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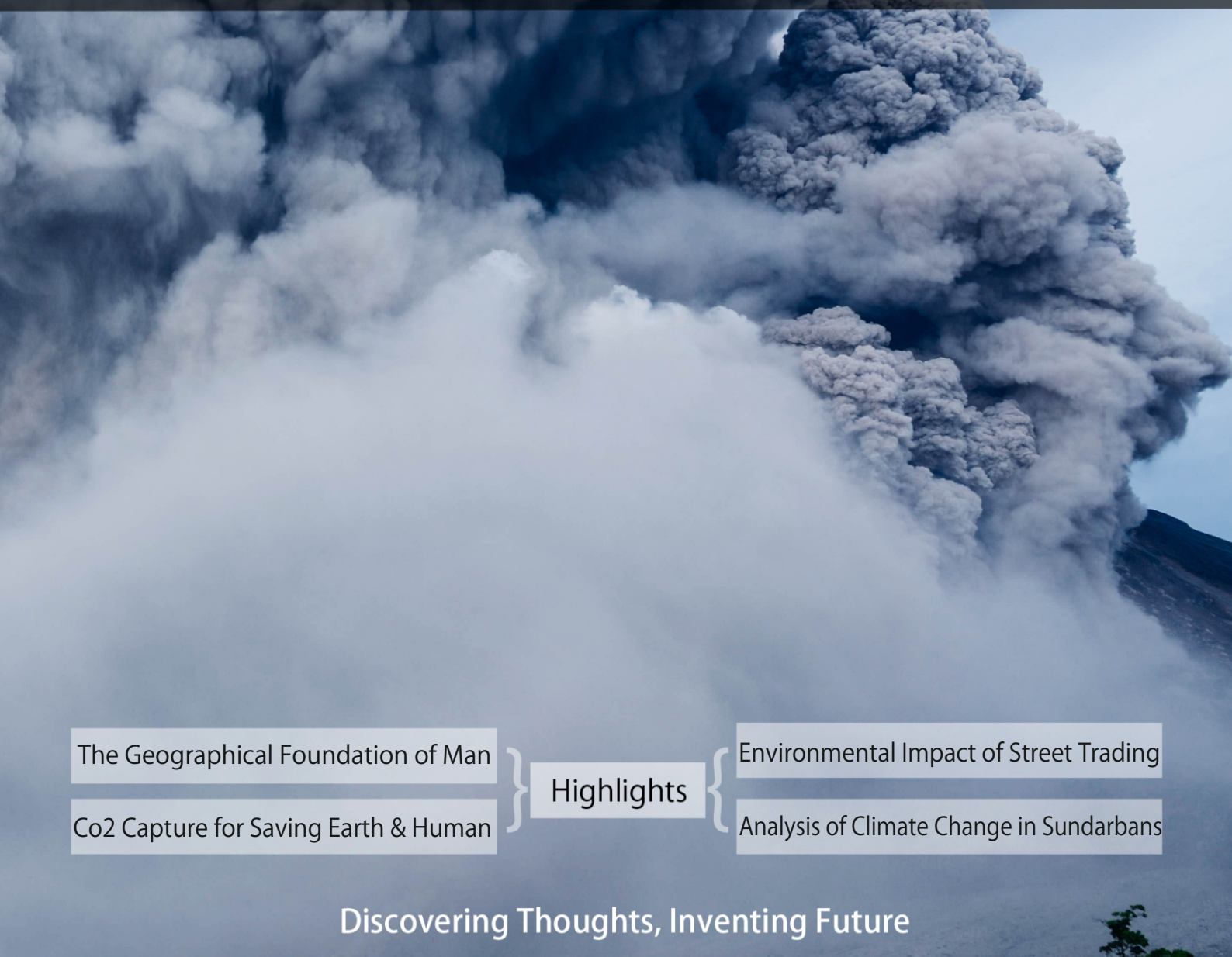

The Geographical Foundation of Man

Co2 Capture for Saving Earth & Human

Highlights

Environmental Impact of Street Trading

Analysis of Climate Change in Sundarbans

Discovering Thoughts, Inventing Future

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Contents of the Issue

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

1. Geography and Ontology: The Geographical Foundation of Man. *1-11*
2. Making use of CO_2 Capture for Transform Industrial Production - Supplement of Making use of CO_2 Capture for Saving Earth and Human. *13-19*
3. Analysis of Climate Change in Sundarbans (Bangladesh Part) in Terms of Temperature and Rainfall Variability. *21-32*
4. Environmental Impact of Street Trading in Akure, Ondo State Nigeria. *33-45*
5. Management of Sustainable Cities in Nigeria: The Imperative of Urban Governance. *47-55*
6. Land Cover and Coastline Change Assessment of Nijhum Dwip, Bangladesh, using Geospatial Analysis. *57-64*

v. Fellows
vi. Auxiliary Memberships
vii. Preferred Author Guidelines
viii. Index

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Geography and Ontology: The Geographical Foundation of Man

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Abstract- The goal of this study is to define the geographic foundation as a constituent determination of man's Being. To this end, it reexamines and redefines certain epistemological foundations of geographic science, thereby setting a new bedrock for the relationship between ontology and geography.

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Geography and Ontology: The Geographical Foundation of Man

Geografia E Ontologia: O Fundamento Geográfico Do Homem

Elvio Rodrigues Martins

Resumo- **Este trabalho busca a definição do fundamento geográfico como uma das determinações constituintes do ser do homem. Para tanto, retoma alguns dos fundamentos epistemológicos da ciência geográfica, no sentido de redefini-los, e com isso estabelecer novas bases para a relação entre ontologia e geografia.**

Abstract- **The goal of this study is to define the geographic foundation as a constituent determination of man's Being. To this end, it reexamines and redefines certain epistemological foundations of geographic science, thereby setting a new bedrock for the relationship between ontology and geography.**

Introduction

When the topic of 'ontology' comes up in a geographic science debate, the term does not seem to warrant a terminological definition. It is as though in geographic studies speaking of ontology means, at first, discussing whether or not there is an ontology of space – of geographical space, to be more precise. After that, the discussion usually proceeds to a definition of the elements that would supposedly characterize an ontology of space.

The key scholars in this tradition are Armando Corrêa da Silva, who conducted seminal research on the topic, and Milton Santos, who contributed substantially to the debate in the first part of his book "The Nature of Space". Other important names are Antônio Robert Moraes and Ruy Moreira. Moraes addressed the topic once, on a short and rather old study[1], then later on changed his stance to consider the possibility of an ontology of space. More recently, Moreira strays a little from that tradition; his position is presented in more detail below.

However, we must begin by outlining what we refer to as Ontology. The topic first originated in Philosophy and therefore is not a traditional geographic science topic, which calls for exchanges between the two fields of study. Whilst an overview of the history of ontology in philosophical studies lies outside the scope of this essay, we must mention a few key elements.

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[1] "Em Busca de uma Ontologia do Espaço" *in* Geografia: Teoria e Crítica, Ruy Moreira (org.), Petrópolis, Ed. Vozes, 1982.

Parmenides was the first to study ontology, also known as First Philosophy or Metaphysics. This pre-Socratic philosopher established the need to consider beings in their essence, that is, as what they are. Each being is that which they are on account of their Being. Thus, all Being is the Being of a being. This claim proposes a key distinction that is known as the 'ontological difference': the Being is not to be confused with any being, and all Being is the Being of a being.

Another key metaphysical consideration is that the Being is absolute, infinite, and transcendental, while a being is the exact opposite of those things. A being is finite and has no effective bearing on the essential constitution of reality. Ontology studies Being, whereas beings are the province of ontic studies. Once that distinction has been established, then ontology, metaphysics, or the first philosophy must dedicate itself to identifying that which is absolute, infinite, and transcendental; in other words, it must concern itself with Being.

From an idealistic metaphysics standpoint, throughout the history of philosophy Being has been identified as Idea, Form, Monad, and Spirit. There is, however, also a materialistic metaphysics, which has proceeded to its own identification and naming of the Being. Many a Marxist school has struggled with this issue – which we claim to be an issue because the radical refusal of all aspects of metaphysics is supposed to be a cornerstone of materialism, which should have led them to set new ontological foundations. Furthermore, we must also point out that the various Marxisms do not deal with the 'ontological distinction'. One example is the work of György Lukács, whose ideas are evidently no less relevant for this; however, in Marxist terms, the ontological debate is limited when one fails to observe the 'ontological distinction'.

Before leaving the issue of identifying and naming the Being, it is worth raising another relevant aspect of Metaphysics' protagonism on the definition of ontology: the process of objectification[2] of the Being. In other words, even as it names the Being, metaphysics makes it into a being, which requires us to wonder about the Being of that newly identified being. This results in

[2] That which Heidegger calls Vergegenständlichung.

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the search for the *causa prima*, the first cause, therefore rendering metaphysics constitutionally essentialist.

After these introductory remarks, we will proceed to a brief critique of how ontology is usually addressed by geographic science. When we speak of an ontology of space, we must ask whether space is to be regarded as being or as Being. If space is Being, we must inquire as to which being has 'space' as its Being, which would be curious, to say the least, for Being would then consist of Being-space. This path would lead us into a labyrinth of theoretical misconceptions, where the terms of the debate seem to be based on metaphors. Most geographic contributions to the debate seem to regard space as being – all aforementioned scholars seem to suggest that is so. However, when we proceed to characterize space in those terms, the product is not an ontological reflection. And the heart of the problem is what geographers traditionally understand as space.

I. Objectivity and Materiality

A distinctive feature of geographic science is the coincidence of *matter* and *space*, which translates into a subsequent coincidence between materiality and objectivity. Examples of this superposition can be found in seminal geographical studies, such as Ratzel's:

> "The task of Political Geography is to study the political division of *spaces* in each historical period, especially the current one" (Ratzel, p.146, 1987).

La Blache's:

> "(...) – the existence of a high population density, of a large number of human beings cohabiting in minimal *space* where, however, safe living means are assured for that collectivity..." (LaBlache, 1954, p.37).

Or Sorre's:

> "Geographical *space* is not solely characterized by geometric dimensions. As men, we measure it by the existence possibilities that it affords us." (Sorre, 1968, p.98).

Upon reading these excerpts, we address them a common question: what is space to these authors? What has its division studied by political geography, what assures a collectivity safe living means, and what is measured by the existence possibilities that it affords us?

A clear answer to those questions is offered by Milton Santos:

> "*Nature and Space* are synonyms if we regard Nature as transformed nature or, in Marx's terms, as a second Nature" (Santos, 1982, p.10).

Transformed or not, Nature is identified as geographical space; in other words, space is regarded as visible, external to one's consciousness, and endowed with materiality.

This synonymy dates far back and can be better understood by reading the following, capital excerpts:

> "(...) there is no real distinction between *space*... and the bodily substance it contains, the only difference lies in how we are used to conceiving them." (Descartes, 1995, p.76).

In addition, there is also:

> "Matter is that which is movable in space. A movable space is called *material space*, or relative space..." (Kant, 1990, p.25).

These quotes are presented to illuminate the sources of the aforementioned superposition. Although insufficient, those are the foundations on which space comes to be regarded as a being identifiable with transformed or un-transformed Nature. It is something endowed with materiality, or even with bodiliness, and thus visible, and even tangible.

Our main objection to this is that matter, body, and nature are not the same but instead refer to different dimensions of reality, while Space has its own place in that picture and definitely cannot be confused with matter, body, or nature[3].

Therefore, on this basis, we disagree with that superposition. Our stance is actually underpinned by Descartes' words quoted above, about how everything depends on how we conceive things. For instance, when we agree that "space is vital", we are actually stressing what is comprised in that space, or what can be confused with it. Something similar happens to other categories of geographic science discourse, especially territory.

However, the need to assert a dimension of that which defines the idea, i. e. all that it is not in itself, such as Matter, or reality's objectiveness in face of the subject, or even the conceptual definition of Nature, is not the same as claiming that Space is an elementary mode of everything that exists. This is why space can be considered as a Category, that is, one of the characteristics identifiable when we reflect upon the existence of all beings in general. Therefore, by identifying space we are not referring to beings in-themselves, but instead to the existence of those beings. This does not entail denying space's objectiveness, seen as how it is a feature of that being's existence. However, beings only exist inasmuch as they participate in the subject/object dichotomy. All that exists must submit to that dichotomy, in which existence is characterized by assuming certain categories, such as space and time. In other words, existence is characterized by these categories. On this basis, a

[3] Here it is worth noting that "In order to avoid a common mistake, it can be useful to stress the fact that we are dealing with the *philosophical* category of matter, not to be confused with the *scientific* concept of matter, for the latter is conditioned by scientific progress and has therefore *changed* significantly throughout history" (Brando, 1989, p.138-39).

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crucial implication of superposing beings and space becomes evident: doing so blocks the path that leads to ontology, for it prevents us from stressing the characteristics of beings' existence. This becomes paramount when one considers, as we do in this study, that existence precedes essence. When we look at man, it becomes clear that this superposition keeps us from determining how geography can be an ontological condition for man. Little by little, we must get used to the ontological density of the expression *Where*.

There is the being and its essence, its Being, and then there is that being's existence. That distinction is precisely what enables us to regard existence as necessary for a Being, which will, in turn, make a being into what it is. Thus, it would be inaccurate to claim that being *is* space, when actually a being exists and, in so doing, it has or it is in a space, which is a dimension and a mode of that being's existence, which in turn is related to the being's essence, to its Being. Phrased otherwise, modes of existence are foundations of the being in which Being is actualized.

Let us discuss a second implication of not superposing space and being: what happens when we consider the importance and meaning of space in the subject-object relationship, its constituent role in the act of cognizing the world? We find ourselves close to asserting that there is no erroneous concept of space, but rather various concepts tied to different levels of understanding about the existence of the world and of beings in general. Regarded as a constituent of existence, space becomes a category related to ordering, that which enables us to verify beings' relative locations to other beings, and how they fit in the set of their correlations and cohabitations – and, consequently, also their contrapositions. Thus, space is the category pertaining to the order of relationships between beings that coexist. Understanding this order equals conceiving a logical system in which that logic is determinant and cohesive. Therefore, there is a relationship between Logic and Space[4]. While one logic pertains to the abstract understanding of reality, the concrete dimension of that same reality has a different logic. Likewise, while one space pertains to an abstract understanding of the existence of beings, there is another space that encompasses the concrete existence of beings in general. For example, if we are able to see how, in logic positivism, space adheres to a taxonomy based on 'grouping' or 'organization', then we must acknowledge that the constituent notion of space will change when framed by a different worldview.

[4] This topic was discussed in detail in our PhD dissertation, "Da Geografia à Ciência Geográfica e o Discurso Lógico" [From Geography to Geographic Science and the Logic Discourse], College of Philosophy, Languages and Literature, and Social Sciences – University of São Paulo, 1996.

In short, our understanding of space and time is our understanding of the *existence* of beings, and thus there is a relationship between gnosiology and ontology. Space and time are categories of the world. And man is, at his core, world.

Thus, space is also an attribute of the act of cognizing the world. As such, it is not something that exists prior to cognition, but instead a product of social construction, a human attribute, a way of seeing, understanding, and constituting the world we live in. Aside from being an existential expression of beings, the idea of space involves different ways of grasping and understanding the world. Under these conditions, space encompasses all modes of existence and therefore all modes of reproducing the world.

Once again, we must stress that there are no strictly incorrect concepts of space or time because, as explained above, all concepts are consistent with a certain worldview. If anything is 'wrong', that limitation belongs to the respective worldview. A-historical and heavily ideological outlooks are grounded on equivalent perspectives on space and time. A perfect example of that can be found in geopolitics, more specifically in the classic formulations of the notion of 'manifest destiny'.

The sole negative observations applicable to the notions of space and time are those in which we suppose that which space and time are not.

From this standpoint, after having determined that there can be no such thing as an ontology of space, we must return to the question: how, then, does ontology fit into geographical thought?

II. Geography and Space

Space is as frequently associated to geography as time is to history. Hartshorne assigned the study of time periods to history and that of sections of space areas to geography, while Edward Soja addressed the issue in "Post-Modern Geographies". This division is in line with the old Kantian tradition as incorporated into geographical studies by Hettner and could lead us to believe that those fields of study have time and space as their respective objects. This belief is traditionally accepted in geographic science but, when it comes to history, things can be slightly more complex. That is because in this tradition, unlike space, time has neither materiality nor a properly empirical nature, which would render it rather odd as a scientific object. Our own stance on the matter, however, is based on a different outlook.

Firstly, we believe that Geography is not the same as Space; instead, space is *just one of Geography's many constituent categories*.

That statement cannot be fully understood unless and until we establish a distinction between Geographic Science and Geography as a characteristic

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of the reality around us, as well as a foundation of thought.

Through geographic science, we make mental representations of the objective reality around us. This subjectivation process involves a series of methodological procedures. A subjective representation is established by means of logic systematization and expressed in one or more languages. The entire process involves phenomenic and essential aspects of reality.

By its use of methodological procedures, a science is structured around interpretative theories; it builds a theoretical framework and defines its main categories. Therefore, geographic science consists of practical theory acts, of theoretical practices. Geographic science is made and identified by geographers in various contexts. However, although Geography as a subject is identified by practices, its foundations are not themselves practices. Geographic practices can often be quite distant from the foundations of Geography, which rest on the constitution of reality, rather than on professional practices. An incapacity to identify the object of geographic science often leads people to fall back on the last-resort definition according to which "geography is what geographers make of it", as though that did not apply to any and all fields of study. Such a statement aborts the debate in which Geography is called to constitute itself as a subject. At its source lies the *geographical foundation that constitutes reality as such*. When we fail to take that into account, we also fail to grasp the importance and the meaning of geography in the constitution of reality.

A person who cannot identify this geographical foundation cannot possibly know what Geography is, or they might confuse it with the subject and its many different practices.

Geographic science has many names for these geographical foundations; throughout the history of geographical studies, they have been called 'geographic factors', 'geographic facts', 'geographic elements', 'geographic aspects', 'geographic causes', or simply 'the geographic'. It is also possible to speak of a 'geographic determination', or of a 'Geography' of reality. This means that when we identify 'geographic elements' or 'geographic determinations' we are not referring to the science, but to reality instead. It is as though we looked at the world and wondered what in it is geographic, or as though the person asking: "Where are the 'historic foundations' of reality?" now asked about the 'geographic foundations' of that same reality. We do not mean to imply that geography somehow exists by itself in reality, just waiting to be discovered; geography can only be instituted in a subject/object or in a society/nature relationship. Geography does not exist outside such relationships any more than history does. Our existence and our awareness of existing as men require us to own our environment by establishing a spatial order. There is more than one way of establishing that order and acting upon it. The location and distribution of beings are initial clues about the importance of *where*, leading us to grasp the need for a science whose purpose is to investigate the *geography* of subject/object and society/nature relationships.

As a science, geographic science consists of a subject's specific outlook on their reality – or on their 'object', to be exact. This requires us to define this 'object' of geography, as well as what exactly is that geography that presents itself as a constitutive property of that object. Likewise, we must determine the importance of that property to the constitution and characterization of our object.

Answers can be found by studying the etymology of the word geography, or that which used to be called "studies or works of a geographic nature" when the subject had yet to be formalized and receive a name of its own. Shall we?

This geography-bearing 'object' emerges from man's coexistence with and alterity towards his environment, like society towards nature. Thus, geographicity has a double meaning, composed of two complementary, simultaneous (and not consecutive) meanings. This can be ascertained when we follow man's process of owning his environment, and/or society's process of owning nature. That process is externalized in the act of '*describing*', which enacts the etymological roots of the term geography.

But how does that happen, and what are those two complementary meanings? In the act of describing, a subject comes to own their object. It is an intimate, constant relationship in which one founds-and-is founding and determines-and-is determining; the sort of ownership established by 'describing' represents a two-way, *simultaneous* transit between objectivity and subjectivity. The topo-logical aspects that will organize thought and guide a subject's actions on his reality are established during various processes, from immediate sensory perception all through the initial systematization provided in the act of describing. There must be one here and another one there. Owning requires establishing a spatial order.

As we have seen, geography belongs to the relationship between society and nature. It is a characteristic of a Man/Environment relationship in which those members are equivalent – an equivalence that comprises both identity and difference. However, it is first and foremost a property of the world in which Environment and Nature are extensions or projections of Man and Society, insofar as they are human creations.

Now that we have identified the object that has geography as its propriety, we must determine what exactly that geographic propriety consists of.

To that end, the geographic process of 'Describing' can prove rather elucidative. Descriptions result from an observation of phenomenic aspects of the objectivity to which the subject belongs. In order to be

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actualized as an expository act, a description must be filled with the meanings of cohabitation and mutual belonging, which involve Location and Distribution. In other words, describing requires a cognitive procedure in which one must perceive each being's location, and subsequently their distribution. This entails the constitution of the geographic sense.

Another key element of description is permanence: we are able to perceive whether beings remain at a certain location or not, which allows us to establish whether a given distribution is constant. Thus, when we observe something, we are also observing its *duration*. We are ascertaining the regularity of its permanence time. This leads us to suppose that there is a balance which, once broken, causes duration to cease, which means that locations will change, and consequently so will distributions. This change is called succession. Succession is actually the disruption of the balance of rhythms of a given distribution, that is, the localization profile – in which rhythms are dictated by the (distributed) nature of contraposition *relationships* between located beings. Thus, there can be no static description: one must always consider the moment. But moments are immediate, while the very nature of a description is being mediated, in that it shapes one's relationship with the reality that comes after – with the next moment, which amounts to stating that the subject transcends their object. Thus, the relationship of mutual belonging and contraposition establishes itself as yet another category of existence.

In this immediate empiricism, the observation process inherent to the act of describing denotes the stability/instability of locations and the constancy/ changes in distribution, thus ascertaining the mutability degree of what is observed over different time periods (duration). In other words, it is through temporality and spatiality that *movements* happen and are observed.

Therefore, descriptions tell us about the *existence* of what one sees – the cohabitation of beings in general – using the basic constitutive categories of existence: Time, Space, and Movement. It is through description that we become aware of a first geography[5], and this awareness allows us to verify the world's immediate existence.

And in this sense, geography can be regarded as a category of Existence. This category is constituted by space, time, relationship, and movement, which are derived from the coexistence of beings in general, man among them. Like history, geography characterizes man's world. And this World presents itself in the processual unity of man/environment and in the subjective/objective relationship.

Now that we have established the basis on which to regard geography as a category of existence, we can argue that it is an ontological foundation – since the notion of existence is connected to the definition of Being. From this standpoint, geographic science may broaden its horizons with the addition of the ontological dimension and the subsequent dialogue with philosophy. All analysis conducted by geographic science may incorporate a philosophical perspective.

Regarding geography as a category of existence allows us to get even closer to the being who is at the core of our reflections: man.

But before we proceed with this reflection, we should address Ruy Moreira's stance in this debate, as promised in the introductory section. There are some differences between his point of view and ours, which we shall not regard as disagreements but instead as divergences that raise doubts and, in so doing, keep the debate alive. Let us look at three short excerpts of his "Marxism Geography (Geographicity and the dialogue between ontologies)".

"Geographicity is existence in its spatial expression. The ontic-ontological point where the man-environment metabolism is translated into man-space metabolism." (Moreira, 2004, p.33)

"And geographicity itself is the synthesis of the relationship between essence and existence, and thus the very concrete totality of Being." (id., p. 34).

"Geographicity is, therefore, a being's spatial Being. It is a Being's ontological state in time-space" (id., p. 34).

Firstly, we object to Moreira's view of geographicity as spatial expression. As we have argued above, geographicity is not constituted exclusively by space; instead, it is a complex comprising the categories of time, space, movement, and relationship. As such, it is the superior expression of a *complex manifestation of existence* (alongside history) and although geography does characterize man's existence, that does not allow us to regard it as a synthesis of essence and existence – especially because circumstances can reveal a non-identity between man's existence and his essence. We will refrain from mentioning the importance of praxis and work just yet, for later on these aspects will be addressed properly and we shall return to the concept of alienation to demonstrate the divorce between man's existence (his factual life) and his essence.

Lastly, speaking of ontic and ontological requires us to return to the relationship between being and Being. How can one regard geographicity as the translation of man-environment metabolism into man-space metabolism, when space (like time, relationship, and so on) is already comprised in the first one? If

[5] The expression 'first geography' refers to this initial stage of the process of ownership of the world and of oneself that the subject engages in during the act of Describing. The following stages or 'other geographies' are presented in detail in our former work, "Da Geografia à Ciência Geográfica e o Discurso Lógico" [From Geography to Geographic Science and the Logical Discourse].

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space is not the same as environment, and the first can only be attained via the latter, the metamorphosis of the environment by man's actions is certainly a change in man's existence conditions. This amounts to claiming that geographicity changes according to the metamorphosis operated by the man/environment relationship, once more supporting our proposition that movement should be regarded as a constituent of the complex mode of existence that is geography.

