AIR POLLUTION CLIMATOLOGY IN SPATIAL PLANNING FOR SUSTAINABLE DEVELOPMENT IN THE NIGER DELTA, NIGERIA

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ABSTRACT

- The paper highlights the relevance of spatial planning in sustainable development
- Justifies the importance of integrating air pollution in planning development in a coastal milieu.
- Underscores the role of air pollution climatology in understanding air pollution dispersion
- Also in the spatial variation in air pollutant concentration

- Data on wind speed and direction and concentration of human activities that affect air quality
- Descriptive analysis illustrated the spatial variation in pollution in temporal context
- Paper recommends planning infrastructures, industries and residential areas appropriately
- Taking into consideration adequate distance of residences from busy road networks , construction sites and industrial zones

INTRODUCTION

- Sustainable development as used in paper synonymous with Environmental sustainability
- That is development that promotes environment friendliness
- A policy instrument that facilitate this is Spatial Planning
- This is akin to environmental (land use) planning at all spatial scales
- An important consideration in such plans is Air Quality

- Dynamic in space-time, attributed to atmospheric dynamics such as wind
- Understanding pollution dynamics underscores Air Pollution Climatology
- Useful in planning allocation of infrastructure vis-à-vis population
- Paper attempts a justification of its relevance in accelerated sustainable development

The Problematic

- Many land uses in the Niger Delta are capable of interacting with air quality, thus compromising the suitability for humans
- Studies confirm differential distribution of parameters
- Suggest atmospheric gradients and differential sources location

- Efforts at strategic location and allocation on the basis of climatic gradients not integrated in most planning
- This is necessary in a coastal milieu such as the Niger Delta
- The coastal environment is distinctive, characterized by dynamic and energetic atmospheric conditions (NAS, 1992)

Land Use and Air Pollution Patterns

- Spatial variation in air pollution attributed to land use differential
- Heterogeneous regional land use means spatial inequality in air quality contribution and concentration
- No studies on spatial variation in air quality vis-à-vis land uses
- A heterogeneous pattern o f air quality attrition in the region exist

- Clearly exemplified in the cities, where land use zoning, are made up of high built-up areas and very cosmopolitan
- The built-up influences ventilation and attenuate wind speed and direction
- In the rural areas are oil and gas facilities capable of generating fugitive pollutants Fig. 1
- The location of these and settlements should consider wind speed/direction as well as land cover that attenuates these climatic parameters

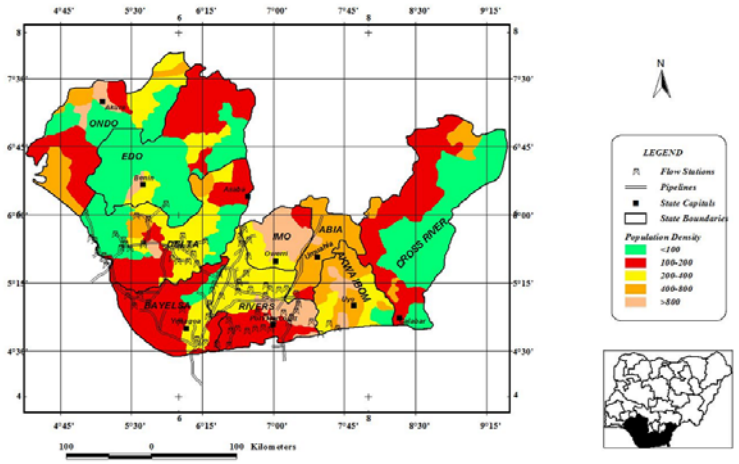


Fig. 1: Population Density, Some Existing Flow Stations and Pipelines in the Niger Delta
Source: Federal Government of Nigeria, 2006.

