



Maria Kondra

The status of the wetlands in the Greater Accra Region

WaterPower Working Paper Volume No. 9



WaterPower Working Paper Series

WaterPower Working Paper Series

ISSN (Print) 2510-0521

ISSN (Online) 2510-2222

Governance and Sustainability Lab

Faculty VI - Regional and Environmental Sciences

Trier University

Suggested Citation: Kondra, Maria (2016): The status of the wetlands in the Greater Accra Region. WaterPower Working Paper, No. 9. Governance and Sustainability Lab. Trier University. Trier.

Authors' contact

Maria Kondra
kondra@uni-trier.de

Abstract

The main socioecological pressures in five wetlands in the Greater Accra Region were first identified and then summarized by reviewing the relevant literature. As a second step, fieldwork in the region was carried out in 2016 to further examine the pressures identified in literature. Most research on the wetlands in Ghana was published around the year 2000. Yet, similar socioecological pressures were to persist today. Based on both, fieldwork observations and the literature review, these pressures were ranked using the IUCN pressures system analysis framework. It is suggested that further research needs to proceed with uncovering how trade-offs between the ecosystem and the quality of life can be defined.

The status of the wetlands in the Greater Accra Region

Maria Kondra

1	Introduction	1
2	Methodology	2
3	Growing threats to the wetland ecosystem	3
3.1	Literature analysis of pressures in the wetlands	3
3.1.1	Densu Delta Wetland	3
3.1.2	Muni lagoon	5
3.1.3	Sakumono lagoon	6
3.1.4	Keta lagoon	7
3.1.5	Songor lagoon	8
3.2	Field work analysis of pressures in the wetlands	11
3.2.1	Densu Delta wetland	11
3.2.2	Sakumono lagoon	12
3.3	Direct pressures of wetland degradation	13
4	Outlook	14
5	References	15

1 Introduction

The five wetlands in Greater Accra Region lie within a dry equatorial climatic region, that covers the entire coastal belt of the country (Finlayson et al. 2000). The area falls within the low annual rainfall zone, with two mild rainfall seasons in June and September (Oteng-Yeboah 1999; Nyame et al. 2012). The approximate mean annual rainfall is 800mm (Nyame et al. 2012). Table 1 provides an overview of the five wetlands in Accra.

The five wetlands provide important nesting grounds for thousands of migratory birds, marine turtles, fish species, and plants. In addition, the surrounding communities obtain their main income from the wetlands. Coastal wetlands that usually have extensive mangrove stripes also mitigate coastal disasters such as storms and flooding (Kumi et al. 2015). In general, wetlands are an important source as well as a sink for regional surface and groundwater (Richardson 1994). Under healthy conditions, wetlands possess the unique attribute to process point-source pollution, diminish the negative impacts of water pollution, and thus provide communities with clean water (Faulkner 2004). Furthermore, tourism in the wetlands can generate revenues and new jobs (Kumi et al. 2015).

Ghana joined the Ramsar Convention on Wetlands in 1988 (Nixon, 2007). The five wetlands located in the Greater Accra Region became designated Ramsar sites in 1992 (Table 1). These wetlands are situated in very densely populated areas and subject to intensive resource exploitation (Ntiama-Baidu, Gordon 1991).

It is not immediately clear and distinguishable who manages and protects the wetlands in Ghana. Nonetheless, certain policies and legislative instruments exist that aim at protecting the wetlands. Overall, Ghana is a party to several international conventions for the protection of wetlands, and the Ramsar Convention is just one of them (Ministry of Lands, Forestry & Mines 2006). Moreover, it is important to note that the wetlands obtained the status as a Ramsar site only due to the protection of the seashore and the Palearctic bird population that migrate there during the northern winter (Willoughby et al. 2001). At the national level, the Wildlife Division of the Forestry Commission is the main governmental institution responsible for the management of the wetlands. Since the Ramsar Convention advises each country to form a National Wetlands Committee, Ghana established a committee of five experts from different institutions. Yet, there are no official records defining the roles of this committee in the protection of the wetlands. Further institutions involved in management of the wetlands are the Centre for African Wetlands, the Council for Scientific and Industrial Research, the Environmental Protection Agency, the Volta River Authority, the Irrigation Development Authority, the Water Resource Commission, but also the district, municipal and metropolitan assemblies, and several NGOs (Ministry of Lands, Forestry & Mines 2006).

Several national policies and legislations adopted the wise use of wetlands. Since they are very scattered, it is very difficult to summarize them all at this

point. Few of them are very old and therefore fail to address the current challenges (Ministry of Lands, Forestry & Mines 2006).

The Ministry of Lands, Forestry and Mines claims that strong traditional management system of the wetlands and their resources still exist in Ghana. This traditional management involves customary laws and taboos, which regulate access to land and resources in the wetlands (Ministry of Lands, Forestry & Mines 2006).

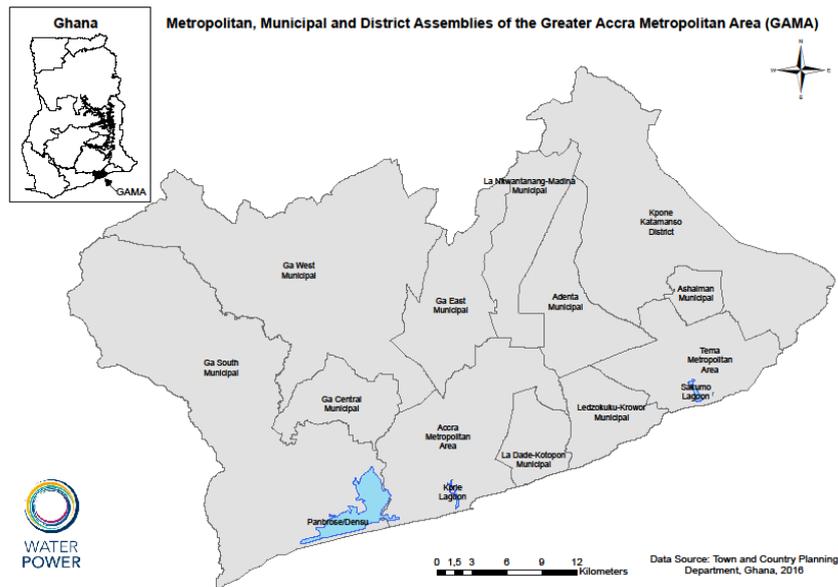


Figure 1: The Greater Accra Metropolitan Area (GAMA) with two wetlands which were visited during the fieldwork.

