WHO-EM/MAL/373/E

Report on the

Sixth meeting of the Scientific and Technical Advisory Committee of the regional WHO/ UNEP/GEF project on sustainable alternatives to DDT

Khartoum, Sudan
25–27 June 2013

World Health Organization
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1. INTRODUCTION

A project entitled “Demonstration of sustainable alternatives to DDT and strengthening of vector control capabilities in Middle East and North Africa” is being implemented by the WHO Regional Office for the Eastern Mediterranean and the United Nations Environment Programme (UNEP), with financial support from the Global Environment Facility (GEF). This regional project (2009–2014) covers the following countries of the WHO Eastern Mediterranean Region: Djibouti, Egypt, Jordan, Islamic Republic of Iran, Morocco, Sudan, Syrian Arab Republic and Yemen. A total of US$ 3.9 million has been made available to support the five components of the project at national and regional level.

The sixth meeting of the Scientific and Technical Advisory Committee (STAC) for this project was held in Khartoum, Sudan on 25–27 June 2013. The sixth STAC meeting aimed to build on the recommendations of the previous STAC meetings held in: Amman (November 2008); Cairo (July 2009), Damascus (July 2010), Marrakesh (July 2011) and Cairo (July 2012). The objectives of the meeting were to:

- present and review the status of the project activities on the demonstration of alternative vector control interventions to DDT;
- report on the status of the disposal of obsolete DDT and other pesticides in the Islamic Republic of Iran, Jordan and Morocco;
- identify challenges and constraints in the overall implementation of the project in countries of the Region; and
- recommend the way forward for timely implementation of the project.

Five members of the STAC were in attendance; the remaining members were unable to attend. Representatives from the eight project countries were in attendance.

The meeting was opened by Dr Anshu Banerjee, WHO Representative, Sudan, who delivered a message from Dr Ala Alwan, WHO Regional Director for the Eastern Mediterranean. In his message, Dr Alwan acknowledged the support of UNEP/GEF and the collaboration between WHO and other United Nations agencies. He drew attention to the important progress made by demonstration countries, with well-designed studies, successful roll-out of interventions, sound systems of epidemiological and entomological surveillance in place and promising preliminary data on cost-effectiveness. Dr Alwan noted the political will of Project countries to implement alternative vector control methods in the context of an integrated vector management strategy has been demonstrated by project countries through their co-funding of the project and through their achievements in policy development and institutional arrangements for integrated vector management.

On behalf of UNEP/GEF, Mr Jan Betlem, Head Monitoring, Quality Assurance Section, UNEP, made a statement underscoring the goals of the project regarding the safe and sound management of public health pesticides. The countries of the Eastern Mediterranean Region who were engaged in the GEF-supported projects were making an important contribution to the evidence for controlling vector-borne diseases in a cost effective way without the use of DDT.

H.E. Mr Bahar Idris Abu Garda, Federal Minister of Health, acknowledged that health is now higher on the international agenda His Excellency emphasized the responsibility this project has in identifying sustainable vector control interventions, which are crucial to making the millennium development goals attainable and in doing so secure a better future for all.

Dr Salaheldin El Mubarak presided over the meeting as the Chair on the first day and Dr Fahad Awad Ali Elnour on the final day. Ms Caroline Barwa undertook the role of the Rapporteur.

The programme and list of participants are given in Annexes 1 and 2, respectively.

2. REGIONAL PROJECT PROGRESS REPORT

Ms Caroline Barwa, WHO Regional Office for the Eastern Mediterranean

The regional activities conducted in the year ending June 2013 were presented in relation to each outcome. For Outcome 1 (Sustainable and cost-effective DDT alternatives demonstrated), a mid-term review (November 2012–March 2013) was conducted to provide a supportive review of the Project in order to suggest corrective action for achieving the objectives and outcomes by the end of the Project. For Outcome 2 (Capacity built to implement DDT alternatives based on principles of integrated vector management), NAMRU-3 and WHO collaborated in conducting a training course on insecticide resistance monitoring in Cairo, with representatives from 13 countries. Activities related to Outcome 3 are covered in detail in the next section. For Outcome 4 (Good practices on sustainable alternatives are shared), a consultative meeting on insecticide resistance management was held in Casablanca, Morocco in September 2012. Missions were conducted to Lebanon, Qatar and Tunisia to identify priorities to strengthen public health pesticide management. For Outcome 5 (Trans-boundary and national coordination, information sharing to promote integrated vector management without the use of DDT), the Regional Office is currently developing a comprehensive insecticide resistance database based on records from the 1940s to 2012. This database aims to provide countries with a databank to facilitate data sharing and establish benchmarks on resistance status among malaria vectors.

Several challenges persist. To date, aside from two countries submitting timely progress reports, communication and response by GEF focal points has been poor. Demonstration countries have experienced delays in implementing their project activities. There was a delay in recruiting a staff member for vector control; consequently activities were covered by regional malaria staff between October 2012 and April 2013. A consultant has been recruited for 6 months from May 2013.