III. History and Geography: Ontological Foundations

When regarded as foundations of existence (of which life is the dynamic complex), man, environment, and their relationship cannot be examined in full without considering history. Like geography, history is but the process dynamics of the society-nature and man-environment relationships that constitute humanness. Its constitutive elements are also movement, space, and time.

There is, however, a difference between Geography and History, which becomes visible when one observes the particular manner in which History expresses itself with regards to the time and space dimensions.

While geography is specifically defined by *rhythms* and *durations*, history's temporality is defined by succession. Also, there is history in geography (the discontinuity of *durations*) and geography in history (the discontinuity of *successions*). Among these discontinuities, one particular inequality/imbalance synthesizes the *rhythms of moments*.

Geographic time is the synthesis of rhythms that define a moment's balance/imbalance – a duration. Geographic time results from the speed of the rhythmic cycle intrinsic to various aspects of the man-environment, society-nature relationship; in other words, that which establishes the location/distribution metamorphosis dynamics.

Pierre George wrote that "the notion of geographic time is something original and difficult to define. *Geographic time is at once geological, historical, and contingent*." (George, p.50, 1969). He suggested that we imagine a *sidereal time* composed of *ordinary times*, each of them characterized by *anomalous times*. The latter are defined by memorable events, such as a crisis, a war, a revolution, and a natural catastrophe.

Although George's observation is not without merit, what makes temporalities change is no alteration in time itself, but rather that in relation to what time is a category of existence. Phrased otherwise, beings change, move, transfigure themselves, and are constantly in process because they continue to exist – *and to exist is to situate oneself in a structure of relationships with other beings.*

Transformations come from relationships because relationships are processes of mutual determination of their members (beings). Relationships can determine cycles with different durations, that is, with different rhythms. To be more precise, relationships have a rhythm of their own, and by looking at each rhythm we can see a cycle reach its completion. In the web of relationships in which a being is involved, the cycles of each relationship become complete at different times, for the rhythms of each relationship are unique. This leads us to believe that each being, in the totality of its distribution, is subjected to a unique metamorphosis speed. And distribution will have a stable duration until the moment when the balance of rhythms is broken, and a new distribution is formed.

Throughout the different relationship scales, in the differential spatiality in which a being is located and situated at different distributions, geography is mobile. In its geography, totality is the real as it undergoes its historical process. There is actually a geographic process with a historical character since, as advocated by Herder, *History is Geography in motion*[6].

For thought, balance is moment. And, since there is an unstable synthesis forged in the relationship between rhythms, the disruption of that moment means a recombination of the rhythmic synthesis and the foundation of a new moment; thus, between one moment and the next, between one duration and another, change generates succession. *This is History*, in terms of space and time.

There is temporal discontinuity in distribution, since each being who locates themselves does so in different moments. Thus, the creation of locations – of this order of temporally distinct cohabitations – originates historical space, that is, a space that is generated by different permanencies deriving from discontinuous successions.

Consistent with this perspective, the present is a varying simultaneity of successions and durations, which makes history present through past geographies and also makes history geography in motion. A geography that remains subjected to another, a present one. In the strength of this relationship between geography and history, the existence of beings can be observed in the moment between Being and Not-Being. Actually, there one historical process with a geographical nature.

Existence itself, existing, is the given fact of there-being (Dasein) – 'there', in a specific Geography, and 'there', in a specific History. In a Geography that imposes itself as an ontological foundation.

[6] Herder aput Ratzel (p.84, 1914).

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IV. The Geographical Foundation of Man

Now we can see geography in its identity and in its difference: identity as subjectivation of what is grasped, and difference from reality in its history.

But identity and difference between what, or whom? Between Man and Environment, between Society and Nature. A geography that will be human geography insofar as it is accomplished through an environmental or physical geography, and a physical geography that can only exist as such by addressing the man-environment relationship.

It is given there (in the environment) as it is identified here (in man, in the subject), and thus it is named. It exists. And to exist means existing to one's awareness. There can be no existence outside the subject/object relationship, because existing is an action that requires the presence of two participants, one affirming what exists, and another being affirmed as existent. To exist is necessarily existing-for, or, as Hegel puts it, "I have certainty *through* an other, namely, the item, and this likewise is within certainty *through* an other, namely, through the I."[7] (HEGEL, 2017, p. 61). In other words, 'there' is determined when I identify 'here'. And 'here' can only be conceived *through* 'there' – more specifically, through a 'here' that will be a being there, or a being-there, a presence, Martin Heidegger's *Dasein*.

And an existent cannot be so unless they have a 'where', which allows us to suppose an environment constituted by beings that coexist. There, Dasein is being present as a being in the midst of other distributed beings. On the basis of such observations, we can deduce geography's preliminary constitutive elements. Insofar as it is a mode of human consciousness, geography constitutes itself through which beings are there, and through my relationship as a being that coexists with other beings. The distribution, the spatial order, and the coexistence of beings are the preliminary steps that lead beings to be that which they are as a result of where they are.

However, our observations so far are but phenomenic findings, amounting to a descriptive appraisal. Therefore, we must advance further. As already indicated, these are preliminary elements that subside the understanding of our key proposition: geography is an ontological foundation of man. In order to argue that proposition, we must go beyond this phenomenological manifestation of human geography.

Let us begin by reading the following excerpts:

> "The direct view of *modes of existence* that are more closely related to the environment, this is the novelty we propose to the systematic observation of humankind's most isolated and backward families". (LaBlache, 1954, p.36)

Later on, he adds that:

"(...) we can understand how certain men, placed in certain specific environmental conditions and *acting according to their own inspiration,* have proceeded to organize their *existence."* (id.)

Pierre George's view on the same matter is also solid and crystal clear. A chain directly links the matters of existence and work, understood as a "means to ensure existence, with existence comprising every modality of life – active or passive – unrelated to the exercise of a professional activity or situated at the most basic level of a production activity meant to satisfy daily needs" (George, 1969, p.133). We are also concerned with observing how work modalities exert a global influence on individuals' lives. From this perspective, existence is discussed in terms of Habitat and Habitation.

Although both La Blache and Pierre George raise key elements for this discussion, a few corrections are necessary. If geography is to regard itself as an ontological foundation of man, we must ask about man; in other words, we must determine what characterizes man ontologically. There is more than one answer to this question. Philosophy, theology, and various sciences, such as anthropology, psychology, sociology, and even neuroscience, would have something to say about this – and we have not listed all participants of this debate. But although their specific answers might be relevant, not all of them would be ontological; in effect, most answers would be ontic. Predication is widely used in this sort of discussion. Many of these predicates involve manifestations of gender, race, nationality, and habits that characterize different social types. Again, the contributions offered by those answers are inestimable. The relevance and strength of certain predicates is observable in the degree to which they mobilize social forces; race and gender identity struggles prove our claim: they are genuinely political forces. However, as already indicated, despite being absolutely relevant and necessary, such predicates do not reach man's ontological foundation, and science cannot provide us with a different set of answers.

Therefore, if we look to science for answers to our question, we will be limited to ontic appraisals. We must proceed to the ontological level. But before we can do that, it is worth noting briefly that these two levels (ontic and ontological) are connected. By observing man's ontological condition, we will see how a reflex operates at the ontic level. Thus, we must go from *modes of being* to man's *mode of Being* – and at the latter level characterization does not involve predicates. After all, to receive any predicate, man must first be a man.

[7] "eu tenho a certeza por meio de um outro, a saber: da Coisa; e essa está na certeza mediante um outro, a saber, mediante o Eu." (Hegel, 1992, p.75)

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Thus, it is to philosophy that we must go for our answer. However, we will adopt a critical perspective – specifically, we will attempt to eliminate any position regarding metaphysics, since even philosophy will resort to naming a Being and identifying it to another being, as discussed at the beginning of this essay.

Different metaphysical interpretations comprised within the hegemonic tradition in philosophical studies have regarded man's Being as interiority, as subjective immanence. Not long ago, we have asserted that man is a being among beings and that this condition is not to be dismissed by an ontological approach. In other words, our point of departure must be to consider man from an object's standpoint: man is body, man is nature. This condition cannot be considered an attribute or a predicate, something that may happen as well as not. It was Marx who pioneered this reflexive standpoint; referring to this topic, he explains that:

> "An objective being acts objectively, and he would not act objectively if the objective did not reside in the very nature of his being.[8]" (MARX, 1959a, XVIII).

As this passage makes clear, if man is capable of acting objectively in his relationship with other beings, that is because it is in his Being to be objective. However, this poses a problem. Once we have reduced man to an object – in other words, ascertained that it is in his Being to be objective, we end up reducing man to an essential passivity, for objects are passive. This forces us to try and recover man's condition of subject, without giving up the previously established objective attributes. But how can that be accomplished? The only acceptable solution lies in establishing that activity is also a part of man's ontological condition. Man is his exteriorization through permanent activity – his *conscious vital activity*, to be more precise. Man's Being arises, therefore, from constant creation, from innovation. This activity is carried out generically, as humankind – in other words, socially. This argument is summarized by Marx's words:

> "Conscious life activity distinguishes man immediately from animal life activity. It is just because of this that he is a species-being. Or it is only because he is a species-being that he is a conscious being, i.e., that his own life is an object for him.[9]" (MARX, 1959b, XIV).

Thus, two aspects must be considered: man's species-being and his conscious life activity. Unfortunately, this analysis is not within the scope of the present study. However, the time has come to return to work and praxis, since activity involves both those categories.

Thus, we return to the La Blache and Pierre George excerpts quoted above with the goal of amending the claims made by those geographers. Both of them work with an equivocated superposition of existence and survival. Survival is merely the material dimension of existence. Survival is what man has in common with other living beings, or simply with nature. As we have seen, it represents the object's condition required by this ontological perspective, thereby adding the economic foundation to our discussion. However, this outlook has proven insufficient. Nothing about man can be reduced to nature, to mere biology. Man's ontological uniqueness causes all of nature, or his biological structure, to become the human condition through the owning-one's-world process inherent to conscious life activity. From this standpoint, we can look at the very notion of gender in a new light. A basic example is the inaccuracy of basing the sexual difference solely on biological aspects; sexuality clearly demonstrates the founding condition of man's humanity. *Work* must be regarded on similar terms, and thus P. George's proposal that work be defined through bioclimatic conditioning factors, or characterized by technical or economic factors, no longer suffices. We must go beyond and see work as man's self-producing activity whose result is man's very humanity.

Therefore, we must stress the fact that working means producing the world, oneself, and one's humanity. *Thus, man cannot be reduced to his own subjectivity, seen as how man is world*. *Therefore, geography is one of the characteristics that expresses the world, which amounts to saying that this geography is essentially human. Existing in a geography is part of man's Being*. We must, however, be careful not to reduce human geography to man's 'physical' constructs, for that would be in line with Pierre George's view on work, or with the 'surface facts' listed by Jean Brunhes[10]. Hartshorne disagreed with the division of the geographic science into physical and human geographies. He did not believe they should be considered separate subjects, even though his observations about the distinction between those areas ascertained a superposition of "physical and cultural aspects". However, our point is not the same as Hartshorne's in that we argue that without its relationship to society, nature is nothing, just as that which does not participate in the subject/object dichotomy cannot be

[8] "o ser objetivo atua objetivamente, e não poderia atuar objetivamente se o objetivo não pertencesse à sua determinação essencial". (Marx, 2008, p.84).

[9] "A atividade vital consciente distingue o homem imediatamente da atividade vital animal. É precisamente por isso que ele é um ser genérico. Ou ele é um ser consciente, isto é, sua própria vida é para ele um objeto, precisamente porque ele é um ser genérico." (idem, p. 84)

[10] BRUNHES, J. *Geografia Humana*. Rio de Janeiro: Fundo de Cultura, s/d.

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considered an object, just a thing. All beings exist as part of that dichotomy and have no Being otherwise[11].

It is from this standpoint that we consider work to be an ontological category. Politics and economy are necessary insofar as they translate as survival man's objective condition, his lack, the fact that he is defined by objects, which are ontological requirements to explain man's existence and, therefore, his mode of Being.

Thus, regarded from the standpoint of conscious life activity, existence is not limited to survival. This reflection, which we have tried to present in its bare essentials, suggests we turn to a traditional geographic science category: the *way of life* (*genre de vie*), which contains several suggestive elements, as we can see in Max Derruau's definition of the way of life as "the set of habits through which the group that practices them ensures its own existence" (Derruau, 1964, p.169).

However, man's existence requires a geography. We must say it again: geography must be regarded as a human construct and, therefore, as a human dimension. As one of the world's founding properties. And since on account of his ontological roots man is also world, geography is a condition of the human existence. We must not overlook the identity between this geography that constitutes a basis for existence and man's ontological essence – between his factual life and his essence. Humankind can only achieve its full potential within this identity. Without making his geography, man cannot exist. In other words, man's existence happens in, or through, a geography. Ultimately, geography is man's spatially-temporally constituted humanity.

V. Way of Life, Factual Life, and Everyday Life

The reflection we have been striving towards has an imperative: it must be a reflection at the service of the existence of real men, of real societies. Without that concern, there would be no reason to turn to philosophy. For that reason, we believe that a scalar dimension must be the focus of our efforts, which is why we will return to the notion of way of life. We believe that category to be closely related to another: everyday life, which shows man's factual life in his immediate geography, the *habitat*.

Maximilen Sorre pioneered the study of this concept in geographic science, followed by Pierre George. Both of them conceive the habitat category in connection with the *Way of Life*.

To Sorre, Habitats are typified according to ways of life. He goes so far as to claim that Habitats are the "*most typical concrete expressions of the ways of life*" (Sorre, 1984, p.122). Thus, if we consider the society/nature relationship, which ensures material survival (production and reproduction), a habitat can be defined as a *rural habitat*, then as a rural-to-urban transition habitat, a properly *urban habitat* and, finally, the urban habitat in its most evolved form: large cities.

Sorre's suggestion is stimulating, but it must be developed further. To that end, it can be interesting to look at Pierre George's thoughts written in response to Max Sorre's death and published at the *Annales de Géographie*. Although not short, the excerpt it is rather suggestive:

"With the organization of the assembly line in consequence of machinery developments, with automation, a new era of work began. While economists and industry managers talk of revenue and work efficiency, sociologists know that there is something else at play, a profound revolution in the relationships between men, and between man and things. They also know that this revolution affects men in their entirety. Here we have the connection between Human Geography and global sociology, on one hand, and the sociology of everyday life on the other. Max Sorre mentions the 'beautiful works of George Friedmann', but we cannot forget his fruitful collaboration with George Gurvitch, nor his recourse to the sociology of everyday life and of modernization to which he was introduced by the study of Henri Lefebvre's work." (George, 1967)

And now the elements that we have pursued throughout this study begin to converge. First, the *way of life*, understood by geographers as the set of habits through which the group that practices them ensures its own existence. In the way of life, we have the elements that describe existence based on society's need for material reproduction, which we call survival. And lastly, we find in Sorre's words the association between way of life and its geographical expression, the *habitat*.

Habitats must be understood as part of a larger scalar context, which requires us to involve other categories. Thus, we begin to discern the path to identify the ontological foundation represented by geography. The habitat must be qualified, which means defining the geographicity that characterizes geography. That requires us to assign meanings to Rural and to Urban, since those terms are defined in relation to a way of life, which in turn points to a type of existence. Geographicity, urban, and rural broaden the meaning of urban geography to encompass more than just the city, and the same applies to rural geography. In effect, this process confirms Herder's maxim "history is but geography in motion". This is the process of going from rural geography to urban geography.

From an everyday life standpoint, both urban and rural geographies are scalar contexts, and more precise information is required to identify the geographical foundation of a specific man. Contrary to

[11] In this short reflection we will unfortunately not discuss in depth how the subject/object dichotomy proves insufficient to solve the ontological issue and must be overcome as a foundation for that line of thought.

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Pierre George's beliefs, it is possible to have different habitats in a single city. Each everyday life is specific on account of its unique, singular aspects. In Heller's words: *"la vida cotidiana es el conjunto de actividades que caracterizan la reproducción de los hombres particulares, los cuales, a su vez, crean la posibilidad de la reproducción social*." [everyday life is the set of activities that characterize the reproduction of specific men, which in turn create the possibility of social reproduction] (Heller, 1987, p.19). From this standpoint, habitat is the space and time specific to one's life, the space and time lived by an individual, it is the immediate effectuation of existence, man's immediate relationship with his environment, man-presence in his most immediate of geographies; it is his *Location*. The *Being's Location, his Being-There (Dasein).*

We have reached a capital point: *location*. To properly understand location in this context, we must examine two situations: the first one involves the meaning of the *sense of location* to man, which will allow us to verify its ontological importance. In other words, *by location a being finds themselves specified by a certain geography, which helps define the nature of their existence*. Thus, the next clarification concerns the notion of sense of location, which we will accomplish by investigating what is revealed when one answers the following questions: what does it mean to be located, to belong to a certain location? To fully understand the first question, we must ascertain the meaning of Location; in other words, what is Location?

For our purposes, it is not enough to regard location as systematic cartography does – that is, as a set of geographical coordinates. We must go further. In this geography, *Location* means a man's position in a relational structure – in a structure of cohabitations, where *distance* is measured by the qualitative intensity of the relationships between members, rather than being a quantitative measurement. A being among beings, participating in a cohabitation structure – and thus in a *distribution* context, in which a specific location is part of a scalar web of a certain *extent*. Thus, the sense of location will be determined by the qualitative intensity of a relationship and by the extent of the being's relational position. There is a relationship between *extent* and *qualitative intensity* which, in phenomenological terms, can be described as varying as a result of factors such as identity, belonging, or even the technical aspect of certain sorts of relationship, such as the media and communications. This relational web implies that contraposition relationships regulate the cohabitation of beings. However, another dimension can come into play: the one that addresses man in regard to his existence, or to his geography. In this case, contraposition is replaced by contradiction, and thus by transcendence. There is identity as well as difference between essence and existence. As a species, man reclaims his geography and thus elevates existence to an act of transcendence, of overcoming. Once again, we meet history.

Therefore, the *sense of location* is how a being gains access to the geography to which he belongs, his condemnation to a factual live. This geography is a part of his constitutive present, or ultimately the one whose geographicity is a foundational element to the effectuation of his Being. It is his existential foundation.

Thus, having *geographic awareness* means understanding the *sense of location*: owning the web of qualitative distance relationships of various extensions that man is a part of, with their rhythm nexuses; in other words, understanding which geographic times constitute his everyday life – which geographic context his habitat is a part of. This represents the awareness of the successive geographies that derive from the historical process.

And it is precisely in that geographical environment that man finds his sense of location. It can be grasped by asking questions such as 'Where am I?', 'Where are the other beings that are constitutive to my alterity?', 'What is their distribution?', 'What is their distance from me?' – in short, 'Which geography surrounds me in its extent, and what is my representation of it?' This representation is one's *sense of location*, one's *geographic awareness*.

This leaves us to address one final, crucial matter: the fact that although geography is a man-made dimension of existence, it *does not belong to man*. This matter concerns the notion of *alienation*, the divorce between existence and factual life. Despite only being addressed in the final section, this notion is relevant to our reflection because it characterizes man's current living situation. Alienated work impacts geographicity, the very nature of what is urban. Urban alienation affects the way of life, inhabits it even, revealing an inhuman geography, for an alienated existence amputates a Being's effectuation. In alienation terms, conscious life activity and the human condition as species-being translate into an alienated geography. This geography does not represent man's humanity in spatial-temporal terms. We live in dystopic realities in which geography discloses the loss of both production and its fruits. These are the outcomes of alienated work. Man's modes of Being are not exempt from this situation that infects his ontological roots. We can see alienation in the *mode of Being*, and the reaction to that condition can be found in *modes of Being*. Racism, homophobia, and gender violence have their own geographies.

For every possible dimension of alienation, there is a geographical consideration. We are referring to the ontological dimension in which man alienates himself from nature, from his fellow man, and from himself. If one's self is lost, the exteriorization process is compromised, resulting in a strange geography. As a subterfuge, fetishism rises – a consequence we intend to examine in detail on a future study.

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Whilst it is possible and even necessary to have a geographic awareness of this condition, such awareness is not enough to overcome it. Geography must be socially conquered, and this means finding our way out of this dystopia and into a geography of the future. May we have a utopia.

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Making use of CO_2 Capture for Transform Industrial Production - Supplement of Making use of CO_2 Capture for Saving Earth and Human

By Jia-Min Jin

Abstract- This paper focuses on the supplementary explanation and modification of the six published article for 9 aspects. Including the energy storage reaction and storage index, push rod type electric furnace, the production of sponge iron and lime is accompanied by the production of nitrogen-free gas, to promote the use of gas in countryside, lime is cycliceally used to capture carbon dioxide in the flue, to make full use of natural resources and some problems to be studied in industrial production.

Keywords: *carbon dioxide storage reaction and storage index CCS CCSE SSE.*

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I. Introduction

The warming of the earth and the frequent occurrence of extreme weather have seriously affected the survival and life of human beings. There was a great deal of anxiety. The United Nations has held many meetings, especially in Paris. Scientists generally believe that the earth is warming as a result of massive emissions of carbon dioxide from industrial production. As a result, the capture and storage of CO_2 on a global scale, known as the Carbon Capture and Storage-CCS technical route, has become the focus of research by many scientists and the strategy of governments. Zhang Dongxiao, director of the Clean Energy Research Institute at Peking University, said that the CCS technical route could become the single largest carbon reduction technology in the world. The UN's International Energy Agency (IEA) has repeatedly stressed that the CCS technical route remains an important solution for reducing greenhouse gas emissions. It calls for 200 CCS projects globally to be operational by 2020 and 3,000 by 2050. Between 2015 and 2050, the world should capture and store 120 billion tonnes of carbon dioxide. The CCS technical route from an American power plant seems to be the only one that can save the earth.

Since 2016, the author has published 6 articles on the use of captured carbon dioxide storage to save the earth in domestic and foreign journals. The contents involve climate change, energy, environmental protection and other major issues, This paper aims to further clarify the author's point of view, it is hoping to arouse people's attention.

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II. There are Many Problems with the CCS Technical Route

In previous articles [1, 2, 3, 4, 5, 6], the author has repeatedly pointed out that there are a number of problems with the current CCS route being rolled out globally. Such as high cost, limited burial places, there is a carbon dioxide leakage of safety risks.

Experts believe that the only way out for CCS technology is through a combination of storage and application. If we have buryed all the captured carbon dioxide, it would be economically unbearable. However, the purification application of carbon dioxide is a worldwide problem, which has not been solved yet. The authors argue that even if this puzzle is solved, its application may be limited, so the CCS technical route is a dead end. Although the internationally recognized CCS technical route is still in the research stage, 56 CCS projects are already operating or planned around the world. China also has 11 CCS projects planned or in operation. It can be seen that people are anxious about the warming of the climate.

III. Carbon Capture and Stored Energy - CCSE and Smoke Stored Energy-SSE Technical Route

The author first proposed CCSE in 2016 and SSE in 2020. CCSE or SSE technology is a technology that can convert electrical energy into chemical energy and then store and apply it.

It`s theory is that carbon gasification is an endothermic or energy-storage reaction ($C+CO_2=2CO$ $\Delta H_0 298^0 k = +162297 kj/mol$). this is a simple chemical reaction. It has been used in industrial production for more than 100 years. Such as gas generator, blast furnace making iron.etc.

The combination of storage and application is the only feasible route for CCSE or SSE. The climate can be controlled by adjusting the proportion of storage and application. SSE different from CCSE is that the smoke is applied directly. SSE saves an expensive capture cost. The deficiency of SSE is that there is a large amount of nitrogen in the gas, the calorific value is lower, if it is used cyclically, the calorific value is getting lower and lower, and the production process is

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unstable. Therefore, it is necessary to improve and stabilize carbon dioxide content in smoke by simple centrifugation- gravity method. If the cost of using compression separation to capture carbon dioxide can reach $25/t, as announced by the Massachusetts Institute of Technology, and the cost of producing carbon monoxide per meter is only $0.025, it is entirely acceptable.

The mechanism of carbon catalysis gasification has been studied for more than 50 years. CCSE or SSE technique is the extension of carbon gasification catalysis mechanism research.

IV. The Energy Storage Reaction and the Energy Storage Index -Zn

There are two common endothermic reactions; namely

$$C+CO_2=2CO\ -162297kj/kg.mol.----------\quad (1)$$

$$C+H_2O=H_2+CO\ -131381kj/\ kg.mol----------\quad (2)$$

Both of these reactions are endothermic or energy-storing reactions. These two reactions exist in the gas generator furnace.

Equation (1) is the carbon gasification reaction, also known as Bouduard reaction. It is very importent reaction. Many industrial products depend entirely on this reaction. such as Fe, Cu etc..

