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ASSESSMENT OF ACIDITY LEVELS IN *EUCALYPTUS CAMALDULENSIS* BARKS FROM BAUCHI AND GOMBE STATES, NIGERIA

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ABSTRACT

Bark samples of *Eucalyptus camaldulensis* obtained from Bauchi and Gombe States were analysed spectrophotometrically for their sulphate-sulphur content. The aim was to assess the extent of sulphur pollution in the environment. The results showed that S concentration ranged from 0.79 to 1.70mg/g for samples from Bauchi with a mean value of 1.11±0.26mg/g while a corresponding mean value of 1.20±0.31 mg/g S was obtained in samples from Gombe state with a range of 0.72-2.13 mg/g. The values obtained are high indicating that the environments under study were polluted with respect to the normal level of 0.5mg/g S in unpolluted plants (Yagodin, 1984). Vehicular exhausts from combustion of fossil fuel is a good source of S as SO_2 which can be absorbed by plants within the vicinity. Manufacturing industries and the use of electrical generators of various sizes using petrol as fuel release S as SO_2 which is readily absorbed by trees. High level of acidity from oxides of sulphur could lead to deterioration of building qualities as lead painting on buildings turn black as a result of formation of PbS (Peavy and Rowe, 1988).

KEY WORDS: Acidity, Sulphur, *Eucalyptus camaldulensis,* Nigeria

INTRODUCTION

Toxic gases such as SO_2, CO and NO_2 are major causes of air pollution. It has been reported that the indirect method of determination of pollutants using plants especially has some advantages over the direct determination (Salami et al, 2005). This is mainly because plants remain in one location and thus are predisposed to environmental perturbations. This method is also cheaper because sampling plant is simpler and cheaper than sampling air for the same determinants taking into account the nature of samplers needed in each case. The plant Eucalyptus has about 700 species and readily available thereby satisfying the requirement to become a bioindicatior (Jackson and Ojo, 1973). Plants are able to tolerate higher concentrations of pollutants because of their physiology (Grodzinska and Kazmierczakowa, 1977). Tree leaves have been used to indicate the sulphur content in Kano (Ayodele and Ahmed 2001). Ayodele and Salami (2004) reported the use of Azadirachta indica bark to indicate environmental acidity.

In this study *Eucalyptus camaldulensis* bark was analysed to assess the pollution level of Bauchi and Gombe states by sulphur.

EXPERIMENTAL

Area of Study

Bauchi state lies between longitude 8^0 15^1-$11^0 30^1$E and latitude 9^0 30^1-$12^0 30^1$E while Gombe state lies between longitude $11^0 10^1$-$13^0 0^1$E and latitude $9^0 25^1$-$11^0 20^1$N (Salami, 2004). Bark samples of *Eucalyptus camaldulensis* were obtained from different locations in the states being sampled covering areas of intense industrial and vehicular activities as well as those of low activities.

Sampling

Samples were taken from each of the 16 zones in each state in 2002, 2003 and 2004 between October and April of the following year. The period coincides with the dry season and hamattan period in Northern Nigeria.

Tree bark samples were excised using a new sharp stainless steel knife at the height of 1.5 metres above the ground (Wagner, 1984) in the direction of the prevailing wind (Ayodele *et al.,* 2002). Each excised material 3-5mm thick was transported in plastic bags and air-dried. The materials were then ground to fine powder using mortar and then stored in clean plastic bottles until needed.

Sample Processing and Sulphur Determination

1g portion of the powdered sample was weighed into a digestion tube and $5cm^3$ $HN0_3$-$HCI0_4$ (ratio 2:1) was added after which the mixture was heated in the fume cupboard. $1cm^3$ 1:1 HCI solution was added to dispel traces of oxides of nitrogen. The solution was cooled and then diluted with $10cm^3$ distilled water, filtered into a $50cm^3$ volumetric flask and diluted to the mark after which the digest was set aside.

Gelatin – Barium chloride solution was prepared by dissolving 0.6g Gelatin (Diflobacto gelatin) in hot distilled water followed by refrigeration to obtain a semi-gelatinous fluid to which 2g of barium chloride dihydrate crystals was added, mixed to dissolve and then stored in a refrigerator until needed (Salami, 2004).