3. UPDATE ON COLLECTION, REPACKING AND DISPOSAL OF PERSISTENT ORGANIC POLLUTANTS

Dr Richard Thompson, Food and Agriculture Organization of the United Nations

Good progress has been made on Component 3 since the previous STAC meeting in Cairo in 2012. The project agreement between FAO and WHO was amended on 5 September 2012 to extend the project to 31 December 2013 and to increase project funds by US$ 336 000 to allow the contract to be concluded. The turnkey contract for safeguarding and disposal of DDT in all three contracts was negotiated with the lowest bidder, Tredi S.A. of France, including a discount of 4%. The contract was signed on 10 December 2012. Tredi initiated the procedures for authorization of the trans-boundary shipment of DDT from each country to France under the Basel Convention. Authorizations were received for Jordan and Morocco on 17 June. In the case of Jordan, the shipper has added a stop in Greece, so an additional approval to transit Greece has been requested. The Port of Aqaba has notified that it will not accept cargos of hazardous waste and the Ministry of Environment has been requested to intervene to allow the shipment. With regard to safeguarding operations in Jordan, Tredi successfully undertook the repacking of the DDT and dieldrin between 6 and 18 June. A total of 23.8 tonnes net weight of pesticides and associated waste were repacked. The items are currently stocked in the store awaiting the Basel Convention authorization for transit through Greece and for the approval to export from Aqaba. The destruction of the DDT is expected to be completed within 2 months of receipt in France. In Morocco, Tredi commenced the safeguarding activities on 14 June 2013. The repacking is expected to be completed by 1 July after which the waste will be exported during July. The destruction of the DDT is expected to be completed within 2 months of receipt in France. In the Islamic Republic of Iran, the originally planned direct shipping route to France ceased to be available in March. An alternate route is expected to be found in July after which the Basel notification document will be submitted for approval. A work plan will then be developed to complete the repacking and shipment from the Islamic Republic of Iran before 30 November 2013.

4. COUNTRY REPORTS: DEMONSTRATION OF ALTERNATIVES TO DDT IN VECTOR CONTROL

4.1 Djibouti

The IVM steering committee was revived and 4 meetings have been conducted. The IVM steering committee played a pivotal role in decision making in the outbreak response during the last malaria epidemic. The major challenges have been a lack of an IVM policy and high staff turnover within the committee all of which have prevented the committee from meeting regularly and developing tangible IVM action plans.

With regard to capacity-building, WHO organized a training course for 22 hygiene officers on vector surveillance followed by practical exposure in active entomological surveillance during the transmission season of dengue and malaria so as to strengthen entomological monitoring in the districts. There remains an immediate need to enhance capacity building for geo-mapping of local foci of all vector borne diseases.

Insecticide resistance tests were conducted using deltamethrin 0.05% (1 hour exposure) in all districts located in the capital. Results show anopheles mosquitoes to be susceptible. Not enough wild female mosquitoes were collected hence restricting the susceptibility tests to one insecticide class. The main concern has been the absence of sufficient funds for entomological surveillance within the Ministry of Health, preventing entomological activities from being sustained. The reintroduction of mosquitoes from neighbouring countries poses a real risk for Djibouti and highlights the need to have strong cross-border collaboration on entomological surveillance and data sharing, which will need to be facilitated by WHO.

A vehicle was repaired for use by the vector control unit in the Public Health Institute of Djibouti; the National Public Health Institute (NPHI) established a new office, providing all the necessary administrative equipment to support the GEF programme.

Challenges include the limited choice of available insecticide in the country increases the risk of resistance emerging. As well, the NPHI is in urgent need of new equipment in conducting vector control activities and entomological surveillance in the districts. The lack of funds to sustain basic entomological activities will affect the sustainability of the project achievements beyond 2014.

4.2 Egypt

The goal of this project is to build national capacity in the areas of IVM, vector surveillance/mapping and resistance monitoring, as well as sound management of public health pesticides. At least seven vector-borne diseases of public health concern affect Egypt, of which lymphatic filariasis and Rift Valley fever are the most important. There have been reported cases of schistosomiasis, leishmaniasis and malaria in the past.

In the second phase, the IVM committee continued to meet regularly to strengthen the IVM concept among the health and non-health sectors. The committee developed an IVM strategy and established a plan of action for all non-health sector stakeholders and got the approval from all participating ministries. Four workshops were held, in Fayoum, Menoufia, Giza and Beni Suef governorates under the auspices of the governor of each governorate so as to facilitate the formation of local committees at the governorate level and discuss issues with the local municipality from different ministry representatives.

Vector surveillance has been carried out in 3 phases; 34 districts from 13 governorates were covered in the first phase (ended in September 2012). In the second phase, 10 districts from 4 governorates were covered and completed in June 2013. Plans are under way to conduct surveillance in 6 remaining governorates, which will be completed in September 2013.

The study collected samples of mosquito adult and larvae, house fly, sand flies, rodents, fleas and conducted insecticide susceptibility tests so as to identify the risk areas using GIS and select the ideal methods for vector control. Eleven mosquito species have been identified during this study; *Culex pipiens, Cx. antennatus, Cx. perexiguus, Cx. sinaiticus, Culiseta longeriolata, Ochlerotatus detritus, Och. caspius,* and *Anopheles multicolor, An. pharoensis,*

An. sergentii and *An. tenebrosis*. *Culex pipiens* adults and larvae were found to be the most common mosquito species among all study areas. The house fly *Musca domestica* was the most common species found throughout the governorates. Insecticide susceptibility tests were conducted on the main vectors: *Culex pipiens, Anopheles pharoensis* and *An. sergenti* (mosquito adults and larvae), *Musca domestica* (house fly), sand fly and rodents) using the standard WHO assays.

A digital map for Egypt was obtained from the WHO Health Mapper computer data management system for public health, illustrating the various administration divisions of Egypt along with different shape files, feature classes for lakes, rivers, roads and elevation. The different vectors have been incorporated into the map and the Research Institute of Medical Entomology is currently developing a database of vector distribution in Egypt.

The Research Institute of Medical Entomology is overseeing construction of an advanced molecular biology laboratory which will be equipped with molecular diagnostic equipment to study molecular genetics of insecticide resistance and diagnose vector borne disease pathogens in human blood and insects.

Discussions highlighted the need to conduct intensive entomological surveillance on vectors for lymphatic filariasis, Rift Valley fever (working alongside the Ministry of Agriculture) and leishmaniasis (ACL and ZCL) – especially given the influx of Syrian refugees, which may increase the potential risk of an outbreak.

