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WHY REHABILITATION, RESTORATION AND PROTECTION OF WATERSHED FORESTS IN NIGERIA SHOULD BE GIVEN A PRIORITY ATTENTION

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ABSTRACT

Watershed is defined as an area of land that catches rainfall, and other precipitation and funnels it into a marsh, stream, river, lake or ground water is the basic building block of sound natural resources stewardship. The water bodies supplied by the watershed, provide our drinking water, water for agriculture and manufacturing, offer opportunities for recreation and provide habitat to numerous plants and animals. Forests among other environmental and socio-economic benefits also play very important role in watershed health. The quantity and the quality of water resources in a given watershed area is dependent on the condition of the forest surrounding it. Forested watersheds when properly managed help maintain ecological balance, minimize the occurrence of floods and droughts, and could mitigate the effects of adverse climatic changes. Because of its known environmental and economic benefits, economic and land use decisions is being made the world over in favour of protecting forested watersheds to help safeguard water supply. The positive relationship between watershed forests and water quality is already being exploited to help supply clean drinking-water to millions of people around the world with over a third of the world's 105 largest cities obtaining some or all of their drinking water from forest protected catchments. In Nigeria however, many watersheds are degraded and considered in critical condition due to overexploitation. Such degradation of the watershed forests has led to many environmental problems such as erosion and flooding with consequent loss of lives and property. Development, rehabilitation, restoration and protection of watershed forests in Nigeria should therefore be given priority attention.

Key wards: Forest, Water, Watershed, Rehabilitation, Degradation, Flood.

INTRODUCTION

Today, the availability and quality of clean water in many parts of the world is increasingly threatened by overuse, misuse and pollution. For this reason, FAO (2008) pointed out that the relationship between forests and water remains a critical issue that must be accorded high priority. This is because of the critical role forests play in water availability and use. Forests play very important role in water availability through its protective functions to water catchments or watersheds. Forested watersheds for example are tapped as vital sources of water supply for ecological, domestic, irrigation and industrial purposes including hydroelectric and geothermal power generation. On the environmental aspect, properly managed forested watersheds help maintain ecological balance, minimize the occurrence of floods and droughts, and could mitigate the effects of adverse climatic changes. Because of its known environmental and economic benefits, economic and land use decisions is being made the world over in favour of protecting forested watersheds to help safeguard water supply. Research has shown that over a third of the world's 105 largest cities take some or all of their drinking water from catchments with protected forests.

In Nigeria however, the story is quite different. Many watersheds in the country today are degraded and are in critical condition due to overexploitation. Many of these watershed forests are being widely devastated by clearance for agriculture, logging and cutting for fuels, overgrazing, and badly managed road construction. Worst still, a good number of urban riverbanks in the country have become dump sites for city garbage which make them to have unsightly looks. Otamiri and Nworie rivers in Owerri, capital of Imo State are typical examples, both of which are presently seriously silted up because of the destruction of their watershed forests (Aju and Popoola, 2011). Such degradation of the watershed forests poses a great threat to the nation's economy, social wellbeing and environment. For example, Owerri, capital of Imo State has remained for years without tap water because its gigantic water scheme based on Otamiri river is no longer working because of the destruction of watershed forests along its head stream. Flooding has also become a regular phenomenon in Nigeria with increasing intensity of occurrence with the worst of such flooding events witnessed in 2012 when over 363 lives were lost and more than 2.3 million people displaced while over 600,000 houses were destroyed.

This paper therefore tries to throw light on the importance of forests in the healthy functioning of watersheds as well as highlights the consequences of forest clearance on watershed degradation. It explains why development, rehabilitation, restoration and protection of watershed forests in Nigeria should be given a priority attention.

Definition of watershed

A watershed can simply be defined as any surface area from which rainfall is collected and drained to a common point or an area of land that catches rainfall, and other precipitation and funnels it into a marsh, stream, river, lake or ground water. Watershed is synonymous with a drainage basin or catchment area. According to Marsh and Grossa (1996), a drainage basin functions like half a funnel placed on its side. Water runs towards the center and concentrates in deeper and faster flows towards the outlet. The bigger the basin, the more water it collects and the larger the stream flow, it is capable of generating. Also, the faster the basin conducts water towards the outlet, the larger the resultant streamflow. All land surface no matter how dry they may be, belong to a watershed or drainage basin of some size. In other words, every square meter of land is a part of watershed and each stream has its own watersheds. Watershed has no definite size as it may vary from a few hectares to several thousands of hectares or even be as small as a football field. The watershed of the Mississipi River for example includes almost half of the United State of America (Ramsey *et al.*, 1978).

