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The Implication of Weather on Road Construction in Nigeria

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Abstract

Weather affects all aspects of human endeavour both directly and indirectly. To a greater extent, weather dictates what man does in a place at a particular time, especially in the developing countries including Nigeria where modern technology is still poorly developed. The aim of this paper was to examine the different stages of road construction and the effect of rainfall and dryness on it so as to suggest when best to carry out each stage. For the purpose of this study, Nigeria was divided into three (3) based on vegetation and rainfall. Primary data which included stages of road construction, road construction / implementation and weather as well as the percentage (%) of road construction achievable during the seasons in Nigeria were used. Tables were used to present data, while percentage was used to analyze table 3. In table 3, the total percentage (%) of each stage gives the total %, while the total % was divided by the number of tasks in the table (that is, 6) to obtain the average percentage. Discussion of the results was closely followed with suggestion on when best to carry out each stage in order to minimize hazard, labour and cost. It was suggested that the dry season is the best for road construction in Nigeria.

Keywords: Weather, Road, Construction, Rainfall, Dryness.

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Introduction

Weather is a natural phenomenon which affects all aspects of man's life/activities. Ayoade (1988) defined weather as the state of the atmosphere at a given point in time at a given location. Weather determines the occupation of man, when, how and where it takes place. Road transport is the commonest and most important means of transport in Nigeria (Dawam & Ebehikhalu, 2008). According to Akpoghomeh and Badejo (2002 cited in Dawam & Ebehikhalu, 2008), the development of roads, which began during the early years of British colonial administration in the country, has had significant effects on the process of regional development in Nigeria. Among all the means of transport; roads are commonly constructed and rehabilitated. The three (3) types of roads, namely; trunk "A" (primary, major, main, high way, express way or federal government road), trunk "B" (secondary or state government road) and the trunk "C" (minor, feeder or local government road) are the major means of movement in the country as other means of transport namely, rail, water, cable car, animal, pipeline and air are either restricted to a particular area, near extinction, inflexible or too expensive and beyond the affordability capacity of an average Nigerian. Again, even in areas where these other means of transport are functional, they do not attract much construction, re – construction, rehabilitation and expansion like roads. In Nigerian cities like Abuja, Lagos, Kaduna, Kano, Ibadan and Port Harcourt among others; roads are being constructed, dualized and expanded into multiple – lanes in order to accommodate the ever – increasing traffic.

According to Dawam and Ebehikhalu (2008), road transport has contributed significantly to the economic development of the country. It has provided the arteries through which the economic life stream of the country which include people, raw materials, finished products, information and services which help to build and maintain the society flows. In carrying out a developmental project, there is need for an environmental Impact Assessment (EIA) to determine the viability of the project to the socio – economic development of the people it intends to serve, the negative impact of the process and the effectiveness among others. The rising wave of violent protests, conflicts and social action on matters perceived as unacceptable to various groups and communities in Nigeria in recent times (Enukora, 2008 cited in Enukora, 2010), makes it imperative that EIA for developmental projects should be taken serious by developers and proposers (Enukora, 2010). According to Enukora (2010), EIA is the process of evaluating the possible negative or positive impacts that a proposed development project may have on the environment. According to the International Association for Impact Assessment (IAIA) (1999 cited in Enukora, 2010), EIA may be defined as the process of identifying, evaluating and mitigating the biophysical, social and other relevant effects of development proposals prior to major decision being taken and commitments made. In Nigeria, reports of EIA are never made public as they are usually kept in files thereby making the public to be ignorant of its content and provisions (including compensations) due for them. This sometimes ignites conflicts between the government and the community on one hand and the executing company and community on the other hand.

According to Temimoye (2006), the civil engineer is responsible for the planning, design, construction, maintenance and rehabilitation of pavements (roads). The first three (3) of the above are directly connected with road construction. In order words, road construction can be broadly classified into four (4) stages. These are planning, design, award of contract and implementation/construction .

