

## Energy, Pollutants and Water

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### **Introduction:**

The major objective of this section of the report is to enunciate a brief assessment of some issues related to water, energy, waste and pollution in the Sudan. These are related to Agenda 21, ten years after its inception. It will attempt to outline practices before 1992, what was agreed upon in Rio (Agenda 21) and what was adopted by the Sudan thereafter.

### **Water:**

Chapter 18 of Agenda 21 stresses the need to "make certain that adequate supplies of water of good quality are maintained for the entire population of this planet, while preserving the hydrological, biological and chemical functions of ecosystems adapting by human activities within the capacity limits of nature and combating vectors of water related diseases". In other words, "to satisfy the freshwater needs of all countries for their sustainable development"

Although water is a renewable resource, it is often not available in the right amounts at the right time in the right place. Almost continuous shortages are experienced in many parts of the developing world. Sudan is not an exception.

Early civilizations grew along major rivers with agriculture as the focal point. Agriculture is still responsible for about 70% of the water use in the world. Monumental efforts are required in developing countries to feed fast growing populations, improve the standard of living especially in rural areas and to develop and manage land and water in a sustainable way.

Sudanese Legislation on water include:

- Irrigation and Drainage Act, 1990
- Fisheries Law, 1988
- River Transport Act, (1923)
- Mining and Quarries Act, (1925)
- General Health Act, (1939, amended 1975)
- Pesticides Act, 1974

These legislations were enforced in isolation of each other. Furthermore they did not share any common theme or objective like poverty alleviation or sustainable development or rural development or sanitation etc..

### **Water Resources:**

It is a paradox that the largest source of water in the Sudan is rainwater. It ranges from almost zero in the extreme north to more than 1000 mm in the extreme South, the total precipitation being around 1250 billion metre cube (bmc). Rainfall is both erratic and variable, the general trend of which is declining in quantity. The accumulated effects of environmental problems such as desertification, degradation of agricultural lands, loss of forests and wetlands, overgrazing of pastures etc. led to serious soil erosion problems. The combined runoff of non-Nilotic streams in the Sudan is estimated at seven bmc annually.

Groundwater resources are estimated at around 900 bmc recharge of around 4 bmc. The annual

consumption being around 1.2 bmc. It is available in the Nubian sandstone formation, Um Ruwaba formation, Alluvial deposits and the Basement Complex areas. Major aquifers include Bara, Baggra and the Nubian aquifer.

The dominant resource remains to be the Nile system. The Nile is the World's longest river, traversing more than 35 degrees of latitude and draining an area equal to one tenth of Africa. It rates ninth in terms of volume of discharge. This is due to the fact that 70 percent of its basin lies in arid and semi-arid areas. The Nile is essentially a seasonal river with 80 percent of its annual discharge flowing between August and October. Annual variations in the volume of discharge can be enormous and are certainly not predictable. While the mean annual discharge between 1871 and 1953 was 92.4 bmc, it dropped from 1871 to 84 in 1959. The maximum flow of 150 bmc was recorded in 1878-79. The minimum was 52 bmc in 1913-1914.

### **Utilization of Water Resources:**

Agriculture is by far the largest water user in the Sudan. Improvement in agriculture techniques and water use efficiency is desperately needed. The irrigated area in the Sudan is about 4 million feddans<sup>1</sup>, which uses about 70% of the allocated share of the Nile waters. It must be stressed that:

- Less than 20% of the discharge of the Nile is "timely water"<sup>2</sup>.
- Silt has influenced considerably the design and operation of dams
- The present water demand, for Egypt and the Sudan, is close to the maximum sustainable level.
- The population growth is undoubtedly faster than agricultural expansion and production.

It is relevant to state that the management of the Nile waters has historically been staggered and sectoral. Biased short-term national interests and narrow disciplinary professional polarization were the overriding constants, disregarding the international character of the river and the nature of its finite resources. The Nile Basin should be developed and managed as a single indivisible whole, within a long-term integrated outlook. Rivarian countries should complement each other rather than compete for shared resources.

According to the 1993 census 65 percent of the urban population have access to piped water (UNICEF, 1996), whereas only 20 of the rural population enjoy the same facility. Other sources give much lower figures. The Government National Programme of Action for Child Survival and Development sets availability of 20 litres of safe water per capita per day, within one kilometer from the users' dwelling, as the acceptable standard. A clear national definition of what a safe source of water is, has yet to be adopted.