Forests and the health of watersheds

Healthy watersheds are the basic building blocks of sound natural resources stewardship. Without healthy watersheds, habitats deteriorate for all living things including man. This is because the water bodies supplied by the watersheds, provide our drinking water, water for agriculture and manufacturing, offer opportunities for recreation and provide habitat to numerous plants and animals. Forests play critical role in watershed health. The quantity as well as the quality of water resources in a given watershed area is dependent on the condition of the forest surrounding it. However, the link between forests watershed conditions, and water quality and quantity is often not recognized. But scientists have been able to study and quantify the importance of forests to the proper functioning of watershed ecosystem. Such studies not only confirm the vital importance of forests to healthy watershed but also documents how the increasing scale of human activities jeopardizes key watershed functions.

Water flow in a stream or river is determined mostly by the conditions of its watershed. A watershed made up of unplanted land does not soak up water. Muddy water can run off rapidly and cause floods. This causes soil to be washed into the streams and reservoirs, causing pollution and reducing the amount of water that can be stored. But when covered with plants, a watershed acts like a blotter, soaking up most of the water falling on it. Floods and droughts are less common where watershed areas are plant covered (Ramsey

et al., 1978). By intercepting precipitation, evaporating moisture from vegetative surfaces, transpiring soil moisture, capturing fog water and maintaining soil infiltration, forests influence the amount of water available from groundwater, surface watercourses and water bodies. They also influence the timing of water delivery through the maintenance or improvement of soil infiltration and soil water storage capacity (FAO, 2008). Watershed forests are particularly important because they protect soil cover on site and protect areas downstream from floods and other harmful fluctuations in stream flow. But the most significant contribution of forests to the hydrological balance of watershed ecosystems is in maintaining high-quality water. This it achieves through the minimization of soil erosion on site, reduction of sediment in water bodies (wetlands, ponds and lakes, streams and rivers) and trapping/filtering of other water pollutants in the forest litter and under-wood. As forestry activities involve no use of fertilizer, pesticide and fossil fuel, or outfalls from domestic sewage or industrial processes, it certainly remains the best cover for drinking water supply watersheds (FAO, 2008).

The important links between forests and watershed health have been documented by several researchers. Binkley et al (2004), in their own study showed that nitrate content of streams from forested watersheds averaged less than 1mg/litre, while Pan et al (2005) in their own research found out that a 10% loss of forest land disproportionately increases the loading of nutrients discharged into the Chesapeake Bay Watershed by 40%. Pan *et al.,* (2005) further observed that forests are capable of storing and filtering six times more rainfall than grass alone and 20 times more than a parking lot. According to Mayer et al (2005), riparian forest buffers reduce nitrogen from upland uses by 70 – 90%. All these give confirmation to the fact that forests yield high-quality, clean water.

Other researchers have also evaluated the relative impact of streamside forest cover on various indicators of stream health. In a Montgomery County, Maryland study, United States, Goetz and others (2003) found that for streams to have a health rating of "Excellent", at least 65% of the length of the stream network in the watershed must be forested (within 100 feet of the stream). And at least 45% streamside forest cover was required for streams to have a health rating of "Good". Research has also shown that the best indicator of watershed health is impervious, cover with the healthiest watershed having less than four percent. The next best land use indicator is the amount of forest cover and the amount of riparian forest. A healthy watershed has over 70% cover. Riparian forest cover is especially important on agriculture dominated landscapes (Goetz, 2003).

Benefits of forested watersheds

Healthy forested watersheds offer a wide array of benefits. They absorb rainfall and snow melt, slow storm runoff, recharge aquifers, sustain stream flows, filter pollutants from the air and runoff before they enter the waterways and provide critical habitat for fish and wildlife. In addition, forested watersheds provide abundant recreational opportunities, help support local economies and provide an inexpensive source of drinking water and improve the quality of lives (USDA Forest Service, 2007). During heavy rainstorms, the highly absorbent forest floor intercepts runoff and reduces flooding. In dry periods, rainfall that soaked into the soil and entered the groundwater table is released to streams to maintain a steady flow. Deep penetration by tree roots or other vegetation makes the soil more permeable to rainwater so that runoff is slower and more uniform than on cleared land. As a consequence, streams in forested region continue to flow in dry weather and floods are minimized in rainy weather (IUCN *et al.,* 1990).

