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Discovering Thoughts, Inventing Future

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Prospect Maturition using Seismic and Offset Well Data: The Osemu-Niger Delta Case Study

By Isaac Aigbedion, Innocent Okogbue & Ataman J.O
Ambrose Alli University

Abstract- The AVO Fluid Inversion (AFI) technique to predict the probability of oil and gas occurrence in OML-X and quantify the uncertainties associated with the fluid prediction using Seismic sections and some well picks from nearby Ose Field. The seismic data interpretation of the Osemu prospect was based mainly on the picking of seven horizon layers (including the sea bottom). Four deeper horizons (C, D, E & F) were analysed for prospect generation and volumetric estimation. Results showed a major NW-SE trending growth fault controlled sedimentation and structural deformation in the study area. The seismic interpretation has identified two main prospects in the Osemu area. These are named Osemu-Main and Osemu-Upper. From the study two wells are recommended to be drilled on the structure. The two are expected to pierce all the four reservoirs considered in the volumetrics mid way between the crest and the flank.

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Prospect Maturition using Seismic and Offset Well Data: The Osemu-Niger Delta Case Study

Isaac Aigbedion [α], Innocent Okogbue [σ] & Ataman J.O [ρ]

Abstract- The AVO Fluid Inversion (AFI) technique to predict the probability of oil and gas occurrence in OML-X and quantify the uncertainties associated with the fluid prediction using Seismic sections and some well picks from nearby Ose Field. The seismic data interpretation of the Osemu prospect was based mainly on the picking of seven horizon layers (including the sea bottom). Four deeper horizons (C, D, E & F) were analysed for prospect generation and volumetric estimation. Results showed a major NW-SE trending growth fault controlled sedimentation and structural deformation in the study area. The seismic interpretation has identified two main prospects in the Osemu area. These are named Osemu-Main and Osemu-Upper. From the study two wells are recommended to be drilled on the structure. The two are expected to pierce all the four reservoirs considered in the volumetrics mid way between the crest and the flank.

I. Introduction

The Osemu anomaly is one of the three major structures identified in OML-X (approx. 725 Sq.km) in water depth ranging between 60 and 160 meters in the Niger Delta- Nigeria. The other prospects are the Osno and Ose in the north and east respectively. The latter have been drilled and are currently producing and providing the referenced logs and well information used for the Osemu prospect study.

A recent acquisition of approximately 360 km^2 3D seismic data over the Osemu prospect and the subsequent delivery of the processed seismic data prompted the interpretation of the data.

The seismic data interpretation of the Osemu prospect was based mainly on the picking of seven horizon layers (including the sea bottom). Four deeper horizons (C, D, E & F) were analysed for prospect generation and volumetric estimation. All the four horizons are considered to lie within the prolific Agbada formation of the Niger Delta basin Integration of 3D seismic model with petrophysical data has been a beneficial endeavor in use in the petroleum industry for some years now (Adeoye and Enikauselu, 2009; Aigbedion and Iyayi, 2007; Emujakporu and Faluyi, 2015) in petroleum provinces where exploration and production strategies merge, detailed understanding of petrophysical properties is highly desired. Landmark's software and computer hardware located in-house were used in the interpretation of the seismic sections. The Geophysical data consisted of approximately 360 Km^2 of conventional 3D seismic and a depth model for the entire volume. The closest well with a check shot (Ose-5) is about 17km away from the prospect. The overall aim of this study is to use the AVO Fluid Inversion (AFI) technique to predict the probability of oil and gas occurrence in OML-X and quantify the uncertainties associated with the fluid prediction.

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II. Objectives of the Study

The overall aim of this study is to determine whether drillable anomalies exist in the Osemu prospect. The specific objectives of the study are as follows:

i. Identify and interpret the potential hydrocarbon bearing anomalies of interest in the study area
ii. Mature the prospect anomalies into drillable targets
iii. Compute the hydrocarbon in place.

III. Location of Study

The Osemu prospect is located in the southern part of the Niger Delta within OML-X (Oil Mining Lease) approximately 80 kilometers from the coastline (Figure 1). It is within the shallow offshore Niger delta.

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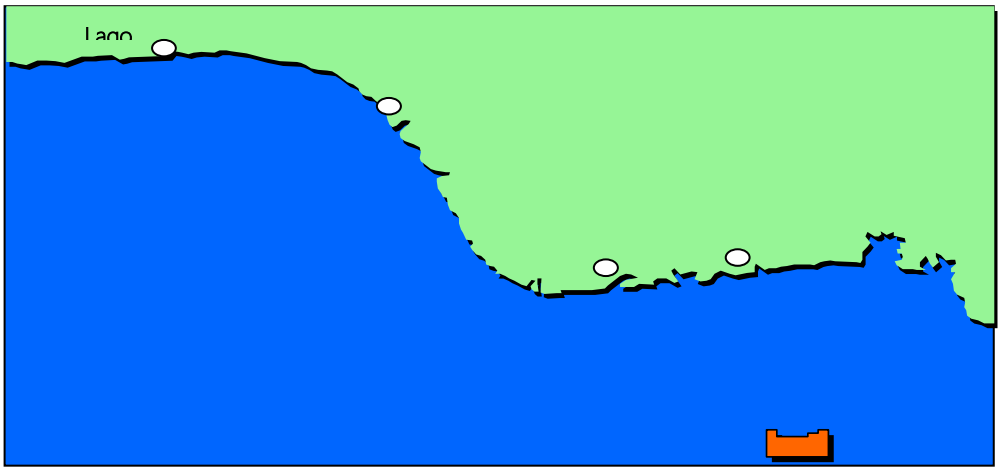

Fig.3.1: Location Map of Osemu Field

IV. Geology of the Study Area

The Niger Delta is situated in the Gulf of Guinea (fig. 1) and extends throughout the Niger Delta Province as defined by Klett et al (1997). From the Eocene to the present, the delta has prograded southwestward, forming depobelts that represent the most active portion of the Delta at each stage of its development (Doust and Omatsola, 1990). These depobelts formone of the largest regressive deltas in the world with an area of some 300,000 km2 (Kulke, 1995), a sediment volume of 500,000 km3 (Hospers, 1965), and sediment thickness of over 10 km in the basin depocenter (Kaplan et al. 1994).

Three geological formations are considered as part of the petroleum system in the Niger Delta. The basal one composed of marine shales, called the Akata Formation. This unit ranges in thickness from 600 m to more than 6000 m (Weber and Daukoru, 1975; Aigbedion and Hafiz,2017). The overlaying formation is named Agbada. This formation consists of interbedded sands and shales and is known as the hydrocarbon bearing zone. The cap unit is the Benin Formation and comprises continental fluvial sands. This unit is a non-hydrocarbon bearing formation.

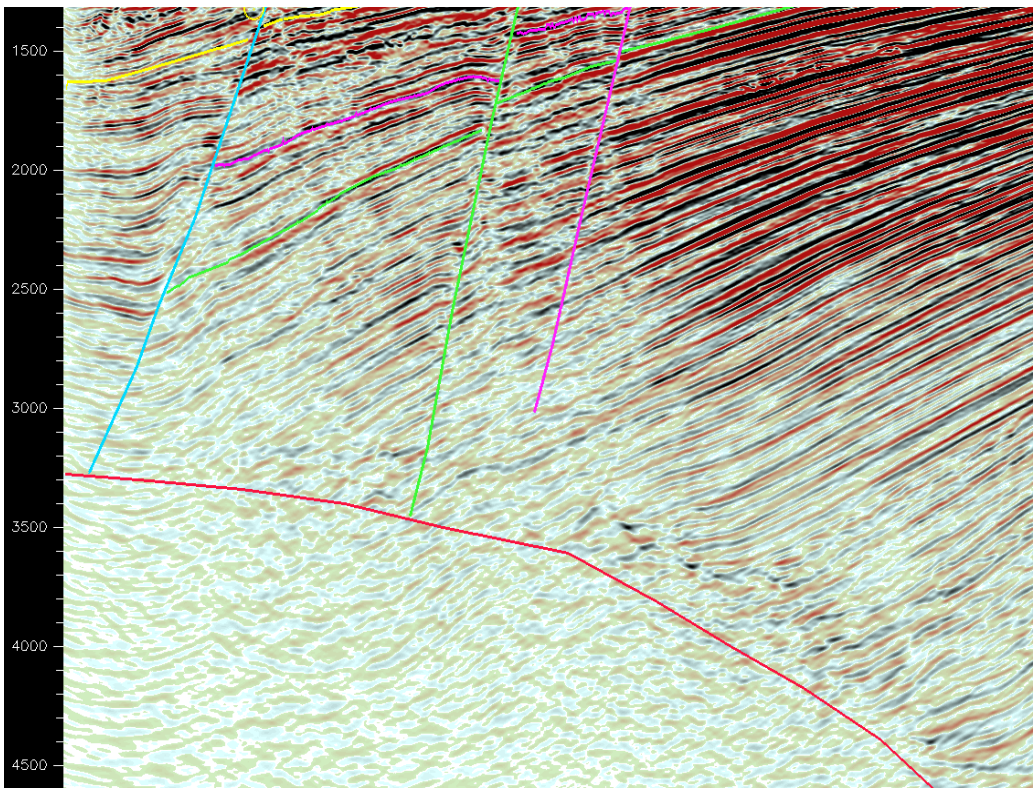

Fig.4.0: Akata Shale mapped from 3300ms

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a) Structures

Two structural patterns can be observed in the Osemu area from the fault orientations, and shape of the mapped levels

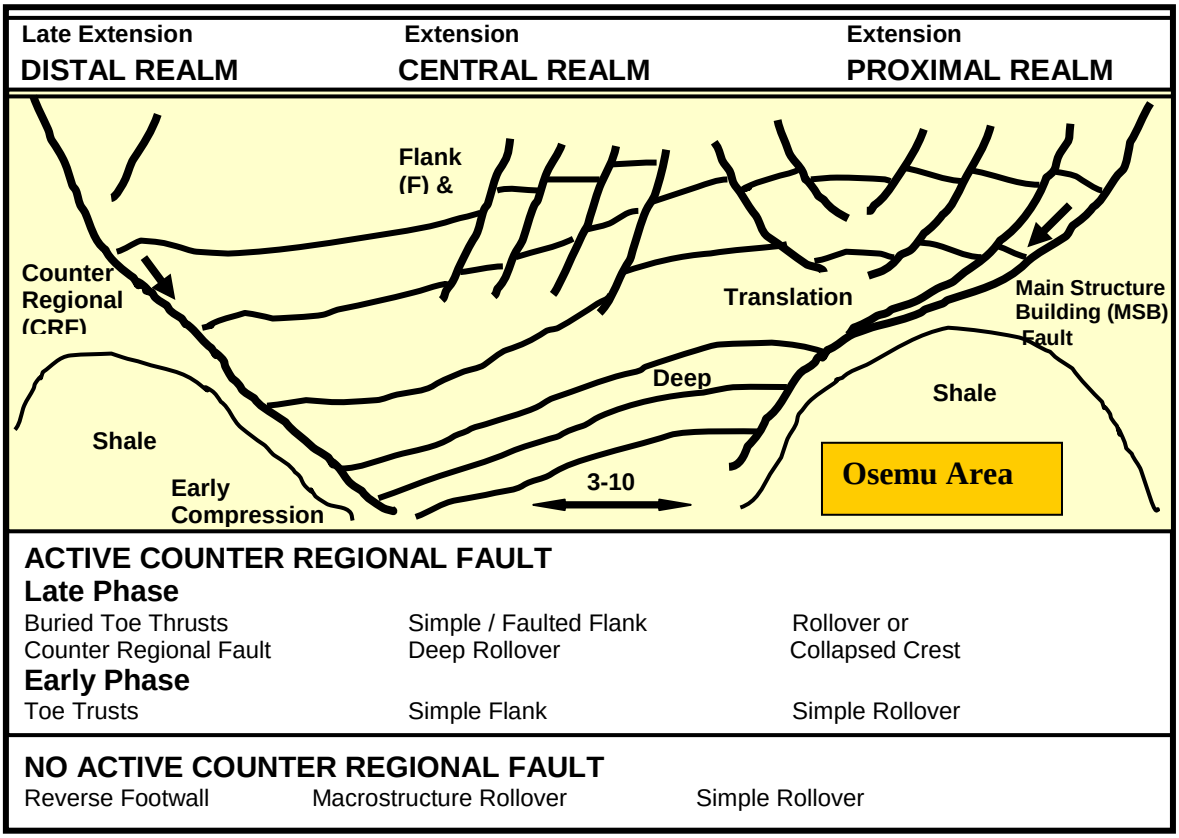

Fig.4.1: The Main Structural Framework of the Osemu Area.

The main structural controls are the arcuate NW-SE trending, synthetic growth faults. The Osemu area faults are subvertical with expressions at the sea-bed. This could be attributed to fault rejuvenation caused by tectonics of the underlying under-compacted massive Akata shales. Deformation takes place by gravitational gliding of rigid block along a decollment horizon above underlying shale as result of sedimentary loading (Figure 5).

Another remarkable feature in the Osemu geology is the pattern of termination of the NW-SE crystal faults which also corresponds to the point of bifurcation of the major fault into a bigger down dip component and a splinter at the up thrown. This arrangement suggests that the crystal collapse also initiated the extension of the major fault SE in a stress release mechanism. Subsequent sediment loading led to the SW rotation of the major fault to form an arcuate limb that supports the high zone of the Osemu closure (figure 15)

Lithostratigraphy: The Tertiary section of the Niger Delta is divided into three formations, representing prograding depositional facies that are distinguished mostly by the lithofacies mix. It is possible to summarise the stratigraphic column of the Niger Basin in three main diachronous lithologic formations; Benin, Agbada, and Akata (Figure 6).

Benin is the youngest formation and is comprised of continental, fluvio-alluvial and upper coastal plain sediments with good porosity, but generally low permeability, this fact limits to oil production from the Benin Formation in the Basin. The sequence passes laterally into the paralitic / deltaic sandstone of the Agbada Formation.

The majority of hydrocarbons produced in the basin come from the alternating sandstone and siltstone that make up the *Agbada* Formation. A shelf to the deltaic/lagoonal environment characterized the sequence deposits. The observed small and large-scale sedimentary cyclicity is probably mainly related to climatic change effects. Growth faults control/influence the sedimentation patterns. The paralic sandstone of Agbada Formation passes offshore into the distal prodelta\deep marine shale of the Akata Formation.

The *Akata* Formation at the base of the delta is of marine origin and is composed of thick shale sequences (potential source rock), turbidite sand (potential reservoirs in deep water), and minor amounts of clay and silt. Beginning in the Palaeocene and through the Recent, the Akata Formation formed during low stands when terrestrial organic matter and clays

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were transported to deep-water areas characterized by low energy conditions and oxygen. Turbidity currents likely deposited deep-sea fan sands within the upper Akata Formation during the development of the Delta. The Akata Formation (Eocene - Early Miocene) is dark grey marine shale throughout the basin and is typically considered to be the source rock for most of the hydrocarbon production in the area.

Deposition of the three formations occurred in each of the five of flapping siliciclastic sedimentation cycles that make up the Niger Delta. These cycles (depobelts) are 30-60 kilometers wide, prograde south-westward 250 kilometers over oceanic crust into the Gulf of Guinea, and are defined by syn-sedimentary faulting that occurred in response to variable rates of subsidence and sediment supply. The interplay of subsidence and supply rates resulted in the deposition of discrete depobelts. When further crustal subsidence of the basin could no longer be accommodated, the focus of sediment deposition shifted seaward, forming a new depobelt. Each depobelt is a separate unit that corresponds to a break in the regional dip of the delta and is bounded landward by growth faults and seaward by large counter-regional faults or the growth fault of the next seaward belt.

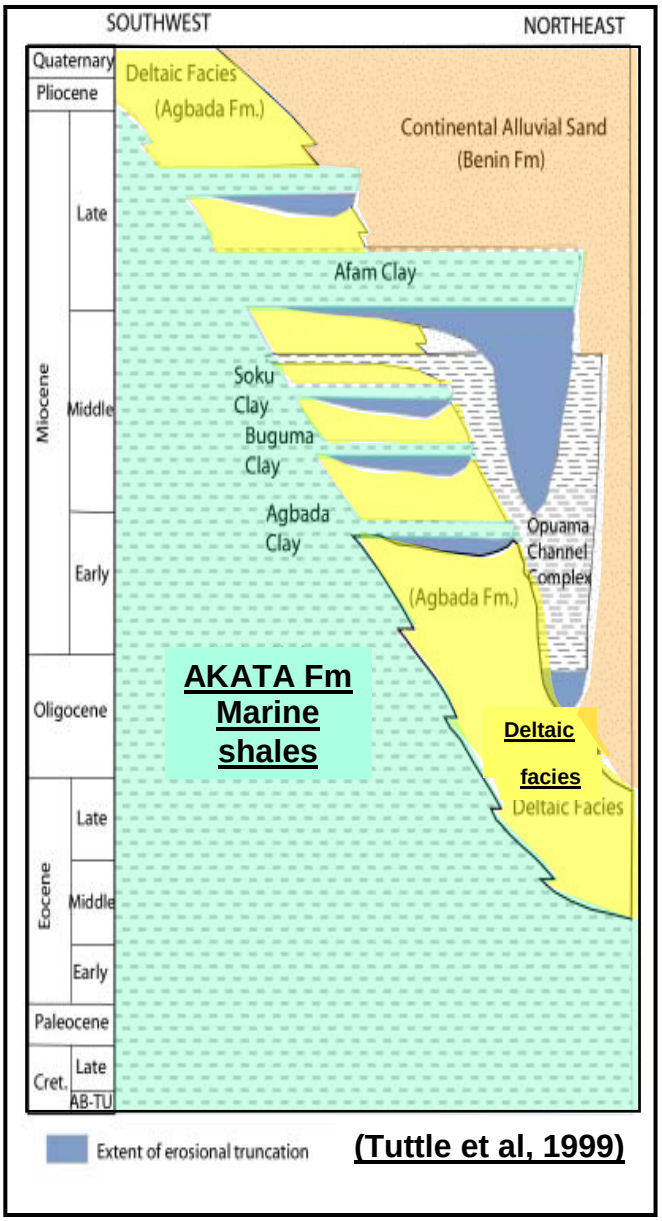

Fig.4.2: The Stratigraphic Profile of the Niger Delta

V. Materials and Methods

a) Materials

The Geophysical data consisted of approximately 360 Km^2 of conventional 3D seismic and a depth model for the entire volume. The closest well with a check shot (Ose-5) is about 17km away from the prospect. Since realistic check shot data was not available, it was necessary to use the RMS velocities provided by the processing company for conversion of the time generated maps to depth. The second order polynomial equation $y=0.0001x^2 + 0.9453x - 97.214$ was used for the conversion.

The geological data and the petro physical information referenced here were some well picks from nearby Ose field.

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The following sets of data were used in the interpretation:

Seismic: Full Stack
Angle stacks (0-15 and 25-40)
Control Well: Ose 5 well data
Velocities: Stacking velocities from seismic

VI. Methodology

The simplified workflow is as outlined below:

- An overview of the entire seismic volume was taken before deciding which reflectors should be mapped. Reference was also made to the depth at which hydrocarbon was found at nearby Ose and Osno fields.
- Horizons and faults were then mapped on crosslines and inlines.
- The mapped horizons were then exported along with their respective fault polygons to the mapping software.
- The time maps were then converted to depth by the RMS-Velocity equation for the seismic volume ($y=0.0001x^2+0.9453x-97.214$).

a) Fault Picking

The major NW-SE (Osemu F1) controlling fault was mapped across the area. The throw of fault decreases gradually towards the SE until it is truncated by a major arcuate, south dipping fault.

b) Horizon Mapping

A total of seven horizons were mapped. They represent the top of seismic sequences identified within a time zone of 1200 ms-2600ms. This is considered as the zone of interest by reference to the prospect levels in the adjacent Ose-Osno fields.

Seven Horizons were mapped including the sea bed. Four Horizons are considered prolific (C, D, E & F) due to their situation within the Agbada depth ranges. All Horizons were interpreted in time, then gridded and converted to depth. Figures (8, 10, 12, 14, 16, 18, & 20) shows Sea Bed, Horizons A, B, C, D, E & F in time. Figure (9, 11, 13, 15, 17, 19 & 21) shows the respective horizons map in depth.

The velocity model for the depth conversion was built into the respective time horizons to produce a depth equivalent using the RMS velocities (figure 2).

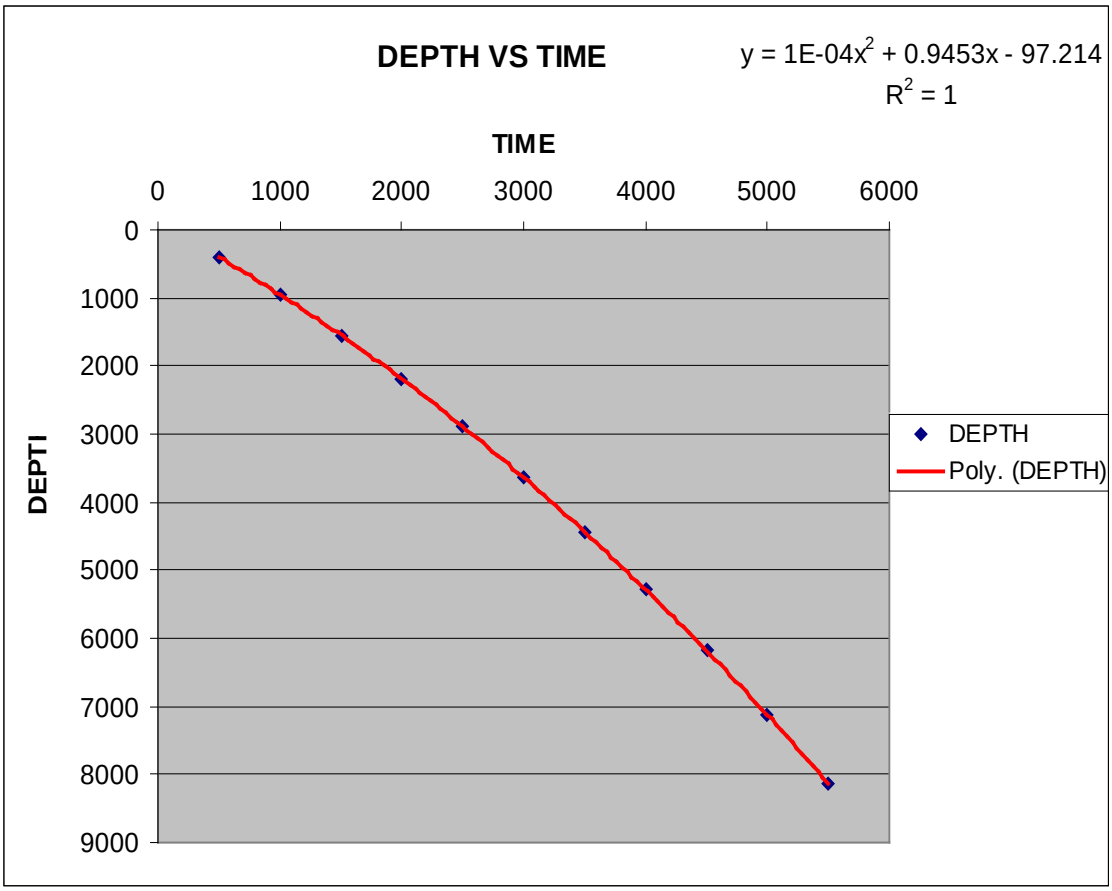

Fig 5.0: Graph Shows plotted Time-Depth value for RMS velocities

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c) Amplitude Extraction

Amplitude extraction was done on all the mapped time horizons. Maximum Negative Amplitude maps were produced (figure 3a & 3b). The amplitudes did not show any hydrocarbon related anomalies as observed by their non-conformance to structure.

