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OIL FOR DEVELOPMENT

REMEDIATION OF OIL CONTAMINATED SITES IN THE CONFLICT-AFFECTED AREAS

BABA GURGUR, KIRKUK, IRAQ
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Background

Scorched earth tactics targeting Iraq's oil industry caused significant environmental damage in the conflict-affected areas in 2016-2017. To assist the Iraqi Government deal with this pollution legacy, UN Environment Programme (UNEP) through the Oil for Development (OFD) Programme, delivered a "hands-on" training course to assist technical staff of the Environment and Oil Ministries implement pragmatic and cost-effective clean-up of oil contaminated sites.

This training builds on two previous OFD supported workshops on contaminated site assessment and environmental sampling held in Baghdad for experts from the Environment and Oil Ministries in January and September 2018 to characterize and evaluate the risks from oil pollution hot spots.

The training was also meant to help address the findings of a rapid oil pollution mapping survey conducted in the four conflict-affected governorates of Ninewa, Salah Al-Deen, Kirkuk and Diyala by a joint team from the Environment and Oil Ministries in October/November 2018 with technical guidance from UNEP. Around 74 polluted sites were identified in this mapping survey of which four clusters are considered of particularly high concern both in terms of scale and severity.

The training course was offered under the UNEP-Government of Norway OFD partnership to enhance national capacities for improved environmental management in OfD-supported countries, including Iraq. The workshop was hosted by the Ministry of Oil's state-owned North Oil Company (NOC) at its headquarters in the historic Baba Gurgur oil field where commercial oil reserves were first discovered in Iraq in 1927. The NOC, whose oil fields and infrastructure suffered extensive damage during the conflict, also availed the necessary equipment and resources to conduct a demonstration bioremediation trial.

The Development Coordination Office of the United Nations Assistance Mission for Iraq (UNAMI) office in Kirkuk played a critical role in liaising with national partners and facilitating workshop preparations including provision of logistical and security support. RSK Group, an international environmental consultancy company with offices in Basra, also provided valuable technical inputs to the workshop and field trial.

Training Course

The Training Course aimed to strengthen the capacity of the Iraqi Government to take quick action on remediating oil contaminated sites in the conflict-affected areas. The workshop was based on a 'learning by doing approach' which involved setting-up a practical bioremediation demonstration trial at the NOC.

A total of 31 participants attended (4 women, 27 men) from the Ministry of Health and Environment and Ministry of Oil. Participants included representatives from the regional and governorate level Environment Directorates, the state-owned national oil companies, and Ministries of Environment and Oil headquarters in Baghdad.

The 4-day training course introduced the different methods and technologies for oil spill remediation. The design and implementation of a tiered Remediation Action Plan (RAP) based on risk and remediation criteria was examined. Dedicated sessions addressed economic valuation of environmental damage from oil spills and reviewed legal and regulatory aspects of contaminated site assessment.

The training included in-classroom exercises, a field visit to carryout a rapid site assessment and develop a conceptual site model of a recent oil spill from a leaking oil pipeline in Qizilyar village (15 km west of Kirkuk city), and practical demonstration of the different steps in setting up a bioremediation cell. Personal protective equipment (PPE) was also provided to all the workshop participants. USBs containing the training materials as well general literature on remediation of oil contaminated sites was also shared with the participants.

A news story about the training event and bioremediation trial was published on both UNAMI and UNEP websites, in [English](#) and [Arabic](#).

Key issues raised

The key concept of risk based contaminated land management including the limitations of relying on Generic Assessment Criteria (GAC) and the need to develop site specific assessment criteria (SSAC) for Iraq was extensively discussed during the training. The training also provided an overview of the different techniques for remediation of oil contaminated sites, emphasizing the potential role of bioremediation given its applicability and cost-effectiveness in the context of national capacities and resources. The key issues can be summarized as follows:

- **Inadequate remediation of oil contaminated sites:** Spills from old and poorly maintained oil pipeline networks is a chronic cause of incidents at national level. Deliberate targeting of oil installations during the ISIL conflict and oil theft by criminal and armed groups is also a major factor in the rising incidence of oil spills over the past 15 years, particularly in the conflict-affected areas of northern Iraq. Overall, the response of state-owned oil companies is generally only to stop and contain oil spills. Limited action if any, however, is taken to clean-up the oil spills. Consequently, in many cases oil spills are simply abandoned; creating significant impacts on the livelihoods and health of local communities as well as natural ecosystems.

