SENSITIZATION WORKSHOP ON PREVENTION AND CONTROL OF SOIL EROSION IN THE 27 LOCAL GOVERNMENT AREAS OF IMO STATE

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INTRODUCTION

This Sensitization Workshop on Prevention and Control of Soil Erosion is organized by Oil Resources and Allied Investments Limited under sponsorship by the Imo State Government, Ministry of Petroleum and Environment and presented by Dr. Odili Ojukwu – Executive Director of World Igbo Environmental Foundation (WIEF). The Workshop developed for, and presented to, the 27 Local Government Areas of the State is aimed at providing participants with basic understanding of how and why soil erosion occurs in the state, and an integrated approach toward its prevention and control at the local and community levels.

Imo State is located within the southeast geopolitical zone of Nigeria and has a land area of 5,329.17 sq. km. with a population of 2,485,499 people (2008, Imo State Government Website). The state is reported to have a population density varying from 230 persons per km in Oguta/Egbema area to 1,400 persons per km in Mbaise, Orlu, Mbano and Mbaitoli areas. A significant portion of the suburban setting comprise predominantly of residential homes and agricultural lands.

Imo State loses so much annually in human and material resources as a result of gully development. Homes and property worth billions of naira are lost annually. Federal and state roads that cost billions of naira to construct are destroyed by erosion. Invaluable lives are frequently lost and families are often put in disarray in perennial floods, landslides and gully-based accidents. Many farmlands and important cash crops are annually lost to flooding and erosion in the state.

The increasing devastation caused by the degrading environment and the existence of hundreds of gully erosion sites in almost all communities in the state, and the government's desire to protect human life, property, aquatic habitats and the quality of life in these communities has brought home the pressing need to

develop and promote a consistent and effective community-based approach to the prevention and control of soil erosion in the state.

PURPOSE OF WORKSHOP

The Imo State Government through this Sensitization Workshop on Soil Erosion Prevention and Control aims to create increased community awareness of the causes and processes of soil erosion as well as induce an active sense of remedial involvement and intervention within the 27 Local Government Areas (LGAs) of the state.

The Workshop will review the historical and existing environmental factors that have contributed to, and/or are contributing to the existence of soil erosion gullies in the state as well as the impacts on communities, and the potential for escalation if nothing is done to mitigate the situation.

WORKSHOP GOALS

The goals of the Workshop include the following:

1) To highlight the various aspects of the environment and how they impact our daily lives;
2) To create an understanding of ecosystems and how human activities cause changes in them;
3) To create an understanding and appreciation of soil erosion processes;
4) To create an understanding of the factors that influence soil erosion and how erosion affects us and our communities;
5) To create an understanding of the need for an integrated approach to preventing and controlling soil erosion; and,
6) To induce an active sense of commitment and involvement in the prevention and control of soil erosion within the 27 LGAs and their respective communities.

THE ENVIRONMENT

The environment consists of all natural and physical elements of the living space. It includes natural components as soil, water (ground and surface), air, and man-made physical improvements such as infrastructural developments. The environment is an integral part of our daily life – it affects what we do, where we live and the overall quality of our lives whether in the cities, towns or villages.

Environmental degradation is "killing" everyone! Everywhere you look there is soil and water contamination, air pollution, and the destructive effects of soil erosion and gullies. Environmental hazards are indiscriminately taking peoples' lives. These hazards include:

- Soil contamination from industrial, commercial and domestic wastes
- Soil pollution from medical and other hazardous wastes;
- Soil surface destruction from soil mining (laterite excavation);
- Soil erosion from storm water and wind;
- Local and regional flooding from rain water;
- Surface water (rivers, streams, lakes, creeks, etc.) pollution from industrial and domestic wastewaters;
- Groundwater contamination from industrial wastes, untreated sewage, petrol station tank leaks, solid waste dumps, etc.;
- Air pollution from industrial waste stacks, indiscriminate waste burning, vehicular exhaust fumes, etc.