The angle stacks were also examined for possible AVO effects. There was slight amplitude boost with offset.

VII. Discussion of Results

a) Prospects Identification

- The seismic interpretation has identified two main prospects in the Osemu area. These are named Osemu-Main and Osemu-Upper. (Figure 6.1)
- The Osemu-Main prospect is a tongue-like NW-SE trending formed at the downthrown block of the structure building fault. The structure is fault assisted at shallower levels (A-C) and faults dependent at depth. The areal extent of Osemu prospect is enhanced by the termination of the controlling fault against a south-dipping synthetic fault. The sealing capacity of the termination point impacts significantly on the prospectivity of the Osemu-Main.
- The Osemu-upper prospect is formed as a wedge between the bigger branch of the major fault and the northern splinter fault.

b) Estimation of Hydrocarbon-In-Place

The deterministic estimation of oil in place for the Osemu Field was completed using 3-D geological modeling in the Zmapp software package. This procedure involves bringing structural surfaces in from the geophysical package (Landmark), building a detailed fault model, and then modeling both facies distributions and the distribution of petrophysical parameters within the facies model (Deutsch and Hallstrom ,2000).

Probable areas measured from depth maps for the prospective horizons ranges from 726 acres in Horizon E.0 to 3975 acres for Horizon C.0 (Table 1). Three cases were considered in determining the possible closure area. These are minimum, most likely and maximum contour closures representing varying sizes.

Table 1: Contour Values, Depth Values [,And Areas] For Each Top

TOPS	CONTOUR LINE	CASE	TVDSS (m)	AREA (acres)
Horizon C	1800	Minimum	1,780	1322
	1900	Most Likely		2622
	2000	Maximum		3975
Horizon D	2200	Minimum	2,125	1655
	2250	Most Likely		2366
	2300	Maximum		3480
Horizon E	2500	Minimum	2,525	726
	2550	Most Likely		1072
	2650	Maximum		2583
Horizon F	3030	Minimum	2,930	2022
	3040	Most Likely		2082
	3050	Maximum		2135

The four (4) Horizons considered for volume estimation (C, D, E & F) have a total of 410.58mmbls as P50, 309.32mmbls P10 and 445.21mmb is as P90.

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Detail of the volumetrics is shown in the table below.

SAND	VALUE	CONTOUR CLOSURE	AREA ACRE	AVERAGE NET THICHNESS	NET RK VOL. ACRE-FT	NET RK VOL. MMBLS	AVG-Ø (%)	AVG-Sw (%)	OHIP MMBLS	FVF	STOIP MMBLS	REC FACTOR	U-RESV OIL-MMB	COM-PROD MMBLS	RR MMBLS
C.0	MINIMUM	-1780	1,322	45.00	59,490.00	461.52	0.26	0.25	90.00	1.260	71.43	0.30	21.43	0	21.43
	MOST LIK	-1900	2,622	45.00	117,990.00	915.37	0.28	0.35	166.60	1.260	132.22	0.30	39.67	0	39.67
	MAXIMUM	-2000	3,975	45.00	178,875.00	1387.71	0.24	0.45	183.18	1.260	145.38	0.30	43.61	0	43.61
D.0	MINIMUM	-2200	1,655	45.00	74,475.00	577.78	0.26	0.25	112.67	1.260	89.42	0.30	26.83	0	26.83
	MOST LIK	-2250	2,366	45.00	106,470.00	825.99	0.28	0.35	150.33	1.260	119.31	0.30	35.79	0	35.79
	MAXIMUM	-2300	3,480	45.00	156,600.00	1214.90	0.24	0.45	160.37	1.260	127.28	0.30	38.18	0	38.18
E.0	MINIMUM	-2500	726	45.00	32,670.00	253.45	0.26	0.25	49.42	1.260	39.23	0.30	11.77	0	11.77
	MOST LIK	-2550	1,072	45.00	48,240.00	374.25	0.28	0.35	68.11	1.260	54.06	0.30	16.22	0	16.22
	MAXIMUM	-2650	2,583	45.00	116,235.00	901.75	0.24	0.45	119.03	1.260	94.47	0.30	28.34	0	28.34
F.0	MINIMUM	-3030	2,022	45.00	90,990.00	705.90	0.26	0.25	137.65	1.260	109.25	0.30	32.77	0	32.77
	MOST LIK	-3040	2,082	45.00	93,690.00	726.85	0.28	0.35	132.29	1.260	104.99	0.30	31.50	0	31.50
	MAXIMUM	-3050	2,135	45.00	96,075.00	745.35	0.24	0.45	98.39	1.260	78.08	0.30	23.43	0	23.43
TOTAL		MINIMUM (P10)									309.32		92.79		92.79
		MOST LIKELY (P50)									410.58		123.17		123.17
		MAXIMUM (P90)									445.21		133.56		133.56

Table Showing detailed volume calculations for the four Horizons considered in the volumetrics.

c) Risk and Uncertainties

The following Table summarizes the risk of finding flowable Hydrocarbons for both Osemu - Main and Osemu-Upper prospects.

S/N	Parameter	Indication	Probability of Success	
			Osemu-Main	Osemu-Upper
1	Trap	Fault assisted. Major fault up to surface	0.5	0.5
2	Seal	Top and lateral seal confirmed in Osno/Ose	0.5	0.5
3	Timing	Migration after syn-depositional, faulting	0.7	0.7
4	Closure	200-1000m structural relief.	1	0.5
5	Reservoir	High quality sands (adjoining blocks of OPL 90, Osno&Ose prolific.	0.8	0.6
6	Porosity	Nearby field in the range of 19-35%	1	0.8
7	Permeability	As in Osno-Ose production profile	1	1
8	Source	Thick Akata shales. Same for nearby discoveries	1	1
9	Maturation	Thick overburden. Targets Deeper than nearby Discoveries	1	1
10	Migration	Migration path through fault systems	1	1
11	Preservation	Unlikelihood of biodegradation due to fault Extension to the surface.	0.6	0.6
12	Hc Quality	Oil and solution gas as in Osno/Ose.	0.9	0.9
13	Recovery	Natural drive as in Osno/Ose	1	1
		Overall Probability of Success	**0.85**	**0.78**

VIII. Conclusion and Recommendations

1. A major NW-SE trending growth fault controlled sedimentation and structural deformation in the area.
2. Two wells are proposed to be drilled on the structure. The two are expected to pierce all the four sands considered in the volumetrics mid way between the crest and the flank.
3. Fault analysis is to be carried on the main structure building fault to ascertain its sealing ability.
4. The Osemu upper prospect should be explored if the Osemu main is successful.
5. A time-depth model to be created from check shot data on one of the exploratory wells and compare with the RMS velocity and update it accordingly.
6. All essential log suite must be run during the exploratory drilling stage to acquire accurate and precise petrophysical details.

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Appendixes

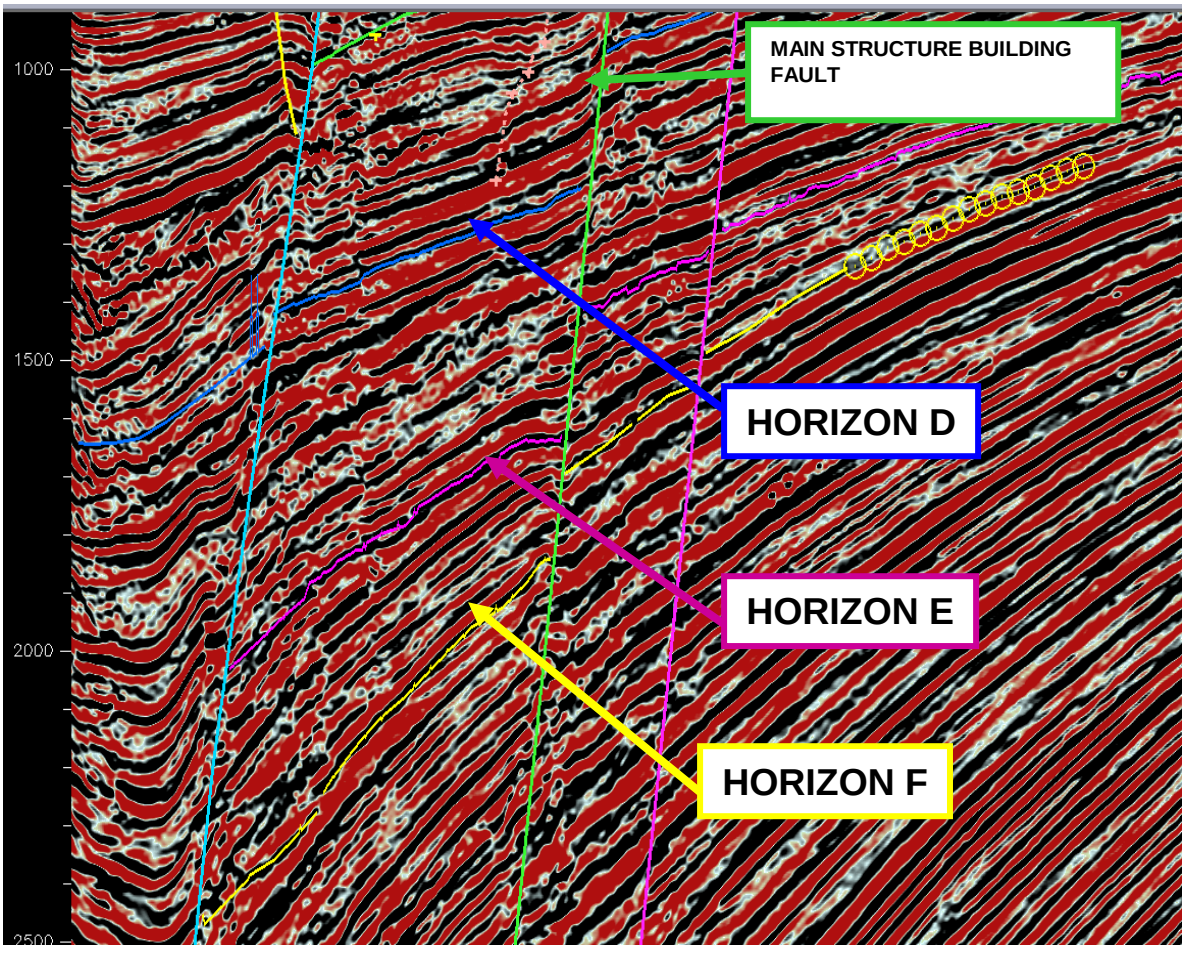

Fig. 7: Seismic in-line showing Main Structure building fault and mapped horizons

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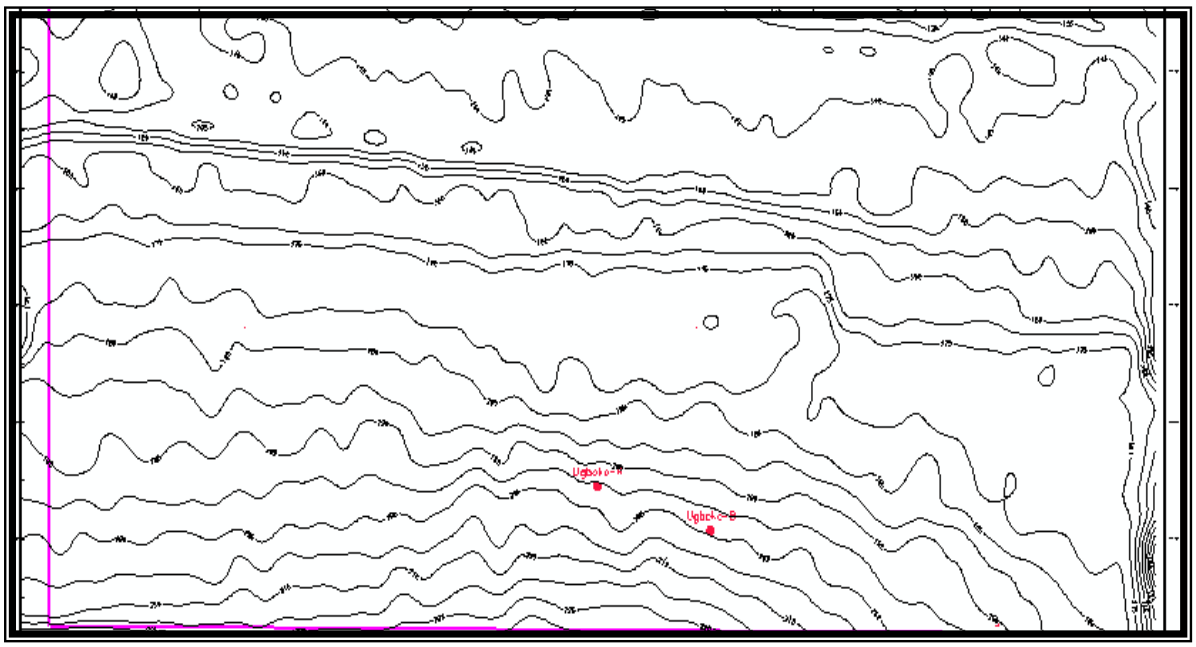

Fig.8: TWT of The Sea Bed

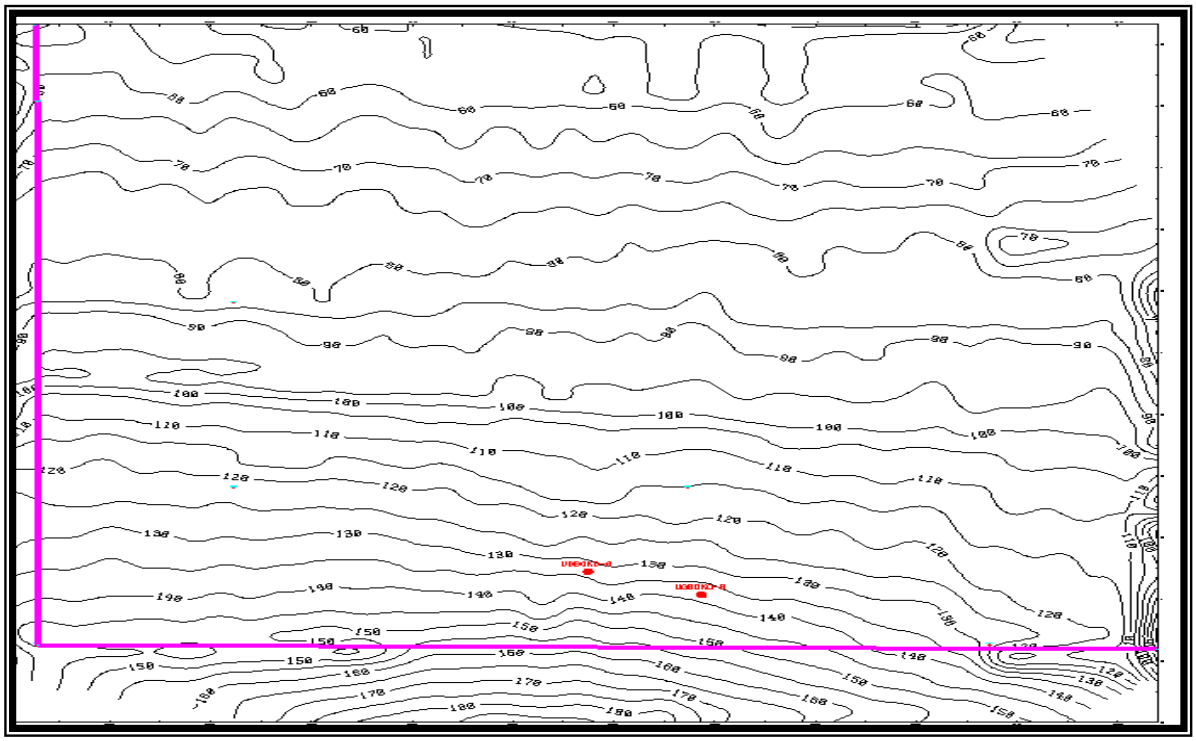

Fig.9: Depth Map of the Sea Bed

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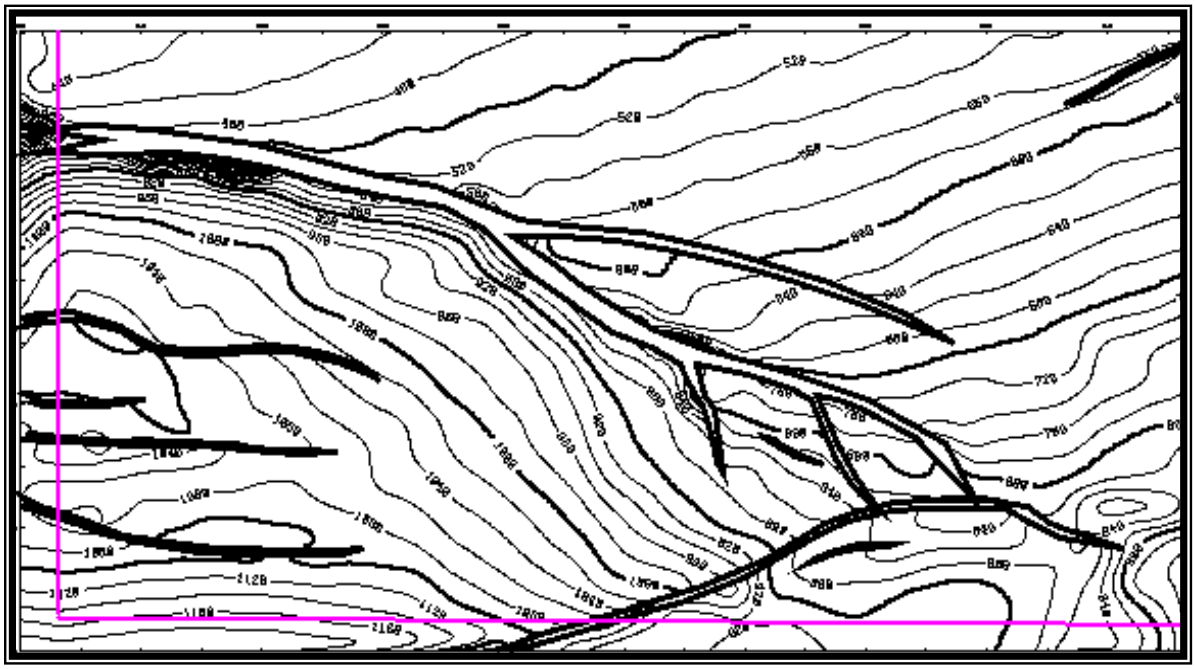

Fig.10: TWT Structure Map Of Horizon A

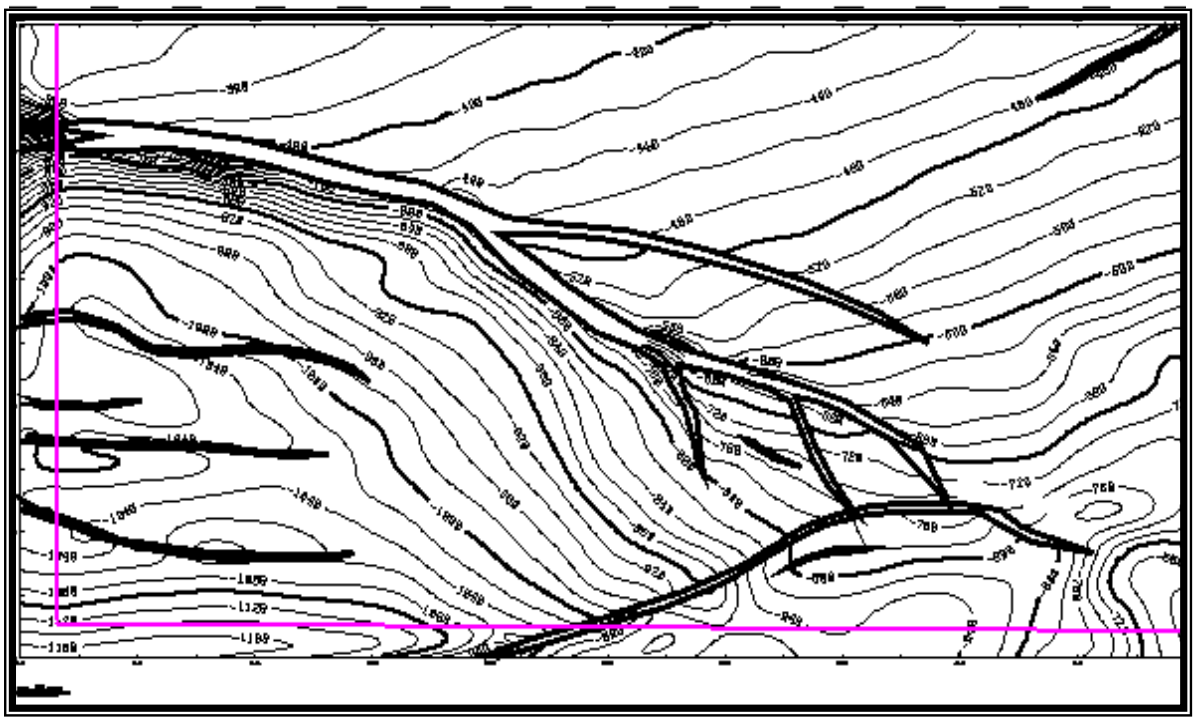

Fig.11: Structural Depth Map of Top A Horizon

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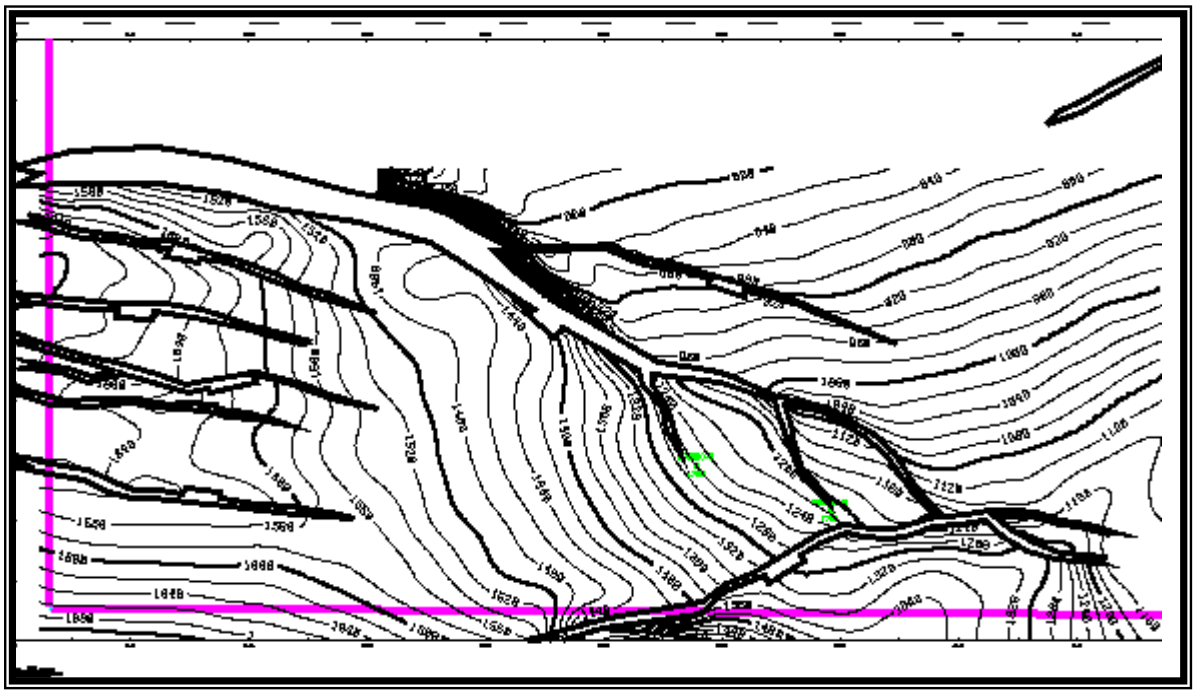

