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14 May 2019

INDIVIDUAL CONSULTANT PROCUREMENT NOTICE

for individual consultants and individual consultants assigned by consulting firms/institutions

Country:	**Viet Nam**
Project:	**"An integrated dengue early warning system driven by Earth Observations in Viet Nam"**
Description of the assignment:	**Technical Consultant for an integrated dengue early warning system driven by climate change Earth observations in Viet Nam.**
Period of assignment/services (if applicable):	**Part-time International Consultant for 80 working days from June 2019 to Feb 2021**
Duty Station	**Home based, with possible travel to Viet Nam and project provinces if required.**
Tender reference:	**A-190504**

1. **Submissions should be sent by email to**: quach.thuy.ha@undp.org no later than:

23.59 hrs., Tuesday 28 May 2019 (Hanoi time)

With subject line: **A-190504 – Intl Consultant for an integrated dengue early warning system**

Submission received after that date or submission not in conformity with the requirements specified this document will not be considered.

Note:

- Any individual employed by a company or institution who would like to submit an offer in response to this Procurement Notice must do so in their individual capacity, even if they expect their employers to sign a contract with UNDP.
- Maximum size per email is 30 MB.
- Any request for clarification must be sent in writing, or by standard electronic communication to the address or e-mail indicated above. Procurement Unit – UNDP Viet Nam will respond in

writing or by standard electronic mail and will send written copies of the response, including an explanation of the query without identifying the source of inquiry, to all consultants.

- After submitting proposal, bidder should send notification by email (without attachment) to: procurement.vn@undp.org informing that the bidder has submitted proposal. UNDP will not be responsible for the missing of proposal if the bidder does not send notification email to above address.
- Female consultants are encouraged to bid for this required service. Preference will be given to equally technically qualified female consultants.

2. Please find attached the relevant documents:

- Terms of Reference (TOR)..... (Annex I)
- Individual Contract & General Conditions.....(Annex II)
- Reimbursable Loan Agreement (for a consultant assigned by a firm).....(Annex III)
- Letter to UNDP Confirming Interest and Availability .....(Annex IV)
- Financial Proposal ..... (Annex V)

3. **Interested individual consultants must submit the following documents/information (in English, PDF Format)** to demonstrate their qualifications:

a. Technical component:

- Signed Curriculum vitae
- Signed Letter to UNDP Confirming Interest and Availability
- Copy of 1-3 publications/writing samples on relevant subject.
- Reference contacts of past 4 clients for whom you have rendered preferably the similar service (including name, title, email, telephone number, address…)

b. **Financial proposal (with your signature):**

- The financial proposal shall specify a total lump sum amount in **US dollar for International Consultant** including consultancy fees and all associated costs i.e. airfares, travel cost, meal, accommodation, tax, insurance etc. – see format of financial offer in Annex V.
- Please note that the cost of preparing a proposal and of negotiating a contract, including any related travel, is not reimbursable as a direct cost of the assignment.
- If quoted in other currency, prices shall be converted to the above currency at UN Exchange Rate at the submission deadline.

4. Evaluation

The technical component will be evaluated using the following criteria:

Consultant(s)' experiences/qualification related to the services		
1	At least Master's degree, in climate and/or environmental sciences, water resources and environment management, environmental engineering, or related field	100
2	At least ten years of working experience with environmental/climate change/water resource planning and management, land-use planning at various levels	200
3	Relevant work experience in Viet Nam's or comparable context working on climate change/environmental health, water resource management and land-use planning would be an advantage	150
4	Excellent conceptualization and analytical skills and proven experience in conducting site-based inventory, data collection and objective analysis on climate change, environment, water resource planning and management, and/or environmental health.	200
5	Prior experience with UNDP or another UN or international organizations will be an asset	100
6	Strong written and spoken skills in English and proven experience in developing analytical reports, academic papers or comparable highly quality technical documents	100
7	Ability to conduct objective analysis of all existing and gathered information, propose relevant and logical mitigation measures	100
8	Experienced in working with multi-cultural partnership and multi-sectoral collaboration is a must	50
Total		**1000**

A two-stage procedure is utilized in evaluating the submissions, with evaluation of the technical components being completed prior to any price proposals being opened and compared.

The price proposal will be opened only for submissions that passed the minimum technical score of 70% of the obtainable score of 1000 points in the evaluation of the technical component. The technical component is evaluated on the basis of its responsiveness to the Term of Reference (TOR). Maximum 1000 points will be given to the lowest offer and the other financial proposals will receive the points inversely proportional to their financial offers. i.e. Sf = 1000 x Fm / F, in which Sf is the financial score, Fm is the lowest price and F the price of the submission under consideration.