4.3 Islamic Republic of Iran

The project aims to investigate the efficacy of covering breeding places with natural materials (mats made of date leaf) compared to the efficacy of covering breeding places with synthetic materials (man-made materials, tile). The results will be compared with the efficacy of regular larviciding activities by Bacillus thuringiensis (Bti). Special attention will be given to the cost effective analysis and sustainability of interventions and also to evaluating community acceptance and participation in the project implementation.

The project was initiated 2 years ago, but it came to a halt for one year due to lack of sufficient funds by WHO/UNEP. A total of US$ 100 000 was allocated by UNDP Office, Tehran 3 months ago allowing the project to resume. A total of US$ 80 000 has been spent on purchasing some of the materials needed for implementation of the project. Meetings have been held with the Chabahar city governor and Rural Islamic Council members to facilitate advocacy at the stakeholders and policy-maker level.

The selection criteria for the covering material included cost, availability, sustainability, social acceptance, ease of implementation, feasibility, being environmentally-friendly. Two types of covers were selected as suitable interventions by the expert panel: straw mats or tile covered with a thin layer of concrete

The intervention phase was initiated by random selection of three clusters. Each intervention cluster comprised three blocks. The community health volunteers (CHVs)

attended a series of briefing sessions on malaria transmission and prevention, community participation and methods to improve social acceptance of interventions. Face-to-face education on malaria transmission and prevention was delivered during home visits by CHVs. The aim of the project was explained and consent was taken to implement the intervention.

Cluster 1: straw mat covering. In the first cluster, blocks 3, 5 and 7 were randomly selected to cover the water reservoirs with straw mats, which were locally produced. The straw mats and palm tree branches are traditionally used for building huts in the area. Local skilled people were available to use the straw mats for covering water reservoirs. The main advantage of this method was its cost-effectiveness. The disadvantages of this method are the changes in the colour and the taste of water during rainy seasons.

Cluster 2: tile and concrete covering. In the second cluster, the intervention included covering the reservoirs with tiles and a thin layer of concrete. The tiles were fitted in metal frames treated with tar. Blocks 2, 4 and 6 were randomly selected for this purpose. The advantages of these methods included durability, social acceptance, feasibility, the speed of implementation. However, the main disadvantage of the tile covering was the cost.

Cluster 3: the control group. In the third cluster (i.e. control group) the reservoirs were treated with routinely used vector control methods, i.e. Bti. This cluster comprised the blocks 1, 34, 37, 38 and 40, with a total population of 3660 and 841 households.

Following the interventions, an assessment of durability and sustainability of the interventions along with community acceptance will be made. Cost-effectiveness analysis of larval source management (LSM) interventions, compilation and dissemination of the reports will be done upon completion of the project. There are plans for expansion of the intervention to the entire area of Chabahr and resource mobilization for the future strategic steps which include facilitating initiatives on LSM.

There was some concern that the project is unable to demonstrate a clear impact on malaria incidence, but the programme explained that the low number of malaria cases makes it difficult to be used as an indicator. This further precludes any epidemiological and cost-effectiveness analysis from being conducted. The programme would use larval density and community acceptance as proxy indicators for the project. Concern was raised on the safety of using Bti in drinking water but the programme cited reassurances from the supplier on the low mammalian toxicity. The programme reassured participants that a thorough entomological surveillance would be conducted to monitor the impact on larval density.

4.4 Jordan

In line with component 2 to strengthen the national capacity for IVM implementation, funds were requested and 50% of allocated budget received was used to conduct a workshop on pesticides management and IVM principles in September 2012. Funds were requested and 50% of allocated budget received was used to conduct a national workshop to launch the developed national plan of pesticide legislation in October 2012.

In order to ensure the safe disposal of the obsolete stock of approximately 23 tonnes of DDT stored at Ministry of Health stores in Jordan, Tredi S.A. was engaged by FAO to manage the repacking and disposal process of DDT and POPs. On 27–28 February 2013, inspection of obsolete pesticide stocks at Jordanian Ministry of Health and Ministry of Agriculture stores was conducted by contract managers of Tredi SA and Polyeco. In February/March 2013 the signing of the notification document took place at the Ministry of Health. In March 2013, the approval for export of hazardous waste according to Basel Convention was given by the Ministry of Environment. On 5 June 2013: Polyeco imported the repacking equipment to Jordan to facilitate the safeguarding works and started construction of site and training on safeguarding.

4.5 Morocco

Morocco is conducting a study to demonstrate the feasibility and effectiveness of vector control methods alternative to DDT as a part of the IVM approach to reduce transmission of cutaneous leishmaniasis.

The study is implemented in a total of 43 localities in 8 provinces with a total population of 27 277 people. The average population per locality is 634 people. Each locality was randomly allocated to one of the three study arms: IRS with a pyrethroid combined with environmental sanitation (14 localities); distribution of LLINs in combination with environmental sanitation (15 localities); and environmental sanitation alone (14 localities).

In continuation with IRS operations conducted the previous 2 years, similar operations (alpha-cypermethrin SC 10% with an application dose of 003 g/m2) were conducted in June 2012 in 14 localities belonging to 4 provinces, namely: Azilal (6 localities); Tangier (6 localities); Sefrou (1 locality) and Taounate (1 locality). A total of 10 109 inhabitants were protected by IRS operations (97.5 % of the total).

Fifteen localities from 5 provinces were targeted for LLIN distribution: Azilal (7 localities), Tinghir (4 localities), Essaouira (2 localities), Chichaoua (1 locality), Moulay Yacoub (1 locality). During 2012, there were multiple campaigns to promote awareness on bed net use during May and June followed by a LLIN utilization survey which revealed the utilization rate to be very low (28.8%–49.15%). In addition to passive case detection, a case detection campaign was conducted twice a year in each locality of the study and in the schools.