Fig.12: TWT Structure Map of Horizon B

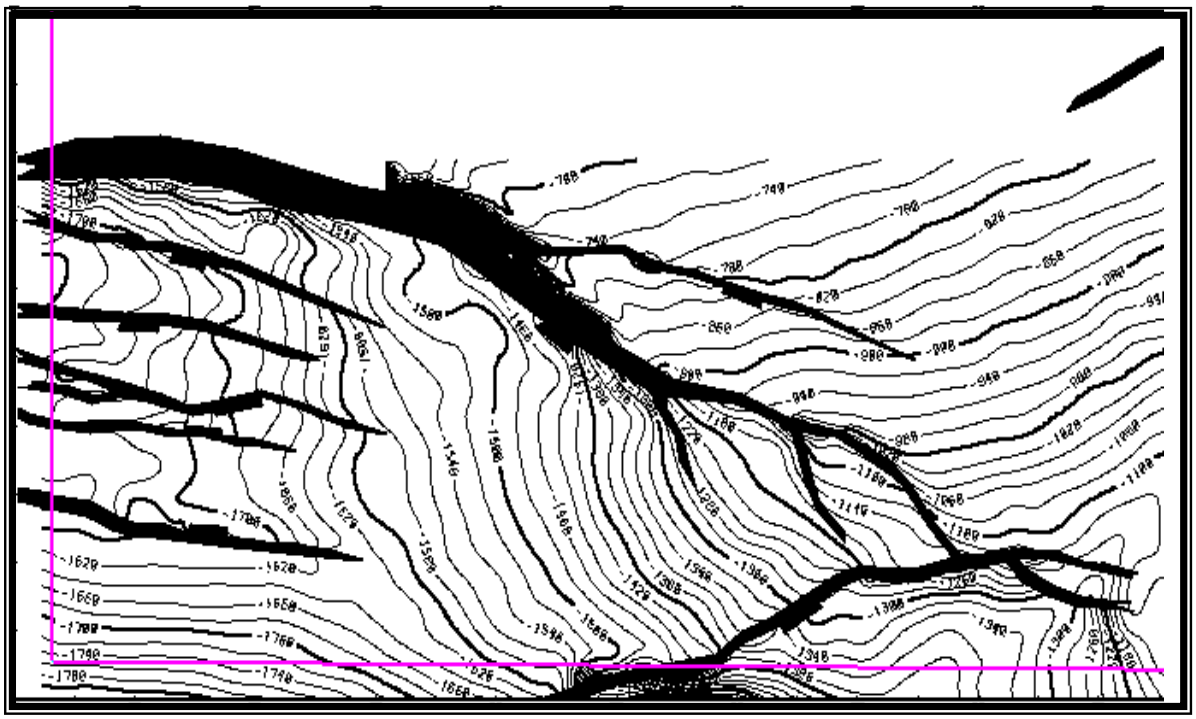

Fig.13: Structural Depth Map of Top B Horizon

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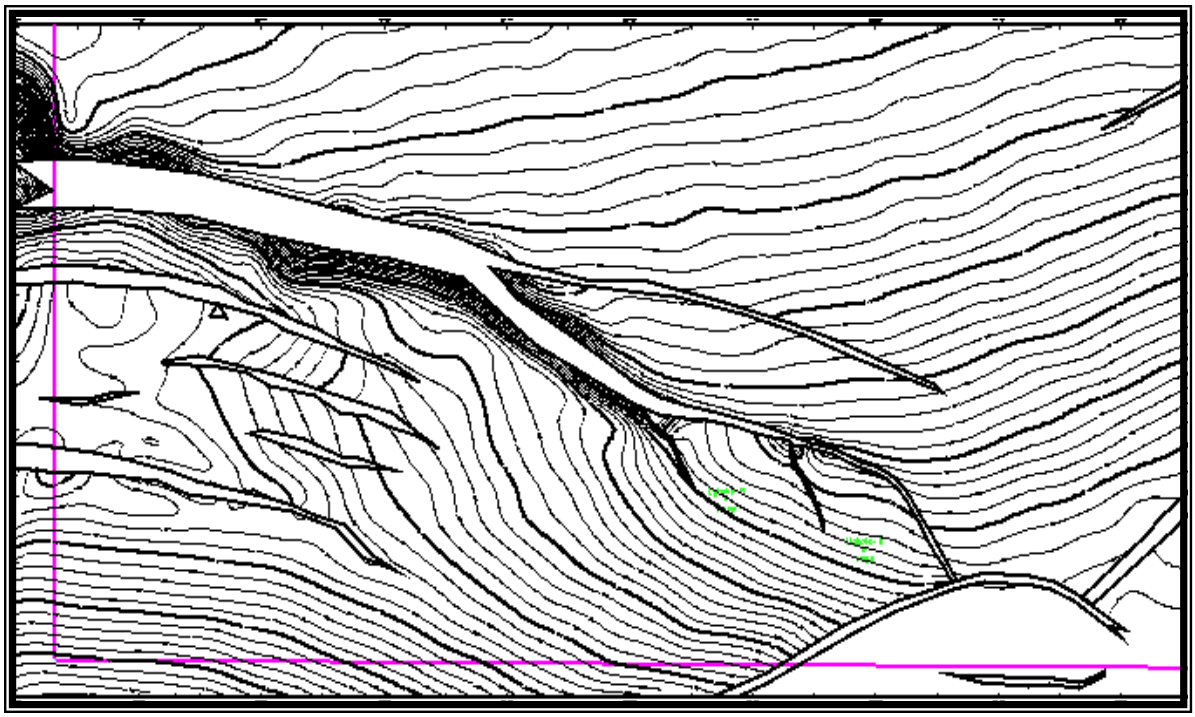

Fig.14: TWT Structure Map Of Horizon C

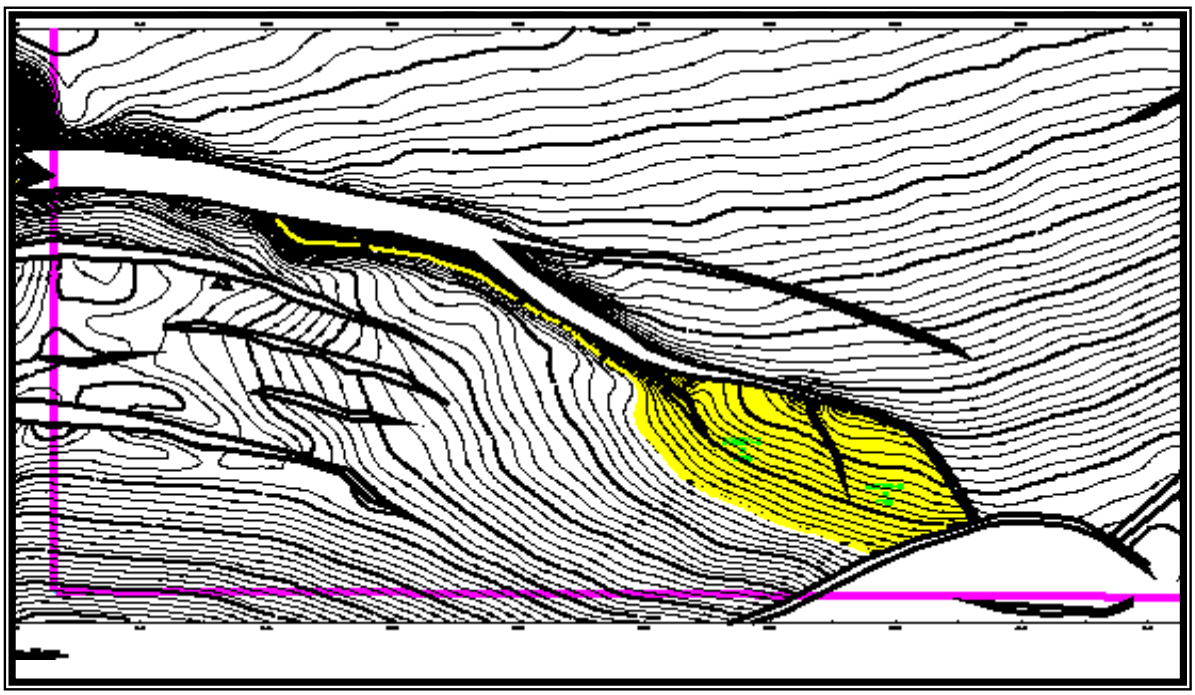

Fig.15: Structural Depth Map of Top C Horizon

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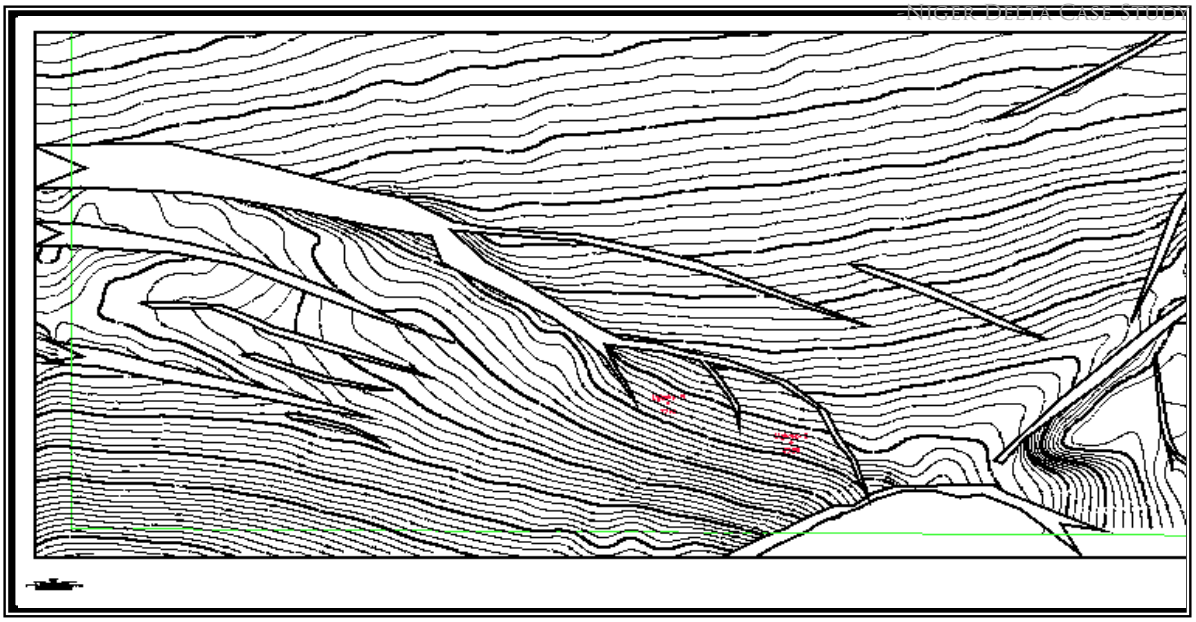

Fig.16: TWT Structure Map of Horizon D

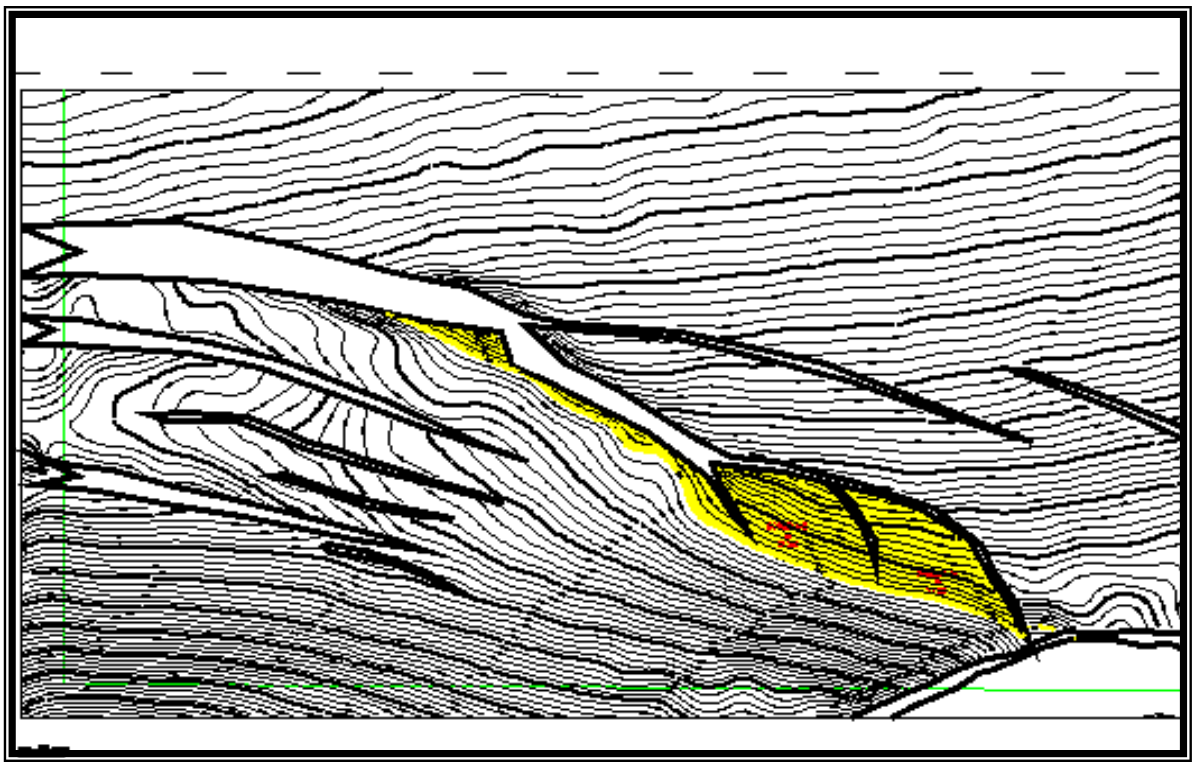

Fig.17: Structural Depth Map of Top D Horizon

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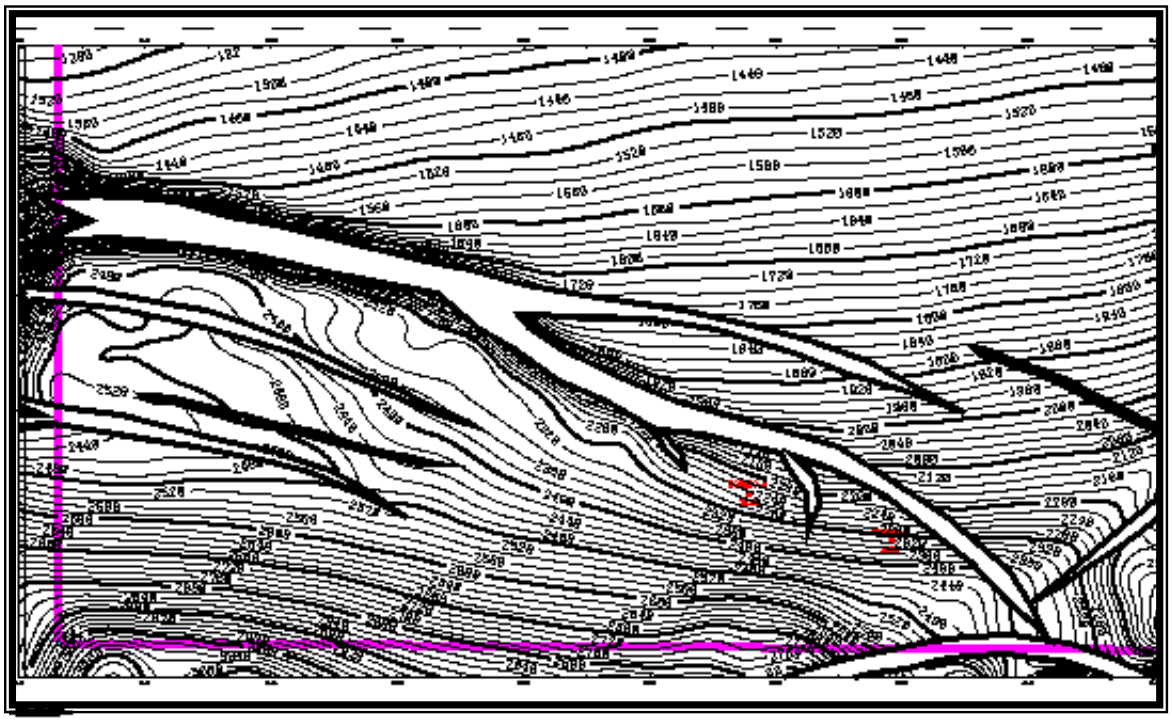

Fig.18: TWT Structure Map Of Horizon E

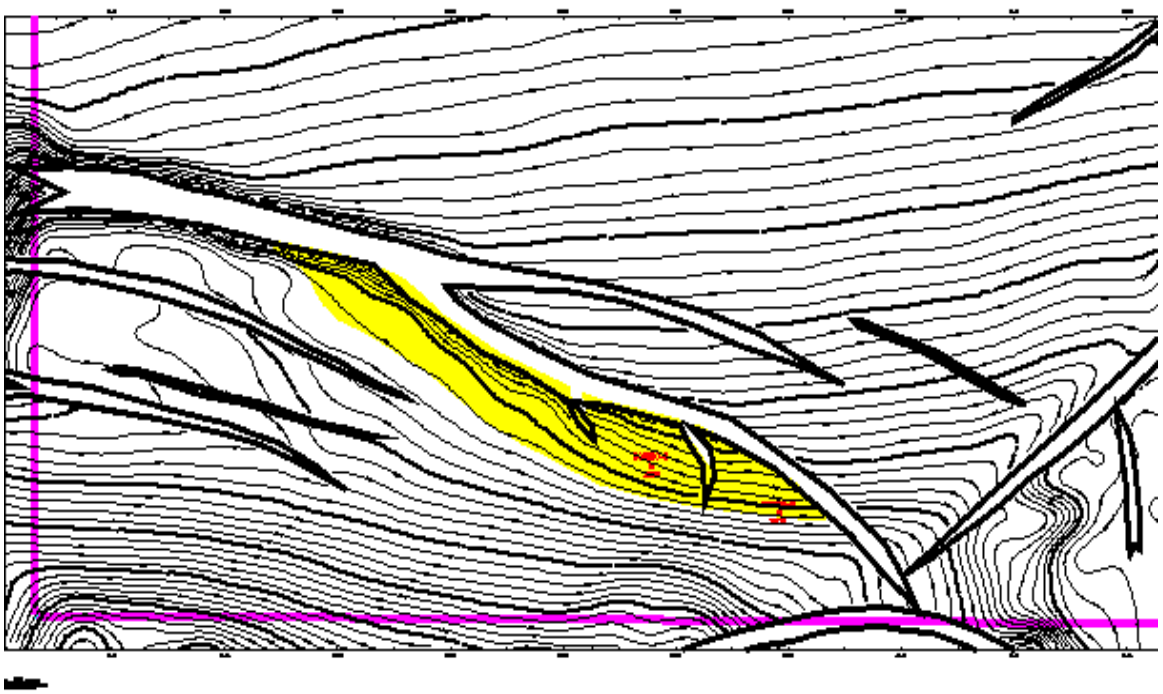

Fig.19: Structural Depth Map of Top E Horizon

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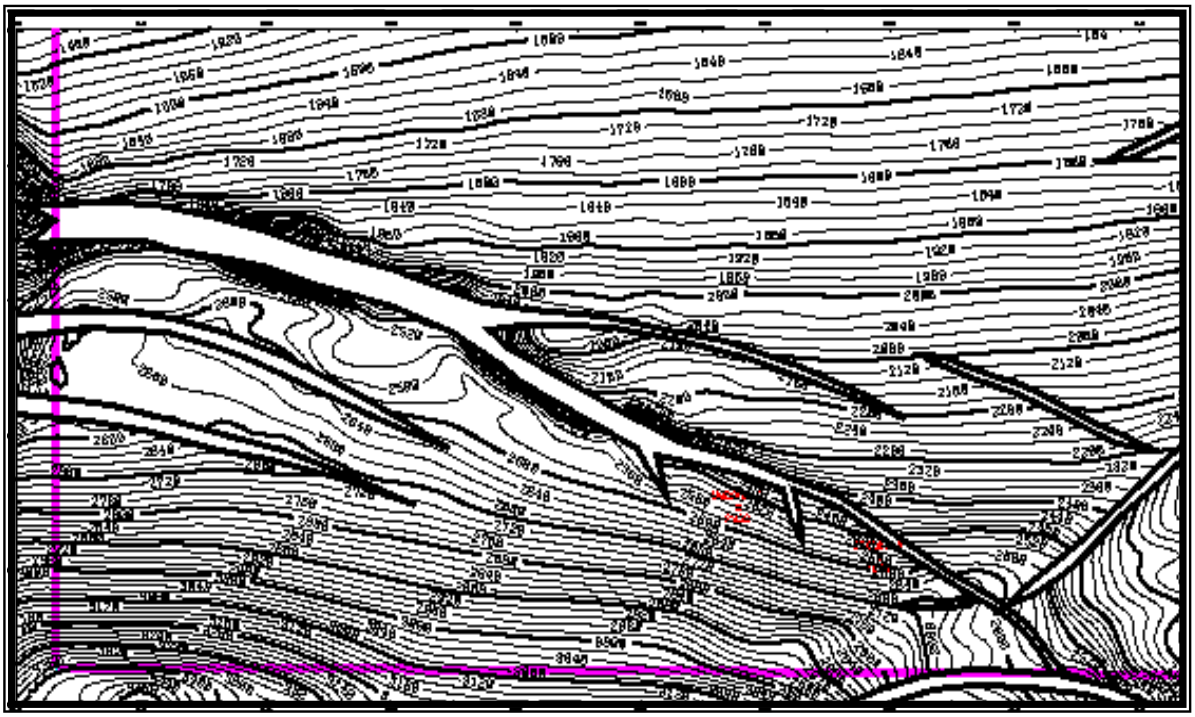

