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Proposed Technical Cooperation Project on "Strengthening Regional Capacity in Latin America and the Caribbean for Integrated Vector Management Approaches with a Sterile Insect Technique Component, to Control Aedes Mosquitoes as Vectors of Human Pathogens, particularly Zika Virus"

Summary

- Mosquitoes carry pathogenic microorganisms which cause infectious diseases resulting in severe morbidity or lethality. Zika virus, transmitted by the mosquitoes of the genus *Aedes*, has been considered as an emerging infectious mild disease; however, recent outbreaks in the Americas suggest that this virus may be associated with microcephaly, Guillain-Barré syndrome and other neurological disorders. According to the Pan American Health Organization (PAHO), Zika virus has spread to 26 countries and territories of the Americas[1] since the first cases were reported in Brazil in May 2015. The World Health Organization (WHO) issued an Epidemiological Alert warning about the Zika virus in the Americas late in 2015, and announced on 1 February 2016 that the recent cluster of neurological disorders and neonatal malformations reported in the Americas region constitutes a Public Health Emergency of International Concern.
- In addition, more than 2.5 billion people in over 100 countries are at risk of contracting dengue, also transmitted by mosquitoes (*Aedes aegypti* and *Aedes albopictus*). Dengue fever is endemic in several countries in Latin America and the Caribbean. According to PAHO, over 2.3 million probable cases were recorded in 2015, with at least half a million being lab confirmed.

[1] http://www.paho.org/hq/index.php?option=com_content&view=article&id=11605&Itemid=0&lang=en&lang=en

Chikungunya is also transmitted to humans by infected *Aedes* mosquitoes. This viral disease can cause high fever, joint and muscle pain, and headache, and while it does not often result in death, the joint pain may become a cause of chronic pain and disability.

- In the absence of vaccines and efficient, safe and inexpensive drugs to control dengue, chikungunya and Zika virus disease, many consider population control of the insect vector to be the most effective way of managing these diseases.
- The IAEA, through its technical cooperation programme, can contribute to strengthen national capacities for the population control of *Aedes* mosquito species that transmit dengue, chikungunya and particularly Zika virus in the Latin America and the Caribbean region using integrated vector management (IVM) approaches with a sterile insect technique (SIT) component. This support will be provided through a proposed off-cycle regional project for capacity building for the development and application of IVM approaches with a SIT component; including the provision of necessary equipment, and the strengthening of national and regional mechanisms for mosquito population control (networking, coordination and information exchange).
- In addition, the IAEA is already contributing through TC Programme Reserve projects to efforts to address disease outbreaks, by helping countries to build and strengthen national and regional capacities and networking in the application of rapid nuclear-derived detection techniques such as Reverse Transcription Polymerase Chain Reaction (RT-PCR)[2], which can be used to rapidly identify the presence of the dengue, chikungunya and Zika virus.

Recommended Action

It is recommended that the Board:

- Approve this proposed off-cycle project as a new project in the Agency's technical cooperation programme for 2016–2017;
- Approve the use of footnote-a/ funding for this project for a total amount of €2 280 000, which will be implemented as resources become available;
- Approve the possible participation of concerned non-Member States of the IAEA in the region.

[2] A WHO-recommended protocol for Zika virus

Proposed Technical Cooperation Project on "Strengthening Regional Capacity in Latin America and the Caribbean for Integrated Vector Management Approaches with a Sterile Insect Technique Component, to Control Aedes Mosquitoes as Vectors of Human Pathogens, particularly Zika Virus"

A. Background

1. Mosquitoes (Diptera: Culicidae) are bloodsucking insects that carry pathogenic microorganisms, which cause infectious diseases resulting in severe morbidity or lethality. Zika virus, transmitted by *Aedes* mosquitoes, has been considered as an emerging infectious mild disease; however, recent outbreaks in the Americas suggest that this virus may be associated with microcephaly, Guillain-Barré syndrome and other neurological disorders. According to the Pan American Health Organization (PAHO), since the first cases reported in Brazil in May 2015, it has spread to 26 countries and territories of the Americas[3]. The World Health Organization (WHO) announced on 1 February 2016 that Zika virus is a potential threat for the entire world. In addition, the economic impact of mosquito-transmitted diseases is enormous in terms of health care, lost working days and decreased productivity, not to mention the effect on the tourist industry in affected countries.