The weight of technical points is 70% and financial points is 30%.

Submission obtaining the highest weighted points (technical points + financial points) will be selected.

Interview with the candidates may be held if deemed necessary.

5. Contract

"Lump-sum" Individual Contract will be applied for freelance consultant (Annex II)

"Lump-sum" RLA will be applied for consultant assigned by firm/institution/organization (Annex III)

Documents required before contract signing:

- International consultant whose work involves travel is required to complete the courses on BSAFE which is the new online security awareness training and submit certificate to UNDP before contract issuance.
- Note: In order to access the courses, please go to the following link: https://training.dss.un.org

  The training course takes around 3-4 hours to complete.
- Full medical examination and Statement of Fitness to work for consultants from and above 65 years of age and involve travel. (This is not a requirement for RLA contracts).
- Release letter in case the selected consultant is government official.

6. Payment

UNDP shall effect payments to the consultant (by bank transfer to the consultant's bank account provided in the vendor form upon acceptance by UNDP of the deliverables specified the TOR.

The payment milestones consist of:

#	Deliverables	Deadline	Percentage of payment
1	One pilot case study report on Climate Change for Health	30 October 2019	10%
2	One pilot case study for water availability	30 November 2019	
3	Reports outlining discussions and preparations with HR Wallingford and the UK Met Office for consultative technical workshops on the modelling system	30 June 2020	10%
4	One critical review report of the water availability system and One technical review paper providing additional inputs and information to improve the system	30 April 2020	10%
5	One report on substantive inputs in water availability, climate change and resilience to the development of communication strategy and dissemination through media	30 August 2020	10%
6	One report on lessons learnt of the project, including findings and opportunities – recommendations for developing new activities	15 Oct 2019	10%
7	Three policy briefs and dissemination to national government stakeholders on dengue, water security and climate resilience	15 Dec 2020	30%
8	Presentations and substantive preparations in water availability, climate change for national and regional sharing	20 Dec 2020	

	workshops		
9	Peer-reviewed journal and conference papers and reports	10 Jan 2021	
10	Substantive inputs to replication of Service Provision to a 2nd country	31 Jul 2020	20%
11	Substantive inputs to sustainability Plan, and to reports water resources and local institutions and regional climate change centres produced by the project.	31 Jan 2021	

If two currencies exist, UNDP exchange rate will be applied at the day UNDP instructs the bank to effect the payment.

7. **Your proposals are received on the basis that you fully understand and accept these terms and conditions.**

ANNEX I

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TERMS OF REFERENCE

Position Title	Technical Consultant for an integrated dengue early warning system driven by climate change Earth observations in Viet Nam.
Implementation	Part-time International Consultant for 80 working days from June 2019 to Feb 2021
Location of Assignment	Home based, with possible travel to Viet Nam and project provinces if required.
Project Title	"An integrated dengue early warning system driven by Earth Observations in Viet Nam"

1. GENERAL BACKGROUND

Dengue fever occurs in 141 countries. Currently there is no system in Viet Nam to forecast the probability of future dengue outbreaks. The epidemiological situation in Viet Nam has been worsened by the lack of capacity of health systems to maintain adequate control of *Aedes aegypti* and *Aedes albopictus*, the species of mosquito that spread dengue. In 2016 there were 122,000 cases of dengue fever in Viet Nam.

In relation to public health and disease outbreaks, the Viet Nam Sustainable Development Strategy for 2011-2020 aims to "speed up comprehensive healthcare, focusing on proactive preventive medicine, timely and effectively control epidemic diseases, early detect and timely cure diseases". One of the major tasks identified in Viet Nam's five-year health sector development plan (2016-2020), issued by the Ministry of Health (MoH), is "*to actively prevent epidemics; to forecast, detect early and prevent the occurrence of epidemics, especially major ones" (MoH 2016).*

The MoH is the government ministry in Viet Nam responsible for the governance and guidance of the health, healthcare and health industry of Viet Nam. In conjunction with other ministries and the prime minister's office, the Ministry is responsible for creating and promulgating long-term health policy. The MoH comprises a number of departments, as follows:

- The general Department of Preventative Medicine (GDPM) assists the MoH in implementing state management functions and organizing the implementation of legal regulations in the field of preventive medicine nationwide, including: prevention and control of communicable diseases, diseases of unknown cause; and prevention and control of non-communicable diseases. GDPM is responsible for dengue surveillance.

