

COMMENTS ON HYDROCARBONS IN AFRICA

Notizie sugli idrocarburi in Africa

ERHARD G.
Deutsche Texaco A.G. Hamburg and Istituto Geologia, Università di Colonia (Germany)

The African continent is distinguished by its compact shape. It gives a picture of coherence. This impression is, however, not reflected in the climatic and cultural geography of the continent. The Sahara "sand ocean" deeply divides the land mass. Geologically, Africa forms the central part of Gondwana. The northern block appears to be related to the northern continents. The southern block has had a different development since the Precambrian. Africa's southern block resembles in many ways the other remains of Gondwana.

The search for oil in Africa is a history of high hopes, deception, surprising success and insistent patience.

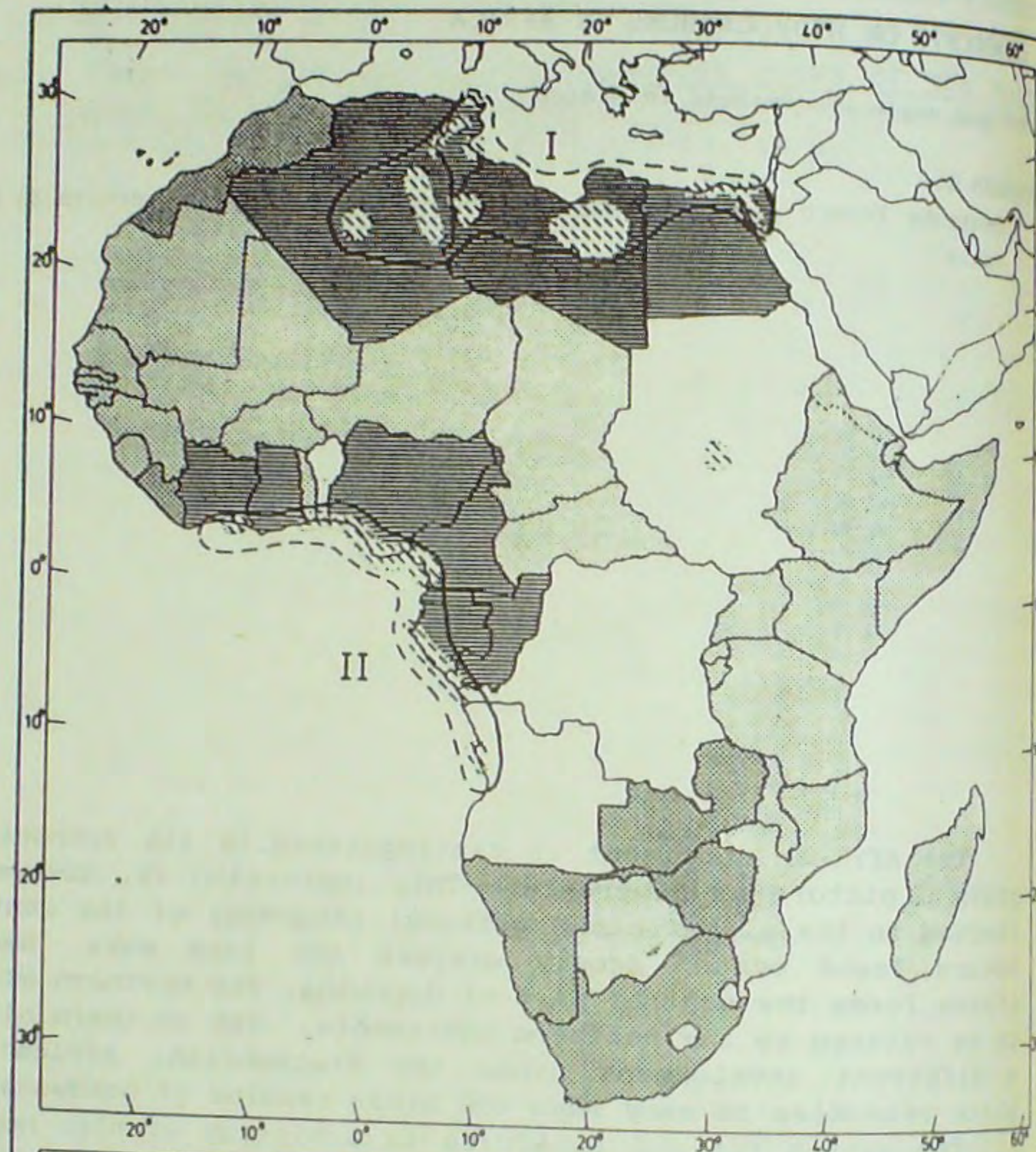
Already in 1909 - only one year after Masjid-i-Suleiman, the first discovery in the Middle East - oil was spotted in the Egyptian Gaza Field near the Red Sea.

