

Environmental Effects and Controls of Physical Development in Wetland Areas: A Case Study

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Abstract

Wetlands are cradles of vital biological diversity and provide water and primary nutrients upon which numerous plants and animals depend for survival. Physical development in such areas therefore destabilises this portion of the ecosystem and hence affect its natural order. Engaging in activities which affect wetlands does not only lead to the loss of biodiversity or diminish the many ecological and hydrological benefits but also cultural and social values of wetlands.

Assessment of the haphazard physical development in wetlands in Kumasi metropolis showed some deficit, for those living within the wetlands as well as the city authorities. Human settlement along wetlands in the city has seen increased volume of household wastes discharged and other pollutants into this natural reservoir. The life of major rivers such as Aboabo, Subin,, Suatem and Kwadaso rivers and others are threatened. Regulations regarding wetlands are either relaxed or not enforced by the city authorities.

From responses of the general public to the questionnaires administered to address some concerns 109 houses out of 124 were inside the legal limit of 100 ft of rivers and streams. In principle therefore about 97.6% of the houses were considered to be in the wetlands. About 90% of the structures are currently being used for residential purposes and more than 70% did not indeed apply for permit before construction. Of the people interviewed, 43.6% of them send their refuse to dump sites, 18.6% dispose off their wastes into the nearby bushes, 33.8% use other means such as disposal in gutters and 4% put them in a hole at their backyard contaminating the groundwater.

1 Introduction

Physical development has been growing at an increasing rate over the past 20 years in Ghana. The scale of development has known no boundary as it involves every facets of the land including wetlands. The rate is such that almost every available piece of land in major cities, especially in the southern portion of Ghana is being released by the custodians, technically referred to as *allodial owners*, under a freehold or leasehold arrangement to prospective developers (da Rocha and Lodoh, 1999). With the increasing development, conservation areas as well as natural resource availability is observed to be declining, creating cumulative negative impacts on the environment and other social systems.

The 2000 Housing and Population Census indicated that more than 43% of Ghana's population live in urban areas while about 57% live in rural areas, and that the urban housing stock experienced an increase of more than 159% as against about 53% in the rural areas (Adarkwa and Oppong, 2007). In fact, the UN also estimates that by the year 2050, more than 50% of the population of developing countries will be urbanized (Cunningham and Cunningham, 2002).

Kumasi, one of the biggest metropolitan areas in Ghana, is experiencing this problem of physical development in wetland areas for some time now. This trend coupled with the inability of city authorities to streamline development issues has brought in their trail related problems as wetland areas are being captured with impunity. Some of the related problems include flooding culminating in the loss of lives and properties, discomfort, misery and psychological imbalance. These affect the general well-being of individual, an index of sustainable development (Prescott-Allen and Prescott-Allen, 1995). It has also been found that human settlements along the catchments areas of rivers tend to reduce the volume of water flow (Newson and Calder 1989). The other issue is that vegetation around the river body is cleared to make way for the physical development. This has the effect of increasing the rate of sediment deposition into the river, causing the rivers to fill up and thus reducing the flow volume and consequently causing river dry-up. It is reported that 30 houses were submerged at Atonsu, a suburb of Kumasi alone, when

the Subin River overflowed its banks. The report indicated that properties worth several millions of cedis were destroyed, while close to a thousand people were rendered homeless (Anon, 2004).

It is also found that unauthorised development in wetland areas most times create slums within the wetlands. This is because most developers in wetlands may not have the economic power needed to build properly-planned settlements in such areas. Again consumption of polluted water by such section of the population affects their health and hence increases the healthcare burden, on the government.

The objectives of this research is therefore to identify the factors that result in physical development in wetland areas, analyze the environmental effects of these developments and explore ways by which such developments can be controlled and streamline for sustainable development.

2 Wetlands and their Characteristics

Wetlands are areas that the land is permanently or for the most part of the year wet. In other words wetlands contain large quantities of water in the interstitial spaces of the soil than upland soils. Generally, there are two broad classifications of wetlands, coastal and the inland wetlands. As the name suggests, the coastal wetlands are those along the seas/oceans where freshwater mixes with the sea water. Examples are tidal salt marshes, tidal fresh water marshes and mangrove wetlands. The inland wetlands are those that occur along rivers, streams, ponds, lakes, etc. The Inland wetlands may be classified into the lotic wetlands and the lentic wetlands. Lotic wetlands, also called riparian wetlands, are those that are associated with flowing water such as rivers, streams and drainage ways. They have a defined channel and a floodplain (Hanson et al, 2000). Examples of lotic wetlands are wet meadows, bottomland hardwood forests, etc. Lentic wetlands, on the other hand are those wetlands that occur around standing water systems such as lakes, ponds, reservoir, marshes, etc. Examples include freshwater marshes, deepwater swamps, and fens.

