taken and consistent through sessions of information, Education, Communication within the populations, the backing of the staff of hygiene and purification in order to cover all precincts of the township.

#### Bibliography

- [1]. Akpotrossou A., (2010) : Approvisionnement en eau potable dans la commune d'Abomey. Mémoire de maîtrise, FLASH/UAC. Abomey-Calavi, 86 p.
- [2]. Boko M., 1988 : Climatologie et communautés rurales du Bénin : rythmes climatiques et rythme de développement. Thèse de doctorat d'Etat ès-Lettres à l'Université de Bourgogne, Dijon, 608 p.
- [3]. Bossou D. B., (2001) : Analyse et esquisse cartographique de la contamination bactériologique de la nappe phréatique alimentant les puits traditionnels de la ville de Cotonou et sa banlieue. Mémoire de DESS/UNB/FAST, 82 p.
- [4]. Fagnon B., 2003 : La question de l'eau potable et de la gestion des équipements hydrauliques dans la commune de Djakotomey. Mémoire de maîtrise, Géographie, FLASH/UAC 107 p.
- [5]. Hilhorst T., Adjinacou C. et Langley P., (2008) : L'approche sectorielle peut-elle renforcer les instances locales? Le secteur eau au Bénin, 16 p.
- [6]. Houndénou C., (1999) : Variabilité climatique et maïsiculture en milieu tropical humide, diagnostic et modélisation. Thèse de Doctorat Unique de Géographie, Dijon, France, 341 p.
- [7]. Kpanou R., (2007) : Impact microbiologique de la qualité de l'eau de consommation sur la santé des populations dans la commune de Kpomassè : cas de l'arrondissement de Dékanmè. Mémoire de maîtrise de DESS/FUNDP, 97 p.
- [8]. Kpoha J.N., 2014 : Approvisionnement en eau potable et santé des populations dans la commune de Za-kpota, mémoire de maîtrise, DGAT/FLASH/UAC, 93 p.
- [9]. Odoulami L., (1999) : Approvisionnement en eau dans la grande ville du Benin. Quel politique pour l'avenir ? cas de Cotonou, Porto-Novo et Parakou. Mémoire pour l'obtention du Diplôme d'Etude Approfondie (D.E.A.), 55 p.
- [10]. OMS (2004) : L'eau pour la santé : Directives de l'OMS pour la qualité de l'eau de boisson, 3ème édition. 6 p.

P Srinivas "Modeling and Simulation of Physiological Systems Using Labview" International Journal of Engineering Science Invention (IJESI), vol. 07, no. 06, 2018, pp 33-39