Source: Cergis, RS/GIS lab-UG (2015)

2 Methodology

The main objective of the Work package 2b within the WaterPower project (www.waterpower.science) is to assess the interlinked dynamic processes, pressures and management practices within the aquatic ecosystems (with a focus on wetlands) by studying interactions between human agents and ecological processes in urbanized regions. Today, land use change is recognized as one of the main human-induced variations of pressures on ecosystems (Kaczorowska et al. 2015). Thus, the purpose of this Working Paper is to assess the different land use forms and pressures on wetland ecosystems in Greater Accra Region. A literature review helped to analyze and summarize these pressures based on existing knowledge. The focus of the literature review was placed on five wetlands located in Accra. The pressures identified through the literature review were compared with the onsite-observations during a pilot study. In total three out of five wetlands were visited within the Greater Accra Area (see location of the wetlands in Figure 1). However, due to the relatively short duration of the fieldwork, it was only possible to

dedicate one day to the Muni lagoon during the pilot study. Therefore, the Muni lagoon is excluded from the pressures assessment in this working paper.

The main land uses and pressures in and around the wetlands were first summarized by screening available scientific articles and official reports. Only peer reviewed articles and official gray literature (e.g. World Bank reports) were taken into consideration. With the information obtained through the literature review, a first fieldwork trip (03.07-16.07.2016) was carried out. For the preliminary assessment, localization and quantification of major pressures causing degradation in wetlands ecosystems, a ground-truthing approach was chosen as a reliable method. Ground-truthing allowed taking data-points in the respective study area and describing land cover types, thereby gaining an overview of specific on-site-conditions. Moreover, a transect walk helped to get a first impression of land use systems and their biophysical as well as socio-cultural characteristics in order to quantify the socioecological pressures in the wetlands.

The exploration of the pressures was done in accordance with the “Pressures and threats system analysis” approach that was developed by IUCN for the assessment of national parks in Ghana (Figure 2). The pressures for each location were then identified and rated. Each threat is assigned a score between 1 and 64. The result is determined by extent (scale 1-4: localized, scattered, widespread, throughout), impact (scale 1-4: mild, moderate, high, severe) and permanence (scale 1-4: short term, medium term, long term or permanent) of a pressure. A pressure score between 1-4 is weak, 4-9 moderate, 12-24 high and 27-64 severe (IUCN/ PACO 2010).

3 Growing threats to the wetland ecosystem

3.1 Literature analysis of pressures in the wetlands

3.1.1 *Densu Delta Wetland*

With an area of 5,893ha and its central location within the city, the Densu delta is one of the most important wetlands in Accra. The main river that drains into the Densu Delta wetland is the Densu River. The wetland has no direct connection to the sea, but during the rainy season, the lagoon is often flooded and discharges into the sea, while seasonal flooding brings detritus, nutrients and pollution (Osei et al. 2010). The river is controlled by the Weija dam, that is located approximately 11km upstream, interrupting the water inflow during the dry season and causing severe flooding of the area during the rainy season. The dam retains sediments, and the blocked inlet reduces the overall water volume (Appeaning Addo et al. 2008). The suspended sediment supply also causes extensive erosion in the shoreline of Accra (Oteng-Yeboah 1999).

The lagoons of the Densu Delta belong to inhabitants of James Town and are controlled by Ga traditional authorities and the Accra Metropolitan Authority. A great variety of fishing methods are employed in the Densu delta, resulting in severe exploitation of fish stock. During the opening of floodgates of the Weija dam, fishing in the Densu Delta becomes impossible. Overall, the elderly fishermen report a decline in fish and the size of the fish (Oteng-Yeboah 1999).

The periodic spills from the Ghana Water Company (GWC) of the Weija dam in addition to flooding cause severe destruction of houses and property (Oteng-Yeboah 1999). Pollution is one of the major threats to the Densu Delta wetland. Human waste pollution is increasing since a majority of the population in the region has no access to adequate toilets (Ntiamoah-Baidu, Gordon 1991; Oteng-Yeboah 1999). Disregarding that the wetland is under Ramsar protection, household waste is indiscriminately dumped into the wetland (Osei et al. 2010).

In addition, the Oblogo Landfill is located directly on a slope bordering on the Densu Delta wetland, where 1,250tons of solid waste are discharged on a daily basis (Osei et al. 2011). The Densu River is located just 250m away from the landfill, causing a leakage of pollutants into the wetland (Nyame et al. 2012; ESSUMANG et al. 2009; Tuani 2008). The Oblogo landfill site was decommissioned in 2012 and is now an open dump in close proximity to the wetland. Both, harmful-organic and non-organic pollutants (liquid and solid) can be found in the landfill (Nyame et al. 2012; ESSUMANG et al. 2009; Tuani 2008). Frequent burning of waste is an usual disposal method (ESSUMANG et al. 2009). The risk of groundwater contamination with heavy metals is very high since there are no groundwater protection measures in place (Keelson 2014). As a result of the waste disposal and pollution, relatively high pH-values that contribute to high alkalinity were detected in the Densu River. High alkalinity is a result of high organic content in the water. Thus, algal blooms can occur creating oxygen depleted zones (Osei et al. 2011). Many local communities withdraw the contaminated water from the Densu River for domestic use both upstream and downstream of the landfill (Oteng-Yeboah 1999).

In addition to these pollution pressures, encroachment presents another threat to the wetland. The rate at which current housing encroachment happens is alarming. Many new houses are built directly in the wetland, and some are adjoined to the saltpans. Large-scale estate and property developers such as Vanderpuye-Orgle Estates Ltd. own large parts of land in and around the wetlands (Oteng-Yeboah 1999). The housing encroachment along the slopes of McCarthy Hill has also caused serious vegetation loss, erosion and sediment gain in the Densu wetland. Moreover, with the increasing housing development in and around Accra, soils as well as sands are being extensively mined for building activities (Oteng-Yeboah 1999). A number of hotels were constructed in the swampy and marshy surroundings of the wetlands, even if property developers usually have no building permits. Most of these facilities have no sewage system, and waste is dumped directly into the wetlands or the sea (Boafo et al. 2014). Directly in the wetlands, salt mining

is practiced by the Panbros Salt Company, which is considered as a core economic activity in the wetland. The total area used by the company is 1.130ha of which 784ha are salt pans (Oteng-Yeboah 1999).