In Ghana, wetland ecosystems constitute about 10% of the country's total land area (Ellis, 2002). Mention can be made of the Densu, the Sakumono and the Songor wetlands in the Greater Accra Region as well as the Amanzuri wetlands in the western region all of which are Ramsar wetlands.

A typical wetland area soil profile does not show much difference between it and any other from a non-wetland area; the main difference is the volume of water present in the interstitial spaces (Lee, 1980). For a wetland soil, the A-horizon is characterized by the presence of large quantities of water. This favours the growth of aquatic plants like water hyacinth which also has an effect on the rate of decomposition of organic matter. Hence, some wetlands are used for the treatment of human waste (Metcalf and Eddy Inc, 1991).

Wetlands generally include swamps, marshes, bogs and similar areas. Wetland scientists agree that three things are cardinal in defining and identifying wetlands. These are the wetland hydrology, which is the driving force creating all wetlands, hydric soils, an indicator of the absence of oxygen and hydrophytic vegetation, an indicator reflecting wetland site conditions (Hanson et al, 2000). Windel et al. (1986) state that wetland areas are part of a continuous landscape that grades from wet to dry. In many cases, it is not easy to determine where they begin and where they end. Thus, they are transitional between the aquatic (water) and the terrestrial (upland) ecosystems (Hanson et al, 2000).

3 Usefulness of Wetlands to Biogenical Diversity

The importance of wetland is not only to humans but to the environment around which all live forms revolves. Wetlands are cradles of vital biological diversity and provide water and primary productivity upon which numerous plants and animals depend for survival. Wetland areas have several importance, environmentally, economically and socially. In affirming the immense importance of rivers and wetland areas, (Salo and Cundy, 1987) observed that streams and adjacent riparian areas provide clean water, habitat for fish and wildlife, recreational opportunities, raw materials and spiritual values. Its uses are wide

and applications varied. In the agricultural sector, it is an important resource that supports both plants and animal life

Wetlands have recreational, historical, scientific and cultural values that can be exploited to man's advantage without impairing the potential of the wetlands. One of the development projects that are compatible to the health of the wetlands is the development of the sites as eco-tourism sites or national parks. Dissolved nutrients in the soil (potassium, nitrogen, phosphorous, etc.) are taken up by the roots of the wetland vegetation for photosynthesis and/or storage (Ayoade, 1988). By the process called *denitrification*, some bacteria in the soil convert harmful nitrates in the soil into harmless nitrogen gas, which is released into the atmosphere.

The litter that fall from the wetland vegetation may be carried into the river and made available to the aquatic animal communities in the river, both upstream and downstream. In such a case, the energy locked up in the litter is released to the other forms of life - e.g. fishes within the food web in the aquatic ecosystem (Casey, 2001). Another very important environmental function of the (natural undisturbed) wetland area is the ability to filter run-off and check erosion. The vegetation helps to slow down the velocity at which rainfall (precipitation) impinges upon the soil. This water that infiltrates into the soil goes to fill the interstitial spaces in the soil. When these are fully filled, the excess water is allowed to go down to the water table and augment the volume of the groundwater .

4 Some Historical Reasons

Historically the use of the waterfronts as settlements for mankind and other activities dates back to the early days of man's civilization. Rivers such as the Tigris, Euphrates, as well as the Nile and Indus have had people settling around it for one reason or the other since the sixth millennium B.C. (Newson, 1992). Gilloti (2005) also indicates that before the discovery of the rail, road and air transports, waterways served as the major trading and travel routes. People also have been using the rivers for fishing, irrigation, etc.

Consequently, people who patronize or engage in these activities naturally settle along the wetlands areas. However, these legitimate reasons for co-habitation along wetland areas has given way to increased vested interest. Despite legislations in several countries and international agreements such as the Ramsar Convention on wetlands (Ramsar Convention, 1971), the problem still persists in several countries. In Ghana's National Land Policy (1999) for instance, physical development in wetlands have been banned but this has not deterred developers.