UNDERSTANDING ECOSYSTEMS

From the cities and towns (urban setting) to the villages (rural setting), the landscape is alive with the beauty and details of nature – the landscapes, oceans, rivers, streams, human beings and other animals, trees, plants, grasses, birds,

insects, fishes, bacteria and other micro-organisms, etc. All these interact with one another to maintain a natural balance or cycle in the universe.

What is An Ecosystem?

An ecosystem is a community of animals and plants interacting with one another and with their physical environment. People are part of the ecosystems where they live and work. Ecosystems include physical and chemical components, such as soils, water, and nutrients that support the organisms living there. These organisms may range from large animals to microscopic bacteria.

When soil structures and soil nutrients are destroyed either through human activities or natural phenomenon like soil erosion, the ecosystem is affected. This is because the activities of other components of the ecosystem are affected. Also, when surface water bodies are polluted, ecosystems are also affected because activities of the other elements are impacted. It is essential to maintain balanced healthy ecosystems.

WHAT IS SOIL EROSION

Soil erosion is a complex, naturally occurring process that results in the detachment of soil particles and transporting of such particles to unintended locations. Soil erosion can be brought about by water or wind, each contributing a significant amount of soil loss each year and leading to the destruction of ecosystems.

For purposes of the Workshop, soil erosion refers to the detachment of soil particles by water. Soil erosion can be a slow process that continues relatively unnoticed, or it can occur at an alarming rate causing serious loss of topsoil.

Surface runoff is the fraction of the rainfall which does not soak into (infiltrate) the soil and flows under the action of gravity. Runoff occurs for two reasons; firstly, if rain arrives too quickly (i.e. high intensity) the water may not have

sufficient time to infiltrate. Secondly, runoff occurs if the soil has already absorbed all the water it can hold (i.e. fully saturated).

TYPES OF SOIL EROSION

There are primarily three types of soil erosion, namely Sheet Erosion, Rill Erosion and Gully Erosion.

Sheet erosion is the soil movement that occurs when raindrop splashes break down soil surface structure and move soil particles away from their original positions. It occurs rather uniformly over the land and can go unnoticed until most of the productive topsoil has been lost.

Rill erosion is the soil movement that occurs when the flow of rain water forms small well-defined channels through which the water flows. These channels are called “rills” when they are small and do not significantly interfere with normal activities on the land.

Gully erosion is the soil movement that occurs when the small well-defined eroded channels become significantly large. Gullies result in large quantities of topsoil and subsoil being lost annually. In general, as sapping, caving and sliding at the gully head and along the sides occur, accompanied by the down-slope transportation of gully floor debris by runoff, the gully continues to expand.

FACTORS THAT INFLUENCE SOIL EROSION

Soil erosion by surface runoff largely depends on soil properties, ground slope, vegetation, and rainfall characteristics. Changes in land use also greatly accelerate soil erosion. These factors contribute to the rate and magnitude of soil erosion in the following ways:

Soil Properties (Erodibility)

Soil consists of particles varying in sizes from very fine grains (clay, silt and fine sand) to large particles (sand and gravel). Organic matter is made up of decaying plants and animal remains. Organic matter provides nutrients to the soil, improves soil structure and can be considered as the “glue” that binds the soil particles in place.

Soil erodibility is a measure of the ability of soils to resist detachment, based on the physical characteristics of each soil. Generally, soils with faster infiltration rates, higher levels of organic matter and improved soil structure have a greater resistance to detachment or erosion. Infiltration is the flow of water into the soil. Coarse particles like sand, sandy loam and loam textured soils tend to be less erodible than silt, very fine sand, and certain clay textured soils.

Tillage and cropping practices which lower soil organic matter levels cause poor soil structure and increase soil erodibility. Compacted subsurface soil layers can cause decreased infiltration and increased runoff. Exposed subsurface soils on eroded sites tend to be more erodible than the original soils. This is because of their poorer structure and lower organic matter. The lower nutrient levels often associated with subsoils contribute to lower crop yields.

Ground Slope (Topography)

Topography is the flatness or undulating nature of an area. Slope length and steepness greatly influence both the volume and flow of surface runoff. Long slopes cause more water to flow to the base of slopes and steep slopes increase runoff velocity. Both conditions increase the chances for erosion to occur. Naturally, the steeper the slope is, the greater the amount of soil loss from erosion by water.