Another important socioecological pressure is the deforestation of mangrove forest, mostly to obtain fuel wood or building materials. However, so called "acaday" - fishing is also practiced in the delta, where branches of mangroves are used to build fish traps (Oteng-Yeboah 1999). Access to fishing is not officially restricted, and merely controlled by informal taboos and other customary rules (Oteng-Yeboah 1999). Land is either privately or commonly owned, but if needed areas can easily be accessed by the Chief Fishermen of the local villages. Nevertheless, conflicts between different actors and sectors, for example between artisanal and industrial fishing, are a regular occurrence. These resource conflicts are normally attempted to be solved with the help of the Community Based Fisheries Management Program that works parallel to traditional institutions (Benett et al. 2001).

3.1.2 Muni lagoon

The Muni wetland is mainly important to the local Efflu people, who practice traditional hunting (Koranteng et al. 2000). The most hunted animals for human consumption are mammals. Fifty seven percent of the population consumes bush meat on a regular basis in Ghana. Commercial bush meat hunting tends to be a common economic activity in the wetland area, while in-migration leads to severe resource exploitation. Especially young hunters disregard sustainable hunting methods and use illegal methods such as starting bushfires, using chemical poisoning, and using shotguns. During the local "Aboakyir" festival, bush meat is hunted extensively, leading to severe natural resource exploitation (Gordon et al. 2000).

In addition, one of the other main economic activities in the Muni lagoon is artisanal fishery. During the rainy season fishing becomes impossible due to the increasing water depth of the wetland (Koranteng et al. 2000). Fishing provides the local communities with an income of about 200 US\$ per year per household (Gordon 2000)

The main fishing community on the beach at Akosua Village consist of migrant Ewe fishermen who originate from the coast of the Volta region (east of Ghana) (Gordon 2000). Due to cultural taboos, fishing is prohibited on Wednesdays. The use of drag nets, nets of mesh sizes below 25 mm and canoes is prohibited as well and only indigenous people are allowed to fish in the lagoon (Entsua-Mensah et al. 2000). Nixon et al. (2007) nonetheless suggest that the local communities do no longer respect traditional customs, mainly because of the migration of fishermen. Still, in some of the studied sites they found that a few customs were still respected (Nixon et al. 2007).

Another economic activity in that region is farming, both on subsistence (62.2%) and commercial (37.8%) bases. Mainly grains and vegetables are cultivated in and around the wetland. It appears that farming is undertaken

without any consideration to sustainable land use practices, since large tracts of forest were cleared (Koranteng et al. 2000).

Bushfires, which can be either natural due to dry land coverage or anthropogenic origin, were reported from late November to early February. Bushfires have direct as well as indirect negative effects, especially on small mammals, whose habitat, nesting and food sources are destroyed in case the fires are not immediately lethal (Lampsey, Ofori-Danson 2014).

3.1.3 Sakumono lagoon

The Sakumono wetland is located between Accra and Tema, two urban centers that show some of the highest urbanization rates in the entire the coastal region of Ghana (Nonterah et al. 2015).

Two rivers, the Dzorwulu and the Mamahuma, supply the wetland with water (Table 1). On both rivers, dams are constructed while water is used for irrigation and livestock husbandry. Both rivers are heavily polluted due to domestic waste disposal (Nartey et al. 2011; Tay et al. 2009). On the Dzorwulu stream, a dam is located north of Ashaiman town near Santeo. On the Mamahuma stream, a dam is located on its upper catchment (Nartey et al. 2011). Due to extensive damming, the lagoon does not receive enough water during the dry season (Nartey et al. 2011), and shows high salinity ranges between 30‰ and 41‰ (Agyepong 1999). As no staff gauges were installed in the Sakumono wetland and lagoon, it impossible to estimate the water level changes throughout the years (Nonterah et al. 2015).

Eighty percent of the communities around the Sakumono lagoon have access to piped water, while only 22% use public dams, wells, boreholes and ponds (Agyepong 1999). The access to domestic waste disposal is scarce. People are using lagoon fringes, seashores and bushes. Forty-four percent of the people have no access to toilet facilities and are therefore forced to defecate in the open (Agyepong 1999).

Fuelwood is harvested on a large scale; the primary savanna vegetation has been almost cleared. The wood is mostly sold for household cooking and for commercial uses such as fish smoking, but in small scale also for commercial charcoal burning (Agyepong 1999).

Generally, fishing is one of the major economic ventures in the Tema district. Artisanal, semi-industrial and industrial fishing activities are prominent (Sal Consult Limited 2015). Tilapia is the most dominant fish caught in the lagoon. However, the fish population is declining, most probably due to over fishing. The main fishing method is casting and dragging. The traditional ban period for fishing is from November to March, but illegal fishing still occurs during that period (Agyepong 1999).

The Tema port is located approximately 1km to the north-west of the Sakumono lagoon. 150 vessels operate from the port. The construction of a new seawall in the port might change the sediment transport and permanently deprive the lagoon of its estuarine characteristics. Pollution in the port

environment is quite high and may result from several sources such as vessel oil spills, disposal of industrial effluence from nearby industries, the use of anti-fouling paints, the discharge of ballast water, and sewage from human settlements (Sal Consult Limited 2015).

Agriculture is not very common in the area and only 36% of the people are involved in farming activities (Agyepong 1999). The land is mainly used for rice, cassava, and vegetable cultivation (Sal Consult Limited 2015). Farms are quite small, with average land holdings between 0.5 and 2.0ha. Most of the farmers do not own the land they cultivate. The use of agrochemicals is also rather low (Agyepong 1999). Most agricultural activities are situated in the northern part of the wetland, but also along the banks of the rivers, that deliver the main fresh water income to the wetland. A new trend of converting agricultural land to real estate is observed (Agyepong 1999).