- The National Institute of Hygiene Epidemiology (NIHE) studies epidemic diseases (including dengue and Zika), immune and microbiological mechanisms, and pharmacodynamics of natural products. It also directs medical prevention campaigns and makes proposals to the MoH concerning the treatment of dangerous and emerging diseases.
- The Pasteur Institute in Ho Chi Minh City (PIHCMC) is a Viet Nam national institute initially created by the French in 1891. PIHCMC has carried out a number of research projects in Viet Nam looking at dengue fever.

Viet Nam is currently undergoing a reform, whereby the responsibility for the management and monitoring of all diseases is being transferred to the Provincial Centres for Disease Control (PCDC). This reform will be completed by 2020. In the meantime, in those provinces which have not yet transitioned, disease management will be done by specialist bodies (e.g. responsible for malaria) but dengue fever will already be managed by the PCDC, as there is no specialist body for dengue fever in Viet Nam.

2. PROJECT BACKGROUND:

The partnership project "An integrated dengue early warning system driven by Earth Observations in Viet Nam" (See Annex 1 for Key Project Description) is funded by the United Kingdom Space Agency for a consortium led by HR Wallingford and participated by the London School of Hygiene and Tropical Medicine, the UK Meteorology Office, Oxford Policy Management Limited, the United Nations Development Program (UNDP) and the World Health Organisation (WHO). The project aims to develop an innovative tool to possibly provide public health authorities and communities in Viet Nam advance warning of likely dengue outbreaks. The activities will spread over 9 inter-connected work packages.

Key project aims

- Develop an early warning system to improve dengue epidemic prevention and increase disease control capacity;
- Create better understanding of the relationships between environmental stressors, the hydrological-climate system and dengue incidence; and
- Benefit local authorities' planning by providing scenarios of the main stressors and their impacts on dengue incidence.

This project will test a tool providing advance warning of several months of likely dengue outbreaks – the dengue forecasting tool. The tool will primarily be developed in work package 2 and 3, but the design, testing and calibration will be done through several inter-connected work packages. This tool will be tested in four provinces (in the Southern, Centre, Highlands, and Northern Regions) in Viet Nam. This project will greatly assist public health authorities to mobilise resources to those most in need. The same methods could also be used to forecast outbreaks of Zika and chikungunya which have recently begun to be reported in Viet Nam.

Under work package 2 and 3, Earth Observation (EO) datasets will be combined with health and water availability information to produce a new integrated dengue forecasting model. The project will also provide projections of dengue fever under a range of climate change scenarios. The tool produced will be used to understand changing health risks posed by dengue for different temporal and spatial scales under future climate change scenarios.

The advance warnings of sufficient accuracy would assist communities better prepare themselves for dengue outbreaks and help authorities make better use of scarce resources and help improve disease surveillance for dengue. Currently there is no system in Viet Nam to forecast the probability of future dengue outbreaks.

The proposed method is an innovative approach which has not been used in Viet Nam before and, if proven to be successful, has the potential to assist MoH and other authorities reduce the impact of dengue outbreaks in Viet Nam. There is evidence that the method has been trialed successfully in dengue endemic countries such as Columbia[1] and Ecuador[2].

The aims and activities of the project are in-line with Viet Nam's Sustainable Development Strategy for 2011-2020[3] which aims to "*timely and effectively control epidemic diseases, early detect and timely cure diseases*". One of the major tasks identified in Viet Nam's five-year health sector development plan (2016-2020)[4], issued by MoH is "*To actively prevent epidemics; to forecast, detect early and prevent the occurrence of epidemics, especially major ones*". One of the key tasks identified in Viet Nam's previous health sector development plan (2011-2015)[5], was "*to develop an early warning system, rapid response; active epidemiological surveillance to prevent epidemic outbreak*". Early outbreak prediction, if successful, will assist Viet Nam meet its obligations under the International Health Regulations (2005) and the Asia Pacific Strategy for Emerging Diseases and Public Health Emergencies (APSED III).

In Viet Nam, UNDP[6] is the lead UN Agency on climate change adaption, biodiversity and ecosystem services in Viet Nam, and has extensive technical expertise on key project components. It will serve as the overall coordinating agency and is responsible for providing climate change inputs to the tool, and for monitoring and evaluation. WHO will provide technical expertise on dengue prevention, control and surveillance required to develop the tool.

