Journal of Environment and Earth Science
ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online)
Vol. 3, No.3, 2013 

# Assessment and Management Strategies for the Receding Watersheds of Ebonyi State, Southeast Nigeria

Ogbodo E N
Department of Soil and Environmental Management, Ebonyi State University,
PMB 053,Abakaliki, Ebonyi State, Nigeria
Email: emmanwaogbodo@ yahoo. com.

**Abstract**
The conditions of the watersheds of Ebonyi State has become a concern for individuals, communities, governments, donor agencies and private and public businesses as everybody depends on its resources. A study was therefore conducted within 2011 to 2012, to identify the dimensions and level of environmental degradation at the watershed sites with a view to developing management strategies for them. The study involved global positioning, reconnaissance survey and evaluation. The assessments of the sites identified were based on technical judgments, using the environmental baseline data collection and secondary information methods. A total of 39 degraded watersheds were identified, and which environmental assessment was carried out on. The results indicated that erosion, siltation and deforestation were the major environmental degradations, and cutting across almost the entire watersheds. Previous restoration measures were reviewed and recommendations for future conservation strategies were highlighted.
**Key words:** Receding watersheds, Degradation, Environmental assessment, Management, Ebonyi state.

## 1. Introduction

A Watershed is a land area whose runoff drains into any stream, river, lake, and ocean. Other terms used for watershed include *catchment* or *drainage basin*. The watersheds consist of land, water and the shed; the vegetative canopy that assists in maintenance of the dynamic equilibrium in the watershed ecosystem. Watersheds are uniquely multifunctional and capable of simultaneously producing agricultural commodities and generating ecosystem services. Black, P.E. (1997) elaborated this by stating that as water flows downhill in small to progressively larger streams and rivers, it moves over land and provides water for urban, agricultural, and environmental needs.

The conditions of the watersheds of Ebonyi State is of utmost concern to individuals, communities, governments, donor agencies and private and public businesses as everybody depends on its resources. The watershed's renewable resources (particularly animal foods e.g. fish, crabs, snails and frogs), are veritable sources of the protein needs of most rural dwellers in the State. Again, fuel woods used for cooking and commercial purpose come from the watershed, recharge of aquifers during the dry season, buffer zone to shoreline of water bodies, home for medicinal herbs, supports luxuriant vegetation, sink to wastes, particularly carbon dioxide ($C0_2$), source of water for domestic and commercial purposes, refuge for the people in times of war, and source of timber. The watershed community of the state is therefore made up of everyone who lives there plus all other animal and plant life; t*he community of humans, plants, and animals depend on the watershed and influence it in many ways.* Management of the watershed therefore, calls for concerted efforts of the communities who particularly are primary users of products of the watershed.

However, watershed restoration has not received much attention in Ebonyi State, with only a few number of programs proposed to control erosion and slow sedimentation. A key weakness of most of these management programs in the state has been their limited capacity to identify and focus efforts on key problem areas. This is often partly because reliable data on soils and erosion rates are lacking and planners may spend too little time in the field. This of course is much expected since the science and practice of watershed management and rehabilitation in the tropics has only begun to be developed. Even in the developed world, authorities face some of the same problems as developing countries in their attempts to manage watersheds subject to episodic mass wasting from natural and human causes. Even with all of their resources and trained personnel, often the best that they can do is avoid further degradation and treat the most obvious problems.

The principal objective of this study was to generate prerequisite data on the major watersheds in Ebonyi State. Specifically, the study identified the dimensions and level of environmental degradation at the watershed sites with a view to developing management strategies for them.

## 2. Methodology

This study was conducted between 2011 and 2012. The sites identified were based on technical judgments, using the environmental baseline data collection and secondary information methods. The study involved the use of Global Information System (GIS) for positioning, Reconnaissance survey and evaluation.

 

**Geographic location**:
Ebonyi State is located within the partially **modified low rain forest** and wooded/ **grassland derived savannah.** The State Lies approximately within Longitude 7°30' and 8°30'E and Latitude 5°40' and 6°45'N, situated within the Warm-Humid Equatorial climatic belt.