Fig.20: TWT Structure Map Of Horizon F

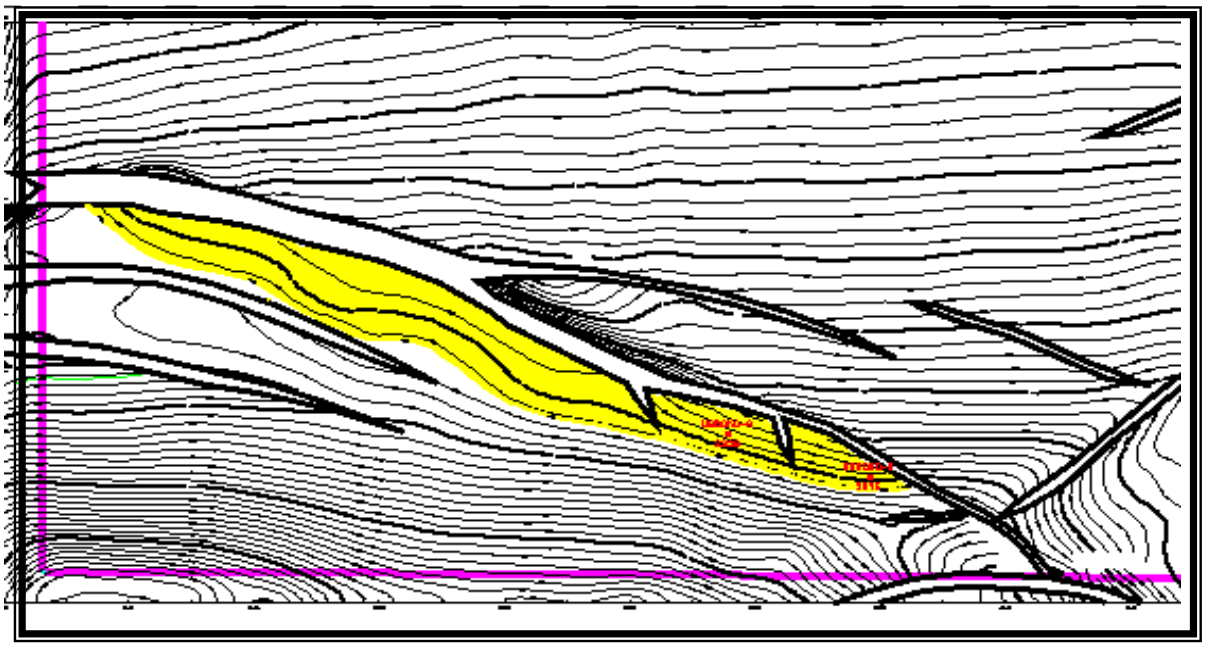

Fig.21: Structural Depth Map of Top F Horizon

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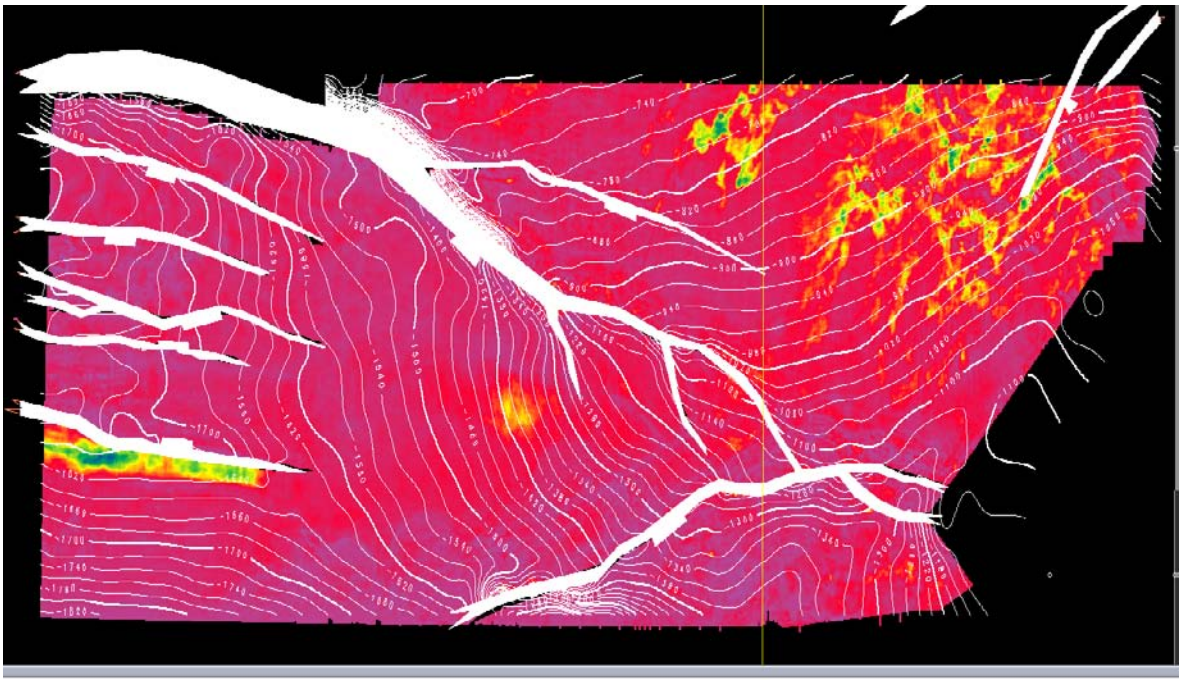

Fig.22: Maximum Negative Amplitude +/-20ms for B.0 Horizon.

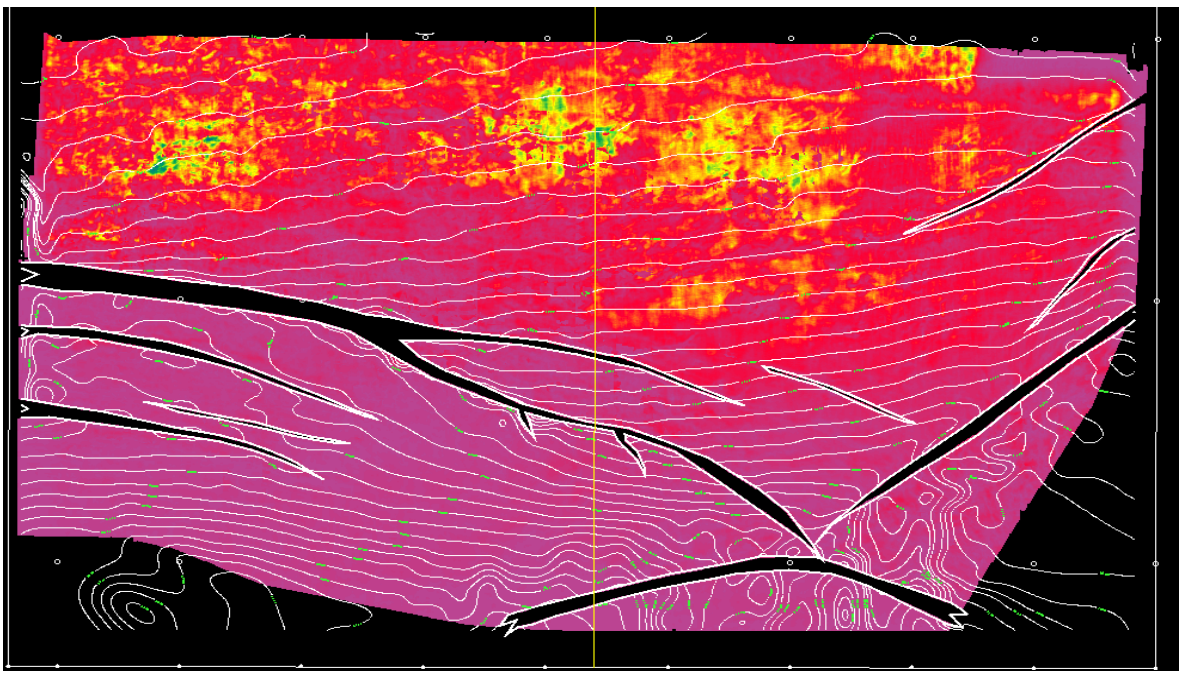

Fig.23: Maximum Negative Amplitude -20+50ms for E.0 Horizon.

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Implication of National Strategies to Reduce Environmental Pollution from Brick Industries at Local Level

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Abstract- Brick industry is one of the largest informal industrial sectors in Bangladesh contributes to 1% of GDP. Brick industry is expanding due to the expansion of the real estate sector while compromising several environmental and social consequences. To modernize the industry and to manage the environmental pollution, the government amended the Brick Burning Act 1989 and issued a number of orders following by enacting the Brick Manufacturing and Establishment of Brick Kilns (Control) Act 2013. The current study aims to understand the implications of regulatory changes in Brick Sector at Faridpur District based on primary and secondary data and identified around 66% brick kilns transformed into modern technology like zigzag and total 23100 tons of GHG emission has been reduced per year. At local level, technological availability, finance, government law and policy enforcement for pollution control, role of local DoE and administration, education and leadership of the local Brick Manufacturing Owners, etc. have influenced the adoption of modern kiln technology. Besides, the government has changed the brick kiln technology very fast. An incremental emission standard should be deployed to improve the energy efficiency of the brick sector.

Keywords: brick kilns, environmental pollution, urbanization, legislative process, GHG emission, national strategy.

GJHSS-B Classification: FOR Code: 300899



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Implication of National Strategies to Reduce Environmental Pollution from Brick Industries at Local Level

Mowshumi Sharmin [α], Rafiul Islam [σ] & Dr. Mahfuzul Haque [ρ]

Abstract[1] - Brick industry is one of the largest informal industrial sectors in Bangladesh contributes to 1% of GDP. Brick industry is expanding due to the expansion of the real estate sector while compromising several environmental and social consequences. To modernize the industry and to manage the environmental pollution, the government amended the Brick Burning Act 1989 and issued a number of orders following by enacting the Brick Manufacturing and Establishment of Brick Kilns (Control) Act 2013. The current study aims to understand the implications of regulatory changes in Brick Sector at Faridpur District based on primary and secondary data and identified around 66% brick kilns transformed into modern technology like zigzag and total 23100 tons of GHG emission has been reduced per year. At local level, technological availability, finance, government law and policy enforcement for pollution control, role of local DoE and administration, education and leadership of the local Brick Manufacturing Owners, etc. have influenced the adoption of modern kiln technology. Besides, the government has changed the brick kiln technology very fast. An incremental emission standard should be deployed to improve the energy efficiency of the brick sector.

Keywords: brick kilns, environmental pollution, urbanization, legislative process, GHG emission, national strategy.

I. Introduction

Brick industries are identified as one of the major environmental pollutants in Bangladesh. Every year five thousand brick industries burn almost 3.8 million tons of coal and another 1.9 million tons of wood indiscriminately to meet the demand of 400 to 1200 tons of fuel to produce 17.2 billion bricks emitting 9.8 million ton of CO2 and 170 billion $\mu g/m^3$ of particulate pollution (World Bank, 2011). The emission from brick industries is causing serious health threats to adults that harm their eyesight, lungs, and throat as well as stunt the psychological and physical development of the children (Guttikunda & Khaliquzzaman, 2013). Brick making subsidizes a lot to the construction sector and contribute 1% of the country's Gross Domestic Product (GDP) or $245 million (2010) but it is not formally recognized as industry (Word Bank, 2011).

In Bangladesh, brick fields are the main supplier of building material. The country's overwhelming dependence on bricks is due to its lack of stones in any sizable quantity or other alternative building materials at a comparable cost (World Bank, 2011). To attain the target of sustainable growth in the country and to achieve the efficacy in the building material sector, there is an urgent need of improving the brick industries in the country.

In the country, there are generally six types of brick kilns: (i) Bull's Trench Kilns (BTKs), (ii) Fixed Chimney Kilns (FCKs), (iii) Improved Zigzag Kilns, (iv) Vertical Shaft Brick Kiln (VSBKs), (v) Hoffman Kilns, and (vi) Tunnel Kilns. Among these technologies, 92% of the total 5000 brickfields are highly polluting FCKs. More energy efficient and less environment polluting improved zigzag kilns, vertical shaft brick kilns (VSBKs), hybrid Hoffman kiln (HHKs), and tunnel kilns are rare (World Bank, 2011).

An expansion in the real estate sector of Bangladesh encouraging brick industries to grow abundantly stimulates the process of urbanization and economic growth sacrificing several environmental and social consequences. For developing countries like Bangladesh, air pollution is acting as one of the main problems of environment pollution and brick industries are identified as major contaminants in the vicinity of the cities of the country in the name of progress. Discharge of huge quantity of toxic elements from brick industries causing serious health threats polluting the environment.

In order to protect the environment, the government of Bangladesh is trying to compress down the brick industries through regulations and encouraging the use of cleaner technologies. There is a lack of government policy to support a long-term brick sector development strategy. As a result, the legal and regulatory framework does not adequately address the relevant energy efficiency guidelines and other

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underlying development constraints. However, the existing legislation is based on the Brick Burning Act (1989) and various amendments and circulars after that. Though in place, these legal frameworks have not been effective to encourage brickfield owners to switch to the most efficient technologies and reduce pollution. The most concrete step taken by the government is the 2010 government notification that banned the operation of FCKs by September 2013 (ADB, 2012). Due to the still-developing economy, businesses often choose cheap, though inefficient, operational techniques to reduce costs. Most brickfields are informal, small to medium-sized businesses that operate with outmoded technologies, are severely polluting, and have poor labor standards. Hence, the country's inability to develop an energy efficient, clean and modern brick sector is a sign of market failure, and is a result of general lacks of (i) awareness of available modern technologies, (ii) technological and operational capacity, and (iii) targeted finance.

After 2013, old kiln technologies are banned and the government is enforcing the proposed three new brick field technologies without having any comprehensive brick sectoral road map or plan. Therefore, brick sectoral upgradation only through legislative change is quite challenging, and the level of upgradation is an objective of this study. The current study looked into the implication of legislative changes as well as the factors which could support the upgradation of the brick sector at local level in Faridpur district.

This paper is organized as follows. Section two summarizes existing empirical evidence and section three presents the objectives. The remainder of the paper includes research methodology in section three, findings and discussion in section four and conclusion and some policy recommendations of the study are drawn in section five.

II. Existing Empirical Evidence

The study reviewed a number of literatures mainly on the brick sectors. The study has reviewed papers and publics form World Bank, ADB, and the SAARC. The review is done to capture the current scenario of the Brick sector in Bangladesh. World Bank (2011) published a comprehensive report on the brick sectoral situation with a set of the policy measure to be taken to make the sector energy efficient. ADB (2012) has analysed the current situation along with the legislative development process to prepare a feasibility study on the sector for developing investment project. SAARC (2014) Energy Centre in Pakistan prepared a detail sectoral study compiling all the available information including World Bank, ADB, and other institutional research documents.

BUET (2007) study on Small Study on Air Quality Impacts of the North Dhaka Brickfield Cluster by Modelling of Emissions and Suggestions for Mitigation Measures including Financing Models intends to find technically and financially viable alternatives polluting brick kilns around Dhaka city taking secondary data. GEF-UNDP (2006) report postulates that brick making is one of the largest sources of greenhouse gas emission in Bangladesh and observes that the country does not have financing and strong regulatory incentives to become energy efficient.

Croitoru, L., & Sarraf, M. (2012) shows that cleaner technologies are more attractive than traditional technologies both from the private and social perspective, and recommended for a cleaner brick sector in Bangladesh. Development Alternatives & Practical Action. (2009) analysis of the brick sector shows the feasibility of cleaner alternative technologies in Bangladesh.

Brick Manufacturing and Establishment of Brick Kilns (Control) Act 2013, (Government of Bangladesh, 2013) is provided for the control of activities relating to brick manufacturing and brick kiln formation and to re-enact with some modifications by annulling the prevailing act. It is necessary to establish control over brick kiln establishment for the conservation of environment and biodiversity.

In summary, from the aforementioned existing empirical literature, it is evident that there is a substantial amount of empirical literature showing the brick field scenario particularly on Bangladesh but very few studies concentrate on the implication of national strategies. This study endeavors to give an inclusive scenario of the implication of national strategies. This study has reviewed all these documents to develop the objectives and methodology to carry out the current study. Although the study tried to analyze both the primary and secondary information to document the current brick sectoral scenario in terms of size, employment, production, technology used, efficiency of fuel burning and environmental pollution etc. and side-by-side the legal instrumental development to promote the sector as an efficient one in the country but it has some limitations also. The study has been done by focusing on the few key literatures. If there were a process of information collection form the key stakeholder at the national level, then the study findings could be further improved.

III. Objectives

The aim of this study is to find out the current scenario of brick industries in Bangladesh and to analyze the impact of national brick sectoral strategies at Faridpur district (local level). However, the specific objectives of this study are the following:

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i. To study the current scenario of national brick industries and the relevant legal instruments promulgated for improving the brick sector in Bangladesh;
ii. To find out the local level situation and the implication of national legal instruments in the brick industries of Faridpur Districts.

IV. Methodologies

The study has been carried out with a structured methodological process. The scope of the study requires having both the review of the current situation in terms of size of the brick industries, employment, materials produced, legal instrumental development, etc. and the local level information collection, analysis and reporting to draw the linkages between the national and local level scenario.

The study was carried out at Faridpur District located in the central part of Bangladesh. Faridpur is a part of the Dhaka Division and has a population of over 1.7 million and is situated on the banks of the Padma River. The study has been carried out using both primary and secondary data. Secondary data has been used to draw the analysis on sectoral scenario, legislative changes while Key Informant Interviews (KIIs) have been carried out with the relevant stakeholders like, brick kiln owner, representatives of local Brick Manufacturing Owners Association (BMOA), Department of Environment (DoE), local administration etc. to find out the implications of the legislative changes and factor influenced the transformative changes in the brick sector of Faridpur. The data analysis was done to draw a chronological change in the brick sector of the country and how it has affected at the local level to adopt modern kiln technologies and the factors which have facilitated the adoption process.

V. Study Findings

The study findings have been arranged from the national scenario on the brick industries of the country from the legislative process development and the local situation at Faridpur and the role of the national legislative related with the brick industries. The following part is showing the findings of this study:

a) Brick Sector related Legislative Development in Bangladesh

From the review on the legal instrumental development process, it is evident that prior to 1989, brick making was an unregulated industry in Bangladesh. In 1989, The Brick Burning (Regulation) Act of 1989 was enacted, and it banned the use of firewood in brick burning with a provision of limited fuel wood burning in the remote areas and also introduced the licensing process for the brick field and soil use guideline for making brick. Later on, a number of amendments of this act have been done by the government and enacted Brick Burning Rules 2002 and issued few notifications on the technology to be used, areas where the brick field to be constructed, and finally the revision of the brick burning act took place in 2011. The following table demonstrates the chronological legal instrumental development process for facilitating and regulating the brick industries in Bangladesh:

Table 4.1: Summary of the legislations of brick burning in Bangladesh

Year	Regulation	Responsible Agency	Details	Remarks
1989	The Brick Burning (Regulation) Act of 1989	Department of Environment (DOE), Ministry of Environment and Forests (MOEF)	Bangladesh's first brick-making law banned the use of firewood for brick manufacturing and introduced licensing for brick kilns.	Use of firewood has largely been discontinued, but in remote areas, it continues on a limited scale.
2001	Revision of the Brick Burning (Regulation) Act of 1989	DOE, MOEF	The 1989 act was amended to regulate the location of brick kilns. The new provision required that brick kilns not be set up within 3 kilometers of the upazilla (district center),municipal areas, residential areas, gardens, and government reserve forests.	Using the given criteria, it is nearly impossible in reality to find land for brick kilns in Bangladesh. The Bangladesh Brick Manufacturing Owners Association often cites this as a major deficiency in the law. Despite this amendment, the location requirements have not been enforced.
2002	Brick burning Rules	DOE, MOEF	The government introduced a rule that made the use of 120 feet (36.6 meters) chimneys for brick kilns compulsory.	This requirement was successfully enforced, especially in the vicinity of urban areas, and most bull's trench kilns were upgraded to fixed chimney kiln technology. However, some bull's trench kilns continue to operate, albeit illegally.

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2007	Government Of Bangladesh notification	DOE, MOEF	The government issued a notification that environmental clearance certificates would not be renewed if an owner did not shift to alternative fuel and improved technologies by 2010.	This regulation has not been implemented since little on-the-ground activity occurred to facilitate the switch.
2010	Government of Bangladesh notification	DOE, MOEF	A new notification was issued banning fixed chimney kiln operation from 2013.	Activities are being undertaken under the government's Clean Air and Sustainable Environment Project with World Bank support
2013	Brick Manufacturing and Establishment of Brick Kilns (Control) Act 2013	DOE, MOEF	The revision of the act has the objective to regulate the brick industry establishment, licensing, efficient fuel use, soil use, the location of brick field, etc.	Brick field technologies were not mentioned.

Source: ADB,2015

There is a lack of a government policy to support a long-term brick sector development strategy. As a result, the legal and regulatory framework does not adequately address the relevant energy efficiency guidelines and other underlying development constraints.

b) Local Context of Brick Industries in Faridpur

The local level consultation with the brick field stakeholders mainly the owners and the manager has revealed a comparatively good scenario of the transformation of the brick industry in Faridpur. The following table shows the at glace brick sector scenario of the Faridpur District.

Table 4.2: At a glance brick field scenario in Faridpur District

Type of Brick Field	No. of Brick Field
Unlicensed FCK	26
Licensed FCK	8
Zigzag	77
Hoffman (coal based)	2
Total	113

Source: Local BBMOA and DoE.

The above table reveals in Faridpur there are around 113 brick kilns. However, out of 113, 87 kilns are licensed, and the rest 26 are unlicensed FCKs. Among the licensed Kilns around 77 Zigzag kilns are found to be mostly upgraded from the FCKs. Among the Zigzag Kilns, around 50% are improved version zigzag which uses water to settling the particulate matters from the emission while other kilns do not use the water for cleaning the smog. In the district, there are two coal-based Hoffman kilns established recently and still there are 8 licensed FCKs exist although the FCKs are banned. Overall the transformation of the FCK into the improved kiln technology is very promising in Faridpur. Around 68% FCKs has been transformed into the Zigzags after banning the FCK by 2013. And most of the FCK have been upgraded into zigzag before 2013.

Table 4.2.1: Understanding about the technologies by the entrepreneurs

Technologies	Key Issues			
	Capacity	Environmental pollution	Investment	Profit
FCK	Capacity of the brick production is same in both the kilns.	Higher environmental pollution	While the FCK has been upgraded in the Zigzag then around 6.0 million BDT additional investment required	Profit margin is same as the fuel requirement is same
Zigzag		Comparatively less environmental pollution due to suction and settling effect.		

Source: Field Survey 2017

Following the World Bank recommendations, if the upgraded zigzag kilns use the internal fuel then it will further reduce the 20 GHG emissions. The conversion from FCK into the Zigzag required around BDT 6.0 million additional investments. While the fuel consumption and production capacities are same with both the technologies, hence the environmental pollution or the GHG emission is less in the Zigzag kilns. It is estimated that the 77 nos. of zigzag kilns are yearly producing around 231 million of brick in the district and reducing average 100 tons of GHG to produce per million brick (BBMOA and World Bank, 2011). Therefore, total 23100 tons of GHG emission has been reduced per year by transforming 77 nos. of FCK into the zigzag kilns.

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Table 4.2.2: Factors Influenced the Brick Making Technology Up Gradation

Factors	Overall responses of the brick field owners/managers
Technological availability	The technological transformation was not very difficult. There were few initiatives on the transformation of FCK into Zigzag by the self-interest of the entrepreneurs which actually helped the other entrepreneurs to follow the up-gradation process.
Finance	No financial supports were available from the government. The entrepreneurs manage the finance by themselves while the CC loan was available at a higher rate of interest.
Government law /policy enforcement for pollution control	Those who have upgraded their brick kiln in zigzag, they did it because of the legal compliance. Because, these entrepreneurs understood, without compliance with the legal process, it is difficult to do the brick business. Therefore, they were interested to comply with the legal process and upgraded their kilns.
Role of local DoE	The entrepreneurs opined that the local DoE officials were very much positive and always were sensitizing the brick entrepreneurs about the benefit of upgrading into the new technologies also about the negative environmental consequences of using un-improved technologies. Even the DOE officials were supporting and motivating towards entrepreneurs in any locations of the district. The officials never demanded any extra amount during the license renewal process and sometimes, the officials were pro-actively informing about the renewal process and timeline.
Role of local administration	Local district and Upazila administration were very active to start the up-gradation of the industry. The local administration was running frequent mobile court operation to stop the un-improved brick kiln operations in the district and they sometimes put pressure on the entrepreneurs to upgrade the kiln technologies.
Education and leadership of the local Brick Manufacturing Owners Association	The local BMOA leaders are comparatively higher educated in Faridpur district and they took the vigilant action by the local administration as one of the disrespectful acts. Additionally, the brick field owners are comparatively the well-off people in the local society. Hence, it became an issue of ego, why to be disrespected by the local administration. The leader has up-graded their kiln first and they also tried to sensitize the other members to upgrade their kiln technology. This process has given a quick result for the kiln up-gradation.
Business potential	The owners of the brick fields understand the current level of growth in the brick sector and they know there is lot more demand of brick in the country since there is actuate shortage of the building material in the country.

