# Editorial Board

**Global Journal of Science Frontier Research**

<table>
<thead>
<tr>
<th>Dr. John Korstad</th>
<th>Dr. Alicia Esther Ares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D., M.S. at Michigan University, Professor of Biology, Department of Biology Oral Roberts University, United States</td>
<td>Ph.D. in Science and Technology, University of General San Martin, Argentina State University of Misiones, United States</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dr. Sahraoui Chaieb</th>
<th>Tuncel M. Yegulalp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D. Physics and Chemical Physics, M.S. Theoretical Physics, B.S. Physics, cole Normale Suprieure, Paris, Associate Professor, Bioscience, King Abdullah University of Science and Technology United States</td>
<td>Professor of Mining, Emeritus, Earth &amp; Environmental Engineering, Henry Krumb School of Mines, Columbia University Director, New York Mining and Mineral, Resources Research Institute, United States</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Andreas Maletzky</th>
<th>Dr. Gerard G. Dumancas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zoologist University of Salzburg, Department of Ecology and Evolution Hellbrunnerstraße Salzburg Austria, Universitat Salzburg, Austria</td>
<td>Postdoctoral Research Fellow, Arthritis and Clinical Immunology Research Program, Oklahoma Medical Research Foundation Oklahoma City, OK United States</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dr. Mazeyar Parvinzadeh Gashti</th>
<th>Dr. Indranil Sen Gupta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D., M.Sc., B.Sc. Science and Research Branch of Islamic Azad University, Tehran, Iran Department of Chemistry &amp; Biochemistry, University of Bern, Bern, Switzerland</td>
<td>Ph.D., Mathematics, Texas A &amp; M University, Department of Mathematics, North Dakota State University, North Dakota, United States</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dr. Richard B Coffin</th>
<th>Dr. A. Heidari</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D., in Chemical Oceanography, Department of Physical and Environmental, Texas A&amp;M University United States</td>
<td>Ph.D., D.Sc, Faculty of Chemistry, California South University (CSU), United States</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dr. Xianghong Qi</th>
<th>Dr. Vladimir Burtman</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Tennessee, Oak Ridge National Laboratory, Center for Molecular Biophysics, Oak Ridge National Laboratory, Knoxville, TN 37922, United States</td>
<td>Research Scientist, The University of Utah, Geophysics Frederick Albert Sutton Building 115 S 1460 E Room 383, Salt Lake City, UT 84112, United States</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dr. Shyny Koshy</th>
<th>Dr. Gayle Calverley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D. in Cell and Molecular Biology, Kent State University, United States</td>
<td>Ph.D. in Applied Physics, University of Loughborough, United Kingdom</td>
</tr>
<tr>
<td><strong>Dr. Bingyun Li</strong></td>
<td><strong>Dr. Baziotis Ioannis</strong></td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Ph.D. Fellow, IAES, Guest Researcher, NIOSH, CDC, Morgantown, WV Institute of Nano and Biotechnologies West Virginia University, United States</td>
<td>Ph.D. in Petrology-Geochemistry-Mineralogy Lipson, Athens, Greece</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Dr. Matheos Santamouris</strong></th>
<th><strong>Dr. Vyacheslav Abramov</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. Department of Physics, Ph.D., on Energy Physics, Physics Department, University of Patras, Greece</td>
<td>Ph.D in Mathematics, BA, M.Sc, Monash University, Australia</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Dr. Fedor F. Mende</strong></th>
<th><strong>Dr. Moustafa Mohamed Saleh Abbasy</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D. in Applied Physics, B. Verkin Institute for Low Temperature Physics and Engineering of the National Academy of Sciences of Ukraine</td>
<td>Ph.D., B.Sc, M.Sc in Pesticides Chemistry, Department of Environmental Studies, Institute of Graduate Studies &amp; Research (IGSR), Alexandria University, Egypt</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Dr. Yaping Ren</strong></th>
<th><strong>Dr. Yilun Shang</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>School of Statistics and Mathematics, Yunnan University of Finance and Economics, Kunming 650221, China</td>
<td>Ph.d in Applied Mathematics, Shanghai Jiao Tong University, China</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Dr. T. David A. Forbes</strong></th>
<th><strong>Dr. Bing-Fang Hwang</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Associate Professor and Range Nutritionist Ph.D.</td>
<td>Department of Occupational, Safety and Health, College of Public Health, China Medical University, Taiwan Ph.D., in Environmental and Occupational Epidemiology, Department of Epidemiology, Johns Hopkins University, USA Taiwan</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Dr. Moaed Almeselmani</strong></th>
<th><strong>Dr. Giuseppe A Provenzano</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D in Plant Physiology, Molecular Biology, Biotechnology and Biochemistry, M. Sc. in Plant Physiology, Damascus University, Syria</td>
<td>Irrigation and Water Management, Soil Science, Water Science Hydraulic Engineering, Dept. of Agricultural and Forest Sciences Universita di Palermo, Italy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Dr. Eman M. Gouda</strong></th>
<th><strong>Dr. Claudio Cuevas</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Biochemistry Department, Faculty of Veterinary Medicine, Cairo University, Giza, Egypt</td>
<td>Department of Mathematics, Universidade Federal de Pernambuco, Recife PE, Brazil</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Dr. Arshak Poghossian</strong></th>
<th><strong>Dr. Qiang Wu</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D. Solid-State Physics, Leningrad Electrotechnical Institute, Russia Institute of Nano and Biotechnologies Aachen University of Applied Sciences, Germany</td>
<td>Ph.D. University of Technology, Sydney, Department of Mathematics, Physics and Electrical Engineering, Northumbria University</td>
</tr>
<tr>
<td><strong>Dr. Lev V. Eppelbaum</strong></td>
<td><strong>Dr. Linda Gao</strong></td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Ph.D. Institute of Geophysics, Georgian Academy of Sciences, Tbilisi Assistant Professor Dept Geophys &amp; Planetary Science, Tel Aviv University Israel</td>
<td>Ph.D. in Analytical Chemistry, Texas Tech University, Lubbock, Associate Professor of Chemistry, University of Mary Hardin-Baylor, United States</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Prof. Jordi Sort</strong></th>
<th><strong>Angelo Basile</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>ICREA Researcher Professor, Faculty, School or Institute of Sciences, Ph.D., in Materials Science Autonomous, University of Barcelona Spain</td>
<td>Professor, Institute of Membrane Technology (ITM) Italian National Research Council (CNR) Italy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Dr. Eugene A. Permyakov</strong></th>
<th><strong>Dr. Bingsuo Zou</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Institute for Biological Instrumentation Russian Academy of Sciences, Director Pushchino State Institute of Natural Science, Department of Biomedical Engineering, Ph.D., in Biophysics Moscow Institute of Physics and Technology, Russia</td>
<td>Ph.D. in Photochemistry and Photophysics of Condensed Matter, Department of Chemistry, Jilin University, Director of Micro- and Nano- technology Center, China</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Prof. Dr. Zhang Lifei</strong></th>
<th><strong>Dr. Bondage Devanand Dhondiram</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dean, School of Earth and Space Sciences, Ph.D., Peking University, Beijing, China</td>
<td>Ph.D. No. 8, Alley 2, Lane 9, Hongdao station, Xizhi district, New Taipei city 221, Taiwan (ROC)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Dr. Hai-Linh Tran</strong></th>
<th><strong>Dr. Latifa Oubedda</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D. in Biological Engineering, Department of Biological Engineering, College of Engineering, Inha University, Incheon, Korea</td>
<td>National School of Applied Sciences, University Ibn Zohr, Agadir, Morocco, Lotissement Elkhier N66, Bettana Sal Marocco</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Dr. Yap Yee Jiun</strong></th>
<th><strong>Dr. Lucian Baia</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>B.Sc.(Manchester), Ph.D.(Brunel), M.Inst.P.(UK) Institute of Mathematical Sciences, University of Malaya, Kuala Lumpur, Malaysia</td>
<td>Ph.D. Julius-Maximilians, Associate professor, Department of Condensed Matter Physics and Advanced Technologies, Department of Condensed Matter Physics and Advanced Technologies, University Wrzburg, Germany</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Dr. Shengbing Deng</strong></th>
<th><strong>Dr. Maria Gullo</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Departamento de Ingenieria Matematica, Universidad de Chile. Facultad de Ciencias Fisicas y Matematicas. Blanco Encalada 2120, Piso 4., Chile</td>
<td>Ph.D., Food Science and Technology Department of Agricultural and Food Sciences, University of Modena and Reggio Emilia, Italy</td>
</tr>
<tr>
<td>Name</td>
<td>University/Institution</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------------------------------------------------</td>
</tr>
<tr>
<td>Dr. Fabiana Barbi</td>
<td>B.Sc., M.Sc., Ph.D., Environment, and Society, State</td>
</tr>
<tr>
<td></td>
<td>University of Campinas, Brazil Center for Environmental</td>
</tr>
<tr>
<td></td>
<td>Studies and Research, State University of Campinas, Brazil</td>
</tr>
<tr>
<td>Dr. Ulrich A. Glasmacher</td>
<td>Institute of Earth Sciences, Director of the Steinbeis</td>
</tr>
<tr>
<td></td>
<td>Transfer Center, TERRA-Explore, University Heidelberg,</td>
</tr>
<tr>
<td></td>
<td>Germany</td>
</tr>
<tr>
<td>Dr. Yiping Li</td>
<td>Ph.D. in Molecular Genetics, Shanghai Institute of</td>
</tr>
<tr>
<td></td>
<td>Biochemistry, The Academy of Sciences of China Senior</td>
</tr>
<tr>
<td></td>
<td>Vice Director, UAB Center for Metabolic Bone Disease</td>
</tr>
<tr>
<td>Nora Fung-yee TAM</td>
<td>DPhil University of York, UK, Department of Biology</td>
</tr>
<tr>
<td></td>
<td>and Chemistry, MPhil (Chinese University of Hong Kong)</td>
</tr>
<tr>
<td>Dr. Rafael Gutierrez Aguilar</td>
<td>Ph.D., M.Sc., B.Sc., Psychology (Physiological), National</td>
</tr>
<tr>
<td></td>
<td>Autonomous, University of Mexico</td>
</tr>
<tr>
<td>Dr. Sarad Kumar Mishra</td>
<td>Ph.D in Biotechnology, M.Sc in Biotechnology, B.Sc in Botany, Zoology and Chemistry, Gorakhpur University, India</td>
</tr>
<tr>
<td>Ashish Kumar Singh</td>
<td>Applied Science, Bharati Vidyapeeth's College of Engineering, New Delhi, India</td>
</tr>
<tr>
<td>Dr. Ferit Gurbuz</td>
<td>Ph.D., M.SC, B.S. in Mathematics, Faculty of Education,</td>
</tr>
<tr>
<td></td>
<td>Department of Mathematics Education, Hakkari 30000, Turkey</td>
</tr>
<tr>
<td>Dr. Maria Kuman</td>
<td>Ph.D, Holistic Research Institute, Department of Physics</td>
</tr>
<tr>
<td></td>
<td>and Space, United States</td>
</tr>
</tbody>
</table>
CONTENTS OF THE ISSUE

i. Copyright Notice
ii. Editorial Board Members
iii. Chief Author and Dean
iv. Contents of the Issue

1. Identifying the Immediate and Remote Causes of Pipeline Disasters in Nigeria. 1-14
2. Characterization of Urban Storm Water Quality for Different Land uses in Rajshahi City, Bangladesh. 15-23
3. Rights to land Ownership, Gender Inequality and Food Security in Rural Cameroon: The Case of Women in the North West Region. 25-33
4. Assessing the Impact of Watershed Management Interventions on Livelihood of Small-Scale Farmers and Ecosystem Services in Choke Mountains, East Gojjam Zone of Amhara Region, Ethiopia. 35-47

v. Fellows
vi. Auxiliary Memberships
vii. Preferred Author Guidelines
viii. Index
Identifying the Immediate and Remote Causes of Pipeline Disasters in Nigeria

By Francis I. Johnson & Marianthi Leon

Robert Gordon University

Abstract- Several occurrences of the transport system of the natural gold vandalisms in Nigeria, especially in the Niger Delta part of Nigeria is so upfront and seem never-ending. However, this seemed also to be a result of many factors ranging from the unemployment of youths and the inadequate management and necessary government policies to be put in place to ensure guaranteed security. Past researchers have observed and given the fact that the major causes of this disaster are attached to a technical fault and some failures in aging, corrosion, and mechanical challenges like those welding effects. This research work examined immediate and remote causes of pipeline disasters considering the dimension of factors, the level of preparedness of people for the pipeline disasters, and the risk perception of people, the socioeconomic characteristics and the destruction of the pipelines.

Keywords: oil spill, oil theft, pipeline attacks vandalism interdiction, GIS, environmental impact mitigation, data, nigeria.

GJSFR-H Classification: FOR Code: 050299

Strictly as per the compliance and regulations of:

© 2020. Francis I. Johnson & Marianthi Leon. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.
Identifying the Immediate and Remote Causes of Pipeline Disasters in Nigeria

Francis I. Johnson & Marianthi Leon

Abstract - Several occurrences of the transport system of the natural gold vandalisms in Nigeria, especially in the Niger Delta part of Nigeria is so upfront and seems never-ending. However, this seemed also to be a result of many factors ranging from the unemployment of youths and the inadequate management and necessary government policies to be put in place to ensure guaranteed security. Past researchers have observed and given the fact that the major causes of this disaster are attached to a technical fault and some failures in aging, corrosion, and mechanical challenges like those welding effects. This research work examined immediate and remote causes of pipeline disasters considering the dimension of factors, the level of preparedness of people for the pipeline disasters, and the risk perception of people, the socioeconomic characteristics and the destruction of the pipelines. This study posted the analytically with the use of confirmatory factor analysis (CFA) and descriptive statistics. This analytical tool is regarded as a superior model of analysis because its purpose is to establish a figurable relationship between observed and unobserved variables. The study involved 300 respondents out of which 286 is regarded valid, which is way above 90% of the respondents who were selected within Nigeria using the multi-sampling method, and the method is the simple random method. The results from the study show the presence of a significant factor such as poverty, poor management of pipelines, political factors and all other factors treated in the study contribute to the pipeline disaster in Nigeria. Further, it was also observed that preparedness and risk perceptive factors also contribute to pipeline disaster in Nigeria. After all views and detailed explanations put to test by the respondents and researchers respectively; the result suggests that there should be a provision of employment for citizens, especially the active youths that could lead such vandalism. Also, it recommends that there should be a provision of social amenities and infrastructural facilities such as roads, electricity, pipe-borne water, and reduction in land devastation so as to reduce violence.

Keywords: oil spill, oil theft, pipeline attacks vandalism interdiction, GIS, environmental impact mitigation, data, nigeria.

I. Introduction

In simple terms, crude oil is a naturally occurring fuel (liquid) that is found under the ground. It is regarded as one of the natural resources which have benefited humanity alongside others like air, water, food, and many more. Crude oil can be gotten from the ground through extraction by drilling. Crude oil is referred to as fossil fuel because of its origins. Over the years, crude oil has gained popularity mostly because of its economic impact but also because of its diversified usable products refined from it. It has gradually become the source of national development in terms of economic value and also infrastructural growth to South America, North America, Europe and the Middle East (Karl, 1997). As it is a natural resource, it’s no news that most oil-producing countries have their government involvement in its management. As seen in countries like Argentina, Bohemia, Great Britain, Egypt, and even around the world. Modern strategies like the one employed by the British government such that they established a petroleum administration which owns a controlling partnership with veto powers on the board of directors in the Anglo-Persian oil company. They also control the oil resources of the greater part of Iran; offers funds to support the development of oil and as such giving rooms to promoting the acquisition of sub-companies and companies under companies exclusively British or under British control.

In Nigeria, the Niger-Delta region is highly ranked in the world and as such the first in Africa which has a landmass covering about 36,000 square kilometers of lagoons and marshlands. The region harbors the Nation’s reserves to the tune of fewer than 35 billion barrels of crude oil, which is suspended for further needs and less than 165 trillion cubic feet of natural gas (Omotola, 2009). Nigeria’s major source of earning is petroleum, and most of the petroleum is found in the Delta state part of the country. Despite that the Niger-delta has access to this crude oil in abundant quantity, the state is considered as one of the states that are suffering from the activities of crude oil as a result of many factors (UNEP, 2011). Although it is significant, we note that Nigeria ranks first in Africa and eighth in the world when it comes to oil export according (Umar, 2014). So, oil production contributes about a billion investments to boost the country’s economy as well as the development of related sectors such as infrastructures, provision of employment for Nigerians as well as improvement of the standard of living of the people. In an aim to develop, quite a few African countries have enabled extreme measures and jeopardized the wellbeing, both health-wise and socially, of their citizens, thereby leading to environmental hazards as a result of crude oil extraction. For example, as explained by Pepper using the Friedman's core-
periphery model in (Friedman, 1973), the areas where petroleum resources are exploited are often categorized based on economic and environmental impoverishment caused by continuous exploitation in those oil-based areas while the development of the urban center which are usually a government administrative seat is improved upon. Although the urban areas also face challenges of environmental degradation and kinds, it tends to be tactically under control, unlike the rural areas where this extraction takes place. There have been numerous hazards, most resulting from human negligence for wellbeing, which resulted in detrimental incidences such as from gas flaring, industrial pollution, farmland losses, oil spillage, and eventually leading to loss of lives and properties. All these effects are results of irregular exploitation of crude oil and the acts of citizens of the country bringing about vandalism of pipelines. Eze (2004) stated that Vandalization which can be defined as the “illegal act of destroying or puncturing oil pipelines either to disrupt oil supply or steal crude oil – or its refined products – to appropriate for personal use or sale on the black market or any other outlet; is outlawed by the provisions of ‘Production and Distribution (Anti-sabotage) Act’ and the ‘Criminal Justice (miscellaneous provisions) Decree of 1974’. Because Pipeline vandalism and ruptures are the regular incidents that cause oil spillages, fires, and explosions in Nigeria, leading to pipeline disasters.

Also, factors contributing to these pipeline disasters, some of which are major technical failures such as inadequate maintenance and regular inspection, operational failures, and natural disasters are some factors causing pipeline disasters. It poses as one of the problems associated with pipeline disasters, which are affecting the source of revenue for government and oil companies operating in Nigeria. Pipelines vandalism may be a result of a natural situation but could also be for selfish reasons to personal gain by greedy individuals through the deliberate use of explosives or machines to cut or drill pipelines. It could sometimes not be for greed for some scary interest, which is unfair to the citizens such as; Scarcity of petroleum products, protest neglect from government, and degradation of the environment as a result of oil companies’ activities. Very many incidents resulting from pipeline disasters in Nigeria have summoned the attention of other countries to the consistent death, property loss, and water pollution resulting from this disaster. Not to mention the soil contamination, air pollution, destruction of the ecosystem (flora and fauna), property and infrastructures, and loss of crude oil and refined products. It makes all parts of the study area vulnerable to attack such as vandalism by Citizen for selfish gains and endangering the lives of the less concerned. Therefore, a quantitative approach which identifies the statistical significance of crude oil transport system vandalism based on the regional classification within Nigeria.

b) Statement of the Problem

As the never relenting disasters of transport systems of crude oil are increasing, so also does the limitation to the number of barrels of petroleum in Nigeria and of course, in turn, affects the revenue generation for the country and oil companies. Also, it does also have effects on the socioeconomic characteristics of the victims in such areas and on the farmlands, thereby also endangering food security. Although efforts are been put to place to identify other possible causes of pipeline disasters it rings round the possibility of vandalism and irregular maintenance of petroleum production.

c) Research Questions

(i) What Is the Dimension of the Factors that Causes Pipeline Disaster in Nigeria?
(ii) What is the Level of Preparedness for Pipeline Disaster?
(iii) What is the Risk Perception of Respondents on Pipeline Disaster?
(iv) What is the Impact of Risk Perception of People, Preparedness and Demographic Factors on Pipeline Disaster in Nigeria?

d) Research Objectives

The Broad Objective of this Study is to Determine the Immediate and Remote Cause of Pipeline Disaster in Nigeria.