3.1.4 Keta lagoon

Due to lack of jobs, many people who live around the Keta lagoon were pushed into fishing, thus increasing the pressure on the ecosystem. Marine and lagoon fishing, salt mining and vegetable farming are the main occupations of the people in the southern area, while one can find mainly farmers and fishermen along the rivers and channels in the northern part of the lagoon. Based on the results of a study undertaken in 1998, about 88% of the people are engaged in fishing as their livelihood activity. The main species caught are tilapia, which fisher women sell locally as well as in Accra. Fishing also has cultural and religious value to the communities who live around the wetland. Few fishing bans were enforced for example a one week ban before the fishing season, but they were never really accepted by the communities (Dankwa et al. 2004). The southern part is famous for its shallots and market gardening, where large quantities of onion and okra are produced. Cultivation practices are generally unsustainable, and include the use of fertilizers and pesticides, especially in the Anloga and Woe areas, where shallot and vegetable farming are the major livelihood activities. Most farmers have a secondary occupation to supplement their income (Dankwa et al. 2004).

The Akosombo and Kpong dams were constructed in 1964 on the Volta River to provide electricity, but cause a loss of littoral sediments (Boateng 2009; Tufour 1999). The reservoir behind the dam is a potential source of water supply for Accra and parts of eastern region. The channels which connect the Keta and the Songor lagoons have been silted and blocked, and now disrupt the direct and natural drainage system which used to regulate the lagoon water level (Tufour 1999). A large seawall project "Keta Sea Defense" was built in 2001 and 2002 with the aim to intercept the reduced, yet significant littoral sediment drift between Keta and Hlove in order to possibly halt the sediment loss. Available secondary data on Keta area are fragmented and incomplete, and do not provide sufficient knowledge on physical processes of Keta's coast that might allow for a critical analysis of shoreline manage-

ment. It is obvious that the sediment discharge from the Volta and the continuous erosion of the sandy Quaternary formation west of the Volta dominate the sediment supply to the beaches and littoral strip along the coast. The entire area is under high flood risk due to the extremely low-lying sea-front and hinterland of the Keta lagoon strip (Boateng 2009).

In the Keta Lagoon, hunting of protected birds has increased over the past few years. A recent study showed that the water bird population has declined by 63.1% during the last 20 years (Lampsey, Ofori-Danson 2014).

In the upper part of the Keta catchment 60% of communities surveyed by CDS (1985) defecated freely whereas 39% of the settlement had a traditional pit latrine. Considering the shallowness of the groundwater resources, the chances of contamination are very high (Finlayson et al. 2000).

Moreover, the mangrove trees are heavily exploited for fuel wood. Most stands with stacks of mangrove wood can be found along the main road from Srog'r to Keta (Tufour 1999).

3.1.5 Songor lagoon

In 1964, the Akosombo dam was constructed to regulate the Volta river. Thus, the water inflow into the Songor lagoon has been reduced. Today, the main water input comes from rainfall and water run-off. During the rainy season, the lagoon gets often flooded, leaving it hyper saline in the dry season (Ntiama-Baidu, Gordon 1991).

The recent study by Adu-Kumi (2015) revealed that around 50% of the people in the lagoon are engaged in fishing as their main source of income. Around 28% are also involved in crop production, and about 12% in salt production. Overall, 72% of the respondents confirmed that the wetland provides financial income to them, while 28% of the people stated that they rely on the food sources delivered by the wetlands. The majority of the interviewed persons indicated that they prefer to build in the wetlands due to the available land. Moreover, the residents said that the land they were building on was reclaimed with sand before they started (Ntiama-Baidu et al., 1996). It was also found that 60% of the residents who own a house in the wetlands inherited it, 12% purchased it, and 28% leased it. According to the residents, obtaining a spot for construction purposes is relatively easy (Kumi et al. 2015).

Concerning socioecological pressures, it has been observed that the vegetation in the area has been cut down, and that parts of the lagoon are heavily polluted with solid waste. Thus, the communities around the wetland have become highly vulnerable to flooding (Kumi et al. 2015). The mangrove forest is also being deforested due to land use pressure, the need for fuel wood, and the creation of fields for salt winning (Quashie, Oppong 2006).

In general, the Keta and Songor Lagoons have the highest concentration of artisan salt production. For the salt winning activity, the lagoons are allowed to dry up completely every year. Thus, the lagoons are very saline and salt can easily be harvested. Vacuum Salt Works Industry is doing the salt mining

in this area and is responsible for temporarily opening of the lagoon to the sea (Finlayson et al. 2000).