Epidemiological analysis in the 14 IRS localities revealed there was a significant decline in the incidence of cutaneous leishmaniasis among sprayed houses, reaching an incidence level of 0 in 7 localities after the second year of intervention. Two localities, Nzala from Azilal province and Tarmoucht from Tinghir, are still showing relatively high incidence of leishmaniasis, respectively 9.17 and 6.91.

Entomological surveillance was conducted between 2010 and 2012. Sandfly collections were made twice a week, from May to October using sticky traps and CDC traps. Compared to the previous year for sandfly density in 4 IRS localities, in Boukidour and Iaamoume

sandfly densities were significantly reduced in 2011 and 2012, while in Lmrouj and Ait Chaib sandfly density persisted in 2011 and 2012 but at a slightly reduced level.

The specimens collected from two treated localities, Mrouj from Taounate province and Ait Chraib from Sefrou, were examined and compared to two other localities from the control arm: Aichoun from Sefrou province and Bouassem from Boulemane province. Following IRS, there was a sharp decline in the proportion of gravid and half gravid sand flies, suggesting the effect of the insecticide on blood feeding may be sustained for longer a period of time than the reduction in sandfly density. The reduction in gravidity of sandfly in the IRS villages supports the conclusion that the intervention offers protection against exposure to *Phlebotomus sergenti*.

The residual activity of alphacypermethrin was tested using bioassay cones in Ait Chaib locality. Results of bioefficacy test showed satisfactory residual effectiveness one day after spraying (89.3%); but this decreased progressively with weeks: 84.4%, 82.9%; 80.5, 78.2 and 72.8% after 2, 4, 6, 8 and 10 weeks after intervention, respectively. The residual activity of the insecticide three months after the spraying was only 61.45%.

Susceptibility tests using wild collected *Ph. sergenti* were conducted using lambdacyhalothrin treated paper. 100% mortality was achieved after 24 hours, lambdacyhalothrin induced 100% knockdown in less than 30 minutes of contact.

In the first year of the study, an increase in the total number of cases was detected in the LLIN arm and may be explained by the improvement in the case detection in these localities. After this, a decline was observed except in Ait Chribou locality (Azilal province), as well as Ait Boulemane and Ait Brahim (Tinghir province). Marked reduction in sandfly density was observed in Ait Chribou, Tabia, Soulaleh in 2011 and 2012, while in Oulad Aid sandfly density increased substantially in 2011–2012.

The insecticide susceptibility status of *Ph. sergenti* and *Ph. papatasi* was assessed during 2011, following the standard WHO technique based on discriminating dosage. A series of 25 susceptibility tests were carried out on wild populations of *Ph. sergenti* and *Ph. papatasi* collected by CDC light traps from seven villages in six different provinces, which included 2 localities where LLINs had been distributed (Ait Chibrou and Boumaine). Knockdown rates (KDT) were noted at 5 minute intervals during the exposure to DDT and to lambdacyhalothrin. Results indicated that *Phlebotomus sergenti* and *Ph. papatasi* are susceptible to the lamdacyhalothrin, DDT and malathion. The KDT values indicated that sandfly populations of Boumaine were more sensitive to the lambdacyhalothrin and DDT compared to Ait Chibrou, with the KDT 100 being over 60 minutes.

Many awareness-raising campaigns have been conducted which aim to improve the general hygiene and the environmental sanitation in all the localities of the study. During 2011 and 2012, a survey was conducted to analyse the hygiene conditions in all localities. The objective was to identify all the enabling environmental conditions that could facilitate sandfly breeding and thereby leishmaniasis transmission. The results will be used in the interpretation of data.

Data related to the cost were collected for 2010 and 2011. Under the guidance of a WHO consultation conducted in January 2011, a standardized cost collection instrument was developed for each of three administrative levels of the country: central, provincial and local. This tool has been used by the staff from the Ministry of Health to collect resource use and price information for all identified resources in all study locations. During a second WHO consultation trip in May 2012, the results were compiled and supplemented with information from the WHO-CHOICE database, where local information was not available, to create estimates of cost and cost per person protected during the first year of the trial. However, no conclusion has been reached as to which intervention is likely to be the best in terms of health impact and will only be made upon the completion of the intervention. The data for the third year of the study has been collected and will be sent to the WHO Consultant for follow up.

4.6 Sudan

The DDT alternative project in Sudan has two main objectives: 1) to determine whether combining LLINs and indoor residual spraying (IRS) provides additional protection compared to one method alone, and 2) whether insecticide resistance has an impact on the effectiveness of vector control interventions. To achieve these two key objectives, the study has been designed to have two arms, LLIN arm (70 clusters) and LLINs plus IRS arm (70 clusters), distributed equally in four study areas. The background and study design has been previously reported.

LLINs were distributed on April 2011 and are still considered active nets. In 2012, two rounds of IRS application campaigns were implemented in all of the 70 clusters targeted for IRS (57 clusters with bendiocarb, 13 clusters deltamethrin). In the first round a total 32 287 households were sprayed (coverage 97.9%) out of 32 967 targeted houses, while in second round 32 111 households were sprayed (coverage 95.6%) out of 33 579 households.

A malaria prevalence survey was conducted during the main malaria transmission season (October) using two approaches: RDTs and blood spot on filter paper for PCR analysis. The entire PCR plasmodium infection analysis was conducted in Sennar molecular laboratory, with technical support from the London School of Hygiene and Tropical Medicine. Survey results indicated malaria prevalence (with RDT) to be between 0.4% to 6.7% in LLIN arm, whereas in LLIN+IRS arm, malaria prevalence ranged between 0.4% to 10.4%. PCR results are currently being analysed and the data will be disseminated shortly.