$10cm^3$ of the digest was transferred into a $50cm^3$ volumetric flask and distilled water was added to bring the volume to about $40cm^3$. $2cm^3$ of Gelatin-$BaCl_2$ solution was added and the volume was made up to the mark with distilled water. It was allowed to stand for 30 minutes after which the percentage transmittance was

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determined at 420nm using CECIL 300 spectrophotometer (Salami *et al.,* 2005). Each of the standard solutions was similarly treated and a calibration curve was prepared from the readings of the standards. The sample solution concentration was extrapolated from the calibration curve.

RESULTS AND DISCUSSION

The results obtained in the present study are shown in Table 1. The sulphur concentration in the samples ranged from 0.79mg/g to 1.70mg/g for Bauchi state. The coefficient of variation is about 23.42%. A mean value of 1.11±0.26mg/g S was obtained. The values obtained are higher than the range 0.829-0.853mg/g reported for *Fagus silvatica* bark (Keller, 1986). The mean is however lower than the range 1.60-2.15mg/g reported for Scots pine needles in Kano municipality (Ayodele and Ahmed, 2001).

The mean values of sulphate-sulphur obtained are higher than the normal level of 0.5mg/g in unpolluted plants according to Yagodin (1984).

Table 1 shows also that the mean value of sulphate-S in *Eucalyptus camaldulensis* bark in Gombe is 1.20±0.31mg/g. A range of 0.72 to 2.13mg/g was obtained. The concentrations of sulphate-S obtained are higher than the range 0.829-0.853mg/g reported for *Fagus silvatica* bark (Keller, 1986) and close to the range 1.60-2115mg/g reported for Scots pine needles in Kano (Ayodele and Ahmed, 2001).

Table 1: Sulphur Distribution in *Eucalyptus camaldulensis* bark in Bauchi and Gombe states (mg/g)

Sampling zone	2002		2003		2004	
	Bauchi	Gombe	Bauchi	Gombe	Bauchi	Gombe
1	0.9333±0.07	1.3253±0.14	1.080±0.13	1.3160±0.12	1.2187±0.25	1.3950±0.04
2	1.0820±0.10	0.8463±0.07	1.1167±0.12	1.1750±0.26	1.1800±0.05	1.1403±0.25
3	1.1080±0.28	1.0303±0.08	1.0993±0.14	1.3040±0.06	1.1313±0.14	1.3060±0.11
4	0.7957±0.14	1.0260±0.07	0.9957±0.12	1.0650±0.08	1.0566±0.16	1.1643±0.06
5	1.4100±0.17	1.1030±0.09	1.3667±0.09	1.4959±0.59	1.2973±0.21	1.5117±0.44
6	1.1473±0.09	1.4590±0.08	1.2340±0.06	1.9587±0.06	1.2713±0.06	2.1300±0.14
7	0.9080±0.16	1.2167±0.07	1.0053±0.14	1.5497±0.09	1.1810±0.07	1.6810±0.09
8	0.8607±0.06	0.1800±0.14	0.9567±0.05	1.6333±0.27	0.9727±0.22	1.6313±0.18
9	0.9967±0.04	0.7970±0.15	1.0757±0.09	0.7657±0.04	1.1020±0.18	1.0980±0.10
10	0.8140±0.03	0.9927±0.16	0.8661±0.07	1.3290±0.19	1.9167±0.04	1.1497±015
11	1.1440±0.27	0.8090±0.09	1.3960±0.14	1.0163±0.08	1.4033±0.10	1.2743±0.29
12	0.8783±0.16	0.9633±0.80	0.9530±0.01	0.9860±0.13	1.0530±0.13	1.0693±0.22
13	0.8330±0.12	1.1770±0.18	1.1240±0.02	1.2417±0.13	1.0900±0.12	1.2937±0.14
14	0.7873±0.20	0.7157±0.09	0.9063±0.11	1.0063±0.15	1.0450±0.07	1.1113±0.15
15	1.3263±0.17	1.3127±0.26	0.8730±0.12	1.2313±0.08	1.3670±0.19	1.0820±0.05
16	1.5926±0.13	0.8913±0.13	1.4656±0.28	1.0393±0.09	1.7030±0.07	1.1893±0.16

	Bauchi	Gombe
Mean	1.11	1.20
Standard deviation	0.26	0.31
Maximum	1.70	2.13
Minimum	0.79	0.72
Range	0.91	1.41