The heat released by the combustion of carbon monoxide from the gasification reaction is the heat stored.

$$2CO+O_2=2CO_2\ +570865kj/kg----------\quad (3)$$

The energy storage index ZN is the ratio of the energy stored by gas after the chemical reaction to the energy consumed during the chemical reaction, which is used to measure the energy storage efficiency of different carbonaceous materials。

For carbon gasification reaction, the storage value is compared with the consumption value, namely (3)/(1), 570865/162297=3.517, deduct about 3% of the furnace wall heat loss, The energy storage index ZN of carbon gasification reaction Is ZN=3.4. This data shows that the energy stored after gasification is 3.4 times that consumed. It is known that the direct combustion to indirect combustion, especially compared with the rural hearth, can significantly improve the thermal efficiency, thermal efficiency can completely offset the heat loss of the furnace wall, so the electric heating gas generator can be called zero energy electric heating gas generator. In terms of economy, it is very economical to use electric heating furnace to produce gas.

The raw materials for the production of gas always contain water, and $C+H_2O=CO+H_2$ is also an endothermic or energy-storage reaction.

$$H_2O+1/2O_2=H_2O\ -285800kj/mol\ kg----------\quad (4)$$

[(4)+2/1(3)]/(2), namely ZN= [285800+285432]/ 131381=4.35.

When zn> 4.0 and the thermal efficiency of the thermal power plant increases to 50%(the highest thermal efficiency of the thermal power plant is 46% at present), the energy stored in the gas produced by valley electricity can fully meet the energy required for peak electricity generation, which alone can save half of the thermal power coal consumption. The reduction in carbon dioxide emissions by nearly half is staggering, I should say. On this basis alone, the amount of gas that needs to be stored may be small.

The United States and China account for 52% of global carbon dioxide emissions, China accounted for 35%. If China and the United States can work together, so it can save half of the coal consumption of the thermal plant, the problem of global warming will maybe solve.

Energy storage index ZN=3.52 is a very reliable and important data. The ZN tells you very clearly, although electricity is in short supply around the world, there are two things that people should understand. First, it is not willing to use electricity to produce gas, which may be that many scientists so far has not proposed the electric gas generation furnace thought concerns. This concern now seems unnecessary. Second, because of the Zn > 4, people would naturally think that the first use of electricity in lighting, electrical machinery and so on seems unreasonable. Electricity shall first be supplied to a zero-energy electric heating gas generator. It can both consume large amounts of carbon dioxide, plastic waste, eliminate white pollution and the ability to control the climate warming that people are so worried about.

V. Develop Electric Gas Generator Energetically

The author thinks that the development of electric gas generator is based on:

① CO_2 buried as waste in CCS technical route becomes the main raw material for gas production in CCSE or SSE technical route. The purpose of climate control can be achieved by adjusting the proportion between storage and application of gas.

② CCSE or SSE technical routes can consume a lot of firewood, waste plastic, eliminate the white pollution that people are so worried about, and protect the environment.

③ The ZN=3.52 for the carbon gasification reaction in the electric heating gas generator is very economical.

The electric gas generator is the only major device in CCSE or SSE, but it is an innovative device that has not been seen so far. It is actually an electric heating furnace. In addition to the generator, the

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ancillary equipment is the compressor and a number of storage gas bags or tank.

The power of furnace depends on the output. It takes about 1kwh (1.06 kwh) to produce $1m^3$ of gas, and 1000kW of power to produce $1,000m^3$ of gas an hour.

The type of furnace may be varied. Such as vertical, horizontal, converter etc..

The converter type which is widely used in cement and sponge iron production, its advantage is that the furnace charge in the furnace is constantly turn back, so it reacts fast. For easily broken processing of raw materials, such as coal, firewood, plastic and so on, it is more appropriate:

The ancient tunnel kiln type electric gas generator has the advantages of mature technology, simple structure, small investment and small operation energy consumption, among which the biggest advantage is that raw materials such as firewood, garbage and corpse do not need to be processed and can be directly put on the kiln car. Its disadvantage is that the reactants such as coal are fixed on the kiln boat and the reaction speed is slower.

Push-rod electric gas generator (FIG. 1) should be the simplest type of furnace and minimum investment. Furnace body can be large or small. It can be generalized in the countryside。

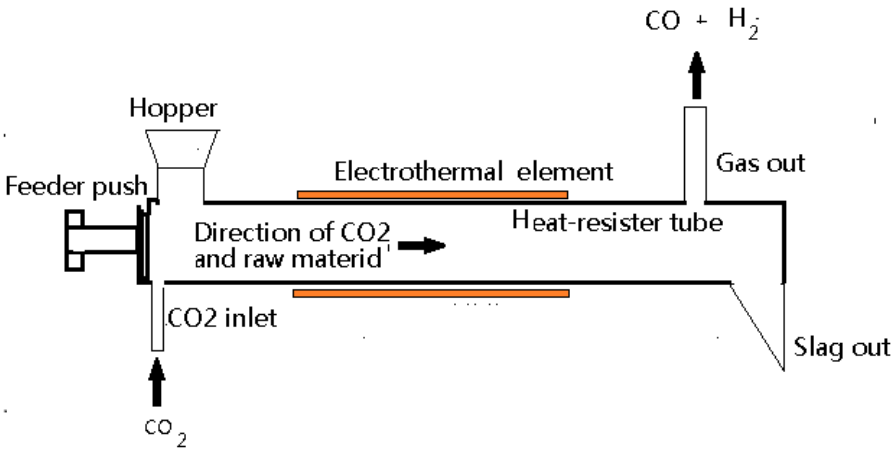

Figure 1: Push-rod type electric gas generator diagram

A 50 kw electric stove; can produce 1200 m^3 of gas a day, can meet the needs of thousands of farmers cooking.

No matter which type of furnace is used, they should have 4 things in common.

a. It is that the furnace chamber or furnace body must be sealed;
b. The flow direction of raw materials and CO_2 must be in the same from low temperature to high temperature;
c. It must be operated at positive pressure to prevent air from entering the furnace;
d. It must have a good measuring instrument, according to the gas composition check results, adjust the CO_2 intake and furnace charge.

Because the composition of raw materials such as firewood cannot be stable。Therefore, a pulverized coal injection device should be installed at the end of the furnace. According to the analysis results of the gas composition, the CO_2 content in the gas should be guaranteed under 2% to ensure the stable calorific value of the gas.

VI. Sponge Iron and Nitrogen-Free High Calorific Clean Gas are Produced Simultaneously by using Electric Heating Gas Generator

At present, the world's production of sponge iron is between 50 and 60 million tons. Most of them are used to make steel in electric furnaces. Part of it is used in powder metallurgy production. There are more than 20 methods to produce sponge iron. However, converter and the tunnel kiln is still the main method .Both completely rely on carbon gasification reaction to produce sponge iron ($C+CO_2=2CO$, $CO+FeO=Fe+CO_2$).

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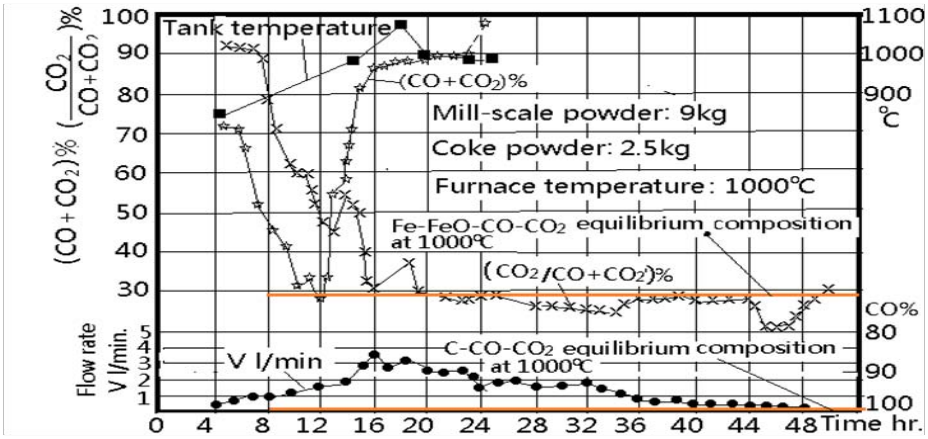

Figure 2: Gas velocity and composition released from the reduction reaction tank

Figure 2 is flow velocity and composition of gas released from the reduction reaction tank. The CO content in the gas is about 65%, and the CO_2 content is about 35% (Different reduction stages have different gas composition). When we add small solid carbon outside the reaction tank and completely convert 35% CO_2 to CO, we can get 100%CO gas with nitrogen-free almost. Because at the beginning, the reaction tank is filled with iron oxide and carbon powder. There is small air left and it's expelled very quickly at the beginning of the reaction. So we get nitrogen-free high calorific value clean gas. The result is similar to using high purity oxygen to produce gas.

According to the chemical reaction formula ($Fe_2O_3+3C=2Fe+3CO$), For every 1 ton of sponge iron produced, 600m^3 of high purity clean gas can be obtained. Now, however, the current production is not like this at all.

The CO released from the reduction reaction tank is burned into CO_2 in the furnace,then It is expeled from the furnace with smoke. At 50 million tons of sponge iron a year, We throw away 30 billion $m^3$of nitrogen-free quality gas every year.

Global iron ore production was 2.163 billion tonnes in 2017. Calculated at an average grade of 48.8%, the concentrates should have 10. 6 billion tons. It contains 306 million tons of oxygen. According to the current production technology, After smelting, these oxygen are expelled as CO_2 form, which is nearly 420 million tons. Oxygen in iron ore is not being used. To the contrary, It pollutes the air. The author thinks that man has wasted the valuable natural resources again.

There are many advantages to producing sponge iron and gas simultaneously. Such as: The iron and oxygen in iron ore are used, reduced CO_2 emissions. obtainded quality nitrogen-free gas, reduced coke consumption, the cost of production has fallen considerably. This approach has a strong competitiveness.

VII. Lime and Nitrogen-Free High Calorific Value Clean Gas are Produced Simultaneously by Make use of Electric Heating Gas Generator

CaO (commonly known as lime) is the main ingredient in cement, and its content ranges from 64 to 67%. Calcined limestone releases 44% of CO_2, that is, a ton of calcined limestone releases 440 kilograms of CO_2. In 2016, the global output of cement is 5 billion tons, China is 2.5 billion tons, based on 65% content, CaO is 3.25 billion tons, the limestone consumption is 5.8 billion tons, and the carbon dioxide emitted is 2.55 billion tons. According to the calculation that one ton of CO_2 can produce 1,000 m^3 of carbon monoxide, 2.55 billion tons of CO_2 can produce 2.55 trillion m^3 of nitrogen-free clean gas with high calorific value. At present, 2.55 billion tons of carbon dioxide are all released into the sky, and valuable natural resources are once again being wasted by humans.

According to the following reaction:

$$CaCO_3=CaO+CO_2 \quad \Delta H^0_{298}=+177.4kj/mol---------- \quad (4)$$

$$C+CO_2=2CO \quad \Delta H^0_{298}=+162.297kj/mol \text{ -----} \quad (5)$$

$$CaCO_3+C=CaO+2CO \quad \Delta H^0_{298}=+339.697kj/mol---- \quad (6)$$

$$2CO+O_2=2CO_2 \quad \Delta H^0_{298}=-570.865kj/mol---- \quad (7)$$

The energy storage index ZN is calculated;

ZN=(7)/(6)=570.865/339.697=1.68. This 1.68 means that one energy is consumed and 1.68 energy is stored, so It is very economical to produce nitrogen-free high calorific clean gas when producing lime.

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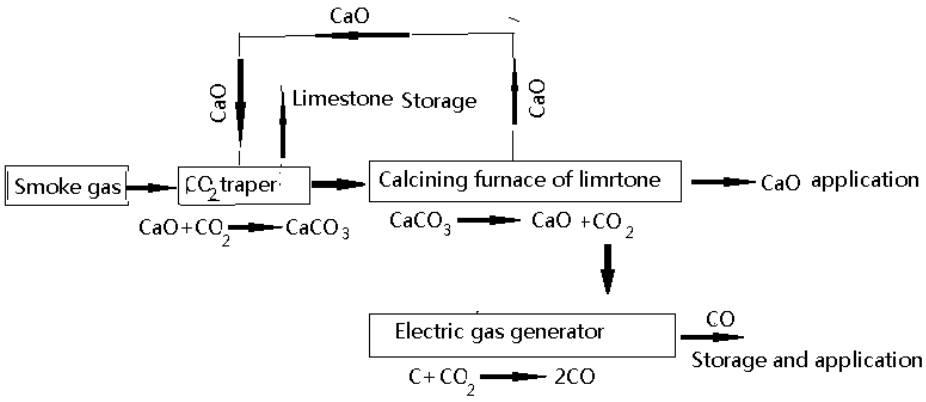

Figure 3: Cyclic reactions between CO2 capture by using CaO and gas production

FIG. 3 shows the cyclic reaction of capturing CO_2 from flue gas with CaO and producing nitrogen-free high calorific clean gas with CO_2 from limestone decomposition.

VIII. Gas is used in the Vast Countryside

The countryside is a vast world. as far as the eye can reach.

Every plant and animal on the ground, growing day and night, have stored a great deal of energy, which people should make full use of.

As shown in Figure 1, push-rod type gas generator is most suitable for general promotion in rural areas. A small 20KW electric stove can produce 480m^3 of gas per day, which can supply thousands of farmers. It's also very economical.

Rural coal gasification, not only the use of resources, and the protection of resources, and the protection of the environment. Beautiful scenery, heaven on earth.

IX. Power Supply

The International Energy Agency (IEA) has called for the capture and bury of 120 billion tonnes of CO_2 in global between 2015 and 2050. That's an average of 3.4 billion tons a year, it is about a tenth of annual emissions 33 billion tons (2018) . Adopting the CCSE technology route to convert 3.4 billion tons of CO_2 into CO requires 3.4 trillion kwh, which can produce 3.4 trillion m^3 of CO. It must be considers that the CCSE technical route must be a combination of storage and application, at the same time, considering the price of electricity (0.72 yuan/kwh rmb) and the price of gas (2.5 yuan/m3), 2.5/0.72=3.47, that is, the cost of applying 1m^3 gas can offset the cost of storing 3.47 m^3 of gas. Because each country coal electricity price is different, afore-mentioned only for reference. To set the application to storage ratio at 1/ 3, which should be feasible. Thus, the amount of CO_2 required for gasification is 4.8 billion tons. The amount of electricity used is 4800 billion kwh. The production of CO is 4.8 billion m^3, of which 3.4 billion m^3 are for storage and 1.4 trillion m^3 for application.

Today, the world's electricity generation is 2.5551.28 billion kwh, China is 6495.14 billion kwh, accounting for 1/4, the United States 4281.74 billion kwh, accounting for 16.8 %. According to this, China's electricity generation alone can fully meet the requirements of 4.8 trillion degrees. But the author still thinks that first time electricity should be electric gas generator. Lighting, electric machinery and so on should be secondary electricity. This not only uses a large number of resources on the ground, protects the environment, Controlling the climate, but also protects underground resources.

X. Several Issues to be Discussed

According to the energy storage index ZN=3.4 of carbon gasification reaction, we consider inevitably that there are many problems worth studying in the current industrial production.

a) Pumped storage power station

The purpose of energy storage is achieved to use valley electricity to lift the water from the lower reservoir to the upper reservoir and convert mechanical energy into potential energy.

There are many such pumped storage plants around the world. China's current installed capacity is 27.73 million kw, surpassing Japan and becoming the world's largest. It accounts for less than 0.01% of the country's total installed capacity.

The thermal efficiency of pumped storage power station is 70% and ZN is negative value, which is compared with the electric gas generator of ZN > 4. Obviously, it is more reasonable to build electric gas generator.

b) Garbage Incinerator and Cinerator

Currently, garbage incinerators and cinerator are widely used worldwide. Firewood, plastic, rubber, seaweed, animal carcasses and so on, which store a large of energy, are burned by a torch, which not only

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consumes a lot of fuel, wastes a large of energy, but also pollutes the environment, which is a very unreasonable measure.

Example; Plastic pollution is already a very serious problem。 Four billion tons of plastic are already buried in the ground or stacked in nature. Ten million tons of tiny plastic particles enter the ocean every year There are now 150 million tons of plastic in the ocean。

According to the molecule structural formula, t he calculation results show that 1 t of PE or PP type plastic reaction with CO2 at high temperature, can produce 4800 m3CO and H2 clean gas. So a lot of energy has been wasted by humans.

A 50-kilogram animal carcass can produce about 120 m^3 of high-heat clean gas. Worldwide, about 150,000 people die each day. If used to produce gas, 18 million m^3 of high-calorific value clean gas could be produced each day.

c) Full use of Natural Resources

As mentioned earlier, gas can be produced at the same time as sponge iron, 1 t of sponge iron and 600m^3 of nitrogen-free high calorific clean gas. Gas can also be produced when lime is produced at the same time. One ton of limestone can simultaneously produce 560 kg of CaO and 440kg or 440m^3 of nitrogen-free or low-nitrogen high calorific clean gas. At present, however, only Fe and CaO are extracted, and oxygen in iron ore and carbon dioxide in limestone are discarded at total and it pollutes the air at same time.

Global cement production is 5 billion tons (China 2.5 billion tons). Based on 65% CaO content in cement, 5.8 billion tons of limestone was consumed. During calcination, 2.55 billion tons of CO_2 are released. Global iron ore production was 2,230.4 billion tonnes. According to the average iron content of 48.8%, the concentrate fines (Fe_2O_3) is 1.55 billion tons。The oxygen content in iron ore is 470 million tons. The amount of CO_2 released after smelting is 640 million tons. Thus, the amount of CO_2 abandoned from cement and steel production alone is 3.2 billion tons. It accounts for one-tenth of the 33 billion tonnes of CO_2 emitted annually. Endless development of natural resources, and a large amount of waste of resources, this is the tragedy of human beings.

d) Making use of Lime to Capture CO_2

As you can see from the literature, the methods of capturing CO_2 include chemical assimilate, physical adsorption, physical chemical adsorption, membrane separation and cryogenic separation. And physical assimilate and chemical adsorption It is relatively mature and has small-scale industrial installations. In the CCS technical route, capture cost accounts for 2/3 of the total capture and storage cost. It means the capture cost is very high.

As shown in Figure 3, the author thinks that there are several advantages of using lime to capture carbon dioxide.

a. $CaO+CO_2 \rightarrow CaCO_3$ reaction is an exothermic reaction, which does not require additional heat.
b. The CaO can be recycled.
c. The requirement of purity of CO_2 in smoke before and after capture is not strict
d. Compared with other capture methods, using lime to capture carbon dioxide, investment and operating costs may be the lowest.
e. Cement production costs can be significantly reduced.
f. etc..

The flue gas passes through an iron drum. The size, rotation speed and reaction temperature of the drum are determined by the experiment.

e) Natural Balance and Balancing Point

The growth of plants and animals on the earth is interdependent。 The ppm of carbon dioxide in the air should have a "balance point". If carbon dioxide emissions are greater than plant growth requirements, As a result, the climate is warming.

If the emissions are less than the equilibrium value, it is not conducive to plant growth, plants will also die because of lack of carbon dioxide. At present, global electricity generation can convert 75% of carbon dioxide emissions into carbon monoxide for use and storage. But this is clearly unnecessary and undesirable.

The realization of natural balance requires a "balance point". Once a "balance point" is found, the amount of CO_2 to be captured can be determined。

XI. Conclusion

1. Thermal power plants should use lime or gravity-centrifugal method to capture carbon dioxide in the flue, which can significantly reduce capture costs.
2. Electric gas generator should be used in garbage incinerator. Using electricity and carbon dioxide to produce high-calorie gas. Increase renewable energy, protect resources, protect the environment and eliminate white pollution.
3. When producing lime, gas should be produced at the same time, which can make full use of natural resources, reduce pollution and reduce the cost of lime production.
4. When sponge iron is produced, gas should be produced at the same time, which can make full use of natural resources and realize carbon-free iron making.
5. Electricity transmission is changed to gas transmission, which can save energy consumption, reduce electricity price and benefit the country and the people.

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The above five conclusions, the author believes that it is only general knowledge, technical difficulties do not exist. There is no problem with electricity supply. The author thinks that if these five measure can be realized on a global scale, perhaps climate warming, environmental pollution, energy depletion and so on can be solved or remissioned.

The author's knowledge is limited, impropriety, eager to knowledgeable people to correct.

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Analysis of Climate Change in Sundarbans (Bangladesh Part) in Terms of Temperature and Rainfall Variability

By Md. Nurul Hoque Upal

Abstract- The Sundarbans, lies on the delta of the Ganges, Brahmaputra and Meghna rivers on the Bay of Bengal, is the largest contiguous mangrove forest in the world. Although the mangrove forests of the Sundarbans provide an important defense in limiting climate change impacts, the forest ecosystems have now become vulnerable due to the effects of climate change. The climate change of the region has been studied through statistical analysis of records of last thirty years of rainfall, temperature, sea level and sea surface temperature. Several statistical techniques such as Mann- Kendall/Modi fied Mann–Kendall tests, Theil and Sen's median slope analysis, simple linear regression method were applied for the study and data used from observed and gridded datasets. The annual rainfall has been decreased by 6.6% at a rate of 5.25 mm/yr. The atmospheric temperature has shown an increasing trend throughout the year except for the winter season which indicates that winter has become colder and summer has become warmer.

Keywords: *climate, ecosystem, mangrove, significant, trend.*

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Keywords: climate, ecosystem, mangrove, significant, trend.

I. Introduction

Climate change is a contemporary burning issue for all around the world. Bangladesh is one of the fastest and severest affected countries of climate change due to its high population density, flat and low-lying topography, and adverse geographic location (Ali, 1999; Stern, 2007). The Sundarbans mangrove forest ecosystem, which is universally recognized as the largest mangrove forest formation in the world, lies to the downstream part of the Ganges-Brahmaputra-Meghna (GBM) Delta system at the point where it merges with the Bay of Bengal (Banerjee, 2013). The total area of Sundarbans estimated at 10,000 km^2 of which 60% area belongs to Bangladesh and the rest of the portion in India (Islam, 2019; Jahanara & Rahman, 2019). The Bangladesh part of Sundarbans is located in the southwestern part of the country, slightly south to the Tropic of Cancer between the latitudes 21°30'N and 22°30'N, and longitudes 89°00'E and 90°00'E (Figure 1).

The mangrove ecosystem of Sundarbans is one of the most biologically protective and taxonomically diverse ecosystems of the Indian Sub-continent (Mahadevia & Vikas, 2012). Several studies have indicated manifestations of climate changes in the Sundarban region in terms of temperature and rainfall variability. Atmospheric temperature has been increased significantly over the period of time. Surface air temperature anomaly data over the Sundarbans and adjoining portions of the Bay of Bengal indicates an increasing trend of 0.019°C per year between 1970 and 2000 (Hazra et al, 2002).

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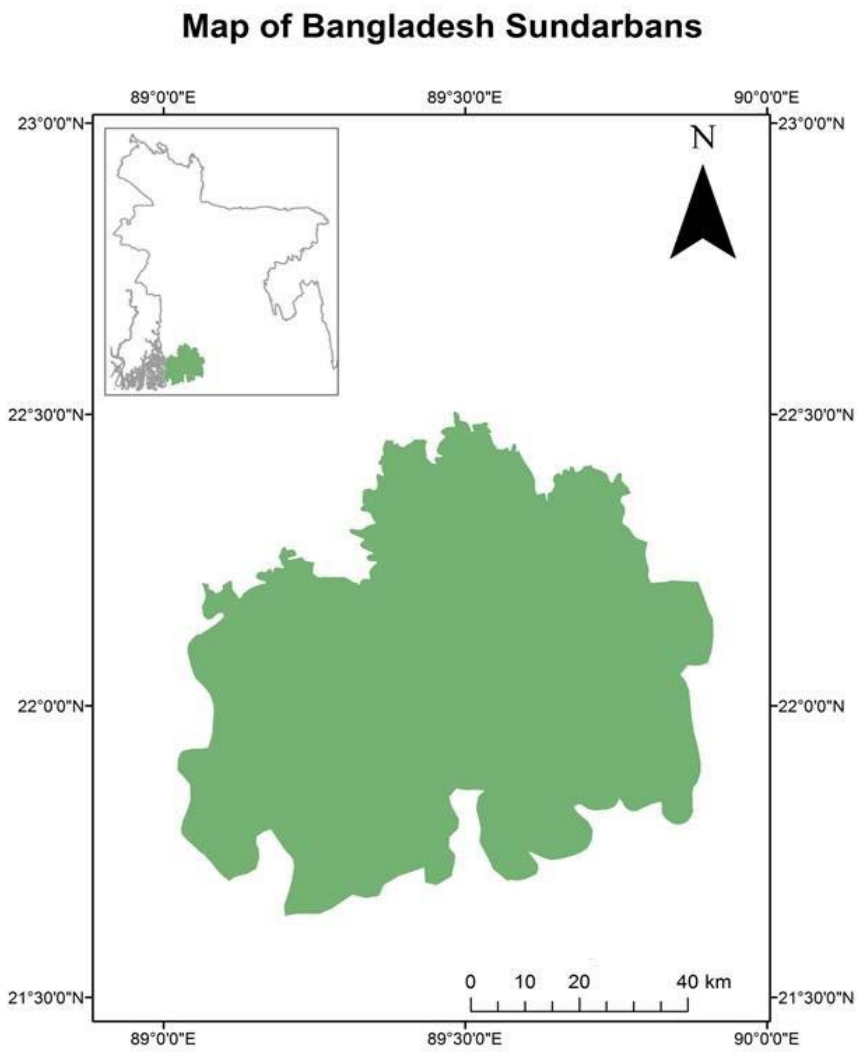

Figure 1: Location map of Sundarbans in Bangladesh

The post monsoon rainfalls in Sundarbans had slightly increased during the period of 1990-99 (Chand et al, 2012). There is also a trend of delayed monsoon and heavy rains at the beginning as well as late recession and sometimes heavy precipitation during August and September (Khosla, 2010). As it is evident that the climatic pattern of Sundarbans is changing gradually which can ultimately affect it diverse ecosystem. Considering the issue, the study will focus trend analysis of the climatic parameters of temperature and rainfall through statistical analysis.