Insecticide resistance monitoring on the predominant malaria vector, *An. arabiensis* continued in 2012, with susceptibility tests (deltamethrin, bendiocarb and DDT – following WHO guidelines and procedures) being conducted in 51 out of 66 sentinel clusters. Results indicated continued susceptibility to bendiocarb in all sentinel clusters with varying degree of mortality, while the tested malaria vector populations in all sentinel clusters exhibited resistance to deltamethrin (mortality ranged: 49.2% to 82%), there was marked elevation in phenotypic resistance compared to 2011 data. Regarding target site resistance mutation, preliminary analysis of subset samples of bendiocarb survivals specimens indicated no evidence of acetyl-cholinesterase (AChE), however, results of kdr alleles frequencies in *An.*

arabiensis are widespread in all sentinel clusters with a significant increase compared to kdr alleles frequencies of base line survey.

During 2012, four entomological surveys (March, September, October, November) were carried out in 30 super sentinel clusters (apart of 66 sentinels). Mosquitoes were collected using PSC, window trap, and light trap and clay pot methods. The key objective for using these different collection methods was to assess if there had been a shift in behavioural traits: from indoor to outdoor resting and from indoor to outdoor biting per resistance marker. Initial results of human biting rate (HBR) as determined by light trap collections in the LLIN arm, indicated the maximum indoor HBR to be between 22:00 and 01:00 hours and the maximum outdoor HBR to be between 01:00 and 4:00, while in LLIN+IRS arm, the maximum HBR occurred between 19:00 and 22:00 hours.

Concerns were raised that the combined interventions (IRS and LLINs) were not demonstrating a beneficial impact given the high level of pyrethroid resistance already observed in the study arms and a request was made to look at the cone bioassay data to verify this unexpected result. The programme assured participants the residual effectiveness was maintained several months post spraying (>70%) in the majority of houses surveyed. Furthermore, it was mentioned that trials conducted in Benin, Gambia and Tanzania have shown similar trends and may be attributed to the common use of LLINs in these countries. The project has yet to analyse data collected on other entomological parameters such as the sporozoite rate, parity rate and human blood meal index before a more conclusive deduction can be drawn. Queries were made on the quality of service, but this was refuted by the programme given the high coverage rate (LLINs and IRS) in the study arms.

4.7 Syrian Arab Republic

Due to the ongoing crisis in Syria, the programme is facing colossal challenges including under-reported cases, weakness of supervision and follow-up, and a huge shortfall of insecticide stock and equipment, as most have been damaged or completely destroyed. There is a consistent shortage of antimonial drugs. Population movement, internal migration and climate change are exacerbating the situation. Most professional health workers have left, leaving a shortage of health care providers in the public sector. Epidemiological and entomological surveillance has been severely neglected, making it difficult to ascertain the current situation of cutaneous leishmaniasis in the country.

4.8 Yemen

The GEF-supported demonstration project in Yemen, through a randomized trial design, will compare the efficacy of LLINs alone; and the combination of LLINs plus IRS to assess the impact of these two different vector control interventions on the malaria burden. The study area has been divided into 12 clusters in which universal coverage with LLINs has been introduced to all 12 clusters, while IRS intervention has been introduced to 6 clusters (2, 7, 8, 9, 10 and 11).

An entomological baseline survey was undertaken in July 2012 indicating a high density of *Anopheles arabiensis* (77.08%) while a small proportion were *An. sergentii* (3.31%). Due to extreme flooding during the rainy season in July 2012, some difficulties were encountered in collecting sufficient larvae within the vicinity of Banat Al-Husin village and Alrabow area of Wusab district (study area for IRS and LLINs). Consequently additional (17) female mosquitoes were collected from indoor collections, but despite these efforts, insufficient mosquitoes were collected. Insecticide susceptibility tests were conducted using deltamethrin, □-cyhalothrin and DDT treated papers. *Anopheles arabiensis* exhibited resistance to deltamethrin (85.7%), □-cyhalothrin (84%) and was susceptible to DDT (100%). Although it should be noted that the mosquitoes used were both males and females, varied in sample size and age – factors which may influence the outcome of the results.

A parasitological survey was conducted in all clusters in July 2012. In each cluster 150–200 children of the group ranged between 2 months and 15 years were tested (microscopic examination and RDTs). The results of the survey indicated the malaria positivity rate to be 8.2% in all study arms, while the SPR was 8.1%. The highest prevalence was reported in clusters number 4 and 2 where the SPR% was 37% and 30% respectively.

LLIN distribution took place in September 2012, covering all 12 study clusters as well as some villages lying in the outskirts of the study area. 16 454 LLINs were distributed to the targeted households and an additional 633 LLINs to the households near the study areas zones, making the sum total 17087 LLINs. Schools and mosques were used to disseminate health messages on the use of LLINs and brochures were also distributed to households.

An entomological survey conducted in September 2012 revealed 85% of the specimens were *Anopheles arabiensis*, while only 14% were *An. sergentii*. Monitoring and supervision of passive case detection was conducted at health facilities in targeted clusters in September 2012 by the local laboratory technician, who collected RDTs and stained slides from the previous month (August). The specimens were bought to the referral laboratory at NMCP for cross checking by the senior laboratory technician after which feedback was given to the respective health facilities.

In October 2012, the IRS campaign (lambdacyhalothrin 10% WP) was conducted in 6 clusters (2, 7, 8, 9, 10 and 11). >90% household coverage was achieved in majority of the clusters aside from cluster 9 and 11, where some resistance was encountered by the community beekeepers, resulting in poor coverage: 33% and 72% respectively.