The following years brought little activity, since there was no substantial expectation for further oil discoveries in the area.

The actual upswing was triggered by the introduction of a new oil legislation in Algeria and Libya.

The year 1956 proved to be the turning-point: oil discoveries in Edjeleh, Hassi Messaud and Tiguentourine were followed by others in Nigeria (Afam Field) and in Gabon (Clariette Field).

Libya became an oil country with its first rather poor Atshan



CRUDE OIL/NATURAL GAS AND PER CAPITA INCOME
IN AFRICA

I Northsahara-Zone II Guineagulf-Zone Oil/Gas fields	per capita income	low	Development countries without Oil Product.	Development countries with Oil Product.
		middle		
		high		

Field in 1957. It was not before 1958-59 that the rich oil region of the Syrte area was discovered when Esso struck oil near Djebel Zelte.

Table 1 lists the proved reserves and further oil possibilities on a global comparison: already 68% of the world's oil reserves have been located, out of which 26% have been exploited up till now. Another 32% remain to be discovered.

It is obvious that these estimations are subject to a certain margin of error. New technologies as well as improved exploitation methods and price fluctuation could influence the picture to a large extent.

Africa's overall reserves are estimated to be 19 billion tons, of which 12 (64%) have been found, and 4.6 exploited already.

Some 6.6 bil t remain to be discovered. Even on the basis of this somewhat generous estimation, Africa's share in the world's crude oil reserves remains below 8%. The continent's oil production and proved reserves are not more than 7% of the global total.

As far as natural gas is concerned, Africa's reserves are even less. Africa appears to be underprivileged in comparison with the reserves of other continents.

We find 10% of the world's population living in Africa which forms 20% of the globe's land mass. However, only 7.7% of the world's crude oil and 4.6% of all natural gas reserves are found or are probably located in Africa.

Table 2 shows the development of Africa's crude oil production during recent years. Production is given in absolute and in relative terms. These should not be underestimated, since the development has been dependent on not too favourable political and economic factors.

Africa's crude oil is important for the international market in spite of its relatively small percentage of the world's production. The continent is the second biggest oil exporter after the Middle East region. This strong position is possible because of the low oil consumption within Africa.

A considerable advantage is the relatively small distance to the oil-hungry European market.

The richest oil discoveries on the globe are, surprisingly, concentrated in relatively few oil provinces. About 90% of the 30,000 so far discovered oil occurrences are of negligible quantity. Thirty-seven super-giant fields contain more than 600 mio t each. Three hundred giant fields have reserves of 70 mio t each.