The specific objectives taking a case study of 20 years; from year 2000 to 2019, are to:
(i) Determine the Dimension of the factors that causes Pipeline Disaster in Nigeria.
(ii) Examine the level of Preparedness of people on pipeline disaster in Nigeria using Confirmatory Factor Analysis (CFA).
(iii) Determine the risk Perception of Respondents on Pipeline disaster.
(iv) Examine the impact of risk perception of people, preparedness and demographic factors on pipeline disaster in Nigeria using Confirmatory Factor Analysis (CFA).

e) Hypothesis of the study

The hypothesis for the study is stated in the null form, thus:

Ho: There is no significant effect of socio-economic characteristics of the respondents and the pipeline vandalism.
f) Significance of the Study

The revenues from oil, of course, presented accumulated level of wealth, giving room for investing more and planning for other sectors based on income generated from crude oil. However, the source of this revenue is invariably becoming the main source of income for the country, and the macro-economic management begins to rely more on the report and result of crude oil sales as a determinant of the state of the economy. Even though crude oil seems to contribute more to the country’s national economic development, the problems of the economy are still not limiting or mitigating. Such problems has an unemployment rate, manufacturing decline rate, increasing poverty level, and poor infrastructural development. The dismal performance of the Nigerian economy in the face of huge rents from oil and high income that is still not limiting the problems of the country has shown that the importance of oil to the country’s economic development is questionable. It is also from the obvious that as a result of personal gain seekers, the whole of crude oil becomes an endangering source leading to loss of valuables, including lives. The above therefore indicates that the advantages offer as tremendous effect to get on just like that of the disadvantage also cause for attention.

II. Empirical Literature Review

a) History of Crude Oil in Nigeria

Although it may seem like Nigeria came into their oil and gas bloom overnight, the fact is, oil discovery in Nigeria stands as far back as 1903 with the Nigerian Bitumen Corporation. They had just started conducting an exploratory project when the attack of world war I began, and as such, all operations of the firm had to be on hold. After that, some other small oil companies tried to pick up the slack but were handicapped by limited facilities as there were not many funds to acquire the needed technology until the many oil-producing sectors commenced with another company that came into the scene and took over the exploration of commercial crude oil in Nigeria.

In 1923, exploration licenses were awarded to D’Arcy Exploration Company and Whitehall Petroleum, still, the two companies did not see reasons to believe that oil has a value in the market as a result of the record sales and potential gains in view. In 1937, after another license was issued to the Shell D’Arcy petroleum development company of Nigeria, a consortium of Shell and British Petroleum, they began their explorations all over the country. In 1953, Oil was discovered in Akata, Afam, and Bomu in Ogoni territory but all in non-commercial quantities till 1956, when oil of commercial quantity was discovered in Oloibiri, Niger Delta area of Nigeria. So, the commercial oil file began production in 1958. Other non-British companies like Mobil, Gulf Oil, Chevron, and Elf were also issued licenses to explore oil in the 1950s. Although this marked a decline in the production of agricultural export crops (which used to be the pillar of the economy), the economy of Nigeria experienced a boost with this discovery. After 1960, exploration rights were extended to other foreign companies to explore oil in both the Inshore and offshore areas of the Delta state.

The discovery of oil in Nigeria placed Nigeria in rank with other oil producers countries when its first oil field started producing commercial quantities of about 5,100 BPD. The first EA filed was discovered by Shell in shallow water southeast of Warri. The end of the Biafran war in 1970 coincided with the rise in the world oil price, and Nigeria was able to accumulate noncapital demanding riches that are spontaneous from the production of oil. During the period of the late 1960s to early 1970s, Nigeria was able to level up to the production of fewer than 3 million barrels of crude oil daily.

It is worthwhile to also know that the Nigerian Government officials have been the ones accessing the profits derived from oil exploration. In 1971, as a result of the level of crude oil available for Nigeria and its potential export rate, Nigeria because she discovered crude oil and relevance to oil matters made rejoined the organization of Petroleum Exporting Countries (OPEC) and simultaneously needs to set up her own petroleum company which led to the establishment of the Nigerian National Petroleum Company (NNPC) in 1977, which is state-owned and controlled company which was to play a key role in both streaming sectors. Strategies were then put in place to increase the production of 4 million barrels per day by the year 2010.

The production of crude oil and its export has played a vital role in national development and so accounts for about almost 100% of her total revenue. In the last two decades, oil and gas exports accounted for more than 98% of export earnings and approximately 83% of federal government revenue, as well as generating more than 14% of its GDP. It also yields 95% of foreign exchange earnings and about 65% of government budgetary revenues.

b) Pipeline Network in Nigeria

Although Nigeria has a total of 159 oil field and 1,482 oil wells in operation. According to the Department of Petroleum resources, the most productive region in terms of quantity derived is from the Niger Delta Basin in Niger Delta, which encompasses 78 of the 159 oil fields. Most of the other oil fields in Nigeria are minute and not in a single place, and as a result of this, an extensive and well-developed pipeline network was developed to transport the oil.
Pipelines in Nigeria (NNPC, 2019) in figure 1 shows the pipeline systems used for transporting petroleum products (mainly Premium Motor Spirit (PMS), Automated Gas Oil (AGO), and House Hold Kerosene (HHK)) in Nigeria. The pipeline system is strategically classified into five (5) operational regions. The Nigerian National Petroleum Corporation (NNPC) own and operate the 5001 km asset through its subsidiary, the Pipeline Petroleum Marketing Company (PPMC). The PPMC pipeline network is made up of multiproduct systems for product supply: the buried pipelines link the refineries with distribution depots.

Proper and effective pipeline Network for the transport of petroleum and other natural resources was put in place in 1979. This form of bulk transport system increased the connection to improve the country’s oil production and meet its growing needs for further distribution and consumption. Today, the pipeline network extends to 3,000km, linking together the major refineries with nineteen depots. There are four refineries in the country: one each in Kaduna and Warri; and two in PortHarcourt, with a nameplate capacity of 438,750 billion b/d. The Kaduna refinery is also linked to the Escravos(Lagos) terminal, through Warri, by a crude oil pipeline. The pipelines are then divided into nine. Since 1979, the advent of this pipeline mode of transport has accounted for 68 percent of all refinery products transported and this number has increased over the years.

c) Pipeline Disasters (PPMC, 2018)

Disaster is any occurrence in shock which could either be naturally occur in, or otherwise, which has way impact, and severity on the individual, community or society and they must respond to this sudden or progressive effect by taking standard measures. It’s no news that the familiarity of this word is a growing concern in the world today. This phenomenon of disaster is becoming rampant in society and concern throughout the world at large. The challenges associated with pipeline alone are enormous and, as such, trend more risks to the lives of people, their properties, and even making their environment unsafe to them. Also, the sources of income of the people tend to be threatened there’s more risk in the level of occurrence of disasters for large populations in recent years as a result of pipeline disaster due to the volatile nature of petroleum products. The occurring disasters have led to the loss of lives and properties in Nigeria.

The Risk management board of Bovas (2018) states:

September 2017 : > 160 killed in Asaba
April 2011 : > 175 killed in Lagos
July 2008: > 200 killed in Delta
Dec 2006: >270 killed in Lagos;
May 2006: >160 killed in Lagos;
Dec 2004: >30 killed in Lagos;
Sept 2004: >70 killed in Lagos;
June 2003: >125 killed in Abia;
Jul 2000: >310 killed in Warri; Mar 2000: >70 killed in Abia;

d) Immediate Causes of Pipeline Disasters

Petroleum is a complex mixture of hydrocarbons. It is a natural occurring fossil fuel as it is an accumulation of the remain of dead organic matter such as animals and plants that decayed several years ago. These remains sank to the bottom of water bodies and passed through a lot of processes under pressure, temperature, and heat, which makes sediment and then referred to as sedimentary rocks. Although Petroleum is a general word in describing a wide range of hydrogen and carbon compounds that are either gases, liquids, or solids under the earth’s surface. There are several forms of petroleum, but the common ones are natural
gas and crude oil, which is sometimes used for the world petroleum. Petroleum consists of complex hydrogen, and carbon compounds like alkanes, alkenes and alkynes. They possess different colors and vary depending on the chemical composition, which could be red, brown, black, red, yellow, and sometimes green.

There are causes of pipeline disasters, and many are grouped into Structural problem (40%), operational error (6%), outside force damage (27%), control problems (2%) and others (25%). In 2005, Moffat and Linden published compiled background research and information associated with oil pipeline failures. The report showed that the causes of downfall on the part of and information associated with oil pipeline failures. The

In addition to all the factors causing pipeline accidents, other factors that can cause a pipeline accident include:

- Poor maintenance of pipes, joints, and valves
- Metal fatigue
- Corrosion
- Mechanical damages.
- Unduly repair welds
- Faulty products
- Chemically caused accidents.
- Mis input of application codes.
- Inadequate safety practices
- Pipeline companies are often

It is no news that the institutions such as governmental agencies guiding Nigeria has failed in years back, which is leading to the counter-reaction by her citizens. UNDP (2006) also observed that even though a large amount of funds is allocated to NDDC, OMPADEC, and derivation fund to enhance the development of the region, less is achieved. This is believed to be a result of corruption, mismanagement of funds, and abuse of constitutional rights acclaimed to citizens. The reason why there has been no meaningful development through infrastructural provision as environmental protection is not prioritized as a result of bad governance. In addition, D’Agostino et al. (2016) posted that on the note that there are abundant resources that are meant to benefit and improve the lives of Africans, which turns out to be natural resources and the price they are put for sale (Khalfa, Alsarhan, & Bertuccelli, 2017). There’s a higher level of unstable production in oil-producing regions as there will be no exact quantity expectancy of crude oil and as such causes disruption in the chain supply as stated in (Misund and Oglend 2016) and (Chen and Xiao, 2015). They also pointed out that petroleum companies usually try to find ways of controlling expected destruction in the supply chain by adopting strategies which may affect the demand and supply more effectively (Liu, Liu, Zhu, Wang, and Liang 2016).

Another important factor contributing to the pipeline vandalism in Nigeria is Institutional factors, just like it is in many other African countries. Practical results show that there’s a high level of correspondence between poor governance and pipeline vandalism. Several African and Latin American Cities are faced large socioeconomic challenges, which were observed to have a ripple effect on macroeconomic instability such as high government budgets with little or no positive results: high inflation rate, and weak legal systems. Weak institutions promote macroeconomic instability, which leads to unstable property rights and also a lack of equal opportunities for education, which may lead to state failure (Acemoglu, Johnson, Robinson, & Thaicharoen, 2003). This factor also points to the reason why many developing countries have a high level of corruption promoting weak law and the absence of accountability. This also explains the low freedom level enforced by the government on her citizens (Bräutigam & Knack, 2004). OSHA (2017) also emphasized that some acts of the government and some stakeholders also accounts for this usual pipeline explosions, of which such attributes include; Negligence, carelessness, and violations of Occupational Safety and Health Administration, workplace safety regulations, are few among the regular factors. Another factor that causes Pipeline explosions is when carelessness of citizens in such that when heavy-duty machines like drilling borehole machines hit a pipeline, which may eventually lead to an explosion.

This then turns to a channel for sustenance of life and occupation for many active abled bodies and
even community leaders in the Niger Delta part of Nigeria. Countless researches claimed that weakness of organization bodies, both governmental and nongovernmental, injustices, and corrupt acts force people to retaliate back in a negative channel and quite self-destructive (Dzhumashev, 2014). Also, D’Agostino et al. (2016) blamed governmental bodies for over-increasing budget without putting to priority the well being of the citizens in terms of basic amenities, which will promote corruption and encourage the citizens to strive for themselves either legally or otherwise. All these are resulting in anger and loss of confidence in government by the youths triggers the vandalism of pipelines. This evidence is spare head has the number of programs set up by the Nigerian government such as the NDDC, OMPADEC, MND, which failed to serve the proposed purpose as a result of corruption, which has inspired pipeline vandalism. Akpomera (2015) observed that policies enacted by these ruling political institutions of rationalize always support unfair act by their team circus of elites and government officials, which in turn lessen the people’s trust in the government and justice system. Ulman and Bujancă (2014). Although the military option was taken to deal with authority body in the pipeline disasters of Niger delta region of Nigeria which led to the befall on the citizens even victims that has little or no idea about the vandalism and there death was recorded as many civilian death as reported by Lutz, 2013).

Nigeria exports a substantial quantity of crude oil as a revenue generation channel, and the United States is a spring day customer as they consume about 40% of Nigeria’s total oil exports. Although, Nigeria only provides 10% of its imports but ranks as the fifth-largest source for the U.S. imported oil (Bovas, 2018). Nigeria has been a member of the Organization of Petroleum Exporting Countries (OPEC), in mid-2001, its crude oil production was averaging around 2.2 million barrels (350,000 mi³) per day. Recent studies show that Nigeria’s proven oil reserves is estimated to be 35 billion barrels (350,000 m³) per day. Nigeria’s proven oil reserves is estimated to be 35 billion barrels; natural gas reserves are well over 100 trillion ft³ (2,800 km³). These quantities of petroleum is high and well enough to sustain some countries. Still sadly, vandalism as a result of poor incorporation of community members, severe environmental and ecological disasters, security challenges and greediness of the active youths and top leaders have cut through the Niger Delta oil which plagues into the oil sector (Bovas, 2018). Despite all these, there’s no government program guiding the citizens or sensitizing them on how to limit these disasters, the major multinational oil companies have launched their community development programs. One of these new entities include, the Niger Delta Development Commission (NDDC). This was created to catalyze and sensitize the social development in the region. Even though it has not fully launched all its programs; It has created help to that economic and social development in the region.

III. Research Methodology

a) Study Area

The study area is Nigeria, and it stretches through 923,769 Km a range of which 13,000 square kilometers is covered by water across 36 states from north to south. With a population of 187 million in 2017, the nation has substantial resources including crude oil. In Nigeria, states which are the largest oil-producing states and make up the 9 Federating States in the Niger Delta Region of Nigeria are, Cross River, Abia, Akwa Ibom, Ondo, Rivers, Delta, Bayelsa, Imo and Edo States.

b) Data source

This study used both primary and secondary data. The primary data from a collection of data with well-structured questionnaires and employed the use of Structural Equation Model (SEM) for analyzing the proposed objectives. The well-structured questionnaires were shared among the respondents and they were administered to them in the study area with adequate explanation and guide for putting them to the right response from their perspective. The respondents were given enough time to see to the different sets of questions relating to causes of pipeline disasters and its reaction on the environmental issues, their awareness about the effects, and their consent level about the significance of environment using the Likert-scale options. The total respondents did not fully capture all questionnaires, but the returned ones consist of 196 males and 90 females. The socio-economic characteristics of the respondents such as age as follows: 33.6% fall within the age group of 20–30, 36.4 % made up characters between the age group of 31–40, while 10.1 % is made up of the age group of 41–50 and 5.2% is made of up the ages of 50 and above. Age is necessary to this study because the focus is on young and sharp minds of the communities affected by pipeline disasters.

c) Normality assessment

The normality assessment is not compulsory for justifying this research; it becomes necessary before undertaking SEM analysis. Although, there a rising interest of different consent between scholars on the cut off points for skewness and kurtosis. Some researchers opined that there should be a normal distribution with the two signs basis of positive and negative sign. (DeCarlo, 1997; Kline, 2011). Factualty, no agreement has been reached on the normality assessment (Kline, 2011). For this study, absolute kurtosis values ranging from ±2.0 to ±7.0 and higher have been proposed as possible early departure points of non-normality (Byrne, 2013 citing Boomsma & Hoogland, 2001; DeCarlo, 1997; West, Finch, & Curran, 1995).
d) Formulation of the Confirmatory Factor Analysis Model

The Confirmatory Factor Analysis (CFA) is an alignment of EFA, and CFA is theory-driven which tries to test specific hypotheses or theories about the dimensional structure that underlines some set of variables. This analytical tool is regarded as a superior model of analysis because its purpose is to establish a figurable relationship between observed and unobserved variables. Amos graphics version 22 was used in analysing the study. The CFA postulate and analysis research works based on the relationship between variables and indicators. This makes a researcher put a theory to test and have access to a full observation of the latent variables (Kline, 2011; Loehlin, 2004). The model for the study, even though affirmed, was validated by other expert researchers in the field after a series of pre-tests.

IV. DATA ANALYSIS AND RESULTS PRESENTATION

This chapter gives an analysis of data collected from the field. It also presents, interprets, and discusses the findings as contained in the study. The structured Questionnaire serves as the basis for statistical analysis in which data retrieved was analyzed using appropriate statistical tools. The descriptive analysis of the data involves the use of tables, percentages frequency, and mean. While inferential statistics were carried out using Confirmatory Factor Analysis (CFA) and regression, to understand the intermediate and remote causes of pipeline disaster in Nigeria. A study of selected areas was carried out.

a) Data Analysis and Presentation

Survey copies of questionnaires were administered directly to respondents in selected listed areas. Out of three hundred (300) questionnaires distributed and sample selected, the study was able to accomplished a ninety-five-point three percent (95.3%) response rate, which makes the study to be more reliable and valid. Also, the whole retrieved questionnaire was deemed fit, and usage for the study. The response rate is considered adequate for the study.

i. Demographic Data Analyses

Six (6) demographic variables are included in this study. They are age, gender, marital status, education level, employment status and income level. The results in below tables and figures represent the distribution of sample individuals according to demographic variables.

Table 1: Respondents Age

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 20years</td>
<td>42</td>
<td>14.7</td>
</tr>
<tr>
<td>20-30years</td>
<td>96</td>
<td>33.6</td>
</tr>
<tr>
<td>31-40years</td>
<td>104</td>
<td>36.4</td>
</tr>
<tr>
<td>41-50years</td>
<td>29</td>
<td>10.1</td>
</tr>
<tr>
<td>50years and above</td>
<td>15</td>
<td>5.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>286</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Source: Field Survey (2020)

Table 1 shows the age distribution of the respondents; it revealed that the mean age of the respondents is 57 years. This implies that on average, the respondent’s age is 57 years. Put differently, it was observed that majority 36.4% of the respondents, 14.7% were less than 20years, 33.6% were 20-30years, 10.1% were 41-50years and only 5.2% were 50years, and above. Table 2 shows the gender of respondents. It revealed that the majority 196(68.5%) of the respondents are male, while 90(31.5%) are female.

Table 2: Gender

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>196</td>
<td>68.5</td>
</tr>
<tr>
<td>Female</td>
<td>90</td>
<td>31.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>286</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Source: Field Survey (2020)

Table 3: Marital Status

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>88</td>
<td>30.8</td>
</tr>
<tr>
<td>Married</td>
<td>102</td>
<td>35.7</td>
</tr>
<tr>
<td>Divorced</td>
<td>32</td>
<td>11.2</td>
</tr>
<tr>
<td>Widowed</td>
<td>34</td>
<td>11.9</td>
</tr>
<tr>
<td>Separated</td>
<td>30</td>
<td>10.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>286</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Source: Field Survey (2020)

Table 3 shows the gender of respondents. It revealed that the majority (35.7%) of the respondents are married, follow by 30.8% who showed they are single. Further, 11.2% revealed they are divorce, and 10.5% are separated.

Table 4: Employment Status

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployed</td>
<td>106</td>
<td>37.1</td>
</tr>
<tr>
<td>Employed</td>
<td>180</td>
<td>62.9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>286</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Source: Field Survey (2020)
Table 4 shows the employment status of respondents. It revealed that the majority 180 (62.9%) of the respondents are employed while 106 (37.1%) are unemployed.