Monitoring and supervision visits were conducted in October, November 2013 and January 2013. Sixteen health facilities were visited in the study arms to collect the slides and the RDTs of the previous month and provide the facilities with adequate supplies of ACTs, RDTs and other testing materials.

A malaria parasitological survey was conducted in December 2012. The results showed the malaria positivity rate was 6.6% in all clusters (RDTs: 6.7% and SPR: 6.6%). When comparing the SPR% in the 3 parasitological surveys implemented during March, July and

December 2012, the highest malaria prevalence was reported in March (12.2%), i.e. prior to the intervention.

Entomological survey conducted in 6 clusters in January 2013 revealed a shift in the vector composition with a higher density of *An. sergentii* (54%) while *An. arabiensis* (24%) was markedly reduced. Further investigation is needed to determine whether this is the outcome of the study or a reflection of the seasonal distribution of mosquito species.

Monitoring and supervision of passive case detection was conducted at health facilities in January 2013. The supervisors observed the performance of the staff involved in the management of malaria cases in the targeted clusters such as staining the slides and fixing the slides and how the health workers managed the cases. At the end of the visit, feedback was provided to staff on the best practices and the mistakes or shortages observed. Due to high attendance in Al-Ahad Area, it was decided to increase health facilities for passive case detection by 4, making the total 20.

An entomological survey was conducted in 4 clusters in April 2013 which revealed vector composition to comprise of 74.14% of *An. arabiensis* and 22.41% of *An. sergentii*. Cone bioassay tests conducted in April 2013 on used nets (using 5 non blood fed 2–3 day old female *Anopheles arabiensis)* revealed 100% mortality. During this period, the net condition and utilization was also monitored via questionnaires using WHO guidelines.

Susceptibility tests were conducted using WHO standard procedures using lambdacyhalothrin 0.05%, deltamethrin 0.05%, bendiocarb 0.1% and DDT 1% in April 2013. A high level of resistance to lambdacyhalothrin (82%) was detected, while moderate resistance to deltamethrin (90.5%) and DDT (92%) was recorded, there was complete susceptibility to bendiocarb (100%). The programme conducted an extensive mapping exercise of breeding sites of *An. bretoriensis* and *An. arabiensis* in April 2013. These results validate the country's decision to change from pyrethroid to bendiocarb for IRS campaigns in the country.

5. ANALYSIS AND INTERPRETATION OF DEMONSTRATION ACTIVITY DATA

Dr Immo Kleinschmidt, London School of Hygiene and Tropical Medicine

The Morocco demonstration project completed four years of data collection. Interim analysis of both the epidemiological and the entomological data has been carried out. A more comprehensive analysis of data and interpretation of results still needs to be undertaken. The Morocco team has requested that this be undertaken by means of a country visit. Support has been given in the preparation of a manuscript for publication. This work is ongoing.

Case data was collected based on 130 508 person-years of follow-up (2 years pre-intervention and 2 years post intervention), from 43 study clusters. A total of 598 cases were reported. Incidence was calculated by cluster, and by study arm, taking into account of between cluster variation in incidence for the estimation of standard errors and 95% confidence intervals. Incidence rate ratios for the IRS and LLIN arms, relative to control arm,

were estimated for each year, and for the pre-and post-intervention periods separately. Initial results show that there is a significantly lower incidence of leishmaniasis cases in the villages receiving IRS, relative to controls. There is no evidence of a reduced incidence of cases in the LLIN study arm, relative to controls. The reduction in gravidity of sandfly in the IRS villages supports the conclusion that the intervention offers protection against exposure to *Phlebotomus sergenti*. Substantial variation between villages in incidence limits the power of the study. This study provides important new evidence of the role of IRS in leishmaniasis vector control.

In Yemen a fourth malaria indicator survey has been conducted. Advice on sampling has been given and statistical analysis of the data needs to be carried out. Serological analysis of dried blood spots has been carried out at the London School of Hygiene and Tropical Medicine.

Major data analysis for Sudan is underway. PCR analysis of the 2012 cross sectional survey has been undertaken. Results will be reported once all the data are made available. Interim results from the cohort follow-up are presented in Table 1 (new data analysis done in May 2013).

Table 1. Comparison of incidence of uncomplicated malaria cases 1 June 2012 to 30 April 2013, in the two study arms (140 clusters) in Hag Abdulla, El Hosh, Galabat and New Halfa

Vector control (# of clusters)	# of cases	Follow-up (person years)	Incidence (cases per 1000 person years)	Rate ratio (LLIN+IRS vs LLIN)
LLIN (70)	429	12 942.8	32.4	1
LLIN + IRS (70)	480	13 000.7	35.8	1.11 [.68–1.80], p=0.69
Total	909	25 943.5	34.1	

6. MID-TERM REVIEW

Dr Henk van den Berg, WHO Temporary Adviser

A mid-term review of the GEF Project "Demonstration of Sustainable Alternatives to DDT and Strengthening of National Vector Control Capabilities in Middle East and North Africa" was conducted. This mid-term review, as per its terms of reference, was a supportive review rather than a systematic evaluation. The review relied mostly on desk study of available documentation and data sets, whereas in-country visits for evaluation purposes were outside the scope of the assignment. Performance in each Project component was reviewed and recommendations for the second term were given.

Component 1: Demonstration of DDT alternatives

The demonstration projects have made substantial progress to date, with well-designed studies, successful rolling-out of interventions, sound systems of epidemiological and

entomological surveillance in place in several countries, and promising preliminary data on cost-effectiveness. An inevitable limitation of the studies is that direct comparisons with DDT on cost-effectiveness could not be made due to the zero-use of DDT at baseline in all Project countries.

