



Basic Purification and Management of Household Waste in the District of Abomey-Calavi in Benin Republic: Case of Agamadin, Gbodjo and Tokpa-zoungo areas

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Abstract

The district of Abomey-Calavi has been going through an important demographic growth since the 1980s. This triggers difficulties in the management of waste and waste water and makes of this district a high-risk area for the basic purification. With the aim of contributing to a better knowledge of the issues of basic purification for a more effective intervention, we studied the problem concerning the management of domestic solid waste in the deprived areas: Agamadin, Gbodjo and Tokpa-zoungo. A descriptive and analytical study was carried out. The technique of sampling was a random one. Of our investigations, it emerges that 34,52 % of the investigated households are subscribed to the structures of pre-collection of garbage while 65,48 % are not. The garbage is daily deposited by households deprived of trash cans. The garbage of both subscribed households and non-subscribers finishes on the wild garbage dumps. The filth heaps proliferates in districts. Waste water of shower, laundry and dish washing is poured in the middle of streets or in open-air, half or fully closed catch basins.

Keywords: Management of household waste, deprived districts, basic purification and Abomey-Calavi.

Introduction

Today the accelerated rhythm of growth in the African cities creates needs in all domains and particularly in purification field¹ where the management of household waste becomes a major concern. The exponential increase of the quantity of waste, its collection and the processing are the serious difficulties which municipalities meet. It is easy to notice this problem in any African city one crosses: piles of waste, garbage along all roads, blocked brooks and smoke from burning of wild garbage dumps. It is the case of Abomey-Calavi district. This district met with a fast growth in population.

With a population of 8.534 inhabitants in 1979², the district of Abomey-Calavi counted 19.943 inhabitants in 1992³ and 61.450 in 2002⁴. This increase in population creates problems in managing the district, especially that it is not accompanied by a good policy concerning purification. This is especially reflected by: i. The insalubrities which reign around houses made of garbage spread almost everywhere in the sandbank, on deserted spaces, on fields, in cesspools), ii. The use of the sandbank as receiving environment for waste resulting either from households or from structures of pre-collection of garbage; iii. The insufficiency of purification works.

These problems are perceptible in all areas of the district, particularly in districts such as Agamadin, Gbojo and Tokpa-Zoungo where insalubrities are rife. These three districts present almost no public works of purification (gutters, public latrines, garbage tanks, water purification plants). The few gutters which do exist are filled with all kinds of waste which block them, creating floods during the rainy season⁵. Furthermore, in these districts there are no places for gathering the garbage. Nokoué lake situated along these districts plays the role site for final disposal for the households and garbage collection structures in the district. This triggers the degradation of the population living environment and consequently their health.

Therefore, the present investigation aims at contributing to a better knowledge of the practices connected to the deficit of purification concerning the management of household waste in districts considered by the present study in order to convince the authorities to put concrete actions into practice regarding hygiene and basic purification.

Material and Methods

Study area: Situated on the coastal sedimentary dock, between 6°24 ' and 6°33 ' north latitude, 2°18 ' and 2°22 ' east longitude,

it is limited by Godomey district in the south, by Akassato district in the north, by the lakeside municipality of Sô-Ava and Nokoué lake then in the east and by Togba district. It includes six districts namely: Agamadin, Agori, Gbodjo, Kanssoukpa, Sème and Tokpa-zoungo. Our study concerns three districts: Agamadin, Gbodjo and Tokpa-Zoungo. These districts cover the eastern part the city and follow Nokoué Lake (figure1).