Table 5: Education Level

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No formal Education</td>
<td>56</td>
<td>19.6</td>
</tr>
<tr>
<td>Primary</td>
<td>81</td>
<td>28.3</td>
</tr>
<tr>
<td>Secondary</td>
<td>77</td>
<td>26.9</td>
</tr>
<tr>
<td>Tertiary</td>
<td>72</td>
<td>25.2</td>
</tr>
<tr>
<td>Total</td>
<td>286</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Field Survey (2020)

Table 5 shows the education level of respondents. It revealed that the majority (28.3%) of the respondents had attained primary school certificate, 19.6% had no formal education, 26.9% had attained secondary school certificate, and 25.2% had attained tertiary school certificate. This result implies that the majority of the respondents had a formal education certificate.

Table 6: Income Level

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 200k</td>
<td>90</td>
<td>31.5</td>
</tr>
<tr>
<td>200k - 399k</td>
<td>82</td>
<td>28.7</td>
</tr>
<tr>
<td>400k - 699k</td>
<td>40</td>
<td>14.0</td>
</tr>
<tr>
<td>700k – 999K</td>
<td>42</td>
<td>14.7</td>
</tr>
<tr>
<td>1m and above</td>
<td>32</td>
<td>11.2</td>
</tr>
<tr>
<td>Total</td>
<td>286</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Field Survey (2020)

Table 6 shows the income level of the respondents. It revealed that the majority (31.5%) of the respondents earned between less than N200k annually, 28.7% earned between N200k – N399K, 14% earned between N400k – 699k annually, 14.7% earned between N700k – N999K. And lastly, 11.2% of the respondent earned 1m and above.

b) Reliability

Hair et al. (2010), state that reliability is a measure of the degree to which a set of indicators of a latent construct is internally consistent in its measurement based on the degree to which the indicators are interrelated. Cronbach’s Alpha is normally used to measure this internal consistency or reliability (A scale is considered reliable when Cronbach’s alpha is greater than 0.7.).

i. Cronbach’s Alpha Reliability

Cronbach’s Alpha for each variable was calculated to reach the threshold. Causes of pipeline disaster produced a Cronbach’s Alpha value of 0.983, and there were no lower values for the individual item correlations. This showed that the scale was acceptable for further multivariate analysis. Risk perception of pipeline disaster was considered next, and this produced the highest Cronbach’s Alpha value of 0.985. It was therefore proven that all four scales were sufficiently reliable for further analysis. Lastly, the preparedness of pipeline disaster produced a Cronbach’s Alpha value of 0.983, and there were no lower values for the individual item correlations (see table 7 below).
Table 7: Cronbach’s alpha reliability of latent variables

<table>
<thead>
<tr>
<th>Causes of Pipeline disaster</th>
<th>Items</th>
<th>Corrected Item-Total Correlation</th>
<th>Cronbach’s Alpha if Item Deleted</th>
<th>Cronbach’s Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Poor management of pipes, joints and valves</td>
<td>9.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pipeline vandalisation</td>
<td>9.78</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Black Market</td>
<td>9.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>poverty</td>
<td>9.19</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Weak political factors</td>
<td>9.49</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unemployment</td>
<td>9.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparedness of pipeline disaster</td>
<td>I have considered the risk of pipeline explosion when deciding to live in the house I do now</td>
<td>9.54</td>
<td>9.75</td>
<td></td>
</tr>
<tr>
<td>Risk perception</td>
<td>I have obtained a working fire extinguisher</td>
<td>9.73</td>
<td>9.72</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I have arranged a place to meet with family or friends in case of pipeline explosion</td>
<td>9.65</td>
<td>9.73</td>
<td>9.81</td>
</tr>
<tr>
<td></td>
<td>I have attended a meeting on how to better prepare for the pipeline explosion</td>
<td>8.81</td>
<td>9.86</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I have purchased first aid kit</td>
<td>9.54</td>
<td>9.75</td>
<td></td>
</tr>
<tr>
<td></td>
<td>How often do you think about preparing for the possibility of a pipeline disaster</td>
<td>9.66</td>
<td>9.81</td>
<td></td>
</tr>
<tr>
<td></td>
<td>How often do you think about the threat of pipeline disaster</td>
<td>9.42</td>
<td>9.84</td>
<td></td>
</tr>
<tr>
<td></td>
<td>How often do you think about the potential of a pipeline disaster</td>
<td>9.57</td>
<td>9.82</td>
<td>9.85</td>
</tr>
<tr>
<td></td>
<td>How much do you care about pipeline disaster</td>
<td>9.53</td>
<td>9.82</td>
<td></td>
</tr>
<tr>
<td></td>
<td>How aware do you think the public is concerning the issue of a pipeline disaster</td>
<td>9.72</td>
<td>9.79</td>
<td></td>
</tr>
</tbody>
</table>

Source: Field Survey (2020)

c) **Analysis Based on latent variables**

The weightings adopted for the section are SA=5, A=4, N=3, D=2, and SD=1. Mean value = \((5 + 4 + 3 + 2 + 1)/5 = 15/3 = 3.00\). A cut off point of 3.0 will be adopted for decision taking. If the item mean value is equal to or greater than 3.0 the item is accepted, but if it is less than 3.0, the item is rejected.

Table 8: Environment Awareness of Pipeline disaster

<table>
<thead>
<tr>
<th>Responses of Pipeline disaster</th>
<th>SD(%)</th>
<th>D(%)</th>
<th>N(%)</th>
<th>A(%)</th>
<th>SA(%)</th>
<th>MEAN</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment Awareness of Pipeline disaster</td>
<td>42 (14.7)</td>
<td>16 (5.6)</td>
<td>78 (27.3)</td>
<td>95 (33.2)</td>
<td>55 (19.2)</td>
<td>3.37</td>
<td>AGREE</td>
</tr>
</tbody>
</table>

Source: Field Survey (2020)

As revealed in Table 8 above it was obvious that the environment is aware of pipeline disaster dues to the agreement and disagreement of respondents to the statement under construct.

Table 9: Factors that causes pipeline disaster

<table>
<thead>
<tr>
<th>Responses of Pipeline disaster</th>
<th>SD(%)</th>
<th>D(%)</th>
<th>N(%)</th>
<th>A(%)</th>
<th>SA(%)</th>
<th>MEAN</th>
<th>RANK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor management of pipes, joints and valves</td>
<td>88 (30.8)</td>
<td>27 (9.4)</td>
<td>36 (12.6)</td>
<td>62 (21.7)</td>
<td>73 (25.5)</td>
<td>3.02</td>
<td>6TH</td>
</tr>
<tr>
<td>Pipeline vandalisation</td>
<td>36 (12.6)</td>
<td>53 (15.7)</td>
<td>44 (15.4)</td>
<td>70 (24.5)</td>
<td>83 (29.0)</td>
<td>3.39</td>
<td>4TH</td>
</tr>
<tr>
<td>Black Market</td>
<td>42 (14.7)</td>
<td>16 (5.6)</td>
<td>78 (27.3)</td>
<td>95 (33.2)</td>
<td>55 (19.2)</td>
<td>3.37</td>
<td>5TH</td>
</tr>
<tr>
<td>poverty</td>
<td>23 (8.0)</td>
<td>18 (6.3)</td>
<td>34 (11.9)</td>
<td>98 (34.3)</td>
<td>113 (39.5)</td>
<td>3.91</td>
<td>1ST</td>
</tr>
<tr>
<td>Weak political factors</td>
<td>15 (5.2)</td>
<td>81 (28.3)</td>
<td>19 (6.6)</td>
<td>102 (35.7)</td>
<td>69 (24.1)</td>
<td>3.45</td>
<td>3RD</td>
</tr>
<tr>
<td>Unemployment</td>
<td>65 (22.7)</td>
<td>38 (13.3)</td>
<td>70 (24.5)</td>
<td>93 (32.5)</td>
<td>100 (35)</td>
<td>3.61</td>
<td>2ND</td>
</tr>
</tbody>
</table>

Source: Field Survey (2020)
As shown in Table 9, the causes identified by respondents as the least causes of pipeline disaster are poor management of pipes, joint and valves, black market sale of petroleum products, and pipeline vernalization which ranked 6th, 5th, 4th respectively. On the other hand, we can deduce from Table 9 that poverty, weak political factors, and unemployment, are the most influential causes of pipeline disaster in Nigeria.

Table 10: Level of preparedness of pipeline disaster

<table>
<thead>
<tr>
<th>Responses</th>
<th>SD(%)</th>
<th>D(%)</th>
<th>N(%)</th>
<th>A(%)</th>
<th>SA(%)</th>
<th>MEAN</th>
<th>DECISION</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have considered the risk of pipeline explosion when deciding to live in the house I do now</td>
<td>79 (27.6)</td>
<td>58 (20.3)</td>
<td>40 (14.0)</td>
<td>92 (32.2)</td>
<td>17 (5.9)</td>
<td>2.69</td>
<td>DISAGREE</td>
</tr>
<tr>
<td>I have obtained a working fire extinguisher</td>
<td>89 (31.1)</td>
<td>34 (11.9)</td>
<td>70 (24.5)</td>
<td>45 (15.7)</td>
<td>48 (16.8)</td>
<td>2.75</td>
<td>DISAGREE</td>
</tr>
<tr>
<td>I have arranged a place to meet with family or friends in case of pipeline explosion</td>
<td>94 (32.9)</td>
<td>72 (25.2)</td>
<td>29 (10.1)</td>
<td>58 (19.9)</td>
<td>33 (11.9)</td>
<td>2.53</td>
<td>DISAGREE</td>
</tr>
<tr>
<td>I have attended a meeting on how to better prepare for pipeline explosion</td>
<td>42 (14.7)</td>
<td>16 (5.6)</td>
<td>78 (27.3)</td>
<td>95 (33.2)</td>
<td>55 (19.2)</td>
<td>3.37</td>
<td>AGREE</td>
</tr>
<tr>
<td>I have purchased a first aid kit</td>
<td>102 (35.7)</td>
<td>67 (23.4)</td>
<td>39 (13.6)</td>
<td>36 (12.6)</td>
<td>42 (14.7)</td>
<td>2.47</td>
<td>DISAGREE</td>
</tr>
</tbody>
</table>

Source: Field Survey (2020)

As showed in Table 10, the variables for disaster preparedness as measured through actual preparedness behaviours such as acquiring a first-aid kit, having a family evacuation plan, attending meetings of how to better prepared and purchase of fire extinguisher. This is driven mainly by the need to increase preparedness at the individual level. As indicated by Miller, Adame, and (2013): “Some large amount of the respondents revealed they are unprepared for pipeline disaster; due to their response towards preparedness for pipeline disaster. For instance, the majority 58.4% and 67.5% disagree and strongly disagree to the arrangement of a place to meet with family or friends in case of a pipeline explosion and obtaining a working fire extinguisher, respectively.

Table 11: Risk perception of individual on pipeline disaster

<table>
<thead>
<tr>
<th>Responses</th>
<th>N (%)</th>
<th>NO (%)</th>
<th>S (%)</th>
<th>VO (%)</th>
<th>A (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>How often do you think about preparing for the possibility of pipeline disaster</td>
<td>34 (11.9)</td>
<td>56 (19.6)</td>
<td>67 (23.4)</td>
<td>76 (26.6)</td>
<td>53 (15.7)</td>
</tr>
<tr>
<td>How often do you think about the threat of pipeline disaster</td>
<td>42 (14.7)</td>
<td>16 (5.6)</td>
<td>78 (27.3)</td>
<td>95 (33.2)</td>
<td>55 (19.2)</td>
</tr>
<tr>
<td>How often do you think about the potential of pipeline disaster</td>
<td>67 (23.4)</td>
<td>51 (17.8)</td>
<td>13 (4.5)</td>
<td>112 (39.2)</td>
<td>43 (15.0)</td>
</tr>
<tr>
<td>How much do you care about pipeline disaster</td>
<td>89 (31.1)</td>
<td>34 (11.9)</td>
<td>70 (24.5)</td>
<td>45 (15.7)</td>
<td>48 (16.8)</td>
</tr>
<tr>
<td>How often do you think the public is concerning the issue of pipeline disaster</td>
<td>36 (12.6)</td>
<td>53 (15.7)</td>
<td>44 (15.4)</td>
<td>70 (24.5)</td>
<td>83 (29.0)</td>
</tr>
</tbody>
</table>

Source: Field Survey (2020)

Note: N = Never, NO = Not Often, S = Sometimes, VO = Very Often, A = Always

As showed in table 11, it was obvious that most of the respondents perceived more risk of pipeline disaster, this was observed due to reaction of the respondents to the questions under risk perception. For instance, about 53.5% of the respondent very often and always think the public is concerning the issue of pipeline disaster.
d) Test of Normality

It is important to check the normality of data before embarking on Confirmatory Factor Analysis. The skewness and Kurtosis were adopted in this study to examine the normality of the data collected through the filed survey. It has been observed that there is a lack of consensus among scholars and in different kinds of literature on the cut-off points for determining normality of data using skewness and kurtosis with a base of the positive and negative sign of kurtosis and the skewness (DeCarlo, 1997; Kline, 2011). However, some scholars agree on absolutes kurtosis values ranging from ±2.0 to ±7.0 and higher to be a sign of non-normality of data set (see Byrne, 2013; Decarlo, 1997; West, Finch, & Curran 1995). The normality test of the data for this study is presented in table 12 -:

Table 12: Normality Test

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Sum</th>
<th>Mean</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>286</td>
<td>963</td>
<td>3.37</td>
<td>-.582</td>
<td>-1.585</td>
</tr>
<tr>
<td>C2</td>
<td>286</td>
<td>969</td>
<td>3.39</td>
<td>-.351</td>
<td>-1.206</td>
</tr>
<tr>
<td>C3</td>
<td>286</td>
<td>963</td>
<td>3.37</td>
<td>-.582</td>
<td>-1.285</td>
</tr>
<tr>
<td>C4</td>
<td>286</td>
<td>1118</td>
<td>3.91</td>
<td>-1.112</td>
<td>1.325</td>
</tr>
<tr>
<td>C5</td>
<td>286</td>
<td>987</td>
<td>3.45</td>
<td>-.338</td>
<td>-1.239</td>
</tr>
<tr>
<td>C6</td>
<td>286</td>
<td>1033</td>
<td>3.61</td>
<td>-.764</td>
<td>-1.837</td>
</tr>
<tr>
<td>Causes of Pipeline disaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td>286</td>
<td>768</td>
<td>2.69</td>
<td>.036</td>
<td>-1.423</td>
</tr>
<tr>
<td>D2</td>
<td>286</td>
<td>787</td>
<td>2.75</td>
<td>.160</td>
<td>-1.319</td>
</tr>
<tr>
<td>D3</td>
<td>286</td>
<td>723</td>
<td>2.53</td>
<td>.432</td>
<td>-1.235</td>
</tr>
<tr>
<td>D4</td>
<td>286</td>
<td>963</td>
<td>3.37</td>
<td>-.582</td>
<td>-1.324</td>
</tr>
<tr>
<td>D5</td>
<td>286</td>
<td>707</td>
<td>2.47</td>
<td>.557</td>
<td>-1.089</td>
</tr>
<tr>
<td>Preparedness of pipeline disaster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E1</td>
<td>286</td>
<td>916</td>
<td>3.20</td>
<td>-.193</td>
<td>-1.039</td>
</tr>
<tr>
<td>E2</td>
<td>286</td>
<td>963</td>
<td>3.37</td>
<td>-.582</td>
<td>-1.585</td>
</tr>
<tr>
<td>E3</td>
<td>286</td>
<td>871</td>
<td>3.05</td>
<td>-.245</td>
<td>-1.464</td>
</tr>
<tr>
<td>E4</td>
<td>286</td>
<td>787</td>
<td>2.75</td>
<td>.160</td>
<td>-1.319</td>
</tr>
<tr>
<td>E5</td>
<td>286</td>
<td>969</td>
<td>3.39</td>
<td>-.351</td>
<td>-5.206</td>
</tr>
</tbody>
</table>

Source: Field Survey (2020) SPSS 25.0

As shown in Table 12 above, following the study of Byrne (2013) by using kurtosis within the range of ±2.0 and ±7.0. The skewness of the data for this study falls within -1.112 to -.160, while kurtosis 1.194 to -5.206, which is still within the acceptable limit. From the questionnaire the respondents were asked set of questions relating to causes of pipeline disaster, risk perception of pipeline disaster, awareness about pipeline disaster and level of preparedness of pipeline disaster as indicated in the questionnaire from the Likert-scale options 1–5: Strongly Disagree = 1; Disagree = 2; Disagree = 3; Agree = 4 and Strongly Agree = 5. As well as 1 = Never, 2 = Not Often, 3 = Sometimes, 4 = Very Often, 5 = Always

e) Confirmatory Factor Analysis (CFA)

Confirmatory Factor Analysis (CFA) was adopted in this study to provide analysis of the relationship between the key variables (such as demographic characteristics, risk perspective, and preparedness of pipeline disaster) and their corresponding indicators.

Table 13: Model Fit Evaluation of the Confirmatory Factor Analysis

<table>
<thead>
<tr>
<th>Metric/Statistic</th>
<th>Observed Value</th>
<th>Recommended value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMIN/df</td>
<td>3.904</td>
<td>between 1 and 3</td>
</tr>
<tr>
<td>CFI</td>
<td>1.000</td>
<td>&gt;0.950</td>
</tr>
<tr>
<td>RMSEA</td>
<td>0.042</td>
<td>&lt;0.060</td>
</tr>
<tr>
<td>CLOSE</td>
<td>0.904</td>
<td>&gt;0.050</td>
</tr>
</tbody>
</table>

Source: Field Survey (2020) AMOS 24.0

As showed in table 13 above, it was observed that the fitted CFA model showed goodness-of-fit to the data. All the factors showed high loading values, and thus, none of the factors were removed. The model fit...
indices showed values which are above the threshold and was reported as such. Table 4 below shows that the goodness of fit for the measurement model is sufficient (see appendix.)

f) Structural Model

Composite variables were created using factors from AMOS version 24. The data was imputed to derive the composite variables and they were used to create the composite model. The path diagram for the CFA was present in figure 1 below:

\[ \text{Figure 2: Confirmatory Factor Analysis (CFA)} \]

\textbf{Notes for Model (Default model)}

\textit{Computation of degrees of freedom (Default model)}

\begin{center}
\begin{tabular}{|l|}
\hline
Number of distinct sample moments: & 190 \\
Number of distinct parameters to be estimated: & 44 \\
Degrees of freedom (190 - 44): & 146 \\
\hline
\end{tabular}
\end{center}

\textit{Result (Default model)}

Minimum was achieved
Chi-square = 7614.019
Degrees of freedom = 146
Probability level = .000

\textit{Note:} C inputs represent causes of pipeline disaster, D inputs represent, Preparedness for pipeline disaster and F input represent risk perspective of pipeline disaster.
Furthermore, the researchers also recommend that:

(i) Technical know-how with the pipeline should be handled by experts and the coatings of the outside should be tackled by improved Coatings such as the use or polyethylene at multiple layers for longer life. The degradation on any of the pipelines should be regularly checked, and as soon as it is detected leaks should be a tester with hydrostatic testing.