Component 2: Capacity building on IVM

The Project's progress reports noted significant advances in the development of policy and regulatory control, institutional arrangements and advocacy on IVM and/or pesticide management, but a lack of progress was reported in relation to training. The progress at the policy and institutional level achieved with co-funding support is a promising result as it signals national commitment to the concepts of IVM and/or pesticide management. Nevertheless, there are some concerns that need to be addressed by the Project in the years ahead. A particular concern is the lack of detailed documentation on activities and achievements under Component 2. As a consequence, it remains difficult to estimate the actual capacity for IVM implementation that has been developed since the baseline.

Component 3: Disposal of POPs pesticides

The activities in the priority countries are on track and the tender process has resulted in a contract for safeguarding, shipment and disposal. The safeguarding and disposal 120 tonnes of POPs pesticides and waste are expected to be completed in 2013. The activities under Component 3 are a good example of multi-stakeholder planning and implementation.

Component 4: Information sharing on good practices

Activities that had been proposed under Component 4 are the preparation of reports and web pages to give wide dissemination to the outcome of the national studies, the regional analysis, and lessons learnt in the Region's main languages. These activities have been planned for the final financial year and, thus, can only be assessed in the final evaluation. Nonetheless, there has already been some progress: 2 articles have been published on the situation and achievements with regard to policy development for IVM and pesticide management. Moreover, several technical publications will be forthcoming from the demonstration projects.

Component 5: Coordination, monitoring and evaluation

The Project's diverse activities covering eight countries demand a major role for coordination, monitoring and evaluation. Communication with, and response from, National project coordinators from several countries has been rather poor. The current mechanism for communication and response should be revisited by the Project in order to make improvements. National Steering Committees were established in Project countries during the PDF-B phase to oversee and guide the implementation at national level and to carry out monitoring and evaluation. However, documented information regarding meetings and the functioning of national steering committees in Project countries is very limited. The regional Scientific and Technical Advisory Committee (STAC) was established to provide overall

guidance to implementation of the Project's activities and to conduct annual reviews of project progress. The STAC has provided: continuity in monitoring and evaluation; a forum for development of methodology for demonstration projects; coordination and guidance on project activities; and opportunity for capacity building; and inter-agency collaboration due to the participation of experts from universities and FAO.

There are generally good prospects for sustainability because of promotion of the IVM strategy and advocacy for political commitment. But community participation and education deserve more emphasis. A major concern for sustainability is the development of insecticide resistance in view of the continued reliance on IRS and LLIN in demonstration projects.

The project has created opportunities for replication through adoption of a regional approach. Regarding demonstration projects, some interventions will be easier to replicate than other interventions. Randomized control trial studies are useful for interventions with a wide application value, but interventions with variable effects demand a more intuitive, adaptive management approach within an operational context.

7. UPDATE OF THE INTERNATIONAL CODE OF CONDUCT ON THE DISTRIBUTION AND USE OF PESTICIDES

Dr Richard Thompson, Food and Agriculture Organization of the United Nations

The code of conduct is a framework for pesticide life cycle management, based on technical guidelines and guided by a panel of experts. It is endorsed by governments, intergovernmental organizations, the private sector, and nongovernmental organizations. The updated code of conduct (2012) includes WHO and UNEP as formal partners, strengthens health and environmental protection and updates code to current thinking and best practice. It has been renamed as the "International Code of Conduct on Pesticide Management", with special reference to pesticides management, human and animal health, integrated pesticide management and IVM, life cycle management, entities.

Governments should facilitate the exchange of information on cases of counterfeit and illegal pesticides being traded; poisoning and environmental contamination incidents data and support the process of information exchange and facilitate access to information on matters including pesticide hazards and risks, residues in food, drinking water and the environment, the use of pesticides in or on non-food products, integrated pest/vector management, pesticide efficacy, alternatives to highly hazardous pesticides and related regulatory and policy actions;

8. RECOMMENDATIONS

The following recommendations made in the mid-term review were discussed and agreed upon as follows.

For Component 1: cost effectiveness of DDT alternatives

Islamic Republic of Iran

- A plan should be prepared for up-scaling or marketing of the intervention and dissemination of information.
- The advantages and disadvantages of the lids for water reservoirs should be explored. (To some extent this has been done).
- An illustrated case study should be prepared with lessons learnt for national and international use.

Morocco

- The reference treatment (environmental sanitation) and its possible changes during the project should be assessed (confounding variable).
- If possible, cost differences of delivery of interventions between provinces should be presented (this is being planned).
- Estimates could be obtained on the cost-effectiveness of DDT in IRS (hypothetical use; assuming equal effectiveness as for pyrethroids), with sensitivity analysis on varying residual activities (this is being planned).
- People's perceptions and compliance with the introduced interventions should be studied and documented (this is being planned).

Sudan

- Quality of data collection related to effectiveness should continue to be prioritized, through monitoring and evaluation and timely consultant missions, if needed.
- Socio-behavioural aspects of the study should be strengthened, through IEC/COMBI campaigns, studying impact on perceptions and behaviour (this is being planned and conducted).

Yemen

- Increased attention should be paid to training, surveillance, M&E and community education to comply with interventions.
- Continued international support (or exchange with Sudan) will be needed to safeguard the quality of data on cost-effectiveness. Hence, Yemen should allocate project funds for a study visit to Sudan.
- Studies on diurnal biting and resting behaviour of *Anopheles arabiensis* should be considered.

For Component 2: capacity built in each country to use alternatives based on IVM principles

- Achievements under Component 2 should be documented, and reference made to the VCNA to see if shortcomings have been addressed.
- Case studies on IVM should be developed.
- Training and human resources development on IVM should be given due attention (e.g. using WHO's manual for curriculum development on IVM).