UNDP in Viet Nam is seeking for a qualified part-time international consultant[7] as the Project Expert to provide technical consultancy service on climate change and water availability management over the implementation of the project.

3. OBJECTIVES

Necessary technical inputs and contributions in the areas of climate change, weather events, water resources and land-use from UNDP to its assigned activities in the 9 work packages and to the D-MOSS project are efficiently and effectively provided and ensured by the technical international consultant, helping eventually to achieve the project intended outcomes.

4. SCOPE OF WORK

The scope of work:

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[1] Early Warning signal for Dengue Outbreaks and Identification of High-Risk Areas for Dengue Fever in Colombia using Climate and Non-Climate Datasets: https://www.ncbi.nlm.nih.gov/pubmed/28693483:

[2] Climate services for health: predicting the evolution of the 2016 dengue season in Machala, Ecuador: https://www.ncbi.nlm.nih.gov/pubmed/29851600

[3] http://dsi.mpi.gov.vn/vietnam2035/en/3/50.html

[4] http://www.euhf.vn/upload/Strategic%20documents/82.%20MoH%205-year%20plan%20(Eng).pdf

5 http://www.wpro.who.int/health_services/VTN_2011-2015.pdf

[6] http://www.vn.undp.org/content/vietnam/en/home/ourwork/environmentclimate/overview.html

[7]Either based in Viet Nam or outside the country

- (1) Technical inputs provision: Taking lead in discussions with HR Wallingford and other partners and in providing technical inputs and contributions to accomplishment of all UNDP's assigned activities and the modelling system of the D-MOSS project. The primary areas of technical inputs cover: climate change, water-use and demand and land-use change, and of relationships between extreme weather events and human health risks

- (2) Knowledge sharing: Drafting a sound communication strategy including a communication plan to widely share the project results. Taking lead in providing peer-review inputs and technical review to tools, products and outputs which are designed, and delivered by UNDP and partners in the D-MOSS project.

- (3) Policy support: Taking lead in developing a short, concise policy brief providing an overview of the project outcomes and how products can strengthen the analysis of climate change and health impacts as inputs into the on-going NAP and NDC review processes; drafting tools and guidelines for replicating the success of the project to Zika and to provincial planning process.

- (4) Representation: Participating in technical team discussions of the consortium (virtually bi-weekly; 2 missions to project provinces). Facilitating workshops and events in the D-MOSS project.

Essential tasks: the following tasks are essential, but the international consultant will need to take proactive actions to accomplish all UNDP's assigned activities:

Key specific tasks and timeline

The international consultant is to proactively work within the scope of service in order to deliver the following deliverables in the D-MOSS project.

Assignment	Tentative Timeline
WP2: Development of a dengue early warning system:	
1. One pilot case study on Climate Change for Health undertaken that provides necessary information to the System.	By 30 October 2019
WP3: Development of a water availability forecasting system:	
2. One pilot case study on Climate Change, including drafting TOR, providing guidance on design, providing inputs and comments, and finalization of the report.	By 30 November 2019
3. Efficient provision of necessary technical inputs (in areas of land-use planning, environment, climate change, water resources, extreme weather) to the system design, system development, calibration and verification through forecast of water stress, and assessments of multi-stressors	30 July 2019 to 30 June 2020
WP4: Software development, integration and testing	August 2019 to April 2020
4. One critical review paper of the water availability system in the software;	
WP7: Knowledge sharing	
5. Substantive inputs in water availability, climate change and resilience to the development of communication strategy and dissemination through	August 2019-

media	August 2020
6. Incorporation of project findings in Viet Nam national adaptation plan and relevant plans, and identify opportunities for climate resilience in new and existing development activities	July 2019 to November 2019
7. Preparation of three policy briefs and dissemination to national government stakeholders on dengue, water security and climate resilience	December 2019 to January 2021
8. Presentation and attendance at conferences and networking events; and reports on local institutions and regional climate change centres.	July 2019 to January 2021
9. Engaging media professionals to disseminate climate information to water managers, industry and other stakeholders	December 2019-August 2020
10. Undertaking peer-review services for journals, conference papers and reports	August 2019 to January 2021
WP8: Sustainability	
11. Providing substantive inputs to replication of Service Provision to a 2nd country	August 2019 to January 2021
12. Providing substantive inputs to sustainability Plan	August 2019 to February 2021

5. ADMINISTRATION

UNDP will provide administrative support to the consultant throughout the implementation of this consultancy service. However, the consultant should be proactive in making appointments, organizing discussions and consultation meetings with key stakeholders including the HR Wallingford, UK Met Office and others (through Skype calls or other tools).