(ii) Internal corrosion should also be prevented by dehydration of gases and periodic pigging of lines to remove accumulated deposits or water.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>S.E.</th>
<th>C.R.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipeline Disaster</td>
<td>Demo</td>
<td>0.923</td>
<td>0.019</td>
<td>48.018***</td>
</tr>
<tr>
<td>Pipeline Disaster</td>
<td>Causes</td>
<td>0.844</td>
<td>0.022</td>
<td>38.951***</td>
</tr>
<tr>
<td>Pipeline Disaster</td>
<td>Prepared</td>
<td>0.887</td>
<td>0.022</td>
<td>41.19  ***</td>
</tr>
<tr>
<td>Pipeline Disaster</td>
<td>Risk</td>
<td>1.023</td>
<td>0.018</td>
<td>57.224 ***</td>
</tr>
</tbody>
</table>

Source: Field Survey (2020) AMOS 24.0

Note: *** indicate variable significance at 1%

From the model in table 14 above, the results generated indicated that demographic factors (such as age, marital status, and income level) significantly contribute to pipeline disaster in Nigeria (Coefficient = 0.923, CR = 48.018& P value = 0.000). The study also revealed that factors such as poverty, poor management of pipelines, political factor and all other factors treated in the study contribute to pipeline disaster in Nigeria. Further, it was also observed that preparedness and risk perceptive factors also contribute to the pipeline disaster in Nigeria.

**V. Conclusion and Recommendations**

Base on the findings of the research, the demographic details of the respondents, shows they are majorly active youths (gender; male and age: 31–40 years), with the majority of them having primary school certificates. The researchers conclude that poverty, weak political factors, and unemployment, are the most influential causes of pipeline disaster in Nigeria, while some of the least significant factors are; poor management of pipes, joint and valves, black market sale of petroleum products, and pipeline vandalism. It was also affirmed that a large percentage of the respondents are unprepared for the disasters to the fact that, the majority disagree and strongly disagree to the arrangement of a place to meet with family or friends in case of a pipeline explosion and obtaining a working fire extinguisher respectively. The researchers also conclude that increase in the creation of wealth by providing employment opportunities and also social amenities in the form of infrastructure such as good roads, health facilities, stable electric supply, pipe-borne water and reduction in land degradation will bring an end to vandalism of pipelines thereby reducing the disasters level and sustain lasting peace within the society. Furthermore, the researchers also recommend that:

(i) Technical know-how with the pipeline should be handled by experts and the coatings of the outside should be tackled by improved Coatings such as the use or polyethylene at multiple layers for longer life. The degradation on any of the pipelines should be regularly checked, and as soon as it is detected leaks should be a tester with hydrostatic testing.

(ii) Internal corrosion should also be prevented by dehydration of gases and periodic pigging of lines to remove accumulated deposits or water.

**References Références Referencias**


Characterization of Urban Storm Water Quality for Different Land uses in Rajshahi City, Bangladesh

By Anupam Chowdhury, Protik Chakraborty & Tamanna Tanjum

Department of Civil Engineering, RUET

Abstract- Urbanization results increased fraction of impervious surfaces, which leads to the generation of pollutants through various anthropogenic activities during dry periods and washout these pollutants during rainfall events that finally enter into the receiving water bodies. This further deteriorate the water quality and unbalance the aquatic ecosystem. Hence, characterization of urban stormwater quality is critically important for selecting a suitable treatment system to safeguard the receiving water sources. The paper focused on the analysis of urban stormwater quality parameters (e.g., pH, turbidity, electric conductivity (EC), suspended solids (SS) and biochemical oxygen demand (BOD) for three different land uses such as residential, commercial and, industrial. The stormwater samples were collected from three different land-use areas in Rajshahi City. The laboratory test results showed that SS, turbidity, EC were found significant for industrial areas where pH and BOD show higher value in residential and industrial areas, respectively. The study results will provide guidelines to the stormwater management authority for the selection of suitable treatment systems to protect the receiving water quality for different land types in Rajshahi city.

Keywords: stormwater runoff, stormwater quality, land use, rajshahi city, principal component analysis.

GJSFR-H Classification: FOR Code: 040699

© 2020. Anupam Chowdhury, Protik Chakraborty & Tamanna Tanjum. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.
Characterization of Urban Storm Water Quality for Different Land uses in Rajshahi City, Bangladesh

Anupam Chowdhury, Protik Chakraborty & Tamanna Tanjum

Abstract: Urbanization results increased fraction of impervious surfaces, which leads to the generation of pollutants through various anthropogenic activities during dry periods and washout these pollutants during rainfall events that finally enter into the receiving water bodies. This further deteriorate the water quality and unbalance the aquatic ecosystem. Hence, characterization of urban stormwater quality is critically important for selecting a suitable treatment system to safeguard the receiving water sources. The paper focused on the analysis of urban stormwater quality parameters (e.g., pH, turbidity, electric conductivity (EC), suspended solids (SS) and bio-chemical oxygen demand (BOD) for three different land uses such as residential, commercial and, industrial. The stormwater samples were collected from three different land-use areas in Rajshahi City. The laboratory test results showed that SS, turbidity, EC were found significant for industrial areas where pH and BOD show higher value in residential and industrial areas, respectively. The study results will provide guidelines to the stormwater management authority for the selection of suitable treatment systems to protect the receiving water quality for different land types in Rajshahi city.

Keywords: stormwater runoff, stormwater quality, land use, rajshahi city, principal component analysis.

1. INTRODUCTION

Water pollution is a crucial concern nowadays. It has created many problems for human beings and water bodies. People are suffering from a lot of water-born diseases. It has become a threat to the fishes and other water bodies. Soni et al. (2019) conducted a study on categories, causes, and control of water pollution. Their study results showed that water pollution affects the aquatic ecosystem, including plants that are exposed to the water.

Currently, stormwater runoff has become one of the major sources of water pollution. Due to the rapid urbanization process, natural land turns into the impervious surface, which is a suitable platform for pollutant build-up and wash-off by rainfall events (Goonetilleke et al., 2005). The stormwater runoff enters into the nearby water bodies through drainage systems or overland flow without treatment and deteriorates the receiving water quality. The type and amount of pollutant generation depend on many factors such as the geology of the land, topography, geography, rainfall intensity and pattern, and land use type (Sarukkalige, 2011). Guzman et al. (2018) conducted a study to examine the physical-chemical parameters of urban stormwater runoff using artificial rain for different land uses in Bogota, Colombia. They showed that nitrates, nitrites, alkalinity, COD and suspended solids concentration were found higher in the industrial area compared to residential and recreational areas. Also, they showed a similar variations of these pollutants for residential and recreational areas due to the presence of traffic and vegetal species.

A similar study conducted by Lucke et al. (2018), where the variability of pollutant build-up parameters was investigated for seven residential and five commercial areas in Australia. They showed that the values of suspended solid, nitrogen, and phosphorus were higher in urban residential areas than the commercial areas. In another study, Maharjan et al. (2017) focused on the development of the build-up model for a large urban Mustoja catchment in Tallinn for different land-use types. Their study results showed that the build-up rate was found higher in the industrial areas compared to commercial and residential areas. Also, commercial areas showed a higher build-up rate than a residential area. A similar study conducted by Khatun et al. (2014), where the variability of pollutant build-up parameters was investigated in five different land uses such as industrial, commercial, residential, heavy traffic, and recreational areas in Guwahati city, Assam, India. They showed that industrial areas had a higher value of co-efficient of variations compared to other land-use types. In another study, Jarvelainen (2014) estimated the stormwater pollutant load and designed the monitoring system for different land-use types in Lahti city, Finland. In this study, the quality and quantity of stormwater being generated in different land-use areas were estimated. He found that industrial and commercial areas had a higher amount of heavy metals and pollutants compared to other land uses. In another study, Liu (2011) investigated the influence of rainfall and catchment characteristics on urban stormwater...

Author a: Assistant Professor, Department of Civil Engineering, RUET, Rajshahi, Bangladesh. e-mail: anupam@ce.ruet.ac.bd
Author a: Under graduate student, Department of Civil Engineering, RUET, Rajshahi, Bangladesh. e-mail: protikchakraborty77@gmail.com
Author p: Under graduate student, Department of Civil Engineering, RUET, Rajshahi, Bangladesh. e-mail: ttturin1996@gmail.com

© 2020 Global Journals
quality in Gold Coast, Australia. In this study, pollutants build-up samples that were collected from twelve road surfaces in residential, industrial, and commercial areas. Study results showed that commercial and residential areas had relatively higher variations of nutrients and organic carbon build-up than an industrial areas.

Based on the above review, it was understood that the types and amount of pollutants generated vary with different land-use types. Hence, proper characterization of urban stormwater quality for different land-use types is essential for the selection of suitable treatment methods. The aim of this study is to characterize the urban stormwater quality for three different land uses, such as residential, commercial, and industrial areas in Rajshahi city. The study will show us the variation among the parameters of urban stormwater in residential, commercial, and industrial areas after a regular time interval.

II. METHODOLOGY

a) Study Site Selection

The stormwater samples were collected from three different land-use, such as residential, commercial, and industrials areas in Rajshahi city. Rajshahi is the 4th largest among the eight divisions in Bangladesh (RCC, 2006). It’s being developed day by day due to many industries and educational institutes. Due to the rapid urbanization process, stormwater gets polluted by the pollutants generated in road surfaces and washout during rainfall events. The sample collection point was six different road surface runoff such as Alokarmor, New market; Belderpara Mor; Zeropoint, Shaheb Bazar; Moni Chattar; BSCIC, Sapura and Match Factory Mor in Rajshahi City (Figure 1). The characteristics of these study sites are discussed in Table 1.

Figure 1: Study sites
Table 1: Characteristics of Study Sites

<table>
<thead>
<tr>
<th>Land use type</th>
<th>Site Name</th>
<th>Road type</th>
<th>Texture depth (mm)</th>
<th>Location Coordinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>Alokarmor</td>
<td>Main road</td>
<td>1.78</td>
<td>24°22'1.0&quot;N 88°36'10.8&quot;E</td>
</tr>
<tr>
<td></td>
<td>Belderparamor</td>
<td>Branch road</td>
<td>1.63</td>
<td>24°22'7.1&quot;N 88°36'22.5&quot;E</td>
</tr>
<tr>
<td>Commercial</td>
<td>Zero-point, Shaheb Bazar</td>
<td>Main road</td>
<td>2.67</td>
<td>24°21'55.5&quot;N 88°35'59.9&quot;E</td>
</tr>
<tr>
<td></td>
<td>Moni chattar</td>
<td>Main road</td>
<td>2.39</td>
<td>24°21'58.0&quot;N 88°35'50.8&quot;E</td>
</tr>
<tr>
<td>Industrial</td>
<td>Bscic, Sapura</td>
<td>Branch road</td>
<td>2.58</td>
<td>24°23'14.3&quot;N 88°36'19.8&quot;E</td>
</tr>
<tr>
<td></td>
<td>Match factory mor</td>
<td>Main road</td>
<td>2.92</td>
<td>24°23'12.8&quot;N 88°36'20.6&quot;E</td>
</tr>
</tbody>
</table>

b) Sample Collection and Laboratory Testing

The stormwater samples were collected from selected six locations (see section II (a)) for three consecutive rainfall events according to the schedule mentioned in Table 2. This further enables to investigate the effect of antecedent dry days on pollutants deposition rate on the road surfaces. The standard sample collection procedure recommended by Simpson et al. (2017) were followed during sample collection. The collected sample bottles were sealed with airtight tape. A permanent marker was used to level each sample bottle for future identification. The collected samples were tested in the public health Engineering laboratory of RUET using the standard test method specified by APHA (2017). Accordingly, stormwater quality parameters such as pH, turbidity, electric conductivity, total suspended solids, and BOD were tested and results were recorded for further data analysis.

Table 2: Sample collection time

<table>
<thead>
<tr>
<th>Sample collection date</th>
<th>Sample no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/06/2019</td>
<td>RA1-1, CA1-1, IA1-1</td>
</tr>
<tr>
<td>09/06/2019</td>
<td>RA1-2, CA1-2, IA1-2</td>
</tr>
<tr>
<td>25/06/2019</td>
<td>RA1-3, CA1-3, IA1-3</td>
</tr>
<tr>
<td>29/08/2019</td>
<td>RA2-1, CA2-1, IA2-1</td>
</tr>
<tr>
<td>04/09/2019</td>
<td>RA2-2, CA2-2, IA2-2</td>
</tr>
<tr>
<td>09/09/2019</td>
<td>RA2-3, CA2-3, IA2-3</td>
</tr>
</tbody>
</table>

c) Data Analysis Method

To understand the variation of stormwater quality parameters for three different land-use types, univariate analysis was undertaken. However, the correlation among the parameters and their influence on land use types were investigated using a multivariate analysis technique.

i. Univariate Analysis Tools

*Mean*: The average of a set of data points is measured by it.

\[ \bar{X} = \frac{\sum x_n}{N} \]  

*Here*, \( \sum x_n \) = sum of data values.  
\( N \) = the total number of data points.  
\( \bar{X} \) = mean

*Standard Deviation (SD)*: The dispersion of the data set is measured from its mean.

\[ \sigma = \sqrt{\frac{\sum (x-X)^2}{N-1}} \]  

*Here*, \( x \) = individual data points  
\( \bar{X} \) = mean/average of the data points  
\( N \) = total number of data point  
\( \sigma \) = standard deviation

*Coefficient of variation (CV)*: The level of dispersion around the mean is measured by CV.

\[ CV = \frac{\sigma}{\bar{X}} \]  

*Here*, \( \sigma \) = Standard deviation.  
\( \bar{X} \) = mean

ii. Multivariate Analysis Tools

Principal Component Analysis (PCA) is a multivariate data analysis technique. PCA is generally used to identify the correlations among the variables and objects which are of similar characteristics. PCA transforms the large datasets into independent new variables called principal component (Abdi & Williams, 2010). The total number of variables influence the number of principal components to be reproduced during transformation. In this transformation, the first principal components represent the highest variance and gradually decrease to end components. Hence, the first two principal components are used to produce PCA bi-plot (Huang et al., 2007). PCA bi-plot is the two-dimensional graphical representation where any two
principal components are plotted in the x and y-axis, respectively. The correlations among the variables and data points can be determined from the PCA bi-plot.

III. RESULT AND DISCUSSION

The summary of the analysis results for different land-use type is presented in Table 3. As seen in Table 3, stormwater pollutants concentration was found variable for different land-use types. This suggests that the distribution of pollutants throughout the catchment is not uniform and significantly influence by different land use types.

Suspended solids (SS) can be considered as one of the main indicator pollutants due to their capacity to absorb other pollutants such as heavy metals, nutrients, hydrocarbons, and transport them into stormwater runoff (Herngren et al., 2006). The amount of SS was found lower for residential areas compared to commercial and industrial areas. This indicates comparatively clear water in residential area than other sites.

The stormwater runoff from industrial area represents highly polluted compared to other land-use. This can be due to the presence of high amount of SS and turbidity in the industrial area. Also, the BOD value was found slightly higher in the industrial area compared to the residential area. This can be due to the presence of fine organic matters produce from industrial processes and distributed by wind during loading and unloading conditions.

Commercial stormwater resulted in containing low concentrations of suspended solids and turbidity value than industrial sites. But commercial areas are recorded the highest amount of BOD compared to other land uses. This may be due to the generation of the highest organic waste, which decomposed on road surfaces and washout through stormwater runoff. The organic wastes in commercial areas are produced from the local market, fruit seller, decomposed fruit bunch or vegetable waste and distribute along the road side. In contrast, the industrial area produces small amount of organic waste, that’s why the value of BOD is lower than the commercial areas.

Table 3: Average pollutant loading for each specified land use

<table>
<thead>
<tr>
<th>Land use type</th>
<th>Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residence</td>
<td>Alokar Mor</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td></td>
<td>6.90</td>
</tr>
<tr>
<td></td>
<td>Beid PARA Mor</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td></td>
<td>6.78</td>
</tr>
<tr>
<td>Commercial</td>
<td>Zero Point</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td></td>
<td>6.57</td>
</tr>
<tr>
<td></td>
<td>Moni- Chatter</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td></td>
<td>6.55</td>
</tr>
<tr>
<td>Industrial</td>
<td>Basic, Sapura</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td></td>
<td>6.42</td>
</tr>
<tr>
<td></td>
<td>Match Factory Mor</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td></td>
<td>6.38</td>
</tr>
</tbody>
</table>

The comparison of stormwater quality parameters among three different land uses was presented by Box Whisker plot in Figures 2-6.
As seen in Figure 2, the highest pH value was found 6.93 in the residential areas where the mean value was 6.83. The commercial area shows the highest value of 6.6, and the mean value is about 6.55. The residential area has a higher concentration compared to industrial and commercial areas. From Table 2, pH value in residential area displays the highest standard deviation among the three different land uses. This indicates high variability in the value of pH concentration. pH value was found lower for both commercial and industrial areas. This can be due to the presence of chemical and metal that reacts with water and decrease the pH value.

The variation of Electric Conductivity (EC) is shown in Figure 3. The industrial area has the highest conductivity (mean 1550 micromohs/Cm) than residential (mean 1060 micromohs/Cm) and commercial (mean 1460 micromohs/Cm) areas. The reaction of chemical and metal substances with the water flowing from the industrial area is the reason for having a higher value of EC in the industrial area.
The significant differences of turbidity among three land uses are presented in Figure 4. Water turbidity is directly caused by the presence of suspended matters such as clay, silt, etc. The overall patterns of SS and turbidity concentration in different land uses were similar. Commercial land-use type was significantly less turbid (mean value is 8.45 NTU) than all other land use types. The highest turbidity was found in the industrial area (mean value 13.15 NTU). This can be due to the presence of the fine particles from the production process of goods and distributed on the road surface by traffic, wind, workers during loading, and unloading time.

The variation of SS for three different land uses shown in Figure 5. The residential area has a lower mean SS value (116.75 mg/l) compared to other land uses. This can be due to the periodic cleaning of road surfaces by street sweepers. It can be seen that the average concentration of SS in the industrial area (394.25 mg/l) was almost two and a half times the values for residential areas. The commercial and industrial area produces a high level of SS. This is due to high population density, traffic density and various anthropogenic activities occur by human and distribute by traffic and wind.
The variation of BOD concentration is shown in Figure 6. The highest BOD value in a residential area is found 2.25 mg/l, and the mean value is 2.18 mg/l. The commercial area shows the highest value of 8.5 mg/l and mean value is about 8.3 mg/l. The residential area has a lower concentration compared to industrial and commercial areas. From Table 3, BOD value in commercial area displays the highest standard deviation. This indicates high variability in the value of BOD concentration. As we know, the BOD value measures the amount of dissolved oxygen to biologically decompose organic matter. The presence of organic matter is higher in a commercial area that is produced from the local market, fruit seller, decomposed fruit bunch or vegetable waste and distribute along the road side. The residential area produces a small amount of organic waste. That’s why the value is lowest among the others.

Table 4: Pearson correlation matrix

<table>
<thead>
<tr>
<th>Variables</th>
<th>pH</th>
<th>EC</th>
<th>Turbidity</th>
<th>SS</th>
<th>BOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>1</td>
<td>-0.913</td>
<td>-0.464</td>
<td>-0.888</td>
<td>-0.302</td>
</tr>
<tr>
<td>EC</td>
<td>-0.913</td>
<td>1</td>
<td>0.278</td>
<td>0.789</td>
<td>0.472</td>
</tr>
<tr>
<td>Turbidity</td>
<td>-0.464</td>
<td>0.278</td>
<td>1</td>
<td>0.792</td>
<td>-0.638</td>
</tr>
<tr>
<td>SS</td>
<td>-0.888</td>
<td>0.789</td>
<td>0.792</td>
<td>1</td>
<td>-0.102</td>
</tr>
<tr>
<td>BOD</td>
<td>-0.302</td>
<td>0.472</td>
<td>-0.638</td>
<td>-0.102</td>
<td>1</td>
</tr>
</tbody>
</table>

The correlation among water quality parameters is essential to identify a possible relationships between them. Table 4 shows the Pearson correlation co-efficient between each water quality parameter. The correlation between variables would be positive if the correlation co-efficient becomes greater than zero. When the correlation co-efficient value becomes greater than zero, then a negative correlation exists. When the value becomes zero, then no relationship exists between the variable. The highest negative correlation is between pH and EC. That means if the value of pH increases, the EC decreases. Turbidity and SS shows the highest positive relationship. That indicates the proportional relation between them. As the value of turbidity increases, the value of SS also increases. SS has a similar relationship with EC and Turbidity. pH has a negative correlation with other water quality parameters. EC has a positive correlation with turbidity, SS and BOD. However, BOD has only a positive correlation with EC.
Multivariate techniques were applied to identify linkage among various water quality parameters for three different land use. The principal component analysis bi-plot of the first two components is presented in Figure 7. This is because the first two components explain most of the data variance. As seen in Figure 7, principal component F1 and F2 explain 51.84% and 29.38% data variance, respectively. Both components explain 81.22% variance of the total dataset.