The total flow of any stream is made up of two main parts: The surface run-off and the sub-surface or ground water run-off into the stream. Through provision of obstacles such as roots, logs and decaying litter which act as spongy absorbent, forests drastically reduce surface run-off, thereby increasing percolation and the amount of water available for sub-surface run-off. Such reduction in surface run-off results in more uniform flow of streams throughout the year by reducing maximum flow during the rainy season. The result is that

maximum flow is nearly always less and the minimum flow, usually more from forested than from a comparable non-forested areas (Nwoboshi, 2000).

A Chesapeake Bay area study in the United States found a 24% decrease in forest cover during the years 1973-1997 resulting in a 19% increase in run off. The cost of treatment systems to intercept this additional run off was estimated at $1.08. Another area, forested watersheds play a very important role is in helping in the improvement of water quality. Although most forests are said to provide less total quantity of water (Calder, 2000), but they almost always increase water quality, compared with most other land uses. Because the water draining from natural forests is often exceptionally pure, it drastically reduces the costs of purification for domestic use. This is made possible because many of the activities that create pollution are absent from natural forests. The presence of leaf litter, ground vegetation, shrub layers and forest floor debris help to keep surface erosion (and therefore sediment) to a minimum, while the dense humus layer in forests may also play some role in filtering water (FAO, 2008). Thus, through the use of forests and forestry practices, applied on a watershed basis, it is possible to provide cumulative water quality benefits and offer low cost, long term solution to many of the nonpoint source pollution problems that confront many nations today.

All the watersheds of the world's major rivers begin in mountain high lands. Over half of the planet relies on fresh water that flows from these regions (Gardner-Outlaw and Engelman, 1999). In such mountainous territory, the value of forests for watershed and erosion protection commonly exceeds their values as sources of timber or recreation. The classic example is found in Switzerland and the neighboring Alpine region where the existence of pastoral settlements in the valley is usually dependent on the maintenance of continuous forest cover on the foot hills of the great peaks (Encyclopaedia Britanica undated).

This positive relationship between watershed forests and water quality is already being exploited to help supply clean drinking-water to millions of people around the world. Running Pure - a research report sponsored by the World Bank/WWF Alliance for Forest Conservation and Sustainable Use – discusses the links between protected areas and drinking water. The report includes study of world's top 105 cities (25 each from Africa, Americas, Asia, Europe and five from Australia) demonstrating the global importance of forests to urban water supplies. The report contains information on the cities that rely on protected areas for their drinking water supply and the measures some of them have taken to ensure sustainable provision of their water supply requirements. The report shows that around a third (33 out of 105) of the world's largest cities obtain a significant proportion of their drinking water directly from protected areas. At least, five other cities obtain water from sources that originates in distant watersheds that also include protected areas. In addition, at least eight more obtain water from forests that are managed in a way that gives priority to their functions in providing water. Amongst these cities with some or all of their drinking water coming from protected forests are Jarkarta, Mumbai, Karachi, Tokyo, Singapore, New York, Bogota, Rio de Janeiro, Los Angeles, Brasilia, Vienna, Barcelona, Dar Es Salam, Johannesburg, Sydney and Melbourne. Many of these protected forests are in official protected areas, with an International Union for the Conservation of Nature (IUCN) protected areas management category; National Parks, Nature Reserves or Wilderness areas (Dudley and Stolton, 2003). Cities are therefore utilizing a mixture of protection, careful management and restoration to maintain their drinking water supplies (ISTF News, 2004).

Countless other smaller town and cities do the same, and industries that need clean water are often deliberately located in the catchment areas of natural forests (FAO, 2008). In Sao Paulo, Brazil for instance, drinking-water for the city's 18 million inhabitants comes from forests in six protected areas. As well, Tokyo city in Japan draws almost all its water from two landscape protected areas: Nikko National Park (IUCN Category V, 140,698 ha) and Chichibu-Tama

National Park (Titibu-Tama) (Category V, 121,600ha) (Dudley and Stolton, 2003). New York City has always relied on the natural filtering capacity of its rural watersheds to cleanse the water that serves 10 million people each day. Rather than spend $7 billion to build water treatment facilities, the city will pay one tenth that amount helping upstream countries protect the watersheds around its drinking water reservoirs (Goldstein and Izeman, 1996). In Nairobi, Kenya, much of the city's water comes from rivers originating in the Aberdares (including Aberdares National Park, IUCN Category II, 76,619 ha) and the Mount Kenya National Park water catchment (Category II, 71,759 ha) (Nakagawa et al., 1994). At the same time, several other cities are currently suffering problems in water supply because of problems in watershed or draw water from forests that are being considered for protection because of their values to water supply (Dudley and Stolton, 2003).According to the United States Forest Service, more than half of the nation's drinking water comes from forested ecosystems (Reese, 2012). The United States Forest Service recognizing how crucial forested lands are to maintaining water quality, made watershed protection one of its main priorities under President Barrack Obama administration.