Study methods: It is about a transverse study with descriptive and analytical aim. The methods were at the same time qualitative and quantitative. The study concerned the households situated in the structured districts, the local authorities (the heads of the districts and the head of each area) and the resource staff (hygiene and basic purification agents, the agents of the collective of the non-governmental structures of waste management and purification of the municipality of Abomey-Calavi (COSGAC). Desk study was carried out in order to obtain information and data along with the determination of the size of sample and with direct observations on the ground. i. The documentary research was made at the level of libraries, documentation centres, research institutions which activities are in connection with the theme of the present study and on the internet. It allowed us to tally up a number of

documents such as memoirs, theses, reports, magazines and maps. These documents allowed us to have information and data on the study area, on the themes concerning waste purification and management. ii. The size of the samples was determined by formula⁶.

$$n = Z\alpha^2 \times pq / i^2$$

n = Size of the sample, To have a level of confidence of 95% in the survey estimates (this means there would only be a 1 in 20 chance of getting a sample that produces an estimate outside the range $P \pm 10$, therefore, $Z\alpha = 1.96$.); reduced Ecart corresponding to a risk α of 5 %; P = Proportion of the households of three districts (n) compared with the number of households in the district of Abomey-Calavi (N); p = n / N, i = wished precision equal to 5 %, q = 1-p the number of households subjected to the investigation in these three districts is equal to 310. These 310 households were proportionally distributed between three districts according to the number of households. Thus 113 households were investigated in Agamadin, 43 in Gbodjo and 154 in Tokpa-Zoungo.