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<sup>1</sup> One feddan = 1.38 acres or 0.42 hectares

<sup>2</sup> Timely period is when water is available for irrigation

**Table 1: Percent Population with access to sources of water**

Sources of water	Northern States			Southern States
	Rural	Urban	Total population	Urban
Pipe connection	19.62	65.81	35.33	7.02
Boreholes	56.12	20.25	43.93	55.16
River/ canal	14.09	2.25	10.06	30.01
Tanker	4.78	0.59	3.35	0.24
Haffir/Fola	1.36	7.17	3.34	5.40
Others	3.97	3.82	3.92	1.74
Not stated	0.06	0.11	0.08	0.43
TOTAL	100.0	100.0	100.0	100.0

Source: UNICEF, 1996

Urban populations theoretically consumes 20 litres per capita per day while rurals get 8 litres at two and a half times the cost per litre. Variations are large from one place to another. People in Darfur consume less than one fourth of those in Khartoum.

Population in pre-urban areas and in newly emerging urban centres are around 35 percent of the total urban population and generally do not have access to safe water.

The quality of urban water supply is questionable (Habeballa, 1981). Surface water sources are contaminated and bear heavy loads of suspended silt. Waterworks are old and small and can not cope with the escalating demand. Increased reliance on ground water in the past few years has partially released pressure off in the way of quantity but not quality. Septic tanks and soakaway wells are a constant threat of contamination.

Distribution networks are old and is a potential weak link taking up contaminants, in the case of the capital Khartoum for example. Increased reliance on booster pumps and storage tanks have contributed to the depletion of the meager power supply as well as offering excellent breeding sites for mosquitoes. The worst case scenario is the city of Port Sudan; suffering from chronic water shortages on the one hand and the heavy incidence of malaria on the other.

The celebrations of the city of El Obied with the new source of water from Bara, was short lived. The old distribution system soon collapsed.

Storm drains is another fiasco.

It is a paradox that there is no clear link between the water supply and sanitation sectors. Even within the water sector there are poor linkages between the Federal and state water corporations. The water sector itself has experienced ten major institutional changes since independence. (Mukhtar, personal communication)

### **Government Policies and Strategies:**

The Sudanese National Plan of Action (NPA) sets the goal of universal access to safe drinking water and sanitary means of excreta disposal by the turn of the decade (UNICEF, 1996). The Comprehensive National Strategy gives priority to the following strategies for achieving the set goals:

- Cost-effective utilization and management of water resources;
- Introduction of low-cost appropriate technologies and encouragement of local production of equipment;
- Rehabilitation of deteriorating water sources and systems;
- An expanded programme of well-drilling and hand-pump installation, especially in priority rural areas;
- Training, capacity building and increased use of domestic technical resources, to increase cost-efficiency and reduce dependence on external resources;
- Development and expansion of sanitation services;
- Increased community involvement in planning, execution and management of water supply and sanitation services encouraging cost sharing and self-help; and
- Encouragement of research aimed at better water resources management, evaluation of existing schemes and identification of cost-effective alternative strategic elements.

The National Comprehensive Strategy gives priority to the rural sector, emphasizing rehabilitation of existing water yards, expansion of low cost technology options (hand pumps) and improvement of surface water sources (water harvesting, hafirs etc.). The priority in urban areas is to restore existing waterworks to their original designed output followed by rehabilitation of other sources and expansion of services especially in Khartoum and the sixteen state capitals recently upgraded from towns to cities.

**Table 2: Rural Water Sources**

Type	Number	Capacity m3/day	
		Installed	Actual Yield
<b>Water yards</b>	4.252	447.000	146.000
<b>Hands pumps</b>	8.000	48.000	32.000
<b>Dug wells</b>	7.000	56.000	44.800
<b>Hafirs/ Dams</b>	856	142.000	56.800
<b>Sand filters</b>	233	16.500	8.200
<b>TOTAL</b>	20.441	710.000	287.800

