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ENVIRONMENTAL HEALTH SITUATION OF THREE RURAL COMMUNITIES LIVING IN THE IMMEDIATE VICINITY OF EBRIÉ LAGOON, CÔTE D'IVOIRE

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Abstract

In order to update on the state of the environment, a cross-sectional survey was conducted in three rural areas (Layo, Ahua and N'djem) in the front of Ebrié lagoon, to identify risk behaviors threatening the stability of this lagoon and causing some recurrent diseases among the population. This study revealed a lack of systems for drinking water supply as well as wastewater and solid wastes management in the three villages. It was observed that 75.7% of the households used boreholes and 24.3% used wells as their main source of drinking water. Meanwhile 37.9% of households practiced open defecation. Traditional showers were used by 70.4% of households and 29.6% used the lagoon for their shower. The majority households (94.9%) disposed their wastewater into the environment. For the storage of solid wastes, 61.2% of households did so in nature and 38.8% in the lagoon. About 84.3% of households were bathing in the Ebrié lagoon while 75.9% defecating in it. Furthermore, 36.8% of the surveyed households used lagoon waters for many activities (bathing, washing clothes and dishes), while 59.4% considered that the lagoon was polluted. Up to 60.6% of households linked the pollution of lagoon to the occurrence of diseases. The most recurring diseases were dermatoses and water-borne illness like malaria, diarrhea and typhoid fever.

Preventive measures such as the construction of adequate sanitation facilities and health education campaigns should be taken by the authorities to prevent the proliferation of these infectious diseases in the rural population in the future.

Keywords : Survey, households, recurrent diseases, pollution, Ebrié lagoon.

RESUME

Afin de faire l'état des lieux de la situation environnementale, une enquête transversale a été menée dans trois zones rurales (Layo, Ahua et N'djem) en bordure la lagune Ebrié afin d'identifier les comportements à risque menaçant la stabilité cette lagune et provoquant certaines maladies récurrentes parmi la population. Cette étude a révélé un manque de systèmes d'approvisionnement en eau potable et de gestion des eaux usées et des déchets solides dans les trois villages. Il a été observé que, 75,7% des ménages utilisent des forages et 24,3% des puits comme principale source d'eau potable. Pendant ce temps, 37,9% des ménages pratiquent la défécation à l'air libre. Les douches traditionnelles sont utilisées par 70,4% des ménages et 29,6% utilisent la lagune pour leur douche. La majorité des ménages (94,9%) évacuent leurs eaux usées dans la nature. Pour le stockage des déchets solides, 61,2% des ménages le font dans la nature et 38,8% dans la lagune. Environ 84,3% des ménages se baignent dans la lagune Ebrié alors que 75,9% y défèquent. De plus, 36,8% des ménages enquêtés utilisent les eaux lagunaires pour de nombreuses activités (baignade, lessive et vaisselle), alors que 59,4% estiment que la lagune est polluée. Jusqu'à 60,6% des ménages ont établi un lien entre la pollution de la lagune et la survenue de maladies. Les maladies les plus répandues sont les dermatoses et les maladies d'origine hydrique telles que le paludisme, la diarrhée et la fièvre typhoïde.

Des mesures préventives telles, la construction des installations sanitaires adéquates et des campagnes d'éducation sanitaire devraient être prises par les autorités pour éviter dans l'avenir, la prolifération de ces maladies infectieuses au sein de la population rurale.

Mots clés: Enquête, ménages, maladies récurrentes, pollution, lagune Ebrié.

INTRODUCTION

Urban water sources are being polluted by inadequate sanitation, poor wastewater management and human activities. This is the case of the Ebrié lagoon which receives all the untreated wastes of the population of Abidjan, the economic capital, and in some peri urban and peripheral cities and villages (Dongo *et al.*, 2010). This lagoon received 40 000 m^3 of domestic and industrial wastewater from the city of Abidjan each day (Koné et al., 2007). The inadequacy of urban and rural sanitation technologies for waste management has environmental and human health consequences (Haryanto et Sutomo, 2012). The pollution of the lagoon could have both health and economic consequences due to the many uses of water and fishery products (Meays et al., 2004). Sewage disposal affect people's immediate environment and leads to water-borne illnesses. Poor water quality, poor hygiene and insufficient sanitation are the causes of water-borne diseases, particularly water-borne diseases (Ledeur, 2004; Kientga, 2008). Every year, nearly 8 million people, half of whom are children, die from diseases due to water quality, lack of water, poor hygiene or sanitation (Camdessus et al., 2004). Surface water plays an important role in the distribution of vectors and spatial and temporal transmission of disease (Poda, 2007).