6. DURATION

The contract duration is from June 2019 to Feb 2021

Maximum number of working days for the consultant is: 80 days.

7. QUALIFICATION AND WORK EXPERIENCE

- At least Master's degree, in climate and/or environmental sciences, water resources and environment management, environmental engineering, or related field
- At least ten years of working experience with environmental/climate change/water resource planning and management, land-use planning at various levels
- Relevant work experience in Viet Nam's or comparable context working on climate change/environmental health, water resource management and land-use planning would be an advantage
- Excellent conceptualization and analytical skills and proven experience in conducting site-based inventory, data collection and objective analysis on climate change, environment, water resource planning and management, and/or environmental health
- Prior experience with UNDP or another UN or international organizations will be an asset

- Strong written and spoken skills in English and proven experience in developing analytical reports, academic papers or comparable high quality technical documents
- Ability to conduct objective analysis of all existing and gathered information, propose relevant and logical mitigation measures
- Experienced in working with multi-cultural partnership and multi-sectoral collaboration is a must -

8. PAYMENT

Fee will be made after the contract deliverables are accepted by UNDP.

#	Deliverables	Deadline	Percentage of payment
1	One pilot case study report on Climate Change for Health	30 October 2019	10%
2	One pilot case study for water availability	30 November 2019	
3	Reports outlining discussions and preparations with HR Wallingford and the UK Met Office for consultative technical workshops on the modelling system	30 June 2020	10%
4	One critical review report of the water availability system and One technical review paper providing additional inputs and information to improve the system	30 April 2020	10%
5	One report on substantive inputs in water availability, climate change and resilience to the development of communication strategy and dissemination through media	30 August 2020	10%
6	One report on lessons learnt of the project, including findings and opportunities – recommendations for developing new activities	15 Oct 2019	10%
7	Three policy briefs and dissemination to national government stakeholders on dengue, water security and climate resilience	15 Dec 2020	30%
8	Presentations and substantive preparations in water availability, climate change for national and regional sharing workshops	20 Dec 2020	
9	Peer-reviewed journal and conference papers and reports	10 Jan 2021	
10	Substantive inputs to replication of Service Provision to a 2nd country	31 Jul 2020	20%
11	Substantive inputs to sustainability Plan, and to reports water resources and local institutions and regional climate change centres produced by the project.	31 Jan 2021	

The consultant will need to send a financial proposal based on Daily Fee using UN-EU cost norm 2017. The consultant shall quote an all-inclusive Daily Fee for the contract period. The term “all-inclusive”

implies that all costs (PIT tax, professional fees, communications, consumables, etc.) that could be incurred in completing the assignment are already factored into the daily fee submitted in the proposal.

For trips to Viet Nam and project provinces, travel costs and daily allowance cost will be provided separately by UNDP as applied using UN-EU cost norm.

9. PRESENCE REQUIRED ON DUTY STATION / UNDP OFFICE

✓ NONE □ PARTIAL □ INTERMITTENT □ FULL-TIME

10. EVALUATION CRITERIA

Consultant(s)' experiences/qualification related to the services		
1	At least Master's degree, in climate and/or environmental sciences, water resources and environment management, environmental engineering, or related field	100
2	At least ten years of working experience with environmental/climate change/water resource planning and management, land-use planning at various levels	200
3	Relevant work experience in Viet Nam's or comparable context working on climate change/environmental health, water resource management and land-use planning would be an advantage	150
4	Excellent conceptualization and analytical skills and proven experience in conducting site-based inventory, data collection and objective analysis on climate change, environment, water resource planning and management, and/or environmental health.	200
5	Prior experience with UNDP or another UN or international organizations will be an asset	100
6	Strong written and spoken skills in English and proven experience in developing analytical reports, academic papers or comparable highly quality technical documents	100
7	Ability to conduct objective analysis of all existing and gathered information, propose relevant and logical mitigation measures	100
8	Experienced in working with multi-cultural partnership and multi-sectoral collaboration is a must	50
Total		**1000**

Annex 1: Key Project Description

Project Title: An integrated dengue early warning system driven by Earth Observations in Viet Nam

Section 1) Project Overview

Name of your organisation	HR Wallingford
Project title	An integrate d dengue early warning system driven by Earth Observations in Viet Nam
Proposal theme	Earth Observation
International partner organisation / country	United Nations Development Programme (UNDP), Viet Nam World Health Organisation (WHO), Viet Nam Institute of Meteorology, Hydrology and the Environment and Climate Change (IMHEN), Viet Nam Pasteur Institute Ho Chi Minh City (PIHCMC), Viet Nam National Institute of Hygiene and Epidemiology (NIHE), Viet Nam
Project start date	19 February 2018
Project end date	21 February 2021

Section 2) Programme Applicability

2.1) Abstract: (Max 250 words).