5 Causes of Physical Development in Wetland Areas

Friedman et al (2004) defines development as the process of adding improvements on or to a parcel of land. Such improvements may include drainage, utilities, access, buildings, agriculture and combination of these elements. These developmental needs have been accelerated by:

Population Explosion, Urbanization and Homelessness

Cunningham and Cunningham (2002) note that urban population grows in two ways- i.e. by natural increase and by immigration. Natural increase is caused by improved food supply, advances in medical care, better sanitation, etc., that make people live longer and the birth rate more than the death rate. Immigration is caused by pull and push factors. They assert that in Africa, the largest source of urban population growth is through immigration.

The strategic location of the city of Kumasi, has encouraged rural-urban drift stretching resources including land and buildings. The condition is such that more housing facilities will be needed. The current population of Kumasi stands at about 1,170,270 (Statistical Service, 2001). Meanwhile, the housing stock of Kumasi only grew from 8,475 to 28,622 between 1960 and 1995 (Owusu, 2001). The total housing stock of Kumasi is estimated at 66,177. The national situation is even more serious as a result of rapid urbanization since the youth find the cities the most attractive places to lead their lives. This urbanization has tended to create congestion in the cities thereby exacerbating the already precarious situation. The available housing and those being delivered are unable to match

up with the rate of population growth, especially in the cities. The Ministry of Works and Housing estimates that 0.1% of Ghanaians are entirely homeless and that if pragmatic steps were not taken to address this, it is likely to shoot up.

High Rental Values

The acute shortage in the supply of landed properties, including housing has resulted in high rental charges, beyond the reach of the ordinary man. The supply of properties is price inelastic and as such cannot increase in the short term due to the excessive long gestation period, large initial capital outlay needed to build as well as lack of credit facilities, among others. Demand for landed property is therefore persistent outstretching supply and has given undue advantage to rental charges.

Cultural Connections of Humans to Water: Sewell (1969) commented that man has affinity for settling along river bodies. The soils along river bodies have deposits of rich alluvium that support growth of plants and hence this ensures good yield for agricultural activities. Also the availability of water bodies enables humans who settle along these rivers to have water to drink and some to feed their domestic animals.

6 Effects of Physical Development in Wetlands Areas

Physical development in wetlands largely destroys the environmental functions of the wetlands due to its adverse effects. It ranges from flooding through pollution of groundwater and rivers to the ultimate destruction of the wetland itself.

Flooding: This is the situation when the water in a river overflows its banks as a result of excessive volumes of flow. This singular act creates discomfort for homes families affected. Indeed loss of properties through flooding has been observed to out weigh real benefit for dwelling on wet lands.

In Ghana, cities and towns have had their fair share of the floods during rainy seasons. The city of Accra experiences periodic floods almost every year. In 2004, 30 houses were

submerged at Atonsu, a suburb of Kumasi and several properties were destroyed when the Subin River overflowed its banks (Anon, 2004).

Pollution of River Bodies: It has been mentioned under the environmental importance of rivers that they are useful in the discharge of household and industrial wastes. However, beyond a certain threshold the river bodies are unable to regenerate themselves as a result of lower chemical and biological oxygen demand, thus, the rivers become polluted.

As human settlements along the banks of rivers increase, the volume of household wastes discharged into the rivers greatly increase, and in most cases beyond the threshold at which the rivers can assimilate and thereby go into extinct.

Destruction of natural Resources Cunningham and Saigo (1999) suggest that wetlands convert naturally to dry land largely through sedimentation, eutrophication or stream-cutting and draining, and that human activities have greatly accelerated these processes in many places. One of the major human activities that destroy the wetlands either directly or indirectly is physical development. It is an entirely drastic change in the land-use that has a serious adverse effect on the wetland and its resources

7 Geo-Physical Characteristics of Kumasi

Kumasi is the second biggest city in Ghana (Fig.1), it is located about 270km north-west of Accra, the capital city of Ghana. It has a strategic central location by way of road networks and therefore acts as the transit point between the northern and the southern part of the country (Songsore, 2003). It covers an approximate area of 254sq.km and lies between latitude 6° 35' and 6° 40'N and longitude 1° 30' and 1°35'W with a wet sub-equatorial climate. The average minimum and maximum temperatures are 25.5°C and 30.7°C respectively with average humidity of about 82% at 1500GMT (Ellis, 2002). There is a double maximum rainfall regime of about 214.3mm in June and 165.2mm in September.

