IWRM Action Hub

CASE STUDY

Nigeria: Integrated Vulnerability Assessment and Pollution Status of the NNEWI Industrial Zone

Summary

From August 26th through September 11th 2020, a team of undergraduate and graduate students from Nnamdi Azikiwe University, along with faculty, graduate assistants and industry experts, conducted a series of geological and geophysical surveys at the Nnewi Industrial Zone of southeastern Nigeria. The field camp aimed at increasing the capacity of participants on the application of geophysics for environmental and water resources management, and enhanced the professional and technical skills of all 30 participants. The field camp featured a four-day in-house session, a week of intensive field data acquisition, and a week of post field work for data analysis and interpretation of results.

Background

The 2020 SEG-NAU Field Camp, themed “Saving the Future, Today”, featured Integrated Vulnerability assessment and Pollution Status Evaluation of the Nnewi Industrial Zone using Geophysical Resistivity and EM methods. These were carefully chosen to draw the consciousness of all participants to the role geoscientists play in environmental sustenance and preservation of human lives.

Nnewi is the industrial epicentre of Eastern Nigeria. It is located specifically in Anambra state and encompasses two local government areas, Nnewi North and Nnewi South. The dexterity of the indigenes of Nnewi makes it home to several industries such as the food, textile, pharmaceutical and automobile industries. The first indigenous car manufacturing plant in Nigeria, Innoson Vehicle Manufacturing Co. Ltd, is located in the city while the first wholly made-in-Nigeria motorcycle, the 'NASENI M1' is also manufactured in Nnewi.

Generating about 10% of the revenue of southeast, Nigeria, the zone plays a critical role in the economic stability of the nation.

However, in recent years, there has been growing disregard for standard environmental regulations in the disposal of wastes generated from industries operating in the zone. The large scale environmental and water pollution pervading the area provides an ideal natural situation where geological and geophysical methods could be employed in dealing with environmental issues. Participants in the 2020 Geophysical Field Camp were therefore opportune to experience, first hand, the use of geophysical methods in the assessment of the groundwater potential, aquifer vulnerability and pollution status study of the Nnewi Industrial Zone.

During the Field Camp, the participants were exposed to a wide range of geophysical methods for subsurface studies and were able to employ those methods in the study of groundwater potentials of the study area, assess the vulnerability of groundwater occurring in the area to contamination and determine the pollution status of the groundwater in that area. With their results, the field camp participants were able to make sound recommendations on groundwater resource management in the area.

In line with the theme and aim of the 2020 Field Camp, the following objectives were proposed to drive the overall program:

1. Engage students in all aspects of geophysical data acquisition, processing and interpretation.
2. Introduce participants to the field applications of geophysical methods in water resource management.
3. Engender and promote team spirit among participating individuals.
4. Assess the groundwater potential and aquifer vulnerability of the study area.
5. Evaluate the pollution status of the aquifer units in the study area.
6. Make proper recommendations that would enhance policies on aquifer protection and groundwater resource management in the area.

Actions taken

To achieve the stated objectives of the Field Camp, the selected participants were taken through a five-phased program over a period of three weeks.

First, a virtual orientation exercise was held for all participants to provide them with a careful description of the 2020 SEG Field Camp aims and objectives, respective timelines and regulations.

Phase 1

In-House Training: This phase marked the beginning of the program. It commenced on the 20th of August 2020 and lasted for a week featuring training classes, seminars, workshops, panel session and break-out sessions. The participants were taken through series of trainings and hands-on sessions encompassing topics on geophysical data acquisition, data analysis and data interpretation. Desk studies and literature reviews were incorporated into this phase to ensure that participants had proper understanding of the nature of the study area. The training classes were 100% visual aided, it featured practical, and hands-on sessions on data acquisition models, field data analysis and data

interpretation.

Additionally, interactive sessions were held with industry personnel, academics, and government officials on topics ranging from ICT, governmental regulations and policies, research and scholarship opportunities and student-industry. During these sessions, A special seminar tagged the "**geopreneur**" was also carried out to equip participants with information needed to convert their geological ideas to business realities.

Workshops served as focused-based sessions which trained the participants principally on soft skills, emotional intelligence, workplace ethics, gender balancing, field safety requirements among others.

Lastly, the participants, through a panel session featuring key industry players in the Nigerian oil and gas sector were exposed to the latest happenings in the world of geosciences and also engaged in extracurricular activities including movie evening, inter-team public speaking contests, football and volleyball competitions, and photo-contests.

Phase 2

Reconnaissance Survey: In this phase, the participants were divided into 2 teams of 15 students each and representatives of each team carried out reconnaissance survey to ascertain the accessibility of the area, availability and location of outcrops for geologic studies.