The objective of this study was to evaluate the environmental health situation of the populations living in sectors IV and V of the Ebrié lagoon and to identify the health risk factors related to the living conditions of these populations on the stability of the lagoon environment.

MATERIAL AND METHODS

Study area

This study was carried in three villages (Layo, Ahua and N'djem). The choice of these localities was based on their location in sectors IV and V of the Ebrié lagoon. In these two sectors, massive fish deaths have occurred in 2013. This has resulted in the closure of numerous fish farms in this area. Layo is located in the department of Dabou, 45 km west of Abidjan on the axis Abidjan-Dabou. Ahua and N'djem are located in the department of Jacqueville. Ahua is about 57 km from Abidjan and N'djem, about 33 km on the axis Abidjan-Jacqueville.

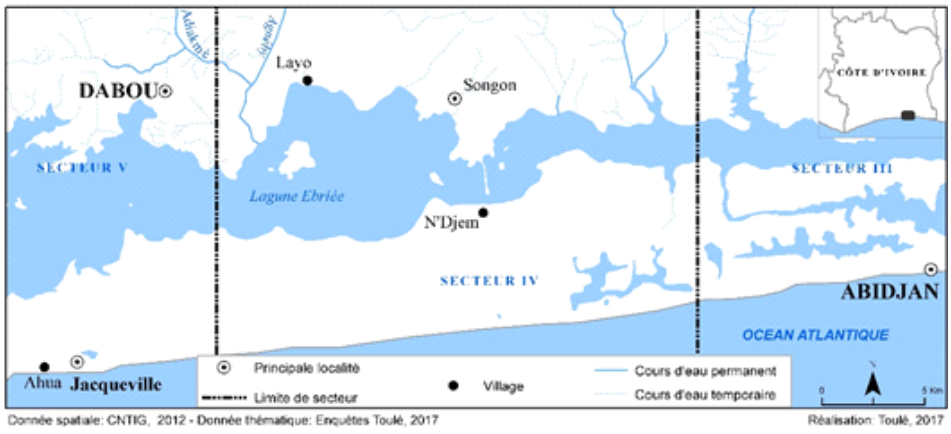

Figure 1: Study Area

HOUSEHOLD SURVEY

We selected the communities of Layo, Ahua and N'djem as the areas of interest. The target for sampling were the households. The community of Layo consists of 96 households, those of Ahua is 78 and those of N'djem, 533. The survey was conducted in March 2015 in 212 households, of which 29 were in Layo, 23 in Ahua and 160 in N'djem, which corresponded to about 30% of households in each village. Random sampling was used to select households (MSLS, 2012), because random sampling gives to each household an equal chance to be selected.

The research employed the use of structured questionnaires. The questionnaires were distributed personally in each of the selected households in the community of the three villages. The questionnaire consisted of a set of questions that were presented to the head of the household or his representative for answers. The questionnaire was divided into three sections. In the first section, respondents were asked about their demographic characteristics such as the composition of the household, the employment status, the level of education. In the second section, the respondents were asked about the living conditions such as the water sources, the type of latrine used, wastewater and solid waste disposal practice. In the third section, the respondents were asked for their diet habits, the source of fishery products, risk behaviors, their perception of the lagoon pollution and its consequences on health, their knowledge and perception about disease and health.

STATISCAL ANALYSIS

The data were analyzed using the Epi Info 3.5.1 software to assess the link between water pollution and human activities.

RESULTS

The characteristics of households surveyed are presented in Table I. It can be seen that 94% of households were headed by men. The heads of the households were self-employed; they did activities such as fishing (43.5%) and selling fishery products (78.5%). In terms of educational background, the majority of selected households in the three villages (56.5%) were illiterates. Most people dropped out of primary and secondary schools of the lack of financial resources.

Table II shows the sources of drinking supply and the sanitary facilities. For drinking water supply, most households surveyed (75.7%) used boreholes while 24.3% used hand dug wells. The main type of latrine used by the households surveyed was the open defecation in the bush (37.9%), followed by defecation on the borders of the lagoon (31.5%) and overhung latrines (22.5%). Most households (70.4%) used traditional bathrooms against 29.6% who bathed directly in the lagoon. Solid wastes and wastewater were dumped directly on the street, the open fields and in the lagoon by 94.9% and 61.2% of the households surveyed. The type of fishery products consumed by surveyed households in the three villages are presented in Table III. Fish were the most widely consumed fishery products in households (100%), followed by crabs (27.8%), shrimps (8.3%) and crayfish (1.6%). A total of 98.2% of these fishery products came from the Ebrié lagoon.