The problems that have arisen as a result of these building construction activities within wetlands and along the banks of river bodies are many and varied, ranging from

environmental, through economic to social problems, thereby encroaching the natural reserves. As far back as 1980, the natural reserve destruction was amazing and has worsen till date (Table 1).

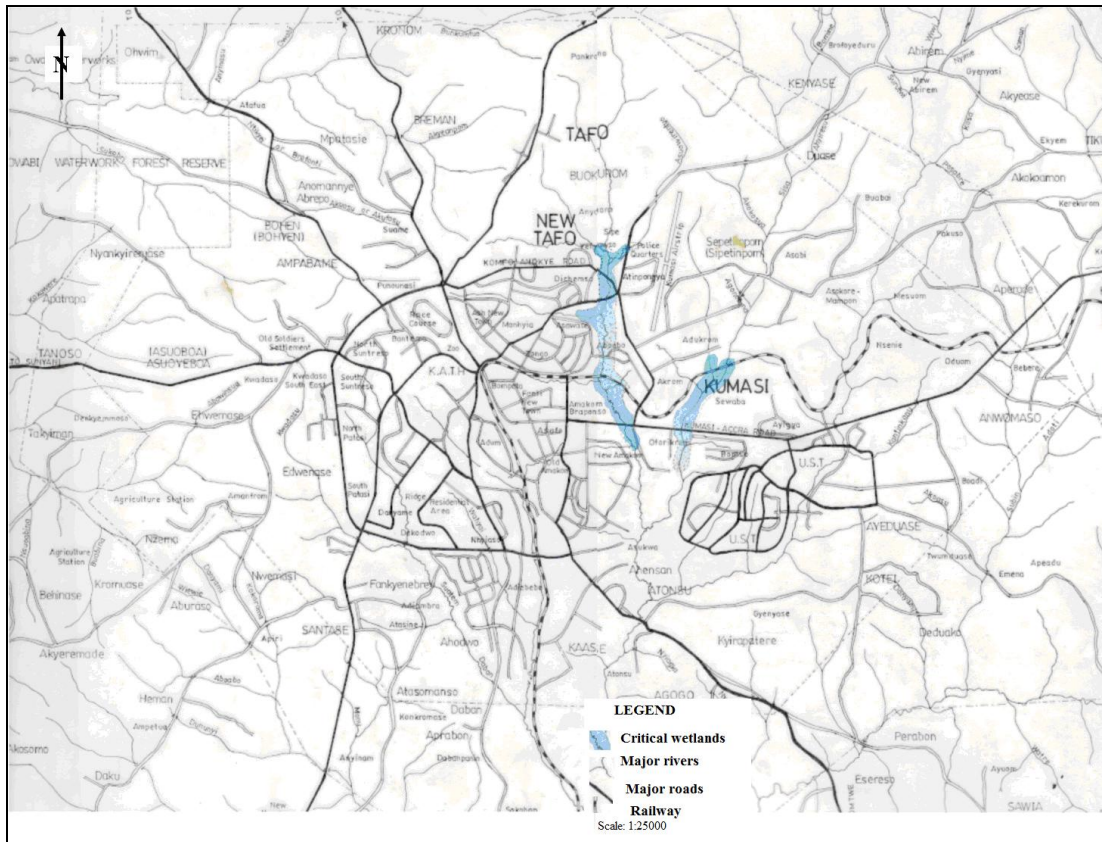


Fig.1: Drainage pattern of Kumasi showing probable wetland areas (Mod. After Anon 1980)

A reconnaissance study of some of the major rivers in the metropolis actually indicates that the problem is distressing. Most river beds have been filled up, affecting the volume and the free flow of the rivers (Fig. 2).

Table 1 Nature Reserves and level of Encroachment

Nature Reserve	Area Covered (ha)	Area Encroached Upon (ha)
Aboabo	446.24	92.15
Sisai	378.42	46.94
Bantama	739.20	121.43
Subin	538.24	10.58
Atonsu	321.78	187.0

(Source: Town and Country Planning, Kumasi, 1980)



Fig. 2: Reduced volume of water in the Aboabo River as a result of increased sediment Deposition

In several houses, the flooding situation has gotten too bad that people have abandoned their houses. In other situation also, the people have built buttresses to hold the fence wall from caving in easily under the torrents of flood.