Source: Field Survey 2017.

VI. Conclusion and Policy Recommendations

Two-thirds of the brick industries have been up-graded till date by converting mostly the FCKs into the Zigzag Kilns. The Brick Field owners lead by local BMOA is in favor of extending time period for conversion of existing FCK to Zigzag beyond 2013. However, the owners require financial assistance from the Bank and other financial institutions with a single digit interest.

The local level brick sectoral scenario has been studied only form Faridpur District; therefore, the situation of Faridpur may not be representative for the whole country. Like the transformation process and the facilitation of the adoption of improved brick kiln technologies may not be in same pace in other districts. Further study could focus more districts of Bangladesh for better representation of the country.

The following recommendations can take place to improve the sector as well as to attain the energy efficiency and less GHG emission in the country:

- Current financing which is one of the key constraints for low sized kilns managed by family business does not offer any additional benefits to the brick entrepreneurs, therefore, some of the entrepreneurs go bank for the CC loan. If government can arrange a finical facility with a single digit interest rate to these entrepreneurs with a condition of technology up-gradation, then it could help the transformation of the sector at a faster rate;
- Local DoE can set-up a monitoring cell at local level jointly with the local BBMOA leaders to monitor the level of pollution, and other social issues like stop child labor, sharing local knowledge among entrepreneurs, stakeholders, specially fireman, owners, and managers, brick makers for capacity building;
- An incremental emission standard should be deployed to improve the energy efficiency of the brick sector like, combining the internal fuel in the zigzag kiln which could further improve the performance of it;
- Need to set-up R&D cell regionally to research on various issue related with the brick industries and the DoE and the BBMOA can link with the universities. The R&D initiatives can undertake the institutionalized training programme on internal fuel, firing, kiln making, process mechanization etc. issues for the target stakeholders; and
- Coals are sometimes not available and low-standard coal is being imported from the neighboring countries which need to be dealt properly.

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GIS-Based Map for Best Suitable Place for Cultivating Permanent Trees in South-Lebanon

By Kamel Allaw & Leila Al-Chami

Abstract- To reduce the human influence on nature resources and to identify an appropriate land use, it is essential to carry out scientific land evaluation. Such kind of analysis allows identifying the main factors for agricultural production and enables decision makers to develop crop managements able to increase the land productivity. Land capability is the ability of land to sustain a type of land use permanently. The key is to match the type and intensity of land use with its natural capability. Therefore; in order to benefit from these areas and invest them to obtain good agricultural production, they must be organized and managed in full. Lebanon suffers from the unorganized agricultural use, we take south Lebanon as study area, due to it is the most fertile ground and have a variety in crops. The study aims to identify and locate the most suitable area to cultivate thirteen type of permanent trees which are: apples, avocadoes, stone fruits in coastal regions and stone fruits in mountain regions, bananas, citrus, loquats, figs, pistachios, mangoes, olives, pomegranates and grapes. Several geographical factors are taken as criterion for selection of the best location to cultivate. Soil, rainfall, PH, temperature and elevation, are main inputs to create the final map. Input data of each factor is managed, visualized and analyzed using Geographic Information System (GIS). Managements GIS tools are implemented to produce input maps capable of identifying suitable areas related to each index.

Keywords: agricultural production, crop managements, geographical factors, geographic information system (GIS), land capability, permanent trees, suitable location.

GJHSS-B Classification: FOR Code: 050299



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GIS-Based Map for Best Suitable Place for Cultivating Permanent Trees in South-Lebanon

Kamel Allaw [α] & Leila Al-Chami [σ]

Abstract- To reduce the human influence on nature resources and to identify an appropriate land use, it is essential to carry out scientific land evaluation. Such kind of analysis allows identifying the main factors for agricultural production and enables decision makers to develop crop managements able to increase the land productivity. Land capability is the ability of land to sustain a type of land use permanently. The key is to match the type and intensity of land use with its natural capability. Therefore; in order to benefit from these areas and invest them to obtain good agricultural production, they must be organized and managed in full. Lebanon suffers from the unorganized agricultural use, we take south Lebanon as study area, due to it is the most fertile ground and have a variety in crops. The study aims to identify and locate the most suitable area to cultivate thirteen type of permanent trees which are: apples, avocadoes, stone fruits in coastal regions and stone fruits in mountain regions, bananas, citrus, loquats, figs, pistachios, mangoes, olives, pomegranates and grapes. Several geographical factors are taken as criterion for selection of the best location to cultivate. Soil, rainfall, PH, temperature and elevation, are main inputs to create the final map. Input data of each factor is managed, visualized and analyzed using Geographic Information System (GIS). Managements GIS tools are implemented to produce input maps capable of identifying suitable areas related to each index. The combination of the different indices map generates the final output map of the suitable place to get best permanent tree productivity. The output map is reclassified into three suitability classes: low, moderate, and high suitability. Results shows different locations suitable for different kinds of trees. Results also reflects the importance of GIS in helping decision makers finding a most suitable location for every tree to get more productivity and a variety in crops.

Keywords: agricultural production, crop managements, geographical factors, geographic information system (GIS), land capability, permanent trees, suitable location.

I. Introduction

The land capability depends on general characteristics with taking into consideration the kind of its use. There have a range of classes' from1 to 8. This classification help us in order to get suitable suit for a crops and unsuitable for another; therefore, land capability is very important in order to get the best productivity of the trees [1]. Suitability of the section of the land affords the production of crops in suitable way this evaluation help to get many opportunities for use of land planning and development [1]. Moreover, these kinds of analysis allows identifying the main limiting factors for agriculture production, and helps the decision makers such as land user, farmers and agricultural support services tp develop a crop managements able to overcome for increasing productivity [1].

According to the different kinds of soil then we get that not all agriculture lands are the same and not all lands are suitable for the same kinds of plants. In a Britch Colombia study they depend on two factors which are climate determining the heat energy and moisture inputs required for agriculture production. Topographic is important for the ability to use cultivation equipment. Although, soil is important key for agriculture, according to upon factors they may be appropriate for sustaining the production of certain agricultural products [2].

So, soil capability for land classification system for agriculture was developed for use across Canada national soil survey committee in cooperation with the federal administration provincial ARDA administrations [3]. Then, they get 8 classes for the soil classifications.[3]

Many factors affect the safety and gain of crops worldwide; from the effects like floods, drought, swarms of insects and poor farming techniques. Now a day, solutions are found one of them is using geographic information system because is being able to map and project current and future fluctuations in precipitation, temperature, crops output and more. Then, farmers and scientists can work together to create more effective and efficient farming techniques; this could help in increasing food production in part of the world that are struggling to produce enough for people around them. Although, GIS can analyze soil data combined; to determine what the best crops to plant, and how to maintain soil nutrition levels to best benefit the plants [4].

GIS in agriculture is not a new phenomenon any more. In order to protect the environment and to capable of providing excellent nutrition to the people, then the best choice for achieve that idea is technology and geospatial, which can create a dynamic and competitive agriculture. Although, because of natural inputs in cultivating is uncontrolled, so all data and information can be now understood and managed by GIS application. However, GIS can help in effective crop yield estimation, soil analyses and erosion identification this things can be more accurate and reliable crop estimate help reduce uncertainty [5]. Using sophisticated agriculture technology by the farmers can

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help them in saving time and money. For example; farmers use precision GPS on the field to save fertilizer. Also, satellites and drones collect the vegetation, topography and weather information from the sky. All of that make geographic information system (GIS), an extremely relevant tool for farmers, so all that data go into agriculture map for better decision maker [6].

Now from GIS we can get a maps and projects that help the farmers to know the annual precipitation, temperature and crops out etc. And also, that helps the farmers to achieve increased production and reduce costs by enabling better management of land resources [5].

Lebanon is one of many counties that have agricultural important sector, according to the rich soil, and moderate climate and abundant water resources provide it, that's why can take Lebanon as an ideal location for agriculture activities [11]. Moreover, Food and Agriculture Organization (FAO) made a study about the agriculture of Lebanon they found that 67% of Lebanese territory is covered by agriculture area, and 14% of the total area of Lebanon is considered arable, besides rainfall which is also an important factor for agriculture it is relatively abundant an average of 2.2 billion m^3/yr; and this is higher than average, Lebanon is rich with major rivers and water resources [7].

Because of this big conflict that Lebanon suffer from, so we took agriculture land capability as an project in order to start getting a solution for this problem. After that we start search about the most permanent trees cultivated in Lebanon especially in south Lebanon that hold the most variety in permanent trees cultivation, then we took a thirteen kind of permanent trees. Lebanese's agriculture occupies about 47% of permanent trees (fruit trees). Moreover, 28% of citrus trees category, 19% of apple trees, 15% of grape trees and 11% of banana trees [4].

Agriculture land capability with organization is a good solution for environment and for economics issues although forget more productivity. The selection of the best location for every tree should be controlled by several factors and criterion that identify the most suitable places for permanent trees. Several indices were defined to determine suitability factor and sustainable development had an important part in the selection process. This selection is managed by several data being mapped and organized using GIS to get output showing different suitability classes. The process of agriculture land capability selection will be accomplished on South Lebanon that suffered from the unorganized cultivation and low productivity of the planted trees.

a) Study Area

The South Lebanon Governorate spans along the Mediterranean cost, limited by the Nabatieh Governorate to its East and the Mount Lebanon Governorate to its North. The governorate has an average altitude ranging between 0 to 300 meters above sea level, with a few areas reaching 1,500 meters above sea level in the north. It encompasses few mixed rural areas mainly concentrated around its 3 main cities (Jezzine city, Saida city, and Tyr city), with a majority of natural areas, and main agricultural lands. It is crossed by 7 rivers, the Awali, Sayniq, Litani, Zahrani, Naqura, Qasmiye, and Hasbani Rivers.South Lebanon is an important agricultural region, spreading from Sidon to Tyr where intensive agriculture is also present in greenhouses. Greenhouse agriculture in South Lebanon covers an area of 6,277 dounoum (2010), 78% of which is used for the plantation of fruits. Permanent agriculture land covers an area of 201,539 dounoum, 38.9% of which is used for planting olives, and 31.6% used for citrus fruits. The Nabatieh governorate is divided into four districts that are the largest in South Lebanon (Nabatieh, Hasbaya, Bint Jbeil, and Marjeyoun).The governorate is located in the far South of Lebanon, with the Mount of Rihan and Jezine district on its northern border, Litani river valley to the East and South, and the fertile coastal plains to the west. It has a total surface area of 1,058 km^2 which constitutes 10% of the total Lebanese territory. Nabatieh city, the capital of the governorate, is 22 km away from Saida and 65km from Beirut.

The two districts are suffering from the lack organization of agriculture, like the other districts of Lebanon so we start to find a solution by south Lebanon, because the land in south Lebanon is so fertile and rich in variety in products due to the good characteristics in soil.

II. Methodology

a) Principle

GIS is capable of providing spatial analysis including manipulating and analyzing form maps. Site selection or suitability analysis is a type of analysis used in GIS to determine the best place for a project. The research methodology is based on using different GIS spatial analysis tool with intersections for the polygons in order to get the best location for every tree in the study area. The selection of the best location for the trees has been done by research around the word. Take thirteen kind of permanent trees which are: apple, avocado, stone fruits on the coastal region, and stone fruit on the mountain region, banana, citrus, figs, grape, mango, loquat, pistachio, olive and pomegranate. Moreover, the chosen factors were different depending on the kinds of trees in the study area. Thus, several factors have been first identified, based on the kinds of trees analysis, which defines the five main factors: soil, PH, rainfall, temperature and elevation. These factors are very important for the productivity of the trees. Each factor gas been classified into different classes

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according to the suitability range. The value 1 was given the most suitable place and different values show suitable and least suitable. Factors of each index were given a same weight. The intersection of these factors it gives the best suitable place for each tree with a single map.

b) Data and Methods

The method used is a combination of the data provided by remote sensing space and the tools of the geographic information system (GIS). It can be considered as an effective method that was used by S.Selvametal and Radhakrishnan. D in 2014 in India, and by Hsin-fu Yeh in Taiwan in 2008 [6].

It consists in choosing the factors affecting the procedure of the suitable location for permanent trees in south Lebanon and then establishing the existing relations between them. These factors are: soil, PH, rainfall, temperature and elevation, the relationship between these factors and suitable location for each tree. For each factor we have established a represented map depended on its effect on suitable location.

i. *Soil*

Soil is a natural body comprised of solids (minerals and organic matter), liquid, and gases that occurs on the land surface, occupies space, and is characterized by one or both of the following: horizons, or layers, that are distinguishable from the initial material as a result of additions, losses, transfers, and transformations of energy and matter or the ability to support rooted plants in a natural environment [7]. Besides, the most suitable soil for cultivating should bet one of third of loam, one of third of clay and one of third of sandy. Although; the organic matter shouldn't be less than 3%, and the color of soil is red or black. So in our project we get the best soil type for every kind of permanent trees, according to FAO soil classification for south Lebanon, then we get the result as shown below in a table -1- depending on GIS maps [8].

Table 1: Soil classifications

Soil type	Most Suitable soil for cultivating this kinds
1. Andic Cambisols	a. Stone fruits in Coastal regions b. Avocado c. Loquat d. Mango e. Pomegranates
2. Anthropic Regosols	a. Stone fruits in Coastal regions b. Avocado c. Citrus d. Loquat e. Figs f. Grapes g. Olives h. Mango i. Pomegranates
3. Association of Haplic Luvisols and Leptic Luvisols	a. Stone fruits in Coastal regions b. Avocado c. Loquat d. Figs e. Grapes f. Olives g. Pomegranates
4. Association of Eutric Fluvisols and Eutric Vertisols	a. Stone fruits b. Pomme fruits c. Citrus d. Loquat e. Figs f. Grapes g. Olives h. Pistachio
5. Association of Hyper-calcaric Fluvisols and Hypereutic Vertisols	a. Stone fruits in Coastal regions b. Avocado c. Citrus d. Loquat e. Mango f. Pomegranates
6. Association of Hypoc-alcaric Fluvisols and Haplic Vertisols	a. Stone fruits in Coastal regions b. Avocado c. Banana d. Citrus

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	e. Loquat f. Pomegranates
7. Association of Vertic Luvisols and Eutric Cambisols	a. Figs b. Grapes c. Olives
8. Calcaric Combisols	a. Stone fruits b. Pomme fruits c. Figs d. Grapes e. Olives f. Mango g. Pistachio
9. Calcaric Fluvisols	a. Stone fruits in Coastal regions b. Avocado c. Banana d. Citrus e. Loquat
10. Calcaric Leptosols	a. Figs b. Grapes c. Olives d. Pomegranates
11. Calcaric Luvisols	a. Mango
12. Calcaric Regosols	a. Stone fruits in Coastal regions b. Avocado c. Loquat d. Pomegranates
13. Eutric Arenosols	a. Stone fruits in Coastal regions b. Avocado c. Loquat
14. Eutric Cambisols	a. Stone fruits b. Pomme fruits c. Figs d. Grapes e. Olives f. Mango g. Pistachio h. Pomegranates
15. Eutric Fluvisols	a. Stone fruits in Coastal regions b. Avocado c. Bananas d. Citrus e. Loquat
16. Eutric Gleysols	a. Stone fruits b. Pomme fruits c. Pistachio d. Pomegranates
17. Eutric Leptosols	a. Stone fruits b. Pomme fruits c. Pistachio
18. Eutric Luvisols	a. Stone fruits
19. Eutric Regosols	a. Stone fruits b. Pomme fruits c. Pistachio
20. Haplic Calcisols	a. Stone fruits b. Pomme fruits c. Figs d. Grapes e. Olives f. Pistachio

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21. Haplic Luvisols	a. Stone fruits in Coastal regions b. Avocado c. Loquat d. Pomegranates
22. Haplic Fluvisols	a. Stone fruits in Coastal regions b. Avocado c. Bananas d. Citrus e. Loquat f. Mango g. Pomegranates
23. Hypereutric Vertisols	a. Stone fruits in Coastal regions b. Avocado c. Loquat d. Pomegranates
24. Hyperskeletic Vertisols	a. Stone fruits in Coastal regions b. Avocado c. Pomegranates d. Loquat
25. Hypoluvic Arenosols	a. Stone fruits in Coastal regions b. Avocado c. Loquat d. Figs e. Grapes f. Olives g. Pomegranates
26. Leptic Andosols	a. Stone fruits in Coastal regions b. Avocado c. Loquat d. Figs e. Grapes f. Olives g. Pomegranates
27. Leptic Luvisols	a. Stone fruits b. Pomme fruits c. Pistachio
28. Rendzic Leptosols	a. Stone fruits b. Pomme fruits c. Pistachio
29. Vertic Cambisols	a. Figs b. Grapes c. Olives

ii. *Rainfall*

Water is obviously a key factor in plant growth, since the greater the average temperature the greater the amount of water required for plant growth. Besides, seasonal variation is important as different crops require water at different time, then looking for rainfall reliability so that we can select the most appropriate crop for the area [8].So, in Mediterranean; crops growth affected by summer drought despite high annual rainfall, since the rainfall is very high in winter month infiltration rates are comparatively low. From our study we get that annual range of rainfall in south Lebanon is between 500 ml/yr and 1300 ml/yr [9].

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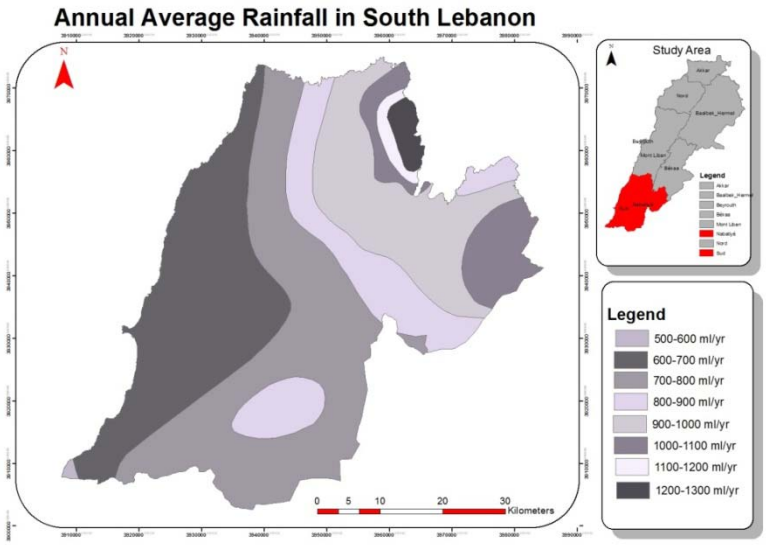

Figure 1: Annual Rainfall Average in South Lebanon

Then, in our project we get the best suitable rain fall for every kind of trees as shown in table-2- below:

Table 2: Rainfall classification

Kind of trees	Factors	Descriptive Scale	Domain of effect	Index
Coastal stone fruits	Rainfall	Most suitable	500-800 ml/yr	1
Stone fruits	Rainfall	Most suitable	900-1300 ml/yr	1
Apple	Rainfall	Most suitable	900-1300 ml/yr	1
Avocado	Rainfall	Most suitable	500-800 ml/yr	1
Banana	Rainfall	Most suitable	500-800 ml/yr	1
Pomegranate	Rainfall	Most suitable	500-1300 ml/yr	1
Citrus	Rainfall	Most suitable	500-800 ml/yr	1
Loquat	Rainfall	Most suitable	500-1300 ml/yr	1
Figs	Rainfall	Most suitable	500-1300 ml/yr	1
Grapes	Rainfall	Most suitable	500-1300 ml/yr	1
Mango	Rainfall	Most suitable	500-800 ml/yr	1
Pistachio	Rainfall	Most suitable	900-1300 ml/yr	1
olives	Rainfall	Most suitable	500-1300 ml/yr	1

iii. *PH*

Soil PH is a measure of the acidity and basicity (alkalinity), is considered a master variable in soil as it affects many chemical processes. It specifically affects plants nutrient availability by controlling the chemical reactions they undergo [10]. However, the optimum PH range for most plants is' between' 5.5 to 7.5, but many plants have adapted to thrive at PH value outside the range [9]. So, the result we get from our project is shown in the table-3- below:

Table 3: PH classification

Kind of trees	Factors	Descriptive Scale	Domain of effect	Index
Coastal stone fruits	PH	Most suitable	5.7-7.7	1
Stone fruits	PH	Most suitable	7.5-8	1
Apple	PH	Most suitable	7.5-8	1
Avocado	PH	Most suitable	5.7-7.7	1
Banana	PH	Most suitable	5.1-7.7	1
Pomegranate	PH	Most suitable	5.7-7.7	1
Citrus	PH	Most suitable	5.1-7.5	1
Loquat	PH	Most suitable	6-7.7	1
Figs	PH	Most suitable	6.8-8.32	1
Grapes	PH	Most suitable	5.7-7.7	1
Mango	PH	Most suitable	5.7-7.7	1
Pistachio	PH	Most suitable	7.5-8	1
olives	PH	Most suitable	6.8-8.32	1

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iv. *Temperature*

Producing trees are formed scientifically according to the number of hours under 7 ^{0}C. For example; bananas shrubs hold out from 50 to 100 hour only under 7 ^{0}C, and it must not reach 0 ^{0}C, while ajami apricot need more than 500 hour under 7 ^{0}CTemperature ranges in south Lebanon is between '17 ^{0}C and 23 ^{0}C [9].

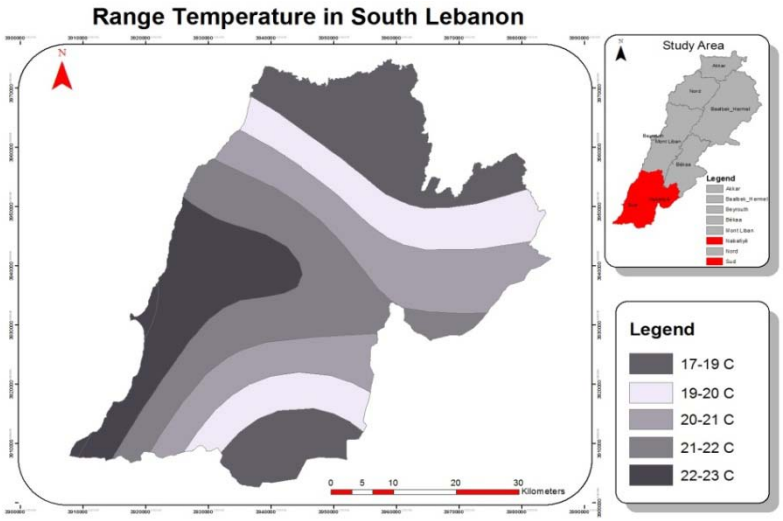

Figure 2: Temperature range Map

Table 4: Temperature classification

After that we search about best suitable temperature for every kind of tree then we get this result that shown in the table-4- below:

Kind of trees	Factors	Descriptive Scale	Domain of effect	Index
Coastal stone fruits	Temperature	Most suitable	21-23 ^{0}C	1
Stone fruits	Temperature	Most suitable	17-20 ^{0}C	1
Apple	Temperature	Most suitable	17-20 ^{0}C	1
Avocado	Temperature	Most suitable	21-23 ^{0}C	1
Banana	Temperature	Most suitable	22-23 ^{0}C	1
Pomegranate	Temperature	Most suitable	17-23 ^{0}C	1
Citrus	Temperature	Most suitable	21-23 ^{0}C	1
Loquat	Temperature	Most suitable	17-23 ^{0}C	1
Figs	Temperature	Most suitable	17-23 ^{0}C	1
Grapes	Temperature	Most suitable	17- 23 ^{0}C	1
Mango	Temperature	Most suitable	21- 23 ^{0}C	1
Pistachio	Temperature	Most suitable	17-20 ^{0}C	1
olives	Temperature	Most suitable	17- 23 ^{0}C	1

v. *Elevation*

There is a relation between climate and elevation. That's why every type of agriculture has a suitable height from mean sea level, so this elevation is taken into consideration because some types of trees shouldn't hold out a high altitude [10].