Phase 3

Field Work: Upon arrival of the participants to the study area on Monday, 31st of August, 2020, they were taken through an in-depth mapping exercise by the Camp Director, to delineate the geologic boundaries of the Formations underlying the study area, define the spatial distribution of the outcropping lithologies and identify viable points for subsequent geophysical surveys. This was followed by a 4-day geophysical data acquisition using the electrical resistivity method at 30 stations within the area.

At the end of each day 's activity, the tasking field works were complemented with a social activity christened "Camp Circle". This offered the participants an avenue to cool off and interact with their co-campers and camp officers. It featured talent hunts, games, quizzes, and debates in addition to feedback sessions where campers could air their views on certain camp activities and proffer solutions to any identified challenge.

Phase 4

Post-Field Work: In this phase, the participants worked collectively in their various teams under the supervision of the Camp Director to analyse and interpret the data collected during the field work exercise. The geophysical data was analysed using geophysical software such as Ipi2win and res2div to understand the groundwater potential, contamination and vulnerability level of the area. The results of the interpretation were graded by experts.

Phase 5

Sensitization: To end the field camp, an environmental awareness program was conducted through the entire area on the 9th of September, 2020 to educate the locals on

environmental pollution and its adverse effect on groundwater within the community.

Outcomes

The following are the achievements and results of the 2020 Nnamdi Azikiwe University Geophysical Society Field Camp. They include:

1. At the end of the training classes, the participants were able to independently acquire and analyse geophysical data for the purpose of determining aquifer vulnerability and pollution status.
2. The seminars offered the participants the opportunity to get insights into real life challenges and prospects for geophysicists
3. At the end of the fieldwork, all the participants were equipped with adequate skills in data acquisition.
4. The participants gained cognitive skills for discriminating accurate data from faulty data.
5. The participants understood the impact of the earth's dynamics on the nature of geophysical data.
6. The participants fully appreciated the need for geological mapping before geophysical survey and were able to identify and define geologic boundaries as they traversed the study area during the electrical resistivity surveys.
7. The camp participants in their various teams learnt the interpretation techniques and were able interpret the Vertical Electrical Sounding data obtained from the field under the tutelage and supervision of the Field Engineer.
8. The camp participants analysed the data in their respective teams under the supervision of the experts/facilitators and the students generally developed hands-on skills in the use of the interpretation software.
9. The working in teams of the participants in the field camp stimulated and promoted team spirit among participating individuals. Assess the groundwater potential and aquifer vulnerability of the study area.
10. The field camp participants produced aquifer potential maps and protective capacity distribution of an area.
11. The field camp participants made proper recommendations that would enhance policies on aquifer protection and groundwater resource management in the area.
12. Through the sensitization, the inhabitants of these communities were enlightened on the dangers of environmental pollution to groundwater quality and ways in which their practices can impair groundwater status. This knowledge gave them the consciousness of a healthy environment in relation to groundwater.
13. The Electrical Resistivity Tomography points around the industrial area were characterized by relatively lower resistance when compared to the areas away from the industrial zone. This lower resistivity values is probably due to and attributed to increased conductivity of groundwater within this region due to possible contamination. This confirms that groundwater within this area is contaminated possibly from industrial waste and intense industrial activities as such making the groundwater in this region unsuitable for direct consumption posing a threat to the numerous inhabitants of the area.
14. Although this contamination appears to be currently only restricted to these areas, as shown from the higher resistance away from the area, it also threatens the aquifer unit eastward and northward of the industrial zone since flow direction moves slightly in these directions as shown in the flow direction map.

15. Considering the survey findings, there is a high chance that the groundwater accessed by locals within the Nnewi Industrial area is highly polluted as most of the industries located within this area empty their waste into the rivers, canals, and gutters. This does not only affect the groundwater quality but also the health of the people living within these communities.

Lessons Learned

Learning in a field setting allows for deeper understanding of underlying causes for groundwater pollution. Besides theoretical training, groundwater researchers should have an opportunity to present their findings to the local communities which allows for constructive dialogues over potential solutions.

Soft skills such as critical thinking skills, team building skills, effective communication skills and presentation skills are essential to apply groundwater research to business realities.

Despite great challenges to invite top facilitators/instructors, secure field equipment, meals, accommodation and transport for the students, executing an initiative that exposed Nigerian geoscience undergraduates to real field experience which was not accessible to them before equips the young professionals to continue working in the sector.

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Related IWRM Tools
Civil Society Organisations , Training Water Professionals , Vulnerability Assessment, Environmental Impact Assessment, Geographic Information System

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