Vegetation (Ground cover)

Vegetation is simply plant growths on soil surfaces. Vegetation provides protective cover for soil and prevents soil erosion in the following ways:

a) Grasses slow down water as it flows over the land (runoff) and this allows much of the rain to soak into the ground;
b) Plant roots hold the soil in position and prevent it from being washed away;
c) vegetation breaks the impact of a raindrop before it hits the soil, thus reducing its ability to erode;
d) Plants in wetlands and on the banks of rivers slow down the flow of the water and their roots bind the soil, thus preventing erosion.

The loss of protective vegetation through deforestation, over-grazing, and fires make soil vulnerable to being swept away by surface runoff. In addition, over-cultivation and compaction cause the soil to lose its structure and cohesion and it becomes more easily eroded. Erosion will remove the top-soil first. Once this nutrient-rich layer of soil is gone, few plants will grow in the soil again. Without topsoil and vegetation the land becomes desert-like and unable to support life - this process is called desertification.

Rainfall Characteristics

Rainfall characteristics such as frequency, intensity, and duration directly influence the amount of rain water that is generated. Rainfall frequency is how often the rain falls. Rainfall intensity is how much rainwater that falls in a unit time and the duration is how long the rainfall lasts. As the frequency of rainfall increases, water has less chance to drain through the soil between rainfalls. The soil therefore remains saturated for longer periods of time and rainwater flow volume can become greater. Therefore, the chances of erosion are high where rainfall is frequent, intense, or lengthy.

The impact of raindrops on the soil surface cause lighter aggregate materials such as very fine sand, silt, clay and organic matter to be easily detached and disperse. As runoff moves downhill, it is at first a thin diffuse film of water which has lost virtually all the energy which it possessed as falling rain. It moves only slowly with low flow power, and is generally incapable of detaching or transporting soil particles. However, as runoff increases through the convergence of rills, it gathers sufficient energy in its flow to move even the larger soil particles. The transport of larger particles induces further soil erosion and increases the size of rills until they become gullies.

HUMAN ACTIVITIES THAT PROPAGATE SOIL EROSION AND DEGRADE THE ENVIRONMENT

Many human activities which occur on a daily basis tend to increase the occurrence of soil erosion and gullies in the various communities. Settlement patterns, the nature of housing and infrastructural development contribute to the propagation of gullies. Settlements are not planned; houses are built indiscriminately without consideration to natural flood paths and drainage systems.

Sand excavations are recklessly carried out by individuals along existing road sides. These excavated sites eventually develop into huge gullies as rainwater continues to impact on them. Large portions of the vegetation cover are cleared annually for farming purposes, thereby exposing the top soil. With the soil exposed, it is no longer capable of resisting the erosive actions of the rain water. These activities essentially result, in many ways, to the continued degradation of the environment. Other specific activities include:

- Poor solid waste management practices;
- Poor road construction practices;
- Poor home construction practices;

- Construction of undersized and inappropriate drainage systems; and,
- Poor infrastructural development practices.

EFFECTS OF SOIL EROSION

The effects of soil erosion are tremendous and multifold.

Soil Quality:

The immediate impact of soil erosion is the reduction in soil quality (i.e. a decrease in the soil's suitability for agriculture or other vegetation). This is because generally, the eroded upper layer of the soil is the most nutrient-rich. Soil structure, stability and texture are usually affected by loss of soil. The breakdown of aggregates and the removal of smaller particles or entire layers of soil and organic matter weaken the soil structure and change the texture. Textural changes in turn affect the water-holding capacity of soil, making it more susceptible to extreme condition.

The implications of soil erosion extend beyond the removal of valuable topsoil. Crop emergence, growth and yield are directly affected through the loss of natural nutrients and applied fertilizers with the soil. Seeds and plants can be disturbed or completely removed from the eroded site.

The most serious impact of soil erosion is its threat to the long-term sustainability of agricultural productivity. Increased use of artificial fertilizers may to an extent, and for a time, compensate for erosion-induced loss of soil quality where economic circumstances are favorable. However, this is not usually feasible in developing countries, including Nigeria.