For Bauchi State, Zone 1 is ATBU Male Hostel, 2 AT BU Games Field, 3 Polytechnic Road, 4 Yelwa Tudu, 5, Rail Way Quarters, 6, Railway Quarters, 7 Industrial Estate 8 Canning factory, 9 Government House, 10 Government House, 11 Gombe Road, 12 Ungwan Tula, 13 Jos Road Junction, 14 Yankari Road, 15 Motor park Inside, 16 Motor Park Entrance

For Gombe Zone 1 is Ashaka Road Junction Duku, 2 Industrial Estate, 3 Duku Road, 4 Duku Park Entrance, 5 Emir's Palace, 6 Market, 7 Tudun Wada, 8 Railway Quarters, 9 Biu Road Junction, 10 Land and Survey Office, 11 Motor park, 12 GRA, 13 Ashaka Gate, 14 Ashaka Staff Quarters, 15 Jalingo –Ashaka, 16 Ashaka Cement Factory.

Fig 1 shows the frequency distribution pattern for S in *Eucalypus camaldelensis* bark in Bauchi State. The distribution is skewed towards high frequencies of low concentration of S.

Fig 2 shows the frequency distribution pattern for S in *Eucalyptus camaldulensis* in Gombe. The distribution is unimodal and is skewed towards high frequencies of low concentrations. The concentration of S is higher in the plant in Gombe state than the value in the plant in Bauchi state (Table 1). This may be due partly to greater level of industrial activities in Gombe than Bauchi. It would be expected that more vehicles will ply the roads of Gombe to Ashaka and other roads for business purposes related to cement purchase etc with the consequent higher level of vehicular emission whose fuel base in fossil fuel – petrol. The cumulative effect of this is to increase the level of SO_2 in the environment of Gombe more than Bauchi.

The sulphate-S concentration in the plant in the two states is higher than the normal level of 0.5mg/g in plants (Yagodin, 1984).

Possible sources of SO_2 in the environment include industrial operations utilizing process heaters, catalytic cracking, H_2S flares, de-coking operations and from decomposing organic wastes as well as sewage. Traffic emission also contributes to environmental SO_2 load (Ayodele and Ahmed, 2001). Sulphur oxidation produces sulphur

dioxide which has been reported to have caused forest decline (NIhgard, 1995) and its presence is a nuisance.

S gets into the atmosphere as a result of bacteria emission of H_2S, the burning of fossil fuel as well as from wind-blown sea salts containing SO_4^{2-} and coal mining releasing gaseous as well as solid particulate matter containing suphur (Rao, 1991).