The angle between the loading vector is significant as the degree of correlation between water quality parameters is inversely related to it as the angle reduces the degree of correlation increases. Vectors situated closely together indicate those variables are highly correlated, while orthogonal vectors represent variables that are uncorrelated. The relative distance traveled along the attribute vectors from different areas represent the relative differences in performances among them.

Commercial and industrial areas perceived to be similar as they are close to each other. They perform similarly concerning the pH and EC. For commercial and industrial areas, the relative distance from pH is much greater than residential areas. In that case, pH has much influence on residential areas. Commercial and industrial areas are performed similarly concerning EC value as their relative distance from the attribute vector are the same.

Water quality parameters such as SS and turbidity are very close to each other. That’s why they are highly correlated with each other. Industrial areas are close to SS and turbidity. So, they exhibited a high correlation with SS and turbidity. Residential areas and commercial areas perform similarly concerning SS and turbidity. The residential and industrial areas are performed similarly concerning BOD value as their relative distance from the attribute vector are the same. Commercial areas are highly influenced by BOD as they are very close to each other.

IV. Conclusions

This paper characterises the urban stormwater quality for three different land-use types. pH is the most influential parameter in the residential area, where in commercial areas BOD is the most significant water quality parameter. Industrial areas are highly influenced by suspended solids and turbidity. Also, EC has an almost similar influence on commercial and industrial areas compared to residential areas. Industrial sites contributed substantially to higher value of SS, turbidity, EC compared to commercial and residential areas. The study results will provide guidelines to the stormwater management authority for the selection of suitable treatment systems or management systems for different land uses in Rajshahi City.

References Références Referencias


This page is intentionally left blank
Rights to land Ownership, Gender Inequality and Food Security in Rural Cameroon: The Case of Women in the North West Region

By Norah Aziamin Asongu & Achu Frida Njiei

Research Officer in the National Center for Education (CNE)

Abstract- This paper examines the relationship between land ownership, gender inequality and food security in Cameroon with a particular focus on women as food producers, consumers, and family food managers. It examines the constraints women face as farmers in terms of their rights to land ownership, access to production inputs, technology, and food. In most rural areas of Cameroon, women have access to land but are denied ownership rights. Access to land meets the practical gender needs of women but fails to meet the strategic gender needs of land ownership. Besides, women have inadequate access to production inputs and technology in rural Cameroon. In most cases, women still rely on traditional farming methods, limited farm inputs, and rudimentary tools for food production. Most women are also generally excluded from every inheritance and do not benefit from their natal or marital clans and thus have no possibility to control and take decisions over land.

Keywords: land ownership, gender inequality, technology, food security, practical gender needs, strategic gender needs.

GJSFR-H Classification: FOR Code: 070199

Strictly as per the compliance and regulations of:

© 2020. Norah Aziamin Asongu & Achu Frida Njiei. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License (http://creativecommons.org/licenses/by-nc/3.0/), permitting all non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.
Rights to land Ownership, Gender Inequality and Food Security in Rural Cameroon: The Case of Women in the North West Region

Norah Aziamin Asongu & Achu Frida Njie

Abstract: This paper examines the relationship between land ownership, gender inequality and food security in Cameroon with a particular focus on women as food producers, consumers, and family food managers. It examines the constraints women face as farmers in terms of their rights to land ownership, access to production inputs, technology, and food. In most rural areas of Cameroon, women have access to land but are denied ownership rights. Access to land meets the practical gender needs of women but fails to meet the strategic gender needs of land ownership. Besides, women have inadequate access to production inputs and technology in rural Cameroon. In most cases, women still rely on traditional farming methods, limited farm inputs, and rudimentary tools for food production. Most women are also generally excluded from every inheritance and do not benefit from their natal or marital clans and thus have no possibility to control and take decisions over land. In most of the villages studied, cultural stereotypes shape the mentality of men and women in that a woman who is considered a property cannot own property but can be allowed access to it since she has as a role to produce food to feed her family. Closing the gender gaps in food production, by allowing women to own land and providing them with improved technology and farm inputs, would significantly increase agricultural output in rural Cameroon.

Keywords: land ownership, gender inequality, technology, food security, practical gender needs, strategic gender needs.

1. Introduction

The agriculture sector is underperforming in Cameroon, and one of the key reasons is that women do not have access to the resources and opportunities they need to be more productive. Rural women form the majority of persons at the bottom of the ladder in terms of ownership to productive resources like land. According to the FAO (2012), achieving the Millennium Development Goal 3 (MDG3) can help us attain the MDG1. It implies that closing the gender gap in agricultural yields could help reduce the number of hungry people by as much as 100-150 million people. Women are the dominant food actors producing over 50% of the food consumed in most societies in Africa (Boserup, 1970). In the North west region, land ownership, use and inheritance are regulated in practice by customary laws mostly unwritten but influential and based on gender distinctions. These customary laws have even superior influence than statutory law when it comes to women's property rights.

The role of gender in agriculture has been marked by the growing attention among researchers, donor agencies, and policy makers. The FAO'S state of food and agriculture 2010-2012 and the World Bank’s development report 2012 turned their attention to gender issues in agriculture. There is a growing recognition worldwide that gender bias and blindness constitute significant constraints that contribute to food insecurity (FAO, 2012). Women play a critical role in determining and guaranteeing food security as food producers, food providers, and contributors to household nutritional security. Furthermore, there is a likelihood that reducing gender disparities promotes agricultural growth, better income for women, and healthier food and nutrition for all (Bina, 2011). The integration of a gender perspective that recognizes the different roles, constraints and, access to and control over resources of men and women in agriculture and rural development must, therefore, be at the center of any strategy for food security and poverty alleviation (Tempelman, 2002). Aggregate data shows that women comprise 43% of the agricultural labor force globally but, this figure varies according to regions and countries. Women constitute 70 - 90 % of the agricultural labor force in many Sub Saharan African countries (FAO, 1984). Women in Cameroon, for example, play a significant role in agricultural activities, particularly in subsistence food production, where they contribute an estimated 60-80% of the total labor force (Ministry of agriculture, 2003).

Despite the central role played by women in food production, in many developing countries, they face gender-specific constraints that reduce their productivity and limit their contributions to agricultural production(Boserup, 1970). They face a serious gender gap in access to productive resources. These gender gaps include the fact that women control less land than men, and the land they control is often of poor quality (Boserup, 1970). Women in some societies do not also control the income they get from their farms and are less likely than men to use modern inputs such as improved

Author a) Research officer in the National Center for Education (CNE)
Yaounde, Cameroon. e-mails: norahasongu@yahoo.com, achufr2002@yahoo.com

© 2020 Global Journals
seeds, fertilizers, and pest control measures. Besides, the chemicals and equipment required to control pests and diseases caused by poor tropical climate and soil conditions are scarce and expensive to the rural farmers. Female Farmers also lack financial means and skills to identify and control crop diseases (UNO, 2008). Deconstructing the notion of food security, Alcock (2009), argues that the world food problem is most often constructed as a natural phenomenon devoid of a political component. The international community and governments should instead develop new policies that will protect the world against the risk posed by the uncertainty and malice of nature rather than attributing food insecurity to environmental degradation and climate change. One of such policies could be closing the gender gap in access to food production resources. Governments need to come up with improved seeds, new technologies, gender-sensitive policies that can help solve the food crisis shortages in the world. Global food problems should not be seen as a supply problem; instead, the emphasis should be on the food production base of developing countries by promoting their self-sufficiency (FAO, 1974).

Maxwell (1988), on his part stated that, the focus on global hunger should not be on the availability of food but access to the hungry population. He emphasizes on shifts in thinking with the replacement of the old by the new. The global and national concern on food supply and production should be replace by a new and more enlightened attention for the household or individual level of food demand and entitlements. The statement made by Maxwell implies that women who are responsible for about 80% of all agricultural production in Cameroon, for example, must be involved in agricultural policies and programs and the focus should be on the access to food by the different members of the household and not on global or national situations. The contribution of women in food production should be evaluated and more value attached to their work.

The attainment of global food security is described as a situation in which all people at all times have access to adequate, affordable, safe and nutritious food to meet their dietary requirements and food preferences for productive and healthy life (FAO, 1996). Food security is presently being subverted by several challenges such as fast increasing demand and variations in consumption patterns, the competition of agricultural land for other uses, the effects of global environmental change, degradation of agricultural soil, erosion of the genetic base of agricultural biodiversity, water scarcity, poor governance and others (pretty, 2009). The government should reconsider the shift in farming practices from subsistence to mechanized agriculture with the use of improved technologies and seeds to increase food production. Globally, indicators of growth in agricultural production and food security are no longer as encouraging as they were before the 1980s (FAO, 2012). The strengthening of agriculture as a result of an increased in demand and limited land requires the development and use of better tools, techniques, and organization of production thus an increase in the mobilization and use of capital. The outcome of the increase in output may even encourage innovation in technologies that can improve long term sustainability of resources contrary to Malthusian views (Dermont et al. 2007). Women in the North West region has weak economic autonomy as compared to men in that they are assigned or given parcels of land to work on by their husbands or relations. The above statement implies that women may have access to land, but the decision on the quantity, quality, and location of the land does not depend on the women themselves but their husbands or fathers. This explains why according to Boserup 1970, the fertile lands that are closer to homes are reserved by men for cash crops while women go further and in less productive valuable lands to plant food for subsistence.

A gendered role of women hinders access to technology, agricultural training, and rural infrastructure (World Bank, 2008). Women make crucial contributions in agriculture in all developing countries as famers and workers. They face gender specific constraints that reduce their productivity and limit their contributions to agricultural production. Women face serious gender gap in access to productive resources. These gender gaps include the fact that women control less land than men and the land they control is often of poor quality (UNO, 2006). The Food and Agricultural Organization (FAO, 2009), indicates that women produce as much as 80% of basic food stuffs for household consumption and sales in sub-Saharan Africa (FAO-ILO-IUF, 2005). Achieving gender equality and empowering women is, therefore, crucial for agricultural development and food security. Closing the gender gap in agriculture will generate significant gains for the agricultural sector and society. If women were allowed same access to productive resources as men, they could increase yields on their farms by 20 – 30%. Access to these resources by women could raise total agricultural output in developing countries by 2.5 to 4 %, which could, in turn, reduce the number of hungry people in the world by 12 - 17 % (UNO, 2006). In particular, it has been suggested that the position of women farmers in both indigenous social organisations and national economies is different from men's; they work under diverse constraints in their farming and have different opportunities for alternative employment (Boserup 1970; Meillassoux 1975). If the gender division of labor is a vital aspect of farming, men's and women's differential access to resources might be expected to have an independent effect on cropping patterns.
II. METHODOLOGY

The study made use of both the qualitative and quantitative approaches with interviews, direct observation, focus group discussions, and questionnaires as our data collection techniques. We randomly selected some villages, which were Bafut, Bali, Santa, Akum, Bambui, Bambili, and Belo, as our study areas. The choice of the study site was because the culture of the North West is made up of patrilineal and matrilineal kinship systems. Researchers were, therefore, interested in understanding how land issues are being managed in the two sub-systems. The only matrilineal society studied was Belo, while all the other areas were patrilineal societies. This is because, only two matrilineal societies in the North West region. Our sampling method was snow-ball. This is because of the gender-sensitive nature of the study. Our entry point was palaces, where we met the chiefs of the different villages, and from them, we could identify our key informants. Figure one below shows the number of informants who participated in the study based on kinship ties.

![Graph showing the number of persons in the two kinship systems in the North West region](image1)

**Fig. 1:** Number of persons in the two kinship systems in the North West region

In the two sub-systems (matrilineal and patrilineal), our study population was made up of more men than women because men could easily make out time to talk to us than women who are always very busy. The daily activities of women in both areas were so charged that they leave their homes as early as 6am and only return between 5-6pm to prepare supper for their families. We therefore, had only the market days to interview the women, while men often returned from their farms much earlier than women and had much more time for our interview conversations.

![Graph showing the villages studied and gender distribution of the study sample](image2)

**Fig. 2:** Villages studied and gender distribution of the study sample
Figure 2 above shows the different villages studied in the North West region and the gender distribution of the studied population. Our study sample was 160 people with a gender distribution 97 men and 63 women.

III. Data Management and Analysis

- **Data analysis**
  The data analysis methods used in this study were the descriptive statistics Analysis and Content Analysis.

  a) **Management of qualitative data**
  - Transcribing Tape-Recorded Data and Completing Field notes

    All tape-recorded materials of conversations and interviews were transcribed as well as field notes completed for all discussions. Time was spent listening and transcribing recorded interviews. Field notes taken in the course of conversations were completed. The transcripts and documentary evidence were typed into word processing software. The transcripts captured features of discussions such as emphasis, speed, tone of voice, timing, and pauses. These elements made up the crucial aspect of interpreting data, given the multiple events that produced them. The data from transcripts were read transcript by transcript. Reading and completing the transcripts and making notes from them permitted the researchers to identify ideas, make observations and get insights, and inferences. All transcripts were labeled with file names, typed in a word processing package and stored using these file names. Once each transcript was read and classified, it was dissected, pulled apart and scrutinized transcript by transcript to enable the full understanding of the nature of the data collected.

- **IV. Management of Quantitative Data**

  The descriptive statistics method was used to describe the basic features of data in this study. This method provides simple summaries about the sample and the measures to describe what the data shows and makes available some comparisons across people or other units. Only one of these characteristics of the descriptive statistics method was considered - the distribution, which is a summary of the frequency of individual values or ranges of values for a variable. Distribution was therefore represented in two ways which are, tables using percentages and graphs or diagrams. The Descriptive Statistics Analysis was calculated with excel version 2016. The steps used in calculating were: typing data into an excel table, labeling the rows, making graphs, and transferring them from the excel table to the word document.

V. Results

a) **Ownership and sale of land in patrilineal societies**

In the North West region Land is a valuable and personal asset for the people and can be used for farming and construction of houses. It remains key to the livelihoods and survival of everybody in the region, and it is owned by individuals, but, still the Fon is the custodian of all the land in most communities. In Santa for example, the Fon said that he owns all the land and can sell it whenever he wants though he acknowledged the fact that individuals own land but must sell it in consultation with the Fon. Statistics from the fieldwork in the North West region show that 65% of all the informants said that land is owned by the traditional authorities while 28% said it men own it, and only 7% of the informants acknowledged that land is owned by women.
The few informants who agreed that women own land are probably the ones who have gone to school and are aware of the rights of women over land and those who do not understand the difference between land ownership and access to land. We discovered that, traditionally, women in this region have the users right and not ownership rights over land.

The decision to sell land or not to sell depends mostly on the cultures of the areas studied. Though it remains a valuable asset in all the communities studied as earlier mentioned, there have been cultural variations when it comes to the sale. In an interview with a quarter head in Bambui, Pa Gogomoh said: “In the past, it was a taboo to sell the land because it had to be passed down to the younger generation. It is of recent that land is sold in Bambui because of the need for money. To date, the sale of land is discouraged though it can be bought for group farming. Individuals who had bought land can sell, but the tradition does not approve of it. This is because land belongs to families and not individuals. It is of recent that overzealous successors sell land to make money.”

In Santa, the Fon and men can sell land, but a woman cannot since she does not own it. If a woman has to sell land, an investigation is made to verify where she got the land. Land owned by women is expected to be handed over to their children and not to be sold. Women in Santa can, therefore, buy land but they cannot sell it.

In most cases, tradition handicaps women from enjoying their rights over land, especially as most of them are not well educated. Their inability to organize themselves and because they are ignorant of their rights to land ownership is a setback to women. Statistics from the field prove that 49% of the informants involved in the study said that only men could sell land in the areas studied in comparison to 39% who said traditional authorities could sell land and only 12% acknowledged that women could sell it.

From the above statistics, it is clear that with the changing economic situation of the country and the demands of the monetary economy, the culture of communal land ownership is giving way to that of individual land ownership with people becoming very individualistic in the North West region. Gender gaps in land ownership continue to widen as the traditional stereotype, which says women can use the land but cannot own it is still being promoted. Women still lack behind, perhaps because the culture has succeeded in maintaining them in a subordinate position when it comes to land ownership.

VI. INHERITANCE OR SUCCESSION OF LAND IN THE NORTH WEST REGION

In the North West region, there exist two kinship systems, which are the matrilineal and patrilineal systems. Inheritance or succession largely depends on the kinship system of the study area. In the areas where
the patrilineal system is practiced such as Bambui, Akum, Santa, Bambil, Bafut, and Bali; It is possible for a woman to inherit her husband’s land, but she is only a custodian, and once the male children are grown up, it is handed over to them. Most often, men prefer to hand their properties to their successors. These successors are usually male children. Female children can inherit from their fathers’ only when they are no male children in the family or when the male children are very irresponsible. In the case where the man had no male child and handed his property to his daughter, it is expected that the daughter will give birth to a son who will inherit his grandfather. In the Bambui community, the male child succeeds the father, and the female child succeeds the mother. Inheritance in this community equally depends on the will of the deceased. According to the chief of Akum, the successor is designated without him knowing, the father can confine in an older adult, quarter head, or a lawyer or tell his best friend. In an interview conversation with Pa Gogomoh a notable in Bambi, he said,

“My wife cannot inherit my land; rather, my son will inherit and remain in the compound. My wife can only control my properties and not inherit it”.

Customs and traditions of the North West region impose certain conditions that are detrimental to women when it comes to inheritance or succession. In Bali, for example, ‘a woman whose dowry was never paid has no right over her husband’s properties even if she has children. Usually, it is the children who take over their father’s property. In this situation, when the woman dies, her corpse might not be buried in the late husband’s compound, but the children can decide where to bury their mother. The relatives of the man can choose to take the corpse back to the woman’s family. According to Mrs. Gemoh, a leader of a women’s group in Bambui, tradition has evolved with many changes taking place in the community. Unlike in the past, where a deceased man’s brother was supposed to inherit his properties and wife, it is no longer the same today. This is because many families have fought against it and also, men are becoming conscious of the need to hand over their wealth to their children. Field statistics show that 43% of all informants said that children are those who inherit from their parents while 31% said wives inherit their husband’s property after death. The other informants who made up 16% for husbands’ brothers and 10% for husband’s nephews are from the matrilineal society where succession is traced through the female line.

In matrilineal societies like Kom and Belo, it is the deceased man’s brother who inherits his property. If there is no living brother, the nephew inherits. In the Kom tradition there are no traditional rites carried out when the brother of a deceased man inherits, but when a nephew is a successor, certain rituals are performed. In this case the brother is usually considered as the caretaker while the real successor is the nephew. The tradition detects that the successor collaborates with the widow so that proper care and control will be taken over the properties of the deceased, but still it is not usually the case because, most successors do not want to take care of the widow and the children of the deceased. They rather most often sell all the properties, and this sometimes ends up causing problems between the widow and successor. In some cases, where the widow cannot defend her rights, she abandons the compound and goes somewhere else. Most successors do not like to be under the control of the widow because they feel that a man should always be in control and not a woman.