8 RESULTS OF RANDOM SURVEY

From responses of the general public to the questionnaires administered randomly to address some concerns, as much as 81% of the public claimed they had no idea of the regulations concerning development in wetland areas. Even some of those who indicated they knew of such laws could not state what the law says. One of the most obvious inferences is that the methods used in information dissemination on developments in environmentally sensitive areas like wetlands have not been effective. People may therefore be building their settlements in wetland areas inadvertently because they do not know the consequences as well as the rules concerning such developments.

The national building regulations 1996, (LI 1630) states categorically that before anybody starts any form of development they should apply to the District (Metropolitan) planning authority for a permit. However, the practice is quite different; Table 2 shows that only 36% of respondents obtained their permit before construction was started. As much as 20% have no permit even after construction. Again, more than 40% of the structures within the study area were never visited by building inspectors during construction, and only about 55% were inspected. Only about 27% of property owners have lease/land title certificate

Table 2: Status of building permit for construction

Permit Status	No.	%
Permit obtained before construction started	9	36%
Permit obtained during construction	6	24%
Permit obtained after completion of construction	2	8%
Permit has never been obtained for construction	5	20%
No idea if the completed building has a construction permit	3	12%
Total	25	100%

Another problem that contributes to physical development in wetland areas is actually the attitude of landowners. Of the 124 houses interviewed 109 houses were within illegal

limit of 100 ft from the river bed. Only 12 people were outside the statutory limit. In principle therefore about 97.6% of the houses would be considered to be in the wetlands.

Table 3 shows that out of the 22 households interviewed, who live in their own houses in the wetland areas, 45.5%, said they bought the lands from the chiefs.

Table 3: Source of land for development

Source	No.	%
From the Chief	10	45.5
From an Elder of the Clan	3	13.6
Other sources ¹	7	31.8

In the study area, it was observed that over 30% of owners actually bought their buildings from previous developers. Fig. 3 shows that over 90% of the structures in the wetland areas are currently being used for residential purposes.