Climate

The area is characterized by high relative humidity of about 75% and surface temperature of about 27° to 30ºC. The mean temperature in the hottest period of February to April is about 87ºF. The rainy season begins between March 1st and March 11th and ends between November 8th and November 18th. Average length of rainy season is between 250 to 270 days in a year. The mean annual rainfall varies between 1750mm in the Northern part of the state to 2250mm in the Southern part (FDALR 1985).

Geology

Ebonyi State falls within the ***Asu-River Geologic Group (Lower Cretaceous), Eze-Aku shale formation and Nkporo Formations***. The State is made up mainly of ***hydromorphic soils*** which consist of reddish brown gravely and pale coloured clayey soil, shallow in depth, and of shale parent material. The topography is largely a table land; highest point 162m and lowest 15m above sea level.

Hydrology and ecosystem

The state lies within the cross River Drainage Basin. Major rivers in the state are the Eastern and Western Ebonyi Rivers which are tributaries of Cross River. All other rivers and streams are tributaries of these two Ebonyi Rivers. Existence of groundwater in parts of the state varies and is seriously influenced by the local geology. While the greater part, which includes the Abakaliki Metropolis, Onueke, some parts of Afikpo north and their environs record reduced groundwater yield to hand dug well and boreholes due to the underlying aquiclude. Other locations have good to fair groundwater yield to hand dug well and boreholes (some parts of Afikpo, Ezzamgbo, Nkalagu and environs). Ebonyi State is located within the partially modified lowland tropical rain forest and wooded grassland derived savannah. It has a total forest reserve of about 1478.98 hectares. Total area presently occupied by forest is 646.96 hectares.

Demography

The state occupies a land area of approximately 5,935 Square kilometers. It is made up of 138 communities, grouped into 64 Development Areas, 13 Local Government Areas, 6 Federal constituencies and 3 Senatorial zones. The people of Ebonyi state are predominantly Ibos and belong to what anthropologists refer to as the North-eastern Igbo group and the Kwa Linguistic subfamily of the Niger-Congo. They Speak Central Igbo and variants of the central Igbo, with about 22 sub-cultural groups. The population by 1996 census figure is 2,173,501 persons, comprising of 1,040,984 males and 1,132,317 females. With an annual growth rate of 2.8 % the projected population is now 2,495,316 persons with a population density of approximately 420/$km^2$. The pattern of human settlement is Predominantly Dispersed in the northern axis and Nucleated in the Southern part. The Major metropolitan towns are Abakaliki and Afikpo, whereas the emerging urban centres include Effium, Nkalagu, Ishiagu, Okposi, Onueke, Uburu, Ezzamgbo, Amasiri, Onicha, Akeze and Ebaunwana.

Land use

The inhabitants depend mainly on primary economic activities. Approximately 85% of the state population depend on agriculture for their livelihood. The agricultural production include: livestock and crops produced at both subsistence and export levels. Major crops for national and international markets are Rice, cassava and yam.

## 3. Results and discussion

Overview

A total of 39 degraded watersheds were identified and presented in tables 1 and 2, and which environmental assessment was carried out on. Table 1presents degraded watersheds in the partially **modified low rain forest, whereas table 2 shows degraded watersheds in the** wooded/ **grassland derived savannah.** Erosion, siltation and deforestation were the major environmental degradation observed, and cutting across almost the entire watersheds identified. Deforestation activities particularly aggravated soil erosion and soil loss across the landscapes, delivering the denuded materials into the watershed basins. There were also the degredative activities accentuated by farming involving tilling the soil up to the shore line for rice cultivation purposes. This predominated the entire landscape because rice culture is mainly a wetland practice, and most parts of these watersheds of the state are wetlands. However there are indications that management and erosion control programs have been planned and undertaken in the State. These activities too often appear to be executed with slight understanding of the actual landscapes and minimal field experience. Magrath, (1992) noted that the peculiar setback to erosion and watershed management projects in the tropics is a tendency to

 

over plan at the watershed/regional level and under plan at the village/micro catchment level. Dunne 1988 agrees largely with this observation when he pointed out that there are few large tropical or subtropical watersheds where such intensive interventions have been accomplished. Some experienced observers now argue that many of such efforts are doomed to failure (Magrath and Doolette 1990, Mahmood 1987).