Siltation of Watercourses and Disruption of Ecosystems:

Soil that is detached by accelerated water can be transported to considerable distances. This gives rise to off-site problems. The main off-site effect of soil erosion is the deposition of sediments into watercourses. This leads to:

- The silting-up of surface water bodies (rivers, streams, creeks, dams, etc.);
- Disruption of the ecosystems; and,
- Contamination of drinking water.

Other impacts include increased downstream flooding and damage to property.

Pollution of Watercourses:

Another major off-site impact results from the chemical pollutants that often move with eroded sediment. These chemicals move into, and pollute, downstream watercourses and water bodies. Most of these surface water bodies serve as the only sources of drinking water for a large segment of the communities.

Loss of Ancestral Land:

For most families in Imo State and in Nigeria at large, land has remained a traditionally inheritable commodity, and is passed on from one generation to another. The risk with gully erosion is its irreversible nature. Once it takes hold, it becomes almost a lost battle to reverse the landslides and the degradation. Thus when it occurs to any land, that precious piece of land is permanently lost to the owner(s). Thousands of families have, historically, become refugees in their own homeland as a result of gully erosion disasters. This is unfortunate but avoidable.

HOW TO PREVENT AND CONTROL SOIL EROSION

In the overall approach to soil erosion, it must be borne in mind that:

"Prevention is better than cure."

The soils of Imo State are typified by weak lateritic and sandy materials that are unstable and poorly consolidated. These lateritic and sandy soils are easily eroded by storm water runoffs. Imo State soils are also generally oversaturated during extended rainfall periods as is the case with other parts of the region. It is

thus necessary to develop an integrated remedial and preventive plan that considers all elements and contributors to soil erosion.

Funding is limited (source and quantity) for erosion intervention, and there are competing interests even for the limited available funds at the federal, state and local government levels. The preventive plan must therefore be driven by the application of non-structural and natural approaches to reduce impacts of stormwater runoff on each local watershed. These approaches are not only cost effective but generally require very low maintenance.

The plan will include activities that redirect excess stormwater flow, conserve natural areas, reduce impervious cover and integrate stormwater treatment, and views stormwater as important resource and opportunity for our communities. Furthermore, the activities must be enhanced through public and community outreach and enlightenment. Public education is essential to ensure sustainability of any gully termination strategy and soil erosion prevention.

Gully formations can be difficult to control if remedial measures are not designed and properly constructed. Control measures must consider the cause of the increased flow of water across the landscape. This is where the multitude of conservation measures come into play.

REMEDIAL AND PREVENTIVE STRATEGIES

1. Any remedial actions for an existing gully must be preceded by a proper understanding of the regional watersheds and topography of the area. This is extremely useful and necessary to assess how much water is actually flowing to the gully and the contributing sources. Many states have already developed a state-wide digital base map which is an essential tool in the ultimate and effective resolution of soil erosion issues.

2. Immediate stabilization of the erosion gullies is the best realistic short-term approach to existing gullies whether small or large. The objective is to divert and modify the flow of water moving into and through the gully so that while scouring is reduced, sediment will appreciably accumulate and re-vegetation can then take place. Stabilizing the gully head is important to prevent damaging water flow and head ward erosion.
3. A variety of options can be used to get the water safely flow from the natural level to the gully floor. Improvements like grass chutes, pipe structures, rock chutes or drop structures can be installed to do this effectively. Structures may also be required along gully floors since some grades can be quite steep. This prevents water rush down under peak flows from ripping away soil and vegetation. These may take the form of rock barrages, wire netting or logs across gullies. Sediments held in the water will then be deposited along the flatter grades as a result of slower water flow, allowing vegetation to re-establish.
4. Re-vegetation and reforestation of eroded lands can be effective at reclaiming and controlling gully corridors in communities. Planting deep-rooted perennial pastures, trees, or an appropriate mixture of both, can help maintain healthy and vigorous levels of vegetation. Cashew trees have roots that serve to cohesively hold the subsurface soil intact creating soil permeable membranes to the runway storm water.