Table IV present the risk behaviors of surveyed households in the villages. About 84.3% of surveyed households bathed, defecated (75.9%) and 62.5% disposed of their wastes in the Ebrié lagoon. The waters of the lagoon were also used for domestic tasks, with a proportion of 33.5% for laundry and 9.5% for dishes. The status of pollution of the Ebrié lagoon and the recurrent diseases according to the opinions of the households are recorded in Table V. Half households surveyed (59.4%) has affirmed that the Ebrié lagoon was polluted. Changes in color, foul odors and solid waste were the most commonly reported signs of pollution by households. Pollution sources were most attributed to runoff water, domestic wastes, open defecations, agricultural wastes, and industrial wastes. 60.6% of households linked the pollution of the lagoon to the occurrence of disease cases. Table V shows that malaria was the most common recurrent disease reported by all households (77.9%) followed by cases of dermatosis (28.7%), diarrhea (20.2%) and typhoid fever (12.4%). About 13.2% of cases of diarrhea were recorded in all the households surveyed.

Table I : Demographic characteristics of respondents in households

	Distribution (%)			
	Localities			
Characteristics	Layo (n=29)	Ahua (n=23)	N'djem (n=160)	Means
Sex of head of household				
Female	0	8,7	9,4	6 ± 5,2
Male	100	91,3	90,6	94 ± 5,2
Educational status of head of household				
No formal education	51,7	69,6	48,2	56,5 ± 11,5
Primary school	20,7	17,4	30,6	22,9 ± 6,9
Secondary school	24,1	13	18,1	18,4 ± 5,6
High school	3,5	0	3,1	2,2 ± 1,9
Main source of income				
Agriculture	6,9	4,3	12,5	7,9 ± 4,2
Fishing / sale of fishing products	75,9	87	72,5	78,5 ± 7,6
Breeding	0	8,7	1,9	3,5 ± 4,6
Commerce	10,3	0	9,4	6,6 ± 5,7
Salaried / day laborer	6,9	0	3,7	3,5 ± 3,5

Table II : Drinking water supply and sanitary facilities used by households surveyed

	Distribution (%)			
	Localities			
Characteristics	Layo (n=29)	Ahua (n=23)	N'djem (n=160)	Means
Main source of drinking water supply				
Communal faucet	0	0	0	0
Borehole	100	100	27,5	75,8 ± 41,9
Well	0	0	72,5	24,2 ± 41,9
Surface water	0	0	0	0
Main type of latrine used				
Modern latrine	0	0	0	0
Traditional latrine	6,9	0	17,5	8,1 ± 8,8
Overhung Latrine	0	0	67,5	22,5 ± 39
Open defecation	17,2	82,6	13,8	37,9 ± 38,8
Borders of the lagoon	75,9	17,4	1,2	31,5 ± 39,3
Main type of bathroom used				
Modern bathroom	0	0	0	0
Traditional bathroom	13,8	100	97,5	70,4 ± 49,1
Lagoon	86,2	0	2,5	29,6 ± 49,1
Wastewater management				
Canal	0	0	0	0
Septic tank	3,4	0	6,9	3,4 ± 3,5
Street	96,6	95,7	92,5	94,9 ± 2,2

Table III : Consumption, mode of acquisition and origin of fishery products

	Distribution (%)			
	Localities			
Characteristics	Layo (n=29)	Ahua (n=23)	N'djem (n=160)	Means
Most consumed fishery products				
Fish	100	100	100	100
Crab	13,8	52,2	17,5	27,8 ± 21,2
Shrimp	0	21,7	3,1	8,3 ± 11,7
Crayfish	0	4,3	0,6	1,6 ± 2,3
Mode of acquisition of fishery products				
Fishing	93,1	100	85,6	92,9 ±7,2
Buy	6,9	0	14,4	7,1 ± 7,2
Origin of fishery products				
Ebrié lagoon	100	100	94,7	98,2 ± 3,1
Other	0	0	5,3	1,8 ± 3,1

Table IV : Risk behaviors of surveyed households in the three villages.