Given the uncertainties involved in the estimation of natural erosion rates, river sediment loads, and the magnitude and impacts of human induced erosion, it is a serious question whether degradation reduction can be planned and executed effectively in many of the large watersheds in the state. It is as a result of this understanding that the coupling of GIS with good field studies in the present research that identified sediment sources across large landscapes would be a significant step forward. This will ensure effectiveness of programs for managing sedimentation in the future, such that these efforts would be directed to specific problem areas in vast, often remote landscapes where governments may have a minimal institutional presence.

Sediment movement in large basins is a complex process taking place over long periods of time. Enthusiasm for the rehabilitation of these watersheds should therefore be tempered by caution about when and where such large, natural systems can actually be managed. Ideally, effective sediment control measures should be in place before the initiation of projects, but it is often left until later. In fact, Dickinson and Tracy (1989), agrees to a large extent that failure to distinguish in the field between relatively uncontrollable natural erosion processes and those that are accelerated by human activities can be costly and threatens the credibility of our management rhetoric

This is why soil conservation programs that focus on agricultural lands are not only necessary and useful for many reasons; but (although the control of agricultural erosion may have many other benefits,) if the control of watershed sedimentation is the principal reason for such programs, more critical thought must be given to the description and quantification of major sediment sources.

Thus far, research on tropical watershed management and erosion has usually been on such small areas that results cannot be generalized. Therefore extrapolating such results to the situation in the Ebony state receding watershed case would lead to colossal failure.

**Problems in the management of the watersheds**

The rhetoric of watershed management in the state extols the benefits of clear water, flood control and conserved soil. This enthusiasm is backed by greatly increased expenditures by donor agencies. However these interventions are rarely based upon an integrated management plan addressing whether or where they are needed and if they are cost effective. There is failure to distinguish in the field between relatively uncontrollable natural erosion processes and those that are accelerated by human activities can be costly and threatens the credibility of our management rhetoric. Hence, the unexpectedly high rates of sedimentation measured in watersheds may be explained partly by inadequate data collection and analysis prior to the projects, not subsequent degradation of the watershed. The capacity to reduce sedimentation probably differs greatly between watersheds, and there have been few efforts in the state to identify those biophysical factors that determine where treatments will be most effective.

**Evaluating sources of sediments**

The potential effectiveness of sedimentation control may be improperly assessed if the sources of sediments are inaccurately estimated. The question of whether sediments are of human or geological origin is therefore of particular importance in the case of the watersheds of Ebonyi state because sediments derived from landslides may be much larger than the finer sediments from agricultural lands. These larger particles move as bed load through river systems while fine sediments are carried as suspended load. Two problems that must be overcome to improve estimates of sedimentation are the episodic nature of erosion and the predominance of mass wasting in supplying sediments in some watersheds.

Identification of the actual sources of sediments and understanding whether they are amenable to control is fraught with difficulty even in the best of circumstances. The planning of such programs in this case usually involved much ‘‘guesswork’’ about the actual conditions on the ground, leading to overly optimistic projections of project success. In fact there are many other tropical watersheds where management programs for sediment control have been proposed and executed, but few of them have yet produced verifiable results.

 

The role of built-up village areas and transportation routes as sources of sediments has received surprisingly little study. Sediment production from some forest road surfaces is estimated to be as high as 25 $m^3$/100 m of road length each year. It is estimated that road construction created conditions 200 times more likely to cause land movements than the combination of other human activities and the natural tendency of the terrain to slide.

Little is yet known about the actual contribution of cultivated lands to sediment loads in the state or the downstream impact of soil conservation programs.

**Remedial measures for the management of the watersheds**

A realistic assessment of the institutional capabilities for carrying out large-scale rehabilitation needs to be done. There should be information on the geological stability of the terrain and natural disturbance regimes.