Table 1: A descriptive overview of five coastal wetlands in Accra

Description	Densu	Muni	Sakumono	Keta	Songor
Location	11km south-west of Accra	Near Winneba/ Central region (56 km away west from Accra)	3 km west of Tema district	Dangme East District (Greater Accra region)	
			Bound in the north to the Yeku - A Forest Reserve established in 1937, on the south it is bound by the Atlantic Ocean, to the west by the Mankwaafa, Brounye and Boaku rivers and to the east by the river Ayensi and Pratu stream (Wuver & Attuquayefio, 2006).	Interconnected to the Avu lagoon in the north and also to the delta of the Volta River through series of interconnecting streams (Tufour, 1999).The Lagoon is separated from the sea by a narrow coastal rim (Ntiamao-Baidu & Gordon, 1991) and gets overwashed just in the periods of high tides (Lamptey & Ofori-Danson, 2014).	Lies within the Dangme East District of the Greater Accra Region (Kumi, Kumi, & Apraku, 2015).
Wetland type	Closed to the sea, lagoons, freshwater marsh, salt pans, scrub, coastal sand and dunes, few mangrove islands	Closed to the see (during rainy season villagers open an entrance to the sea through digging a canal in the sand-banks), the lagoon is shallow and saline, coastal savanna vegetation zone with flood plains (mangrove and wetland vegetation), sand bar (dune), riverine vegetation, marginal forests, grassland, thicket islands, savanna trees	Semi-open lagoon (due to the construction of two parallel culverts which keep the lagoon in a stage between open and closed (Tay, Asmah, & Biney, 2009), alluvia plain, brakish water, area has limited groundwater availability due to low rainfall and impermeability of underlying rocks	Open lagoon, sand dunes, 23 inhabited and uninhabited islands in the western part, a small corridor of mangrove trees at Totokpoe (Ntiamao-Baidu & Gordon, 1991), Towards the coast the elevations are lower and are even below the sea level at some locations (Tufour, 1999), in the wet season its water depths range between 0.47 to 0.94m and in the dry season between 0.14 to 0.56m (Lamptey & Ofori-Danson, 2014), in the dry season large areas of the lagoon and marshlands dry up, leaving small ponds of hyper-saline water (Tufour, 1999)	Open lagoon, ca. 20 km along the coast and goes 8km inland behind a narrow sand dune, the lagoon dries out in the dry season and a passage needs to be opened to let the sea water come in
Size of the Ramsar catchment area (ha)	5,893	9,461.1	1,364.1	101,022.7	51,133.4
Estimated Population of dependence on Ramsar Sites (National population and housing census 2010)	485,700	442,550	141,500	506,980	523,180
Incoming rivers streams	Densu river	River Muni and Pratu	Mamahuma-Onukpawahe (west), Dzorwulu-Gbagbla-Ankonu (north)	Receives fresh water from large catchment areas: run-off from Todzie river, which originates from the Akwapim-Togo ranges; run-off from the Aka and Belikpa catchments, which enters the lagoon from the north; inflows from the Volta estuary through Anyanui creek (Lamptey & Ofori-Danson, 2014).	Avu lagoon (north) and to the delta of the Volta River (Anyanui creek), run-off from Todzie river (Akwapim-Togo range), run-off from Aka and Belikpa catchment (north)The lagoon has no perennial inflowing streams, it can dry out much faster than the Keta lagoon (Ntiamao-Baidu & Gordon, 1991).
Bird population	57 bird species with total population of 35 000	42 species with total population of 35 000	70 waterbird species with total population of 30 000	72 species with total population of 100 000	23 inhabited and uninhabited islands (Kumi et al., 2015).
Communities	Aplaku, Tetegbu, Bortianor, Panbros, Weija and is under control of the Ga (dominant group) (Wulomei), Ewe (along the shoreline)	Fanti (the dominant group), Efflu, Efetu, Gomoa (own the land), Efutu (own the lagoon), Ewe (fishermen)	Ga and Dagme (mainly), Ewe (migrant fishermen), traditionally the lagoon belongs to the people Teshie, Sakumono and Tema and they revere the lagoon as a god (Agyepong, 1999; Sal Consult Limited, 2015)	Anlos in the south, the Tongus and Avenors in the north (Tufour, 1999)	Dangme (east), Ada (west), Anlos (south), Tongus and Avenors (north)
Human settlements dependent on the wetlands		11 settlements	21 settlements; Adjiringano, Amanfro, Amrahia, Amrahia Diary farm, Ashalex Botwe, Ashaiman, Damfa, Fafraha, Kakasunaka, Gbetsile, Katamanso, Kubekro No. 1, Lashibi (Klagon), Nungua farm, Ogbodzo, Sakumono, Santeo, Tema Comm. 3, Tema Comm. 12	Over 20 settlements are dependent on the wetlands (Lamptey & Ofori-Danson, 2014)	20 settlements
Stakeholders	Salt production, fisheries	Salt production, forest resource exploitation, agriculture, fisheries	Forest resource exploitation, farming, fisheries	Salt production, forest resource exploitation, agriculture, fisheries	Salt production, agriculture, fisheries, hunting
Governmental structures	Ga Assembly control	Controlled by two DA`s based at Winneba and Apam	Tema Municipal Council	Keta, Ketu, Akatsi, South Tongu	Dangme East and South Tongu

3.2 Field work analysis of pressures in the wetlands

Nine places and their respective dominant land use patterns were identified around the Densu Delta wetland, and seven places around the Sakumono lagoon (always within the Ramsar delineation zone, see table 2).

3.2.1 *Densu Delta wetland*

Urban areas are generally increasing in both wetlands that have been visited, although the Densu delta shows a slightly higher rate than the Sakumono lagoon. Within the Ramsar delineation border, the housing encroachment is at most times illegal and uncontrolled, thus causing wetland drainage, deforestation, ecosystem degradation and biodiversity loss. Around the Tetegu area, houses are built in the wetland even without basic available infrastructure. Many houses show a warning “not permitted to build” in the respective area. In two areas, we were asked if we come to examine the area in order to reclaim it. Many houses that have been built in the wetland are fully constructed, but not inhabited. Since most of the houses do not have a sewage network, the wastewater is either directly dumped into the lagoon, or it reaches them through sewage canals and rivers. Open defecation is common in the wetland and along the beach.

Solid waste is seen everywhere. Small dumps are created just behind houses and waste is burned frequently. The waste is mostly plastic and metal, but organic waste is also present. Several illegal open dumps were created. Collection and recycling activities are undertaken there as well, the Oblogo land-fill mentioned in the literature could not be found on site.

The Panbros Salt winning company owns the only direct road that leads to the wetland, and a permission is needed to enter this road by car. As the company owns a big portion of the wetland, on site investigations are difficult to perform. Salt harvesting happens all year around, and the company employs many people from the surrounding areas. Even traditional fishermen work there as a second occupation. Small-scale salt pans were found behind a number of houses. The soil in these areas looked very saline, evidenced by a thick salt crystal layer on the top soil layer.

Few fishing villages still exist around the Densu Delta wetland, for instance Faana. Fishing is an important income source and often the only occupation. In general, the head of the fishermen community (the King fishermen) reported that many people use every possible fishing method (e.g. chemicals and dynamite). All fishermen reported a decline in fish stocks and increasing plastic and sewage waste pollution. Moreover, they claimed that if the gates of the Weija dam are opened, fishing becomes impossible due to flooding. Vegetation in the Densu delta still exists, but only a few patches of mangrove trees are left due to overexploitation, since mangrove trees are cut for traditional fishing methods.

At least in two locations within the Ramsar borders cattle herds were seen. The cattle belonged to the local residents. The cattle was crossing the Densu River getting inside the mangrove forest.