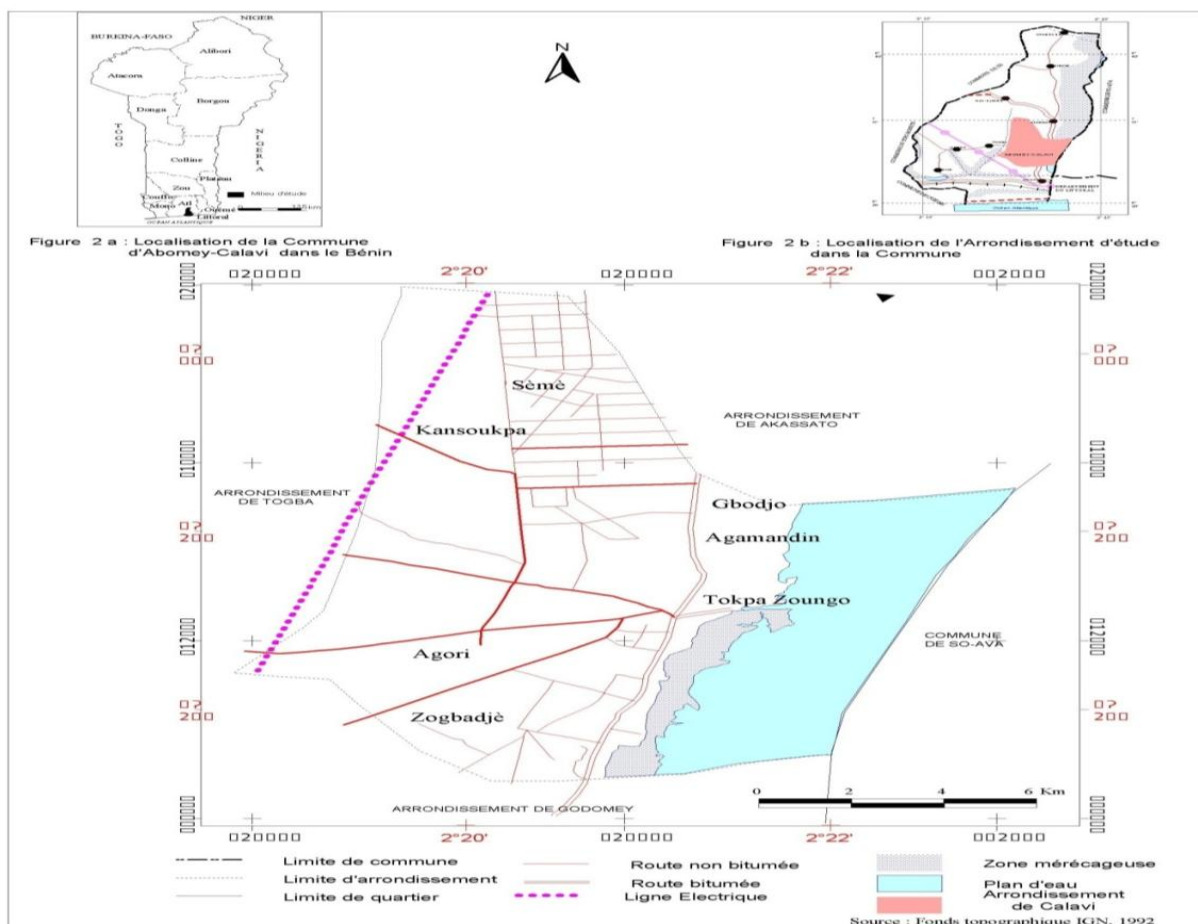


Figure-1
 Map of the study area

Ground investigations: they allowed to collect information regarding the households, the local authorities, the resource staff and of the association of garbage collection structures COSGAC, the size of the households, he practices connected to waste and waste water management, ehaviour and perception of households regarding hygiene and basic purification in the field of waste and waters management.

The data gathered are handled and analyzed using Epi info (version 3.3.2), Excel and Arc-View softwear.

Results and Discussion

Pre-collection of waste: Practices connected to waste management in houses: In the districts included in our study, the garbage is evacuated by the very households or by means of waste pre-collection structures through a monthly subscription whose price is between 2 and 3dollars. Our investigations prove that two (02) households in three (03) or (65.48 %) are not subscribed to garbage collection structures.

Among those unsubscribed households, nearly one (01) in three (03), granted 33.9 % directly evacuates the waste on open air isolated garbage dumps. The remaining 31.58 % and the subscribed households representing 34.52 % of our sample gather household waste in dustbin. These dustbins stay for four to five days with the non-subscribers and for three days with the subscribers before being evacuated. Most of the time the dustbins are worn out. They particularly consist in baskets, aluminium, iron or plastic buckets, cut paint or oil cans and bags. Most of them are not covered. According to the ground investigation, approximatively one in two dustbins (51.26 %) is covered. Dustbins are often full and big part of waste lies on the ground (figure 2a, 2b).



Figure-2b
Aspect of dustbin at Gbodjo

In spite of the lack of maintenance of dustbins observed in houses and illustrated by photo 1a and 1b, most of these dustbins are installed on the courtyards or very often near drinking water storage bowls, rooms, wells and the kitchens (figure3).

A similar observation was reported by Ali⁷ in a study on waste management in Parakou. He noticed that waste is directly evacuated in garbage dumps or gathered in worn-put recipients for two to three days a week then evacuated by households or garbage dump staff.

As shown on figure 1a, 1b and 3, these dustbins are not effective any more in suitably playing their role of collecting the garbage and purifying the environment but they are a problem for the environment and the health of the populations. Very fast they become a free medium for flies, mosquitoes and other insects then a source of pollution for drinking water which threatens the health of the populations⁸⁻¹¹.

Practices connected to evacuation of waste: Evacuation of household waste is the issue of households and garbage collection structures in districts. According to the results of field works, it emerges that non-subscribed households throw their waste on garbage dumps, the edges of public highways, along slums, in holes, bushes and gutters situated in courtyards, in front or at the back of houses or near buildings (figure4). As for pre-collection structures, the garbage collected from door to door by means of carts or vehicles are transported through districts and are discharged in wells and deserted toilets, in idle spaces, flooded streets and slums (figure5).