Sources: Based on UNICEF, 1996

**Table 3: Urban Demand for water**

Region	Capacity m3/day	Demand/m3/day	Coverage %
Khartoum	350.000	700.000	50
Northern	30.000	64.000	47
Eastern	48.000	205.000	20
Central	80.000	184.000	39
Kordofan	23.000	114.000	17
Darfur	14.000	74.000	20
Southern	20.000	103.000	16
Total	565.000	1.445.400	39

Sources: After UNICEF, 1996

Only 40 percent of the urban population have access to safe water. Investment does not match growth in needs

The State Ministry of Housing and Public Works of Khartoum conceded that “the estimated deficit of clean water supply in Khartoum is about 40 thousand cubic metres per day” (Al Rai Aal Am Newspaper, 23/9/ 2001). The unaccounted for losses in the distribution system are as high as 40%.

**Cumulative Remarks:**

Legislation and policies adopted after 1992 include:

- Drinking Water Standards, 1999
- State Environmental Health Act, Kassala State, 1997; Khartoum State, 2000 (This replaced the General Health Act of 1939)
- The National Water Corporation Act, 1995. This replaced the Rural Water Corporation Act as well as the urban Water Act. The act tried to integrate Nilotic as well as Non-Nilotic water resources, in addition to groundwater. It is concerned with planning and establishing para-statal companies as a step towards privatization.
- The Environmental Protection Law (2001)

**The Water Policy (2000):**

To fulfil the overall objective of water resources planning and management, in order to enhance the development and implementation of effective national water policies and strategies for integrated water resources management (IWRM), the Sudan has successfully produced a "National water Policy" document in the year 2000. A workshop was convened and the policy was adopted.

The policy, however, should have adopted a comprehensive framework and should have treated water as an economic good. Greater attention should have been given to pricing and the fuller participation of stakeholders. Relevant concepts that could have been considered include:

- Adopting an analytical framework
- Institutional and regulatory systems
- Incentives
- Water conserving technology
- Poverty alleviation
- Participatory approach
- Environmental protection
- Skill upgrading

The Water Resources Act was passed in 1995 and the National Water Resources Council was formed. It made reference to stakeholders, research, pricing, licensing brick making, river Transport vessels and water abstraction. It failed, however, to mention wetlands, erosion, drainage, standards, water harvesting, water related diseases, rain water as a resource ..etc. The act concerned itself with freshwater only as it does not mention the Red Sea and its bountiful marine resources.

The **Nile Basin Initiative** process matured in May 2001 by adopting both the *Initiative* and the *Common Vision*. This is an Strategic Action Programme involving basin-wide projects in addition to sub-basin joint projects. These are seven broad-based programmes:

- The Nile Trans-boundary Environmental Action
- Nile Basin Regional Power Trade
- Water Resources Planning and Management
- Confidence Building
- Stakeholders Involvement (Communication)
- Applied Training
- Socio-economic Development and Benefit Sharing

Concurrently, countries of the “Eastern Nile” and those of “Equatorial Lakes region” have identified joint projects (Subsidiary Action Programmes). Basically, the Nile Basin Initiative is a country and needs-driven programme. It should be stressed here that the Nile should have been treated as one indivisible whole. Historically all control works and projects have been carried out where and when the need arose. Engineers and diplomats were the only players and other stakeholders were never involved. The not unexpected consequence is that six of the Nile Basin countries are among the poorest in the world.

### **Sanitation:**

Sanitary means of excreta disposal in the way of sewerage systems are scarce. Pit latrines are the predominant facility. Only parts of Khartoum enjoy a water-based sewerage system, constructed in the early 1960s. It is overloaded and is overtaken by the vertical and horizontal expansion of the city. The Khartoum north sewerage system was never commissioned. VIPs (ventilated improved pit latrines) have been introduced in rural area as part of UNICEF-assisted water supply and sanitation project. VIPs cover the needs of six percent of the rural population of northern states of the Sudan. Eastern states of the Sudan have no access to any sanitary facilities. Affluent residential areas in urban centres use pit-latrines and soak away wells. As mentioned above this poses an obvious threat to ground water quality.

Public latrines are almost nonexistent. Use of open-air latrines are only too common with the obvious consequence of surface water contamination. This is particularly felt with the onset of the rainy season.