A beach resort is located just on the edge of the Densu River estuary. The resort can only be entered by guests or by buying a daily ticket. Many fishermen fish in the estuary just behind the resort. In general, tourism is growing in the Densu Delta area, and a lot of advertisement are put up for new hotels and resorts along the main streets.

Table 2: Dominant land-uses in the Densu Delta and Sakumono wetland

Wetland	Area	Dominant land-use
Densu Delta wetland	Tetegu	Urban areas, towards the wetland rather peri-urban areas
	Aplaku	Urban areas, grazing land, land spread solid waste
	Bojo Beach Resort	Recreational area
	Panbros Salt winning	Salt winning area
	McCarthy	Urban areas
	Glefe	Urban areas, salt winning area, land spread solid waste
	Wiabowa	Urban areas, salt winning area
	Faana	Mangrove islands, water bodies
	Oblogo	Urban areas, land spread solid waste
	Sakumono lagoon	Community 3
Community 5		Urban areas, land spread solid waste
Community 6		Urban areas with partly very rich looking villas (inhabited)
Community 11		Agricultural areas
Community 12		Urban areas, agricultural areas
Community 17		Water bodies, agricultural areas
Klagon river		Urban areas, agricultural areas, grazing land
Celebrity golf club		Recreational area

3.2.2 Sakumono lagoon

Currently, the encroachment process around the lagoon is ongoing, but it does not affect the Ramsar delineation zone. In general, different types of houses can be found around the lagoon: from very wealthy villas to slum areas and informal settlements. Particularly on the edge of the wetland, many wealthy communities can be found. In the 1960s Community 3 was created to give living quarters for people employed in the Tema port. Behind the houses, septic reservoirs were created which are out of function today. This space rather functions today as an open waste dump, where people were also seen defecating. Open drainage channels can be found in all communities around the lagoon, which directly enter the wetland.

Agriculture is also practiced and outside the Ramsar delineation zone, mostly smallholder rain-fed agriculture. The vegetables that are grown in the area are usually used for own consumption. In the Ashaiman region, just up north

the Sakumono lagoon, big agricultural fields are located where farmers extensively use pesticides. Thus, agricultural run-off can reach the lagoon.

The fishermen from community 17 declared the Sakumono lagoon as an big open sewer due to all the incoming waste water streams. Yet, they try to fish in the lagoon, usually by using dragnets, thus fishing very close to the shore. Almost no vegetation was found around the Sakumono lagoon.

On the edge of the Sakumono lagoon, next to the Ramsar delineation border, a golf club has been built. The conditions of the greens are quite bad, but still people use the course.

3.3 Direct pressures of wetland degradation

At this point, seven pressures were identified in the Densu Delta wetland and eight pressures in the Sakumono lagoon (see figure 2).

The literature review and the fieldwork observations both support the assumption that inadequate waste disposal in the lagoons represents a severe threat to the wetland's ecosystems. Consequently, the identified pressure *discharge of untreated sewage/solid waste* was rated with the same degree of severity in both wetlands. In both wetlands, local communities were also fully aware of high water pollution, and even put in effort to clean up the plastic waste. Still, untreated sewage flows directly into both wetlands due to the open sewage drains and channels.

Overfishing and deforestation were also rated with the same severity in both lagoons. Fishermen reported decline in fish catch and decreasing fish sizes. Although none of the communities states to deforest the mangroves, the percentage of the mangrove trees in both lagoons is very low. If mangrove trees are present, it is obvious that they are newly planted due to the small size of the trees.

Urbanization and population growth seem to pressure especially the wetland in the Densu Delta. The encroachment in the Sakumono lagoon is, at least within the Ramsar site, very low.

Due to the Dam construction on the Densu River and the two rivers entering the Sakumono lagoon (see the pressure *river regulation/water diversion*) the wetlands do not receive enough water in the dry season (see literature chapter 3.1.1). In the Densu Delta wetland the fishermen reported flooding during the opening of the dam, but also increasing fish catch afterwards. In the Sakumono lagoon fishermen stated that they cannot use the water for irrigation due to the high water salinity.

Salinization of soil was especially observed in the Densu Delta wetland where people do artisanal salt winning. The salt winning company Panbros lies within the wetland area, and if unsustainable practices occur, the salinity levels in the wetland can rise very quickly. Deforestation and increase of agricultural lands might intensify this effect.

Cattle breeding was found in both wetlands but very scattered and with low number of animals.

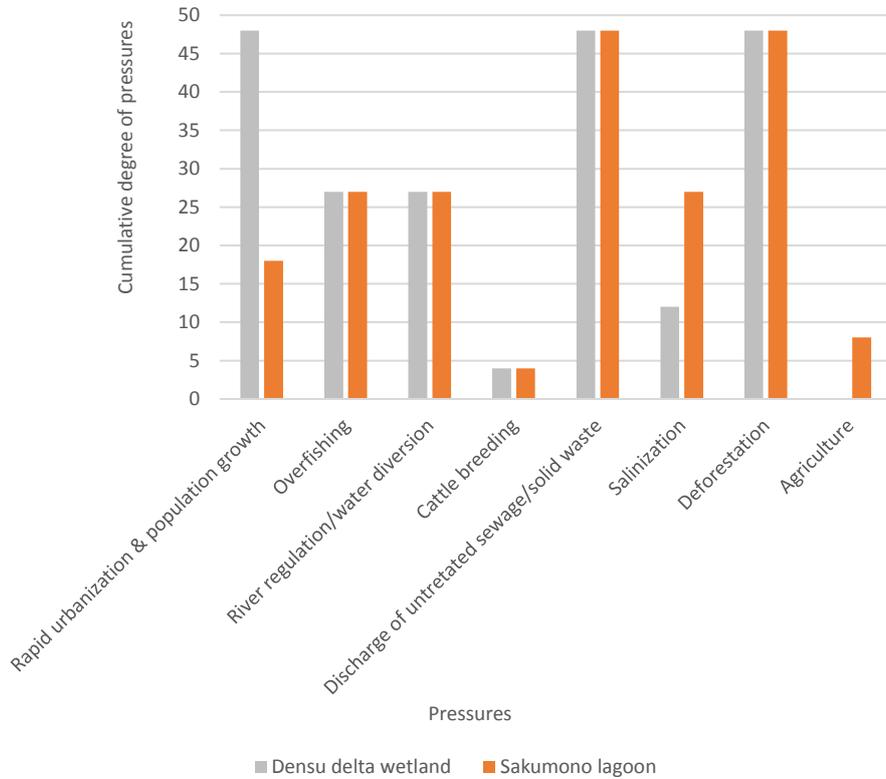


Figure 2: Quantification of pressures

4 Outlook

This paper focused on identifying and summarizing the existent pressures in five coastal lagoons in Accra. The pressures identified by the literature review were largely verified in the field. Although most of the available literature was published in the early 2000s, the pressures on the wetlands still persist today, thus making further research on socioecological pressures particularly relevant. The overall pressures in two lagoons, namely the Densu and Sakumono lagoons, were ranked using information collected during a short field visit.