It is, therefore, not surprising that only 50 oil provinces (with reserves in excess of 260 mio t each) contain 95% of the globe's oil

TABLE 1 : Crude Oil and Natural Gas in Africa

	Line	World	Africa	West Europe	Middle East ²⁾	Eastern block	Africa %share
Crude Oil (bil t) ³							
Cum. Prod. (to 1.1. 1981) ⁴	1	63,6	4,6	0,8	17,7	10,5	7,2
Proved Res.	2	103,4	7,4	3,6	63,4	10,2	7,2
Probable Res.	3	78,6	6,6	2,4	17,9	15,6	8,4
Total (L 1-3)	4	246	19	7	99	36	7,7
%	5	100	7,7	2,8	40,2	14,6	-
Natural Gas ('000 bil.m ³)							
Cum. Prod. (to 1.1.1983)	6	37,2	0,7	3,1	2,0	6,8	1,2
Proved Res.	7	90,4	6,8	4,8	25,7	33,6	7,5
Probable Res.	8	143,9	5,1	6,2	27,5	61,7	3,5
Total (L 6-8)	9	271,4	12,6	14,2	55,1	102,2	4,6
%	10	100	4,6	5,2	20,3	37,7	-

- 1) Rahmer, B.A., Reserves and Resources. Petrol. Econ., Sept. '83, p. 325
 2) Middle East without North Africa
 3) Crude Oil with more than 10° API but without NGL
 4) Reserves: 11% are of 10-24° API; 57% are of 25-35° API; 32% are of more than 35° API.

TABLE 2 : Crude Oil Production 1975-1982 (in mio t)

	1975	1978	1980	1981	1982
Africa	243	301	298	224	215
World	2707	3097	3059	2904	2756
%	9,0	9,7	9,7	7,7	7,8

(ESSO), Oeldorado 1981 and 1982

TABLE 3 : Crude Oil Balance (in mio t)

Africa	1975	1980	1981	1982
Production	243	298	224	215
Consumption	55	63	63	61
Surplus	188	235	161	154
%	77,4	78,9	71,8	71,6

(ESSO), Oeldorado 1981 and 1982

TABLE 4 : Crude Oil Production

	Prod. wells ¹⁾ 1982	Oil Prod. ²⁾ mio t 1981	1982
Algeria	1085	40	33
Tunesia	91	6	5
Libyen	680	56	51
Egypt	411	29	33
Nord-Sahara- -Zone	2267	131	122
Ivory Coast	16	0,4	0,8
Ghana	4	0,1	0,06
Benin	---	---	---
Nigeria	1312	72	65
Kamerun	95	4	5
Gabun	266	8	8
Kongo	179	4	5
Zaire	10	1	1
Angola	205	7	7
Guinea-Gulf- -Zone	2087	96	91
Africa	4357	227	213
World		2904	2755

¹⁾ Oil & Gas J.27.11.82, p. 85 ff.

²⁾ North Sahara Z. after MEES. 27.6.83, Guinea Gulf Z. after Petrol. Econ., May'83, p. 169.

reserves. Africa's share is small by comparison.

The continent's oil provinces form a chain in only two oil zones, i.e.:

- North Sahara Zone (stretching from Algeria to Egypt);
- Guinea Gulf Zone (stretching from the Ivory Coast to Angola).

The latter is almost an amphibian zone (partly offshore).

Table 4 shows that both oil zones are similar in size and economic magnitude.

The North Sahara zone delivers 57% and the Guinea Gulf zone 43% of the continental production.

We are inclined to overestimate the importance of the North Sahara zone: almost 85% of African crude oil came from this zone until 1977. This has changed meanwhile, although the North Sahara zone potentially predominates. The maximum capacity of this zone should be reached in 1985 with the production of 250 mio t, out of which Libya alone will ship about 140 mio t.

The capacity of the Guinea Gulf zone is about 160 mio t annually. Nigeria leads with its 120 mio t production capacity. It is obvious that the smaller countries, above all newcomers, are hardly prepared to accept production restrictions. The problem arises from prices affecting over-production. Countries like Libya, Algeria and Nigeria, due to their limited national crude oil consumption, are extremely flexible in their production and their oil exports.

The difference between production capacity and national consumption equals the export potential. By subtracting the actual production from the production capacity, we obtain the figure which reflects the elasticity of oil exports.