In this relation, there is a need for an improved collective response to overcome bureaucratic and security delays in removing oil from spill sites. While damaged pipelines are typically repaired in less than one day, it can take more than one year(s) before any action is taken to remove oil from a spill site. The lack of action is difficult to understand, and there is a sense that security issues are being used as an excuse for not taking rapid and effective action.

- **Need for prioritization of oil remediation by national oil companies:** The poor response by national oil companies in addressing spills is reportedly driven by prioritization of revenue generation over social and environmental considerations, and the lack of an effective system of accountability. It is noteworthy that NOC have limited equipment to use for clean-up activities and need to invest more resources in remediation. There is a clear need for state-owned oil companies to place protection of health and environment on equal par with production.
- **Good potential for bioremediation of oil contaminated sites:** Bioremediation is an appropriate low-cost technology to clean-up the substantial legacy of oil spills in the Iraq context as it is relatively simple, effective and affordable. Generally, bioremediation could address the bulk of oil-spills and contaminated soils, while a small portion (10-20 %) of more complex materials (such as bituminous fraction) may still require some kind of thermal treatment. The bioremediation field trial carried out by UNEP at the government owned North Oil Company headquarters was well received by the Ministries of Oil and Environment, who expressed high-level of interest in replicating and scaling-up this technique. Furthermore, the Deputy Environment Minister, Dr. Jassim Humadi, who visited the demonstration trial on the workshop's concluding day reiterated the Ministry's endorsement and

commitment to promoting bioremediation of oil polluted sites across the country. Nevertheless, given existing preconceptions by the national oil industry favouring expensive remediation options, there is a need to maintain a sustained advocacy for biological clean-up approaches; especially as the more expensive thermal remediation options are rarely, if ever, implemented given their high-cost.

- **Follow-up actions on demonstration trial and future training:** The Environment and Oil Ministries agreed to maintain the bioremediation demonstration trial over the next 5-6 months. UNEP and RSK will support laboratory analysis of soil samples from this trial to scientifically document the results. The Ministry of Health and Environment indicated it will mobilize grants from its National Environment Fund to encourage implementation of bio-remediation pilots. Several workshop participants also expressed their intention to set-up similar bio-pilots through their respective national oil companies. Furthermore, the Oil Ministry requested that the same training be repeated to the Ministry of Oil and state-owned companies in Baghdad and Basra.
- **Importance of risk assessment in determining appropriate remediation options:** Iraq's framework environment law (2009) stipulates that contaminated sites should be restored to their natural condition. While this is a laudable goal, it may be counterproductive to place such a high remediation benchmark as it may be very costly to implement and inadvertently lead to no action; especially given the scale of legacy sites in Iraq. A 'risk assessment approach' to contaminated land management is therefore recommended as it is more pragmatic and cost-effective. This would entail detailed quantitative risk assessment (DQRA) to derive site specific assessment criteria (SSAC) that are representative of local conditions. The additional costs of refining the risk assessment can be repaid several times over by reducing the amount of remediation required. It is also important to take into account the final intended use of remediated sites to determine potential exposure risk.

In assessing the risk of petroleum hydrocarbons, it is equally recommended to adopt the method of the Total Petroleum Hydrocarbon Criteria Working Group (TPH-CWG). This involves risk assessment for specific indicator compounds (e.g. benzene, benzo(a)pyrene etc), and of hydrocarbon fractions which exhibit similar fate and transport properties. As applying a single cumulative concentration, representing total TPH, cannot be used in quantitative risk assessment as it is likely to lead to over or underestimation of risk.

Adoption of risk assessment methods to contaminated land management and remediation may require revision of the existing environmental law and development of subsidiary regulations and/or guidance. Specifically, it is recommended that Iraq develops its own Generic Assessment Criteria (GAC) as it can speed-up, simplify and reduce the cost of risk assessment of contaminated sites in Iraq.

- **Improved coordination between national oil companies and the Environment Ministry in addressing oil spills:** Oil companies need to work closely with

environment supervisors and regulators, and not only bring them in at the end of the process when proposing oil clean-up solutions. Environmental regulators are part of the oil spill clean-up team and should be involved in the early stages of response formulation.

- **Clarifying mandates and roles regarding clean-up of oil contaminated sites:** The government reportedly recently awarded the Ministry of Science and Technology exclusive right to treat hazardous waste, which also includes oil spills. Therefore, it will be important to better understand the plans and capacities of the Ministry of Science and Technology in this field, which reportedly started to carry out oil spill remediation work in Basra in 2020.
- **Need for public engagement in clean-up:** Local communities are bearing the brunt of repeated oil spills from leaking pipelines, theft and sabotage. However, there is a notable absence of public consultation and involvement in determining and implementing oil spill clean-up actions. Further, it was reported that residents affected by oil-spills receive no compensation – even where their livelihoods are negatively impacted, such as contaminated farm-land. There is therefore a need to improve engagement with local communities in addressing oil spills. It would also be desirable that future trainings also involve representatives of affected communities, local government representatives and local environmental NGOs.

Results of Participant Assessments

UN Environment carried out knowledge assessments after all presentations at the end of the training, using a set of “exam” questions (27 questions in total), as one way of evaluating improvements in knowledge attained as a result of the training. The set of questions was based primarily on the technical presentations delivered during the course of the training. Responses were in multiple choice or True/False statements. These assessments were translated to Arabic which is the national language in Iraq to enable participants fully understand the questions.

It should be noted that this type of written assessment only provides a partial assessment of knowledge gained by individual participants, given that additional knowledge is gained through their group work discussions and direct interactions with their peers and UNEP experts. Hence, it is important to view these assessments in conjunction with their own personal evaluation of the training and whether the training met their learning needs (discussed further below).

Of the total number of participants (31), only 24 were able to complete the knowledge assessments, as several participants had to leave the training earlier due to other commitments. The average score of those who completed the assessment was 79%.

Results of the Training Evaluations

UNEP provided the opportunity for participants to evaluate the training based on their own expectations and learning needs. All participants completed the evaluation.

Most participants gave scores of 4/5 or 5/5 for meeting the set of learning objectives outlined by the training. Participants were also asked to rate the extent to which individual Modules (1-5) met their individual learning needs (score range of 1= not met to 5=fully met). Most participants scored each Module 4/5 or 5/5.

When asked to rate their overall satisfaction with the training course, 43% of participants rated the training as excellent, while 30% rated the training as highly satisfactory, and 26% rated the training as satisfactory. Participants appreciated the participatory/interactive, practical training approach. Participants wished to have a more extended period of training.

When asked ways the knowledge received from the training will be applied, 77% indicated through sharing training materials with other colleagues, 50% indicated organizing a follow up meeting to share knowledge and training materials with other colleagues who could not attend this training; and 18% other means which included conducting central workshop in their Ministry.

The other means included:

- Transfer also to my college students also, external university lecturer in Kirkuk Technical College / Environment Department
- Apply in the daily work in my organization in the Ministry of Health and Environment
- Benefit from it in my work for site assessment in Ministry of Health and Environment

Future considerations for improvement include:

- Translation of knowledge assessments and other documents to avoid language barrier

For further details of evaluation results, consult Annex 1.

Annex 1. Detailed results of Participants' Training Evaluations

The majority of participants gave scores of 4/5 or 5/5 for meeting the set of learning objectives outlined by the training.

Table 1. Participant Rating of Learning Objectives Met (score range of 1 = not met to 5 = fully met)

	1= NOT MET	2	3	4	5= FULLY MET	TOTAL	WEIGHTED AVERAGE
Understanding the different methods and technologies for oil spill remediation	0.00% 0	8.33% 2	0.00% 0	25.00% 6	66.67% 16	24	4.50
Design and implementation of a tiered Remediation Action Plan (RAP) based on risk assessment and remediation criteria	0.00% 0	0.00% 0	0.00% 0	41.67% 10	58.33% 14	24	4.58
Practical experience and understanding of the bio-remediation of oil contaminated sites	0.00% 0	0.00% 0	0.00% 0	37.50% 9	62.50% 15	24	4.63
Appreciation of the legal and regulatory aspects of contaminated site remediation	0.00% 0	0.00% 0	20.83% 5	58.33% 14	20.83% 5	24	4.00
Economic valuation approaches of environmental damage caused by oil spills	0.00% 0	0.00% 0	29.17% 7	33.33% 8	37.50% 9	24	4.08

Participants were also asked to rate the extent to which individual Modules (1-5) met their individual learning needs (score range of 1 = not met to 5 = fully met). Most participants scored each Module 4/5 or 5/5 (Table 2).

Table 2. Participant Rating of each Module against their learning needs

	1= NOT MET	2	3	4	5= FULLY MET	TOTAL	WEIGHTED AVERAGE
1. Contaminated site assessment including links to risk assessment and remediation planning	0.00% 0	0.00% 0	0.00% 0	45.83% 11	54.17% 13	24	4.54
2. The different methods and technologies for oil-spill remediation	0.00% 0	0.00% 0	12.50% 3	41.67% 10	45.83% 11	24	4.33
3. Design and implementation of a tiered Remediation Action Plan (RAP) based on risk assessment and remediation criteria	0.00% 0	0.00% 0	21.74% 5	39.13% 9	39.13% 9	23	4.17
4. Appreciation of the legal and regulatory aspects of contaminated site remediation	0.00% 0	0.00% 0	26.09% 6	39.13% 9	34.78% 8	23	4.09
5. Economic valuation approaches of environmental damage caused by oil-spills	0.00% 0	0.00% 0	12.50% 3	45.83% 11	41.67% 10	24	4.29
Field trip and exercises	0.00% 0	0.00% 0	13.04% 3	17.39% 4	69.57% 16	23	4.57
Action Planning	0.00% 0	0.00% 0	4.35% 1	47.83% 11	47.83% 11	23	4.43

When asked to rate their overall satisfaction with the training course, 39% of participants rated the training as excellent, 39% rated the training as highly satisfactory, while 14% rated the training as satisfactory, and 7% as needs Improvement. (Figure 1).

Figure 1. Participants' evaluation of their overall satisfaction with the training course

Answered: 23 Skipped: 1

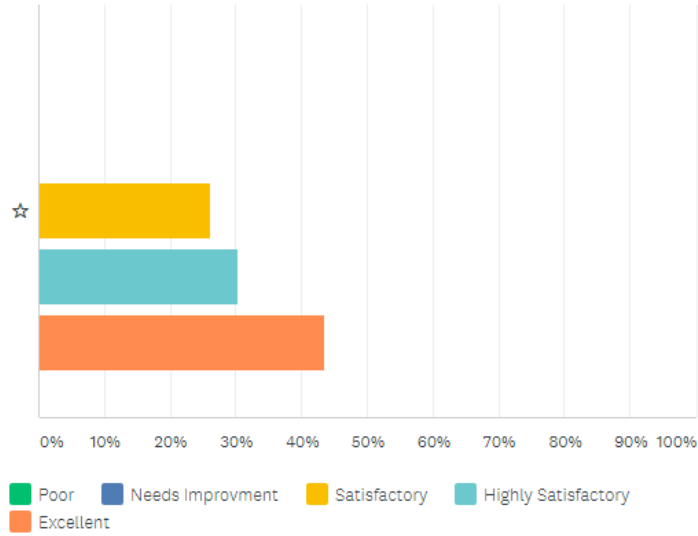
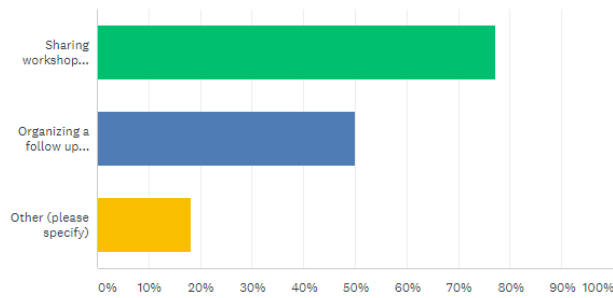


Figure 2. Participants' indication of how knowledge received from the training will be applied

Answered: 22 Skipped: 2



Participants were also asked what they found most and least useful about the training and how the training can be improved. Their individual comments are listed in Table 3.

Table 3. Participants' feedback on the training

<p>What did you like about the training? Which part of the training was most useful to you?</p>	<ul style="list-style-type: none"> • Practical training: it was the best training I ever had without contest, excellent lectures explaining key principles, especially Mike's. • The practical training was important for me, as I work in the Contaminated Site Assessment Unit, and the training was very good. • The practical fieldwork was very useful for me, as there is a similar situation in the Kasak refinery which needs to be remediated. • This was a very good workshop and we benefited from the important fieldwork, and it's possible to disseminate this approach widely as it's effective and not costly and we can apply it in our areas. • Practical fieldwork gave a clear approach for characterizing the key aspects to be taken into consideration during oil spill incidents. Especially the methodology on bioremediation that was demonstrated during day 3. • Field training on bio-remediation of oil spills • Remediation in site • Practical Exercises • Risk assessment, Economic & Treatment. • Training in field • Risk assessment evaluation, on filed training about bio-remediation. • Risk assessment and Bioremediation for oil spill • I liked the subject of the training which was very related to our work regarding remediating and treating the oil polluted sites. The most useful was the fieldwork and also the seminars. • Bio-remediation principles, practical part of training. • Practical part of training. • Work part was most useful to me. – Bioremediation methods. • 1) Understanding biological remediation theoretically and practically 2) Having knowledge about real cases of oil spills and remediation in different parts of the world • I learned about several methods for treating oil spills, and which can be applied to clean-up spills and contaminated areas in our oil installations where we work and to correct the misconception or belief that is it not possible to remediate oil spills and polluted soils.
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<p>Which session or part of the workshop did you find least useful, and why?</p>	<ul style="list-style-type: none"> • Remediation by government institutions as they lack the resources. • Bioremediation is a useful method for treating light hydrocarbons as demonstrated in the fieldwork, but it's not possible to treat heavy hydrocarbons such as in some of the remaining spills in Qayyarah by this method. • Method for compensating damages by oil companies and calculating the environmental costs • Another method such as venting, air stripping, thermal technology • I think limitations of remediation method and economic valuation need more explanation. (19 participants responded none, all was useful or left this section blank)
<p>What do you think could be improved?</p>	<ul style="list-style-type: none"> • Preventing pollution; Regulations; Application of the training; Performance of companies • Need to learn about the other remediation methods in practical manner • To learn more about the treatment of solid oil waste such as natural asphalt and the remaining sludge from burning of oil wells in Qayyarah. • Making use of bioremediation and the key steps it entails and taking action to stop source of spill when it happens, and giving due consideration to pollution pathways and receptions and taking such measures and not leaving the polluted site as it is. • Improving environmental awareness and environmental regulations • Contaminated site assessment including links to risk assessment and remediation planning • More details for other methods in site. • Methods of treatment and how to choose between them for good results; Enhance the ability for risk assessment and kind of analysis which is effective in choosing the right method. • The part of oil treatment should be improved • It's all ok to me. • Continue this workshop with increased level • More practical part we need, especially how to control nutrient deal with leaks and follow up. • Subjects of other workshops provided in advance • Increase training workshop in this course. • It is important to have information about other ways to treat contaminated sites including thermal method.

Annex 2. List of Participants

	Institution	Participants	Title
1	NOC	Azad Jalil TAHIR	Director of Environment
2		Ihsan Hussein MOHAMMED	Head of Oil Spill Processes
3		Aziz Mohammed MURAD	Senior Engineer
4		Tahsen Yaseen TAWFIQ	Chemical Engineer
5		Muayad Hussein Hamdi	Safety Section
6	NRC	Mohammed Ahmed ALWAN	Senior Chemical Engineer
7		Faroq Mohammed IBRAHIM	Deputy Technical Director
8	OPC	Eman Khalil HASAN	Senior Engineer
9	Ministry of Oil	Nashwan M. KHADHER	Chief of Engineers
10		Mohammed F. ABDULLAH	Deputy Chief of Engineers
11		Manaf Abdul Hadi SHAKIR	Senior Engineer
12	MoH&E	Ali Abdel RAZAAQ	Director Kirkuk Environment
13		Waleed Ali HUSSEIN	Chief Engineer, Head of Oil Pollution
14		Ali SAMI	Senior Biologist, Contaminated Sites
15		Adel KHALEEFAH	Senior Biologist EIA Department
16		Mohammed A. N. ALDEN	Chief Engineer Assistant
17		Jasim Ali NAWAR	Chief Chemist Assistant
18		Ali KADHIM	Technical Manager, Al-Muthanna
19		Amar SALIM	Chief Chemist, Nineveh Environment
20		Omer AMER	Chief engineer assistant, contaminated sites
21		Mahmoud K. MAHMOUD	Chief Chemist Assistant, Hazardous Waste
22		Husam ABDLMUTTAEB	Chief Engineer, Oil Pollution Division
23		Taghreed QASIM	Chief Chemist Assistant, Hazardous Waste
24		Radhi Mohammed RADHI	Engineer, South Environment Protection Directorate
25		Mays Abbas KADHIM	Senior Biologist, Oil Pollution
26		Esraa Jawad ABDULLA	Senior Engineer, Oil Pollution
27		Ahmed HABEEB	Senior Chemist, Kirkuk Environment
28		Hayder THAMER	Senior Engineer, Industrial Activities
29		Adnan KHALEEFAH	Senior Chemist, Salah-al-din
30		Luay Sadik AL-MOKHTAR	Manager, Chemical Management
31		GIO	Hussam Flyied Jassam
32	Aqeel Muzhir Gati		Inspector

	Organization	Trainers	Title
1	UNEP	Mike COWING	Senior Advisor
2	UNEP	Geraint WILLIAMS	Senior Advisor
3	RSK	Ian GOODACRE	Senior Expert
4	UNEP	Hassan PATROW	Programme Manager

	Organization	Facilitators	Title
1	UNAMI-DCO	Martijn DALHUIJSEN	Liaison Officer
2	UNAMI-DCO	Ammar JASIM	Associate Officer
3	UNAMI-DCO	Najat ABDULLAH	Associate Officer
4	UNAMI-PIO	Harith ALOBAIDI	Public Information Officer
5	UNAMI-FMS	Mohammed WAHID	Facilities Management Assistant

Acronyms

DQRA	Detailed Quantitative Risk Assessment
EIA	Environmental Impact Assessment
GAC	Generic Assessment Criteria
GIO	General Inspector's Office
MoH&E	Ministry of Health and the Environment
MoO	Ministry of Oil
MoST	Ministry for Science and Technology
NGOs	Non-Governmental Organizations
NOC	North Oil Company
NORAD	Norwegian Agency for Development Cooperation
NRC	North Refinery Company
OFD	Oil for Development
OPC	Oil Production Company
PPE	Personal Protective Equipment
RAP	Remediation Action Plan
SSAC	Site Specific Assessment Criteria
TPH	Total Petroleum Hydrocarbon
TPH-CWG	Total Petroleum Hydrocarbon Criteria Working Group
UNAMI/DCO	United Nations Assistance Mission for Iraq/Development Coordination Office
UNEP	United Nations Environment Programme



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