According to the WHO, about 90% of major epidemics in the Sudan are water-borne or water-related. These come in the form of Diarrhea, viral hepatitis, malaria, billharzia and guinea worm, whose incidence constitute 90% of global incidence. Some 40% of infant mortality are due to diarrhea. The Federal Ministry of Health estimates that seven to eight million individuals are infected by malaria annually. Only 40% to 60% of these cases are reported. Facilities are up to 35% (Al Rai Ala'am Newspaper, 2001).

A social cost that has to be paid is the burden of fetching water in rural areas. This is the responsibility of women and girls. During the rainy season they collect water from rain-pools, tube wells, hafirs and seasonal streams. In the dry season they might have to walk for much longer distances to get to the contaminated sources. The walk could take from four to eight hours and could use one third of their daily nutritional intake, undermining their health. Sometimes young girls are forced to drop out of school to help their mothers. Polygamy is sometimes encouraged in order to spread out the tedious burden.

### **Other uses of water include:**

- Industry: It has been estimated that it amounts to one percent of the water use in the Sudan. This is mainly in the sugar industry, mining, dairies, tanneries, slaughter-houses, refineries, oil and soap production.
- Hydropower: The present installed capacity is 280 MW at Roseires, 15 MW at Sennar and six at Khashm el Girba. The potential in the Sudan may exceed 9000 MW. Siltation and evaporation are the major constraints.

- Navigation: The River Nile and its tributaries are only partially and seasonally navigable. The White Nile is navigable all year round from Khartoum to Juba. Unfortunately, the River Transport Corporation has almost totally collapsed in the not very far past. It can barely manage to run passenger ferries across the rivers. The private and traditional sectors have become rudimentary.
- Fisheries: The Sudan had a coastline of 750 km on the Red Sea and over 6400 km of river waters covering an estimated 2 million hectares. Lakes Kundi, Keilak, Abyad and Dariba form the group of natural lakes while Sennar, Roseires, Khashm El Girba, Jebel Aulia and lake Nubia form the group of man-made lakes. The Sudan also enjoys some of the largest wetlands in the world. In the Nile Basin as a whole wetlands cover at least a hundred thousand km<sup>2</sup> or about 3% compared to 2% forest and 1.4% irrigated croplands. Stretches of rivers near large markets are over-fished while many others are under exploited. It is not irrelevant to mention that management practices at Khashm El Girba dam (flushing the silt) has depressed the quantity of fish as well as its biodiversity in the River Atbara. The reservoir has only 10 species of fish as opposed to the 106 species found in the Nile within the Sudan.
- Recreation: Is almost never accredited as a use.

### **Coastal Environment:**

The Red Sea is a semi-closed sea. It is linked to the Gulf of Aden over a 100 meter sill at Bab el Mandeb. The Suez Canal connects it to the Mediterranean. It takes 30 years for the complete exchange of its waters to the north and south. The Red Sea is saline and shallow and does not receive the flow of any major river. It is vulnerable due to extremes of temperature and salinity in addition to the fact that it is the major highway of the oil traffic. It is bordered by nine countries whose influence on the coastal and marine environments varies in quality and quantity. The Red Sea does not experience high tidal activities. The coast is lined by a fringing reef as well as a barrier one. It has numerous islands and many bays and lagoons. The maximum depth of the sea is about 2000m and the deeps are characterized by a myriad of currents and gyros. It is rich in minerals and biodiversity but is not one of the important commercial fishing grounds of the world.

The Red Sea is a unique and complex marine ecosystem. It is an extraordinary rich biological diversity and a high degree of endemism. There are also well developed mangrove stands. Seagrass beds cover large areas, in the sheltered coastal lagoons and bays (*marsas*). The Sudanese coast has the most diverse coral reefs of the Red Sea (PERSIGA, 1996) and one of the largest atolls in the world (Sanganeib)

Negative impacts also include the destruction of coastal habitats by dredging, reclamation and construction works, anchor damage to coral reefs, breakage of corals by divers, land-based pollution (as well as that from marine traffic), over-exploitation of fish and shell fish and disturbance to wildlife, such as turtles and birds.

The Sudan is a member of the Regional Organization for the Conservation of the Marine environment of the Red Sea and the Gulf of Aden (PERSIGA), a regional effort, supported by the Global Environmental facility (GEF) to protect the marine and coastal environment of the Red Sea and to promote compatibility and a balance of use. The Project also aims at concentrating at defined issues concerning coastal management, carry out prior assessment of the impacts of major projects as well as promoting issues such as national resources and environmental accounting.