Over the years, most researchers' emphasis has been on weather/ climate and its influence on agriculture, health, water resources, flooding, drought and biodiversity among others (see Audu *et al*, 2010; Sambo *et al*, 2010; Bello, 2010) neglecting other aspects especially the construction industry. Over the years, road construction is undertaken in Nigeria without considering the influence of weather condition and the negative effect of the later on the general well-being of the people. Proposed site for road construction may be cleared, graded and left for so many months or even years uncompleted. Roads may be re-constructed at any period of the year without considering the negative effect (s) of it on the users and dwellers. Where and when this occurs, the people are usually left to battle with these effects which ranges from severe dust pollution, flooding / erosion, traffic congestion, vehicle break-down to even armed robbery without compensation from the government or the construction firm. It is in the light of this that this research has become necessary.

The aim objectives of this study are to access the implication of weather on road construction in Nigeria, examine the different stages of road construction, assess the effect of weather, especially rainfall on each stage and suggest the period of year best suited for each stage.

Materials and Methods

Nigeria is a former British colony, which came into existence as a result of the amalgamation of Northern and Southern protectorates, empires and smaller territories (Bello 2007). Today, Nigeria is made up of 36 states and the Federal Capital Territory (FCT). Nigeria extends from latitude 4^oN to 14^oN and from longitude 3^oE to 15^oE. This makes it to be almost central in the African continent. It is bounded to the North by Niger Republic, Benin Republic in the West, Cameroun in the East and the Atlantic Ocean to the South. Nigeria experiences both rainy and dry seasons. In terms of size, it has a total area of $923{,}700km^2$. There are three (3) most influential ethnic groups namely, Hausa, Yoruba and Igbo. The major export commodity is crude oil (petroleum) which also serves as the backbone of its economy. Its relief is generally divided into lowlands and highlands (Bello, 2007). It is drained by many rivers the major ones being Rivers Niger and Benue. The vegetation is also grouped into two (2) main categories- forest and savanna (Bello, 2007). Its population is estimated to be one hundred and sixty seven million (167,000,000), (National Population Commission, 2011). Of this population, over 60% engages in agriculture (Bello, 2007). The crops grown in Nigeria are classified into three (3) namely; tree, tuber and grains. Figure 1 shows the study area.

Primary data are used for this study. The primary data which deals with the stages of road construction, road construction, implementation and weather (Season) and percentage (%) of road construction achievable during the seasons

in Nigeria were collected through observations and oral questions. Results are presented in tables and analyzed using percentage and discussed.

Results and Discussion

Encarta Dictionary (2011) defined planning as the intend to do something or make arrangements to do something. Enukora (2010) opined that planning include description of actual project and site description, break down of the project into its key component i.e. design, award of contract and construction among others, a detailed list of all the stages. Hence, planning in this context involves all decisions agreed upon on how to carryout road construction. This is mostly done in the office so it is not affected by weather. Therefore, it can be done at any period of the year. Design is defined as an attempt to create detailed plan for something: to make a detailed plan of the form or structure of something, emphasizing features such as its appearance, convenience and efficient functioning (Encarta English Dictionary, 2011). In Nigeria, the California Bearing Ratio (CBR) method is almost the only method used for design of flexible pavements. The use of design curves to determine a thickness requirement is used (Telimoye, 2006). This design could be described as "civil engineer's graph". This stage is done in the office and it is not affected by weather elements; hence it could be done at anytime of the year. A contract is a formal or legally binding agreement (Encarta English Dictionary, 2011). In this contest of study, it is the legally binding agreement usually in writing, between the prospective civil construction company and the government. It is not affected by weather and as such, it can be carried out at any period of the year. The construction/ implementation stage is the most crucial stage of construction because it is the stage at which the construction job is executed and it is done in different phases (see table 2).