As well, because of the important role of forested watersheds in the quality of water supply, many other countries are today making conscious efforts to protect their watersheds. According to IUCN et al (1990), watershed protection has helped justify many valuable reserves that otherwise might not have been established, so irrigation and energy agencies can make powerful potential allies for protected areas that safeguard watersheds. In Honduras, for example, La Tigra National Park, a 7,500 hectare area consisting mainly of cloud forest produces a high quality well- regulated water flow throughout the year, producing over 40% of the water supply to Tegucigalpa (the capital city). Some 25 small collection facilities scattered throughout the park require only limited maintenance because the water is so pure and free of sediments. Because of its value for watershed protection, La Tigra is the focus of a major investment programme involving a series of economic incentives for villages living in the surrounding regions. The 2.5 million people in the Tanzanian capital of Dares Salam rely on drinking water from the Ulugura mountains, and for hydroelectric power from the cloud forests of the Udzungwa mountains (Hostettler, 2002). Some 40% of Third world farmers depend on forested watersheds for water to irrigate crops or water livestock. In India, forests provide regulation and flood control valued at $72 billion per year. Siltation of reservoirs cost the world economy about $6 billion per year in lost hydroelectricity and irrigation water (Durning, 1994).

The effects of forest clearance on watershed degradation

The great values placed on watersheds comes from their ability to absorb and cleanse water, recycle excess nutrients, and hold soil in place, and prevent flooding. When plant cover is removed, it results to water and wind erosion which leads to the loss of valuable topsoil. Exposed soil is eroded at several thousand times the natural rates. Under normal conditions, each hectare of land loses somewhere between 0.004 and 0.05 tonnes of soil to erosion per year – far less than what is replaced by natural soil building process. On lands that have been logged or converted to crops and grazing, however, erosion rates are many thousands of times higher than that. The eroded soil carries nutrients, sediments, and chemicals valuable to the system it leaves, but often harmful to the ultimate destination (Pimentel *et al.,* 1995).
Removal or degradation of watershed forest and pasture can cause great human suffering. Without the spongy-like effect of their vegetation, which retains moisture and releases it slowly, the flow of water becomes erratic leading to both floods and water shortages. The increased rate of water runoff causes additional damage by stripping the soil away, depriving agriculture of nutrients while clogging reservoirs, irrigation system, canals and docks with silt and smothering coral reefs (IUCN-UNEP-WWF, 1980).The Yangtze watershed in China, home to nearly 400 million people, has lost 85% of its original forest cover. The combined effects of logging, agricultural expansion and the population growth that helps fuel these activities has reduced the forest-to-people ratio in China to

one-sixth of the global average. More than 20 years of massive government tree-planting programme failed to keep pace with the escalating food and housing needs of China's 1.25 billion inhabitants (Gardner-Outlaw and Engelman, 1999).Such deforestation was also cited as a major factor in a landslide in northern India that killed 239 people in August of 1998. The devastation prompted the Chinese government to ban the cutting of old-growth forests in a desperate attempt to halt further damage in the Yangtze watershed **(**Ekholm, 1998). In Nepal, environmental officials said that the clearing of trees for fuel and farmland worsened the severity of floods that killed more than 125 people and caused over $20 billion in damage in 1998. Bangladesh complained that the worst flooding of the last decade was partly due to deforestation in the mountains of India and Nepal (Gardner-Outlaw and Engelman, 1999). It costs Argentina $10 million a year to dredge silt from the estuary of the River Plate and keep Buenos Aires open to shipping. Yet 80% of the 100 million tonnes of sediment that every year threaten to block the harbor comes from only 4% of the drainage basin, the small but heavily overgrazed catchment area of the Bermejo River 1800 km upstream (Pereira, 1973).