Since the main state of the wetlands and the pressures were summarized and analyzed, it is suggested to proceed with uncovering how trade-offs between the ecosystem and the quality of local livelihood can be defined. A number of interviews revealed that stakeholders do rely on the benefits provided by the ecosystems and are very much aware of the negative consequences of ecosystems loss. Therefore, it is proposed to further examine the major challenges and pressures of encroachment and build urban ecosystems for urban planning and decision-making. Thus, an in-depth study will be carried out in January-February 2017 to investigate how social practices,

power relations and networking capabilities of different actor groups are related to ecological processes and ecosystem dynamics.

5 References

- Agyepong, G. T. (1999): Management plan for Sakumo Ramsar site. Wildlife department. Legon, Accra.
- Appeaning Addo, K.; Walkden, M.; Mills, J. P. (2008): Detection, measurement and prediction of shoreline recession in Accra, Ghana. In *ISPRS Journal of Photogrammetry and Remote Sensing* 63 (5), pp. 543–558. DOI: 10.1016/j.isprsjprs.2008.04.001.
- Benett, E.; Neiland, A.; Anang, E.; Bannerman, P.; Rahman, A. A.; Huq, S. et al. (Eds.) (2001): Towards a better understanding of conflict management in tropical fisheries: evidence from Ghana, Bangladesh and the Caribbean. Aquatic Sciences and Fisheries Abstracts CEMARE Research Paper (159): University of Portsmouth.
- Boafo, Y. A.; Asiedu, A. B.; Addo, K. A.; Antwi, K. E.; Boakye-Danquah, J. (2014): Assessing landcover changes from coastal tourism development in Ghana: Evidence from Kokrobite-Bortianor coastline, Accra. In *Civil and environmental research* 6 (6), pp. 9–16.
- Boateng, I. (Ed.) (2009): Development of Integrated shoreline management planning: A case study of Keta, Ghana. Coastal Zone Management.
- Dankwa, E. V.O.; Shenker, J. M.; Lin, J.; Ofori-Danson, P. K.; Ntiamao-Baidu, Y. (2004): Fisheries of two tropical lagoons in Ghana, West-Africa. In *Fisheries Management and Ecology* (11), pp. 379–386. DOI: 10.1163/221160604X01278.
- Entsua-Mensah, M.; Ofori-Danson, P. K.; Koranteng, K. A. (2000): Management Issues for the Sustainable Use of Lagoon Fish Resources. In *Biodiversity and sustainable use of fish in the coastal zone*, pp. 24–27.
- ESSUMANG, David Kofi; ADOKOH, Christian. Kweku; AFRIYIE, Joseph; MENSASH, Esther (2009): Source Assessment and Analysis of Polycyclic Aromatic Hydrocarbon (PAH's) in the Oblogo Waste Disposal Sites and Some Water Bodies in and around the Accra Metropolis of Ghana. In *JWARP* 01 (06), pp. 456–468. DOI: 10.4236/jwarp.2009.16055.
- Faulkner, S. (2004): Urbanization impacts on the structure and function of forested wetlands. In *Urban ecosystems* (7), pp. 89–106.
- Finlayson, C. M.; Gordon, C.; Ntiamao-Baidu, Y.; Tumbulto, J.; Storrs, M. (2000): The hydrobiology of Keta and Songor Lagoons. Implications for coastal wetland management in Ghana. With assistance of Supervising scientist report 152. Supervising scientist. Darwin.
- Gordon, C. (2000): Hypersaline lagoons as conservation habitats: macro-invertebrates at Muni Lagoon, Ghana. In *Biodiversity and Conservation* (9), pp. 465–478.