II. Data and Method

a) Data

Temperature and precipitation are two basic components of climate. The study focuses on trend detection of seasonal and annual precipitation along with monthly and annual temperature. Both observed and gridded datasets have been used to operate the trend analysis. The observed series are collected from the Bangladesh Meteorological Department (BMD) for the station Mongla which is closest BMD station to Sundarbans. As the BMD inaugurated the station in 1989, the temperature and rainfall data are available from 1989 and 1991 respectively. On the other hand, precipitation and temperature data have also been extracted from CRU TS (Climatic Research Unit gridded Time Series) 3.23 dataset for the period of 1985–2014 at 0.5° X 0.5° resolution for gridded time series. The study area belongs to the range of latitude 21°30'0" N to 22°30'0" N and longitude 89°0'0" E to 90°0'0" E comprising four adjacent grid areas cover the whole Sundarbans (Bangladesh part) as seen in Figure 2.

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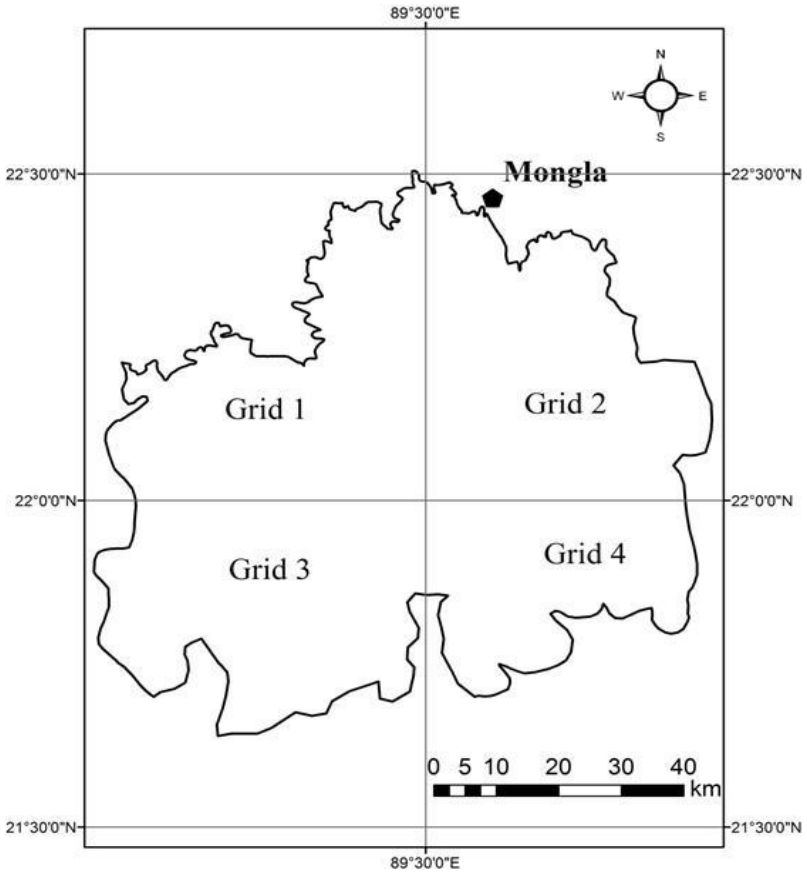

Figure 2: Location of BMD Station and CRU TS Grids of Temperature and Rainfall Data Series

The daily series of the datasets were collected for the both parameters. The rainfall records were converted to monthly scale from the daily series which were in turn converted to seasonal and annual analysis. Three seasonal variations have been considered for rainfall data analysis: pre-monsoon season (January to May), monsoon season (June to September), and post-monsoon season (October and December). The temperature data is processed as average figure from daily maximum and minimum records.

b) Methods

All the climate data series have been processed for trend analysis through several statistical methods. First, student's t test at lag-1 is functioned at 10% significant level to check the significance of autocorrelation. The test result indicates level of significance of the correlated data series. Modified Mann-Kendall (MMK) test at 10% significant level is conducted for the autocorrelated series, Mann-Kendall (MK) test is performed for the rest of the analysis at same significant level (Basistha et al., 2009). The presence of positive or negative trend has been determined from the Z_S value of the MK and MMK test of the series. Linear trend analyses for the climate parameters have also been carried out and the scale of the trend have been calculated by the Theil-Sen's slope method. The magnitude percentage change of the parameters has calculated through applying the Sen's slope value. Trend of linearity of variables has also calculated by simple linear regression method at 95% confidence interval. The regression method was applied to explore the magnitude of the climate variables.

i. *Student's 't' test for autocorrelation*

The detection of trend in a series is influenced by the presence of positive or negative autocorrelation (Anderson & Anderson, 1941; Taxak et al., 2014). There are more odds of a series being found as having trend with a positively autocorrelated series while there may be essentially nothing (Basistha et al., 2009). The case is opposite for negatively auto-correlated series, where a trend fails to get identified. The autocorrelation coefficient ρ_k of a discrete time series for lag-k is calculated as

$$\rho_k = \frac{\sum_{t=1}^{n-k}\left(x_t-\bar{x}_t\right)\left(x_{t+k}-\bar{x}_{t+k}\right)}{\left[\sum_{t=1}^{n-k}\left(x_t-\bar{x}_t\right)^2 \times \sum_{t=1}^{n-k}\left(x_{t+k}-\bar{x}_{t+k}\right)^2\right]^{\frac{1}{2}}} \quad (1)$$

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where, $\bar{x}_t$ and *Var* (X_t) are the sample mean and sample variance of first *(n-k)* terms, and xt+k and *Var* $(\bar{X}_{t+k})$ are the sample mean and sample variance of the last *(n-k)* terms. The hypothesis of serial independence is then tested by the lag-1 autocorrelation coefficient as H_0: $\rho_1 = 0$ against H_1: $|\rho_1| > 0$ using

$$t = |\rho_1| \sqrt{\frac{n-2}{1-\rho_1^2}} \tag{2}$$

where the test statistic *t* has a Student's *t* –distribution with *(n-2)* degrees of freedom (Cunderlik and Burn, 2004). If $|t| \geq t_{\frac{\alpha}{2}}$, the null hypothesis about serial independence is discarded at the significance level (α = 10%).

ii. *Mann-Kendall trend test*

Mann Kendall test is a statistical trial broadly exercised for the trend analysis in climatologic and in hydrologic time series (Yue & Wang, 2004). Using the test provides two important benefits. Firstly, it is a non-parametric test and does not necessitate the data to be normally distributed. Secondly, the test has low sensitivity to abrupt breaks due to inhomogeneous time series (Tabari et al., 2011).

According to this test, it is assumed that the there is no trend for the null hypothesis H0 (the data is independent and randomly ordered) and this is tested against the alternative hypothesis H1, which supposes that there is a trend (Onoz & Bayazit, 2012). The rank correlation test (Kendall, 1955) for two sets of observations X = x_1, x_2… x_n and Y = y_1, y_2,…y_n is expressed as follows. The statistic S is calculated as in the following equation:

$$S = \sum_{i<j} a_{ij} b_{ij} \tag{3}$$

and b_{ij} is correspondingly defined for the observations in Y. Under the null hypothesis that X and Y are independent and randomly ordered, the statistic S tends to normality for large n, with mean and variance given by:

$$E(S) = 0 \tag{4}$$

$$V(S) = n\,(n\text{-}1)\,(2n+5)/18 \tag{5}$$

If the values in Y are substituted with the order of the time series X, i.e. 1, 2,...n the test can be used as a trend test. In this circumstance, the statistic S decreases as

$$S = \sum_{i<j} a_{ij} = \sum_{i<j} sgn\,(x_j - x_i) \tag{6}$$

$$Sign(x_j - x_i) = \{1 \; if \; x_j - x_i > 0 \; 0 \; if \; x_j - x_i = 0 \; -1 \; if \; x_j - x_i < 0 \tag{7}$$

with the same mean and variance as in equations, and x_j and x_i are the annual values in years j and i, j > i, respectively. The standard test statistic Z_s is calculated as follows:

$$Z_s = \{\frac{s-1}{\sigma} \; for \; S > 0 \;\; 0 \; for \; S = 0 \;\; \frac{s-1}{\sigma} \; for \; S < 0 \tag{8}$$

where V(S) is from Equation (5). The rest is as in the MK test.

iii. *Modified Mann–Kendall (MMK) test*

Pre-whitening has been used to reveal a trend in a time series in presence of autocorrelation (Cunderlik and Burn, 2004; Basistha et al., 2009). In spite of this, pre-whitening is reported to decrease the detection rate of significant trend in the MK test (Yue et al., 2003). Hence, the MMK test has been applied for trend detection of an auto-correlated series (Basistha et al., 2009). In this, the autocorrelation between ranks of the observations ρ_k are evaluated after deducting a non-parametric trend estimate such as Theil and Sen's median slope from the data. Only significant values of ρ_k are applied to calculate the variance correction factor n/ns*, as the variance of S is undervalued when the data are positively auto-correlated:

$$\frac{n}{n_s^*} = 1 + \frac{2}{n(n-1)(n-2)} \times \sum_{k=1}^{n-1} (n-k)(n-k-1)\,(n-k-2)\rho_k \tag{9}$$

where n is the actual number of observations, ns* is considered as an 'effective' number of observations to account for autocorrelation in the data and is the autocorrelation function of the ranks of the observations. To account only for significant autocorrelation in data, number of lags can be limited to 3 (Rao et al., 2003). The corrected variance is then computed as

$$V^*(S) = V(S) \times \frac{n}{n_s^*} \tag{10}$$

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iv. *Theil and Sen's median slope*

When a monotonic trend is determined using the Mann-Kendall test and the trend seems to be linear, we can use a Theil-Sen line to estimate the slope of the trend. The slope line is a nonparametric substitute to the parametric ordinary least square regression line. The slope of N pairs of data is estimated by Theil and Sen's estimators (Theil, 1950; Sen, 1968) using the following formula

$$Qi = (x_j - x_k)/(j-k) \text{ for } i=1,\ldots N \tag{11}$$

where x_j and x_k represent values at times j and k (j > k), respectively. The median of these N values of Q_i is considered as the Sen's estimator of slope. If there is a single data in each time period, then

$$N = \frac{n(n-1)}{2} \tag{12}$$

where n is the number of time periods. The median of the N assessed slopes is obtained in the normal way, i.e., the N values of Q_i are ranked by $Q_1 \leq Q_2 \leq \ldots \leq Q_{n-1} \leq Q_n$ and

$$\text{Sen's estimator} = \begin{cases} Q_{\frac{(N+1)}{2}} & \text{if } N \text{ is odd} \\ \left(\frac{1}{2}\right)\left(Q_{\frac{N}{2}} + Q_{\frac{(N+2)}{2}}\right) & \text{if } N \text{ is even} \end{cases} \tag{13}$$

v. *Change magnitude as percentage of mean*

Some trends may not be assessed to be statistically significant while they might be of practical interest, and vice versa (Yue and Hashino, 2003, Basistha et al., 2009). For the current study, change percentages have been figured by approaching it with a linear trend, calculate approximately its magnitude by Theil and Sen's median slope and assessing the change over the period as percentage of mean of the period concerned, following (Yue & Hashino, 2003).

$$\text{Percentage change (\%)} = \frac{\beta \times Length\ of\ year}{Mean} \times 100 \tag{14}$$

That is, the change of percentage equates median slope (β) multiplied by the length of study period divided by the corresponding mean, expressed as percentage. The significance level has been established to be 10%, the same as the level for statistical signi ficance.

vi. *Confidence interval for linear regression slope*

The equation of simple linear regression is expressed as

$$Y_i = \alpha + \beta X_i + \varepsilon_i \tag{15}$$

The dependent variable Y has a linear relationship to the independent variable X, whereas α and β are fixed quantities for the parameters of the model. Here, α act as a constant or intercept which determines the value where the regression line intersects the y-axis; β is called coefficient or slope, and measures the gradient of the regression line; the random component ε_i is called disturbance or error in observation i.

One intuitive criterion would be to estimate α and β by a and b so as to minimize the deviation ε_i between the observed values of Y, Y_i, and the predicted values of Y, $\hat{Y}_i$. In this way values for a and b would be sought that minimize the sum

$$\sum(Y_i - \hat{Y}_i) = \sum \varepsilon_i = \sum\left(Y_i - \hat{\alpha} - \hat{\beta}X_i\right) = \sum (Y_i - a - bX_i) \tag{16}$$

Thus it is desired to estimate α and β by a and b such $\sum \varepsilon_i^2$ is minimum. Denoting the sum by M, we have

$$M = \sum \varepsilon_i^2 = \sum(Y_i - \hat{Y}_i)^2 = \sum (Y_i - a - bX_i) \tag{17}$$

The solution of normal equations in terms of a and b is

$$b = \frac{\left[\sum X_i Y_i - \frac{\sum X_i \sum Y_i}{n}\right]}{\left[\sum X_i^2 - \frac{\left(\sum X_i\right)^2}{n}\right]} = \sum x_i y_i / \sum x_i^2 \tag{18}$$

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$$a = \frac{\Sigma Y_i - b\Sigma X_i}{n} = (\overline{Y} - b\overline{X}) \quad (19)$$

An unbiased estimate is S^2 calculated from

$$S^2 = \frac{\Sigma e_i^2}{n-2} = \frac{\Sigma (Y_i - \hat{Y}_i)^2}{n-2} \quad (20)$$

Confidence limits of regression line are given by

$$U = a = bX + S[\frac{1}{n} + (X - \frac{\overline{X})^2}{\Sigma X_i}]^{\frac{1}{2}} t_{1-\frac{\alpha}{2},\, n-2} \quad (21)$$

$$L = a = bX - S[\frac{1}{n} + (X - \frac{\overline{X})^2}{\Sigma X_i}]^{\frac{1}{2}} t_{1-\frac{\alpha}{2},\, n-2} \quad (22)$$

U and L represent the upper and lower limits of the regression line respectively.

III. Results and Discussions

a) Rainfall Analyses

i. Observed Data

The rainfall pattern of Mongla station has been studied to understand the precipitation scenario of the study area. The results of statistical analysis for the period of 1991–2014 are presented in Table 1. Percentage changes over mean values have also been shown in the table. Out of the three seasons only the pre-monsoon season is showing a decreasing trend, while monsoon and post-monsoon have an increasing trend. The rainfall has decreased at annual scale, though it is not statistically significant. However, significant increase (at the 10% significance level) has occurred only in post-monsoon season.

Table 1: Results of MK (MMK) test (at 10% level), Theil & Sen's Slope analysis and percent change of observed rainfall over 1991–2014 of Mongla station.

	Pre-Monsoon	Monsoon	Post-Monsoon	Annual
Mean	311	1380	218	1908
Z	-1.61	0.02	0.32*	-0.57
Theil & Sen's Slope	-4.34	1.06	0.79	-5.25
Percentage Change	-33.49	1.84	8.66	-6.60

**marked value indication of auto-correlated series*

The statistical analyses of the single observed station indicate that the pre-monsoon rainfall decreased considerably (33.5%), whereas the monsoon rainfall has been increased slightly (1.8%) and post-monsoon rainfall has been increased significantly (8.7%). The analysis of the annual rainfall shows that rainfall has decreased by (6.6%) at a rate of 5.25 mm/yr.

The highest annual rainfall in the Mongla Station has been observed in 2002 which was peaked to 2786 mm, whereas the annual average is 1908 mm. Generally, the monsoon season contributes about 60-80% of total annual rainfall. It is noticeable that monsoon rainfall is almost proportional to the annual rainfall, which indicates that annual rainfall pattern predominantly determined by the rainfall received during monsoon season.

The annual rainfall in the observed station has also been analyzed by simple regression method at 95% confidence interval (Figure 3). The trend line appears as horizontally parallel straight line which is an indication of almost unchanging magnitude of total annual rainfall. The maximum and minimum edges of the regression trend are exhibited by upper limit and lower limits in the graph respectively.

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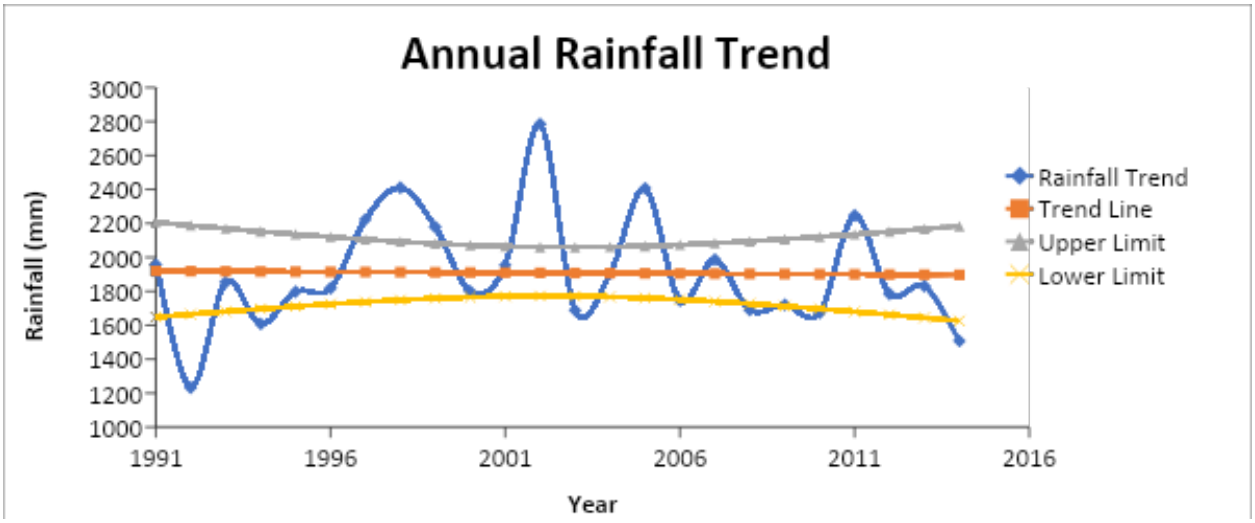

Figure 3: Annual Rainfall Trend at 95% Confidence Interval of Mongla Station from the year 1991 to 2014

ii. *Gridded data*

Precipitation data has also been collected from CRU TS 3.23 datasets for further analysis. The assessment is carried out for seasonal and annual series for the data sets of four grids. The analysis figure indicates that there is overall an insignificant change throughout the study period except for the annual level of grid 2. The annual rainfall has decreased for every grid, whereas seasonal rainfall has also decreased for most of the grids apart from the pre-monsoon and monsoon seasons of grid 4. The results of the autocorrelation analysis for 1985–2014 are presented in Table 1.

Table 1: Results of MK (MMK) test (at 10% level), Theil & Sen's Slope analysis and percent change of CRU TS 3.23 gridded rainfall between 1985 and 2014.

	Grid 1				Grid 2			
	Z Value	Mean	Sen's Slope	Change of Percentage	Z Value	Mean	Sen's Slope	Change of Percentage
Pre-Monsoon	-0.14	293.96	-0.58	-5.87	-0.32	363.16	-0.75	-6.20
Monsoon	-0.54	1452.33	-2.20	-4.54	-0.50	1526.51	-3.06	-6.02
Post Monsoon	-1.28	234.27	-3.21	-41.15	-1.00	238.12	-2.12	-26.75
Annual	-1.07	1980.56	-8.67	-13.13	-2.34*	2127.79	-8.45	-11.92
	Grid 3				Grid 4			
	Z Value	Mean	Sen's Slope	Change of Percentage	Z Value	Mean	Sen's Slope	Change of Percentage
Pre-Monsoon	-0.14	292.66	-0.29	-2.92	0.04	448.06	0.02	0.15
Monsoon	0.43	1591.82	1.28	2.42	0.00	2204.26	0.11	0.14
Post Monsoon	-1.25	268.49	-3.27	-36.50	-1.61	281.73	-3.65	-38.87
Annual	-0.43	2152.97	-3.23	-4.50	-0.61	2934.05	-5.18	-5.30

**marked value indication of auto-correlated*

b) Atmospheric Temperature Analyses

i. *Observed data*

The air temperature records of Mongla station has been studied for the period of 1989-2014. Monthly temperature records indicate that May is the hottest month of the year and January is the coolest month of the Sundarbans. The warmest (29.6°C) year was observed in 2010 and coolest (28.4°C) year was 1997, whereas the annual average temperature was 28.9°C during the 26 year study duration. The statistics shows that a significant rising trend of mean annual temperature at 95% confidence interval (Figure 4). The upper and lower confidence limits of the regression line are also displayed for the increasing trend of observed atmospheric temperature.

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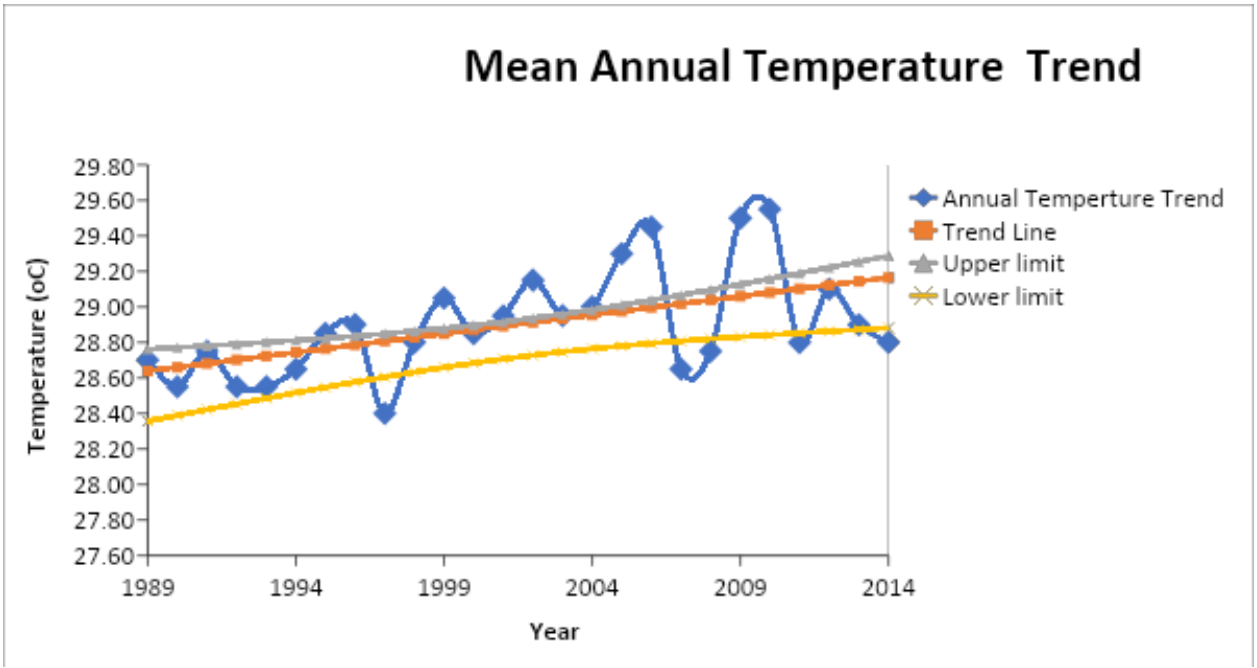

Figure 4: Annual Mean Temperature Trend at 95% Confidence Interval of Mongla Station from 1989 to 2014

The results of statistical analysis monthly and annual air temperature datasets are shown in the Table 2. The autocorrelation tests reveal that the datasets are statistically not auto-correlated. However, the temperature has increased for all months except for December, January and February. The maximum increase is observed in the month of April, May and June which belongs to the summer season. This can be interpreted as summers getting warmer and winters getting colder, thus increasing the range of temperature. Such change can have catastrophic effects on the delicate wetland/mangrove ecology.