Comparing the productivity of oil wells worldwide, Africa is in a relatively good position. We know the number of wells with the exception of the Eastern Bloc countries. The oil wells of the Free World (702,286) produced 1,918 mio t in 1982 which is, on average, 2,731 t/year for each oil well. The African average is 48,878 for each oil well (Table 4).

Libya, Nigeria and Algeria together have 82% of all African oil reserves.

Such a figure is typical by global standards. More than half of the world's crude oil reserves are concentrated in 37 super-giant fields (more than 600 mio t each). Only three of these are located in Africa, i.e., in the North Sahara zone (Hassi Messaud and Sarir, each with 1 bil t, and the Syrte Field with 600 mio t).

Table 6 shows also the recent discoveries in Sudan which deserve

TABLE 5 : Elasticity of Crude Oil Production

Line	Production 1982	Nat. consumption	max.prod. capacity	Potent. ¹ surplus	Elasticity ²
1	2	3	4	5	
Libyen	51	4.2	140	136	85
Algerien	33	5.1	75	70	37
Nigeria	65	3.4	120	116	51

¹ Line 3./2; ² Line 4./1

TABLE 6 : Crude Oil Reserves (Jan. '83)

	mio t	%
Algeria	1284	
Tunesia	253	
Libya	2924	
Egypt	452	
North Sahara-Zone	4913	62,5
Ivory Coast	15	
Ghana	2	
Benin	3	
Nigeria	2278	
Kamerun	72	
Gabun	63	
Kongo	211	
Zaire	19	
Angola	222	
Guinea-G.-Zone	2885	36,7
Sudan	54	0,7
Africa	7852	100

Oil & Gas J. 27.12.82, p. 78 f. u.a.

attention, since they are outside the two African oil zones, thus encouraging the search in other African sediment basins including the interior of the continent. Other isolated discoveries can be neglected in this context, since there are no reliable figures available yet.

Africa's chances of discovering more oil are mediocre at best: one-third of the continent can be neglected, since only two-thirds are sedimentary in the sense of not being crystalline or volcanic. Half the sediments are situated in the interior basins which are flat and, due to their restricted accessibility, less suitable for exploitation. Oil search in this area would be prohibitively expensive and burdened with additional political risks along the export lines. The other half of the sediments - 1/3 of Africa - is situated in the coastal and shelf areas. The continental shelf areas do not play a role yet. There are too few test drillings and their cost could not be justified by the remote chances of discovering oil.

The continental consumption of 61 mio t of crude oil (1982) compares with 40 refineries and their capacity of 94 mio t/year (1977 still only 73 mio t and 38 refineries).

This means that Africa possesses 2.4% of the world's refinery capacity. More than 1/3 of that capacity is located on the Mediterranean north coast and is linked to the North Sahara zone. One-quarter operates in the Guinea Gulf area. The rest is dispersed all over sub-Saharan Africa.

South Africa built the biggest capacity with 21.2 mio t and 4 refineries. Egypt follows (6 refineries and 17 mio t), then Nigeria (3 refineries, 13 mio t), Algeria (4 refineries, 6.9 mio t), and Libya (2 refineries, 6.5 mio t).

South Africa, Egypt and Nigeria hold 50% of the African refinery capacity and, together with Algeria and Libya, more than two-thirds.

The desire of all countries to boost their economic independence through national refinery capacity is understandable but not always economically justifiable. There will in any case be dependence on other countries as long as there is no national crude oil production. And there is little hope of operating a refinery economically as long as half of the imported crude oil is unsuitable for local consumption and has to be re-exported. This situation is aggravated by the limited flexibility of refineries to handle crude oil of different chemical properties.

The oil consumption of African countries varies greatly. The overall figures give an incomplete picture.