## **Energy and Pollution:**

The Sudan energy consumption is modest by international standards. The energy balance is dominated by biomass. Woody biomass make up 71 percent, petroleum products 19%, non-woody biomass 8% and hydropower 2% (EL Gizouli, 1999).

The total Consumption of the country is as low as 6.3 million tons of oil equivalent (TOE) while the total primary supply is about 11 million TOE. This means that 43% of the energy is lost in converting wood to charcoal. Distances transported nearly always exceed 600 km. The major consumer are households (78% of the total energy) The largest consumer of firewood are brick makers. The efficiency of the traditional charcoal stoves is as low as 16 percent.

The forest cover of Sudan receded from 25% in 1956 to 12% in 2001. Sudan is a member of the club of the 18 countries of "Least Forest Covered". (Merghani, personal Communication)

By the turn of the 20<sup>th</sup> century Sudan started exploiting its modest but expanding proven oil resources. Oil fields are in Addar Yale, Bashair and Heglig. Crude from the former two is transported by river barges and trucked respectively. The environmental impacts of the various processes involved have never been addressed. Further more some of the crude is wastefully used directly as a source of energy. The contribution of the two fields to the GNP has never been disclosed neither have their negative impacts on the environment.

The oil is pumped from the various wells and field through a system of 160 km of pipes the central facility at Heglig. The crude is de-watered at Heglig and then piped 1610 km to the Red Sea export terminal.

The infrastructure of the operation includes an extensive network of raised roads and five field facilities. in addition to the central facility at Heglig, there is the airport, the contractors' camp, the newly-founded towns of Helgig and Keilak Al Kharassan, five pumping stations, a metering station at El Obied, two refineries at El Obied and Khartoum and the large refinery al El Gaili. Environmental Impact Assessment (EIA) studies have been carried out on some of the activities<sup>3</sup>.

The roads interfere to varying degrees with the free flow of water in a globally important wetland. It has also made the area more accessible to settlement and over-exploitation (especially forest products and wildlife) and introduced the threat of large-scale pollution. In Addition to "production water", which is in excess of 6,000 M<sup>3</sup> per day, wastes generated include both solid and liquid domestic effluents as well as floor washings, workshop debris ..etc. It should be stressed that up till now there is not even one single waste treatment facility in any of the above mentioned sites. Especially vulnerable are sensitive areas like lake Keilak and the mangrove swamps and coral reefs around the marine export terminal.

## **Pollution:**

Industrial activities in the Sudan suffered a series of setbacks. Only 30% of the established factories can be considered as operational. These are mainly food and sugar industries. The other light industries, mainly in Khartoum North, El Bageir, Wad Medani and Port Sudan, have almost been

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<sup>3</sup> One of the mitigation measures suggested, concerning the production water, was taken up. A full-scale de-toxication project has been adopted. It involves the use of a man-made wetland.

grounded to a standstill. Almost all are neither connected to any form of sewerage system and did not adhere to internationally adopted standards of pollution abatement, inside or outside the factories. There are no statistics available as to the solid, liquid or gaseous effluents, in spite of available legislation and local regulations (cf Atbara and the Nile Cement factories). Very little is known on the large new complex of GIAD industrial city at El Gedid, 45 km south of Khartoum. Effluents from sugar factories flow freely into the Blue and White Niles, in spite of the presence of legislation prohibiting that.

The air of some cities is much more polluted than what we would like to believe. Khartoum is an striking example:

- Prior to the use of Sudanese fuel, we used to import whatever we could, in the way of price and quality. No standards were adhered to as to the octane quality or the amount of antiknock added.
- There are no standards enforced on the permissible exhaust emissions
- The several thousand feddans of "greenbelt" around Khartoum have been transformed into residential neighborhoods, the thing that depressed the carbon sequestration capacity of the city. Furthermore an appreciable percentage of the private farms and ranches along with the large agricultural schemes, like Gammouiya, Seleit, Soba, El Waha; have been abandoned. They were no longer economically profitable under the prevailing policies.
- In the past few years thousands of two-stroke powered "rickshaws" went into the public transport business. They are notoriously environmentally unfriendly. This has further been aggravated by commissioning thousands of three-piston-powered mini-vans to the public transport sector.
- In the meanwhile the brick industry, the second largest consumer of biomass fuel, had been on a steady in if not appreciating mode.
- The largest source of pollution is El Gaili refinery, 40 km north of Khartoum. It is unfortunate that about 90% of the butane gas produced is burnt out at the refinery. The storage, export and household capacity are still minimal.
- There are three thermal generating stations in and around Khartoum; Kilo-10 (gas), Burri (Diesel) and Khartoum North (furnice). Needless to stress that they are very close to and in the case of Burri in the heart of residential neighborhoods.
- Immediate plans include a Malaysian financed 260 Mega Watt (MW) diesel station in Kilo 10 and a Chinese financed 210 MW at El Geili.

It is, however, pleasing to report that the governor of Gedarif State, after enforcing a total ban on the use of plastic carrier bags, instructed his local authorities not to renew licenses of restaurants using charcoal or firewood. Only gas operators will be allowed to carry on. At the Federal level, the new Minister of Agriculture recently issued a number of decrees to protect the depleted forests, like banning the trans-state transport of firewood and charcoal.

### **Pesticides:**

Some 85% of the pesticides imported are used intensively and extensively in the Gezira Scheme. Organo-chlorines have been banned since the early 1980s. There are many forms of strict controls of the use of pesticides, starting with the Pesticides Committee, registration procedures, storage etc. The situation remains far from perfect. Pesticides somehow find their way to the local markets, and to waterways etc. The Sudan has large quantities of obsolete pesticides, getting rid of which is still

an unsolved problem.

A new use for pesticides was discovered in the Sudan that of hunting wildlife. In the 1970s and 1990s, villagers around Dinder National Park were able to obtain large amounts of meat by poisoning some water points in the Park. The meat was sold at the local markets.

Aerial spraying of Khartoum State has become a matter of routine in the past few years. The name and concentration of the pesticide (s) used were never disclosed to the public. No Studies were made on their impact on target species (mosquitoes) and house fly and non-target species (humans) were ever carried out... acute or chronic.

Mining activities in the eastern Sudan have been employing arsenic compounds for extracting gold. Are the used chemicals and tailings, disposed of safely? The same question was asked of the pipeline coating plant at Sinkat town in the late 1990s. No answers were given.

These examples are to demonstrate that the general policy adopted is defiantly not transparent. The notion of sustainability does not seem to find any audience.

The largest source of air pollution in the Sudan is, without question, the dust storms. They are so common (and increasing in frequency and intensity). That Sudanese do not seem to see the water under the bridge or the wood in the forest.

### **Final Remarks:**

Some meagre efforts have been carried out by the Sudanese NGOs in the spirit of Agenda 21. An example is the Sudanese Environmental Conservation Society's document "Towards an Environmental Action Plan, (1997). It is sad to report that it was not taken up by the Sudanese Government.

The National Water Council, created in 1995, was in a way transgressing on the mandate of the Higher Council of Environment and Natural Resources (HCENR). However, the mandate of the Water Council did not include marine resources and it was neither involved in the inception of the Water Policy nor the Nile Initiative.

The National Comprehensive Strategy was produced in 1992 but was never taken up seriously by the various Ministries at the Federal or State levels (Moghraby, 1999).

Activities related to Agenda 21 are four isolated projects housed in the HCENR. These are isolated from the mainstream activities and policies of the activities of the Government as well as from the activities of the National Drought and Desertification Unit (NDDU), housed in the same building but belonging to another Ministry.

There is largely no political will or commitment of the government towards such activities at large. A question poses itself here. How effective is the HCNER in guiding or influencing the government policies to environmental issues and sustainable development? How effective are NGOs in that respect?. The HCNER is not even represented in the Advisory Council of the Minister of

Environment and Physical Development. Ideally it should have been instrumental in the Advisory Councils of all Federal Ministries. The Environment Protection Law (2001) should have the power of enforcement and strong instruments for implementation and safeguarding Sudan's commitments, especially those clearly outlined in Agenda 21. For example the gas burnt at Geili refinery directly contradicts Sudan's commitments of reducing the gas emission levels. Other examples are the White Nile Sugar Factory, the IDP settlements ..etc..

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