As part of the preventive strategy, vegetation and residue combinations that completely cover the soil and which intercept all falling raindrops at and close to the surface are the most efficient in controlling soil erosion (e.g. forests, permanent grasses). Also the effectiveness in preventing or reducing soil erosion will depend on the type, extent and quantity of cover. Partially incorporated residues and residual roots are important as these provide channels that allow surface water to move into the soil.

Many local foot pathways in all the communities in the state have become runoff flow corridors because of the depressions created by foot movements. Consequently, these foot pathways are easily eroded when water flows over them. To prevent the propagation of erosion on foot pathways, proactive steps must be taken to break the water flow with logs, stone packs or old tyres. It is important to take the above steps to prevent gully formation along any portion of the foot path corridor.

Other strategies for preventing gully erosion include:

- Harvesting of rain water on the foot prints of homes and other building structures as a way of resource utilization;
- Construction of earth dams for purposes of runoff diversions and flow reductions;
- Maintaining remnant vegetation along drainage lines and eliminating grazing from these areas;
- Vermin control;
- Avoiding excessive cultivation.

CONSERVATION MEASURES

Soil conservation is the prevention of soil erosion or soil becoming altered by overuse, acidification or contamination.

Certain conservation measures can reduce soil erosion. It is important to grow plants that are indigenous to your area since the local flora has been there for a very long time and aid in conservation. Another thing to do is to plant trees and shrubs that can provide shelter for your soil, while the roots will help to prevent excess water from washing it away. Keeping enough vegetation strong, healthy and growing will bind the soil together and protect its surface.

Physical structures made of earth, stone or other organic materials can aid in protecting soil against uncontrolled runoff and erosion. With a little bit of design, it can also retain and direct water to where it is needed most. The best structure will depend on climate and the need to either discharge or retain runoff.

Vegetation such as rye and clover will protect soil by thickly covering the ground and will also restrict weed growth and reduce runoff.

PARTICIPATING IN EROSION PREVENTION AND CONTROL

In a general sense and given the massive destruction already caused to the state land mass, the prevention and control of soil erosion in the state must be the responsibility of all stakeholders - the three tiers of government, non-governmental groups/agencies, the private sector and the communities. All stakeholders must work together on the solutions in a coordinated fashion in order to achieve sustainable results.

Since the effects and full impact of soil erosion processes as well as any environmental or ecological degradation in any community are exclusively borne by the members of that community, the community must step up and take greater responsibility for protecting its environment. This is not only logical but favors common sense.

It is therefore important that:

1. Each community must decide and determine how much of her land space or environment is to be eroded or degraded.
2. Every community must take ownership of her environment and effectively take lead responsibility for its protection.

The termination of gully processes on a significant scale in the state will require adjustments to the construction industry's professional outlook, and the

peoples' lifestyle. Activities in highway construction and maintenance as well as residential constructions must be altered to prevent or minimize stormwater erosive effects. This can be achieved through close interaction between the affected communities and the local and state/federal authorities together with the private sector working on the scale of the entire drainage basins affected.

At the LGA level, the LGA Administrators must put in place appropriate and necessary institutional controls, and also provide necessary guidelines relating to the conduct of specific activities to monitor, prevent, and control soil erosion within their respective communities. Such programme guidelines must not be complicated; but must be simple enough to be easily understood and followed by the uneducated villager.

The programme guidelines must also provide appropriate requirements and well defined responsibilities for all responsible parties within a community. Such responsible parties may include, but not limited to, property owners, works superintendents in LGAs, civil construction companies, grader and heavy equipment operators, road construction workers and community leaders.

At the community level, community members who intend to build new homes must build in a manner that is protective of the environment. For example, runoff from such construction efforts must be kept at the barest minimum by ensuring that most the rain water on the foot print of the site seeps into the ground. Water harvesting techniques need to be practiced on a larger scale than currently exist.

For all major construction works that take place in a community in which there is exposure of the soil to direct impact of rainfall, the project owners must be required to construct in a manner ensures maximum onsite runoff infiltration on the construction site.