Rehabilitation of the watersheds must be undertaken to begin the process of reducing the transport and deposition of sediments, even though for large basins the time lag for noticeable reductions may be decades or centuries. Magrath and Doolette (1990) state that watershed rehabilitation must be undertaken to begin the process of reducing the transport and deposition of sediments, even though for large basins the time lag for noticeable reductions may be decades or centuries. Regardless of the questions raised by many of the prospects for watershed reclamation, almost all extol the value of soil conservation in its own right.

It is proposed that when the degree of degradation on the upper slopes exceeds a certain limit and the feasibility of erosion control is questionable, the possibility of controlled colluviation on the lower slopes should be considered. This may often mean the use of vegetated buffer strips on the lower slopes adjacent to the streams where sediments eroded from hill slopes may be trapped and stored. Such buffers require a dense ground flora with quick growth and high colonizing capacity able to keep up with the rate of sedimentation. This requires the provision of adequate vegetal cover to exposed land especially along the slope and the planting of some species of native tress.

It is often assumed that humans are the main factor in the degradation of watersheds, with the cultivation of steep slopes the chief culprit. There should be dredging of the river channels especially downstream to increase their carrying capacity. The larger a watershed, the more opportunities there are for storage in river and tributary channels from which sediments will continue to move downstream regardless of upland control measures. The dredged and excavated materials should be used to build up the banks. The other important measure is the straightening of the river/stream course in order to remove constricting bends and bows.

**Conclusion**

The watershed is a natural unit of land which collects precipitation and delivers run-off to a common outlet. This makes it naturally a home for thick and luxuriant vegetation. It is a system in dynamic equilibrium and is influenced by man in all the stages of its evolution.

The watersheds of Ebonyi State have become a stream of life without which life of the inhabitants would have been a mirage. Its roles are source of animal food, (fish, crabs, frogs and snails). The watershed ecosystem is very rich in biodiversity (plants and animal species), but sensitive and fragile to changes arising from man's anthropogenic activities, like human settlement in wetlands, deforestation for fuel wood and swamp rice farming up to shorelines. When the watershed ecosystem is modified by these socio-economic interventions, it becomes imperative that it be put back to its original state using certain mitigating measures. There is the need for efforts to be directed toward management of the watershed which has local and global roles in man's survival.

The degraded watersheds in Ebonyi State have already been identified. There is the need for development of various steps to be employed in the effort to put a halt to further environmental degradation in these areas and possibly regenerate some degraded areas for use by man. This effort, therefore, should be focused on soil conservation and reforestation as two of the important measures towards prevention of more degradation and mitigating the adverse impacts of Erosion and siltation on the watersheds. This will involve the reintroduction of forest condition i.e. to cover again with forest. A planned expansion of tree covers to counteract the various side effects of deforestation, soil erosion, disruption of water cycle or global warming.

**Acknowledgements**

I sincerely appreciate the benefits of the pioneering work of the Green Scenario Services, under the auspices of the United Nations Development Programme (UNDP), Ebonyi state. May I also acknowledge the assistance and services of Engineer L. O. Eze-Ukpa of Ebonyi State Environmental Protection Agency (EBSEPA) and Benjamin Uguru of Ebonyi State Agricultural Development Programme (EBADEP).

 

**References**

Black, P.E. 1997. Watershed functions. *Journal of The American Water Resources Association*, 33(10): 1–11.

Chang, J. H. 1993. Hydrology in humid tropical Asia. *in* M. Bonnel, M. M. Hufschmidt, and J. S. Gladwell (eds.), Hydrology and water management in the humid Tropics . Cambridge University Press, Cambridge. 55–66

Costa, J. E. 1975. Effects of agriculture on erosion and sedimentation in the Piedmont Province, Maryland. *Geological Society of America Bulletin* 86:1281–1286.

De Ploey, J., and A. Yair. 1985. Promoted erosion and controlled colluviation: A proposal concerning land managementand landscape evolution. *Catena* 12:105–110.

Dickinson, J., and F. Tracy. 1989. Stream corridors in watershed management. Prepared for Agency for International Development, DESFIL, Washington, DC, 17 pp.