Sedimentation as a result of unwise or careless use of watershed forests can drastically reduce the economic life of reservoirs, hydroelectric facilities and irrigation system. For instance, the capacity of India's Nizamsagar Reservoir was more than halved, from almost 900 million cubic meters to less than 340 million m3. As a consequence, not enough water was available to irrigate the 110,000 hectares of sugarcane to supply local sugar factories (Das, 1977; IUCN-UNEP-WWF, 1980). Deforestation in northern Luzon in the Philippines silted up the reservoir of the Ambuklao Dam so fast that its useful life was reduced from 60 to 32 years (USAID, 1979). Flooding was said to have costs India alone from $140 to $750 million a year (Das, 1977; Sterling, 1976). Elsewhere in Asia, deforestation and poor land management have caused fluctuation in stream flows that have left high yield varieties of rice with either too much or too little water thereby reducing rather than raising yields.

It is said that only 10% of the world's population live in mountainous areas, but then, another 40% live in the adjacent plains (FAO, 1978); this by implication means that the lives and livelihoods of half the world directly depends on the way in which watershed ecosystems are managed.

Watershed forests situation in Nigeria

Nigeria is among the countries that have done a great deal of damage to her watershed forests. Many watersheds in the country today are degraded and considered in critical condition due to overexploitation. Worst still, a good number of urban riverbanks in the country have become dump sites for city garbage making them to have unsightly looks. Typical examples are Otamiri and Nworie rivers in Owerri, capital of Imo State both of which are presently seriously silted up because of the destruction of their watershed forests. A whopping sum of N9 billion was earmarked for the dredging of Nworie river by the Niger Delta Development Commission (NDDC) during the administration of Chief Ikedi Ohakim but no meaningful work was done. Such degradation of the watershed forests poses a great threat to the nation's economy, social wellbeing and environment. Much of the watershed forests in Nigeria have been destroyed as a consequence of agricultural expansion, logging and cutting for fuel, overgrazing, over-cultivation, rapid urbanization and infrastructural development such as badly managed road construction. Thus, deforestation and the large-scale transformation of the original vegetation of the country's forests to non-forestry purposes, coupled with inappropriate land use practices, have in effect disrupted the hydrological condition of watersheds.

These have brought about to some extent flash floods and prolonged drought that is leading to desert encroachment from the northern end of the country. Flooding has become a regular occurrence in Nigeria today. Ibadan the second largest city in Nigeria for instance is one of the most frequently flooded non-coastal cities in the country. The most recent and most catastrophic flood disaster to hit Ibadan occurred on 26th of

August 2011. The flood disaster, described as the most disastrous with 187.5mm of rainfall, the highest in the city since 1951 led to the loss of over 100 lives, while over 2,105 buildings were washed away. According to the chairman of Oyo State Task Force on Flood Prevention and Management, Mr. Bolanle Wahab, over N100 billion worth of property were damaged by the flood while thousands of people were displaced. The country as a whole witnessed her worst flood disaster in 50 years in 2012. The flood disaster led to the loss of over 363 lives while affecting another 7.7 million people, 2.3m of whom were displaced while over 600,000 houses were destroyed. The frequent occurrences of flood in Ibadan and other towns and cities in the country are attributable to forest destruction particularly watershed and riparian forests.

Another adverse consequence of the destruction of watershed forests in Nigeria is sediment build-up in our rivers, streams and other water bodies thus leading to poor water quality. Indeed, poor quality of water supply is a major problem in the country today particularly in the urban centres. Virtually all the water bodies found within Nigeria's urban centres are highly polluted, but in spite of this extreme pollution, they serve as the only source of drinking water for many urban households (Aju and Popoola, 2011). The health implications of the water pollution in Nigerian cities are quite obvious. Preventable water–related diseases which have been put under effective control in countries with adequate supplies of good quality water remain major killers in Nigeria today. The most serious of these are dysentery, cholera, typhoid, guinea-worm and bilharzia with dysentery remaining the second commonest health complaint after malaria in Nigeria (Onokerhoraye, 1995). In spite of the obvious negative consequences of forest destruction, particularly watershed forests, little has been done to ensure that policies and forest-management methods that recognize the vital role that forests play in our water supply are put in place.

Conclusion

It is important to note that our nation's economic health and the health of her citizens are dependent on having an abundant, clean and reliable source of fresh water. And from the forgoing analysis, it is obvious that clean, healthy forests are essential for the supply of such fresh water in our country. Considering the wide array of benefits accruing from forested watersheds, efforts should be geared toward the development, rehabilitation, restoration and protection of watershed forests in Nigeria. To do this, it is therefore necessary that policies and forest management methods that recognize the vital role of forests in fresh water supply are put in place. The local, states and federal governments are called upon to pay priority attention to watershed development in Nigeria as a means of checking erosion, flooding and other environmental problems occasioned by forest destruction as well as ensuring adequate and clean water supply to her citizens.

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