Survey is defined as the process by which measurement of land is made and then represented by tables, plans or layout for specific purposes, while engineering survey include all aspect involved in the preparation of engineering works to its execution. The features mostly considered are roads, channels, rails, dams and other construction works (Iwena, 2007). Road construction cuts across physical or natural features such as vegetation, mountains, water bodies (rivers, lakes, streams and areas liable to flood among others), rocks and so on; hence the best period for it is dry season to avoid rain hindering the exercise or damaging the equipments such as theodolite and prismatic compass among others. Again, the presence of thick vegetation and water bodies would affect the surveyor's work and equipments. Therefore, in the forest zone, survey should be done between January and March which corresponds with dry season in the zone, in Guinea savanna, November to May is suggested; while October to June is suggested for the Sahelo-Sudan savanna. This is because during the dry season, grasses have withered and would make the survey's work easier especially in the savanna region.

Earthwork for highways usually is classified as rock earth, wet excavation (waterlogged material) unsuitable material and unclassified excavation (Duttenhoeffer *et al*, 1983). Earthwork operations are those processes that involve the earth in its natural form, which need to be undertaken before the actual construction of pavement structure – grading and construction of the roadbed, which include clearing and grubbing, excavation, construction of embankments and finishing operates for the preparation of highway or run way (Telimoye, 2006). Clearing and grubbing consist of removing and disposing of grass, bushes, tress, tree stumps and all rubbish from the right of way (Telimoye, 2006). Grading operations are all the construction activities between site clearing and the actual paving including hauling, spreading and compacting of the materials. Accompanying or preceding grading is the installation of drains, culverts and bridges (Telimoye, 2006). Excavation refers to the loosening and removal of earth or rock from its original position in a cut and transporting it to a fill for road foundation or to a waste deposit (Telimoye, 2006). According to Telimoye (2006), embankment refers to the fill added above or below points along the roadway to raise the level to the bottom of the pavement structure. Earthwork operations are best carried out during the wet season in the Guinea and Sudano – Sahel Savanna. The reason is that, when grading is done during the dry season, it leads to serious dust pollution which affects the road users and dwellers. It should be however noted that dust, when inhaled over a long period of time can accelerate lung and trachea diseases especially asthma. Also, large body of dust obstructs the view of road users. Meanwhile, in forest zone, this phase is suggested for the dry season, preferably December to March. This is due to the marshy nature of the area as during the peak of the rains, the heavy duty equipments such as bulldozers and graders among others may be unable to operate. The second phase of the clearing has to do with the construction of culverts which is best done in dry season. This is to allow the culverts have sufficient solar energy for drying.

The base course is the layer (or layers) immediately below the wearing surface. It may be composed of crushed rock or stone, stabilized granular material and stabilized lateritic soil or rock laterite (Telimoye, 2006). This can be done during the rainy season since it is less affected by rain, but best suited for the dry season because it generates only little dust. The wearing course which includes the use of asphalt or tar is best suited for the dry season to avoid washout by rain and to facilitate quick drying by the sun. Road shoulders according to the American Association of State Highway and Transportation Officials (AASHTO) (1986 cited in Telimoye, 2006) is the portion or roadway contiguous with the travelled way (carriage way) for accommodating stopped vehicles for emergency use and for lateral support of base and surface courses. The minimum width is 10ft or 12ft (Douttenhoeffer *et al*, 1983). This, including road marks or signs is best done during the dry season to avoid rainfall interference.

Generally, road construction is best done during the dry season as only few works can be achieved during rainy season due to interference by rain. From table 3, it could be seen that less than 50% of road construction can be achieved in wet season, while its construction in dry season can be achieved 100%. Meanwhile, with improvement in technology which has facilitated near accurate weather forecast, some of the works stipulated for dry season could be done during wet season.

Conclusion and Recommendations

In conclusion, roads are very vital in Nigeria in the daily socio – economic activities of the people as other means of transportation are uncommon. Also, because weather plays an important role during constructions generally and road construction in particular; it is therefore imperative that weather condition is put into consideration during construction. If the above suggested periods of road construction are strictly adhered to, it would help to minimize the Initial Construction Costs (ICC) and the adverse negative consequences of road construction, especially dust pollution on the populace. Earthworks have the greatest negative effect on man's health due to dust pollution. This can be controlled by heavy and regular wetting of the surface. On the other hand, where there is an outbreak of dust related diseases (due to the construction of township roads in particular), the government and / or construction company should pay compensations and offer free medication to the victims. Also, where sites are been cleared and / or graded for construction or rehabilitation especially highways, security should be provided at sharp bends, depressions, hilly and rocky places as well as water courses to prevent armed bandits from using such places as robbery spots. Reports of EIA should be made public through the mass media, while the Constitution of the Federal Republic of Nigeria should include a compensation for victims of developmental projects.