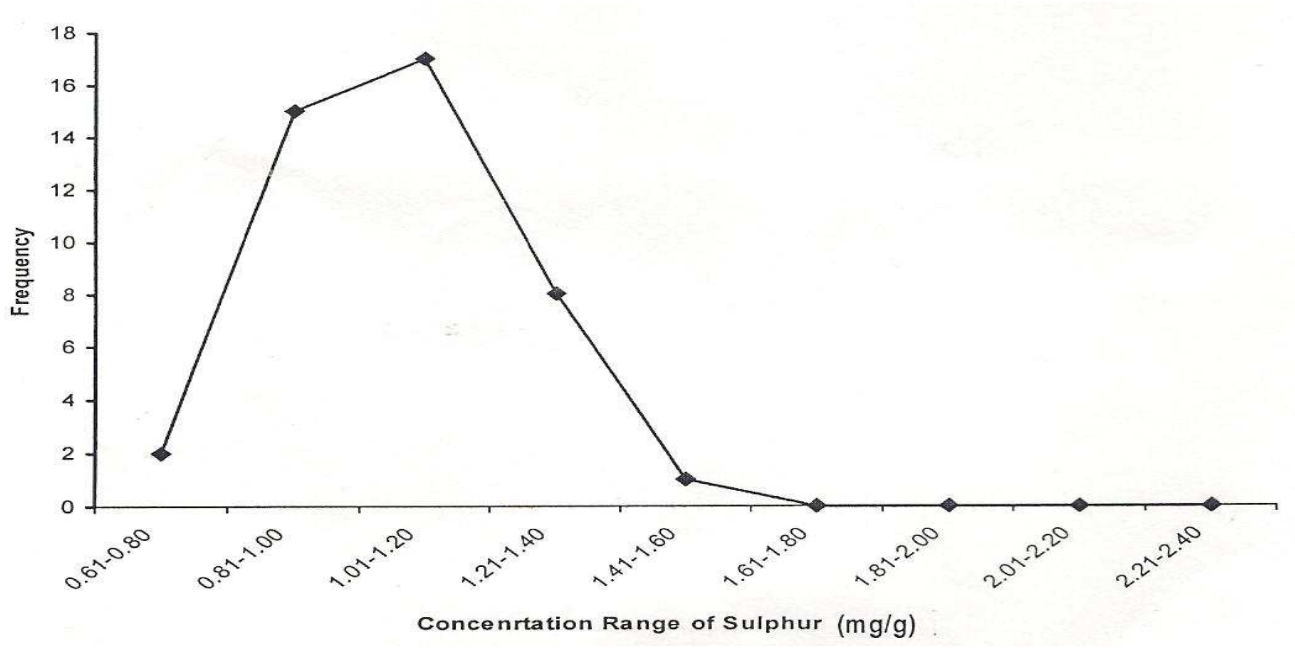

Fig 1: Frequency distribution pattern of Sulphur in *Eucalyptus camaldulensis* Bark in Bauchi state.

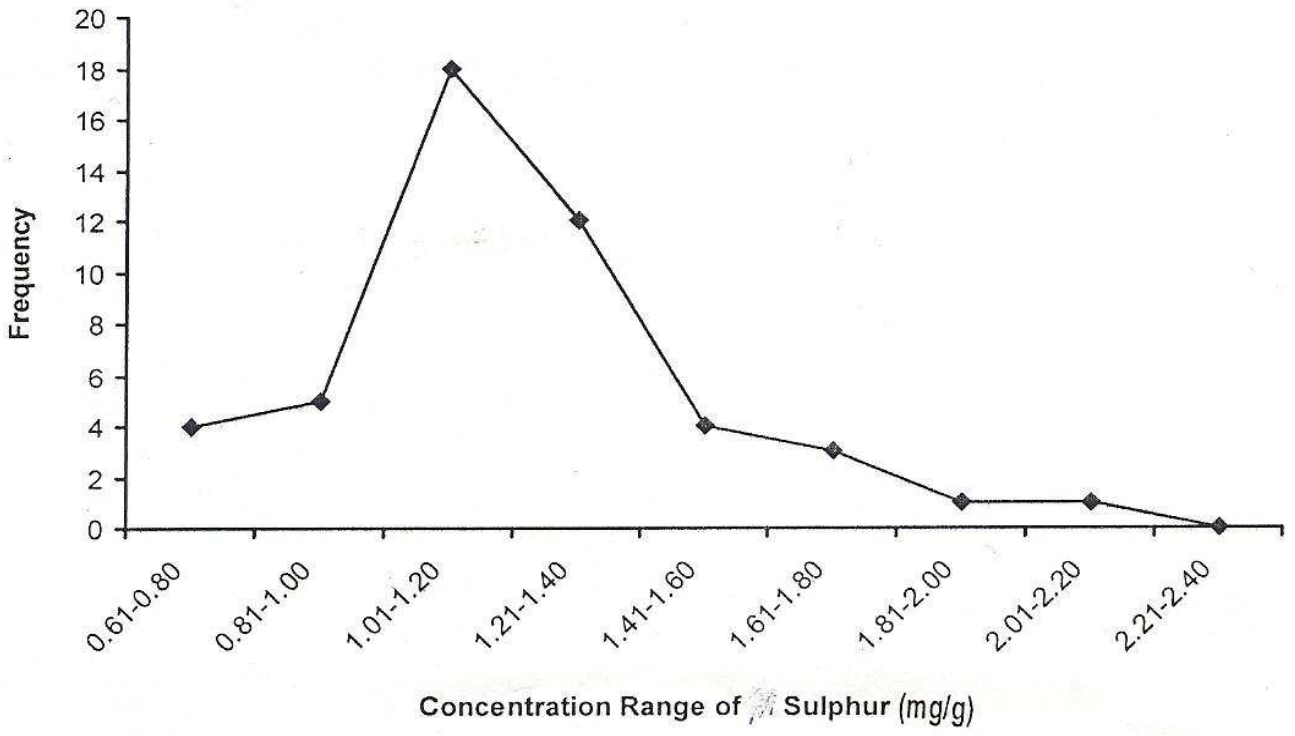

Fig 2: Frequency distribution pattern of Sulphur in *Eucalyptus camaldulensis* Bark in Gombe state