Dunne, T. 1988. Geomorphologic contributions to flood control planning. Pages 421–438 *in* V. R. Baker, R. C. Kochel, and P. C. Patton (eds.), Flood geomorphology. John Wiley & Sons, New York.

Dunne, T., andW. Dietrich. 1982. Sediment sources in tropical drainage basins. *in* S. A. El-Swaify and William Moldenhaur (eds.), Soil erosion and conservation in the tropics. Soil Science Society of America, Madison, Wisconsin. 41–75

FDALR (Federal Department of Agriculture and Land Resources) (1985). The reconnaissance soil survey of Anambra State soil report 1985. Federal Department of Agriculture and Land Recourses. Lagos-Nigeria

Magrath, W. B., and J. B. Doolette. 1990. Strategic issues in watershed development. Pages 1–25 *in* J. B. Doolette and W. B. Magrath (eds.), Watershed development in Asia: Strategies and technologies. Technical Paper Number 127. World Bank, Washington, DC.

Mahmood, K. 1987. Reservoir sedimentation: Impact, extent, mitigation. Technical Paper Number 71. World Bank, Washington, DC, 118 pp.

S Shukla (2010) Watersheds-Funtions and Management. University of Florida IFAS Extension. 1-6

 

**Table 1: Degraded Watersheds of Ebonyi State**

| S/No | Community | Location | **Watershed degraded** | **Level of environmental degradation** |
|---|---|---|---|---|
| 1. | Ekoli-Edda | N05°48.645[1] E007°51.487[1] Alt.46m | Otoghu stream | Eutrophication & siltation |
| 2. | Nguzu-Edda (1) | N05°45.033[1] E007°58.754[1] Alt.105m | Iroyi Mgboro River | Sedimentation |
| 3. | Nkagbogo-Unwana | N05°48.932[1] E007°51.148[1] Alt.83m | Egwini stream | Asphyxiation & siltation |
| 4. | Okposi | N06°01.370[1] E007°49.515[1] Alt.43m | Ata stream | Bridge damage & siltation |
| 5. | Eziotinya-Owuta Unwana | N05°48.304[1] E007°55.808[1] Alt.73m | Owuta stream | Siltation |
| 6. | Ndibe | N05°52.012[1] E007°56.966[1] Alt.69m N05°52.012[1] E007°56.966[1] Alt.69m | Iyiobasi stream | Siltation |
| 7. | Nkpoghoro (1) | N05°52.483[1] E007°56.226[1] Alt.44m | Uji stream | Siltation |
| 8. | Ozizza (1) | N05°53.357[1] E007°58.160[1] Alt.127m | Ekeje stream | Siltation |
| 9. | Enohia Itim | N05°52.431[1] E007°56.034[1] Alt.81m | Cross River | Deforestation |
| 10. | Ebunwana | N05°47.634[1] E007°55.415[1] Alt.35m | Odonneligi stream | Siltation |
| 11. | Ozizza | N05°53.083[1] E007°58.125[1] Alt.90m | Eluma lake | Siltation |
| 12. | Agbabor-Isu | N06°10.006[1] E007°50.315[1] Alt.75m | Igneoma stream | Siltation |
| 13. | Owutu-Edda (1) | N05°48.890[1] E007°51.136[1] Alt.80m | Ofoyi Abiewere stream | Siltation |

| | | | | |
|---|---|---|---|---|
| 14. | Ukawu (1) | N06o00.7201<br>E007o55.7671<br>Alt.44m | Omo stream | Deforestation and siltation |
| 15. | Orrah-Ozizza (2) | N05o53.1421 E007o58.2141<br>Alt.54m | Ekeje stream | Siltation |
| 16. | Ukawu (2) | N06°03.413[1]<br>E007°59.593[1]<br>Alt.56m | Asu/Ebonyi Rivers | Deforestation and siltation |
| 17. | Akaezeukwu | N05°57.875'<br>E007°33.218'<br>Alt 59m | Eziaku River | Deforestation and siltation |
| 18. | Amaenu-Okposi | N06°02.767[1]<br>E007°45.663[1]<br>Alt.35m | Asu River | Deforestation |
| 19. | Eluma-Amasiri | N05°52.012[1]<br>E007°56.966[1]<br>Alt.69m | Asu River | Deforestation |
| 20. | Uburu (1) | N06°04.399[1]<br>E007°44.245[1]<br>Alt.49m | Asu River | Siltation |
| 21. | Obeagu Amokwe isiagu | N05°52.599'<br>E007°32.467'<br>Alt.68m | Ugwoagwuiyi stream | Siltation |
| 22. | Ndibe | N06°01.370[1]<br>E007°49.515[1]<br>Alt.43m | Cross River | Deforestation |