References

Audu, H.O; Balogun, R.B; Nwoga, R.C; Garba B.G; Kalejaiye-Matti, R.B; Amadi, G; and Audu, E.B. (2010). Climate Change: Causes, Implications and Mitigation Strategies. In *Nigerian Meteorological Society Proceedings of the National Conference on Climate Change Impact and Adaptation: Is Nigeria Ready*? Pg4.

Ayoade, J.O. (1988). *Introduction to Climatology for the Tropics.* Spectrum Books Limited. Pg2.

Bello, N.J. (2007). Extreme Weather and Climate Effects: implications for Water Resources. In *Nigerian Meteorological Society Proceedings of the International Conference on the Impacts of Extreme Weather and Climate on Socio-Economic Development in Africa.* Pg46.

Dawam, P.D. and Ebehikhalu, N.O. (2008). Analysis of Major Causes and Cost of Road Traffic Accidents in the Federal Capital Territory, Abuja; 1998 – 2006. *In Abuja Journal of Geography and Development*. Volume 2, No. 2, September, 2008. Pg. 30.

Dutenhoeffer, Richard; Podwal, B.E; Delle, A.U; and Kirklya V.A (1983). Highway McGraw- Engineering. In *Standard Handbook for Civil Engineers*. Frederick S. Merritt (ed). Third Edition. Hill Book Company. Pg 16- 17, 16-29. *Encarta English Dictionary* (2011).

Enukora, L.O. (2008). In Enukora, L.O. (2010). Towards Integrating Socio- Cultural and Economic Consideration in Enukora, Environment. In the *Cardinal Point*. Journal of the Institute of Certified Geographers of Nigeria. Issue 2 Vol. 1 May, 2010. Pg3&4.

Iwena, O.A. (2007). *Essential Geography for Senior Secondary Schools.* Tonad Publishers Ltd. Pg138.

National Population Commission (2011). *Population Estimate for Nigeria*. Unpublished (no page).

Sambo, A.O; Abdulkadir, A.B; and Imam, I. (2010). Climate Change, Agriculture and Water Resources: The Niger Delta in Focus. *Nigerian Meteorological Society Proceedings of the National Conference on Climate Change Impacts and Adaptation: Is Nigeria Ready*? Pg121.

Temiloye M. Oguara (2006). *Highway Engineering- Pavement Design, Construction and Maintenance.* Malthouse Press Limited. Pg8.

Tables

Table1: Stages of road construction.

S/N	Stage	Task Element (s)
1	Planning	Description of actual project and site description.
2	Design	The use of design curves to determine thickness requirements.
3	Award of Contract	Bidding and award of contract to a suitable construction firm.
4	Construction/ Implementation	Survey, clearing and earthworks just to mention but few.

Source: Author's field work (2011).

Table 2: Road construction /implementation and weather (season)

S/N	**Task**	**Best Season**	**Remarks**
1	Survey of the road site	Dry	Affected by rain
2	Earthwork	Rainy	Not affected by rain
3	Place Base Course	Rainy/ Dry	Less affected by rain
4	Place Wearing Course	Dry	Less affected by rain
5	Reinstate the shoulders	Dry	Less affected by rain
6	Road marks	Dry	Less affected by rain

Source: Author's field work (2011).

Table 3: Percentage (%) of road construction achievable during the seasons in Nigeria

S/ N	Task	% of work in wet season	% of work in dry season
1	Survey	40	100
2	Earthwork	60	100
3	Place base course	50	100
4	Place wearing course	40	100
5	Reinstate the shoulders	40	100
6	Road marks	50	100
	Total	**280**	**600**
	Average	**46.7**	**100**

Source: Author's field work (2011).

Figure

Figure1: Map of Nigeria.