TABLE 7 : Crude Oil Refineries (1983)

	Number	Capacity mio t / years
Marokko	2	3,7
Algeria	4	6,9
Tunesia	1	1,7
Libya	2	6,5
Egypt	6	17,0
North- Sahara-Zone	15	35,8
Jvory Coast	2	4,5
Ghana	1	1,3
Nigeria	3	13,0
Kamerun	1	2,2
Gabun	1	1,0
Zaire	1	0,9
Angola	1	1,6
Guinea-Gulf-Zone	10	24,5
South Africa	4	21,2
Kenya	1	4,5
11 countries ¹⁾	11	8,0
Outside of both oil zones:	16	33,7
Africa	41	94,1

Oil & Gas J. 27.12.82, p. 78 ff.

1) The 11 countries with one refinery each (less than mio t/years): Ethiopia, Liberia, Madagascar, Mozambique, Senegal, Sierra Leone, Sudan, Somalia, Tanzania, Togo, Sambia.

TABLE 8 : Oil consumption

	1982 mio t	per capita kg
South Africa	13,5	482
Egypt	10,6	255
Algeria	5,1	276
Libya	4,2	1500
Nigeria	3,4	37
Rest Africa	36,8	---
Africa	60,6	121
World share %	2,1	---

(ESSO) Oeldorado 1982.

More relevant is the annual per capita consumption. Libya leads here with 1½ tons. South Africa follows with 482 kg and then, at a great distance, all the others.

The per capita consumption in African countries decreases on average between 1977/82 from 140 kg to 121 kg.

This is certainly not the result of government-imposed restrictions, but the consequence of rising oil prices.

Natural gas discoveries in remote areas without market access were still considered a burden by international oil companies a few years ago. This has changed to some extent.

Consumption and production of natural gas has multiplied since 1950. Natural gas discoveries gained importance accordingly. The African continent has a share of only 1.2% in the global natural gas production (cf. Table 1). Proved reserves are approximately 7% and as such comparable to Africa's share in the world's oil reserves. The probable gas reserves are only 3.5% and consequently much lower than the respective crude oil figure (8.4%). However, these figures contain a strong element of speculation. We know too little about Central and East Africa.

Table 9 shows the most recent figures attributable to countries and oil zones in Africa.

Algeria has the largest natural gas reserves (3.6% of global reserves). Nigeria has less than half of that. All the other countries follow at a great distance. The respective figures for natural gas production are similar: Nigeria had a share of 1.7% of the world's natural gas production (26 bil cu.m.). The North Sahara zone produced altogether 2.1%, while the Guinea Gulf zone had only 0.2%. Africa's share in the world's natural gas production was only 2.3%.

The international oil economy leads to a substantial redistribution of financial resources. The giant income of the oil-exporting countries drains the economies of oil-importing countries.

The oil-producing countries' relative income from oil exports is determined by the size of the national population: fourteen billion US dollars income (1982) of Libya and Nigeria each is - theoretically - distributed over a population 36 times larger in Nigeria than in Libya.

It is mainly due to Libya's relatively small population that this country is the only one on the continent to enjoy a high per capita income. According to the world development reports of the World Bank, all African countries are developing countries.

An additional listing of these countries with a view to their oil

TABLE 9 : Natural Gas (in bil. m³)

	Production			Reserves		
	1981	1982	%	1978	1983	%
Marokko	0,1	0,1		1	4	---
Algeria	21,9	26,0	1,7	3000	3195	3,6
Tunisia	0,4	0,4		100	83	0,1
Libya	3,2	3,3		730	560	0,6
Egypt	2,4	2,7		90	167	0,2
North-Sahara- -Zone	28,0	32,5	2,1	3921	4009	4,5
Ivory Coast	-	-		-	23	-
Nigeria	2,2	2,2		1220	1385	1,6
Kamerun	-	-		-	110	0,1
Gabun	0,1	0,2		70	13	-
Kongo	-	-		28	70	0,1
Angola	0,3	0,2		40	51	-
Guinea-Gulf-Zone	2,6	2,6	0,2	1358	1652	1,8
Tansania	-	-		-	117	0,1
Africa	30,6	35,0	2,3	5279	5778	6,6
World	1549	1525	100	66509	88064	100