 

**Table 2: Degraded Watersheds of Ebonyi State**

| S/No | Community | Location | **Watershed degraded** | **Level of environmental degradation** |
|---|---|---|---|---|
| 1. | Mkpuma-Akpatakpa, Agbaja | N06°33.455' E008°10.239' Alt.123m | Ofiaesu stream | Siltation |
| 2. | Nkaleke layout | No6°17.688' E008°05.292' Alt.72m | Iyiokwu stream | Siltation |
| 3. | Ogidiga-Nwakpu | N06011.8621 E008017.8931 Alt.43m | Ikpete stream | Siltation |
| 4. | Amudo | N060 05.9621 E00 80 01.564' 53m | Ndende stream | Deforestation and siltation |
| 5. | Onu-enyim Sheik | N060 25.5631 E0080 05.6401 Alt. 62m | Ebonyi/Odidi/Benue River | Deforestation and siltation |
| 6. | Ete, Nkaleke | N06°22.296[1] E008°06.710[1] Alt.59 | Utorobi/Ebonyi River | Deforestation and siltation |
| 7. | Ndiagu-Echara | N06$^0$09.271[1] E008$^0$16.715[1] Alt.42m | Ebonyi/Cross River | Deforestation and siltation |
| 8. | Nkalagu | N06$^0$28.675[1] E007$^0$46.172[1] Alt.78m | Ora River | Deforestation and siltation |
| 9. | Azuiyiokwu layout | No6°18.704' E008°06.456' Alt.54m | Azuiyiokwu stream | Siltation |
| 10. | Idembia Sheik | N06°22.093[1] E008°03.302[1] Alt.58m | Isinkpuma stream | Deforestation |
| 11. | Ntezi | N06$^0$24.329[1] E007$^0$54.814[1] Alt.115m | Ikam stream | Siltation |
| 12. | Igbudoke-Effium | N06$^0$ 37.88' E008$^0$.32.154' 108m | Okpilicho stream | Deforestation |
| 13. | Ishiagu-Ohafia, Agba | N06$^0$17.689[1] E007$^0$49.354[1] Alt.62m | Okpuru pond | Deforestation |
| 14. | Uburu-Amachi | No6°19.069' E008°11.784' | Oto stream | Siltation |

 

| | | | | |
|---|---|---|---|---|
| | | Alt.80m | | |
| 15. | Izenyi Isieke | N06°28.238[1] E008°08.564[1] Alt.103m | Odidi River | Siltation |
| 16. | Abeh Mgbabuluzo Ndieze-echi | N06°23.038' E008°16.175' 88m | Abeh stream | Siltation |
| 17. | Enyaumali nsokkara | N06$^0$ 06.081[1] E00 8$^0$ 01.484' 70m | Ebonyi River | Deforestation and siltation |

This academic article was published by The International Institute for Science, Technology and Education (IISTE). The IISTE is a pioneer in the Open Access Publishing service based in the U.S. and Europe. The aim of the institute is Accelerating Global Knowledge Sharing.

More information about the publisher can be found in the IISTE's homepage: http://www.iiste.org

## CALL FOR PAPERS

The IISTE is currently hosting more than 30 peer-reviewed academic journals and collaborating with academic institutions around the world. There's no deadline for submission. **Prospective authors of IISTE journals can find the submission instruction on the following page:** http://www.iiste.org/Journals/

The IISTE editorial team promises to the review and publish all the qualified submissions in a **fast** manner. All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Printed version of the journals is also available upon request of readers and authors.

### IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar