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Briefing Note

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OIL FIRES IN KUWAIT - *An Update*

POST Briefing Note 21 described possible environmental consequences of Iraqi sabotage of Kuwaiti oil wells, before significant numbers of wells had been set on fire. Now the extent of destruction has become clearer, it is possible to narrow some of the uncertainties in the previous analyses.

INFORMATION AVAILABLE

Amounts of oil. The Kuwait Petroleum Company's (KPC) damage assessment shows that approximately 950 wells have been sabotaged, of which 550 are burning (BN21 suggested that up to 750 could potentially be set alight). Damage has been severe enough to destroy safety and flow-limiting devices and, in some cases, to allow the oil to flow around the casing, increasing the flow further still. KPC now estimate that between 5 and 6 million barrels per day (mbd) are burning. **This exceeds most of the worst case scenarios cited in BN21.**

Oil refineries and storage facilities have also been sabotaged, where up to 15 million barrels could have been in place. Damage is considerable but initial assessments by KPC suggest that less than a quarter of the storage tanks have been affected - i.e. less than 4 million barrels. Most of these fires are now out, so that the environmental threats emanate almost exclusively from the burning wells.

How Long could the Fires Burn? Earlier estimates of the time taken to extinguish fires ranged from a few months to a year, which many now regard as optimistic. While fires will be extinguished steadily once the logistics required (particularly the provision of large amounts of water) are in place, some estimate that it could be 1-3 years before all fires are extinguished.

Pollutants Generated. If it is assumed that fires are extinguished at a steady rate over 2 years, emissions would be as shown in Table 1. Emissions over the first year are three times those in Table 1 of BN21 and in a recent analysis in Nature(7 March 1991, pages 11-12).

Smoke Plume Behaviour. The environmental effects of the fires depend on the behaviour of the smoke. BN21 explained that if smoke stayed low, it would fall out, or be washed out, locally or regionally. On the other hand, if smoke reaches altitudes of 10 km or more, it remains in the atmosphere for much longer and could have more widespread effects on climate. Calculations cited in BN21 had predicted that smoke from individual oil well fires would rise only a km or so, although any large fires at refineries could loft smoke higher.

Table 1: UPDATED ESTIMATES OF EMISSIONS (million tonnes)*

Pollutant	First Year	Second Year
Sulphur Dioxide (as SO_2)	12.6	4.2
Carbon Dioxide (as C)	171	57
Smoke	6.9 - 22.8	2.3 - 7.6

*Assumption that 6 mbd is reduced to 3 mbd at end of year 1, and to zero at the end of year 2.

More recent model calculations also predict that individual well fires may rise to 1 km, and that more concentrated refinery fires could rise as far as 3km. In either case, smoke and pollutants are predicted to remain in the lower troposphere and be subject to normal weather processes. Recent observations confirm that smoke plumes are dispersing as single plumes staying low. Exact measurements would have to await special research flights, but most smoke appears to be levelling out at or below 5000 ft (1-2 km). There is thus general agreement between model predictions and actual smoke behaviour to date. However, some scientists argue that under certain conditions, smoke could rise much higher (for instance, some storms can lift air from ground level high into the troposphere; large smoke clouds in still weather could rise further through extra buoyancy caused by solar absorption). In such circumstances, some of the smoke could stay in the atmosphere longer and spread further afield.

ENVIRONMENTAL IMPACTS

BN21 discussed the expected environmental impacts of smoke, acid rain and carbon dioxide at local, regional and global levels. Since then, a number of further investigations have been carried out by the Met Office and others.

Global Effects. Carbon dioxide emissions could add nearly 3% to the global emissions from other human activities in the first year and 1% in the second. The ozone layer is unlikely to be affected, provided the current majority view is sustained that the gases capable of destroying ozone are unlikely to reach the stratosphere in significant quantities.

Climate changes. Earlier analyses had examined the possibility that smoke could trigger climate effects forecast in a 'nuclear winter' - including failure of the Asian monsoon. Calculations reported in BN21 had suggested this was unlikely, although the earliest Met Office analysis did not rule out the possibility that smoke could cause local reductions in rainfall during the summer monsoon.

More detailed modelling by the Met Office and others suggests that any effect on the monsoon would be negligible and much less than year-to-year variability. These results also support earlier suggestions that any diluted smoke in the troposphere that did reach the Indian Sub-continent could create additional atmospheric warming which would be more likely to enhance monsoon conditions than suppress them. However, such predictions assume the release of 50,000 tonnes per day of smoke (which could now be exceeded by up to 60%) and that smoke stays in the lower (up to 5 km) atmosphere. More detailed information on the quantity and behaviour of smoke is thus urgently needed if more reliable forecasts are to be made.

Local Effects. The reason that regional climatic impacts are not predicted is that much of the pollution falls out or is washed out of the atmosphere in a relatively short time. It is precisely this behaviour which will seriously affect the local environment. Models predict that the worst fallout will be within 2000 km -i.e. primarily over Kuwait, the Gulf, Iraq, Iran, eastern Turkey, and Saudi Arabia. But irregular fallout could occur as far away as Pakistan and northern India to the east and Greece, the Balkans and northeast Africa (e.g. Ethiopia) to the west. Fallout of soot is already widespread locally, and the large amounts of suphur (and nitrogen) oxides cause rain to be highly acidic. 'Black rain' has been reported in Iran, Iraq and Kuwait, and given recent weather patterns, 'black' snow in the mountains of Iraq and Iran may have fallen. Smoke has reduced daytime temperatures through shading, but will also reduce nightime cooling through its blanketing effect.

Under the earlier scenario of 1.5 mbd, the Met Office model predicted rainfall acidity as high as in the most polluted areas of Europe. In the short term, emissions of sulphur dioxide will be four times the original assumption. Leaves can be scorched by highly acid precipitation; photosynthesis could be reduced by soot covering leaves (in addition to reductions in sunlight in the shadow of smoke clouds); rivers or lakes in areas without much natural buffering capacity could become more acidic, affecting aquatic life. In addition, contaminants may reach underground water supplies. Iran may have the most agriculture in the area likely to be most severely affected.

Furthermore, the health of the population could suffer as a result of severe local air pollution - including photochemical smogs in the absence of strong winds. Such conditions are particularly harmful to those with breathing difficulties. Since incomplete combustion of oil also produces carcinogens, there may also be potential for longer term health effects.

RELEVANT UK EXPERTISE

The dimensions of this sabotage are becoming clearer, but at the moment, the environmental impact can only be forecast in the qualitative way above. UK expertise could assist in quantifying these impacts. For instance, the Met Office has been running special weather models for operational use during the war, and could continue to do so to prepare forecasts of weather events, including 2-day forecasts of the dispersion and washout of pollutants. In this way, an area would have some warning of black acid rain, or severe smogs etc. Scientific uncertainty over the behaviour of the smoke in special conditions could be reduced by measurements of smoke plume characteristics by the Met Office's research aircraft. The latter investigations are critical to confirming whether climate effects predictions are valid.

The UK has extensive monitoring networks for acid rain, water quality etc. (for example, DTI's Warren Spring Laboratory has expertise in measuring and predicting acid deposition). Related expertise could not only assist in monitoring the extent and effects of fallout in and around Kuwait, but also help in validating the Met Office predictive models and extending our understanding of pollution processes relevant to acid rain in Europe.

There is also much expertise on environmental impact assessment in the UK. NERC Institutes have expertise in atmospheric, terrestrial and aquatic processes and how they are affected by pollution. Some Universities (e.g. Imperial College) have their own EIA 'teams' which could conduct assessments and look for ameliorative action. With the UK's historical experience of air pollution-induced respiratory problems, there may be considerable relevant expertise here as well.

The Environment Minister has suggested that the Met Office's local forecasting service could be made available, and that other sources of UK expertise might be useful. However the basis on which such services could be provided has yet to be clarified.

FURTHER READING

Additional details are available from P.O.S.T., 2, Little Smith St., London SW1P 3DL. Tel: (071)-222-2688.

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