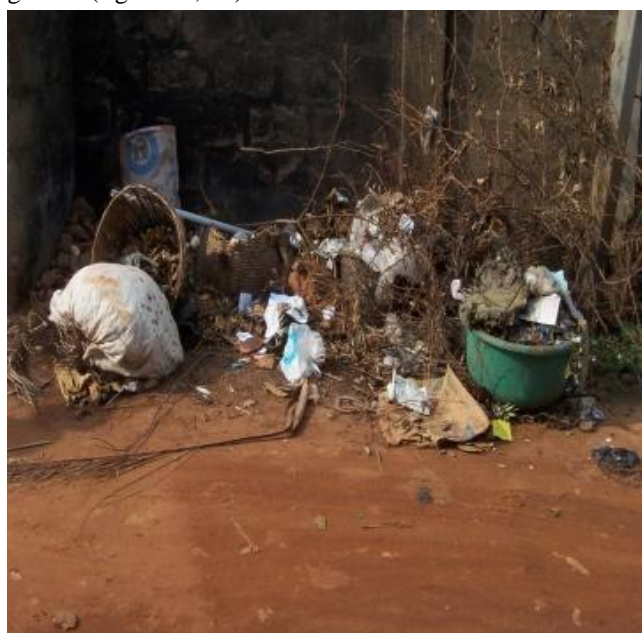


Figure-2a
Aspect of dustbin at Tokpa-Zongo

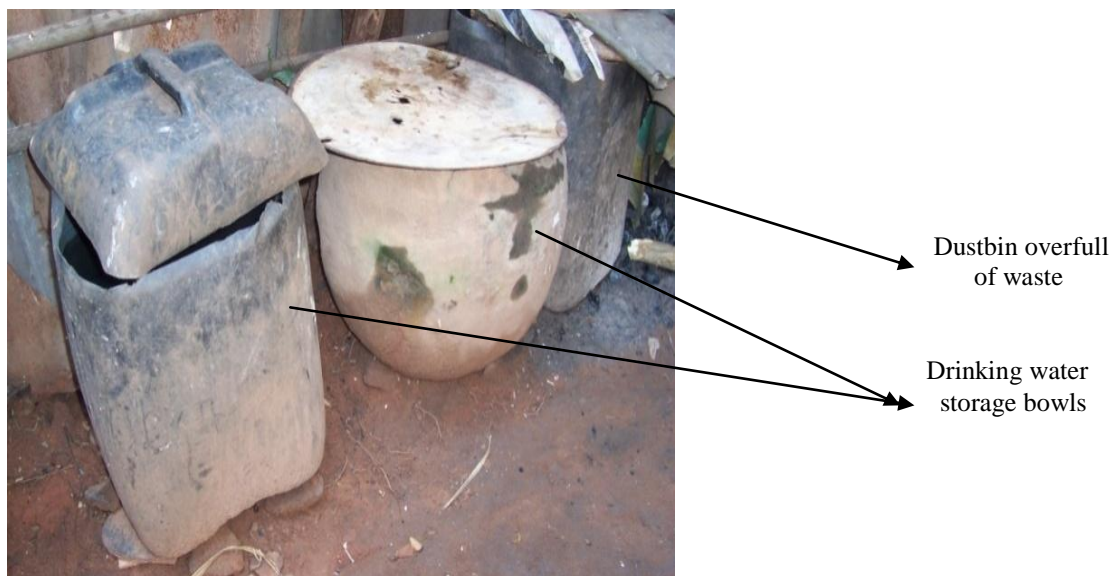


Figure-3
Dustbin next to drinking water storage bowls in Agamadin



Figure-4
Garbage dump created behind houses by the households



Figure-5
Garbage dump of pre-collect structures situated in a sandbank

This practice depicted in photos 3 and 4 shows that there is presence of a significant number of wild garbage dumps in the districts taken into account by the study. For most of the time these garbage dumps serve as depositing places for certain households.

This despicable situation strengthens the insalubrities in these districts, disturbs the populations by the nauseous smells and exposes them to multiple diseases especially during the rainy season. These garbage dumps created everywhere in the districts and especially around Nokoué lake are also sources of contamination for the groundwater and surface water. They also

trigger the filling of the lake and the flood which rages in certain houses of the districts concerned by the present study during the rainy season. This problem which continues in districts concerned by our study is connected to the lack of garbage tubs, of gathering points and final discharges.