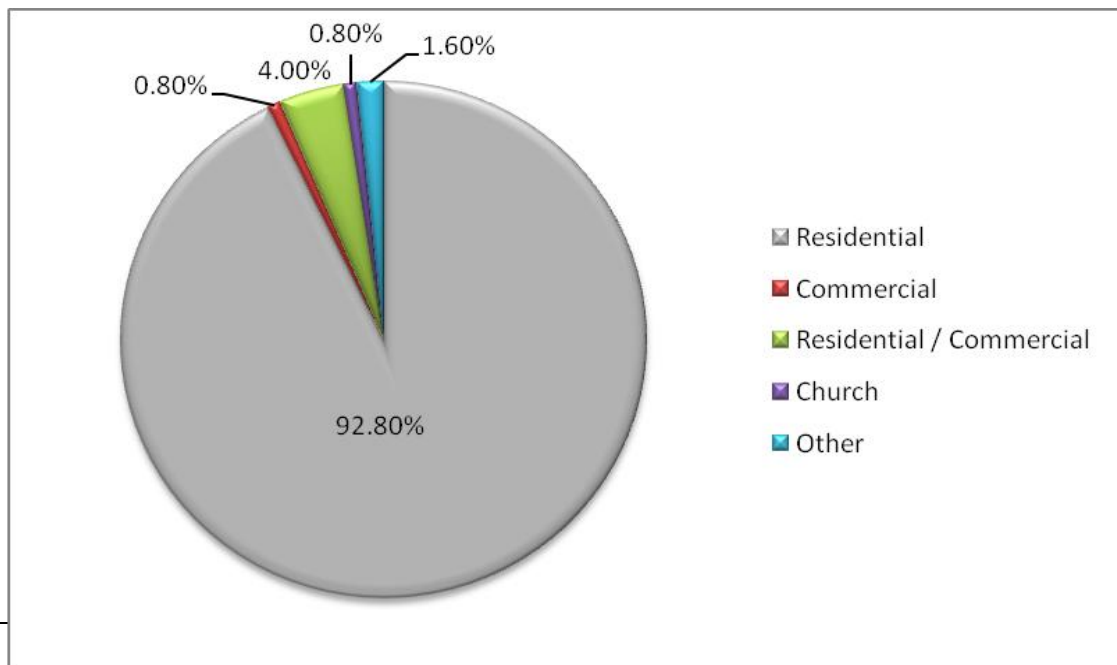


Fig. 3: Description of the buildings in wetlands

The study wanted to find out whether or not household activities have the potential of releasing wastes into the river bodies. In this case, respondents were asked to indicate where they dispose off wastes such as plastics and organic matters. Of the 124 people interviewed, only 43.6% of them send them to KMA approved refuse dump sites (Fig. 4). 18.6% of them dispose off these wastes into the nearby bushes. 33.8% use other means such as disposing them into gutters (26.6%) or burn (7.2%) them. 4% put them in a hole at the backyard. Those who dispose them in the nearby bushes and the gutters ultimately get their refuse ending up in the streams, to pollute them.

As far as liquid wastes were concerned, respondents from 20 of the houses, representing 16% said they dispose them unto the street, 5 of them representing 5% indicated it goes into a soak-away whiles the bulk of them, 99 representing 80% said they use other means such as discharging into the gutter which may ultimately end up in the stream or directly into the street).

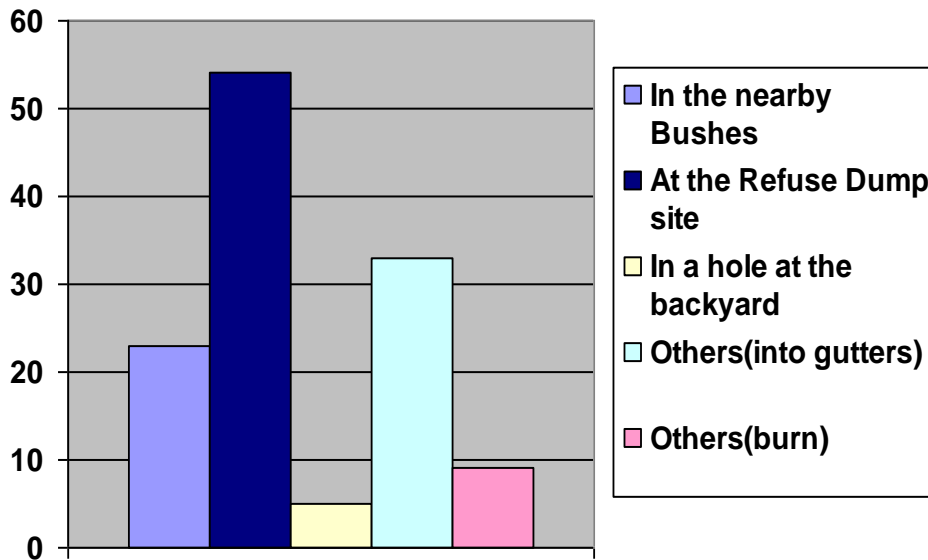


Fig. 4: Types of wastes disposal

The public was also asked whether or not they agree that physical development in wetland areas in the metropolis create environmental problems (Fig. 5).

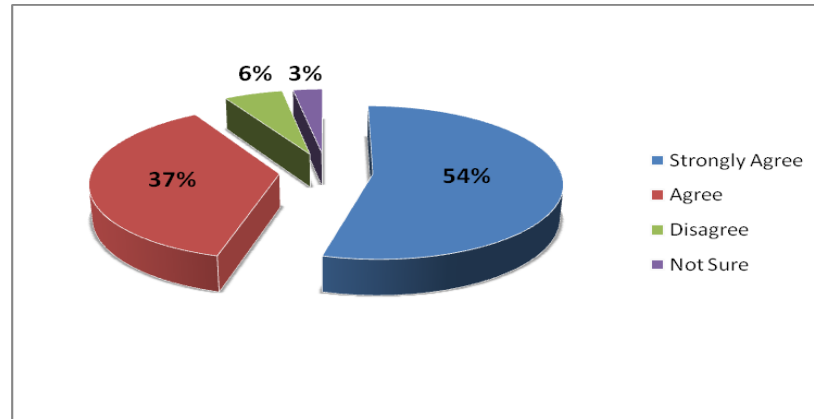


Fig. 5: Buildings in wetlands create environmental problems

Thus, the survey indicated that as much as 54% households suggested that in the opinion of the public, this situation is a major cause of problem to the wetlands. When asked whether flooding was a problem where they live; as many as 120 people, representing 96.8% of the 124 people said they were being disturbed by flooding and that any time it rains heavily most houses get flooded

A number of houses in the study area were found to have been abandoned (Fig. 7a) or re-levelled (Fig. 7b) as the waters begins to take over the buildings. Of the 70 people interviewed, only 13 of them representing 19% said they know of the legislation involving unauthorised building sites.