VIII. Conflict Resolution and Access to Land by Women in the North West Region

Women in the North West region, be it in the patrilineal or matrilineal societies, are expected to remain in their husband’s families after the death of their husbands. Talking about instances where a woman has had a conflict, Mrs. Lemma said “suppression of women by men is part of their culture, and has been maintained over the years. She said a typical example is when, “I bought my land with my money and the land documents were registered under my name but when I got home my husband was advised not to accept by his friends and kin. This matter brought us problems until we had to go back to the landowner to change the document. My name was replaced with my son’s name on the documents. I was however, finally satisfied with the way the case was resolved”.

In the North West, land conflicts are usually judged in the community at different levels, but women are most often not part of those who assess cases in the Fon’s palace. According to Mrs. Lemma, “I will like women to be part of the court sitting so that they can defend other women in matters of land”. The fact that very few women own land certificates in all the areas studied is an indicator that proves women have very little control over land in the North West region and, therefore, cannot make key decisions concerning it. This is because one cannot control something that does not belong to him or her.

Statistics from the field shows that 8% of women get land on which they plant crops through self-purchase, 31% through renting, 24% inherit from husbands, 22% inherit from their parents, in comparison 15% of women acquire land through donations (women are allowed to work on land for as
This implies that women in the North West region are still being marginalized on issues of land ownership. 30% of the women in the North West region are farmers, while only 20% of men have farming as their major livelihood. Since women's main occupation is farming, they are supposed to be given the right to land ownership.

**IX. Gender and Food Security in the North West Region**

According to Desjardins (2008), The World Food Summit of 1996 defined food security as existing "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life". Food insecurity refers to the unavailability and the inaccessibility to food in sufficient quantity and quality. Article 25 of the Universal Declaration of Human Rights also states that, food is a basic need and right of every human being. Food security is also a situation where at the individual, household, national, regional and global levels people at all times have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life (FAO, 2001). Food security, according to the FAO, does not only require an adequate supply of food but also entails availability, access, and utilization by all men and women of all ages, ethnicities, religions and socioeconomic levels. This implies that to achieve food security there must be social justice and access to productive resources by both men and women. This is far from being the situation in the North West region of Cameroon. This social injustice is seen in their types of crops cultivated and the fact that many do not plant certain crops because of cultural constraints. Women in this region are still mostly responsible for subsistence as opposed to men who produce for the market. Food crops cultivated by most women in the North West region include: cocoyams, yams, maize, cassava, plantains, and Irish potatoes. Also, market gardening crops commonly cultivated by women and men are: carrots, green beans, tomatoes, green spices, beans, lettuce, and cabbages. While agro forestry crops like coffee and cocoa were identified as crops cultivated mostly by men in the North West Region. This is because it takes a longer period to get to maturity, and it is believed that only men who own much land can cultivate agro forestry crops and still have land for food crops. Formally, men were not interested in food crop production because it was destined only for subsistence. The sudden interest of men in food crop production is probably for power negotiation in that men want to have money all year round. According to our informants, food crops now fetch them more money than agro forestry or cash crops. We found out that only 0.6% of women plant coffee or agro forestry crops in the North West region. Most of the women involved in this coffee cultivation inherited the produces from their late husbands or their parents. The reasons why women do not cultivate certain crops range from constraints, a choice, and tradition.

In the study, 69.4% of women say that the main reason why they do not grow agro forestry crops is because of constraints and not choice. Most women are not allowed to cultivate crops that take many years to be matured. This is because they do not own the land and therefore have no right to plant crops with long growth duration. These types of crops are meant for men who are land owners. Also, 21.9% hold that they do not cultivate crops like coffee, cocoa and cotton as a matter of choice, most women consider the cultivation of these
crops as strenuous, and meant for the men, while 8.7% said it was because of tradition. Cultural stereotypes shape the mentality of men and women in that coffee, for example, is considered a male crop by both men and women.

According to Gaymard et al. (2015), the effects of climate change on food production shows that Cameroon is one of the countries most threatened by climate change. The North West region is not left out of this phenomenon. In the field, the farmers complained of falling yields in food production due to extension of the dry or rainy seasons and the difficulties for them to adapt to the new climatic alterations. According to our respondents, women are most affected by the environmental, and climatic changes. However, they are struggling of adapt to these changes in different indigenous ways. If gender aspects are incorporated into the national agricultural policies, crop yields will undoubtedly increase and the region will be more food secured.

X. Conclusion

Land remains a strategic gender need for women in rural Cameroon. Unfortunately, women in the North West region are denied ownership of this very vital agricultural need. They are often allowed the practical gender need of access to land but do not have control or take key decisions on the land. However, in the field, we discovered that most women in this region have control over what they produce, sell, donate, and consume though it varies from one household to another. Land remains key to the livelihoods and survival of everybody in the North West region, and it is owned by individuals still, the Fon is the custodian of all the land in most communities. The decision to sell or not to sell it depends mostly on the cultures of the areas studied. Traditionally, Women in this region have the user’s right and not ownership rights over land. Inheritance or succession largely depends on the kinship system of the study area. Land disputes are part and parcel of their daily lives. According to the Fon, cases judged in the palace are out for justice, and the verdict does not depend on whether the victim is a man or woman. Despite the fair judgments as pronounced by the Fon, women remain at the losing end due to the customary laws that are discriminatory. It was discovered that very few women own land certificates, and the majority of the women said they have never seen a land certificate. Land ownership issues in the North West region are therefore fundamentally regulated by the customary laws, which are most often gender bias.

Trefry et al. (2014), in the article ‘Culture and food security, explore the relationship between culture and food security in a local context. An inductive approach to field research on cultural analysis reveals that several elements of culture have direct influences on local food production. These elements include: gender, power, identity, and cultural change. The study offers insights into the multi-level dimensions of authority as it relates to individuals, households, and broader community dynamics that are central to understanding the local dynamics of food security. Trefry (1988) sees a lack of adequate technologies as the main problem of agricultural sustainability in Africa. This lack of technology is often at the level of maintaining soil fertility. The practice of leaving fields to fallow for long periods has been abandoned due to increase in population. This has forced farmers to make intensive use of land that was cultivated only after long cycles. To him, reduced fallows have led to an increase in nutrient depletion rate, erosion, and changes in soil texture, an increase in insects and pests and crop diseases.

Women in the North West region can be more productive if they are allowed ownership of land, provided with modern farm inputs and better technology. Many of these women need to be educated on their elementary human right to own land. The region could be better food secured if micro- financial institutions could help farmers, especially women, access loans, which they can use to acquire land, buy modern farm tools and inputs. Besides breaching the gaps in food production by eliminating all gender discriminatory laws and changing stereotypes that continue to maintain the women at a subordinate position will further boost the food production capacity of the region.

References

8. FAO (2009b), The global Information and Early warning system on food and Agriculture.
This page is intentionally left blank
Assessing the Impact of Watershed Management Interventions on Livelihood of Small-Scale Farmers and Ecosystem Services in Choke Mountains, East Gojjam Zone of Amhara Region, Ethiopia

By Yenealem Gemi & Belay Semane
Addis Ababa University

Abstract- In Ethiopia, natural resources management interventions have been implemented since the 1980s to restore degraded landscapes. However, little efforts have been made to investigate the impacts of natural resources management interventions on ecosystem services and livelihood. This study was conducted in the Choke Mountain, Northern Ethiopia, to investigate the effects of community-based watershed management interventions on ecosystem services and livelihood of smallholder farmers. Both qualitative and quantitative methods were used to collect and analyze data. The results indicated that deforestation, population pressure, topography, overgrazing, and continued cultivation are major causes of land degradation. Consequences of land degradation include a reduction in farm size, a decrease in soil fertility and crop production, drought, food insecurity, and poverty. Also, the results demonstrated that a shortage of clean water and a decline in vegetation composition are among the impacts of land degradation on ecosystem services.

Keywords: benefit-sharing, land degradation, local communities, watershed management interventions, participation.

GJSFR-H Classification: FOR Code: 960305

© 2020. Yenealem Gemi & Belay Semane. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/, permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.
Assessing the Impact of Watershed Management Interventions on Livelihood of Small-Scale Farmers and Ecosystem Services in Choke Mountains, East Gojjam Zone of Amhara Region, Ethiopia

Yenealem Gemi & Belay Semane

Abstract: In Ethiopia, natural resources management interventions have been implemented since the 1980s to restore degraded landscapes. However, little efforts have been made to investigate the impacts of natural resources management interventions on ecosystem services and livelihood. This study was conducted in the Choke Mountain, Northern Ethiopia, to investigate the effects of community-based watershed management interventions on ecosystem services and livelihood of smallholder farmers. Both qualitative and quantitative methods were used to collect and analyze data. The results indicated that deforestation, population pressure, topography, overgrazing, and continued cultivation are major causes of land degradation. Consequences of land degradation include a reduction in farm size, a decrease in soil fertility and crop production, drought, food insecurity, and poverty. Also, the results demonstrated that a shortage of clean water and a decline in vegetation composition are among the impacts of land degradation on ecosystem services. The local communities perceive that watershed management interventions support to restore ecosystem services and improve livelihood. They are also optimistic that degraded landscapes can be restored through the implementation of watershed management interventions, and have been contributing to the establishment of watershed management interventions on communal and private lands mainly through providing free labor. Collaboration among local communities, government, and non-governmental organizations is key to sustain the implemented watershed management interventions.

Keywords: benefit-sharing, land degradation, local communities, watershed management interventions, participation.

I. Introduction

Land degradation includes all process that diminishes the capacity of land resources to perform essential functions and provide ecosystem services (Hurni et al., 2010). It is usually caused by two complex interlocking systems: the natural ecosystem and the human social interaction. The impact of land degradation on livelihood is particularly severe in Sub-Saharan Africa because 65% of the population is rural and the main livelihood of about 90% of the population is agriculture (Project Development Facility, 2007). Ethiopia is one of the rich countries in Sub-Saharan Africa in terms of natural resources (Gete et al., 2006). However, natural resource degradation in Ethiopia has been going on for centuries (Hurni et al., 2010). The problem is getting worst as the population pressure and the demand for food, fuel wood, building materials, and land for cultivation increases (Hurni et al., 2010).

The Choke Mountain and its associated watersheds, located in the Blue Nile highland regions of Ethiopia, is broadly representative of many of the challenges related to land degradation. The Choke Mountain ecosystems are under threat from multiple sources, including the pressure from population growth, soil erosion, deforestation, overgrazing, and decline of soil fertility (Simane et al., 2013). In turn, it has affected the livelihood of local communities through mainly reducing water availability, and livestock feed (Simane et al., 2013).

To combat land degradation and restore degraded landscapes, the Ethiopian government launched a massive soil and water conservation program in the middle of the 1970’s (Hawando, 1997). Particularly, soil and water conservation campaign has been implemented since 2010 to increase agricultural productivity through improved natural resource management (Mekuria et al., 2017). The objectives of the study was to (1) Investigate the causes and consequences of land, (2) Investigate the contribution of the implemented watershed management interventions to enhancing ecosystem services and livelihood of smallholder farmers, (3) Identify the concerns of local communities on watershed management practices, (4) Investigate factors affecting the preference of the intervention by the communities, and (5) Explore the

Author a: Southern Agricultural Research Institute (SARI), Worabe Agricultural Research Centre, Worabe, Ethiopia. e-mail: gemiyenealem@gmail.com

Author σ: College of Development Studies, Center for Environment and Development, Addis Abeba University, Addis Abeba, Ethiopia.
assessing the impact of watershed management interventions on livelihood of small-scale farmers and ecosystem services in choke mountains, east gojjam zone of amhara region, ethiopia

II. MATERIALS AND METHODS

a) Description of the study area

The study was conducted at Choke Mountains (Figure 1). It is located on plateaus that rise from a block of meadows and valleys and have elevation ranging from approximately 800 to 4200 m above sea level. The central peak is located at 10050'24'' N and 370 58'24'' E. The watershed is found entirely in Eastern Gojjam Zone of six Woredas such as; Bibugne, Debay Titaqgin, Gozamen, Hulet Eju Enessie, Machakel, and Senan (Bewket, 2010). As measured at Debre-Markos weather station, mean annual temperature is 14.5°C with a range from 13.2°C in July and August to 17.3°C in March. Average annual precipitation ranges from 600 to 2000 mm year-1, and exhibits local variability associated with topographic gradients (Simane 2011). Dominant soil types are volcanic in origin, derived from Mio-Pliocene shield volcano lavas and, at lower elevations, Oligocene flood. The dominant agricultural practice in the Choke Mountain watersheds is crop-livestock mixed systems (Simane 2013).

b) Sampling technique, sample size and data sources

Purposive sampling was used to select the study Woredas and Kebeles as well as the specific watersheds. The main criteria used to select the study woreda and kebeles was based on their agro-ecology, the presence or absence of well-designed watershed management interventions, and accessibilities. Accordingly, four Kebeles with well-designed watershed management interventions and four less sustained were selected. Then from each kebele, a watershed was selected to investigate the effectiveness of watershed management interventions to enhancing ecosystem services and improving livelihood. In total, eight watersheds were selected. Systematic random sampling was used to select respondents for the household survey. A total of 120 respondents were selected from the 1897 total number of households using the (Cochran, 1977) formula.

\[ n_0 = \frac{z^2pq}{d^2} \rightarrow n = n_0/1+n_0-1 \]

Where, \( n_0 \) = the desired sample size when the population is greater than 10,000. \( n \) = number of sample size when the population is less than 10,000 \( z \) = is statistical certainty at 95% confidence limit i.e. 1.96 \( p \) = 0.1 (proportion of the population to be included in the sample i.e. 10%). \( q \) = 1 – \( p \) e (0.9) \( N \) = total number of the households (1897), \( d \) = degree of accuracy desired (0.05).

Also, 20 key informants (five from each of the selected Woreda; were selected for key informant’s interviews. The Key informants comprise of watershed management experts at district and regional level, development agents and watershed committee. Further, focus group discussion was held to strengthen the information gathered through household surveys and key informant interviews. During the entire study, 12...
focus group discussions were held (i.e., three from each Woreda).

The qualitative design approach was applied to describe meaning, concepts and definition of data in word when the quantitative approach was applied to describe quantitative data in the statistical method. And also have applied both primary and secondary data sources and data collection techniques. Primary data was generated through a household survey, focus group discussion, and key informant interview. Secondary data was collected from published and grey literature as well as from government official documents obtained from district agricultural offices. To investigate changes in ecosystem services and human livelihood following watershed management interventions, participatory tools such as household survey, focus group discussion, key informant interviews, and transect walk was used.

i. Qualitative data collection
   a. Assessment of the perception of local communities
      Semi-structured questionnaires were prepared to gather data. Both open and close-ended questions were included in the questionnaires. The open ended questions were developed to enable the respondents to give responses by their language freely. The questions in this study were prepared in a simple and clear way and arranged in a logical order to make it more inclusive. The questionnaires were first developed in English language and then translated into Amharic language. The questions focused on land degradation problems, participation, and perception of the communities towards the implementation of watershed management interventions, changes in ecosystem services, and livelihood following the implementation of interventions, the rate of adoption of interventions, tradeoffs of interventions, and local communities concerns on interventions.
   
   b. Data analysis
      The methodologies employed to analyze the data for this study was included descriptive statistics. Descriptive statistics (frequency, percentage, mean, minimum and maximum values of the variables used to summarize a collection of data in a clear and understandable way as well as constructed tables and figures was used to show respondents’ attitude towards individual items of the questionnaire. Inferential Statistics was used to draw inferences about a population from a sample. All the gathered data were carefully entered into Microsoft Excel. Editing and coding of numerical symbols to answers were made. After completion of editing, assigning, or coding, finally, data were exported from the program Microsoft Excel to Statistical Package for Social Science, version 20. Then, descriptive statistics, and correlation were used for analysis. The qualitative data from individual interviews were analyzed using content analysis (Bernard, 2006).

III. Results and Discussions

   a) Driving forces of land degradation
      Survey respondents and key informants considered that population pressure and over utilization of natural resources as the main driving forces of land degradation. Consequently, 40% of respondents in Mechakel woreda considered over utilization of natural resources as main driving force, while population pressure was considered as the main cause by 26.7% of respondents. In Shebel Berenta woreda, 26.7% of respondents considered over utilization of natural resources as the main driving force, while a population pressure was considered as the main cause by 40.0% of respondents. In Shewa k/mihret kebele 66.7% of sampled households considered the topographic condition of the areas as the main driving force of land degradation and also this are supported by field observation (Picture 1). Few (5%) of respondents considered road construction and poorly designed diversion ditches as driving forces of land degradation. The results from focus group discussion also confirmed that population pressure, lack of implementation of conservation measures, and poor land management, as the main driving forces of land degradation. The result also demonstrated that family size and land degradation is positively correlated ($r = 0.24; p < 0.05$) (Table 5 below).

      The results also revealed that poor implementation of policies related to NRM, lack of awareness raising campaigns towards the implementation of natural resources management interventions and lack of rules and regulation that support the sustainable management of natural resources contributed to land degradation in the study areas.
Simane et al. (2013) also demonstrated that land degradation in the highland areas (i.e. Areas above 1500 m.a.s.l) had been a concern for many years and steep slopes that promote rapid erosion as well as limited agricultural land characterize the Choke environment. Similarly, the study conducted in Choke Mountain (Shegaw, 2011) and the southern part of Ethiopia, revealed that steep topography and population pressure are the main driving forces of land degradation (Worku, 2016).

b) Pressures on the natural environment

Survey respondents, key informants, and field observation confirmed that deforestation, overgrazing, and high rate of soil erosion are the main pressures on the natural environment that lead to severe land degradation. A considerable proportion of respondents (19.2%) considered overgrazing as the main pressure on natural environment and aggravates soil erosion and land degradation. Similarly, 8.3% of respondents reflected deforestation and overgrazing, as the major pressures (Table 4). In this line, (Simane et al., 2013) indicated that soil erosion in Choke Mountain watersheds is a well-recognized problem and a priority area for intervention. The results demonstrated that the perception of local communities on major driving forces of land degradation and pressures varies across the studied kebeles (Table 1).

Table 1: Driving forces of land degradation and pressures on the natural environment as perceived by sampled respondents

<table>
<thead>
<tr>
<th></th>
<th>Shebel berenta</th>
<th>Mechakel</th>
<th>Sinan</th>
<th>Awabel</th>
<th>Agg in (%) for n=120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deforestation</td>
<td>0.0</td>
<td>33.3</td>
<td>13.3</td>
<td>26.7</td>
<td>6.7</td>
</tr>
<tr>
<td>Overgrazing</td>
<td>33.1</td>
<td>13.3</td>
<td>0.0</td>
<td>0.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Continuous cultivation</td>
<td>6.7</td>
<td>6.7</td>
<td>6.7</td>
<td>0.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Limited use of conservation structures</td>
<td>6.7</td>
<td>20.0</td>
<td>6.7</td>
<td>26.7</td>
<td>6.7</td>
</tr>
<tr>
<td>If 1,2</td>
<td>6.7</td>
<td>20.0</td>
<td>0.0</td>
<td>13.3</td>
<td>6.7</td>
</tr>
<tr>
<td>If 1,2,3</td>
<td>6.7</td>
<td>0.0</td>
<td>26.7</td>
<td>26.7</td>
<td>0.0</td>
</tr>
<tr>
<td>If 1,2,3,4</td>
<td>13.0</td>
<td>0.0</td>
<td>20.0</td>
<td>6.7</td>
<td>13.3</td>
</tr>
<tr>
<td>If 1,3,4</td>
<td>0.0</td>
<td>6.7</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>If 2,3</td>
<td>0.0</td>
<td>0.0</td>
<td>6.7</td>
<td>6.7</td>
<td>0.0</td>
</tr>
<tr>
<td>If 2,3,4</td>
<td>0.0</td>
<td>6.7</td>
<td>0.0</td>
<td>13.3</td>
<td>6.7</td>
</tr>
<tr>
<td>If 2,4</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>6.7</td>
<td>6.7</td>
</tr>
<tr>
<td>If 3,4</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>13.3</td>
<td>0.0</td>
</tr>
<tr>
<td>If others</td>
<td>26.0</td>
<td>0.0</td>
<td>0.0</td>
<td>6.7</td>
<td>6.7</td>
</tr>
<tr>
<td>Missing</td>
<td>6.7</td>
<td>40.2</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Source: computed from household survey data 2016/17
Note: one is for Deforestation, two is for overgrazing, and three is for continues cultivation, and four is for limited use of conservation structures
Note: Led is for Ledie, Geda is for Gedaysu, A.Z is for Amanuel Zuria, D.K is for Debre Kelemo, S.K/M is for Shewa Kidane Mihret, Dan is for Dangule, E.C is for Enebiy Chifar, YEK is for Yekeyit, and Agg is for Aggregate
The results of this study indicated that existence and severity of soil erosion varies across studied kebeles (Table 5). According to the survey respondents, Sinan and Mechakel districts are the most affected compared to Awabel and Shebel berenta districts. Also, all of the respondents in Sinan district in Dangule kebele confirmed the existence of soil erosion in their area as high. In contrast, the majority of respondents in Awabel woreda in Enebiy Chifar and Yekeyit kebele (93% and 60%) respectively, confirmed that they did not observe soil erosion in their farmland.