Dengue fever occurs in 141 countries. Currently there is no system in Viet Nam to forecast the probability of future dengue outbreaks. The epidemiological situation in Viet Nam has been worsened by the failure of health systems to maintain adequate control of *Aedes aegypti* and *Aedes albopictus*, the species of mosquito that spread dengue. In 2016 there were 122,000 cases of dengue fever in Viet Nam. This work will provide a tool giving beneficiaries advance warning of several months of likely dengue outbreaks. This will greatly assist public health authorities to mobilise resources to those most in need. The same methods could also be used to forecast outbreaks of Zika, which has recently begun to be reported in Viet Nam. The project will also provide projections of dengue fever under a range of climate change scenarios. Earth Observation (EO) datasets will be combined with health and water availability information to produce a new integrated dengue forecasting model. The integrated modelling system will link EO data with climate forecasting and a land-surface model to understand and predict for the first time the impacts of primary stressors, (including water availability, land-use, climate), on the likelihood of future dengue epidemics. The tools produced will be used to understand changing health risks posed by dengue for different temporal and spatial scales under future climate change scenarios. The dengue forecasting tool will also include a water assessment module that will feature the additional benefit of improving water management in Viet Nam's transboundary river basins.

2.2) Official Development Assistance (ODA) Applicable:

Viet Nam's Sustainable Development Strategy for 2011-2020[8] aims to "*timely and effectively control epidemic diseases, early detect and timely cure diseases*". One of the major tasks identified in Viet Nam's five-year health sector development plan (2016-2020)[9], issued by the Ministry of Health, is "*To actively prevent epidemics; to forecast, detect early and prevent the occurrence of epidemics, especially*

[8] http://dsi.mpi.gov.vn/vietnam2035/en/3/50.html

[9] http://www.euhf.vn/upload/Strategic%20documents/82.%20MOH%205-year%20plan%20(Eng).pdf

major ones". One of the key tasks identified in Viet Nam's previous health sector development plan (2011-2015)[10], was "*to develop an early warning system, rapid response; active epidemiological surveillance to prevent epidemic outbreak*". In terms of dengue fever this target was not achieved but our proposed project will contribute significantly towards its realisation. According to a WHO report on Dengue Prevention and Control in 2016[11], although significant progress has been made in strengthening regional and country capacities to detect, assess, report and respond to dengue, the Asia Pacific Region has not seen the degree of success expected from the "Dengue Strategic Plan for the Asia Pacific Region 2008-2015"[12]. Limited tools and resources have made it difficult to sustain efforts to control dengue and its burden continues to increase. According to the same report, early adoption of new tools, investing and undertaking the development of new methods and making better use of available interventions will contribute to mitigating the challenge of dengue.

By developing an EO-based early warning system for dengue outbreaks linked to water availability, the project will contribute to the identification of high risk areas and times for dengue epidemics and other arboviruses transmitted by the same mosquito vector, such as Zika. This will enable decision makers to target resources towards the most vulnerable areas to ensure effective disease control and ultimately reduce disease burden. In compliance with ODA's requirements, the proposed work will pave the way to increase the country's resilience to dengue epidemics and enhance local adaptive capacity. Further, and in line with the ODA criteria, the project will address the following development needs: (a) the need for proactive preventive medicine, to timely and effectively control epidemics, and for early detection of diseases; and (b) the need for increased resilience to climate change, land-use change, population growth, and enhanced local adaptive capacity. This work will help the Viet Namese Government to achieve the following targets of the priority SDG3 - Good Health and Wellbeing: Ending the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases by 2030; Strengthening the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks.