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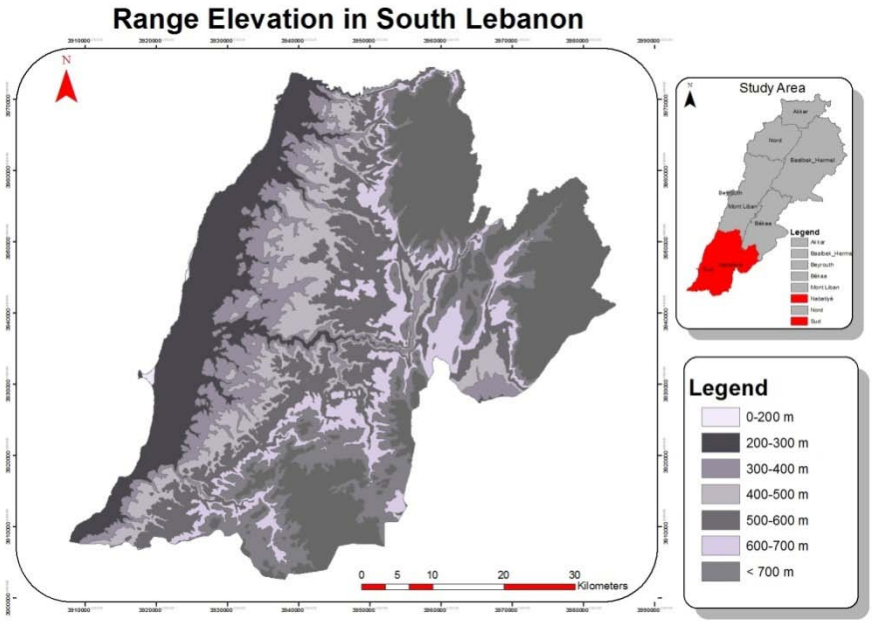

Figure 3: Range elevation in south lebanon

Now as before we practice this map for every kind of trees according to the most suitable elevation for every trees as shown in the table below:

Table 5: Elevations classification

Kind of trees	Factors	Descriptive Scale	Domain of effect	Index
Coastal stone fruits	Elevation	Most suitable	0-600 m	1
Stone fruits	Elevation	Most suitable	600-3000 m	1
Apple	Elevation	Most suitable	600-3000 m	1
Avocado	Elevation	Most suitable	0-400 m	1
Banana	Elevation	Most suitable	0-200 m	1
Pomegranate	Elevation	Most suitable	0-600 m	1
Citrus	Elevation	Most suitable	0-400 m	1
Loquat	Elevation	Most suitable	0-3000 m	1
Figs	Elevation	Most suitable	0-600 m	1
Grapes	Elevation	Most suitable	600- 3000 m	1
Mango	Elevation	Most suitable	0-300 m	1
Pistachio	Elevation	Most suitable	600- 3000 m	1
olives	Elevation	Most suitable	0-600 m	1

c) Implementation of simple additive weight method

The simple weight method was used as multi attribute decision technique. A score is calculated for each alternative by multiplying the scaled value given of the alternatives of that attribute with the weights of relative importance directly assigned by decision maker followed by summing of the product for all criteria. The SAW was used in generating each index map taking the weight of each factor with its obtained score from several associated factors, as well as in producing the final map considering the index weight with the obtained score from each index map.

$S=\sum W_iX_i$ Eq.(!)

Where;

S= Suitability index

W_i= weight of ith factor

X_i= score of the ith factor attribute

Then, the weighted was assigned in our project is equal, since there is no appropriate or exact value for agriculture, so we use it as 0.2 for all of the factors, in order to get the final map for every tree and get the most suitable location for it.

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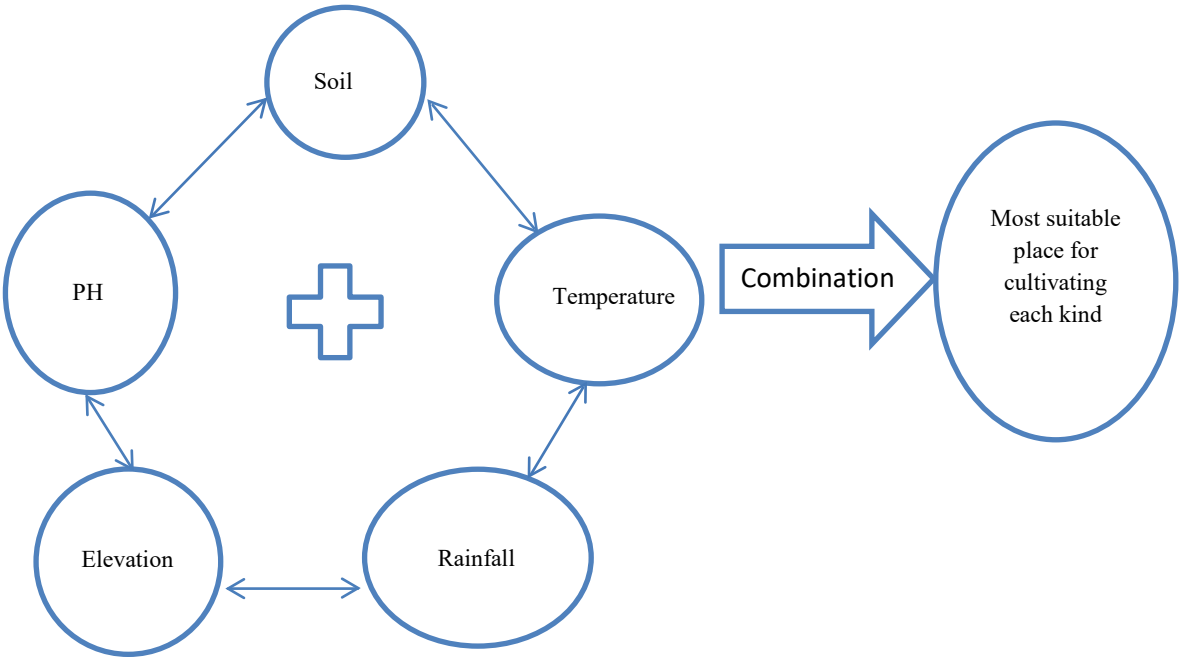
III. Modeling



IV. Results and Discussions

a) Results

Since many factors are incorporated in the agricultures land capability selection for the best location of permanent trees, GIS is identify this kind of study to accomplished using Arc GIS software. Vector data type was used as a data type for all factors. For each determined factor a map was produced and classified according to suitability classes. Several geoprocessing tools were applied to generating the map representing each factor. A classification was obtained for each map by assigning values from 1 to 3 to its own attribute table according to the suitability classes. The factors maps related to each index were used to produce the index map. After getting five maps for the five factors for every tree we use the intersection tool which helps us to get a final map for every kind of tree. The simple weighting method was then implemented to calculate the suitability index for each produced polygon based on the assigned weight for each factor. The generated index map was classified using the natural break classification; which was found the best suitable location for every permanent trees of area of study; as most suitable (class 1), suitable (class 2) and least suitable (class 3). The procedure was applied for all of the thirteen kind of trees I was shoes them in our study. We are going to present 13 types of trees with their maps after unifying the 5 factors we talked about in chapter 3 and we classified them into 3 classes: first class which is "most suitable" that represent from 1 to 1.4, second class which is "suitable" that represent from 1.4 to 2, third class which is "least suitable" from 2 to 3. The maps for each kind of tree will be shown below:

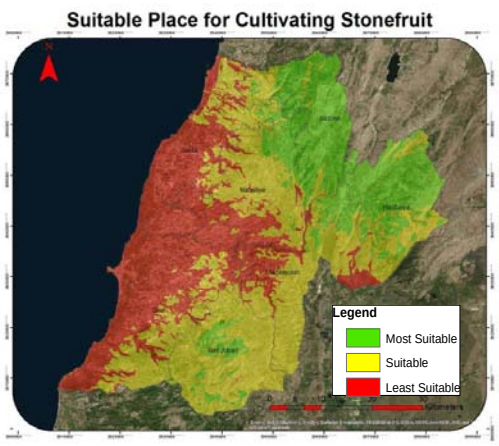


Figure 5: Stone Fr Uits Map

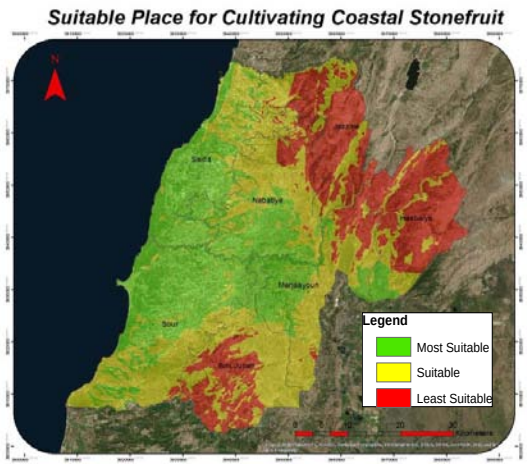


Figure 6: Coastal Stone Fruits Map

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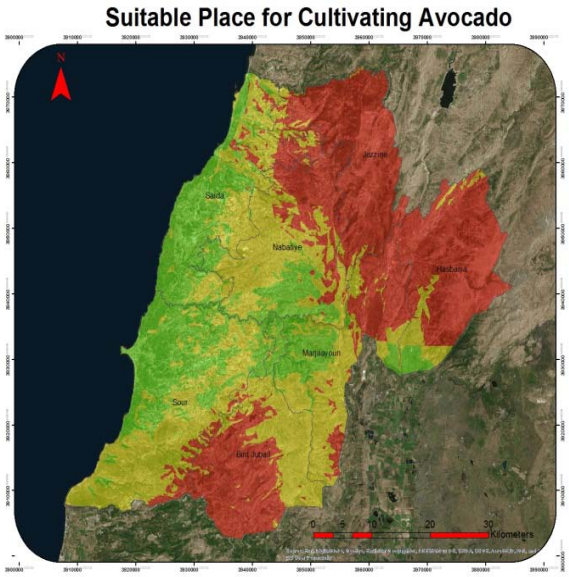

Figure 7: Avocadoes Map

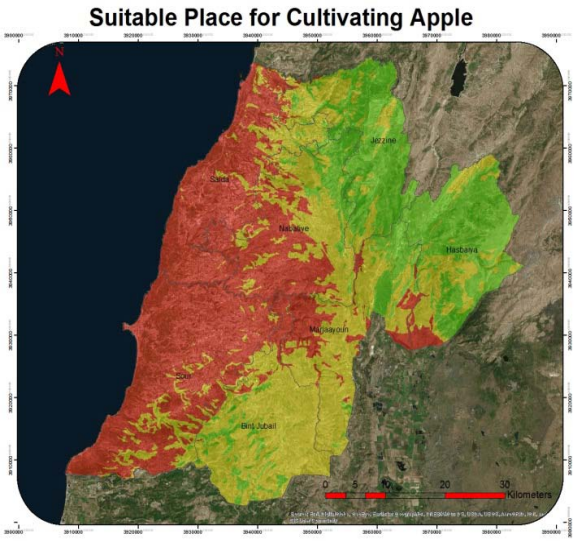

Figure 8: Apples Map

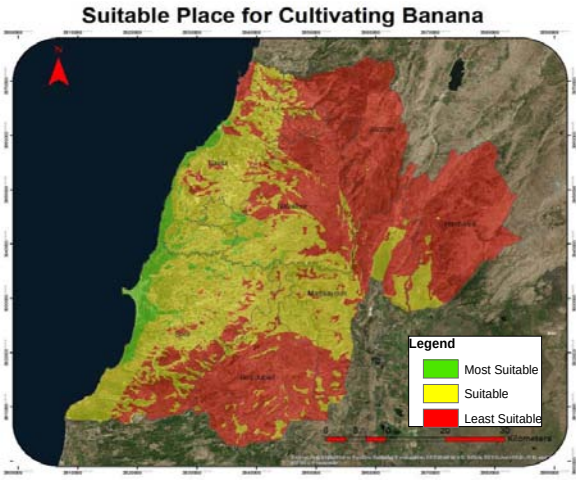

Figure 9: Bananas Map

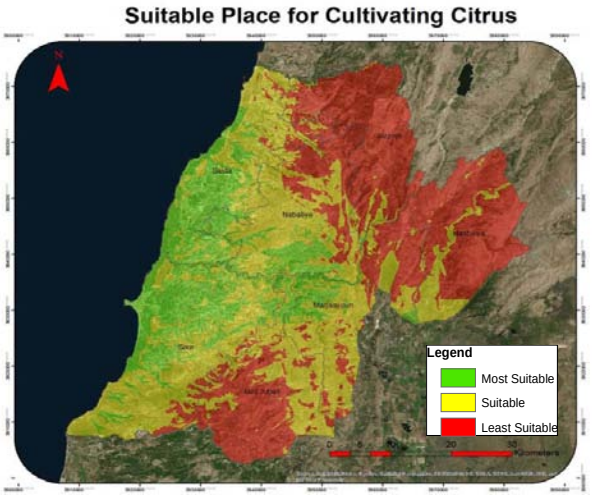

Figure 10: Citrus Map

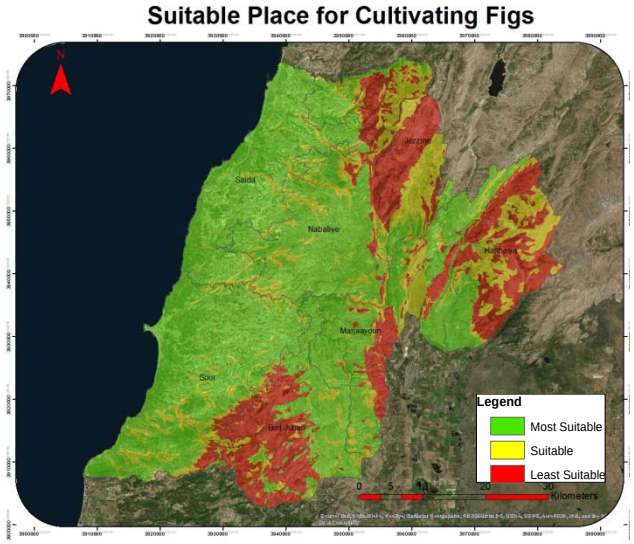

Figure 11: Figs Map

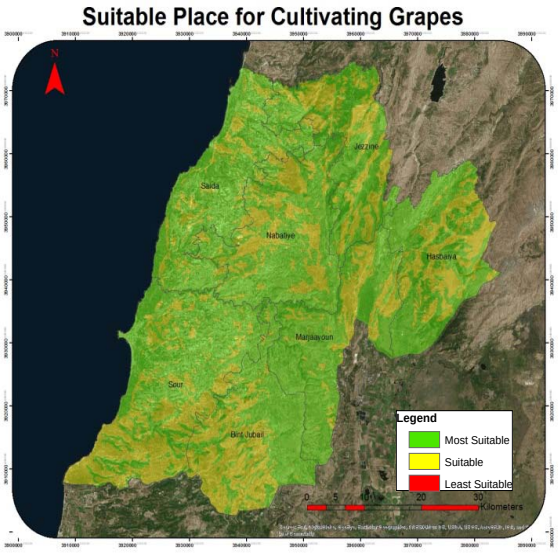

Figure 12: Grapes Map

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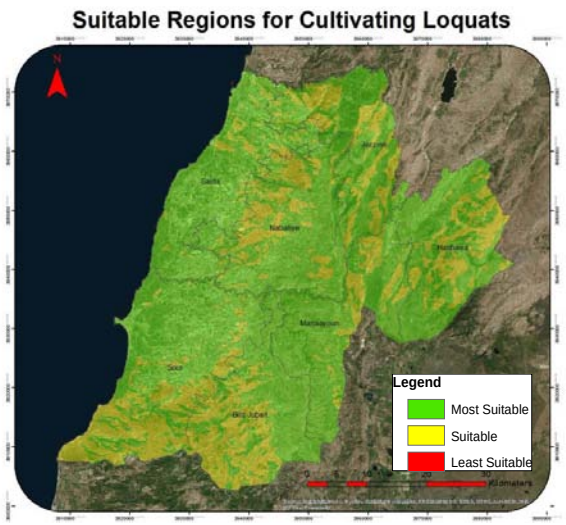

Figure 13: Loquat Map

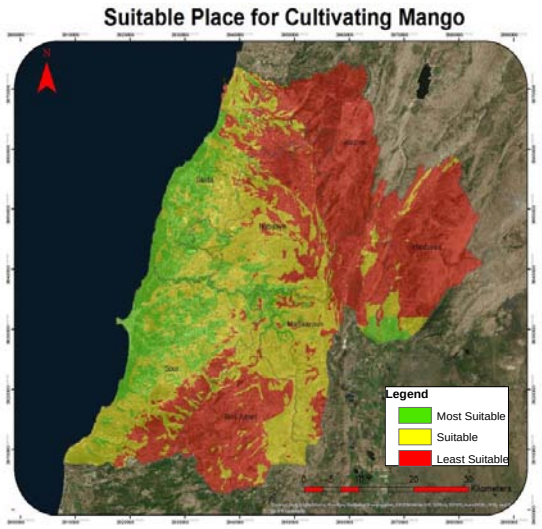

Figure 14: Mangoes Map

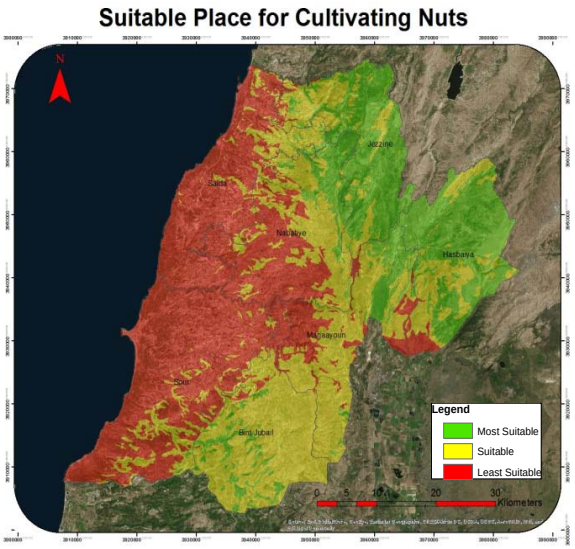

Figure 15: Nuts Map

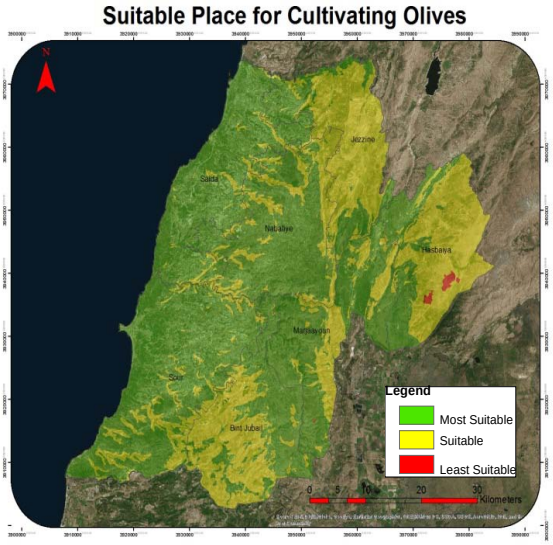

Figure 16: Olives Map

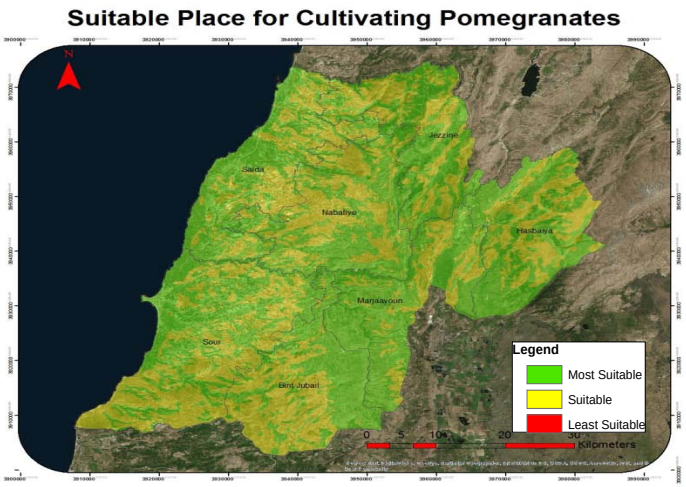

Figure 17: Pomegranates Map

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The map obtained in figure 4.14 and its classified into 5 classes: first class is "zero" means no trees can cultivated in this place, second class is "one" means only one kind can be cultivated, third class is "between 2 and 4" trees that can be cultivated, fourth class is "between 5 and 7" trees that can cultivated, the last class is "between 8 and 10" trees that can be cultivated.

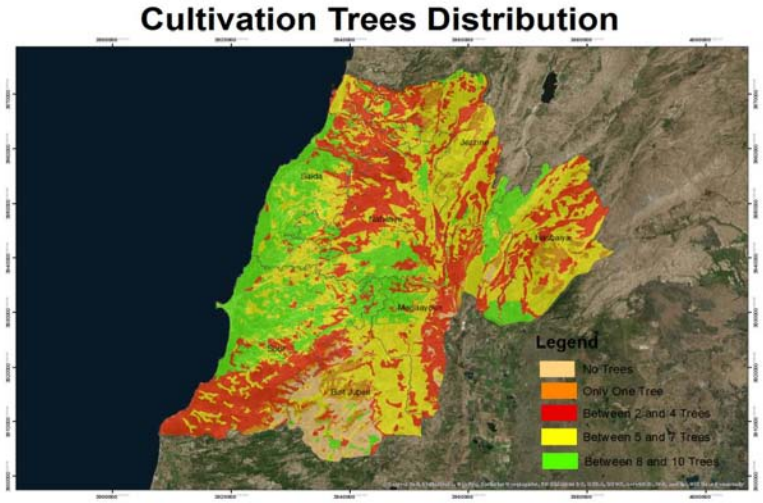

Figure 18: Trees distribution

Then by using "identify tool" in GIS we can get the kind of trees we can plant in its suitable place "1" means found and "0" means cannot be cultivated in this place, like it is shown in figure 4.2 below.