Petrol. Econ., August 1983, p. 295)

TABLE 10 : Value of African Oil Exports - OPEC members
(in bil. U.S.\$)

	1974	1978	1979	1980	1981	1982
Libya	6	8,6	15,2	22,6	15,6	14
Nigeria	8,9	8,2	16,6	25,6	18,3	14
Algeria	3,7	4,6	7,5	12,5	10,8	8,5
Gabun	-	0,5	1,4	1,8	1,6	1,5
Total	18,6	21,9	40,7	62,5	46,3	39
OPEC in bil	90,5	115,8	195,2	278,8	252,9	201,9
in mio t	1480	1395	1440	1235	1040	845

Petrol. Econ., June 1983, p. 215.

production (or lack of it) is interesting: the map shows which countries in both oil zones stand out for their high per capita income.

The "poverty belt" covering the Sahara and East Africa might be broken up, one day, by Sudan, which hopes to export oil as of 1985. South Africa's vast coal reserves and their exploitation are well known. The coal hydration at Sasol is a technical achievement, but it does not put coal to better use. It represents a politically motivated emergency solution.

I should like to add some remarks on a chapter which is all too often misunderstood: Africa's opportunities to use bio-mass as an energy source are less than generally presumed.

Tropical rain forests and savannah areas, certainly the Sahel zone, could not yield bio-mass to any great extent.

Traditional societies do not produce much combustible garbage. Nomads and their camels appear to be a case in point for the complete adaptation of man to his surroundings, including the full utilisation of the available resource, the camel.

There are some areas very well suited for the exploitation of wind and solar energy. Technical solutions still to be found should be maintenance-free and their economies should compare favourably with more traditional energies.

Summary and prospects

- Of the respective global reserves, Africa has only 8% crude oil and 5% natural gas;
- Africa's crude oil equals 19 bil t. Of these, one-quarter has already been consumed. Three-quarters (14 bil t) should still be available if 6.6 bil t of probable reserves are identified as extractable;
- The oil fields are concentrated in two oil zones: the North Sahara and the Guinea Gulf. Both are well positioned with respect to their export market;
- There are only isolated oil discoveries outside these two oil zones. These isolated discoveries have not yet led to economically viable oil fields. The exception is the oil discovered in Sudan - handicapped, however, by its great distance from the Red Sea;
- The search for oil in Africa is usually expensive due to ailing infrastructures and difficult access (10-20 mil US dollars per bore-

- hole). This does not encourage activities in high-risk areas. The anticipated future oil shortage should justify persistent search efforts for oil in all African sediment basins;
- Approximately 72% of crude oil produced in Africa could be exported due to the still relatively low consumption on the continent. The export quota was previously 80%, but decreased because of increasing national consumption in Libya, Algeria and Nigeria. Both African oil zones export mainly to the European market but also to North America;
- Political crises in the Near East, but also political and economic tensions inside Africa definitely tend to burden the oil economy of the continent;
- Africa has relative geopolitical importance for the world's oil trade since indispensable shipments from the Middle East have to circumnavigate the continent;
- If Africa's future were dependent on mineral oil, continued poverty might be inevitable. Yet it looks as if the industrial energy demand of the continent will occur at a time when non-oil energy resources will probably be available.

Note

This article is an abridged draft from "Erdöl und Erdgas in Afrika", published in Afrika 1984, pp. 111-122, Deutscher Afrika-verein, Hamburg, Germany, 1984.

The article tries to give reliable figures enabling the reader to form his own opinion. However, published figures differ considerably, which is understandable for estimations. In these cases average figures are quoted. Differences in published production figures are to some extent explained by the variety of measures applied.

Barrels are calculated as tons on the basis of the formula:

$$b/d \times 50 = t/year$$

- b/d = barrels per day
- t/year = tons per year
- t = metric ton
- mio = million
- bil = billion (1000 mio)

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