Table 2: Results of MK (MMK) test (at 10% level), Theil & Sen's Slope analysis and percent change of atmospheric temperature over 1989–2014 of Mongla station.

	Mean	Z	Sen's Slope	Change of Percentage
Jan	19.6	-0.86	-0.02	-2.21
Feb	23.1	-0.33	0.00	-0.56
Mar	27.4	0.99	0.02	1.90
Apr	29.9	1.83*	0.05	4.09
May	30.3	1.97*	0.03	2.86
Jun	29.8	2.08*	0.03	2.84
Jul	29.1	1.70*	0.02	1.84
Aug	29.1	1.35	0.01	1.28
Sep	29.0	2.19*	0.02	1.99
Oct	28.1	1.59*	0.02	1.54
Nov	25.0	0.00	0.00	0.00
Dec	21.0	-0.55	-0.01	-1.24
Annual	28.9	2.98*	0.025	2.25

**marked value indication of auto-correlated series*

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ii. *Gridded data*

Air temperature data of CRU TS 3.23 datasets have been utilized for climatic study of Bangladesh Sundarbans. Although there is largely a rising trend observed for monthly temperature series except for the months of January, August and December, the trends are not statistically significant (Table 3). The highest temperature increase is observed for the month of June with for all grids, January shows the lowest temperature reduction for the same. As for the gridded datasets temperatures are mostly showing decrease in winter, the changing patterns are almost identical with the observed data point.

Table 3: Results of MK (MMK) test (at 10% level), Theil & Sen's Slope analysis and percent change of CRU TS 3.23 gridded temperature data between 1985 and 2014.

	Mean				Z values			
	Grid 1	Grid 2	Grid 3	Grid 4	Grid 1	Grid 2	Grid 3	Grid 4
Jan	19.77	19.59	20.21	20.53	-1.32	-1.56	-1.70*	-1.93*
Feb	23.15	22.79	23.35	23.16	-0.07	-0.25	0.00	-0.11
Mar	27.52	27.26	27.25	26.84	0.79	0.64	0.88	0.91
Apr	29.46	29.12	29.02	29.13	0.91	0.70	0.97	0.98
May	30.01	29.56	29.69	29.68	1.49	1.24	1.54	1.11
Jun	29.77	29.37	29.45	29.16	1.70*	1.20	1.94*	1.86*
Jul	28.93	28.67	28.75	28.23	1.45	1.36	1.80*	1.23
Aug	28.96	28.66	28.69	28.29	-0.23	-0.67	-0.07	-0.65
Sep	29.09	28.84	28.82	28.50	0.88	0.86	1.29	1.15
Oct	28.14	27.99	28.05	27.74	0.57	0.30	0.99	0.95
Nov	25.10	24.99	25.21	25.18	0.54	0.68	1.10	0.77
Dec	21.24	21.03	21.51	21.92	-1.27	-0.86	-0.74	-0.74
Annual	26.76	26.49	26.67	26.53	0.95	0.38	0.95	0.62
	Sen's Slope				Change of Percentage			
	Grid 1	Grid 2	Grid 3	Grid 4	Grid 1	Grid 2	Grid 3	Grid 4
Jan	-0.025	-0.026	-0.024	-0.029	-3.79	-4.03	-3.49	-4.17
Feb	0.000	-0.007	0.000	0.000	0.00	-0.98	0.00	0.00
Mar	0.013	0.012	0.017	0.014	1.36	1.38	1.83	1.52
Apr	0.017	0.011	0.014	0.017	1.70	1.08	1.48	1.72
May	0.020	0.011	0.020	0.012	2.00	1.07	2.02	1.26
Jun	0.027	0.020	0.030	0.032	2.75	2.04	3.06	3.27
Jul	0.013	0.011	0.013	0.007	1.30	1.16	1.39	0.71
Aug	0.000	-0.004	0.000	-0.004	0.00	-0.39	0.00	-0.38
Sep	0.009	0.005	0.010	0.009	0.90	0.55	1.04	0.92
Oct	0.006	0.004	0.010	0.011	0.63	0.41	1.07	1.20
Nov	0.004	0.011	0.014	0.010	0.43	1.33	1.62	1.19
Dec	-0.019	-0.011	-0.011	-0.009	-2.65	-1.58	-1.55	-1.24
Annual	0.004	0.002	0.004	0.003	0.40	0.19	0.47	0.30

**marked value indication of auto-correlated series*

IV. Conclusions

Because of its geographical settings the Sundarbans of Bangladesh is vulnerable from various perspectives of climate variability and climate change-related phenomenon. The fluctuation of seasonal rainfall is an indication changing rainfall pattern. Although the monsoon rainfall increased slightly, it delayed to befall in

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usual monsoon period. The overall analysis suggests that the annual rainfall has been decreased and the seasonal monsoon rainfall has shifted to post-monsoon season. Mangrove growth and its spatial distribution are supposed to be affected by changing rainfall pattern of Sundarbans. Furthermore, decrease of rainfall can increase salinity, which consequently reduces diversity, productivity, growing and seedling existence, hence moving competition among mangrove species. Changes in rainfall generally can have undesirable impacts to the biodiversity, ecological settings, agricultural practices, local livelihood as well as the socio-economic systems of the Sundarbans.

The temperature analysis reveals increase of average annual temperature of Sundarbans locality. The temperature has shown an increasing trend throughout the year except for the winter season that indicates that winter has become colder and summer turned into warmer. Temperature has an effect on basic physiological processes and mangrove reproduction and distributions. Increasing temperature can result altering species composition (extinction) and changing phenological patterns (timing of flowering and fruiting) of plants (Gilman et al., 2008). On the other hand, reproduction system of Sundarbans can be restricted by low temperatures (Duke 1990).

There are several climate induced impacts such as tropical cyclones, sea level rise, scarcity of fresh water, salinity intrusion which have already been observed in the region and the outcomes are severe in most cases. Climatic vulnerability can further endanger a wide range of floral and faunal species in the forest. A comprehensive study is required in a greater quantitative scale to understand the threats of climate change on biodiversity and mangrove ecosystem of Sundarbans.

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Environmental Impact of Street Trading in Akure, Ondo State Nigeria

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Abstract- Street trading is a common activity in Nigerian cities, including Akure. This is prominent in cities because a lot of people migrate to cities to get a better life. When the desired jobs are not available, street trading is usually resulted to in an attempt to earn a living. This activity has lots of issues attached to it but this study examines the environmental impact of street trading activity in Akure, Ondo State. Federal University of Technology Akure (FUTA) North gate area and Olukayode axis around Oja-Oba were selected for the study. 85 respondents were randomly selected for the study. The relevant government agencies in Ondo State such as Ondo state Ministries of Environment, Education and Women affairs were also sampled for the study in order to get information on their efforts in relation to street trading activities, especially in Akure. Findings revealed that the street trading activities usually cause filthy environment, traffic congestion among others. Sensitization of the public on the dangers that come with street trading was strongly recommended.

Keywords: *akure, environment, price, street trading and traffic.*

GJHSS-B Classification: *FOR Code: 040699p*



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Environmental Impact of Street Trading in Akure, Ondo State Nigeria

Olusa Adekemi [α], Omole, Felix [σ] & Abereola Temitayo [ρ]

Abstract- Street trading is a common activity in Nigerian cities, including Akure. This is prominent in cities because a lot of people migrate to cities to get a better life. When the desired jobs are not available, street trading is usually resulted to in an attempt to earn a living. This activity has lots of issues attached to it but this study examines the environmental impact of street trading activity in Akure, Ondo State. Federal University of Technology Akure (FUTA) North gate area and Olukayode axis around Oja-Oba were selected for the study. 85 respondents were randomly selected for the study. The relevant government agencies in Ondo State such as Ondo state Ministries of Environment, Education and Women affairs were also sampled for the study in order to get information on their efforts in relation to street trading activities, especially in Akure. Findings revealed that the street trading activities usually cause filthy environment, traffic congestion among others. Sensitization of the public on the dangers that come with street trading was strongly recommended.

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I. Introduction

There is an advancement in modern retailing and despite this, millions of people throughout the world still make their living partly or wholly through selling goods on the streets. (Amoo, Fadayomi & Oluyomi (2012). This is particularly the case in our environment. A vibrant array of traders selling various goods which varies from fruits and vegetables, to clothes, traditional umedicine, audio and video compact disk and even furniture is what characterizes African cities (Dickson, Benneh, & Essah, 1970; Owusu, Abrokwah, & Frimpong (2013). A visible feature along major streets of most urban centers in Nigeria especially, at the Central Business District (CBD) or core areas is the bustling of commercial activities involving various categories of people displaying all kinds of articles for sale. This act of display of articles on the street could be regarded as "street trading". Street trading has been observed as a phenomenon causing city distortions, reducing the beauty and orderliness in our cities especially at the central business districts Owusu, Abrokwah & Frimpong. (2013). Street trading activities have become a permanent feature of most of urban and semi-urban centers in the country. Akure the capital of Ondo state is not left out of this phenomenon.

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A *street trader* is a person who offers goods or services for sale to the public without having a permanently built structure but with a temporary static structure or mobile stall (or head-load) Brown (2010): Kaushik & Rahman (2016). Street traders in Nigeria are forced to operate in high risk and unfriendly environment, in which they are constantly exposed to hazardous conditions that most often results in body harm, injures and even death. This is expected, in a country where the road environment is dominated largely by illiterate, inexperienced, often drunk, over confident drivers, who operate poorly maintained vehicles on a poorly designed and ill-maintained roads. They have succeeded in transforming the roads into arenas of tears, blood and death (Onakomaiya, 1988; Atubi, 2018). According to Nduka & Duru (2014), total of 69,248 road accidents were recorded within the period of 2000-2005 in Nigeria and similarly, estimated that an average of twenty-five people (excluding pedestrians) die every day as a result of road accidents in Nigeria, thus, making auto accident the second most important cause of death in the country, with street traders often at the receiving end. Apart from loss of lives of individuals that are involved in this sector, there are a lot of environmental damages done as a result of this practice. Yet, the numbers of people that involve in this practice continue to increase in number especially in the cities (Nduka et al, 2014).

Due to the emergence of oil boom in the late 1970s, the rapid urbanization where the hopes for better opportunities with the increase in population which also leads to rapid urbanization. The rural urban migrants came to the city for green pasture, better employment opportunity and when these things were not met it contributed to the street trading, which they used as means of survival (Nduka et al, 2014).

The task of this study therefore includes investigation on the nature of street trading in Akure, the Capital of Ondo State, Nigeria (Figures1-3); the reason for engaging in street trading and the danger posed by the activity into the environment with a view to explore strategies to ameliorate the menace of street trading in Akure.

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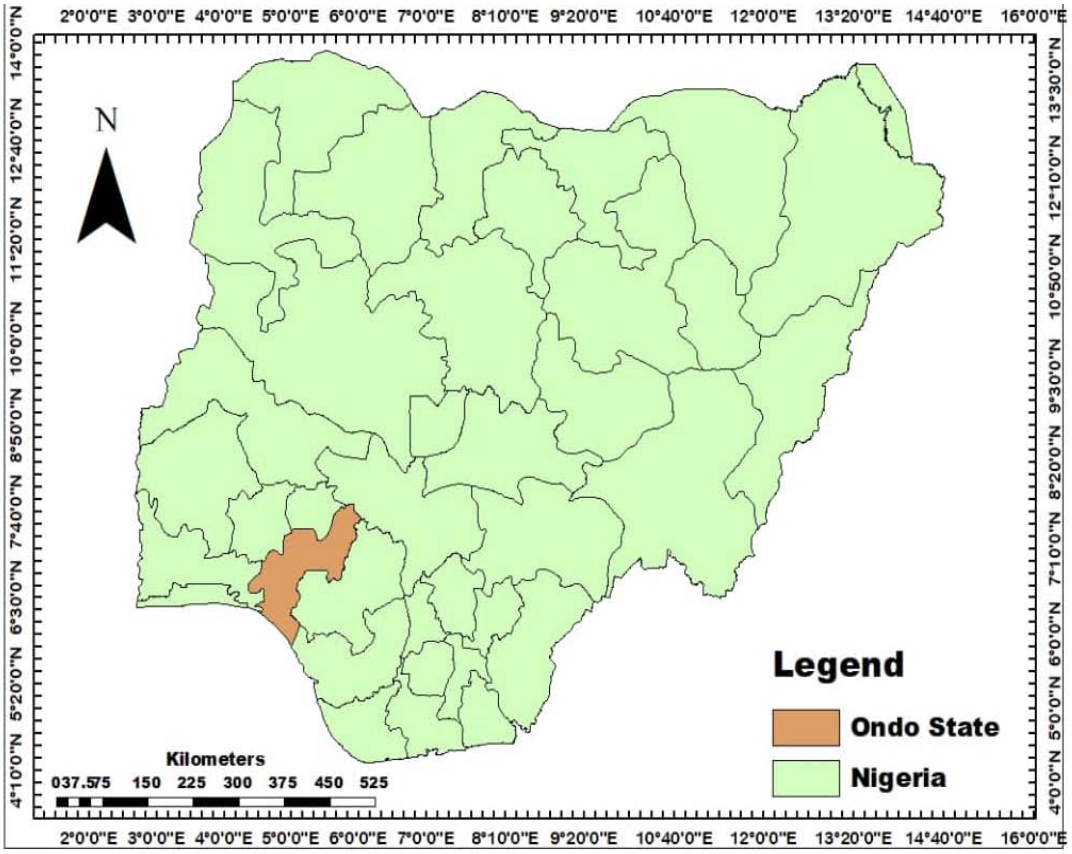
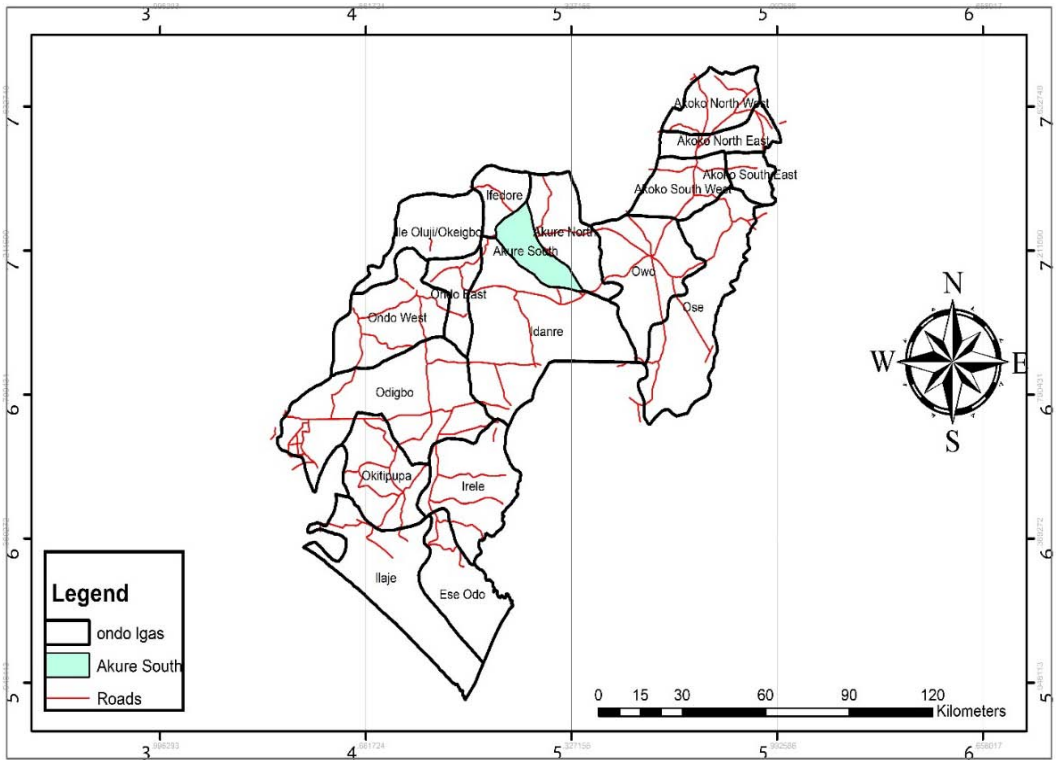


Source: Google Earth 7.1.7.2606; Authors' Digitization with ArcGIS 10.5.0, (2019).

Figure 1: Map of Nigeria Showing Ondo State



Source: Google Earth 7.1.7.2606; Authors' Digitization with ArcGIS 10.5.0, (2019)

Figure 2: Map of Ondo State Showing Study Area.

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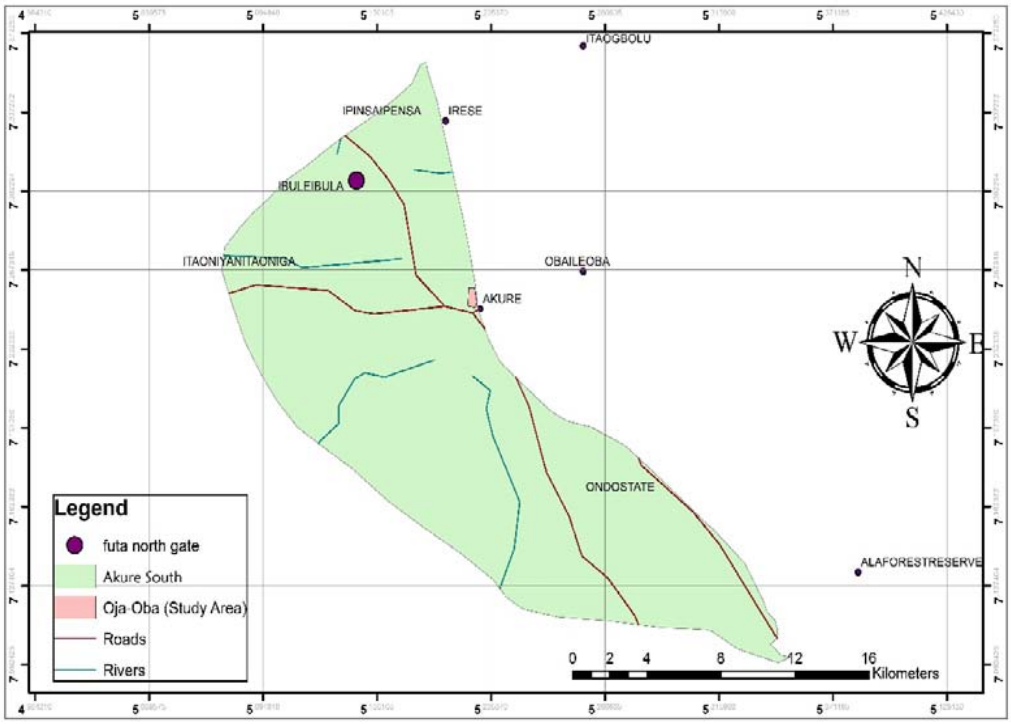

Source: Google Earth 7.1.7.2606; Authors' Digitization with ArcGIS 10.5.0, (2019).

Figure 3: Map of Akure South LGA Showing the Study Area

II. Literature Review

The World Employment and Social Outlook Trends reports that in the past, street trading has always been regarded and perceived as an underground activity which does not comply with public health regulations and therefore it is always denied recognition in national economic statistics (WESCO, 2015). Broomley (2000) regards street trading as a norm which is archaic in practice but a very dominant and important occupation found in every country and major city around the world. As a result, street traders have become the contentious participants on the informal sector. Mitullah, (2003) reveals that street trading occurs in different parts of streets and roads (movement routes). In giving much clarity Broomley (2000) argues that street traders are always strategically positioned in most populated ('heavy human traffic') areas (such shopping centers, streets and even in main roads where they can be easily seen and accessed by motorists) while others move around to places selling their products. Mitullah (2003) made an excellent observation that the largest number of street traders are women even though there a noticeable number of males and children is also active in the business. In addition, she further clarifies that street traders usually work 8 to 12 hours a day, however, gender and location are the most determinants of how time is managed as in what time to start and quit for the business day.

Mitullah (2004) study on street trading in Africa highlighted that the most active traders are at the average of 20-50 years old. In identifying the age group, there is a further analysis which posits that trading involves a diverse kind of people ranging from youths to pioneers in the informal trade both as a career for self-sustenance and a way of supporting family. Due to uncertain factors on the diverse needs of individuals in street trading it is a very difficult thing to formulate 23 policies which focuses on addressing their needs. According to Skinner (2008) street traders work very long hours every day because they are always bound to catch early morning commuters to work and also come back home late evening. Street traders often provides goods rather services in order to gain quick returns since goods are easily and quickly sold as they are always in demand (e.g. cigarettes and food stuffs) effect (Skinner, 2008).

a) Causes of Street Trading

The act of street trading has been viewed by many as a consequence of several co-morbid factors rooted in socio-economic, political and cultural aspects of the society in very complex dimensions. (Ekpenyong & Nkereuwuem, 2011) attributes the causes of street trading to poverty and low level of education or illiteracy. He also cited unemployment as another contributing factor to street trading. It is reasonable to expect that people engage themselves in informal activities since formal employment opportunities are no more abundantly available. Since they are unemployed and cannot raise enough capital, they tend to stay where operational cost in terms of rent and utility bills will be

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minimal, hence the street sides" According to "it is a reflection of the state of affairs in the country; Street trading is booming because of the grinding financial hardship in the country to the effect that most people interested in doing business cannot afford the cost of renting shops, which are very exorbitant. Also, the nation's large population is part of the problem because paid employment is becoming scarce by the day coupled with the strangulating policies of government.

As adopted by Nduka & Duru, (2014); Basorun, (2011); Ekpenyong & Nkereuwuem, (2011); causes of street trading could be summarized as unemployment, poverty, migration, illiteracy, lack of good government policy.

b) Effects of Street Trading on the Physical Environment

Street trading activities has a lot of effects on the physical as well as social live of any city where it's being practiced (Umahi, 2008). People view Street trading from different perspectives. While, some regard the act as detestable practice, others believe it has some positive attributes" (Adeagbo, 1997)). Basorun, (2003) "identified some problems associated with street trading as follows: it causes traffic congestion because traders congregate at points along the roads where pedestrian and vehicular traffic is heavy. The issue of traffic congestion can also be attributed to the narrowing of the width of traffic lanes. The practice of street trading also poses problems of hygiene and sanitation because, traders dealing in food items usually expose them to flies and displays them under unsanitary conditions thus, they transmit diseases like Cholera" (McGee, 1979, in Adeagbo, 1997). Similarly, they generate a lot of wastes which are not properly managed. Another problem is the unfair competition with legal sellers both in public markets and private stores because, street traders do not pay overhead cost such as rents and utility bills. Also, the city image is distorted and given a bad aesthetic value and serious problem of accidents. it is a known fact that traders generate a lot of wastes which are not properly handled in terms of its disposal. The menace of the traders includes: degrading the environment by littering the road with dirt, impeding movement on pedestrian bridges which they have taken over and slowing vehicular movements in an urbanized city across the globe. (Shweta, 2015).

Prior literatures show that the informal sector or informal economy is that part of an economy that is not registered, taxed, monitored by any form of government but categorized by social convention are considered as legal in themselves. The main factors determining the reasons to involve in street trading includes is poverty, migration, illiteracy, lack of good government policy among others.

Street trading is one of the informal sector and its researchable area, but in the area of study (Akure) little has been done. However, in order to ameliorate the menace of street trading in the study area, the aforementioned complementary concepts serve as an invaluable measure which aid reduction of participants in street trading activities. Street trading needs to be seen as poverty alleviation project that negates the abolitionist policies of the past through registration of trading activities and reducing poverty through creating decent work opportunities, increasing incomes and improving livelihoods for local people, especially vulnerable groups.

III. Methodology

Multi-stage sampling method was adopted for this research in order to select trading locations and trader. Trading locations were purposively selected owing to their high trading attractions (see Figures 4, 5 & 6). A sample is a smaller representation of the whole group that is being studied (Ogunbameru & Ogunbameru, 2010). From the successful counting of street traders in the selected trading points, there were 846 traders on the average at the selected trading points (See Table 3). A sample of 10%, amounting to 85 traders were selected for the study. This is as propounded by Neuman, (2011) that larger population permits smaller sampling ration for early good sample because as the population size grows, the return in accuracy for sample size shrinks. Simple random sampling method was adopted for questionnaire administration so that all the traders will have equal chance of being selected.

Street traders and non-street traders (Motorists, Cyclists and buyers) in areas of study were randomly sampled for information on the impact of street trading activities on the environment. However, getting genuine information on reasons for engaging in the activity from the street traders requires their audience and this was made possible by purchasing some of their items being offered for sale. Effort was made to explain to each respondent the contents of the questionnaire and purpose of the research.

Frequency tables and charts were used to present the analyzed data for presentation.