- Gordon, C.; Ntiamoa-Baidu, Y.; Ryan, J. M. (2000): The Muni-Pomadze Ramsar site. In *Biodiversity and Conservation* (9), pp. 447–464.
- Kaczorowska, Anna; Kain, Jaan-Henrik; Kronenberg, Jakub; Haase, Dagmar (2015): Ecosystem services in urban land use planning. Integration challenges in complex urban settings—Case of Stockholm. In *Ecosystem Services*. DOI: 10.1016/j.ecoser.2015.04.006.
- Keelson, K. B. (2014): Evaluation of groundwater pollution with heavy metals at the Oblogo No.1 Dumpsite in Accra, Ghana. In *International Journal of Engineering and Technology Innovation* 4 (3), pp. 170–181.
- Koranteng, K. A.; Ofori-Danson, P. K.; Entsua-Mensah, M. (2000): Fish and fisheries of the Muni lagoon in Ghana, West Africa. In *Biodiversity and Conservation* (9), pp. 487–499.
- Kumi, John; Kumi, Mary; Apraku, Andrews (2015): Threats to the Conservation of Wetlands in Ghana. The Case of Songor Ramsar Site. In *JSRR* 6 (1), pp. 13–25. DOI: 10.9734/JSRR/2015/13906.
- Lamprey, A. M.; Ofori-Danson, P. K. (2014): Review of the Distribution of Waterbirds in two tropical coastal Ramsar lagoons in Ghana, West Africa. In *West African Journal of Applied Ecology* 22 (1), pp. 77–91.
- Ministry of Lands, Forestry & Mines (2006): A national wetlands conservation strategy and action plan (2007-2016). Ministry of Lands, Forestry & Mines. Accra, Ghana.
- Nartey, V. K.; Ekor, K. A.; Doamekpor, L. K.; Bobobee, L. H. (2011): Nutrient Load of the Sakumono Lagoon at the Sakumo Ramsar site in Tema, Ghana. In *West African Journal of Applied Ecology* 19, pp. 93–105.
- Nixon, S. W.; Buckley, B. A.; Granger, S. L.; Entsua-Mensah, M.; Ansa-Asare, O.; White, M. J. et al. (2007): Anthropogenic enrichment and nutrients in some tropical lagoons of Ghana, West Africa. In *Ecological application* 17 (5), pp. 144–164.
- Nonterah, Cynthia; Xu, Yongxin; Osae, Shiloh; Akiti, Thomas T.; Dampare, Samuel B. (2015): A review of the ecohydrology of the Sakumo wetland in Ghana. In *Environmental monitoring and assessment* 187 (11), p. 671. DOI: 10.1007/s10661-015-4872-0.
- Ntiamoa-Baidu, Y.; Gordon, C. (1991): Coastal wetlands management plans: Ghana. World Bank.
- Nyame, Frank K.; Tigme, Jacob; Kutu, Jacob M.; Armah, Thomas K. (2012): Environmental Implications of the Discharge of Municipal Landfill Leachate into the Densu River and Surrounding Ramsar Wetland in the Accra Metropolis, Ghana. In *JWARP* 04 (08), pp. 622–633. DOI: 10.4236/jwarp.2012.48072.
- Osei, J.; Fianko, J. R.; Anim, A.; Ganyaglo, S. Y. (2011): The impact of Oblogo Landfill Site in Accra-Ghana on the surrounding environment. In *Journal of Environmental and Earth Sciences* 3 (6), pp. 633–636.
- Osei, Juliet; Nyame, Frank Kwakyi; Armah, Thomas Kaku; Osae, Shiloh Kwabena; Dampare, Samuel Boakye; Fianko, Joseph Richmond et al. (2010): Application of Multivariate Analysis for Identification of Pollution

- Sources in the Densu Delta Wetland in the Vicinity of a Landfill Site in Ghana. In *JWARP* 02 (12), pp. 1020–1029. DOI: 10.4236/jwarp.2010.212122.
- Oteng-Yeboah, A. A. (1999): Development of a management plan for the Densu Delta Ramsar site. Wildlife division Forestry Commission (Ministry of lands and forestry).
- Quashie, A.; Oppong, D. (Eds.) (2006): Ghanian solar saltworks: promoting and protecting the ecology. Ecological importance of solar works. Santorini island, Greece, 20-22 october. Presidents special initiative on salt works.
- Richardson, C. J. (1994): Ecological functions and human values in wetlands: A framework for assessing forestry impacts. In *Wetlands* 14 (1), pp. 1–9.
- Sal Consult Limited (2015): Environmental and social impact assessment (ESIA) study of port infrastructure development if Tema. Ministry of Transport. Accra, Ghana.
- Tay, C. K.; Asmah, R.; Biney, C. A. (2009): Trace metal levels in water and sediment from the Sakumo II and Muni Lagoons, Ghana. In *West African Journal of Applied Ecology* 16, pp. 75–94.
- Tuani, E. M. (2008): Managing urbanisation and waste disposal in West-Africa, case study of Oblogo, Accra-Ghana.
- Tufour, K. (1999): Keta lagoon complex Ramsar site Management Plan. Ghana Wildlife Division (Forestry Commission).
- UICN/ PACO (2010): Parks and reserves in Ghana: Management effectiveness assessment of protected areas. IUCN. Gland, Switzerland.
- Willoughby, Nick; Grimble, Robin; Ellenbroek, Wim; Danso, Elijah; Amatekpor, Julius (2001): The wise use of wetlands: identifying development options for Ghana's coastal Ramsar sites. In *Hydrobiologia* 458 (1/3), pp. 221–234. DOI: 10.1023/A:1013158329107.
- Wuver, A. M.; Attuquayefio, D. K. (2006): The Impact of Human Activities on Biodiversity Conservation in a Coastal Wetland in Ghana. In *West African Journal of Applied Ecology* 9, pp. 1–14.
- Agyepong, G. T. (1999). *Management plan for Sakumo Ramsar site*. Legon, Accra.
- Kumi, J., Kumi, M., & Apraku, A. (2015). Threats to the Conservation of Wetlands in Ghana: The Case of Songor Ramsar Site. *Journal of Scientific Research and Reports*, 6(1), 13–25. doi:10.9734/JSRR/2015/13906
- Lamprey, A. M., & Ofori-Danson, P. K. (2014). Review of the Distribution of Waterbirds in two tropical coastal Ramsar lagoons in Ghana, West Africa. *West African Journal of Applied Ecology*, 22(1), 77–91.
- Ntiamoa-Baidu, Y., & Gordon, C. (1991). *Coastal wetlands management plans: Ghana*.
- Sal Consult Limited. (2015). *Environmental and social impact assessment (ESIA) study of port infrastructure development if Tema*. Accra, Ghana.

- Tay, C. K., Asmah, R., & Biney, C. A. (2009). Trace metal levels in water and sediment from the Sakumo II and Muni Lagoons, Ghana. *West African Journal of Applied Ecology*, 16, 75–94.
- Tufour, K. (1999). *Keta lagoon complex Ramsar site Management Plan*.
- Wuver, A. M., & Attuquayefio, D. K. (2006). The Impact of Human Activities on Biodiversity Conservation in a Coastal Wetland in Ghana. *West African Journal of Applied Ecology*, 9, 1–14.

WaterPower is a laboratory for experimenting with novel ways of doing research based on the integration of multiple disciplines, approaches, methods and non-academic knowledge through dialogue and collaboration.

We contribute to current debates on society-nature relations by mapping, analyzing and understanding processes that unfold in the urban water sphere.

Our analyses critically study the interplay of socio-political and ecological processes and how they configure place and scale.

Governance and Sustainability Lab

Faculty VI - Regional and Environmental Sciences

Prof. Dr. Antje Bruns

Trier University

www.uni-trier.de

www.waterpower.science

WaterPower is funded by

SPONSORED BY THE