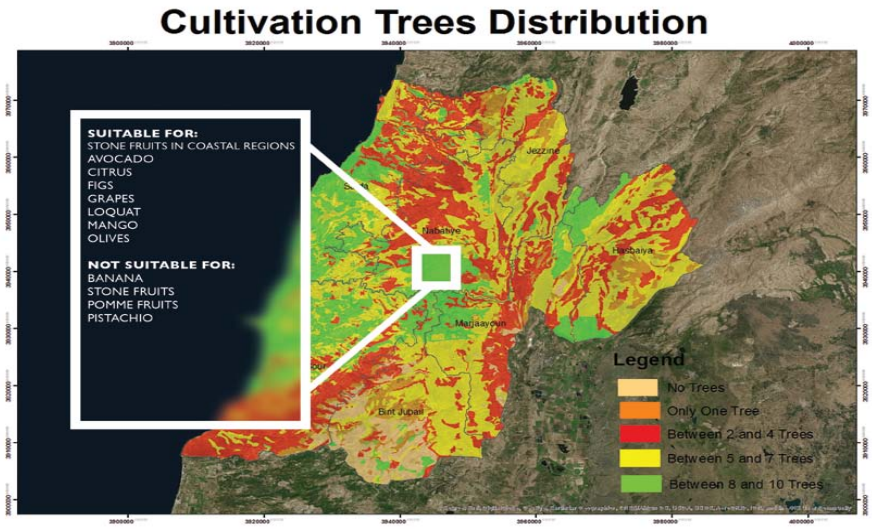

Figure19: The trees we can cultivate in this place.

From this figure we can see that in the same place we can plant Coastal stone fruit, avocado, citrus, figs, Loquat, grapes, mango, pomegranates, and olives.

V. Discussion

In this project we took South Lebanon as a study area and we chose 13 types of trees to know the suitable location for planting these types to have high productivity.

It is a study to organize the agriculture in Lebanon. We noticed that in South Lebanon 40% of land we can plant from 5 to 7 trees, and 20% of land we can plant from 8 to 10 trees, and 30% we can plant from 2 to 4 trees, and 6% of land we can't plant anything. So I have the choice of planting between 2 and 4 trees, and 5 and 7 trees, and 8 and 10 trees, so we made this Atlas to guide the farmers and people where to plant the type of trees, so they can have high productivity and this Atlas is a beginning in organizing agriculture in Lebanon.

VI. Conclusion

To sum up this study, we can conclude that the coastal strip up to an altitude of 300 m is most suitable

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for planting tropical and sub-tropical fruit trees, such as mangoes, bananas as long as the soil cultivated in is high in organic matter and low on clay matter and low Ph, and as for citrus and avocadoes cultivation can be successful up to 600m elevation regardless. Regarding pomegranates, olives, grapes, figs, loquat and stone fruits, we find that they can be cultivated over the entire area regardless of elevation or soil type, except for a few stone fruits varieties like Ajami Apricot which require higher chill requirements and accordingly need to be planted at higher elevations.

Finally, Pomme fruits and Pistachios, since they require high chill requirements to fruit dictates that they be cultivated higher than 700m, with the exception of a few apple varieties like Gala and Anna, which can be cultivated at elevation as low as 250m.

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A Study on Cyclone Recovery and Rehabilitation of Hizla Upazila in Barisal District of Bangladesh: A Case of Cyclone Sidr

By Abu Hassan, Md. Moniruzzaman, Md. Ohidur Zaman & M. Hasinur Rahman

Jagannath University

Abstract- Since independence in 1971, Bangladesh has endured almost 200 disaster events – cyclones, storm surges, floods, tornadoes, earthquakes, droughts and other calamities. The cyclone Sidr is the superset cyclone in Bangladesh. The study has been conducted at Hizla Upazila in the Barisal district of Bangladesh. Natural disasters are increasing day by day according to the opinion of the participants of the study. The local government does not act systematically as per government rules. Damage and losses assessment was not systematic according to standing orders on disaster. The dwellers of the study area continue their livelihoods very miserable after Sidr. The farmer lost their all crops and crops value was 45,75,362 dollar. The fisherman lost their net, fish and boat and their wealth value was 35735 dollar. 39 education institution fully and 66 education institution partially were damaged. But all sectors cannot recover properly from their losses. Some national or international NGO and Bangladesh government provided relief like dry foods, seeds, fertilizer, rice and old clothes etc. Relief was not sufficient for the dwellers in the study area. The study area has no Disaster Management Committee or no Red Crescent members to recover from the impacts of natural hazards during the disaster period.

Keywords: *cyclone sidr, assessment, damage and losses, recovery and rehabilitation.*

GJHSS-B Classification: *FOR Code: 059999*



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A Study on Cyclone Recovery and Rehabilitation of Hizla Upazila in Barisal District of Bangladesh: A Case of Cyclone Sidr

Abu Hassan [α], Md. Moniruzzaman [σ], Md. Ohidur Zaman [ρ] & M. Hasinur Rahman [ω]

Abstract- Since independence in 1971, Bangladesh has endured almost 200 disaster events – cyclones, storm surges, floods, tornadoes, earthquakes, droughts and other calamities. The cyclone Sidr is the superset cyclone in Bangladesh. The study has been conducted at Hizla Upazila in the Barisal district of Bangladesh. Natural disasters are increasing day by day according to the opinion of the participants of the study. The local government does not act systematically as per government rules. Damage and losses assessment was not systematic according to standing orders on disaster. The dwellers of the study area continue their livelihoods very miserable after Sidr. The farmer lost their all crops and crops value was 45,75,362 dollar. The fisherman lost their net, fish and boat and their wealth value was 35735 dollar. 39 education institution fully and 66 education institution partially were damaged. But all sectors cannot recover properly from their losses. Some national or international NGO and Bangladesh government provided relief like dry foods, seeds, fertilizer, rice and old clothes etc. Relief was not sufficient for the dwellers in the study area. The study area has no Disaster Management Committee or no Red Crescent members to recover from the impacts of natural hazards during the disaster period.

Keywords: cyclone sidr, assessment, damage and losses, recovery and rehabilitation.

I. Introduction

Bangladesh is one of the most disasters prone and particularly the worst flood-affected countries of the world. About one tenth of the global tropical cyclone occurs in the Bay of Bengal (GOB, UNDP, World Bank, 1993).Therefore, about one-third of the country is flooded almost every year. It is one of the most densely populated countries in the world, with more than 1000 people per square kilometer. As Cyclone hits almost every year, the people who live in the coastal regions as well as in the Coastal Chars areas are suffering from different types of social, physical and environmental problems.

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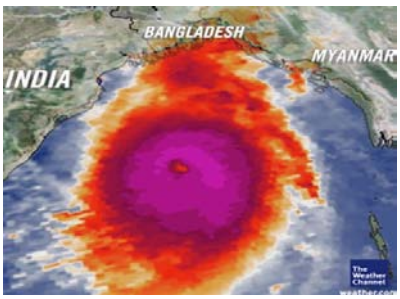
Sidr was the strongest named cyclone in the Bay of Bengal. It is known as super cyclonic Storm Sidr. The fourth named storm of the 2007 North Indian Cyclone season, Sidr formed on November 9, an area of disturbed weather developed southeast of the Andaman Islands, with a weak low-level circulation near the Nicobar Islands (Wikipedia, 2008) and gradually strengthened to reach peck one minute sustained winds of 260 km/h. The storm eventually made landfall in Bangladesh on November 15, 2007. The cyclonic storm of hurricane strength, Sidr was one of the 10 fiercest cyclones that hit the region of Bangladesh in the 131 years between 1876 and 2007. Almost 9 million people in 30 southern districts were affected by the cyclonic storm. Current figures report a death toll of 3,406 people, with a further 871 missing, over 55,000 injured (Assaduzzaman, 1986). Of the 30 districts affected, the government has classified four as the "worst" affected – Bagerhat, Barguna, Patuakhali and Pirojpur and eight districts as "moderately" affected - Khulna, Madaripur, Shariatpur, Barishal, Bhola, Satkhira, Jhalakathi, and Gopalganj.



Source: weather.com

Figure-01: Cyclone Sidr

On the other hand, according to the calculation by the Local Consultative Group, the total number of houses damaged was estimated at 1,522,077. Extensive damage to roads (8084 km), bridges/culverts (1687), protection embankments (1875 km) and public buildings, including 2,240 educational institutions destroyed and another 11,490 partially damaged(Islam & Neliam, 2010). Electricity and communication were knocked out. Roads and waterways became intransitive. The cyclone caused contamination of drinking water sources, in particular wells and ponds, which were

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spoiled by debris and leaves, as well as dead human bodies and animal carcasses. Many ponds were inundated by saline water brought by the tidal waves. Sanitation infrastructure was destroyed or damaged.

Table 01: Synopsis of cyclone Sidr

Formed	November 11,2007
Enter to Land	November 15,2007
Dissipated	November16,2007
Highest winds	215 km/h (130)
Lowest pressure	944 hPa(mbar)
Damage	$ 450 million (2007 USD)
Area Affected	Bangladesh and West Bangla, India

Source: Banglapedia, 2008

The selected study area is situated in Barisal city and is vulnerable to tidal inundation, cyclone, storm surges and monsoon floods under the coastal area of Bangladesh. The people of the area faced different kinds of the problem by natural hazards like Cyclone, storm surges, river bank erosion, water logging and heavy rainfall etc. Climate change puts extra burdens on the social and economic challenges that the poorest people already face.

The main objective is to assess damage and losses in the HizlaUpazila.

The specific objectives of the research are (i) To describe the processing of assessment system damage, losses and need (ii)) To explore damage and losses assessment in the study area, (iii) To assess recovery and rehabilitation programs during/post-disaster period, (iv) To assess disaster preparedness activities.

II. Methodology

The study has been conducted at HizlaUpazila in Barisal. The selected area is divided into six unions. About 40 In-depth Interview has conducted among six chairmen, male and female Local government member of the study area, Thana Nirbahi Officer of HizlaUpazila, Upazila Agriculture Officer, Upazila Fisheries Officer, Secretary of all of Union Parishad and Manager of BRAC. Three FGD has conducted among dwellers of the study area (three unions out of the six unions). Secondary data was collected from different organizations like Disaster Management Bureau (DMD), Compressive Disaster Management Program (CDMP), UpazilaNirbahi Office, Upazila Agriculture Office, Upazila Fisheries office, all Union Parishad of HizlaUpazila, Environment and Population Research Centre(EPRC), Bangladesh Statistical Bureau (BBS), Central library of JagannathUniversity, Central library Dhaka, Public Library and BRAC. Secondary data was collected from different websites related to the department of environment, disaster and government. The database was created using the data collected from the field. The data was analyzed by using Micro Soft Excel. The results are presented in tabulated forms. Arc GIS 9.2 software was also used for preparing map purpose.

III. Result

a) *Describe processing of assessment system damage, losses and need*

Damage, losses and need assessment is very important activities in post disaster period for local government/disaster management committee. It has rules and regulation what is responsibilities and how asses of damage, losses and need by local government, disaster management committee and relevant sector. Everybody have to follow Standing orders on disaster. TNO have to arrange meeting with Local government, disaster management committee and relevant sector and discussed about the situation affected area and damage, losses and need. After that local government /disaster management committee assess what kinds of wealthdamage and losses, what kinds of relief need in post disaster period and how much wealth damage and losses and how much wealth need in post disasterperiod. The assessment processing system was not appropriate at standing order of Disaster Management. The local government assesses the damage and losses by going to door to door in the study area. They used white paper for writing down of damage, losses and needs and submitted to Chairman like Report. Some member said that straight line papermade by own self and use for assessment how many wealth damage, losses and needs item. Most of the member said that they do not get any kinds of Form from TNO or Chairman to calculate for DLNA. After that Union Porishad Chairman submitted it to TNO. But they do not use D Form for assessment damage, losses and need and they do not know how they will fill up the D Form. It takes to get all information easily by D Form.

b) *Explore damage and losses assessment in the study area*

i. *Affected family*

An estimated that 22454 family houses were fully damaged, 3221 family houses partially damaged by Sidr in HizlaUpazila.797 fisheries family lost their net and boat,34134 farmer lost their crops and others,2315 handicraft families lost their only basic needs by Sidr.

Table 2.1: Affected Families by Sidr

Sector	Number of Family
Fully damaged House	2245
Partially damaged House	3221
Fisheries Family	797
Farmer	34134
Handicraft Family	2315

Source: Project Implementation officer (PIO) in HizlaUpazila

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ii. *Damage and Losses on Agriculture sector*

The study area is agriculture prone area. About 75% people are directly or in directly depended on agriculture sector. Different type of crops like paddy, jute, chili, lentil, banana and soabinetc is grown in the area. At estimated 11,588 tone crops damaged by Sidr in 2007 and losses of money 45, 75,362 dollar (Details table 2.1).

Table 2.1: Losses of Money on Agriculture Crops

Name of Crops	Damage of Production (Tones)	Losses of Money (Doller)
Paddy	7550000(7550)	90600000(13,13,043)
Vegetables	1316000(1316)	18424000(26,70,145)
Banana	1125000(1125)	16875000(2,44,565)
Papaw	570000(570)	5700000(82,609)
Betel leaf	225000(225)	5625000(81,522)
Variety pulse	760000(760)	11400000(1,65,217)
Lentil	42000(42)	1260000 (18,261)
Total	11588000(11588)	149884000(45,75,362)

Source: Agriculture office of HizlaUpazila

iii. *Fisheries Sector*

The study area is riverincountry. The study area stands beside the Meghna and the Naiabangani.6.18% peoples depends on fisheries sector. 266.23 acres small and big ponds were damaged by Sidr, 997 boats were partially damaged and 3986 kg net were partially damaged by Sidr. According to fisheries office of Hizla Upazila minimum 35735 dollar was lost during disaster period in Sidr(Details table 2.2).

Table 2.2: Damage Fisheries Sector and Losses Money

Description	Damage Fisheries Sector	Losses of Money (dollar)
Small Ponds	679 (218.61 Acres)	6000000.00 (86957)
Large Ponds	75 (47.62 Acres)	307200.00 (4452)
Boat	997	63760.00(924) (Repairing cost)
Net	3986 (kg)	103610.00 (1502) (Repairing cost)
Total		24,65,710.00 (35735)

Source: Fisheries office of HizlaUpazila

iv. *Infrastructure Sector*

An estimated 2245 houses were fully and 3221 houses were partially damaged, 16 km road were fully and 186 km road were partially damaged in the study area by Sidr. 16 culverts were partially damaged, 5km embankments were fully damaged,36 education institutionswere fully and 66 education institutions were partially damaged by Sidr in the study area (Details table 2.3).Most of the people used ponds water for bathing, washing and cooking but all of the ponds were flooded by water. TW is main source for drinking water but TW was partially damaged by Sidr. Sanitation condition was very poor and most of the sanitation was fully damaged by Sidr in the study area.

Table 2.3: Damaged infrastructure sector of the Area

Sector	Damaged	
	Fully	Partially
House	2245	3221
Road	15 (km)	186 (km)
Culvert	-	16
Embankment	5 km	-
Education institution	39	66

Source: Project Implementation officer (PIO) in HizlaUpazila

c) *Assess recovery and rehabilitation programs post disaster period*

Recovery and Rehabilitation programs arevery important programs in post disaster period. This program depends on damage and losses assessment report from local government. After that TNO communicated with higher-level of government authorities.

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i. *Agricultur sector*

Agriculture is main income source of the study area. Most of the crops were damaged by Sidr. The Republic of Bangladesh, Chains government and FAO helped recover from Sidr. At estimated 25 power pump,30 power tiller and 20 power maria machine provided by Chain government among the farmer in the study area. According to Project Implementation officer (PIO) of HizlaUpazila reported 1250 farmers used that materials got from Chain government. Each famer got 8 kg TSP fertilizer from Chain government. 130 kg different type seeds provided by FAO and 4016 kg different type seeds provided by Bangladesh government(Details table 3.1). 195 kg different type fertilizers provided by FAO and 2129 kg different type fertilizer provided by Bangladesh government (Details table 3.1).

Table 3.1: Recovery Status on Agriculture Sector

Relief items	Quantity	From Country /Organization	Remarks
Power Pump	25	China Government	Harinathpur=8,Guabaria=8,Borjalia=9
Power tiller	30		Harinathpur=9,Guabaria=9,Borjalia=12
Power MariyMachin	20		Harinathpur=6,Guabaria=6,Borjalia=8
Seeds	130 (kg)	FAO	Paddy=20, Maze=20,Falon=20,muge=50,Water Mallon=20
	4016 kg	Bangladesh Government	Hybrid Boro=1125,Upsey Boro=1500,Vegetables=391
Fertilizer	195 kg	FAO	Ureia=77,TSP=64,MPO=54
	2129 kg	Bangladesh Government	Ureia=870, TSP=70,MPO=549
	10000 kg	China Government	TSP=10000

Source: Project Implementation officer (PIO) in HizlaUpazila

ii. *Relief items*

Different type international organizations like save the children, Red Crescent and national organizations like BRAC, Bangladesh Army and Bangladesh government distributed relief items among the study area peoples. According to Project Implementation officer (PIO) of HizlaUpazila reported that Save the Children provided rice among 6500 families and each family was got 30 kg rice, BRAC provided among 2050 families and each family was got 20 kg rice, Red Crescent provided among 700 families and each family was got 5kg rice and Bangladesh army provided among 1000 families and each family got 5 kg rice. Save the children provided pulse among 6500 families and each family got 9kg pulse, BRAC provided pulse among 2050 families and each family got 5 kg and Bangladesh Army provided among 400 families and each family got 1 kg. About 300 bottles and 0.30 tone of safe drinking water provided among 1500 families by BRAC. Save the Children provided oil among 6500 families and each family got 2 kg, BRAC provided oil among 2050 families and each family got 2 kg (Details table 3.2).

Table 3.2: Provide relief food items among the area people

Relief items	Number of family	Provided Country /Organization	Remarks
Rice	6500	Save The Children	Each family get 30 kg
	2050	BRAC	Each family get 20 kg
	700	Red Crescent	Each family get 20 kg
	1000	Bangladesh Army	Each family get 5 kg
Pulse	6500	Save The Children	Each family get 9 kg
	2050	BRAC	Each family get 5 kg
	700	Red Crescent	Each family get 5 kg
	400	Bangladesh Army	Each family get 1 kg
Oil	6500	Save the Children	Each family get 2 kg
	2050	BRAC	Each family get 2 kg
	700	Red Crescent	Each family get 1 kg
	-	Bangladesh Army	One Cartoon provide in the area
Salt	6500	Save The Children	Each family get 1 kg
Saline	2050	BRAC	Each family get 2Pack

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	1850	Bangladesh Army	8 Cartons and 150 Bags
Biscuits	2050	BRAC	-
	450	Bangladesh Army	-
Safe drinking water	1500	Bangladesh Army	300 Bottles & 0.30 tones

Source: project implementation officer (pio) in hizlaupazila

iii. *Cyclone shelter*

15 cyclone centres was established before Sidr. 18 cyclone centers were established after Sidr by Bangladesh government (Details table 3.3).

Table 3.3: Number of cyclone Centre in HizlaUpazila

Name of Union	Number of cyclone Centre		
	Before	After	Total
Harinathpur	3	4	7
Borjalia	3	4	7
Guabaria	2	3	5
Mamonia	2	2	4
Dulkhola	3	3	6
Guabaria	2	2	4
Total	15	18	33

Source: Project Implementation officer (PIO) in HizlaUpazila

iv. *Daily necessary items & Money*

According to Project Implementation officer (PIO) of HizlaUpazila reported that78696 Dollar provided among 2055 families for repairing house by Bangladesh government.18696 dollar provided among 129 families by chief advisor own fund.15000 BGF card distributed among 15000 families, 875009 kg BGF rice and 71000 GR- rice provided among the study area peoples (Details table 3.3).

Table 3.4: Distributed Daily necessary needs items and money among the study area peoples

Distribution items	Quantity
BGF Card	15000
BGF Rice	875009 (kg)
GR- Rice	71000 (Kg)
Blanket	804
Haricane	327
Pot	40
Sari	146
Oldcloth	1500
Tin	130 (among 65 families)
Money (For repairing house)	54,30,000.00 (78696 Dollar) (among 2055 families)
Money from Chief Advisor	1290000.00 (18696 Dollar) (among 129 families)

Source: Project Implementation officer (PIO) in HizlaUpazila

d) Assess Disaster preparedness activities

The study area is natural disaster prone area. But disaster preparedness activities were very poor of the area. There were no communications local governments with general people. But one chairman out of the six chairman said that he was announced with hand mike among the dwellers and shifted general dwellers to safety place. Cyclone centre was not sufficient. In spite of few cyclone centres, it was very difficult to reach cyclone centre because most of the cyclone centre beside the river and there were no road to go cyclone centre. The dwellers did not want to go security place because they have house, domestic animals and birds.Some dwellers kept faith on Allah.Sanitation system was not good in the cyclone centre. Safe drinking water was very crises in the cyclone centre.Some dwellers thought cyclone centre was not security place because there was not separate room for female or children. The study area has no ward disaster management committee. Red Cross member

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was not available in the area.Alarming system was very poor. They do not get any alarm from local administration.The dwellers did not reserve any kinds of food for future. But some dwellers valuable maters like gold and money deposited under the soil with polithian.

IV. Discussion

Bangladesh is among the world's most disaster-prone countries and the frequency of natural disasters has increased in recent years. Since independence in 1971, the country has endured almost 200 disaster events – cyclones, storm surges, floods, tornadoes, earthquakes, droughts and other calamities – causing more that 500,000 deaths and leaving serious impacts on quality of life, livelihoods and the economy. The cyclone Sidr is the superset cyclone in Bangladesh. Bangladesh is also one of the world's poorest and most densely populated countries, where poverty often compels families to settle in areas that are particularly disaster – prone, such as coastal areas and lands newly emerged from riverbeds (char-lands). The local government member contribution had not systematic per government rules according to standing orders on disaster. Most of the member reported any kinds of decision have taken by only local chairman. Damage and losses assessment system was not systematic according to standing orders on disaster. The chairman influenced to assess damage or losses on member most of times for writing their relative or support party peoples. When all member submitted their report to chairman, the chairman would write report by own view. As a result the actual information or data did not arise of the area. Most of the families were attacked by Sidr. The dwellers of the study area continue their livelihoods very miserable after Sidr. The farmer lost their all crops and crops value was 45,75, 362 dollar.The fisherman lost their net, fish and boat and their wealth value was 35735 dollar. 39 education institution fully and 66 education institution partially were damaged. But all sectors cannot recover properly from their losses. Some national or international NGO and Bangladesh government provided relief like dry foods, seeds, fertilizer, rice and old cloths etc. Relief was not sufficient for the dwellers in the study area. Generally fisheries sector did not get any kinds of help from Government or NGO. It would like to mention that 18 cyclone centre built up after Sidr. Disaster preparedness activities were very weak in the study area. The study area has no Disaster Management Committee or no Red Crescent members to recover from the impacts of natural hazards during disaster period. As a result local administration cannot strong contribution in pre, during and post disaster period for dwellers of the study area.

V. Conclusion

Disaster management process in this country is not strong enough. The local level management system which is known as Ward Disaster Management Committee (WDMC), is very weak. The government has to make strong ward disaster management committee. Female ward commissioner has to be included in the committee. The government has to take arrange training program regularly for local government and disaster management committee to improve their ability. The government should focus on the strong alarming system of the area. Local government administration, Local chairman, member and Ward disaster management committee should take responsibility in the pre-disaster period. More and more tress has to plant to protect super cyclone. The government has to include disaster-related topics in primary and secondary level books.