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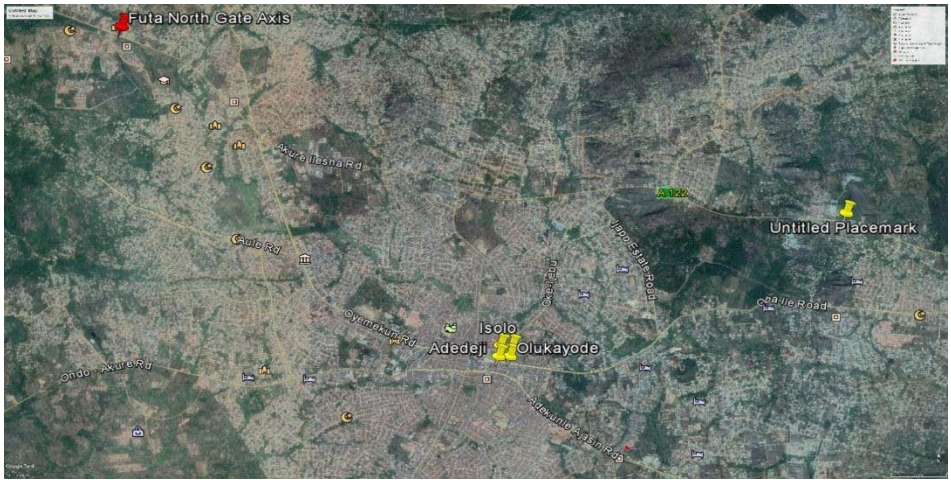

Source: Google Earth 7.1.7.2606; Authors' Digitization, (2019)

Figure 4: Google Imagery of the study area



Source: Google Earth 7.1.7.2606; Authors' Digitization, (2019)

Figure 5: Google imagery of FUTA North Gate Axis



Source: Google Earth 7.1.7.2606; Authors' Digitization, (2019)

Figure 6: Google imagery of the study areas in the C.B.D

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Table 1: Periodic counts of street traders at purposively selected trading points in the morning at 9.00 am to 10:00 am

Study Locations	Trade point Count at 9:00-10:00 AM	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Average Total
Oja Oba	1. Olukayode Complex axis	90	89	80	91	89	95	89
	2. Ijomu street	142	155	143	151	148	147	147
	3. Adedeji street	371	360	388	352	380	389	373
	4. Isolo street	134	142	127	132	125	168	138
FUTA North Gate	5. FUTA Northgate axis	27	31	28	30	31	35	30
Total								777

Source: Authors' Field Work, (2019)

Table 2: Periodic counts of street traders at purposively selected trading points in the evening at 4.00 pm to 5:00 pm

Study Locations	Trade point Count at 4:00-5:00 p.m	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	Average Total
Oja Oba	1. Olukayode complex axis	103	99	107	100	102	112	103
	2. Ijomu street	197	194	190	199	191	201	195
	3. Adedeji street	389	392	385	399	380	402	391
	4. Isolo street	187	167	175	190	188	196	183
FUTA North Gate	5. FUTA Northgate Axis	43	41	40	37	39	48	41
Total								913

Source: Authors' Field Work, (2019)

Table 3: Average numbers of street traders at the purposively selected sample areas which make the sample frame.

Study Locations	Trading Points	Total Average	Sample frame
Oja Oba	1. Olukayode complex Frontage	$\frac{89+103}{2}$	96
	2. Ijomu street	$\frac{147+195}{2}$	171
	3. Adedeji street	$\frac{373+391}{2}$	382
	4. Isolo street	$\frac{138+183}{2}$	161
FUTA North Gate	5. FUTA Northgate frontage	$\frac{30+41}{2}$	36
TOTAL			846

Source: Authors' Field Work, (2019)

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Table 4: Estimation of Sample Size and Administered Questionnaires.

Trade Locations	Terminal Count	Sample Size (10%)	No. of Questionnaires Administered
1.0 Oja Oba (C.B.D)	1. Olukayode complex Frontage		10
	2. Ijomu street		17
	3. Adedeji street		38
	4. Isolo street		16
2.0 FUTA North Gate	5. FUTA-Northgate frontage		4
Total		85	85

Source: Authors' Field Work, (2019)

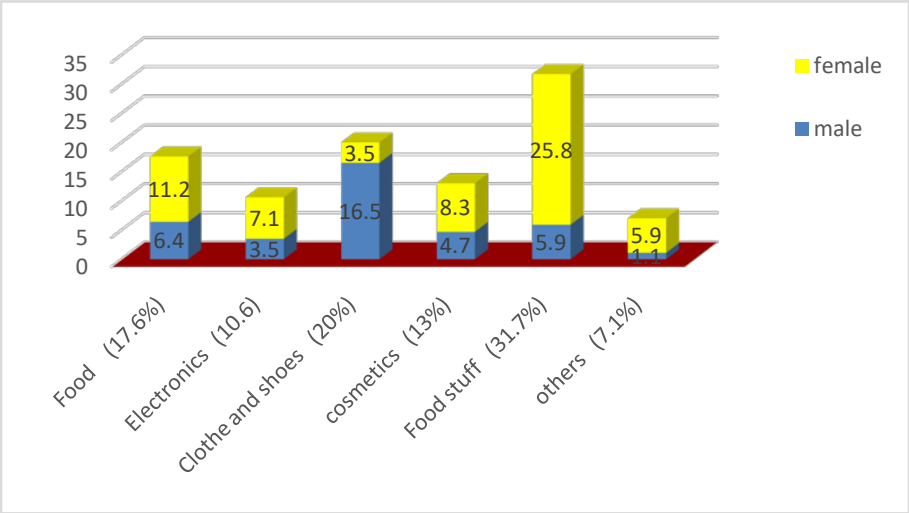
IV. Discussion of Findings

a) Assessment of the Nature of Street Trading

i. Distribution of Articles Sold by Street Traders

Market structure of street trading is perfectly competitive; homogenous product with competition on price. The price of street traders' items is cheaper compared to formal sectors. Street trading has high demand because of low economic status and the main consumers come from low income group. Figure 7 indicates that the highest percentage of the street traders (31.7%) were selling food stuff like raw rice and perishable goods to mention just a few. While 20% sell clothe and shoes, 17.6% sell cooked food, 13% trade in cosmetic items, 10.6% engaged in trading of electronics and the remaining 7.1% sell other items like wrist watches and mobile phone accessories.

It should be noted that some items are dominated by some tribes. For instance, the Yorubas are the majority among those selling raw foodstuff and perishable goods like tomatoes while the Igbos dominate sale of electronics and cosmetics.



Source: Authors' Field Work, 2019

Figure 7: Distribution of articles sold by street traders

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Source: Authors' Field Work, 2019

Plate 1: Clothing items being sold by street traders at Olukayode frontage axis



Source: Author's Field Work, 2019

Plate 2: Fruits being sold by street traders along FUTA North Gate axis

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Source: Authors' Field Work, 2019

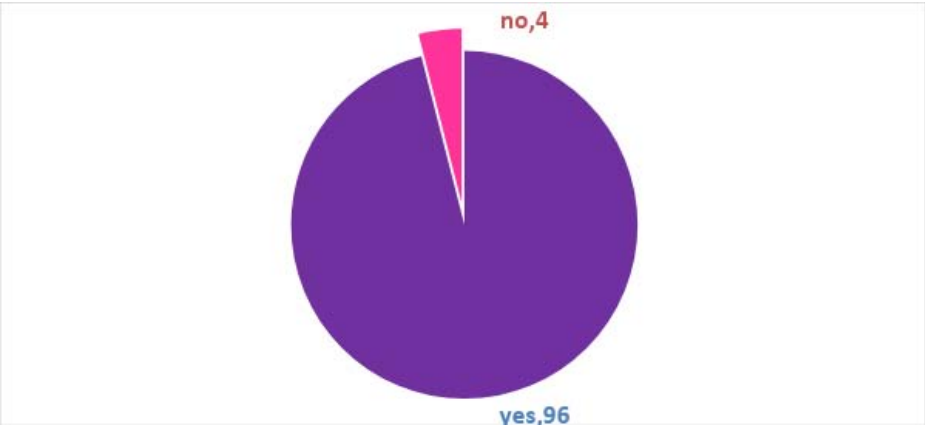
Plate 3: Perishable items sold by street traders at Adedeji street Akure

b) Investigation on the Environmental Problem of Street Trading in the Study Area

The menace of street trading in the environment cannot be over emphasized (Khayesi, Monheim, & Nebe, 2010). This informed the engagement of 25 non-street traders (motorist, cyclist and buyers) in the data collection process as information gotten from them in relation to the environmental impact of the street trading activity helped stem the achievement of the purpose of the study.

i. *Patronage of Non-Street Traders*

According to (Alimi, 2016; Ikioda, 2016) patronage serves as a contributory factor to engaging in street trading. Findings revealed that 96% of the non-street traders patronized street-traders and 4% does not (Figure 8). This depicts significance of the benefit of street trading.



Source: Authors' Field Work, 2019

Figure 8: Patronage of Non- Street Traders

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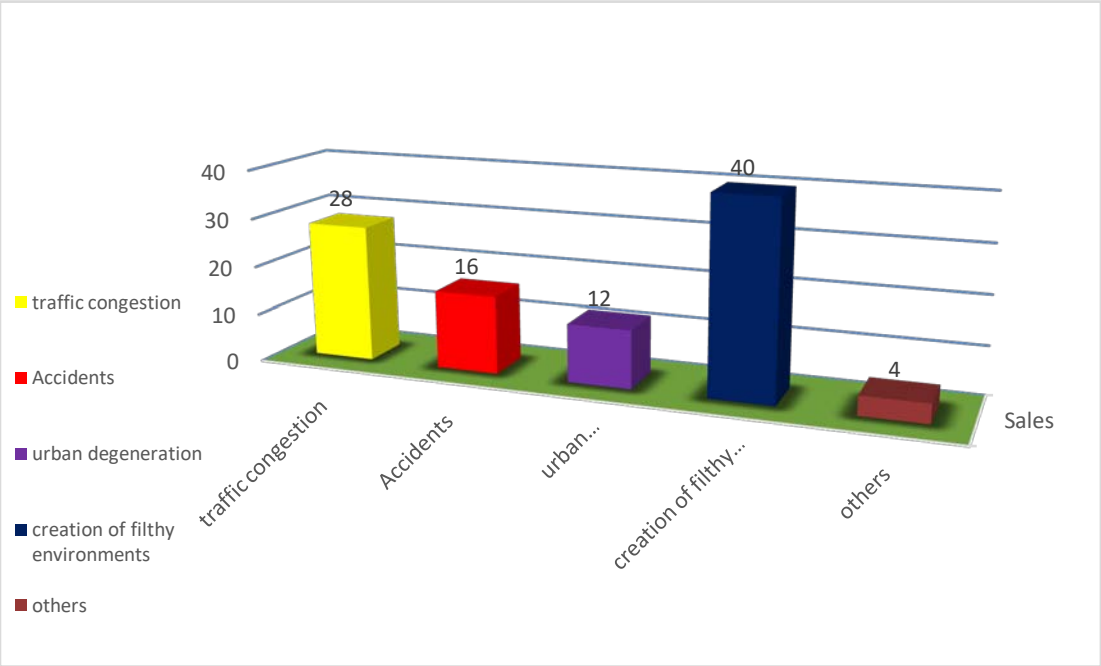
ii. *Perception of Non - Traders on the Problem Caused by Street Traders*

Although the place of street trading in distribution chain cannot be overemphasized but the dangers attached to it are too intense to be overlooked. Street trading impacts negatively on the environment. This claim is supported by dangers pointed out from the non-street traders' opinion. From the perception of the respondents on street trading activities presented in Figure 9, 40% of the respondents affirmed that creation of filthy environment cannot be separated from street trading activities as waste generated are been disposed indiscriminately which will result in pollution. 28% of the non-street traders claimed that street trading leads to traffic congestion (pedestrian and vehicular) as pedestrians are forced to walk on the streets because they have been pushed off pavement and vehicular traffic movement has been turned into a crawl as a result of street trading activities. 16% and 12% of the respondents gave accident and urban degeneration (gradual loss of city aesthetic) respectively as problems the activities pose in the environment due to street traders competition with motorist for space.



Source: Authors' Field Work, 2019

Figure 9: Problems caused by street traders



Source: Authors' Field Work, 2019

Plate 4: Filthy environment created by street traders through waste disposal

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Source: Authors' Field Work, 2019

Plate 5: Vehicular traffic congestion as a result of street trading activities



Source: Authors' Field Work, 2019

Plate 6: Predominance of street traders closing up the Oba-Adesida and Arakale bye pass

c) *Assessment of the Agencies Responsible for Discouraging Street Trading in Akure*

Ondo State Ministry of Environment, Ondo State Ministry of Education and Ondo State Ministry of Women Affairs and Social Development are the Ondo State agencies that are to curb street trading, especially among children in Ondo state. One official from each of these agencies were interviewed to get their view on the menace of street trading in Akure.

i. *Ondo State Ministry of Environment*

The task force Department of the Ondo state ministry of environment was created in the year 2010 with the purpose of relocation of street traders in the markets into the constructed neighbourhood markets.

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The official mentioned that the purpose for the establishment of the department has only been fairly achieved. The department has engaged the tools of advocacy and routine monitoring of the traders to enforce compliant with non-street trading policy in the state. There are some factors inhabiting the achievement of this which include; inadequate man power, inadequate funding, lack of political will. It was also revealed that the street traders always go back to the streets after they have been driven away. They are usually found back on the streets, especially after 5pm when the task force officials would have closed.

ii. *Ondo State Ministry of Education*

The Ministry was created in the year 1976 with the purpose of enhancing the quality of learning through massive investment in the restoration and expansion. The official in the Ministry adjudged that the ministry has fairly achieved its purpose. As a way of minimizing street trading in Akure and Ondo State in general, some programmes were put in place. This includes; school feeding program at primary school level, establishment of Special Education Department in the Ministry to cater for education of the persons with special needs and the gifted children at secondary and tertiary levels. The ministry identified inadequate funding and manpower to conduct comprehensive survey on educational needs of the children as the major constraints to their achievement.

iii. *Ondo State Ministry of Women Affairs and Social Development*

The ministry was created on 28th June,1991 with the aim of empowering and educating women folk generally in an attempt to provide an enabling environment where the rights to survival, protection and development of the people, especially the vulnerable groups, as well as their empowerment to participate in socio-economic benefits.

As a way of curbing street trading, the social welfare unit of the Ministry embarked on empowerment program for skill acquisition for women and children and loan to establish the learnt trade through the programme. Poor funding, instability of fund and shortage of staff are the mitigating factors against the success of the programmes by the ministry.

V. Conclusion and Recommendation

a) Conclusion

Some of the dangers attached to street trading has been identified in this study. It was revealed that accident, urban degeneration, filthy environment and the creation of congestion are critical dangers street trading pose to the environment. Though it can be said to bring wares close to the buyers and a source of income to thousands of Nigerians that are involved in the activity, but its dangers outweigh its benefits. There is therefore the need to urgently curb street trading activities, especially in urban centres in Akure and Nigeria at large else, the environment will at the long run be imperiled.

b) Recommendation

i. *Public Awareness on the Menace of Street Trading in the Environment*

It is imperative for the government through the Ministries of Women Affairs and Environment to sensitize the public regularly through all social media on the social, health on environmental implications of street trading.

ii. *Resettlement Programme through Good Urban Governance*

Lack of space and high cost of renting a shop are some of the reasons for engaging in street trading. Therefore, in order to ameliorate the menace of street trading, government in conjunction with the Ministry of physical planning and urban development through good urban governance should involve the stakeholders in decisions on how to plan, finance provide and manage affordable locked up shops at an appropriate location close to the city center in order to reduce number of street traders.

iii. *Regular Waste Collection*

Markets usually generate waste. As such, plan should be put in place for regular collection of the wastes in order not to create a filthy environment.

iv. *Enforcement Agents*

The enforcement agents like the War Against Indiscipline (WAI) brigades should be made to patrol the locations prone to street trading in Akure to regularly ensure that people are compelled to use shops for trading activities so that the roads and walkways can be free for easy movement of vehicles and humans.

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Management of Sustainable Cities in Nigeria: The Imperative of Urban Governance

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Introduction- The 21st century is a century of cities. Over half of the world's population now lives in cities, and by 2050 this figure may rise to 70 percent globally (UN-HABITAT, 2010). The unprecedented pace of urbanization has had a profound impact on the number and size of cities and has created a phenomenon called "megacities": (UN-HABITAT, 2007). This ongoing transformation to a global urban society offers an unprecedented opportunity to use the urbanization process as a catalyst for sustainable economic and social development since urbanization is a precondition for social and economic development (SDSN, 2013). State of World Population (2009) shows that the more developed countries are all highly urbanized; the least developed countries are all low on urbanization. However, the urbanization process in most cities of less developed countries heightens such conditions as lack of resources, poverty, inequality, the pervasiveness of slums and insanitation, overcrowding, housing congestion, crime and violence, and several other demeaning situations (Omisore et al., 2003; Ogunleye, 2005; UNEP, 2012, Adeboyejo, 2013; Ogunkan and Adeboyejo, 2015). This is particularly true of Nigerian cities which today are one of, if not, the greatest contributors to the urbanization profile of Africa (Adeboyejo 2013).

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Management of Sustainable Cities in Nigeria: The Imperative of Urban Governance

David V. Ogunkan

I. Introduction

The 21st century is a century of cities. Over half of the world's population now lives in cities, and by 2050 this figure may rise to 70 percent globally (UN-HABITAT, 2010). The unprecedented pace of urbanization has had a profound impact on the number and size of cities and has created a phenomenon called "megacities": (UN-HABITAT, 2007). This ongoing transformation to a global urban society offers an unprecedented opportunity to use the urbanization process as a catalyst for sustainable economic and social development since urbanization is a precondition for social and economic development (SDSN, 2013). State of World Population (2009) shows that the more developed countries are all highly urbanized; the least developed countries are all low on urbanization. However, the urbanization process in most cities of less developed countries heightens such conditions as lack of resources, poverty, inequality, the pervasiveness of slums and insanitation, overcrowding, housing congestion, crime and violence, and several other demeaning situations (Omisore et al., 2003; Ogunleye, 2005; UNEP, 2012, Adeboyejo, 2013; Ogunkan and Adeboyejo, 2015). This is particularly true of Nigerian cities which today are one of, if not, the greatest contributors to the urbanization profile of Africa (Adeboyejo 2013).

The above-described scenario shows that there is a very intricate relationship between urbanization and development. While urbanization is a stipulation for development, rapid and uncontrolled urbanization threatens sustainable development. However, it must be understood that many urban problems are the result of poor management, poor planning, and the absence of coherent urban policies rather than urbanization itself. (Ogunkan, 2018; Ogunkan, 2017). Thus, while urbanization is quintessentially a demographic phenomenon, development is essentially a factor of urban management and planning. Urban centers become an engine of development and play a fundamental role in macro-economic development if properly governed, managed, and planned.

The growing awareness of the role of urban management in answering the city's sustainability question has reinforced the increasing international interest in urban management. It is, however, regrettable that the scant attention of the research community to urban management and how it is influencing city's performance is a far cry from to the great attention directed to many other aspects of cities in Nigeria. It is on this background that this study examines the imperative of urban governance as the key to cities' prosperity, development, and sustainability.

II. What is Urban Governance?

Urban governance is a subset of the general concept of governance that has been investigated worldwide by various bodies both at the local, national, and international levels. Therefore, when dealing with the concept of urban governance, it is essential to examine the general concept of governance. According to UNDP (1997), governance may be understood as processes, regulations, or the results of interactions between the legislative and executive governments, the civil society, the judiciary, and the people. It has also been conceived as how power is exercised in the management of the country's economic and social resources for development. It is the joint responsibility of the state, market, and citizens to mobilize public resources and promote decision making towards the common public good. (PRIA, 2013). Governance means a more cooperative way of government, where state and non-state institutions, public and private actors, take part and often cooperate in public policy formulation and implementation (Mayntz, 2001).

From the array of the definition of governance, it can be deduced that the notion of governance is broader than government as it incorporates a lot more stakeholders than just governmental agencies to include informal arrangements and the social capital of citizens. Therefore, one of the main objectives of governance is to undertake holistic developmental planning for an area with the maximum utilization of the economic and human resources available therein (PRIA, 2013).

The term "governance" becomes more specific when we use the prefixes urban, rural, good, etc. with it. In this context, urban governance can be defined as the sum of the many ways individuals and institutions, public and private, plan and manage the common affairs of the city. "Urban governance" implies a greater diversity in organization of services, a greater variety of actors and stakeholders, and greater flexibility in the

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relationship between municipalities and their citizens (Aribigbola et al, 2013)

In the search for a common ground to the understanding of the concept of urban governance the United Nation Habitat (UN-HABITAT), the Nigerian National Bureau of Statistics and the United Nation Development Fund (UNDP) instituted researches to know the characteristics that constitute good governance (Egunjobi and Sani, 2010). Through these efforts, six principles of good governance emerged and twenty-five indicators were identified. The six principles are accountability, political stability, and absence of violence, government effectiveness, quality of regulation, rule of law, and control of corruption.

Further, in 2001, there was an inter-ministerial committee set up to carry out a campaign for good governance in Nigeria. This might have been because the six principles identified have been violated in Nigeria. The campaign focused on issues relating to the constitutional reform and decentralization of power, participatory budgeting, improved urban safety, and the role of women in local governance. The communiqué issued at the end of the committee's work is as presented below:

That campaign for good urban governance should be carried out rigorously at all levels especially at the local government level.

- That the norms or principles of good urban governance be publicized widely around the country.
- That the campaign should be accompanied by capacity building of all categories of Local Government functionaries.
- There should be full implementation of the Urban and Regional Planning Law of Nigeria, 1992 to ensure the development of cities in Nigeria.
- That the current level of women's participation in governance is not acceptable and that the 30% participation as recommended by affirmative action should be advocated for.
- That program is developed in conjunction with the National Council for Women to promote awareness and enlightenment on women empowerment and gender issues.
- That the issues of corruption, transparency, and accountability should be addressed more seriously and that the Anti- Corruption and other related offenses commissions and Agencies be given full support in the fight against corruption in Nigeria.
- That the rapid urbanization in the country resulting in the miss-match between urban growth and the resources to cope should be addressed through the improvement of our rural areas, the promotion of medium-sized cities, and the enhancement of city resources.
- That full participation of all the citizens in all processes of urban governance including planning, budgeting, revenue mobilization, etc. should be practiced by all Local Governments.
- Nobody should be excluded from enjoying the political, economic, social infrastructure and other benefits of the city; and
- That poverty reduction is accorded top priority in all aspects of urban governance. (Egunjobi and Sani, 2010, pp. 14 & 15).

From all the points raised in the communiqué, it is evident that Nigeria has a long way to go. It is observed, however, that most of the points raised are directly related to the functions of physical planners. This is because urban planning is at the center of transforming the cities into sustainable ones. The act of good governance is therefore imperative in developing sustainable cities in Nigeria in the 21st century. It is equally important that planners should understand the process of and type of urbanization before any meaningful progress is made in developing sustainable cities.

It is, however, important to note that the type of urbanization rather than the city per se provides decisive sustainable development. Although the pace of urbanization remains unprecedented across the globe, the patterns of urbanization have been diverse within developing regions and between developing and developed regions. While urbanization in the developed world follows a planned order, the urban expansion in developing nations is based mainly on the informal process. Consequently, developing nations of Asia and African develop more cities than their western counterparts. Therefore, one could not agree less with Dogan and Kassarda (1988) that the world is becoming more and more a world of giant cities, and these cities are increasingly located in less-developed countries.

As a result, developing world cities, which are growing much faster than their developed-world counterparts, are particularly vulnerable to lack of resources, poverty, inequality, and vulnerability to climate change (UNEP, 2012). This is particularly evident in Nigerian cities, where there are growing inequalities, poverty and the pervasiveness of slums and insanitation, overcrowding, housing congestion, crime and violence, and several other demeaning situations (Omisore, et al, 2003; Ogunleye, 2005; Adeboyejo, 2013; Ogunkan and Adeboyejo, 2015).

Consequently, Nigerian cities appear economically weak and may even be declining in real terms to fulfilling the immediate and long-term goals and aspirations of city dwellers (Adeboyejo, 2013) but they have the potential to be generative of growth and development like their counterparts in developed nations. However, to put their urban advantages to work,

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Nigerian cities need competent, accountable, and equitable systems of governance. The ability of Nigerian cities to replicate the functional and sustainable qualities of their counterparts from developed nations requires their management to take place within an understanding of the factors that are shaping the socio-spatial aspects of cities and the institutional structures which attempt to manage them. When governance systems ensure that the gains of growth and development are shared by all, cities are better placed than rural areas to improve the quality of life of residents. It is therefore within the purview of this study to examine the role of urban governance in the management of sustainable cities in the 21st century Nigeria.