These results are in agreement with those of Dossou O.V.¹² who noted that the structures in charge of garbage collection in the municipality of Abomey-Calavi collect household waste without considering their final destination. She also stressed that 98 % of the NGO-s in charge of waste management threw the garbage on isolated plots of land situated in suburbs or somewhere else,

in swamps closest to the collection areas, in flooded streets to block holes, in the old sandpits or abandoned yellow lands.

Our results are similar to those of Djigo A.A.¹ in Senegal who reported that the collection of household waste is a notorious problem in the district of Medina Gounass. The households in the district dig holes or throw garbage in flooded houses as a way of fillings. This manner of managing household waste is enrooted in the practices of most part of the populations belonging to developing countries. Thus correcting it will be a long-term job.

Techniques of waste treatment: In the districts studied, 35.16 % of the households which answered the questionnaire stated that they use the technique of slash-and-burn the field; 6.13 % bury the waste, 1.29 % exploits the garbage as fertilizer and 22.90 % use no methods (Figure2). During the rainy season a big part of the heaps of garbage abandoned in districts are transported towards the lake Nokoué by runoff waters. This is possible because of the orientation of the roads which generally follow the direction of slopes. This makes us observe small heaps scattered through districts. As for the structures of pre-collection of garbage, they practise only the technique of slash-and-burn field.

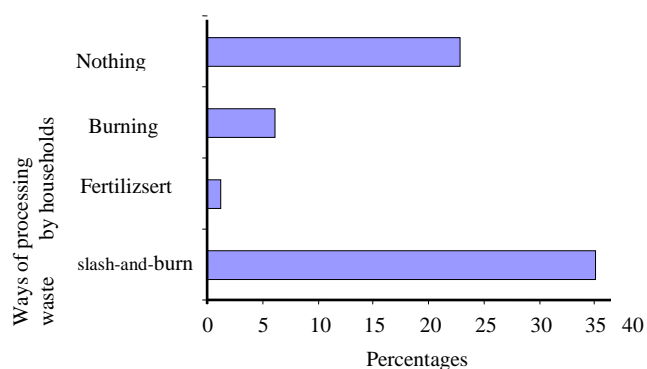


Figure-6

Ways of processing the waste by the households of the districts studied

Out of the observations of figure 2 it is remarkable that the technique of slash-and-burn field is the most used by households.

This choice adopted by most of the households is understandable by the fact that the latter consider it to be simpler and very easy and doesn't require physical efforts.

This technique which consists in burning heaps of garbage outdoors makes the houses dirty with the shards of glass and ash that invade their courtyards and rooms. These shards of glass and the ash infect the food and wells left open. The burned heap also releases smokes which propagate in the surrounding houses and bother the inhabitants. These smokes can contain gases such as HCl (hydrochloric gas), SO₂ (sulfur dioxide), H₂S (hydrogen sulphide) and carbonyl chloride which is very harmful to man. This state of things was notified by François Xavier, a local resident in the Tankpè district of Abomey-calavi.

He revealed that when the pre-collection agents start burning the garbage dump situated just behind his room, the thick fire lasts about ten days before going off and pieces of bottles end up in the house. For him the smell which is released and which they inhale daily makes them sick. The method of burying is practised by populations with the aim of filling the flooded roads as well as the plots of land generally situated in the slums and making them accessible for sale or building houses. The elevation system consists at first in putting the garbage on plots of land and then in covering them with laterite and some marine sand. This technique contributes to the pollution of ground and groundwater.

Evacuation of waste waters: Evacuation of waste waters stemming from shower: Sixty one point sixty one per cent (61.61 %) of the households investigated use catch basins to evacuate waste waters from shower, 9.35 % resort to holes of fortune, 28.39 % allow waters flow on the street and 0.65 % in the Sandbank as indicated in table 1.

According to table 1, more than half investigated households (61.61%) use catch basins to evacuate their waste waters from shower. But it is observed that out of the 61.61% households which use catch basins, 57.09% covered their catch basin while 4.52% left them open. From ground observations it is noticed that the so-called covered catch basins are generally covered in half with the paving stone or with corroded and drilled sheet metal. Others are covered with trunks of tree or with old sheet steels retained by bricks.