The majority (45%) of respondents indicated the severity of soil erosion in the studied areas as high, while an equal proportion of respondents indicated the severity of soil erosion as medium and low (Table 2). Lal, 1981, Eswaran et al., 2001 and Tesfahunegn, 2013 have mentioned that exploitation of soil resources by farmers, resulting from a need to increase agricultural productivity, aggravates soil erosion. The study further claims that the severity of soil erosion is higher in developing countries, where the economy mainly depends on agriculture.

Table 2: The severity of soil erosion as perceived by respondents

<table>
<thead>
<tr>
<th></th>
<th>Shebel berenta</th>
<th>Mechakel</th>
<th>Sinan</th>
<th>Awabel</th>
<th>Agg in % for n=120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severity of soil erosion</td>
<td>Led</td>
<td>Geda</td>
<td>A.Z</td>
<td>D.K</td>
<td>S.K/M</td>
</tr>
<tr>
<td>Low</td>
<td>13.3</td>
<td>40.0</td>
<td>13.3</td>
<td>0.0</td>
<td>6.7</td>
</tr>
<tr>
<td>Medium</td>
<td>53.3</td>
<td>40.0</td>
<td>46.7</td>
<td>13.3</td>
<td>20.0</td>
</tr>
<tr>
<td>High</td>
<td>33.3</td>
<td>20.0</td>
<td>40.0</td>
<td>86.7</td>
<td>73.3</td>
</tr>
</tbody>
</table>

Source: computed from own household survey data 2016/17
Note: Led is for Ledie, Geda is for Gedasyu, A.Z is for Amanuel Zuria, D.K is for Debre Kelemo, S.K/M is for Shewa Kidane Mihret, Dan is for Dangule, E.C is for Enebiy Chifar, YEK is for Yekeyit, and Agg is for Aggregate

The rate of soil erosion, as the majority of respondents, confirmed the rate of soil erosion as high, while the other respondents do not consider soil erosion as a major problem. In the Choke Mountain, soil erosion is a key environmental and socio-economic problem. Topography has a strong influence on aggravating soil erosion. On the other hand, the result indicates that the implementation of NRM interventions in Choke Mountain is a key to control soil erosion and restore degraded landscapes. Also it is consistent with the perception of local communities; the majority of respondents confirmed the effectiveness of the implemented natural resource management intervention in reducing soil erosion (see section 3.4).

c) State of the natural environment in Choke Mountain

The majority of (87.5%) survey respondents perceive that the productivity and the size of their farm land have declined through time. For example, 93.4 % of respondents in Dangule and Gedasyu kebele considered that their farm land is reduced; fertility of agricultural soil and productivity is declined due to increased soil erosion, whereas 40.0 % of respondents in D/kelemo elaborated that, land degradation has resulted in reduced land size and agricultural production. Similarly, 40% of respondents in Yekeyit kebele discussed a reduction in farm size due to land degradation (Table 3). The results also indicated that the deterioration of the natural environment as a consequence of land degradation varied across the studied kebeles, and is more severe in Gedasyu and Dangule kebeles than the other studied kebeles. A survey respondent elaborated the state of the natural environment as:

"The decline in soil fertility and reduced workability of farm lands due to land degradation has led to reduction in crop production. Also, land fragmentation due to land degradation has resulted in reduced crop production. This, in turn, resulted in food insecurity, reduced income, and poverty". (Interview 2016/17)

The reduction in agricultural productivity could be attributed to poor land management and land degradation due to soil erosion. The survey respondents have mentioned that they started to use different land management practices such as crop rotation, application of inorganic fertilizers and compost, and fallowing to restore degraded farm lands. Also, farmers also use irrigation and planting of fruit trees to diversify their livelihood. However, 9.2% of the respondents did not perceive that the productivity of their land is declining.

The majority of respondents indicated the severity of soil erosion in the studied areas as high, while an equal proportion of respondents indicated the severity of soil erosion as medium and low (Table 2). Lal, 1981, Eswaran et al., 2001 and Tesfahunegn, 2013 have mentioned that exploitation of soil resources by farmers, resulting from a need to increase agricultural productivity, aggravates soil erosion. The study further claims that the severity of soil erosion is higher in developing countries, where the economy mainly depends on agriculture.
d) Impact of land degradation on ecosystem services and livelihood

The survey respondents, key informants, and focus group discussion confirmed that, shortage of clean air and water (mentioned by 27.5% of respondents), and decline in vegetation composition (24.2%) are among the impacts of land degradation on ecosystem services (Table 4). The majority of survey respondents confirmed that, they experienced deterioration of their livelihood due to degradation of ecosystem services.

Particularly, 100.0% of respondents in Gedayasu kebele revealed that, they faced a serious problems including drying up of water bodies due to degradation of ecosystem services (Picture2).

A survey respondent elaborated this as:
“The negative impacts of land degradation on ecosystem services has resulted in drought, drying up of water bodies and shortage of water supply as well as shortage of animal feed, occurrence of flood, and out migration” (Interview 2016/17)

Another respondent further elaborated on this as:-
“Degradation of ecosystem services due to land degradation has resulted in decline in productivity (e.g., reductions in honey, milk, and meat), loss of soil fertility, loss of shelter for animals, food insecurity, loss of living house due to flood, shortage of clean water and exposing to water borne diseases” (Interview 2016/17).

Table 3: State of the current natural environment in Choke Mountain as perceived by respondents

<table>
<thead>
<tr>
<th>Consequence of LD</th>
<th>Shebel berenta</th>
<th>Mechakel</th>
<th>Sinan</th>
<th>Awabel</th>
<th>Agg in % for n=120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce in farm size</td>
<td>Led</td>
<td>Geda</td>
<td>A.Z</td>
<td>D.K</td>
<td>S.K/M</td>
</tr>
<tr>
<td>20.0</td>
<td>20.0</td>
<td>20.0</td>
<td>20.0</td>
<td>20.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Rise in soil erosion</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Decreasing SF and LP</td>
<td>20.0</td>
<td>6.7</td>
<td>13.3</td>
<td>6.7</td>
<td>20.0</td>
</tr>
<tr>
<td>If 1,2,3</td>
<td>13.3</td>
<td>93.4</td>
<td>66.7</td>
<td>53.4</td>
<td>13.3</td>
</tr>
<tr>
<td>If 1,3</td>
<td>40.0</td>
<td>0.0</td>
<td>13.3</td>
<td>40.0</td>
<td>0.0</td>
</tr>
<tr>
<td>If 2,3</td>
<td>6.7</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>6.7</td>
</tr>
<tr>
<td>If others</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Drought</td>
<td>40.0</td>
<td>33.3</td>
<td>33.3</td>
<td>33.3</td>
<td>53.3</td>
</tr>
<tr>
<td>Food insecurity</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Poverty</td>
<td>6.7</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>If 1,2</td>
<td>46.7</td>
<td>53.3</td>
<td>26.7</td>
<td>33.3</td>
<td>0.0</td>
</tr>
<tr>
<td>If 1,2,3</td>
<td>6.7</td>
<td>13.3</td>
<td>33.3</td>
<td>0.0</td>
<td>46.7</td>
</tr>
<tr>
<td>If 1,3</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>6.7</td>
</tr>
</tbody>
</table>

Source: computed from own household survey data 2016/17
Note: one is for reducing in farm size, two is for rise in soil erosion, and three is for decreasing soil fertility and land productivity
Note: one is for drought, two is for food insecurity, and three is for poverty
Note: LD is Land Degradation, SF is Soil Fertility and LP is Land Productivity
Note: Led is for Ledie, Geda is for Gedayasu, A.Z is for Amanuel Zuria, D.K is for Debre Kelemo, S.K/M is for Shewa Kidane Mihret, Dan is for Dangule, E.C is for Enebiy Chifar, YEK is for Yekeyit, and Agg is for Aggregate.

Table 4: Perceptions of respondent’s on impact of land degradation on ecosystem services

<table>
<thead>
<tr>
<th>Consequence</th>
<th>Shebel berenta</th>
<th>Mechakel</th>
<th>Sinan</th>
<th>Awabel</th>
<th>Agg in % for n=120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shortage of clean water</td>
<td>Led</td>
<td>Geda</td>
<td>A.Z</td>
<td>D.K</td>
<td>S.K/M</td>
</tr>
<tr>
<td>66.7</td>
<td>20.0</td>
<td>26.7</td>
<td>6.7</td>
<td>33.3</td>
<td>6.7</td>
</tr>
<tr>
<td>Creates complexity to regulate erosion problem</td>
<td>0.0</td>
<td>0.0</td>
<td>6.7</td>
<td>33.3</td>
<td>6.7</td>
</tr>
<tr>
<td>Leads to high emission rate of carbon dioxide</td>
<td>0.0</td>
<td>20.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Leads to decline in vegetation composition</td>
<td>0.0</td>
<td>0.0</td>
<td>13.3</td>
<td>20.0</td>
<td>33.3</td>
</tr>
<tr>
<td>If 1,2</td>
<td>6.7</td>
<td>0.0</td>
<td>0.0</td>
<td>6.7</td>
<td>6.7</td>
</tr>
<tr>
<td>If 1,2,3</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>If 1,2,4</td>
<td>0.0</td>
<td>0.0</td>
<td>20.0</td>
<td>20.0</td>
<td>0.0</td>
</tr>
<tr>
<td>If 1,3</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>6.7</td>
</tr>
<tr>
<td>If 1,4</td>
<td>26.7</td>
<td>53.3</td>
<td>0.0</td>
<td>6.7</td>
<td>6.7</td>
</tr>
<tr>
<td>If 1,2,3,4</td>
<td>0.0</td>
<td>6.7</td>
<td>33.3</td>
<td>0.0</td>
<td>6.7</td>
</tr>
<tr>
<td>If 2,4</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>13.3</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Source: computed from own household survey data 2016/17
Note: one is for shortage of clean water, two is for creates complexity to regulate erosion problem, three is for Leads to high emission rate of carbon dioxide, and four is for leads to decline in vegetation composition.
Note: Led is for Ledie, Geda is for Gedayasu, A.Z is for Amanuel Zuria, D.K is for Debre Kelemo, S.K/M is for Shewa Kidane Mihret, Dan is for Dangule, E.C is for Enebiy Chifar, YEK is for Yekeyit, and Agg is for Aggregate.
Also, the household survey respondents pointed out that drought and food insecurity are among the impacts of land degradation. For example, drought was mentioned by 35% of respondents as the main impact of land degradation. Similarly, food insecurity was mentioned by 16.7% respondents. Both food insecurity and drought were mentioned as impact of land degradation by 23.3% of respondents. Few (3.3%) of the survey respondents has mentioned the reduction in the number of livestock as one of the impacts of land degradation.

Different studies have revealed that the impacts of land degradation on ecosystem services have direct impacts on human societies (Cardinale et al., 2012; Berendse et al., 2015; Brevik et al., 2015; Yazdani et al., 2015). Thus, the prevention of land degradation for sustaining the food and energy security is a significant concern for mankind. A study indicated that soil erosion which is particularly severe in Ethiopia is the major indicator of soil loss and soil fertility decline (Haile et al., 2015). The positive correlation between impact of land degradation on ecosystem service and on human livelihood \( (r = 0.168, p > 0.05) \) also supports that enhancing ecosystem services through reducing land degradation is key to improve the livelihood of rural communities (Table 5).

### Table 5: Correlation analysis result

<table>
<thead>
<tr>
<th>Correlations</th>
<th>MS</th>
<th>EDU</th>
<th>TLS</th>
<th>TFS</th>
<th>OCC</th>
<th>Impacts of LD on HLV</th>
<th>Impacts of LD on ES</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EDU</td>
<td>-0.32</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TLS</td>
<td>.040</td>
<td>.091</td>
<td>.670</td>
<td>.325</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TFS</td>
<td>.156</td>
<td>-0.216</td>
<td>.329</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OCC</td>
<td>.013</td>
<td>.178</td>
<td>.063</td>
<td>.032</td>
<td>.888</td>
<td>.498</td>
<td>.730</td>
</tr>
<tr>
<td>Impacts of LD on HLV</td>
<td>.094</td>
<td>.039</td>
<td>.277</td>
<td>.125</td>
<td>.308</td>
<td>.099</td>
<td>.168</td>
</tr>
<tr>
<td>Impacts of LD on ES</td>
<td>.205</td>
<td>.065</td>
<td>.071</td>
<td>.099</td>
<td>.026</td>
<td>.479</td>
<td>.443</td>
</tr>
</tbody>
</table>

Note: MS is for marital status, EDU is educational status, TLS is total land size, TFS is total family size, OCC is occupational status, LD is land degradation, HLV is the human livelihood, and ES is ecosystem services.

e) Response to land degradation in the Choke Mountain and benefits from the watershed management interventions

The implemented Watershed management interventions in the studied kebeles includes terraces, trench, exclosure, afforestation, and diversion ditches to address land degradation and improve ecosystem services and livelihoods (Picture 2). The survey respondents, key informants and results from FGD confirmed that the implementation of watershed management interventions was jointly done by the government and local communities.

A survey respondent elaborated on this as:

“We adopted the construction of terraces and bunds mainly to protect our land from soil erosion and thereby improve the fertility of soil and agricultural productivity. Also, we adopted soil and water conservation measures to harvest water for the dry season, improve water holding capacity of the soil and increase the workability of farm lands as well as enhance the effects of inorganic fertilizers in increasing crop yield”.

The majority (68.9%) of the respondents confirmed that they implemented at least one conservation measure to control soil erosion and restore degraded landscapes. Although there is variability in the adoption rate of conservation measures, the majority (64.8%) of respondents confirmed that they adopted soil and water conservation measures on their farm land. The result also indicated that soil and water conservation measures had been more adopted in Sinan district than the other studied districts. The most adopted conservation measures are the construction of terraces on farm lands (mentioned by 53-87% of respondents). The results also confirmed that the implemented soil and water conservation measure had been introduced to the local community by the agricultural development agents. However, the local communities have participated during the implementation stages.
implemented natural resources management interventions in the studied kebeles

Note: pic. One, is in Gedayasu, pic. Two, is in Ledie, pic. Three, is in Enebiy Chifar, and pic. Four, is in Dikelemo kebele. (Photo source: Yenealem Mekuria, captured during the field visit 2016/17)

The majority of survey respondents perceive that, land degradation minimized through different watershed management interventions. However, out of the total households, 14% of respondents perceive that the problem of land degradation can’t solve using watershed management interventions. Those survey respondents who were optimistic about the possibility of minimizing land degradation suggested several natural resources management interventions such as terrace, diversion ditches, afforestation, and controlled and rotational grazing. Also, these respondents recommended that, planting of grasses and forage trees on the banks of soil and water conservation measures to stabilize the structures and produce livestock feed. Those who are pessimistic justified their opinion that, once a land has lost its fertility, it is difficult to restore within a short period and convert it in to productive land. However, soil degradation can reverse by restoring degraded land and the implementation of recommended management practices (Lal, 2015). Protection and restoration of land use on slopes are very important to minimize soil erosion, which will not only contribute to greater safety in many land uses around the world but will also help to maintain soil and quality of water in a watershed (Giménez Morera et al., 2010; Wildemeersch et al. 2015; Mekonnen et al., 2014; Yazdani et al., 2015).

The survey respondents and key informants stated that all groups of local communities are benefitting from watershed management. For instance, out of the total respondents, 53.4% of respondents confirmed that the poor, medium and rich members of a community are benefitting equally. The sampled households were discussed on the idea and they have mentioned their views; such as the benefit from watershed management practice has brought considerable change on the livelihood of all community as well as on the ecosystem, and there is no difference depending on the wealth status. The watershed management practice has implemented for all, and all the communities are participating in watershed management practices because it has become the source of animal feed and fuel wood and shelter for animals. But, 12.5% of the respondents confirmed that the relatively wealthy members benefit more than the poor ones. These members of the community argue that the poor farmers forced to sell one of the tangible benefits of watershed management (i.e., grass) with a cheap price as they don’t have livestock to feed. When there is the training they have the opportunity to be selected primarily, and the poor are needed only for their labor. Rich is protecting the land by using improved materials and producing much by participating in different production practices like.
farming and animal husbandry. In contrast to this, 30% of respondents confirmed that the poor member of a community benefits more. Due to small agricultural land holdings, the poor are participating in protecting and restoring degraded land and changing it to give benefit for them in such approach, they are benefiting more through producing twice in a year, and they got good crop production due to reduction of soil erosion and improvement in soil fertility. Also, they got financial support from a safety net program.

The results of this study are inconsistent with the study by (Assefa, 2011) who reported that poor households in the Choke Mountain upper Muga watershed in East Gojjam, Ethiopia were fewer participants and beneficiaries of NRM interventions. A study conducted in central Tigray (Meaza, 2015) also shown that poor households are not equally benefiting from watershed management practices compared to the relatively wealthy families.

The key informant confirmed that the youth was also getting benefits from the interventions by providing opportunities for them to participate in animal husbandry, stone, and soil supply from the highly degraded areas with the support of technical advice by experts (Picture 3). According to the discussions with the key informants and as it’s observed during field observation, the way they are getting the benefits from the watershed management intervention practices was almost similar in all the studied areas. There are benefit-sharing mechanisms in the studied communities, which is led by the watershed committee members.

![Picture 3](benefitfortheysinanimalhusbandrybycuttinggrassfromthWSinLediekebele.jpg)  
**Picture 3:** Benefit for the youths in animal husbandry by cutting grass from the WS in Ledie kebele, (Photo source: Yenealem Mekuria) taken during household survey 2016/17

The local communities also have bylaws that support the management and use of natural resources. The main tangible benefit of watershed management interventions are livestock feed (mainly of grasses). As it was observed during the field visits, members of a watershed use the produced grass through a cut and carry system (Picture 4). The bylaw is a key to ensure equity in benefit-sharing and control free riders.

![Picture 4](livestockfeedigrassobtainedfromtherestoredwatershed.jpg)  
**Picture 4:** Livestock feed (i.e., grass) obtained from the restored watershed, (source: photo taken during the field observation 2016/17)
f) The preference and effectiveness of watershed management intervention by the local community

The majority of the survey respondents, key informants, and results from focus group discussions confirmed that the implemented watershed management practices were effective. For instance, 78.7% of respondents revealed that, the interventions are vital and effective. However, 18% of respondents considered the interventions are ineffective. The majority (90%) of respondents considered as the implemented natural resource management activities are preferable in their area.