III. What is Sustainable City ?

In many countries, building sustainable cities has been considered as a starting point for the building of sustainable development (DESA, 2013), yet it is essential to understand the concept of sustainable development as a prerequisite for understanding the concept of sustainable cities. The concept of sustainable development is always connected to the Bruntland report (1987), which coined the concept and marketed it very efficiently (Sneddon, Howarth & Norgaard 2006). Brundtland Report (UNWCED, 1987), defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The concept has traditionally been focused on an environmentalism framework that gives priority to the issues of ecological degradation (Nurse 2006). Thus it is logical to argue that the concept has been reinforced by a series of environmental disasters. As the concept of sustainability matured, further reflection led to a shift from a purely environmentalist perspective and toward a greater focus on the social and economic dimensions of development (Kadekodi 1992; Nurse 2006). The contemporary mainstream notion of sustainable development emphasizes the interface between environmental, economic, and social sustainability (Bell 2003; Nurse 2006; OECD 2011).

The first attempt at applying the principle of sustainable development to city context was in 1991 when the United Nations Centre for Human Settlements (UNCHS) Sustainable Cities Programme attempted to define a sustainable city as one "where achievements in social, economic and physical development are made to last" (United Nations Human Settlements Programme (UN-Habitat, 2002,). Thus, the definition included the three pillars of sustainability; environmental, economic, and social sustainability. The fourth pillar was added at the first session of the World Urban Forum convened at the headquarters of the United Nations Human Settlements Programme (UN-HABITAT) in Nairobi in May 2002. The Forum affirmed that addressing economic, social, environmental and governance issues were integral to the creation of sustainable cities and that the inability to address those issues would prevent the achievement of sustainable development (UN-HABITAT, 2002). Therefore, the context of achieving the sustainability of cities can be conceived as entailing the integration of four pillars: social development, economic development, environmental management, and urban governance. The literature of sustainability studies has been saturated with issues on the economic, social, and environmental aspects of sustainability but urban governance is a relatively new concept that needs to be examined.

IV. Managing Sustainable Cities in Nigeria: Issues and Challenges

One of the central facts of development and social change in Nigeria is rapid urban growth. The enormity of the challenges that come with this backdrop has been documented (Adeboyejo, 2013; Ogunkan and Adebojejo, 2015; Olokesusi, 2015). However, the most significant challenges, which have far-reaching implications for economic, social, ecological, and political dimensions of cities' sustainability are, as discussed.

a) Unabated and Rapid Population Growth

Nigerian Cities are diverse in terms of their size, structure, spatial form, economy, wealth, local resources availability, and ecological impact but are phenomenal in population growth. Generally, the growth of Nigerian cities has been through both natural increase and unabating rural-urban migration (CBN, 2009). The natural increase in the growth is as a result of rising birth rates vis-a-vis declining death rates, however, much of the demographic expansion of Nigerian cities is through rural-urban migration. The rapid increase in rural-urban population migration is largely a response to the real or perceived economic and social opportunities in the cities. The movement of people from rural to urban areas is also considered an essential element of their household strategies for increasing and diversifying incomes, mitigating the risk of dependence on agricultural production, and improving individual and general welfare through improved access to education and health facilities. (AfDB, 2005).

As a result of rapid population growth, Nigeria has the largest number of cities with a population of over 20,000 in Africa. According to Adeboyejo (2013), the seventy-four largest Nigerian cities have a total population of 36.6 million (24% of the country's total population) which is higher than the total population of Ghana (25.3 million) or 71 percent of South Africa's population.

Although, Nigerian cities have benefited from this population growth as a necessary condition to unleash growth but have gained from urbanization at a price of environmental degradation and pollution,

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haphazard housing and informal settlement development, insecure land tenure, land shortage, deteriorating living conditions as well as the proliferation of deprived neighborhoods such as slums and squatter settlements (Omisore and Akande, 2003; Ogunleye, 2005; Ogunkan et al, 2015; Olokesusi, 2015). Most Nigerian cities have heightened the possibilities for economic development, innovation, and social interaction. Regrettably, the social, economic, and environmental challenges inflicted by rapid and unplanned agglomeration of people have exerted direct and indirect effects on these cities and the lives of people therein.

Therefore, Nigerian cities are a mere concentration of people and less of articulation of resources as well as the mediation of major functions of the global economy, unlike their counterparts in developed countries where urban growth is synonymous with a concentration of resources, development of trade, culture, information, and technology as well as industry with the cities contributing substantially to national economic growth (Adeboyejo, 2013).

b) Unplanned and Unregulated Physical Growth and cities Expansion

Unplanned urban expansion has seriously outstripped the capacity of Nigerian cities to provide adequate basic services to their citizens. Therefore, the cities are reputed to have been characterized by non-functioning infrastructural facilities, extensively dotted with illegal structures, uncontrolled physical growth and development, and poor city management (Aluko, 2000; Aribigbola, 2008).

The unplanned and unregulated physical growth and expansion of the cities have become the dominant feature and a fundamental challenge to Nigerian cities. The problem is most pervasive in such cities as Lagos, Ibadan, Kano, and Onitsha (Okpala, 2009). It is, therefore, obvious that most of the major cities in Nigeria expand without incorporating the major element of physical planning. This has enormous demographic and environmental implications. Most Nigerian cities, just like their African similitudes, have poor infrastructure facilities and deteriorating public utilities such as poor drainage and inadequate sanitation, inadequate water supplies, mounds of garbage and other solid waste, constrained mobility as a result of outdated physical layouts, or no planned layout, flourishing street trading, overcrowded, inadequate transport systems and inadequate and deteriorated road facilities resulting in overcrowding and congestion, and noise pollution (Okpala, 2009). Despite the effort of successive administrations in Nigeria in ensuring qualitative developmental control through urban planning, the problems of unregulated growth and expansion is still a fact of life in many urban areas in Nigeria today (Amujiri 2001).

A master plan is a key planning tool that guides the growth and development of cities, it is, therefore, inexplicable that most cities in Nigeria lack master plans. Although some cities have this document, such plans bear so little relation to the reality of rapidly growing and poor to cities (Olokesusi, 2015). Moreover, such plans are grounded in legislation that is so outdated, that they are not implemented or are just simply ignored (Olokesusi, 2015; Adedibu, 1985). The situation is not helped by bribery and corruption that have become "cankerworm" among planners and urban managers, it is therefore not surprising that new houses and shops spring up especially in open spaces, environmentally sensitive areas, and derelict lands and often without formal approval contrary to the dictates of the master plans (Abolade and Adeboyejo, 2013).

c) Pervasiveness of Socioeconomic Inequalities

Inequalities between rural and urban areas as well as within urban areas have been features of development and urbanization in developing countries (Cohen, 2006; Baker., ed., 2012). This is particularly true of Nigerian cities where the social and economic development is challenged by sharp inequalities not only between urban centers and rural areas but also among different socio-economic groups residing within the same city. It was on this basis that Mabogunje (1975) conceptualizes city as a social product - a particular geographical concentration of largely man-made resources of great economic, social, psychological and symbolic significance - the consumption of which puts certain people at a relative disadvantage owing to both the location of such resources and their “externality effect”. By implication, inequalities have pervaded every sphere of urban life in Nigeria and are reflected in significant differences in access to job opportunities and basic public services such as water and sanitation, electricity, education and health, transportation, housing, and communications.

As a result, there is a growing gap between rich and poor neighborhoods. While the wealthy ones can move out to more spacious locations outside the city center where they even pay lower rent per unit of space, the poor often live in city centers with highly overcrowded dwellings in shacks that lack basic infrastructure and services (CBN, 2009). This dichotomy between the rich and the poor has solidified into a permanent divide creating new apartheid (Ibrahim 1997). By this divide, a Nigerian city can assume a bivalent status of the formal and informal city. While the informal city, usually occupies by the poor, is characterized by the housing of poor quality and with inadequate provision of water, sanitation, and drainage that put the lives and health of residents under continuous dangers; the formal city, usually the gated communities of the ruling elites, enjoys the advantages

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of city life usually at the expense of the informal city (Olokesusi, 2015).

d) Ineffective Urban Planning and Management Institutions

There is no denying the fact that effective urban planning and management are the antidotes to the mounting urban challenges across the globe, but the most fundamental and critical challenge faced by urban areas in most developing countries, particularly in Anglophone (Sub-Saharan) African countries is the crippling weakness of institutions of urban development planning and management (Okpala, 2009). This is particularly apparent in Nigeria where city authorities, urban planners, urban managers, and other stakeholders have failed to effectively deal with the aftermath of the rapid urbanization process. This ineffectiveness is often manifested in forms of low entrepreneurial, technological and managerial capabilities, inadequate finance, a large number of the parasitic individual coupled with the inabilities of towns and cities to generate revenues to sustainably finance their selves (Agbola, 2005). Despite many efforts aimed at ameliorating the urban problems through the enactment of the plethora of planning laws and regulations, the institutional base and infrastructure for effective urban planning and urban development management is still largely weak in Nigeria and their effectiveness is threatened by inadequate technical and administrative skills and as yet the limited political will of planners to act according to the dictates of the profession (Okpala, 2009, Jelili, etc. 2013).

Another fundamental challenge to effective urban planning and management in Nigeria is the lack of institutional structure at the local level (Okpala, 2009). In contrast to the situation in developed nations, the role of the local government in towns' physical development has been neglected and has excluded the local populace from infrastructure planning and physical planning (Alabi and Akinbode, 2010). The national and state governments have not allowed the local government, as an agent of grassroots physical development, and their instruments to effectively function. This has become an obstacle to effective urban planning and management in Nigeria. After all, Planning is only as effective as the administrative system supporting it, and the political philosophy, willingness, and commitment of the state in which it operates allow it to be (McAuslan 1985). Okpala (2009) observes that poor governance, corruption, and waste of resources is yet another challenge to urban planning and management in Nigeria and most other African countries.

In total, Gyuse (2013) has identified seven major characteristics of our urban development in Nigeria. These characteristics include growth without planning, expansion without infrastructure, growth without autonomous financial resources, growth without employment base, growth without governance structure, and growth without spatial boundaries. All these characteristics point to the fact that our cities are parasitic rather than generative, and to have sustainable cities in the 21st century all these characteristics must be addressed.

V. Achieving Sustainable Cities: The Imperative of Urban Governance

The growth and expansion of urban areas, especially in developing countries, have come with a wide-ranged social, economic, and environmental challenges. As large cities grow in developing areas, the needs of their populations for ordinary services-such as drinking water, sanitary services like trash collection and sewerage, roads, housing, public transport, education, and health-become very insistent (Stren, 2002). This threatens the ability of cities to become viable pillars of sustainable development. As a result, the question "how can we make cities sustainable?" has dominated the debate on urban development at the local, national, and international levels. It is increasingly recognized that unequal access to, and inefficient use of, public services, as well as financial fragility and the harm inflicted by natural hazards required institutional, legislative and regulatory frameworks ((Fiorino, 2012; DESA, 2013; Aribigbola et al, 2013; Olokesusi, 2015). It has been posited that government policies, corporate strategies, human capital, major political forces, and decisions, investments in strategic sectors influence the fate of cities (UN-HABITAT, 2012). Therefore, a city that fails to meet the core expectations of governance-maintaining order, making and carrying out collective decisions, providing basic services-will not be able to sustain the ecological, social, and economic aspects of the concept of sustainability (Fiorino, 2012). Therefore, urban governance has become a dictum in developmental “dictionary” and the important factor in achieving sustainability of cities.

Achieving the sustainability of cities can be conceived as entailing the integration of four pillars: social development, economic development, environmental management, and urban governance. The capacity of the city to achieve sustainability depends on its capacity to adapt, within the context of its particular history, to the policy priorities and goals defined by each pillar (DESA, 2013). However, the importance of urban governance as a coordinating pillar cannot be overemphasized. Although, until recent time, the sustainability field has failed to appreciate the role of effective, legitimate governance in enabling societies to sustain the other pillars of sustainability and maintain an appropriate balance among them, the imperative of urban governance to make and carry out decisions that are accepted as legitimate and ensure the survival of the

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other three systems has been increasingly recognized by social commentators (Fiorino, 2012; Aribigbola, 2013; Olokesusi, 2015).

In recognition of the imperative of urban governance in achieving sustainable cities, scholars are constantly acknowledging the immensity of urban governance in the integration and coordination of other pillars in the areas of land use issue, employment creation, provision of health care facilities, provision of education, health care and housing, promotion of sustainable and inclusive economic development, promote people's right to the city, reviewing urban planning policies among several others (DESA, 2013; Olokesusi, 2015). UNDP (1997) points out that whenever good things are happening, people point to good governance. To this end, it was recommended that the institution for governance must not only be designed to function but to contribute to achieving sustainable human development, by establishing the political, legal, economic and social circumstances for poverty reduction, job creation, environmental protection and the advancement of women.

Regrettably, since 1989 when World Bank declared that 'a crisis of governance' underlay 'the litany of Africa's development problems', the stark reality is beginning to emerge that many cities in African and those in Nigeria in particular, are not properly governed, a factor that accounts for their poor state and inability to significantly contributes to the national economy (UN-HABITAT, 2001; UN_HABITAT, 2008; Falade, 2010; Aribigbola, 2013).

VI. Managing Sustainable Cities in Nigeria: Issues for Policy Consideration

Having established that developing the capacity for effective urban governance is an important means to building and managing sustainable cities and given the prevailing socio-economic circumstances in Nigerian cities, the following are put forward for policy consideration in achieving and management of sustainable cities in Nigeria.

a) Planning and Decentralisation

In the face of demographic, spatial, and environmental crosscurrents in Nigerian cities, it is evident that planning administration has not been effective in Nigeria. This is a reminder of the fact that so far, in most cities of developing world, planning has been unable to address much of city challenges such as the power relationships that have been at work to the detriment of a great majority of urban populace, the segregation of urban poor from the socio-economic fabric of the city, the unending environmental degradation or formation of the slum (UN-HABITAT, 2012) and the grafting of rigid and outdated planning law and regulations that encourage bribery and corruption (Egunjobi and Ayoade, 1987).

Amid the perceived failure of urban planning to address the mounting urban crisis, a fundamental question of planning interest has been raised in the minds of scholars: why have these problems remained intractable in the face of many physical planning tools? The accusing finger is constantly been pointed at the weak and seemingly ineffective institution of urban planning in Nigeria (Alabi and Akinbode, 2010; Aluko, 2010; Aribigbola, 2013). The technical and political capacity of urban governments to deliver services depends on the space provided by existing rules and regulations. The traditional top-down approach to urban planning and management in Nigeria is not sufficient to achieve economically sustainable, liveable, socially, and aesthetically pleasing cities. Although in Nigeria, there is a devolution of power among the three tiers of government, the federal and state government control, interferences and domineering influence have denied the local governments of political identity, autonomy, and significance. Moreover, fundamental and constitutionally assigned responsibility to this tier of government is not being discharged thereby contributing to ineffective or poor urban governance in the area (Aribigbola et al, 2013). The local governments in Nigeria are also frequently under-funded and under-staffed and thus unable to adequately fulfill the task required of them. This include among others, physical development planning at the grassroots level.

Given this, local government should be reconfigured and repositioned to have a powerful impact on addressing poverty and improving access to basic services and infrastructure for urban dwellers. Local government should be made autonomous not only in terms of administrative convenience but must be backed by fiscal devolution. Decentralization works well when backed by a strong commitment and support from the central government (UN-HABITAT, 2006). Therefore, the local government must be supported by the central government in all ramification but the central government's interference in terms of governance, fiscal, project implementation and capacity building for planning should be reduced.

b) Reduction of Inequalities

The growing physical and social division between rich and poor neighborhoods has characterized Nigerian cities. This urban divide has not only brought social and economic divisions, but it is also responsible for exclusion and marginalization. In Nigeria, institutions are not fully contributing to equity. This is evident in the growing proliferation of squatter settlements and slums which arose from a combination of the poverty of the inhabitants, a deficient national policy framework, and the weak, inefficient, and corrupt systems of urban governance within which they find

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themselves (Corbbet, 1991). It must be understood, therefore, that inequality in any form is a bane in achieving sustainable cities. Unaddressed socio-economic fragmentation can jeopardize urban prosperity and pose a major risk to political stability (UN-HABITAT, 2012).

Addressing inequalities requires political will, strong institutions, and well-targeted policies. This is reflected in most developed countries where urban policies promote inclusion, diversity, multi-action, positive discrimination, and pro-poor planning (UN-HABITAT, 2012). Urban governance in Nigeria must borrow a leaf from European cities where an abundance of initiatives has been introduced to promote social inclusion, and their benefit seems to have registered in the UN-Habitat "City Prosperity Index" (UN-HABITAT, 2012). However, this has to be done with reference to the prevailing socio-economic situation in Nigeria. In this regard, it is suggested that the government should be more committed to distributional equity in terms of infrastructure and social services such as health, education, housing as well as functional and liveable environment among many others.

c) Good and Effective Urban Governance

Good urban governance speaks about the quality of urban governance. Governance can be defined as good when all the issues that make it ineffective are addressed, removed, or taken care of (PRIA, 2013). The fact that we speak of good or effective urban governance implies that urban governance may be bad or ineffective. We, therefore, analyze the positive transformations that are alternatives to the current format, which can improve the functioning of urban governance in Nigeria.

One of the cornerstones to good urban governance is participation by both men and women (PRIA, 2013). The current "imposing democracy" where most governors of the states select their allies to manage the affairs of local government is undemocratic and does not guarantee good governance. Urban governance in Nigeria should encourage a participatory approach through representative democracy and participative democracy. However, participation needs to be informed and organized to ensure freedom of association and expression and to guarantee an organized civil society.

Participatory governance does not automatically translate to good governance until it is made accountable. The principle of accountability in urban governance is not limited to governmental institutions alone, the private sector and civil society organizations must also be accountable to the public and institutional stakeholders. However, accountability cannot be ensured until the system is made transparent. The prevailing situation in Nigeria is such that the local government chairmen are accountable to themselves alone and to the state government that select them and not to the people they are made to govern.

The system of urban governance in Nigeria should also be made to respect the civil and political rights of people. This requires that all individuals and groups, especially the downtrodden, have opportunities to improve their wellbeing. Besides, the full protection of human rights, particularly those of minorities should be ensured. Good governance requires fair and just legal frameworks that are enforced impartially through an independent judiciary and an impartial and incorruptible police force (PRIA, 2013).

If all the above suggestions will come into operation in Nigeria, it is imperative that planners now and for the 21st century should develop along with the general skills needed to face the diversities found in the development of sustainable cities. These skills are thirteen in number as presented by the American Planning Association in recent times:

- Knowledge of urban spatial structure or physical design and the way cities work.
- Ability to analyze demographic information to discern trends in population, employment, and health.
- Knowledge of plan-making and project evaluation.
- Mastery of techniques for involving a wide range of people in making decisions.
- Understanding of local, state, and federal government programs and processes.
- Understanding of the social and environmental impact of planning decisions on communities.
- Ability to work with the public and articulate planning issues to a wide variety of audiences.
- Ability to function as a mediator or facilitator when community interests conflict.
- Understanding of the legal foundation for land regulations.
- Understanding of the interaction among the economy, transportation, health, human services, and land use regulations.
- Ability to solve problems using a balance of technical competence, creativity, and hard-headed pragmatism.
- Ability to envision alternatives to the physical and social environment in which we live, and, lastly.
- Mastery of geographic information systems and office software.

Competence in all these basic skills would go a long way equipping urban planners now and the future to transform our cities into sustainable ones with the application of the six principles of good governance mentioned earlier.

VII. Conclusion

This study has confirmed that the system of government in cities and the traditional systems of the

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bureaucratic and top-down decisions in Nigeria are completely inadequate to cope with the enormity of urban challenges in Nigeria. It observes that the management of cities, that are sustainable, requires new governance systems where the administration, planning, coordination, and management of cities are seen as the joint responsibilities of various stakeholders such as local city governments, private enterprises, civil society, and voluntary sector. It is strongly believed that if good urban governance is promoted, Nigerian cities would compete favorably with their counterparts in the developed nation as a generator of growth and development.

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Land Cover and Coastline Change Assessment of Nijhum Dwip, Bangladesh, using Geospatial Analysis

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Abstract- Nijhum Dwip is a southern island of Bangladesh isolated from the mainland, in the convergence of the Meghna River and the Bay of Bengal. This island has studied through overlay analysis and supervised classification by geospatial and remote sensing technique, over 38 years (1980-2018) using multitemporal Landsat MSS, TM, OLI, and TIRS satellite images with identification of historical changes. This landform is facing frequent shifting of its coastline and leading to sequential changes on the land surface. Analysis revealed substantial growth of settlement and agricultural land whereas significant lessening on vegetation cover and open space. In 1990 agricultural land was 4.47 km2 (13.29%) and improved to 9.16 km2 (19.17%) in 2018. Similarly, settlement also increased from 1.92 km2 (4.79%) in 1999 to 5.72 km2 (11.97%) in 2018. Conversely, vegetation was primarily 8.02 km2 (27.71%), 18.70 km2 (55.61%), 20.97 km2 (52.29%), 18.47 km2 (36.28%) and 15.28 km2 (31.98%) in 1980,1990,1999, 2010 and 2018, indicating declination. As well, water bodies and open space also fluctuated through the period because of geomorphological processes and human intervention. Besides, the least and highest unstable char land was 1.15 km2 (3.42%) and 1.68 km2 (5.80%) in 1990 and 1980.

Keywords: dynamic, spatial analysis, land utilization, erosion-accretion processes, enlargement.

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Mohoua Sobnam [α] & Al Mamun [σ]

Abstract- Nijhum Dwip is a southern island of Bangladesh isolated from the mainland, in the convergence of the Meghna River and the Bay of Bengal. This island has studied through overlay analysis and supervised classification by geospatial and remote sensing technique, over 38 years (1980-2018) using multitemporal Landsat MSS, TM, OLI, and TIRS satellite images with identification of historical changes. This landform is facing frequent shifting of its coastline and leading to sequential changes on the land surface. Analysis revealed substantial growth of settlement and agricultural land whereas significant lessening on vegetation cover and open space. In 1990 agricultural land was 4.47 km2 (13.29%) and improved to 9.16 km2 (19.17%) in 2018. Similarly, settlement also increased from 1.92 km2 (4.79%) in 1999 to 5.72 km2 (11.97%) in 2018. Conversely, vegetation was primarily 8.02 km2 (27.71%), 18.70 km2 (55.61%), 20.97 km2 (52.29%), 18.47 km2 (36.28%) and 15.28 km2 (31.98%) in 1980,1990,1999, 2010 and 2018, indicating declination. As well, water bodies and open space also fluctuated through the period because of geomorphological processes and human intervention. Besides, the least and highest unstable char land was 1.15 km2 (3.42%) and 1.68 km2 (5.80%) in 1990 and 1980. All over the study period, the island gained 18.84 km2 instead of 2.63 km2 loss, which indicates accretion is prominent than erosion. Findings from 1980 to 2018 indicating 2.125 km2/y total average annual growth rate while enlargement rate was 0.469 km2/year (1980-1990), 0.719 km2/y (1990-1999), 0.937 km2/y (1999-2010) and 0.328 km2/y reduced in 2010-2018 as well. The upper portion of Nijhum Dwip is shifting more towards the north, east, and north-west direction than south. In 1990 and 1999, the coastline extended westwards while in 2010 and 2018 shifted to the northwest. Because of the dynamic nature of the coastal environment, this island experienced enlargement during the last 38 years.

Keywords: dynamic, spatial analysis, land utilization, erosion-accretion processes, enlargement.

I. Introduction

Coastline and coastal areas of Bangladesh are neither uniform nor static, but also dynamic (Brammer, 2014) due to shifting through the short and long-term processes (Schwartz, 2006). The Coastal zone covers 32% of Bangladesh involving Jessore, Narail, Gopalganj, Shariatpur, Chandpur, Satkhira, Khulna, Bagerhat, Pirozpur, Jhalakati, Barguna, Barisal, Patuakhali, Bhola, Lakshmipur, Noakhali, Feni, Chittagong, and Cox's Bazar. Estuaries, islands, accreted land, beaches, peninsula, rural settlements, urban and industrial areas, ports, etc. are usual features (Iftekhar, 2006). Around 35 million people representing 29% of the total inhabitants live in the coastal zone (Uddin & Kaudstaal, 2003). Except for Chittagong-Cox's Bazar, all parts of the coastal zone are plain land with extensive river networks and accreted land (Sarwar, 2005). The morphology of the coastal region in Bangladesh is quite unstable due to simultaneous erosion and accretion, variation of river flow, sediment load (Shibly and Takewaka, 2012). Besides, strong tidal currents, vigorous wave action (Sarwar & Woodroffe, 2013) along the coast and physical environments, human interventions (Hassan et al., 2017) are other crucial reasons for the changes. Identically, mangrove forest is decreasing while cultivable lands and settlement are growing over the year (Hossain et al., 2016). However, rapid geomorphological changes are going on in the Meghna estuary (Brammer, 2014), also Nijhum Dwip is one of the islands in the Meghna estuary of the Bay of Bengal where changes are instantaneous. Along with, land use patterns are changing to meet the demand of society, which may be a concerning issue in the perspective of putting pressure on the environment and deteriorating newly formed land. Usually, land use changes indicating the land utilization by people (Anderson et al., 1976; Di Gregorio and Jansen, 1997; Lillesand and Kiefer, 2002) when change detection is practicing to identify the spatial changes of the surface of the earth at diverse temporal ranges (Singh, 1989). Various studies have carried out on islands with remote sensing and GIS techniques for detecting Spatio-temporal changes of the forest, erosion-accretion, and land use (Alam and Uddin, 2013; Sarwar and Woodroffe, 2013; Emran et al., 2016; Hossain et al., 2016; Kumara and Ghosh, 2012; Rahman et al., 2017; Rahman et al., 2018). Instead of this, very few studies noted here considered population migration, risk, vulnerability, and livelihood issues (Hossain et al., 2013; Islam et al., 2015; Kumar and Luna, 2018; Tanim et al., 2013). As study concerning Spatio-temporal changes on land cover and coastline of the Nijhum Dwip is less frequent, the present investigation is broadly an attempt to detect the land cover changes and evaluate the lateral shifting of coastline from 1980 to 2018 of Nijhum Dwip, Bangladesh. Therefore, coastal change detection is critical in coastal zone application and is significant for future coastal dynamic studies (Lu et.al. 2004). This research provides an integrated spatial analysis using

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time-series satellite images towards better management of the study area.