Fig. 7a Abandoned wetland area habitation



Fig. 7b Wetland area leveled for habitation

To the responses of the general public to the questionnaires as much as 81% of the public claimed they had no idea of the regulations concerning development in wetland areas. Even of those who indicated they knew of such laws could not state what the law says.

It was observed that since the cost of non-wetland areas for development purposes is high, people who still want to own homes, avoid paying exorbitant rental charges and rather settle for wetlands that are cheap. In certain cases, when such lands are bought, the prospective developers also fill up these wetlands with laterite to “dry the lands” and develop them later creating inter-bank wet grounds. It is logical that within the same socio-economic set up the less expensive a piece of land is the more expensive it is to develop; wetlands may be cheap to buy but very expensive to develop adequately.

9 Discussions

The study identified the causes of this physical development as multi-faceted. It stems partly from the *pull factor* resulting from rural-urban migration and population explosion. The process of urbanisation, among others have brought along the problem of urban housing. As many people come to settle in the cities, housing becomes crucial as facilities are stretched to their limits. For instance, nearly 93% of the buildings whose occupants were interviewed in the wetlands were all for residential accommodation. Tied directly to housing is the issue of land. As demand for land for building is increased, the tendency to put every piece of land on the market for sale arises. The study observes that the increase in the demand for land has also being heightened partly by the high rental charges in the metropolis. There is therefore a general increase in price of rental accommodation, especially in the so-called first class residential areas like Atasomanso, Ayigyaa, Bomso, Nhyiaeso, etc. in Kumasi triggering rush for plots in wetland areas.

Another cause is the lack of knowledge on the regulations on development in environmentally sensitive areas as well as ineffective law enforcement in the metropolis. People ignore the laws concerning development in conservation areas such as the

wetlands. Over 80% of the public interviewed do not know the laws, and once law enforcement is also not effective people treat the law with impunity.

The major environmental effects identified from indiscriminate physical development in wetland areas include massive pollution and the consequent drying up of major rivers in the metropolis, (eg. Sisai, Subin and Aboabo). People dump refuse into these rivers the banks of which form the wetlands, thus, creating unsanitary conditions at these conservation areas. For instance over 50% of the houses whose occupants were interviewed do not have toilet facilities and about 45% dispose off solid wastes into gutters and the surrounding areas. Such unhygienic practices heighten the risk and outbreak of epidemics, which ultimately increases the health-care burden of the metropolis. Other effects are pollution of groundwater, destruction of aquatic life and eco-tourism.

It was also found that anytime it rains heavily such areas within the wetlands got flooded destroying life and properties. Asked whether or not the people would like to be resettled because of some of these adverse problems in wetland areas, 83.1% responded in the affirmative.

10 Conclusions

The study concludes that:

- Wetlands are major resource as they constitute an environment around which all live forms revolve. In Ghana wetlands constitutes about 10% of the land area are cradles of vital biological diversity and provide water and primary productivity upon which numerous plants and animals depend for survival.
- Physical development in wetlands is threatening precious conservation areas. This immoral activities is continuing with impunity despite local and international legislations
- In Kumasi, the unauthorised development in wetland areas is threatening aquatic life, polluting and drying river bodies (i.e., Aboabo, Subin, Aboabo, Suatem and Kwadaso rivers at Dakodwom, etc), resulting in flooding and slums.

- Out of 124 houses interviewed, 109 houses were out of the legal limit of 100 ft of the rivers/streams. In principle therefore about 97.6% of the houses were considered to be in the wetlands. About 90% of the structures are currently being used for residential purposes, 45.5% bought the lands from the chiefs and more than 70% did not indeed apply for permit.
- Land acquisition as well as physical development must be streamlined in the metropolis. Resettlement remains an option for most wetland dwellers if government will cooperate with developer or enforce legislations involving wetland usage.

11 Recommendations

The following recommendations and suggestions are being made:

- There should be effective collaboration between city authorities and allodial land owners
- Enforcement of regulations against development in wetland must be strengthened.
- Government policy and intervention of providing affordable housing for the urban poor should be exploited.

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