A survey respondent on the effectiveness of the interventions elaborated as:

“We preferred and implemented the interventions, as the practice has brought changes to the livelihood condition of the local communities through reducing soil erosion, increasing livestock feed, enhancing soil fertility, and agricultural productivity, and creating job opportunities. Also, the implemented conservation measures improve access to water supply and restoring degraded landscapes” (Interview 2016/17).

A key informant also elaborated on this as:

“By looking at the benefits obtained from watershed management interventions, the local communities are motivated to expand conservation measures and cover degraded landscapes by vegetation. The implemented conservation measures have already brought changes in vegetation cover, availability of livestock feed, and increase the income of local communities”. (Key informant interview 2016/17).

The respondents who considered the implemented watershed management interventions ineffective justified their opinion as the implemented conservation measures are not sustainable, doesn’t cover all the degraded land, all the communities are not protecting and controlling it and the implementation of watershed management interventions lacks participatory approach.

The sampled household respondents have mentioned main factors affecting the favorite of the intervention by the local community as:

The main factors affecting the preference of the measures by the local community were improvement in soil fertility and agricultural productivity, the lack of sustainability and short term benefit of the implemented soil and water conservation measures, the structures consume more land and lead to a decline in land size.

g) Contributions and responsibilities of communities related to the implementation of natural resource management interventions

Almost all of the survey respondents in all studied areas and key informants have confirmed that the members of the studied communities have contributions in the management of watersheds. The societies have been contributing to the implementations of natural resource management interventions on communal and private lands mainly through contributing free labor (Picture 3.6) (mentioned by 37.5% of respondents). Other studies also reported a similar result in that farmers in central Tigray, Ethiopia, provide support to the implementation of natural resource management interventions through providing free labor (Meaza, 2015). Such collaboration of local communities in watershed management activities can enhance the success of watershed management activities, as the participation of local communities is key to sustain natural resource management practices (Pretty and Ward, 2001 as cited in Meaza, 2015).

h) Conditions which initiates the community to participate in NRM activities

The participation of communities in natural resource management activities varies within the studied areas. For instance, 98.3% of the survey respondents in most of the studied kebeles have confirmed that all of the local communities have been participating in watershed management interventions in comparison 1.7% of respondents in D/kelemo kebele have confirmed that, all of the local communities have no any contributions in watershed management intervention practices.

The survey respondents and key informants indicated that the main factor that initiates local communities to participate in the implementation of natural resource management interventions is the severity of soil erosion in their locality. Other factors that affect the participation of local communities in watershed management include implementation period (majority indicated that watershed management activities needs to implement after March), material and financial support and follow-up by agricultural experts, and availability of short-term benefits from interventions. The respondents stressed that financial support and availability of short-term economic benefits from the interventions is key to participate in watershed management activities. The results suggest that generating short term economic benefits from watershed management activities could enhance the participation of local communities and the sustainability of implemented natural resource management interventions.

Some of the household survey respondents have also mentioned that, they have the interest in contributing and participate in watershed management practices if communities must control and protect the implemented natural resource management practices from damage. The respondents mentioned that awareness-raising and experience sharing campaigns are needed to enhance the interest of local communities to participate in watershed management activities. According to the respondents, training facilities, for
example on afforestation practices, crop and animal husbandry systems as well as natural resource management practices could support to enhance the participation of local communities in the implementation of watershed management activities.

IV. Conclusion and Recommendations

The results demonstrated that a large proportion of the available land assigned for cultivation compared to grazing and other uses. The majority (55.7%) of survey respondents perceive that the productivity of their farm land has declined through time. This could be attributed to poor land management (i.e., monocropping) and land degradation due to soil erosion. Land degradation resulted from population pressure, topography, deforestation, overgrazing, poor implementation of policies and strategies related to natural resource management, lack of awareness-raising campaigns is one of the major environmental and socio-economic problems of the study areas. The results indicated that the local communities well understood the negative consequences of land degradation on human livelihoods and ecosystem services. Local communities are also optimistic on the possibility of reversing degraded landscapes into productive land through the implementation of natural resource management interventions. The results of study also indicated that different types of natural resource management interventions were adopted in most of the studied areas, and the local communities considered the implemented natural resource management interventions are effective in restoring degraded landscapes and improving livelihood. The local communities perceived that providing training on afforestation practices, crop production, and animal husbandry systems as well as natural resource management practices could support to enhance the participation of local communities in watershed management activities. From the result of this study we recommend that, designing mechanisms to enhancing the short-term benefits of natural resource management interventions is key to increase the participation of local communities as well as integrating income generating activities such as livestock fattening and beekeeping could support to sustaining watershed management interventions through generating short-term economic benefits and building a sense of ownership. Finally, further studies are required to generate empirical evidence on the impact of natural resource management interventions on livelihood and ecosystem services and to inform decision makers.

Acknowledgement

First of all, glory to the almighty God, for his help throughout my whole life. I would like to express my profound and sincere thanks to my advisor Dr. Belay, for his valuable comments, constructive criticism, providing necessary data, and guidance throughout the study. I am also highly indebted to Dr. Ermiyas head of center of Environment and Developmental studies in Addis Abeba University for his cooperation in facilitating the opportunity to get financial support to undertake this research. I would like to thank to Mr. Desalegn Dawit and staff members of D/Markos University Dr. Mesfin, Dr. Getinet and Mr. Behailu, for their encouragement and helpful support through providing me transport facilitation during the field work.

I am grateful to provide heartfelt thanks to all my families to my mother Workinesh Mola and to my father Germi Meekuria for their blessing and encouragement to my sister Ms. Jemanesh Gemi and to my brothers Mr. Tilahun Meekuria, Dr. Wolde Meekuria and his wife Dr. Mulugeta Gemi and Mr. Dagnachew Meekuria for their unlimited follow up, encouragement, financial and material support more over being there for me when I need them throughout the study. My heartfelt thanks also goes to my friends, Zuriyash Tadesse and to all of my classmates, data enumerators, and respondents, for their cooperation throughout the study.

References Références Referencias


MEMBERSHIPS
FELLOWS/ASSOCIATES OF SCIENCE FRONTIER RESEARCH COUNCIL
FSFRC/ASFRC MEMBERSHIPS

INTRODUCTION

FSFRC/ASFRC is the most prestigious membership of Global Journals accredited by Open Association of Research Society, U.S.A (OARS). The credentials of Fellow and Associate designations signify that the researcher has gained the knowledge of the fundamental and high-level concepts, and is a subject matter expert, proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice. The credentials are designated only to the researchers, scientists, and professionals that have been selected by a rigorous process by our Editorial Board and Management Board.

Associates of FSFRC/ASFRC are scientists and researchers from around the world are working on projects/researches that have huge potentials. Members support Global Journals’ mission to advance technology for humanity and the profession.

FSFRC
FELLOWS OF SCIENCE FRONTIER RESEARCH COUNCIL

FELLOWS OF SCIENCE FRONTIER RESEARCH COUNCIL is the most prestigious membership of Global Journals. It is an award and membership granted to individuals that the Open Association of Research Society judges to have made a ‘substantial contribution to the improvement of computer science, technology, and electronics engineering.

The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Fellows are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Fellow Members.
**Benefit**

**To the institution**

**Get letter of appreciation**
Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

**Exclusive Network**

**Get access to a closed network**
A FSFRC member gets access to a closed network of Tier 1 researchers and scientists with direct communication channel through our website. Fellows can reach out to other members or researchers directly. They should also be open to reaching out by other.

**Certificate**

**Receive a printed copy of a certificate**
Fellows receive a printed copy of a certificate signed by our Chief Author that may be used for academic purposes and a personal recommendation letter to the dean of member's university.

**Designation**

**Get honored title of membership**
Fellows can use the honored title of membership. The “FSFRC” is an honored title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., FSFRC or William Waldroff, M.S., FSFRC.

**Recognition on the Platform**

**Better visibility and citation**
All the Fellow members of FSFRC get a badge of “Leading Member of Global Journals” on the Research Community that distinguishes them from others. Additionally, the profile is also partially maintained by our team for better visibility and citation. All fellows get a dedicated page on the website with their biography.
FUTURE WORK
GET DISCOUNTS ON THE FUTURE PUBLICATIONS
Fellows receive discounts on future publications with Global Journals up to 60%. Through our recommendation programs, members also receive discounts on publications made with OARS affiliated organizations.

GJ INTERNAL ACCOUNT
UNLIMITED FORWARD OF EMAILS
Fellows get secure and fast GJ work emails with unlimited forward of emails that they may use them as their primary email. For example, john [AT] globaljournals [DOT] org.

PREMIUM TOOLS
ACCESS TO ALL THE PREMIUM TOOLS
To take future researches to the zenith, fellows and associates receive access to all the premium tools that Global Journals have to offer along with the partnership with some of the best marketing leading tools out there.

CONFERENCES & EVENTS
ORGANIZE SEMINAR/CONFERENCE
Fellows are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

EARLY INVITATIONS
EARLY INVITATIONS TO ALL THE SYMPOSIUMS, SEMINARS, CONFERENCES
All fellows receive the early invitations to all the symposiums, seminars, conferences and webinars hosted by Global Journals in their subject.
PUBLISHING ARTICLES & BOOKS

EARN 60% OF SALES PROCEEDS
Fellows can publish articles (limited) without any fees. Also, they can earn up to 60% of sales proceeds from the sale of reference/review books/literature/ publishing of research paper. The FSFRC member can decide its price and we can help in making the right decision.

REVIEWERS

GET A REMUNERATION OF 15% OF AUTHOR FEES
Fellow members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

ACCESS TO EDITORIAL BOARD

BECOME A MEMBER OF THE EDITORIAL BOARD
Fellows may join as a member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. Additionally, Fellows get a chance to nominate other members for Editorial Board.

AND MUCH MORE

GET ACCESS TO SCIENTIFIC MUSEUMS AND OBSERVATORIES ACROSS THE GLOBE
All members get access to 5 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 10 GB free secure cloud access for storing research files.
ASSOCIATE OF SCIENCE FRONTIER RESEARCH COUNCIL

ASSOCIATE OF SCIENCE FRONTIER RESEARCH COUNCIL is the membership of Global Journals awarded to individuals that the Open Association of Research Society judges to have made a substantial contribution to the improvement of computer science, technology, and electronics engineering.

The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Associate membership can later be promoted to Fellow Membership. Associates are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Associate Members.
Benefit

To the Institution

Get Letter of Appreciation

Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

Exclusive Network

Get Access to a Closed Network

A ASFRC member gets access to a closed network of Tier 1 researchers and scientists with direct communication channel through our website. Associates can reach out to other members or researchers directly. They should also be open to reaching out by other.

Certificate

Receive a Printed Copy of a Certificate

Associates receive a printed copy of a certificate signed by our Chief Author that may be used for academic purposes and a personal recommendation letter to the dean of member's university.

Designation

Get Honored Title of Membership

Associates can use the honored title of membership. The “ASFRC” is an honored title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., ASFRC or William Waldroff, M.S., ASFRC.

Recognition on the Platform

Better Visibility and Citation

All the Associate members of ASFRC get a badge of ”Leading Member of Global Journals“ on the Research Community that distinguishes them from others. Additionally, the profile is also partially maintained by our team for better visibility and citation. All associates get a dedicated page on the website with their biography.
FUTURE WORK
GET DISCOUNTS ON THE FUTURE PUBLICATIONS
Associates receive discounts on the future publications with Global Journals up to 60%. Through our recommendation programs, members also receive discounts on publications made with OARS affiliated organizations.

GJ INTERNAL ACCOUNT
UNLIMITED FORWARD OF EMAILS
Associates get secure and fast GJ work emails with unlimited forward of emails that they may use them as their primary email. For example, john [AT] globaljournals [DOT] org.

PREMIUM TOOLS
ACCESS TO ALL THE PREMIUM TOOLS
To take future researches to the zenith, fellows receive access to almost all the premium tools that Global Journals have to offer along with the partnership with some of the best marketing leading tools out there.

CONFERENCES & EVENTS
ORGANIZE SEMINAR/CONFERENCE
Associates are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

EARLY INVITATIONS
EARLY INVITATIONS TO ALL THE SYMPOSIUMS, SEMINARS, CONFERENCES
All associates receive the early invitations to all the symposiums, seminars, conferences and webinars hosted by Global Journals in their subject.
PUBLISHING ARTICLES & BOOKS
EARN 30-40% OF SALES PROCEEDS
Associates can publish articles (limited) without any fees. Also, they can earn up to 30-40% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.

REVIEWERS
GET A REMUNERATION OF 15% OF AUTHOR FEES
Associate members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

AND MUCH MORE
GET ACCESS TO SCIENTIFIC MUSEUMS AND OBSERVATORIES ACROSS THE GLOBE
All members get access to 2 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 5 GB free secure cloud access for storing research files.
<table>
<thead>
<tr>
<th></th>
<th>ASSOCIATE</th>
<th>FELLOW</th>
<th>RESEARCH GROUP</th>
<th>BASIC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost</strong></td>
<td>$4800</td>
<td>$6800</td>
<td>$12500.00</td>
<td>APC per article</td>
</tr>
<tr>
<td></td>
<td>lifetime designation</td>
<td>lifetime designation</td>
<td>organizational</td>
<td></td>
</tr>
<tr>
<td><strong>Benefits</strong></td>
<td>Certificate, LoR and Momento</td>
<td>Certificate, LoR and Momento</td>
<td>Certificate, LoRs and Momentos</td>
<td>GJ Community Access</td>
</tr>
<tr>
<td></td>
<td>2 discounted publishing/year</td>
<td>Unlimited discounted publishing/year</td>
<td>Unlimited free publishing/year</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gradation of Research</td>
<td>Gradation of Research</td>
<td>Gradation of Research</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 research contacts/day</td>
<td>Unlimited research contacts/day</td>
<td>Unlimited research contacts/day</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 GB Cloud Storage</td>
<td>5 GB Cloud Storage</td>
<td>5 GB Cloud Storage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GJ Community Access</td>
<td>GJ Community Access</td>
<td>GJ Community Access</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Certificate, LoR and Momento</td>
<td>Online Presence Assistance</td>
<td>Online Presence Assistance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unlimited research contacts/day</td>
<td>Cloud Storage</td>
<td>Cloud Storage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 GB Cloud Storage</td>
<td>5 GB Cloud Storage</td>
<td>5 GB Cloud Storage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GJ Community Access</td>
<td>GJ Community Access</td>
<td>GJ Community Access</td>
<td></td>
</tr>
</tbody>
</table>
We accept the manuscript submissions in any standard (generic) format.

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

Alternatively, you can download our basic template from https://globaljournals.org/Template.zip

Authors should submit their complete paper/article, including text illustrations, graphics, conclusions, artwork, and tables. Authors who are not able to submit manuscript using the form above can email the manuscript department at submit@globaljournals.org or get in touch with chiefeditor@globaljournals.org if they wish to send the abstract before submission.

BEFORE AND DURING SUBMISSION

Authors must ensure the information provided during the submission of a paper is authentic. Please go through the following checklist before submitting:

1. Authors must go through the complete author guideline and understand and agree to Global Journals' ethics and code of conduct, along with author responsibilities.
2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author’s email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s’) names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted must not have been submitted or published elsewhere and all authors must be aware of the submission.

DECLARATION OF CONFLICTS OF INTEREST

It is required for authors to declare all financial, institutional, and personal relationships with other individuals and organizations that could influence (bias) their research.

POLICY ON PLAGIARISM

Plagiarism is not acceptable in Global Journals submissions at all.

Plagiarized content will not be considered for publication. We reserve the right to inform authors’ institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures
Global Journals follows the definition of authorship set up by the Open Association of Research Society, USA. According to its guidelines, authorship criteria must be based on:

1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

Copyright

During submission of the manuscript, the author is confirming an exclusive license agreement with Global Journals which gives Global Journals the authority to reproduce, reuse, and republish authors’ research. We also believe in flexible copyright terms where copyright may remain with authors/employers/institutions as well. Contact your editor after acceptance to choose your copyright policy. You may follow this form for copyright transfers.

Appealing Decisions

Unless specified in the notification, the Editorial Board’s decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.
Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27” x 11”", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word “Abstract” in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper’s subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned un refereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.
Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title
The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details
The full postal address of any related author(s) must be specified.

Abstract
The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords
A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods
Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations
Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations
Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends
Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.
Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Electronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

Tips for Writing a Good Quality Science Frontier Research Paper

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can’t clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of science frontier then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

© Copyright by Global Journals | Guidelines Handbook
6. **Bookmarks are useful:** When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. **Revise what you wrote:** When you write anything, always read it, summarize it, and then finalize it.

8. **Make every effort:** Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. **Produce good diagrams of your own:** Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. **Use proper verb tense:** Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. **Pick a good study spot:** Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. **Know what you know:** Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. **Use good grammar:** Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice. Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. **Arrangement of information:** Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. **Never start at the last minute:** Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. **Multitasking in research is not good:** Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. **Never copy others' work:** Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. **Go to seminars:** Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. **Refresh your mind after intervals:** Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.
20. **Think technically:** Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. **Adding unnecessary information:** Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. **Report concluded results:** Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. **Upon conclusion:** Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

**Informal Guidelines of Research Paper Writing**

**Key points to remember:**
- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

**Final points:**

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

**The introduction:** This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

**The discussion section:**

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

**General style:**

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

**To make a paper clear:** Adhere to recommended page limits.
Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.
The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

**Approach:**

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

**Procedures (methods and materials):**

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

**Materials:**

*Materials may be reported in part of a section or else they may be recognized along with your measures.*

**Methods:**

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

**Approach:**

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

**What to keep away from:**

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.
Results:
The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:
- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:
- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:
As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:
If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:
The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

**The Administration Rules**

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

*Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.*

**Segment draft and final research paper:** You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else’s analysis. Do not allow anyone else to proofread your manuscript.

**Written material:** You may discuss this with your guides and key sources. Do not copy anyone else’s paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.
### Criterion for Grading a Research Paper (Compilation)

**By Global Journals**

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

<table>
<thead>
<tr>
<th>Topics</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A-B</td>
</tr>
<tr>
<td><strong>Abstract</strong></td>
<td>Clear and concise with appropriate content, Correct format. 200 words or below</td>
</tr>
<tr>
<td></td>
<td>Above 200 words</td>
</tr>
<tr>
<td><strong>Introduction</strong></td>
<td>Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited</td>
</tr>
<tr>
<td><strong>Methods and Procedures</strong></td>
<td>Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads</td>
</tr>
<tr>
<td><strong>Result</strong></td>
<td>Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Discussion</strong></td>
<td>Well organized, Meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph, reference cited</td>
</tr>
<tr>
<td><strong>References</strong></td>
<td>Complete and correct format, well organized</td>
</tr>
</tbody>
</table>

© Copyright by Global Journals | Guidelines Handbook

XXI
# Index

## A
- Alleviation · 5
- Amenities · 1, 6, 1
- Amharic · 17
- Anthropogenic · 3, 2

## B
- Barrels · 1, 2, 3, 6

## C
- Corpse · 10

## D
- Devastation · 1
- Disparities · 5

## H
- Hydrostatic · 1

## I
- Impervious · 3

## K
- Kinship · 7, 10, 12

## L
- Lettuce · 12

## M
- Malice · 6
- Matrilineal · 7, 10, 11

## O
- Oligocene · 16

## P
- Patrilineal · 7, 9, 10, 11
- Pliocene · 16

## R
- Rudimentary · 5

## S
- Strenuous · 12

## T
- Terrace, · 22
- Tradeoffs · 17
- Trillion · 1, 6

## V
- Vandalisms · 1