2. According to WHO, more than 2.5 billion people in over 100 countries are at risk of contracting dengue, transmitted by mosquitoes (*Aedes aegypti* and *Aedes albopictus*). Dengue fever is an infectious disease caused by the dengue virus. Dengue viruses (DENV 1–4) are mosquito-borne members of the family Flaviviridae, genus *Flavivirus*. Dengue has become a worldwide problem since the Second World War and the incidence of dengue fever has increased dramatically since the 1960s. Approximately 100 million cases of dengue are reported annually, resulting in approximately 500 000 cases of DHF (dengue haemorrhagic fever) with an estimated 50 000 deaths. Dengue fever is endemic in several countries in Latin America and the Caribbean. According to PAHO, more than 2.3 million probable cases were recorded only for 2015 and at least half a million were lab confirmed.[4]

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[3] http://www.paho.org/hq/index.php?option=com_content&view=article&id=11605&Itemid=0&lang=en&lang=en

[4] http://www.paho.org/hq/index.php?option=com_topics&view=article&id=1&Itemid=4073

3. Chikungunya, another viral disease transmitted to humans by infected *Aedes* mosquitoes, was originally confined to Africa but has more recently been rapidly spreading to the Indian Ocean, Europe and the Americas. It can cause high fever, joint and muscle pain, and headache. Chikungunya does not often result in death, but the joint pain may last for months or years and may become a cause of chronic pain and disability. According to PAHO, more than 600 000 suspected cases were recorded in 2015.[5]

4. In the absence of vaccines and efficient, safe and inexpensive drugs to control dengue, chikungunya and Zika virus disease, many consider population control of the *Aedes aegypti* mosquito insect vector as the most effective way to manage these diseases. Most vector control strategies are insecticide-based and their expanded use is resulting in increasing incidences of insecticide resistance. WHO and other major stakeholders have recognised the need for more sustainable, effective and biologically-based methods. Growing public awareness and concerns about the impact of chemical control on human health and the environment is also encouraging investment in the development of vector control methods that are complementary to current control mechanisms, including the sterile insect technique (SIT), always as a component of integrated vector management approaches.

B. IAEA support to Member States

5. Through its technical cooperation (TC) programme, the IAEA can contribute to efforts to address Zika virus disease outbreaks in the Latin America and the Caribbean region, supporting both detection of Zika virus and control of the mosquito population.

B.1. Detection of the virus using RT-PCR

6. Regarding detection, reverse transcriptase-polymerase chain reaction (RT-PCR) is a nuclear-derived technique that offers fast and efficient virus detection. It is a WHO-recommended protocol for Zika virus. For application in field conditions, fluorescent-labelled markers are used. In cases where higher sensitivity, resolution and accuracy are necessary, radio-labelled markers continue to be the preferred reference methodology (for example, their use is key in the identification and verification of the genetic characterization and sequencing of pathogens). IAEA support can help Member States to develop or strengthen national and regional capacities and networking in the application of RT-PCR. This will also enable countries in the region to establish or strengthen early warning systems and to improve and quicken their responses to control *Aedes* mosquito populations as vectors of major human pathogens, including Zika virus. There are several significant examples of the impact of the transfer of nuclear-derived RT-PCR technology, including the worldwide eradication of rinderpest in June 2011, combatting H7N9 avian influenza in 2013 and combatting Ebola virus disease in 2014–2015.

7. In view of the urgent need to address and contain the current Zika virus disease outbreak, immediate, small-scale TC support for rapid Zika virus detection using RT-PCR will be provided to the affected IAEA Member States, using the TC Programme Reserve mechanism.

8. The TC Programme Reserve projects are strengthening the capacities of affected Member States for rapid, effective Zika virus detection, by providing specialized consumables related to the application of RT-PCR technology (detection kits): these consumables are not commercially available.

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[5] http://www.paho.org/hq/?Itemid=40931

Training and technical assistance in the application of the technology will be provided as needed, using distance learning tools, information technology or relevant regional centres.

9. The TC Programme Reserve project activities in the targeted countries are being carried out in close coordination with the United Nations and with WHO/PAHO coordinators in the field, to ensure complementarity with the responses of other international organizations. Relevant technical backstopping is being undertaken by the IAEA's Division of Human Health in this regard.