	Distribution (%)			
	Localities			
Risk Behaviors	Layo (n=29)	Ahua (n=23)	N'djem (n=160)	Means
Bathing	96,5	91,3	65	84,3 ± 16,9
Defecation	86,2	69,6	71,9	70,8 ± 1,6
Garbage throwing	62,1	60,9	64,4	62,5 ± 1,8
Cooking	0	0	0	0
Washing Dishes	10,3	0	18,1	9,5 ± 9,1
Laundry	41,4	21,7	37,5	33,5 ± 10,4

Table V : Opinions on the pollution status of Ebrié lagoon waters and recurrent diseases cases

	Percentages (%)			
	Localities			
Opinions	Layo (n=29)	Ahua (n=23)	N'djem (n=160)	Means
Nature of the Ebrié lagoon				
Polluted	65,5	47,8	65	59,4 ± 10,1
Unpolluted	31	34,8	17,5	27,8 ± 9,1
No idea	3,4	17,4	17,5	12,8 ± 8,1
Signs of pollution				
Odor	31	17,4	32,5	27 ± 8,3
Color	55,2	30,4	27,5	37,7 ± 15,2
Solid waste	17,2	13	43,1	24,4 ± 16,2
Sludge	0	13	5	6 ± 6,6
Lack of fish	6,9	4,3	13,1	8,1 ± 4,5
Sources of pollution				
Domestic waste	44,8	34,8	55,6	45,1 ± 10,4
Industrial waste	13,8	17,4	14,6	15,3 ± 1,4
Agricultural Waste	48,3	13	18,1	26,5 ± 19,1
Anarchic defecations	37,9	21,7	44,4	34,7 ± 11,7
Runoff water	41,3	47,8	50	46,4 ± 4,5
Periodic	0	17,4	4,4	7,3 ± 9
Link between water pollution and diseases				
Link	69	52,2	60,6	60,6 ± 8,4
No link	20,7	34,8	25,6	27 ± 7,2
No idea	10,3	13	13,8	12,4 ± 1,8
Recurrent diseases				
Malaria	82,8	73,9	76,9	77,9 ± 4,5
Typhoid fever	10,3	8,7	18,1	12,4 ± 5
Diarrheal diseases	20,7	13	26,9	20,2 ± 7
Dermatosis	34,5	21,7	30	28,7 ± 6,5
diarrhea	13,8	8,4	17,5	13,2 ± 3,2

Means per locality may be greater than 100% because each household may incriminate more than one sign, one source of pollution or one disease.

DISCUSSION

The main source of income for most surveyed households was fishing. In general, these waterfront communities were traditionally fishermen (Diaby et al., 2012). Fishing activity, often informal, contribute to the food security and create jobs for the rural population. According to Adingra and Kouassi (2011), the lagoon fishery, contribute to the food security of the families of the fishermen, and through the marketing of fishery products, increase the financial income of these families. The fishery products (fish, crabs, shrimps, crayfish) consumed by all the households surveyed come mostly from the Ebrié lagoon. According to Koffi (2009), lagoon fisheries resources play an important role in the diet of communities living in front of the lagoon. However, these resources could constitute

a public health risk if contaminated by the pathogenic micro-organisms that proliferate in this lagoon (Koffi-Nevry et al., 2008).

In this study, none of the surveyed households in the villages was connected to the national water distribution network. In Layo and Ahua, households used only borehole as a source of drinking water. In N'djem, the majority of the households used hand dug wells. These water sources were considered to yield freshwater from the ground (Rowan, 2008). This was supported by Bogaard et al. (2008) that groundwater was the largest storage of freshwater. The failure by the municipality to extend water and sanitation services to villagers put people at risk. The villages are forced to use open sources water from rivers, hand dug wells and boreholes which often have serious consequences to health and hygiene (Maoudombaye et al. 2015). However, the wells, because of their proximity to the polluted Ebrié lagoon could be directly contaminated by bacteria, virus, protozoa, nematodes, etc… as indicated by Kifuani (2004). These unprotected wells could also be contaminated by the water collection vessels such as buckets and ropes, that usually lie around the wells. A study on the assessment of the hygienic quality of well and source water in Morocco undertaken by El Ouali et al. (2014) showed a poor bacteriological quality of well water due to the presence of fecal coliforms, faecal streptococci) at high levels.