Table-1

Presentation of the means of evacuation of waste waters from shower according to different districts

Quartiers Districts	Means of evacuating waste waters from shower							
	Catch basin		Fortune hall		Overland flow		Sandbank	
	n	%	n	%	n	%	n	%
Agamadin	87	77	11	9.73	15	13.27	00	00
Gbodjo	20	46.51	07	16.28	15	34.88	01	2.33
Tokpa-Zoungo	84	54.55	11	7.42	58	37.66	01	0.65
Total	191	61.61	29	9.35	88	28.39	02	0.65

Source: Field study, 2011, %: Percentage, n: Size

As for the holes of fortune, 4.84% of households covered them either with corroded sheet steels or tree trunks whereas 4.51% leave them open. In a general way households do not take care of these means of evacuation of waters from shower. They are sometimes full and overflow on the roads. The water contained is often greenish or blackish and submerged by the flies and the mosquitoes.

In the case of the households which use neither catch basin nor hole of fortune, the water from shower streams on the roads. All these means contribute at different levels to the degradation of living environment of the households.

This defect of purification of waste water in the studied districts can be justified by: the insufficiency of purification works (catch basins, used water purification plant), the lack of compliance by households with the standards of purification and the bad policy of the municipality authorities regarding hygiene and basic purification.

Evacuation of sewage from washing dishes and laundry: The places of sewage disposal in the districts studied are: courtyard (56.45 %), catch basins (15.48 %), holes of fortune (4.52 %) and other places, 23.55 % (figure 7).

According to the figure 7, the majority of the households in the districts taken into account by the present study throw their waste water stemming from dishes and laundry in the courtyard. These waste waters and all they contain as rest of food are evacuated in the open air without any processing treatment. They eventually end up forming nests of mosquitoes and flies. Pets come to these places to feed. This way of managing waste water pollutes the environment.

Our observations accord with those of Adjahi T.P.¹³ and Kèkè^{14,15} in Calavi who reported that waste water from toilet, kitchens and laundry is rejected by households on the roads or towards spaces not yet occupied by pipes or transported and thrown directly on free spaces or on the public highway.

Our results also confirm with those of Vincy M.V.¹¹ in the village of Abobo-Baoulé in Ivory Coast. He underlined that the village does not arrange purification service. The main way of sewage disposal in this village consists in open latrines, nature, gutters and drains. This explains the insufficiency of cesspool emptiers trucks.

Conclusion

In the light of the results recorded, it can be mentioned that the district of Abomey-Calavi encounters a very high demographic growth rate. The population boom of this district is especially due to the hospitality of its site and to the overdevelopment of the city of Cotonou. This triggers an enormous amount of problems regarding management of household waste and waste water. In the districts of Tokpa-Zoungou, Agamadin and Gbodjo, the problem rises acutely. This is connected to the presence of the slums which are used as garbage dumps for households as well as for pre-collection structures, in the topography of the environment which causes the flow of run off water leaving heaps of garbage almost everywhere in the districts studied. This situation is also connected to the lack of compliance with the conditions of public hygiene, to the behaviour of households regarding the pre-collection, the evacuation and the methods of waste water treatment, and to the lack of maintenance of purification works. Thus in these districts one of the major challenges remains the problem of hygiene and basic purification for the welfare of the populations with a precarious living standard.