The proposed early warning platform will include a water availability component. Water availability directly impacts dengue epidemics due to the provision of mosquito breeding sites. These dynamics are often non-linear; too much rainfall can fill outdoor containers, e.g. gutters, potholes, rice paddies, while too little water availability can lead to people storing water in open containers within their homes. Both increase the population of *Aedes aegypti* mosquitoes and in turn the risk of dengue outbreaks. However, water availability or water resource management is rarely accounted for in dengue prediction models. This project will generate monthly water stress assessments and use them as input to a component of the dengue early warning system which will also improve the skill of the system's predictions. In addition, these forecasts of water stress would help to improve Viet Nam's water management. Viet Nam's Sustainable Development Strategy for 2011-2020 identifies one of the major challenges facing Viet Nam as the issue of transboundary water management, because 63% of the surface water comes from upstream countries. The proposed dengue early warning system will include a water assessment module that will assist IMHEN and the Viet Namese Ministry of Natural Resources and Environment[13] (MONRE) to access EO-based information on water availability and improve integrated water management. This secondary benefit, arising from the project, will help Viet Nam to meet SDG6 - Clean Water and Sanitation by helping to implement integrated water resources management at all levels, including through transboundary cooperation as appropriate by 2030.

[10] http://www.wpro.who.int/health_services/VTN_2011-2015.pdf

[11] http://iris.wpro.who.int/bitstream/handle/10665.1/13599/9789290618256-eng.pdf?ua=1.

[12] http://www.wpro.who.int/mvp/Dengue_Strategic_Plan.pdf

2.3) Background, Knowledge and Experience of All Key Participants:

HR Wallingford (HRW) with headquarters in Wallingford in the UK, is a not-for-profit, independent research organisation formed in 1947 specialising in research and consultancy which includes early warning systems, water resources and climate change adaptation, with offices in Malaysia and China. HRW employs 250 staff and works closely with government and non-governmental organisations worldwide to provide the evidence-based tools to support decision making related to water availability and climate change adaptation across a range of sectors. HRW has developed strategies to integrate flood mitigation and water resources planning measures in Viet Nam's Red River Basin and has led a multi-disciplinary team to deliver the UK's first Climate Change Risk Assessment. HRW has experience of using and applying space and EO-based information for a number of decision making tools, including to manage wetlands in the Nile River Basin and to develop a service based on a combination of EO data and numerical modelling to monitor sources of diffuse pollution to respond to the requirements of the European Commission Water Framework Directive. HRW is currently responsible for the hydrological modelling component of a UK Space Agency project developing a drought and flood warning service for Uganda. HRW has experience of leading multi-million pound projects and multi-disciplinary teams. We have recently carried out a study to assess the effectiveness of early warning systems for weather related hazards in low income countries in Africa and South Asia. HRW will lead the team. Key staff – Darren Lumbroso (Technical Director) has 25 years' experience working in some 40 low income countries worldwide, including Viet Nam, on early warning systems for a range of hazards.

The London School of Hygiene and Tropical Medicine (LSHTM) has an international reputation as a centre of excellence for public health, with a strong track record in vector-borne disease research. The proposed work builds on research carried out by the LSHTM in other low income countries with similar climates to Viet Nam to predict outbreaks of dengue fever using climate data. The LSHTM brings a multidisciplinary group of epidemiologists, ecologists, mathematicians, statisticians, economists and clinicians to the team. The LSHTM has carried out investigations into the clinical management and host susceptibility of dengue in Viet Nam. The LSHTM has used climate forecasts to develop probabilistic tools to predict dengue epidemics in Ecuador. The method developed use seasonal climate forecasts to correctly predict the peak in dengue incidence to occur three months earlier than expected, following one of the strongest El Niño events on record. The LSHTM will lead the development of the dengue forecasting method. Key staff – Dr Rachel Lowe (Assistant Professor) leads research on how environmental and socio-economic factors interact to determine the risk of vector-borne disease transmission. She has worked with Malawi's Ministry of Health to develop predictive models for malaria and a platform to integrate climate information and rural telemedicine, developed dengue forecasting tools in collaboration with public health decision makers in Brazil and Ecuador, and worked with the WHO to develop decision making tools for climate and a range of health impacts.

The United Nations Development Programme's (UNDP) portfolio of programmes in Viet Nam support inclusive, equitable and rights-based development in Viet Nam and respond to the Government's need for support to meet the Sustainable Development Goals (SDGs) and national growth targets. The UNDP has strong links and memoranda of understanding with all the relevant Viet Namese Ministries and NGOs and is leading a number of relevant programmes and projects including capacity building for the implementation of national climate change strategy, strengthening sustainable development and climate planning. As a provider of policy and governance advice, the UNDP in Viet Nam has had a positive influence on a broad spectrum of policy outcomes. UNDP in Viet Nam plays a key role in assisting government organisations identifying the risks posed by climate change and providing tailored solutions in key areas. The UNDP has extensive experience of carrying out the Monitoring & Evaluation (M&E) of projects and programmes and has excellent links with private sector organisations and NGOs who can assist with M&E. Key staff – Jenty Kirsch-Wood (Senior technical specialist disaster risk and climate change) has over 20 years' experience in humanitarian and development assistance, and has been providing technical support on climate change adaptation and resilience building in Viet Nam

UNDP for the past three years. This has included work to establish climate change adaptation mapping and decision making tools for Government and supporting SDG target setting and implementation.