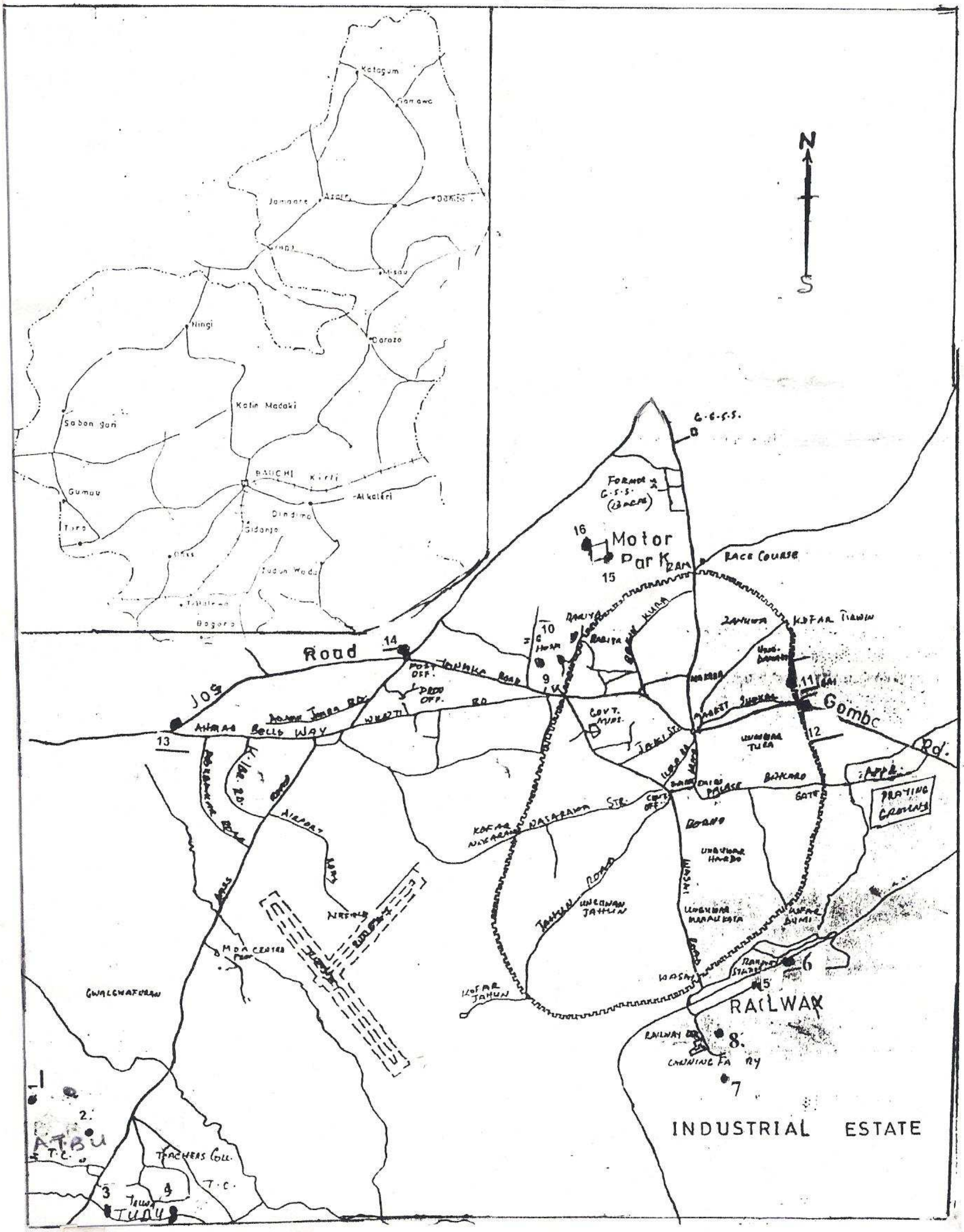

Fig. 3 Map of Bauchi State showing sampling locations

Sampling locations
Major roads
Rivers/streams
Rail ways

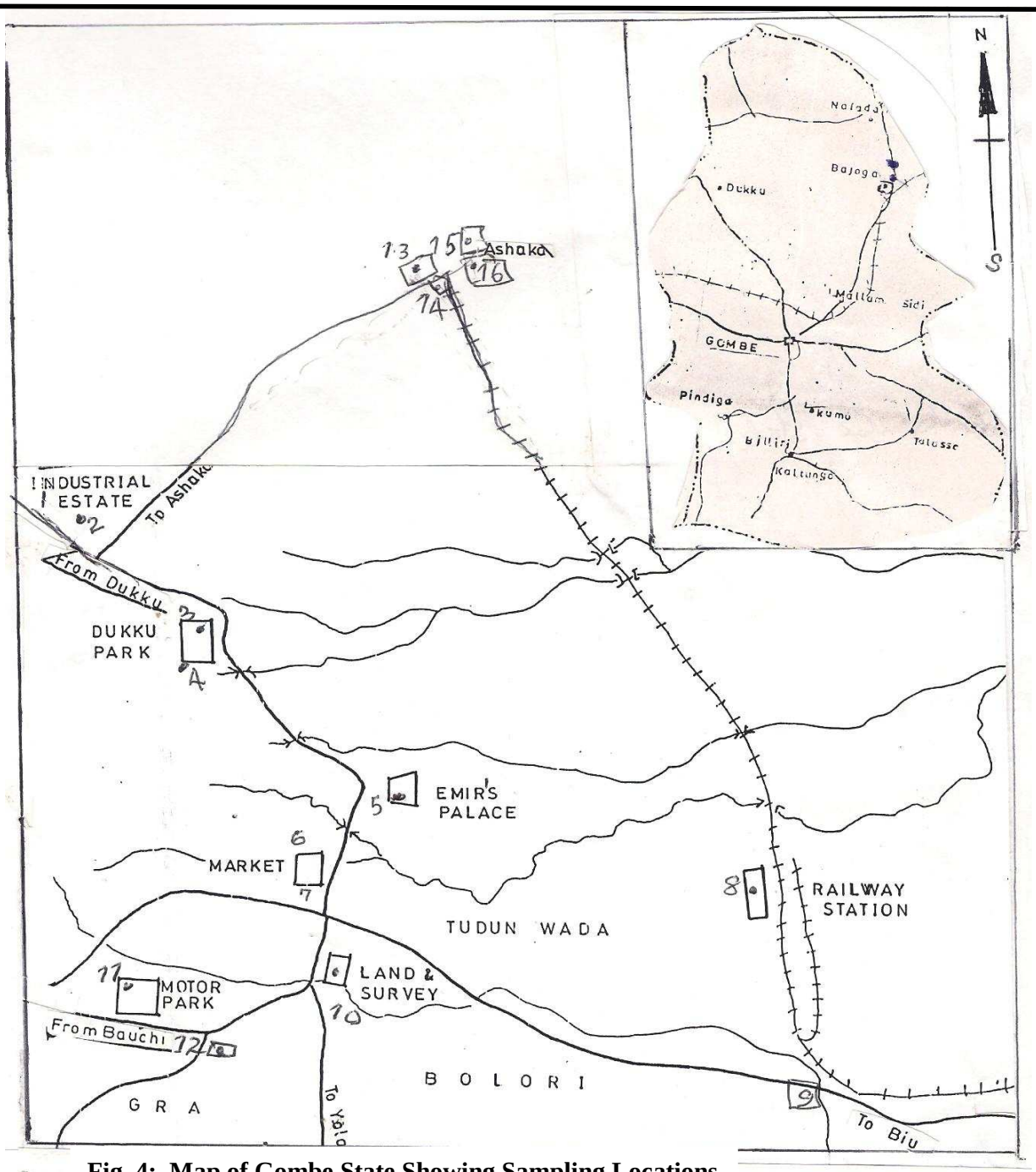

Fig. 4: Map of Gombe State Showing Sampling Locations

CONCLUSION

The environment of Gombe was more polluted than Bauchi with respect to sulphur. Vehicular emission is an important source of SO_2 in the environment which is partly responsible for acid rains.

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