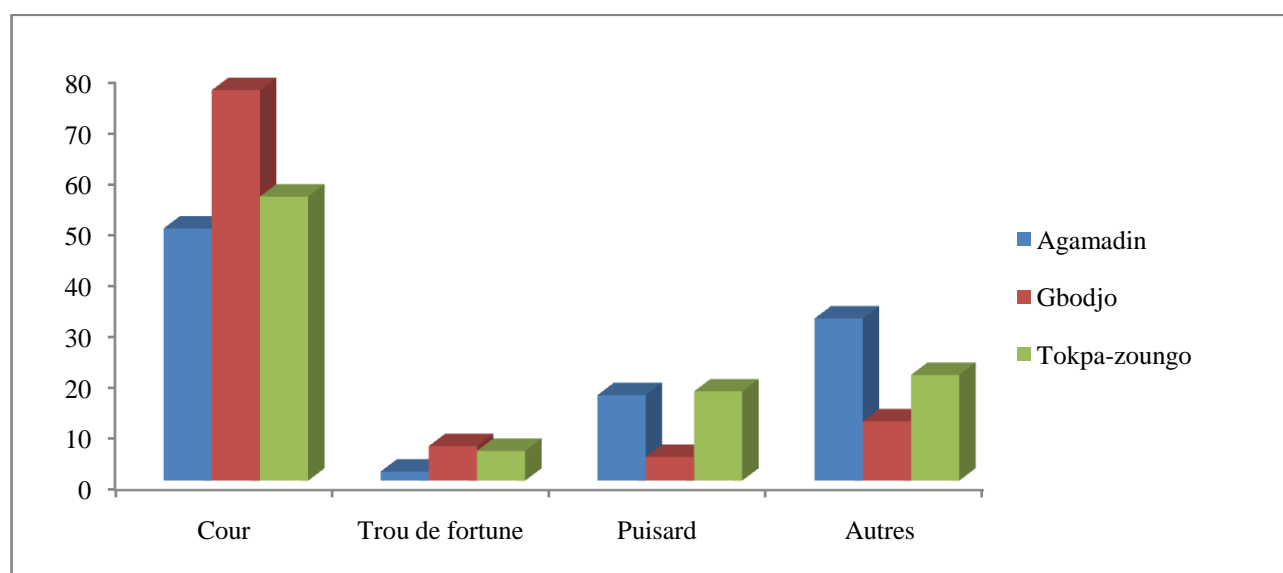


Figure-7
Places of evacuation of sewage from dishwashing and toilets by district

References

1. Djigo A.A., Cleansing of worn water and its impact on the socio-medical situation of the populations of Médina Gounass, Memory DEA/University of Lubumbashi, 61 (2005)
2. Insaë Rgph1, The Atlantic population, villages and city districts, 10 (1988)
3. Insaë Rgph2, The Atlantic population, villages and city districts, 8 (1994)
4. Insaë Rhph3, General Census of Population and Housing, 3rd Edition, in 5 Summary of results, 11 (2002) www.e-geopolis.eu/IMG/pdf/FicBen0708.pdf
5. Gardien-ngo Marie Abomey-Calavi, Identification and evaluation of the supports to be brought to the underprivileged districts retained by the communes of Abomey-Calavi, Kandi and Lokossa, 60, (2007)
6. Schwartz D., Statistical methods for use by doctors and biologists 4th edition, Medical Publishing Flammarion, Paris, 314 (1995)
7. Ali I., The management of domestic and industrial waste with Parakou, Master's paper DGAT /FLASH /UNB, 161 (1995)
8. Tiwari Seema and Tripathi I.P. Lead pollution -an overview, *Int. Res. J. Environment Sci.*, **1(5)**, 62-68 (2012)
9. Devi Priyamvada, Sirisha D., and Gandhi N., Study on the Quality of Water and Soil from Fish Pond in Around Bhimavaram West Godavari District, A.P., INDIA, *Int. Res. J. Environment Sci.*, **2(1)**, 58-62 (2013)
10. Kinsiclounon Eustache G., Edoth Patrick A., Guedenon Patient, Deguenon Yvette, Sossou Bernard, Dougnon Victorien T., Loko Frederick and Boko Michel, Risks of Drinking Water Contamination by Chemical and Organic Substances in the Lakeside City of So-Ava in Benin Republic, *Int. Res. J. Environment Sci.*, Vol. **2(1)**, 1-9 (2013)
11. Vincy M.V., Brilliant Rajan and Pradeep Kumar A. P., Water Quality Assessment of a Tropical Wetland Ecosystem with Special Reference to Backwater Tourism, Kerala, South India, *International Research Journal of Environment Sciences*, **1(5)**, 62-68 (2012)
12. Dossou O.V., Contribution of strategic environmental assessment in planning: the case of the master plan of the plateau of Abomey (RB), Thesis memory, FLASH / UAC, 348 (2005).
13. Adjahi T.P., Study of the degradation of urban sites: Case of Abomey-calavi, Masters thesis DGAT / FLASH / UNB, 70 (1994)
14. Kèkè E., Erosion stormwater in urban areas: Case of the town of Abomey, Aspects, Impacts and Control Methods, Masters thesis, DGAT / FLASH / UAC, 88 (2002)
15. Yadav Janeshwar, Pathak R.K. and Khan Eliyas, Analysis of Water Quality using Physico-Chemical Parameters, Satak Reservoir in Khargone District, MP, India, *International Research Journal of Environment Sciences*, **2(1)**, 9-11 (2013)