Wind speed and direction in Air Pollution Variation

- The need for development planning that integrates air pollution climatology very important
- Air pollutants have local, regional and continental effects
- Wind in an attempt to equalize pressure gradient carries with it pollutants

- Concentration dependent on prevailing wind direction
- Generally upwind location have less pollutant concentration
- Calm and Light wind accelerate pollutant concentration around emission sources
- Speed and direction change with season; hence pollutant concentration variation

Winds in the Niger Delta

- Winds vary with location and season mostly in speed
- At the global scale, the synoptic wind is south westerly (Fig 2 -5)
- Speed varies between 0-2.99 ms^{-1}, 3-5.99 and 6-7.99 ms^{-1}, with season and location
- Light winds to gentle breeze most dominant (Fig 2-5)

January Wind

- Station base pattern shows winds predominantly in four directions in January (S, SW, W and NW) and three in July (S, SW, and W)
- Speed mainly calm and light wind in January and light to gentle breeze July (Tables 1 and 2)
- Corroborates synoptic data, with light wind mainly in the coast in January, greater part of the region light to gentle in July (Figs 2 and 4)
- Also varies between stations, suggesting differential air pollution pattern

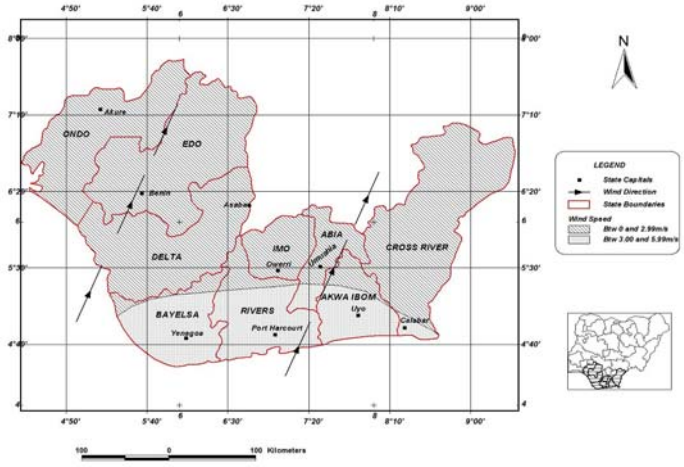
January conditions at selected locations

	DIRECTION								SPEED (MS^{-1})				
Location	NE	E	SE	S	SW	W	NW	N	0-0.2 (CALM)	0.3-1.5	1.6-3.3	3.4-5.4	5.5-7.9
Akure	8.42	8.18	7.57	14.16	14.29	20.39	8.42	5.50	13.06	13.06	53.84	19.29	0.98
Benin	6.53	5.25	2.34	7.30	10.50	10.50	4.68	3.26	49.68	12.21	20.51	16.82	1.77
Warri	2.59	0.73	1.29	18.63	14.57	12.36	6.27	11.26	32.28	15.13	31.92	19.58	1.10
Port Harcourt	7.98	0.54	0.54	6.09	4.74	8.86	11.07	3.52	46.04	8.05	24.61	17.58	3.72
Owerri	10.62	2.07	3.11	7.18	12.56	9.73	8.78	4.35	42.09	32.57	15.87	5.66	3.80
Uyo	19.51	4.54	10.06	3.56	8.47	4.19	23.19	13.00	12.76	25.77	47.61	13.74	0.12
Calabar	12.4	3.0	3.7	13.9	13.4	12.3	16.2	12.4	-	-	-	-	-
Total	68.05	24.31	28.61	70.9	78.53	78.33	78.61	53.29	195.91	106.79	194.36	92.67	11.49
Mean	9.72	3.47	4.09	10.13	11.22	11.19	11.23	7.61	32.65	17.80	32.39	15.45	11.92