II. Study Area

For this study Nijhum Dwip (Silent Island) has selected as the study area, a mauza under Zahajmara Union of Hatiya Upazila of Noakhali district (PDO-ICZM, 2002) in Bangladesh. It is an extreme southern isolated small island of Bangladesh separated by the Hatiya channel (Alam and Uddin, 2013), about 2.2 meters high from the sea level situated in the Meghna estuary, confluences of the Bay of Bengal and enclosed by the Bay of Bengal (South and West), Domar char and the Meghna River on the East and Hatiya Island on the North (Saha et al. 2014). Nijhum Dwip lies between 22°1'30" N to 22°6' N latitudes and 90°58'30" E to 91°3' E longitudes (Figure 1). During 1960 this island was a small piece of sandy barren land and in 1970 devastating cyclone swept away almost all. This island is divided into two parts by a canal, named Kamalarpur (Northern part) and Char Osman (Southern Part) that is mostly populated. This mudflat land is still unstable because of erosion, deposition, storm surge, monsoon inundation, cyclone, etc. for safe living rather than supporting people's livelihood as located in the west of Char Damar, east of Manpura, south of the Hatia Mainland, and north of Bay of Bengal. Instead of these risks, the population is increasing from 4372 to 7835 and then 12796 in 1991, 2001 to 2011, along with the total number of households are 2464 (PDO-ICZM, 2002; BBS 2011).

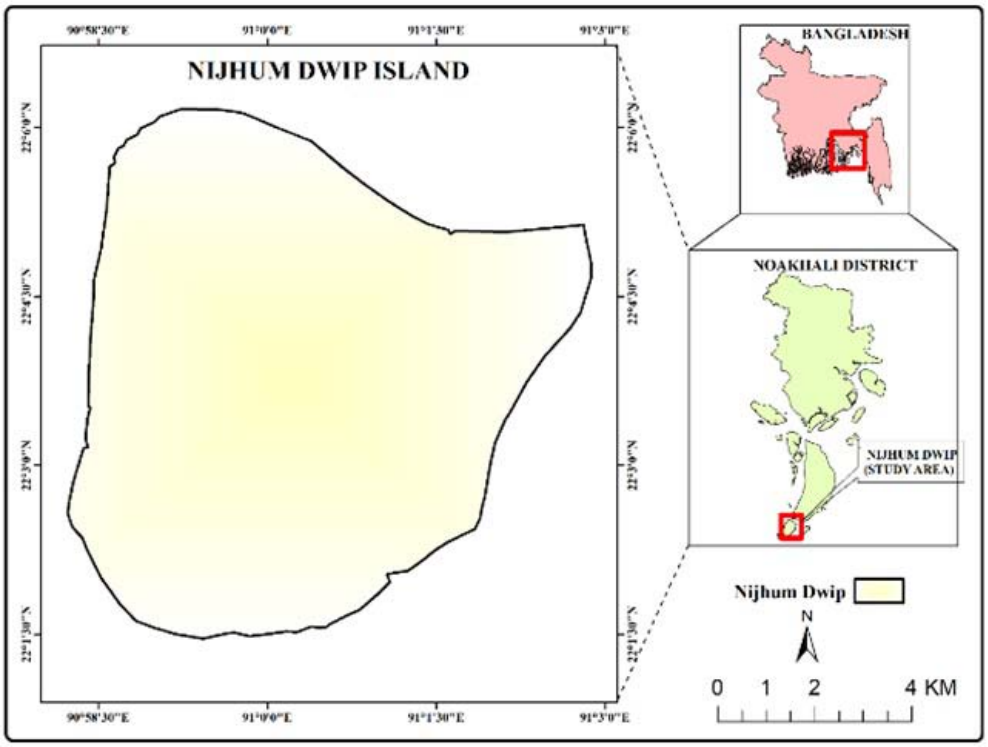

Figure 1: Location of Nijhum Dwip (Silent Island)

III. Materials and Methods

This study uses multi-temporal Landsat satellite images and data to analyze the spatial dynamics of Nijhum Dwip from 1980 to 2018 (Table 1). Five different Landsat images required to compare the land cover changes with spatial variation at the study area for 1980, 1990, 1999, 2010, and 2018. The satellite images of Landsat are Multispectral Scanner System (MSS) for 1980, Thematic Mapper (TM) for 1990, 1999, 2010, and Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) for 2018 respectively. Images acquired from the United States Geological Survey (USGS) site (http://earthexplorer.usgs.gov/) based on data availability and cloud cover, only dry season and cloud-free Landsat scenes considered. Geometric correction conducted to rectify the image through UTM (Universal Transverse Mercator) projection system.

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Table 1: Properties of Used Satellite Images

Satellite	Sensor	Band Number	Path/ Row	Date of Acquisition	Spatial Resolution
Landsat	MSS	4, 5, 6, 7	147/ 45	November 16, 1980	60 m
Landsat	TM	1, 2, 3, 4, 5, 6, 7	136/ 45	October 31, 1990	30 m
Landsat	TM	1, 2, 3, 4, 5, 6, 7	137/ 45	January 16, 1999	30 m
Landsat	TM	1, 2, 3, 4, 5, 6, 7	136/ 45	November 23, 2010	30 m
Landsat	OLI & TIRS	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	136/ 45	December 31, 2018	30 m

Source: USGS Earth Explore (Accessed in 2019)

Analysis of coastline changes generally carried out using survey maps (Kadib 1969), past coastline mapping, and comparison of beach profiles over a long period (Inman and Jenkins 1985). Shoreline alteration monitoring needs a long-term observation based on the temporal variation modeling using remote sensing (RS) and geographic information system (GIS) (Bouchahma and Yan 2012). Identification, mapping, and analyses have gained importance in recent years as high-resolution satellite data have become more accessible (Adegoke et al. 2010). Firstly, collected images clipped by using the area of interest (AOI). After that, manual digitization and classification have used to delineate the coastline and identify the land cover from each image rather than automated technique at the same scale under similar zooming level by using ArcGIS 10.5 software and its extensions. Land cover change detection assessed by the processing of multi-temporal images (1980–2018), differencing, overlaying the post-classification images, visual interpretation, and onscreen digitizing (Ahmadi et. al 2014). Six categories of land use and land cover identified naming water bodies, char land, open space, agricultural land, settlement, and vegetation through supervised classification. On the other side, two temporally succeeding coastline boundaries for the island compared to calculate shoreline shifting, increase or decrease using GIS overlay techniques. Then topological error has corrected through the conversion tool. In addition, annual shifting for each epoch calculated from the total movement and the number of years in that epoch. Meanwhile, the entire summary of extracted data shown and interpreted through tables and represented by maps and Diagrams.

IV. Result and Discussion

a) *Changes on Land Surface:* Land cover and land use (LCLU) analysis are fundamental to assess the changes of past and current land association due to natural processes and local land utilizations by the people. For this reason, the land use pattern of this island became examined from 1980 to 2018 (Figure 2), and evident from the interpretation of satellite images that Nijhum dwip undergoes a continuous change. In 1980, vegetation cover was 8.02 km2, which was 27.71% of the total land cover, whereas, during 1990, the vegetated area increased by 18.70 km2 that was 55.61% of the entire land use and land cover. Later, in 1999, 2010, and 2018 green area decreased gradually from 20.97 km2 to 18.47 km2 and 15.28 km2 which was 52.29%, 36.28%, and 31.98% respectively. Results indicate that in 1980 vegetated area was less than 1990 because that time land was newly formed, barren, and took time to grow vegetation. In 1990, vegetation grew on the mature developed fertile landform, and after that, vegetation cover decreased because of the more accessibility of surrounding peoples. In the study area, forest converted to other lands by human intervention such as clearing and converting of forestland to cropland and settlements, when forest converted to water by natural processes such as coastal erosion. Besides, other lands to forest and water to forest altered when newly accreted land (formed in the sea) later planted with the mangroves (Rahman *et. al.* 2018). On the contrary, a reverse situation such as increasing with slight drop observe

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in the case for agricultural land because more people started to involve with cropping as economic activities. In 1980, there were no suitable lands which utilized for agricultural practice but subsequently, 4.47 km2 (13.29%), 4.84 km2 (12.07%), 6.44 km2 (12.76%), 9.16 km2 (19.17%) land used for cropping in 1990, 1999, 2010 and 2018 respectively (Figure 2 and 3), where agricultural land was increasing continuously after 1990.

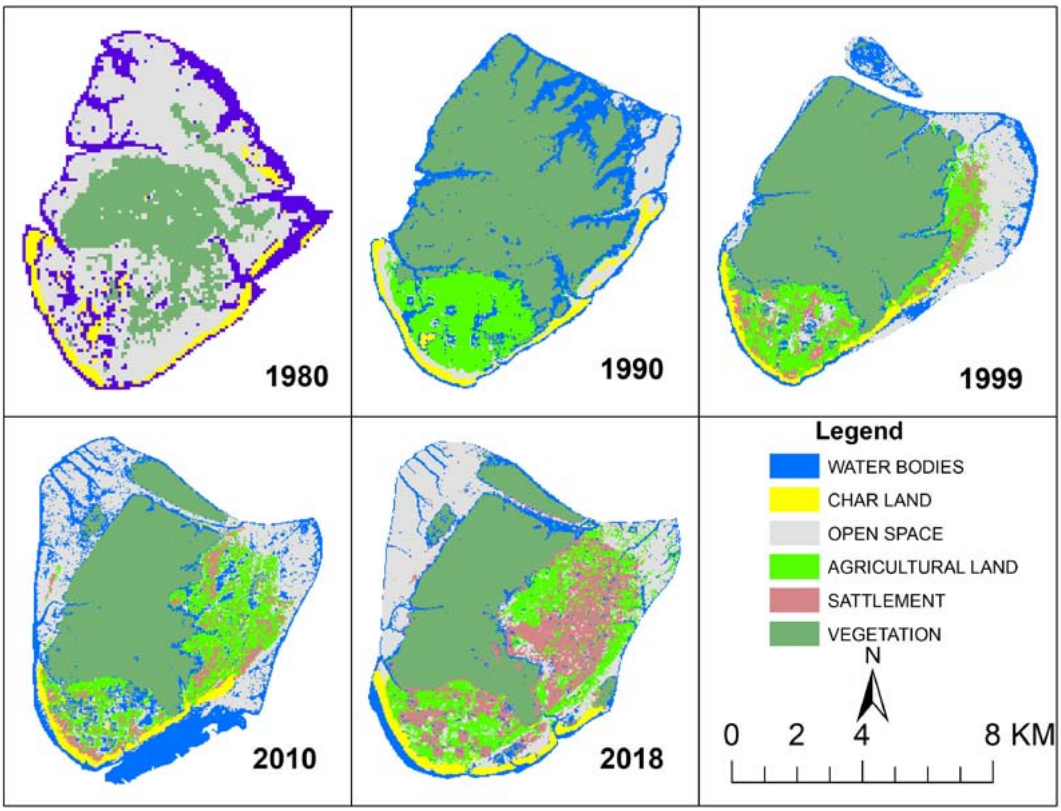

Figure 2: Land use and land cover classification

However, inland water bodies in the study area are a fluctuating phenomenon because of their location in the estuary which is always active, unpredictable, and due to erosion-accretion amount variation. Maximum inland water bodies were 9.76 km2 (19.36%) in 2010 and 4.68 km2 (9.79%) was minimum in 2018. Along with, 5.45 km2 (18.83%), 6.42 km2 (19.09%), 4.40 km2 (10.97%) area were as water body in 1980, 1990 and 1999 respectively. Likewise, char lands were another changeable feature because of varied fluvial and marine geomorphological agents and processes. Accordingly, 1.68 km2 (5.80%), 1.15 km2 (3.42%), 1.24 km2 (3.09%), 1.57 km2 (3.11%) and 1.61 km2 (3.37%) was as char lands along the riverside in 1980, 1990, 1999, 2010 and 2018. On the other hand, 13.78 km2 (47.62%), 2.87 km2 (3.06%), 6.72 km2 (16.76%), 11.61 km2 (23.03%), 11.31 km2 (23.67%) identified as open space on the land surface in 1980, 1990, 1999, 2010 and 2018 consequently. However, in the analysis open space is showing a frequent change than the other land-use types. Furthermore, with time this landmass turned into a lucrative place for seasonal migrants and then permanent settlement. Developed char lands or islands like Burir char, Sukh char, Sonadia, etc. might be another choice but people are moving to the Nijhum Dwip rather than shifting to the mainland despite facing numerous disasters like cyclones, riverbank erosion, flood, storm surge, sea-level rise, salinity intrusion, etc. considering livelihood opportunities, low price of land and have no other options (Kumar and Luna, 2018). Although, primarily the island was just an afresh settled sediment deposited landmass in the Meghna estuary without human population. Thus, there was no settlement in the years 1980 and 1990 since the land was less suitable for settlement and agriculture than older land. Afterward, 1.92 km2, 2.56 km2, and 5.72 km2 area occupied and which were 4.79%, 5.09%, and 11.97% out of the total land surface in 1999, 2010, and 2018 for settlement on the mainland (Figure 2 and 3). The abovementioned findings of the study area indicating that more population settlement, expansion of infrastructure each year on the island, and more land utilization for agricultural practice, farming, etc. are the main reasons for open space and vegetation cover reduction.

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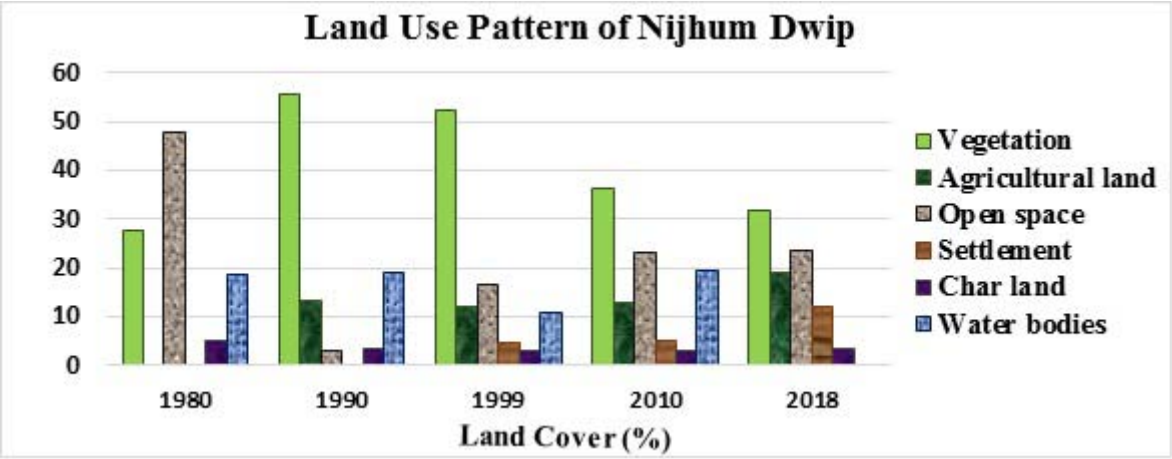

Figure 3: Percentage of Land use and Land cover Area

b) *Coastline Shifting:* The study area is an energetic zone on the shores of the Bay of Bengal as an oversized volume of sediment from the Ganges-Brahmaputra-Meghna (GBM) river systems deposited here (Hossain et al., 2016) and for this reason, coastline continuously changes under different physical and social condition. Nijhum Dwip is principally an unstable landform traversed by inter-tidal narrow creeks. The whole area of Nijhum Dwip was 28.94 km2 in 1980 and after a decade in 1990, the area increased by 33.63 km2. Later, the area enlarged by 40.10 km2 and 50.41 km2 in 1999 and 2010 by reason of sediment accretion. From 1980 to 2010, Nijhum Dwip total surface area shows enlargement by accretion of sediments coming with river water and regular tides, waves from ocean, river. within the period of 1980 to 1990, the rate of enlargement is 0.469 km2 annually. Similarly, 0.719 km2 and 0.937 km2 land increased per annum over the period of 1990-1999 and 1999-2010. Then again, in 2018 total area of the island decreased than the previous by 47.78 km2, when erosion was more than deposition. Although 0.328 km2 area reduced by erosion annually for the period of 2010 to 2018 (Figure 4).

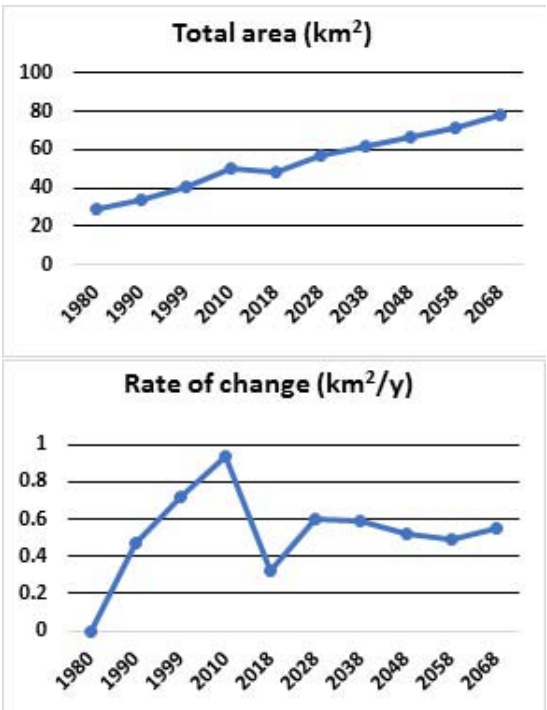

Figure 4: Total Area and Rate of Change with projection (1980-2068)

Comparison of Landsat images in 1980,1990, 1999, 2010, and 2018 shows a net land gain of 18.84 km2 in the Meghna estuary within that period (1980-2018), representing an average annual growth rate of 0.496 km2, and again lost about 2.63 km2. This analysis of land variation in the Meghna estuary demonstrates

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that land gain might exceed land loss resulting from the slow rate of erosion (Figures 4 and 5). After that, a projection from 2028 to 2068 produced based on existing total area and rate of change per year data to evaluate the pattern of transformation and increase of land surface forecasted here because the overall accretion rate is over than the rate of erosion in Nijhum Dwip (Figure 4). However, the direction of the accretion and erosion on the island varies from year to year and it is a lively process. From 1980 to 1990, the coastline changed by raising and decreasing towards the northeast through deposition and erosion. Later, from 1990 to 1999, the shoreline extended westwards whereas from 1999 to 2010 shoreline shifted to the northwest by sediment deposits. Then again within the period of 2010 to 2018, the overall reduction of the landmass observed on the southwest and southeast edge. Hence, it is visible that the upper north part of Nijhum Dwip is shifting by enlargement of landmass towards the north, north-east and north-west direction than the southern part which is mostly sediment wearing away prone side of the island (Figure 5).

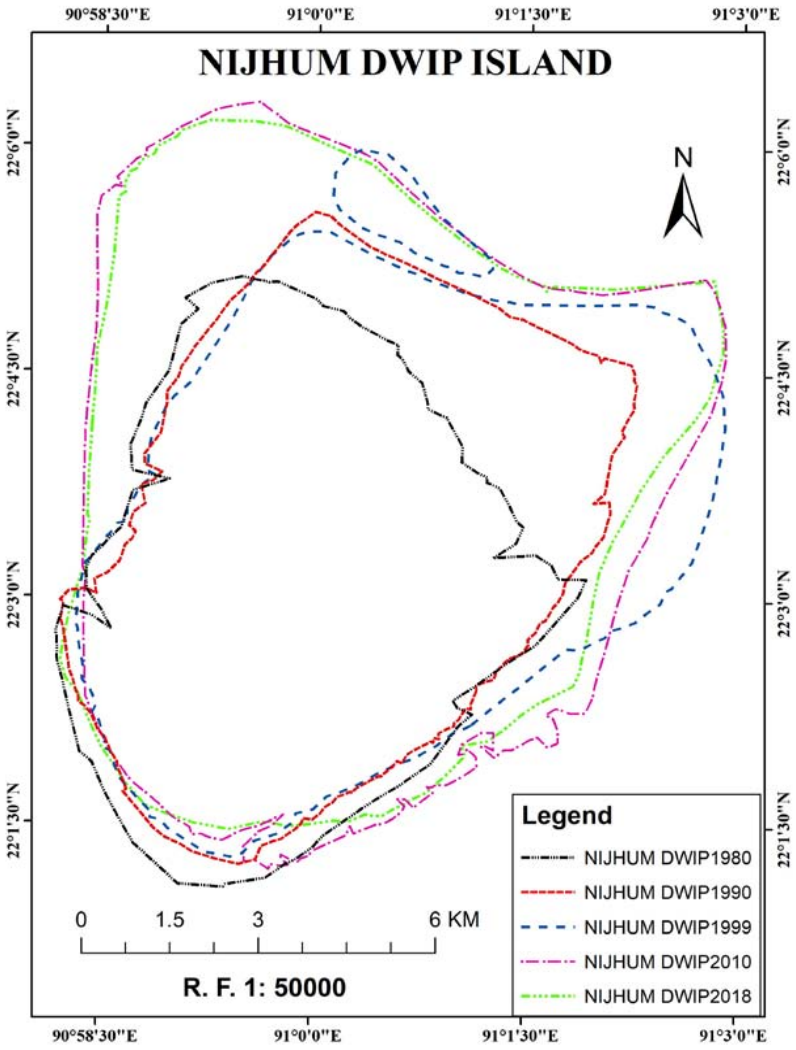

Figure 5: Coastline Shifting (1980-2068) of Nijhum Dwip

V. Conclusion

Conversions of land like, from non-buildup barren open space or char land to settlement and farming; naturally vegetated area cleared for agricultural practice, etc. have resulted within the study area. The entire area of an intertidal zone has increased over time, though the findings and analysis show increases in agriculture, becoming more intermixed with settlements. It is apparent that land utilization is usually direct by the population growth, development activities putting pressure, and filling of low-lying areas, and clearing of vegetation may result from erosion of topsoil and a large range of negative environmental impacts. However, expansion and reduction of landform largely rely on land gaining and losing with the influence of coastal geomorphological agents and processes. Sustainable

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land-use planning and releasing overpressure is indispensable for this type of coastal island like Nijhum Dwip in Bangladesh, and deliberation, therefore, must obtain addressing proper development.

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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 Eletronic 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 before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for writing a good quality Social Science Research Paper

Techniques for writing a good quality homan social science 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 homan social science 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.



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.
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.

19. 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.

20. 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.

21. 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.

22. 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.



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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.



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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.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

INDEX

A

Anxious · 12
Ascertained · 4, 8, 9
Assured · 2

B

Booming · 33
Bustling · 30

C

Catastrophic · 26
Cognitive · 5
Conducive · 17
Consolidated · 43
Constituent · 1, 3, 4, 6
Cornerstone · 1
Cultivable · 59

D

Decade · 63
Derelict · 52
Devolution · 54, 55

E

Elucidative · 5
Essence · 1, 3, 5, 6,
Exorbitant · 33

F

Factual · 6, 9, 10, 11

I

Illuminate · 2
Imperiled. · 41
Implication · 3, 45, 52
Influenced · 21
Inherent · 5, 8, 46
Insanitation · 49, 51

M

Merely · 8

P

Parasitic · 53
Passive · 7, 8
Perceived · 32, 51, 54
Pervasive · 52
Precise · 1, 6, 8, 10
Predication · 8
Prerequisite · 46, 47, 51
Prominent · 30, 58

R

Relevant · 1, 8, 11, 30,
Revealed · 10, 30, 38,
Rigorously · 50

S

Sediment · 59, 62, 63, 64

T

Tangible · 2
Terminological · 1

V

Vulnerable · 19, 27, 33, 41,



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