16. Diabagate S., Assainissement et Gestion des ordures ménagères à Abobo (v2) : cas d'Abobo-Baoulé, Mémoire de Maîtrise IGT 96 (2006)
17. Agamuthu P., Solid waste: principle and management, Kuala Lumpur: University of Malaya Press (2001)
18. Agamuthu P. and Fauziah S. H. MSW disposal in Malaysia: landfill management. Published in Proceedings of the 2nd Expert Meeting on Solid Waste Management in Asia and the Pacific Islands, Kitakyushu, November 23-24, (2006)
19. Agamuthu P., Hamid F.S. and Khidzir K., Evolution of solid waste management in Malaysia: impacts and implications of the solid waste Bill 2007, *Journal of Mater Cycles Waste Management*, **11**, 96-103 (2009)
20. Ayotamuno J. M. and Gobo A. E., Municipal solid waste management in Port Harcourt, Nigeria: Obstacles and prospects, Management of Environmental Quality: *An International Journal*, **15(4)**, 389 – 398 (2004)
21. Dako S., Problems of cleansing in urban environment: case of the Ladji district in Cotonou. Memory of CAPES/University of Abomey-Calavi, 51 (2007)
22. Doka M., Management of household waste in Abidjan. Masters thesis, IGT.158 (1990)
23. Fauziah S. H., Simon C. and AGAMUTHU P., Municipal solid waste management in Malaysia – Possibility of improvement?, *Malaysia Journal of Science*, **23(2)**, 61-70 (2004)
24. Gardien-ngo Marie Abomey-Calavi, Assistance with the placement of the composition C in the new underprivileged district Tokpa-Zoungo of the town of Abomey-Calavi, 42 (2007)
25. Hadjibiro K., Dermatas D. and Laspidou C., Municipal solid waste management and landfill site selection in greece: irrationality versus efficiency, *Global NEST Journal*, **13(2)**, 150-161 (2011)
26. Haferkamp B.H., Burmester I. and Goede M., New identification and sorting strategies for solid waste management and a closed-loop recycling process, Proc. 5th Int. Conf. on Environmental Science and Technology, Vol. A, University of the Aegean, 186-193 (1997)
27. Jalil A., Sustainable Development in Malaysia: A Case Study on Household Waste Management, *Journal of Sustainable Development*, **3(3)**, 91-102 (2010)
28. Sane Y., The management of waste in Abidjan, a recurring problem and apparently unresolved, 105 (1999).
29. Nasi H., Theng L.C. and Rahman M., Solid waste management – what is the Malaysian position? Published in Proceedings of the National Seminar on Environmental Management: Issues and Challenges in Malaysia, Bangi, Malaysia: National University of Malaysia, July 25-26, (2000)
30. Tsiligiannis C., Kavvadas C., Kornaros M. and Lymberatos G., Comparative assessment of solid waste treatment and disposal technologies and sites for Attica. Proc. 5th Int. Conf. on Environmental Science and Technology, Vol. A, University of the Aegean, 138-145 (1997)