July conditions at selected locations

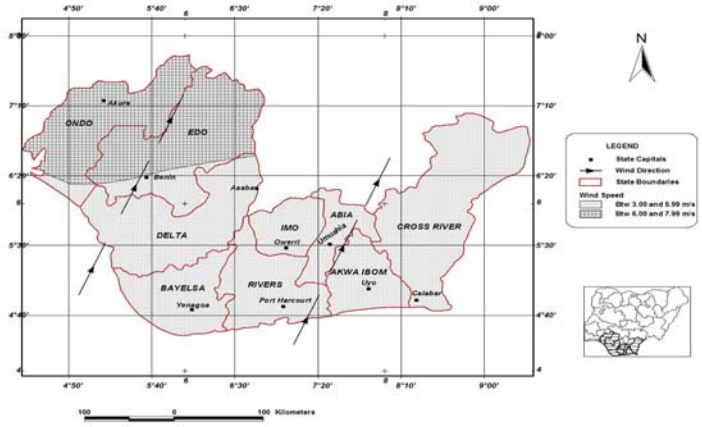
	DIRECTION								SPEED (MS^{-1})				
Location	NE	E	SE	S	SW	W	NW	N	0-0.2 (CALM)	0.3-1.5	1.6-3.3	3.4-5.4	5.5-7.9
Akure	0.36	0.72	1.79	14.23	34.09	36.84	4.06	0.72	7.17	7.89	45.58	33.37	5.98
Benin	1.35	1.94	2.98	11.71	18.12	17.06	6.25	1.04	39.59	8.88	26.99	20.14	4.40
Warri	-	-	1.86	32.44	19.36	11.36	0.56	1.49	32.03	17.13	30.54	18.25	1.68
Port Harcourt	0.37	0.44	1.11	9.53	23.87	12.79	5.40	0.74	45.75	9.01	18.11	19.44	7.69
Owerri	0.58	1.91	7.51	15.97	25.04	18.03	4.41	0.58	26.29	35.86	25.87	8.65	3.33
Uyo	4.38	3.00	17.15	11.14	28.16	10.98	11.89	1.38	12.02	42.05	36.80	7.63	1.50
Calabar	5.9	2.6	5.5	19.6	24.1	13.8	8.3	5.1	-	-	-	-	-
Total	14.66	10.61	31.94	114.58	172.74	120.8	40.88	11.05	162.85	120.82	183.89	107.48	24.58
Mean	2.44	1.77	4.56	16.37	24.68	17.26	5.84	1.58	27.14	20.14	30.65	17.91	4.10

January wind



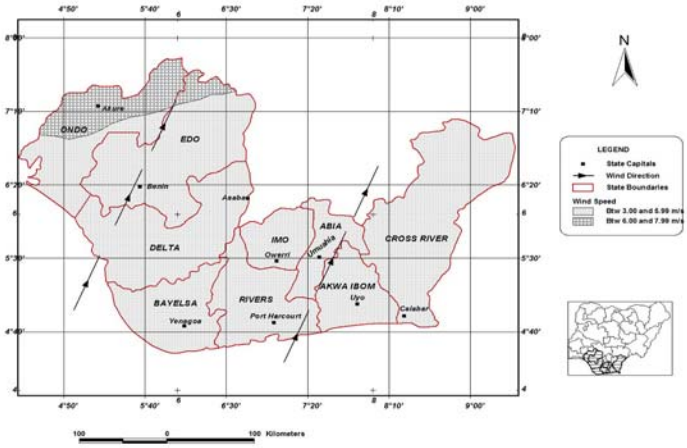
July Wind

April wind

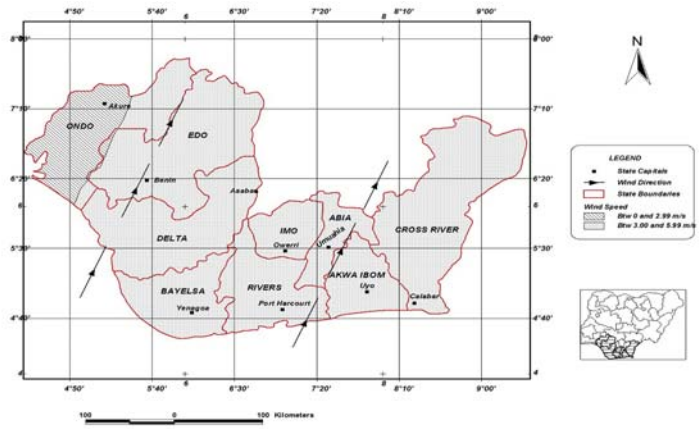


October Wind

July wind



October wind



Implications for pollution patterns

- Pollutants concentration high, given generally stable atmosphere
- Concentrations however higher in the hinterland than coastal fringes because of higher percentage of calm to light winds
- Varies between seasons, with coastal concentration generally lower in all seasons, except end of Autumn and first quarter of Winter
- Generally higher concentrations in November to January

Implications for spatial planning

- Increasing industrial and infrastructure development and built-up in cities means increased concentration of pollutants and high skill in planning
- The relatively stable atmosphere implies appropriate allocation of land uses
- Residential areas South East of emission sources such as industrial zones, oil and gas installations, and far away
- Separated by Green belts in between, applicable to residences along high traffic routes

THANK YOU FOR LISTENING