None of the households surveyed had modern latrines and bathrooms. In Layo, most households commonly bathed and defecated directly in the Ebrié lagoon. In Ahua, households practiced open defecation in the bush and bathed in traditional bathrooms. In N'djem, the overhung latrines and the traditional bathrooms were commonly used by households and all the wastewater generated were directly drained into the lagoon. In General, coastal and waterfront communities such these living on the border of the Ebrié lagoon, are faced with a wide range of problems caused by their location and environment. Sanitation is a predominant concern. Sanitation facilities are absent and direct defecation into the surface water has been the traditional practice. The overhung latrine is commonly used. Inadequate sanitation has negative effects on health (e.g. waterborne diseases: diarrheal diseases, intestinal infections, polio, typhoid, cholera, etc), economy (e.g. poverty, illness, illiteracy and lost income inclusive of GDP and GNP) and environment (e.g. dispersed and diffuse pollution of water sources resulting in the water and faecal disease cycle for communities with untreated water supplies) (DWAF, 1996; 2001). It also leads to social and psychological problems such as loss of privacy and dignity and exposure and increased risk to personal safety. In worse cases, the Ebrié lagoon over which such latrines are built, the water is used for domestic and personal washing, thereby increasing the risk of contracting diseases (Koffi, 2009). This behavior was observed in Layo and N'djem, where households used the lagoon water for washing dishes and laundry, while in Ahua this water was used only for laundry. It is likely that this situation observed in these villages could be due to the absence of public drinking water services, but it should also be pointed out that this could be due to the lack of awareness of these populations about the health risks associated with their behavior.

The solid and liquid wastes generated in the study area are disposed indiscriminately, as most of the inhabitants either dispose their wastes in open fields, at the side of the road, on the border of the lagoon and in the lagoon as indicated by Sackou et al. (2006) and Koffi-Nevry et al. (2008). These practices pose a risk to public health. Improper waste disposal by households also created a favorable environment for disease-

carrying pests such as rodents, flies, and cockroaches. These pests not only transmit disease directly but also expose inhabitants to allergens as indicated by Rauh et al. (2002).

Concerning the knowledge and perception about the pollution of the lagoon, the majority of the households surveyed found that the Ebrié lagoon was polluted. According to them, the obvious signs of this pollution were water color change, foul-smelling odors and the presence of solid waste. The obvious causes are runoff water, domestic waste, uncontrolled defecation, agricultural waste and industrial waste. They also mainly linked the pollution of the lagoon to the occurrence of disease cases. As a result, four diseases such as malaria, dermatosis, diarrhea and typhoid fever, were identified in this study as the most recurring diseases in all households. These diseases are important causes of morbidity, and sometimes generate significant disabilities as well as stigmatization of affected populations, perpetuating poverty (Freeman et al., 2013). In under developed country such as Cote d'Ivoire it is difficult to quantify morbidity and mortality related to unsafe and inadequate sanitation because of lack of an effective monitoring and surveillance system and country-wide baseline survey. Malaria was the recurring disease most often incriminated by the households. Similar observations were made by Sy et al. (2011) in their study on health and environmental vulnerability in disadvantaged neighborhoods in Mauritania. Malaria is a major cause of morbidity and mortality in Côte d'Ivoire, where it is endemic (Koné, 2008).

The diarrhea cases reported in this study were higher than those published by the Ministry of Health and AIDS in 2011, which were 7.6% and 6.7% respectively in the departments of Dabou and Jacqueville. This difference can be explained by the fact that the statistics only take into account the data collected from the public health centers, whereas some patients do not attend them and they do self-medication or use traditional medicine. Diarrheal diseases are considered an important public health problem because of their frequency and high rate of infant mortality attributable to them (Wierzba et al., 2006). The National Institute of Statistic (INS) reported 18% of cases of diarrhea in children under 5 years of age in the 2013 Multiple Indicator Cluster survey (MICS).

CONCLUSION

This study showed that there is strong anthropogenic pressure on the Ebrié lagoon. The lack of adequate sanitary facilities and proper waste disposal system in the study area forced communities living in front of the Ebrié lagoon to dumped all their wastes into the lagoon and open fields indiscriminately. Dumping of wastes into the lagoon contaminate the water making it unsafe for human consumption while dumping in open fields leave the environment very untidy. Health education would therefore be necessary to prevent the health risks associated with these behaviors and to avoid possible epidemics.

RECOMMENDATIONS

In view of potential risks of the environment of rural areas bordering the Ebrié lagoon on public health, it seems important for the authorities to invest in the construction of adequate sanitation facilities in these areas, to carry out sensitization campaigns on the hazards associated with risky behavior towards populations in order to encourage them to good hygiene practices.

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