B.2. Vector control using the sterile insect technique (SIT)

10. Regarding insect pest population control, the SIT is a proven and robust technology which has been applied successfully in an area-wide integrated pest management approach against several Diptera and Lepidoptera pest and disease vector insect species. SIT is environment friendly and affects only the target population without adverse effects on the environment or the human population. Radiation is central to the use of the SIT – male insects are mass-reared in captivity and are exposed to ionising radiation to render them sterile. Upon release, these sterile insects compete with wild males, and mate without offspring. Over time, the insect population is selectively suppressed. To be effective, SIT needs to be integrated with other suppression methods on an area-wide basis and requires detailed baseline data and regular field surveillance. Through its Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, the IAEA provides technical assistance in the collection of entomological base line data, vector surveillance, mosquito release and trapping systems, mass-rearing of vector mosquitoes, sex separation strategies, irradiation procedures, and radiation safety and security.

11. Within the framework of its TC programme, the IAEA successfully supports the transfer and further application of this technology to numerous Member States, including nine Member States in Latin American and the Caribbean. Since 1997, the IAEA has been working to transfer SIT to Member States to combat pests that affect food and agriculture, as well as insect vector species including mosquitoes that transmit human pathogens. Today, a total of 54 SIT TC projects are active, of which 15 address population control of mosquito species.

C. Proposed off-cycle IAEA regional TC project

12. The IAEA is already contributing to international efforts to control the outbreak of the Zika virus disease in the Latin America and the Caribbean region through ongoing TC Programme Reserve projects on the detection of Zika virus. The IAEA proposes the following off-cycle regional project on *Aedes* mosquito suppression.

C.1. Proposed support to Member States on vector control

13. The off-cycle regional TC project will aim to strengthen national capacities for the population control of *Aedes* mosquito species transmitting dengue, chikungunya and particularly Zika in the Latin America and the Caribbean region using IVM approaches with a SIT component, through:

- Training local staff on all aspects required for the development and application of IVM approaches with a SIT component;
- Provision of equipment needed for the development and application of IVM approaches with a SIT component; and
- Strengthening national and regional mechanisms for *Aedes* mosquito population control (networking, coordination and information exchange).

14. Relevant technical backstopping will be undertaken by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, in collaboration with relevant Member States institutions.

15. The proposed project is open to all Latin America and Caribbean IAEA Member States that are affected by populations of *Aedes* mosquito species that transmit dengue, chikungunya and particularly Zika virus. The participation of non-Member States from the region could also be considered in accordance with the Board's decisions on assistance to non-Member States contained in documents GOV/2810 and GOV/2818. The project will be executed over four years.

16. The project will be designed and implemented in line with the recommendations and strategies developed by PAHO/WHO and FAO, and in close cooperation with relevant partner organizations in the Latin America-and the Caribbean region.

C.2. Project description

Title: Strengthening regional capacity in Latin America and the Caribbean for integrated vector management approaches with a SIT component, to control *Aedes* mosquitoes as vectors of human pathogens, particularly Zika virus.

Objective: To enhance population control of *Aedes* mosquito species transmitting diseases such as dengue, chikungunya and particularly Zika using integrated vector management approaches with a SIT component

Outcome: Established integrated vector management approach with a SIT component to control *Aedes* mosquito populations transmitting dengue, chikungunya and particularly Zika virus

Expected Outputs:

- Partner entities in Member States, and their capacities, identified and mapped.
- Personnel trained on mosquito population monitoring, mass rearing, sex separation, irradiation, handling, releasing and quality control analysis of sterile mosquitoes.
- Physical infrastructure for the development and application of the SIT for the control of *Aedes aegypti* and *Aedes albopictus* mosquito populations.
- Transfer of relevant evaluated strains.
- Selection of sites and pilot trials to control *Aedes aegypti* and *Aedes albopictus* mosquito populations using integrated vector management approaches with a SIT component.

17. **Project duration:** 4 years (April 2016–April 2020)

Project budget: €2 280 000

FOOTNOTE -a/ FINANCING

Year	**Human resource Component** (€)				**Procurements Components** (€)			**Total** (€)
	Experts	Meetings	Training Course	Subtotal	Procurement	Sub contracts	Subtotal	
2016	80000	120000	120000	320000	300000		300000	620000
2017	80000	120000	120000	320000	300000		300000	620000
2018	80000	120000	120000	320000	200000		200000	520000
2019	80000	120000		200000	200000		200000	400000
2020		120000		120000			0	120000
Total				**1280000**			**1000000**	**2280000**