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The Determinants of International Reserves in West African States

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Abstract- This study examined the relationship between international reserve and its determinants in west African States for the period of 2005 to 2014. The study was based on buffer stock model and was estimated using Panel ARDL approach. In the short run, All the variables except imports and NEER have a positive impact on international reserve. In the long-run, (IMP), export (EXA) and nominal effective exchange (NEER) does not have a statistical relationship with international reserves accumulation.

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The Determinants of International Reserves in West African States

Philip Olomola Ifeoluwa [α] & Tolulope Ajayi [σ]

Abstract- This study examined the relationship between international reserve and its determinants in west African States for the period of 2005 to 2014. The study was based on buffer stock model and was estimated using Panel ARDL approach. In the short run, All the variables except imports and NEER have a positive impact on international reserve. In the long-run, (IMP), export (EXA) and nominal effective exchange (NEER) does not have a statistical relationship with international reserves accumulation.

I. Introduction

International reserve accumulation is considered to be a form of self-protection against financial crisis; they enable the central banks to intervene in the foreign exchange market and help to cushion the economy from external shocks Andreas (2014). International Monetary Fund (IMF) sees international reserves as a means of crisis prevention and proposed new measures to evaluate their adequacy IMF (2000). Feldstein (1999) advised emerging markets to rely on large foreign exchange reserves as a form of self- protection and to count less on assistance by the IMF. Countries have sought to self-insure against future crises, either because of a perceived increase in the cost of crises or because of the perceived conditionality costs of using IMF credit Bird & Mandilaras (2011). A country needs to maintain international reserve for various purposes, such as to finance import, to maintain exchange rate at a certain range of levels, or to maintain a certain level of reserve.

Countries accumulate reserves to fight against future financial crises IMF (2000). Reserve accumulation has been said to be a means by which a country insure itself against external shocks and also escape the conditions of getting loans from IMF (feldstein, bird and mandilaras (2011)). ECOWAS has 15 countries, all of which are developing countries, they are characterized by poor economic performance, political instability, unemployment/ underemployment, low level of technology, poor social infrastructures etc. Nevertheless, member states still accumulate reserves despite the fact that they are seen as Less Developed Countries, the recent fluctuations in the level of international reserve accumulation has gained renewed interest from both academicians and researchers to investigate the major determinants of international reserves especially in ECOWAS States. Hence, this study. This study would also be useful to foreign investors, as it would give insights to the structure of reserves in ECOWAS before trading with them as maintenance of adequate reserves boost investors' confidence and enhance investment and growth.

II. Literature Review

David and Baba (2013) examined the determinant of foreign reserve accumulation. They estimated buffer stock model with ARDL. For the determinants of foreign reserves in Nigeria, they focused on income, monetary policy rate, imports and exchange rate. The result provided a strong evidence for the long run relationship among the determinants of reserves in Nigeria and provides strong evidence in support of income as a major determinant of reserves management in Nigeria.

Bentum-Ennin (2014) studied the relationship between international reserve accumulation and economic growth in WAMI zone and confirmed that international reserves accumulation promotes economic growth in the zone, a result which is consistent with the findings of Polterovich & Popov (2003) and Fukuda & Kon (2010).

Frenkel and Jovanovic (1981) states that most of the rules for a country's demand for foreign exchange reserves consider real variables, such as imports, exports, foreign debt, severity of possible trade shocks and monetary policy considerations. Similarly, Shcher-bakov (2002) states that, there are some indicators that are used to determine the extent of external vulnerability of a country and the capability of foreign reserves to minimize this vulnerability.

Disyatat & Mathieson (2001) adopted Frenkel and Jovanovic (Buffer stock) model for fifteen countries in Asia and Latin America and submitted that the volatility of the exchange rate is an important determinant of reserves accumulation and that the financial crisis of the late 1990s produced no structural breaks. Adam and Ndikumana (2009) investigated sources, motivations, and effects reserves accumulation in African countries. According to the study, African countries have reserves in recent years from exports and aid flows. African countries are urged to hold reserves to allow monetary authorities to intervene in markets to control the exchange rate and inflation. The study used panel data from 21 African countries to

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examine the sources, motivation and economic implications of reserve accumulation with a focus on the impact on the exchange rate, inflation, and public and private investment. While the level of reserves remains adequate on average, some countries have accumulated excessive reserves especially in recent years. The empirical analysis in this paper shows that the recent reserve accumulation cannot be justified by portfolio choice motives (in terms of returns to assets) or stabilisation objectives. At the same time, it has resulted in exchange rate appreciation, while it has yielded little benefits in terms of public and private investment. The evidence suggests that African countries, especially those endowed with natural resources need to adopt a more pro-growth approach to reserve management.

Gerti (2012) analyses the change in international reserve pooling and their determinants, and evaluates their optimal level from a cost opportunity perspective. The buffer stock model was analyzed with ARDL approach. Results indicate a negative relationship of reserve pooling with opportunity cost, volatility and deviation of exchange rate from the trend and positive relationship with imports. The approach estimation suggests that the level of optimal reserve holdings is more sensitive to precautionary rather than mercantilist motives. Ramachandran (2004) applied the buffer stock model for India covering the period 1993 - 2003, which was characterized by flexible exchange rate, and high level of capital flows.

From the empirical literature surveyed above the links between international reserves and many variables such as Gross Domestic product (GDP), exchange rate, imports, exports among others have been tested in various economic regions of the world but it has not been studied critically in ECOWAS. Furthermore, there have been variations in the results on the analysis of international reserve pooling. This variation in the result is with regard to the choice of sample period (monthly, quarterly, yearly etc.), estimation techniques and regions considered (Latin America, ASEAN, OECD etc.)

III. Methodology

a) *Theoretical Framework*

Reserve holdings are important macroeconomic indicators. They are necessary as a guarantee to balance external sector shocks. The higher the reserve stock level, the more protected the economy is. On the other hand, reserve holdings have a financial and economic cost expressed as forgone earnings from investment and in the growth of the external government debt. Thus, it is necessary to evaluate the optimal level of reserve that satisfies both outlined criteria. Estimating the optimal level is a task faced by the monetary authority of a country. The most widely used of these models in the literature is the 'buffer stock model'.

The model implies that the authorities demand reserves as a buffer to curb fluctuations in external payment imbalances. This is to avoid macroeconomic adjustment cost arising from imbalances in the external payments. The advantage of the model over others is its adaptability to both fixed and floating exchange regimes. The model is as relevant in a modern floating exchange regime as it was during the Bretton Woods regime. Frenkel & Jovanovic (1981) developed Buffer Stock model of the demand for reserve. This model describes reserves as a continuous exogenous Wiener process of the following form:

$$dIR(t) = -\mu dt + \sigma dw(t) \quad (1)$$

$I(t)$: reserves held in time t

W(t): standard Weiner process based on a simple random walk, with mean μ and variance

σ

μ: deterministic part of the instantaneous change in reserves

σ : standard deviation of the Weiner increment in reserves At each point in time the distribution of reserves holdings R (t) is characterized by

$$IR(t) = IR^* - \mu t + \sigma IRW(t) \quad (2)$$

Where:

*IR**is the optimal stock of reserves, which is obtained by minimizing two types of costs:

i. The cost of adjustment, which is incurred once reserves reach an undesirable lower bound;
ii. Foregone earnings on reserve holdings. The optimal stock of reserves is obtained by minimizing these two costs and it yields an expression:

$$R^* = \left[\sqrt{\frac{2c\sigma^2}{(2r\sigma^2)0.5}}\right] \quad (3)$$

Where:

c: fixed cost of adjustment

r: opportunity cost of holding reserves

σ: standard deviation of change in reserves

In this model, reserves are a stochastic process governing the inflows of payments and receipts in the balance of payments. Thus, changes in reserves are a normal variety process with mean $-\mu\Delta t$ and variance. The actual stock of reserves, in time t, is a random $\sigma\Delta W(t)$The actual stock of reserves, $IR\ (t)$ in time *t,* is a random variable characterized by:

$$IR(t) = IR_0 - \mu t + \sigma W(t) \quad (4)$$

$$\text{And } IR(t) \sim N(IR_0 - \mu t; +\sigma 2(t) \quad (5)$$

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In the above case, according to Frenkel & Jovanovic (1981),IR_o is the initial stock of reserve (assumed to be the optimal level). If we also assume that overall reserves are at their optimum level, in other words on average each year stocks are close to the optimal level, the displacement constant μ is zero and thus the product μ is zero. So the stochastic process that governs changes in reserves is without a drift. For developing economies, μ is a conditional 0 IR variable, which requires further discussion. It is, however, worth noting that many authors, who have been basing on this model, have adjusted this assumption as described below.

Under the above assumption, Frenkel and Jovanovic (1981) assume that the optimal level is the stock of reserves that minimises the cost of adjustment (which itself means a cost that can be derived by adjusting the current level of reserves to the optimal level and the opportunity cost of holding reserves). In the case of the first cost, it can be considered as the level of money that should be withdrawn from the economy so as to yield the desired balance of payments surplus that is necessary to accumulate reserves. Thus, this cost measures the cost of pursuing reserves in the case when it is below the optimal level (in other words the cost of real adjustment necessary to enable a positive balance of the foreign payments). The second cost represents the opportunity cost (forgone earnings) of reserve holdings. So, it is the amount of forgone earnings from not investing the reserves, or the amount of forgone earnings lost in the form of interest in case of borrowing. It measures the cost for the society whenever the level of reserves is above the optimal level and should be adjusted down. The optimal stock serves to simultaneously minimise both costs, so that it minimises the loss function.

Using a second order approximation of Taylor series and then the log linearization of the obtained expression; the optimal stock of reserves can be expressed by:

$$\text{Log } IR(t) = b_0 + b_1 \log(\sigma t) + b_2 \log(rt) + \mu t \quad (6)$$

Where, r is the opportunity cost of reserve holdings.

Frenkel & Jovanovic (1981) evaluated equation (6) in order to calculate the corresponding value of the coefficients, which later can be used to estimate the optimal level of reserve holdings.

The priorities of the Buffer Stock model relate to the appearance as a time continuous approach and to the possibility to evaluate easily generated variables. To evaluate the same equation, in order to find the approximate values of the respective coefficients, variables included in equation (6) are expressed in nominal value.

b) Model Specifications

This study adopted the model specification of Aizenman & Marion (2003) in determining the optimal level of reserve.

$$IR = f(POP, GPC, EXA, IMY, NEER) \quad (7)$$

Where IR is actual holdings of reserves minus gold, POP is the total population of the country; GPC is real GDP per capita; EXA is the volatility of real export receipts; IMY is the share of imports of goods and services in GDP; and NEER is the volatility of the nominal effective exchange rate.

Transforming equation (7) to its explicit form, it becomes:

$$IR_{it} = \beta_0 + \beta_1 POP_{it} + \beta_2 GPC_{it} + \beta_3 EXA_{it} + \beta_4 IMY_{it} + \beta_5 NEER_{it} \quad (8)$$

Therefore, taking log of equation (8) and putting the model into an econometric form, we have:

$$Log\ IR_t = \beta_0 + \beta_1 \log POP_{it} + \beta_2 \log GPC_{it} + \beta_3 \log EXA_{it} + \beta_4 \log IMY_{it} + \beta_5 NEER_{it} + e_t \quad (9)$$

According to Aizenman & Marion (2003), there should be a positive relationship between IR and POP, IR and EXA, IR and GPC. IR should be negatively correlated with NEER, IMY.

From equation (9) above, the volatility of real export and nominal effect exchange rate is generated using GARCH model.

Based on Pesaran, Shin, and Smith (1999), using the autoregressive distributed lag ARDL (p, q), the dynamic heterogeneous panel regression equation with the error correction model can be formed as:

$$\Delta \log IR_{i,t} = \alpha_0 + \sum_{j=1}^{p-1} \lambda_j \Delta \log IR_{i,t-j} + \sum_{j=0}^{q-1} \delta_j \Delta \log POP_{i,t-j} + \sum_{j=1}^{p-1} \psi_j \Delta \log GPC_{i,t-j} + \sum_{j=1}^{p-1} \varpi_j \Delta \log EXA_{i,t-j} + \sum_{j=1}^{p-1} \varphi_j \Delta \log IMY_{i,t-j} +$$
$$\sum_{j=1}^{p-1} \sigma_j \Delta \log NEER_{i,t-j} + \phi_i' \left[\log IR_{i,t-1} - \left\{ \beta_0 + \beta_1 \log POP_{i,t-1} + \beta_2 \log GPC_{i,t-1} + \beta_3 \log EXA_{i,t-1} + \beta_4 \log IMY_{i,t-1} + \beta_5 \log NEER_{i,t-1} \right\} \right] + \varepsilon_{it} \quad (10)$$

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IV. Empirical Results

Table 1 reports the descriptive statistics such as means, median, maximum, minimum and standard deviation. For the purpose of achieving the objectives of the study, the variables were logged, which will also enhance the robustness of the estimated model and consistency of the residual.

a) Descriptive Statistics of the Data

Table 1 shows that all the variables displayed moderate level of consistency, as the difference between their mean and median are not really significant; the mean and median values lie within their maximum and minimum values. However LIMY is the least volatile variable with standard deviation of 0.411204 while LEXA is the most volatile variable with 2.073573 of standard deviation. The skewness statistics revealed that both LNEER and LPOP were negatively skewed while every other variable are positively skewed. Also, the low deviation of all variables showed that each variable is not far to its mean. The kurtosis of all the variables in the analysis exceeds 3, meaning that the series are leptokurtic (peaked) relative to normal distribution. Finally,

The Jarque-Bera statistics rejected the null hypothesis of normal distribution at 5% level of significance; all the variables are below 5% level of significance, except POP which is above 5% level of significance.

Table 1: Descriptive Statistics of the Variables

	LEXA	LGPC	LIMY	LIR	LNEER	LPOP
Mean	21.61097	6.247141	3.696664	20.40294	5.615554	15.93656
Median	21.34133	6.101914	3.706968	20.30022	6.172257	16.20088
Maximum	27.31922	7.916361	4.974859	24.70480	8.855680	18.99435
Minimum	18.16663	5.110542	2.560431	15.98210	-0.098408	13.06944
Std. Dev.	2.073573	0.605706	0.411204	1.622055	1.901631	1.324381
Skewness	0.977356	0.945644	0.238002	0.557077	-1.100476	-0.110497
Kurtosis	3.772483	4.107894	4.132991	4.139005	4.835767	3.429366
Jarque-Bera	25.95357	29.82732	8.998556	15.65515	50.65442	1.457461
Probability	0.000002	0.000000	0.011117	0.000399	0.000000	0.482521
Sum	3047.147	930.8241	528.6230	3019.634	831.1020	2390.484
Sum Sq. Dev.	601.9589	54.29822	24.01055	386.7664	531.5814	261.3437
Observations	141	149	143	148	148	150

Source: Author's Computation

Table 2: Panel Unit Root

Variable	LM, Pesaran and Shin W-stat	ADF - Fisher Chi-square	PP - Fisher Chi-square	Remarks
LEXA	-3.7886	71.169	84.1165	I(1)
LGPC	-4.7599	82.584	86.828	I(1)
LIMY	-3.9707	74.832	122.547	I(1)
LIR	-3.4874	69.2598	84.7767	I(1)
LNEER	-1.78596	45.7295	77.0863	I(1)
LPOP	-5.9546*	111.512*	89.8324*	I(0)

Source: Author's Computation

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Table 2 shows that all the variables are I (1) except Population which is I (0), therefore panel ARDL is suitable for estimating the model.

b) Bound Test/Cointegration Test

In investigating the long run relationship among the variables, the null hypothesis of co integration and long run convergence was tested using the bound test obtained after ARDL. The null hypothesis of no co integration was tested against the alternative hypothesis by the means of F-test with an asymptotic non-standard distribution. Table 3 reports the bound test among the variables. The F-statistic of 8.288 is greater than the upper critical bound at all the level of significance, this implies that long run relationship exists among the variables and therefore, they are co-integrated. This informed the decision of the study to estimate both short run and long run relationship of the variables.

Table 3: Bound Test

Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	k
F -statistic	8.288316	4
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

Source: Author's Computation

Table 3 shows that the calculated F statistics (8.29) is greater than the tabulated upper boundary of the F statistics of the bound test (5.06) then the variables are co-integrated at 1% level of significance.

Table 4: Short Run Coefficient

Variable	Coefficient	t-Statistics	P-value
D(LIMY)	-0.635298	- 3.127117	0.0022
D(LEXA)	0.162989	2.377177	0.0188
D(LNEER)	-0.303724	- 5.523703	0.0000
D(LNEER(-1))	-0.176254	- 3.298717	0.0012
D(LPOP)	0.673941	7.751094	0.0000
D(LGPC)	0.182826	2.820754	0.0740
CointEq(-1)	-0.185774	-3.849175	0.0002
R-squared	0.895354		
Adjusted R-squared	0.887716		
S.E. of regression	0.547001		
Sum squared resid	40.99183		
Log likelihood	-114.9988		
F-statistic	117.2178		
Prob(F-statistic)	0.000000		
Durbin-Watson stat	2.064344		

Source: Author's Computation

After ascertaining that there is a long run relationship between the variables, equation 9 is then estimated. The short run estimate reports the coefficient of the error correction term and other explanatory variables. The coefficient of the error correction term (-0.185774), being negatively signed indicates a significant adjustment process, correcting short-run disequilibrium from long-run positions. This occurs at a speed of 18.57 percent per period till the disequilibrium is corrected and long-run stability is achieved. The coefficient of import is -0.6353 in the short run and statistically significant at 5 percent level of significance,

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which indicates that in the short run rise in import will leads to fall in international reserve of the ECOWAS countries. Studies have established that most ECOWAS countries have preferences for imported goods Rincón (2007), and this reflect in a rapid rate of decay in their international reserves. The mono-cultural nature of these countries' economies affect their export capability and encourage the importation of finished commodities. Countries in this part of the world engage in exportation of primary commodities with low value addition processes. This arguably leads to shallowness in international reserve of most ECOWAS countries.

Also, International reserves adjustment in the short run, responds positively to the volatility of real export in ECOWAS countries. The coefficient of 0.1629 shows that positive movement in export revenue will induce the reserve to be in equilibrium and aid it stability over the horizon. It is a well-known assertion that export grows reserve of any economy, while imports deplete it. The positive effect of export on international reserve revealed the extent to which sustained export promotion in ECOWAS countries could boost their international reserve position and prepare them for future investment and consumption in the event of unfavourable external shocks effect. The strength of currency of countries in ECOWAS depends on export revenue and international reserve position.

Furthermore, corroborating a-priori expectations that the nominal exchange rate critically influences the level of reserve pooling, Disyatat and Mathieson (2001) submitted that the volatility of the exchange rate is an important determinant of reserve accumulation. The short-run estimates revealed that a 1% appreciation in the nominal exchange rate precipitates fall in international reserves by 30% basis points. This implies that depreciation of exchange rate will reduce the depletion of international reserve, as it will discourage importation, increase export earnings and simultaneously enhance the inflow of foreign capital.

In the same vein, the coefficient of the population of ECOWAS member states (POP) shows a significant positive impact on the accumulation of international reserves. This implies that a percentage increase in population, drives an expansion in the reserves position of member countries by a factor of 67 percentage basis points. Thus, the population of a country, the degree of factor mobility and the educational demographic of its workforce, serve as a major determinant of foreign capital investment inflow. This implies that increase in population will arguably leads to rise in investment and thereby bring about increase in the volume of local production. ECOWAS countries can thus exploit the growing demand from rapid population expansion, provided that the social capital of the population is well enhanced through education.

Besides, the estimates also indicate that upward movements in production volume exerts a positive significant increase in the level of pooled reserves. The reported coefficient of 0.182826 on GDP, implies that reserves will grow by approximately 18% if the National Income of member states appreciates jointly by 100%. The explanatory power of the model shows that 89.53% of the model variation was accounted for by the independent variables, though after adjusting for the loss in degree of freedom, the coefficient of determination fell to 88.77%. The F-statistics of the model reports the joint significance of the variables. It indicates that the variables are jointly statistically different from zero. The Durbin-Watson of 2.064 also revealed a model robust against the problems of serial correlation.

Table 5: Long Run Coefficients

Variable	Coefficient	t-Statistic	Prob.
LIMY	0.156444	0.200563	0.8413
LEXA	0.093847	0.593270	0.5540
LNEER	-0.176037	-1.226982	0.2219
LPOP	0.895799	3.409821	0.0009
LGPC	0.951555	20.63009	0.0000
C	4.518502	0.760349	0.4484

The long run estimate of reserves among the member states was captured using the panel autoregressive distributed lag model owing to the mixed order integration of the variables. Table 5 reports the long run estimates of the model. Imports do not statistically affect the international reserve in the long run. Similarly export of the ECOWAS countries does not have statistical relationship with long run accumulation in international reserve. The same is applicable to nominal effective exchange rate which exhibit no statistical relationship in the long run. Nevertheless, the results suggest that international reserve of members

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states is an increasing function of population growth in the long run, with a coefficient of 0.895799. This is expected because remittance rate will rise due to the high dependence nature of the ECOWAS countries on international remittances.

c) Heteroskedasticity Test

Harvey test for heterokedasticity was used to determine the constant variance and robustness of the overall model. Lack of constant variance could have a devastating effect on the efficiency and consistency of the estimate. The table 6 reports that the model is free from the problem of heteroskedasticity at 5% level of significance with p-value of 0.4798 and f-statistics of 0.9615. Table 7 reports the serial correlation test. The table shows that the presence of serial correlation is rejected and therefore, the model is free from the problem of autocorrelation.

Table 6: Heteroskedasticity Test

Heteroskedasticity Test: Harvey			
F-statistic	0.961548	Prob. F(10,137)	0.4798
Obs*R-squared	9.706279	Prob. Chi-Square(10)	0.4666
Scaled explained SS	12.27136	Prob. Chi-Square(10)	0.2673

Source: Author's Computation

d) Serial Correlation LM Test

The test of serial correlation in Table 7 proved that there is the absence of autocorrelation in the residuals of the model given that the reported F-statistic (0.322850) is insignificant at the 5% level of significance (p-value = 0.7246) permitting the conclusion that there is insufficient information to reject the null hypothesis of no autocorrelation.

Table 7: Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.322850	Prob. F(2,135)	0.7246
Obs*R-squared	0.704508	Prob. Chi-Square(2)	0.7031

Source: Author's Computation

V. Conclusion

This study examined the relationship between international reserve and its determinants in west African States for the period of 2005 to 2014. The study established that export constitute a great factor in ensuring stability of international reserve. The variables used in the study tend to have a high proportional effect on international reserve. The study lends support to the views of scholars like Ramkishen, Reza and Graham (2003) and Jiae (2013) who claim that countries will gains from reserve pooling and it will reduce their risk exposure.

Based on the findings from the study the following recommendations are worthwhile: Export should be encouraged in the ECOWAS countries, especially among the member countries. Since member countries export more of primary products, the products should be repackaged in such a way that it would meet international standard. This will reduce the member countries vulnerability to international shocks. Impediment to trade among member countries should be removed and free flow of goods and services should be embraced. This will go a long way in ensuring stability of the reserve after pooling. Furthermore, countries should focus on the accumulation of reserves for future use and prudently manage the reserve by putting a sound management strategy in place.

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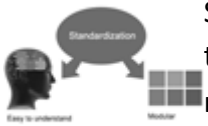

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4. Use of computer is recommended: As you are doing research in the field of homan social science then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then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

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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.

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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.

The Administration Rules

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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

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