- WHO should translate guidance documents (French and Arabic) on IVM and testing of insecticide resistance.
- As a follow-up to the regional MSc course, the spill-over effects should be studied and documented by the WHO Regional Office, in terms of adaptation and use of curriculum in other countries, current position and role of trainees, and effect on entomological surveillance and decision-making.
- If possible, the Project should continue to support the training of candidates from Project countries in response to the severe shortage of public health entomologists and vector control specialists in the Region.

For Component 4: information on good practices and alternatives taken up by national institutions

- The substance of any planned scientific articles should be produced in report format before the end of the Project, so that it can be available for final evaluation.
- Technical and operational guidance is needed on how to adopt the results obtained in one country for the benefit of other countries with different eco-epidemiological and operational settings. This would facilitate the replication of good practices.
- Project results should be shared at forums within and outside of the Region, particularly with policy makers and programme managers.
- Roster of experts: details should be worked out – how it will be used to benefit other countries, and how it will be managed beyond the end of the Project. WHO maintains an expert roster and it is proposed that national project experts are incorporated in that system.
- Web pages: A plan should be made for web pages as a platform for dissemination of project outcomes, including a scheme on how this will be managed beyond the end of the Project.

For Component 5: Trans-boundary coordination, information sharing, replicability

- STAC should improve the mechanism of communication and reporting between the regional level and national project coordinators.
- In view of the observed sources of variation in local conditions (insecticide resistance development; variable costs), an IVM strategy should embrace an adaptive management approach, in which the choice of interventions can be changed if the situation so dictates.
- The Project should try to make innovative advances in developing and testing an adaptive management approach in an operational setting.

General recommendations

- Demonstration projects should explore options for education of rural communities, e.g. collaboration with agricultural extension services or farmer field schools.
- As an exit strategy, demonstration projects should engage with local authorities and provide guidance to ensure local adaptation and correct use of new methods.

- To provide an indicator of success, the Project could measure for selected countries the likelihood to revert to use of DDT in case of disease outbreaks. This exercise would benefit other DSSA projects.

The STAC formally approves a shift of insecticide in the Sudan trial in the study arm in the Galabat area to bendiocarb.

The STAC recommends that, while the situation in the Syrian Arab Republic is currently not conducive to implementing any project activities, it should nonetheless be considered in the development of new regional proposals for post-conflict situations. Future project consideration should be given to the obsolete pesticide remaining in the country and possible development of a harmonized subregional pesticide registration scheme.

9. RECOMMENDED BUDGET ALLOCATIONS

1. The STAC recommends that US$ 30 000 be allocated for the hire of two consultants to develop two separate funding proposals, one focused on the Eastern Mediterranean Region which builds and extends on the lessons learned in the WHO/UNEP/GEF-supported project to extend and further implement activities within the Region. The second would be focused on translation of these activities and lessons to the African Region (including both Eastern Mediterranean and African countries). The STAC suggests that the WHO Regional Office for Africa be approached for possible co-financing of this activity.
2. The STAC recommends that US$ 80 000 be allocated for final technical assistance including effectiveness analysis, cost and cost-effectiveness analysis, as well as other technical support and final reporting.
3. The STAC recommends that US$ 80 000 be reserved for the final STAC meeting to be held in Nairobi, Kenya in June 2014.
4. The STAC recommends that US$ 50 000 be allocated for a regional IVM course, to be hosted by Sudan with external technical expert support in its first implementation.
5. The STAC recommends that US$ 15 000 be reserved for FAO for contingency purposes in case there are budget overruns on disposal activities, but these funds will be redistributed to cover other priorities as the final FAO budget becomes more absolute, ideally by the end of the calendar year 2013.
6. The STAC recommends that an additional US$ 5000 be allocated to Morocco for the support of insecticide resistance surveillance for sand flies.
7. The STAC recommends that an additional US$ 20 000 be allocated to Sudan to support PCR and serological analysis from cross sectional surveys in demonstration activity areas.
8. The STAC recommends that an additional US$ 12 700 be allocated to Djibouti for WHO technical support/staff support to the vector borne disease control programme.

Annex 1

PROGRAMME

Tuesday, 25 June 2013

08:00 – 08:30	Registration	
08:30 – 09:15	Opening Session	
	Message from Dr Ala Alwan, Regional Director, WHO Region of the Eastern Mediterranean	*Dr A. Banerjee, WR/Sudan*
	Address by H.E. Mr Bahar Idris Abu Garda, Federal Minister of Health	*Dr H.Atta*
	Speech by Dr Jan Betlem, Task Manager, United Nations Environment Programme (UNEP)	
	Nomination of officers	
	Objectives of the meeting and methods of work	
09:15 – 09:45	Project progress report	*Ms C. Barwa*
09:45 – 10:15	Update on collection, repacking and disposal of POPs	*Dr R. Thompson*
11:00 – 12:30	Country Reports – Demonstration of Alternatives to DDT	
	Sudan: Combination of interventions in the face of resistance	
	Morocco: Combination of vector control interventions for control of cutaneous leishmaniasis	
	Islamic Republic of Iran: Cost effective, sustainable and alternative larval control method in urban setting in Chabahar, Sistan and Baluchistan	
	Yemen: Comparison of IRS and LLINs for malaria vector control	
12:30 – 13:00	Discussion	
14:00 – 15:00	Country progress reports	
	Djibouti	
	Egypt	
	Jordan	
15:00 – 15:30	Discussion	
16:00 –16:30	Presentation of the mid-term review report of the EMRO/UNEP/GEF-supported Project	*Dr H. Berg*
16;30 – 17:30	Discussion and endorsement	

Wednesday, 26 June 2013

06:00 – 18:00	Field visit to Wad Medani

Thursday, 27 June 2013

09:00 – 12:00	Presentation of planned activities (July 2013–July 2014)
12:00 – 13:00	Feedback from STAC Members
14:00 – 15:00	Conclusions and recommendations
15:00	Closing session

Annex 2

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