The World Health Organization (WHO) is the specialised international health agency of the UN. Its objective is the attainment by all people of the highest possible level of health. WHO has 194 Member States and operates in 147 country offices, six regional offices, and is headquartered in Geneva. The WHO Hanoi office responds to requests from the host country by: providing technical guidance, supporting national collaborative partnerships in health, and providing assistance to Viet Nam in its national programme to control dengue in alignment with global and regional best practice. WHO is ideally placed to implement the proposed activities and ensure suitability and high quality management and reporting according to international standards. Lessons learned from the project will contribute to policy dialogue on best practices for dengue control. Key staff – Dr Kidong Park (WHO's representative to Viet Nam) leads the WHO's work in Viet Nam. He has worked for the WHO for over 15 years and has extensive experience in public health, health systems development, and communicable diseases, with responsibilities spanning from programme planning, M&E and international collaborations.

The UK Met Office provides world-leading science on meteorology, enhanced by the close working relationships with partner organisations around the globe. The Met Office has worked with the Viet Namese Department for Hydrology, Meteorology and Climate Change, the National Centre for Hydrology and Meteorology Forecast, and the Institute of Meteorology, Hydrology and Environment to improve their weather and climate forecasting on short, seasonal and long range time scales through a range of technical assistance projects, training and consultancy services. It has also developed climate change scenarios for Viet Nam. They have developed climate forecasting products for a range of sectors that are relevant to Viet Nam. Key staff – Dr Mark Harrison (Applied Science Planning and Development Manager) has worked at the Met Office for 14 years. He has worked on projects in a number of low income countries. He is currently working on a UK Space Agency funded project providing climate forecasts for a drought and flood mitigation service in Uganda.

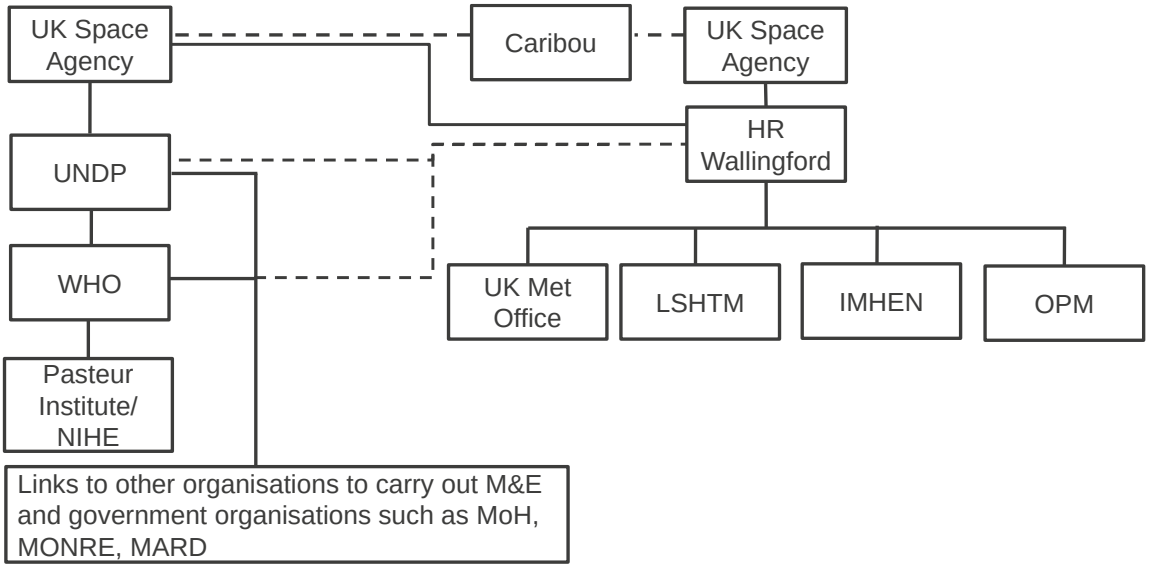
Oxford Policy Management Limited (OPM) is an international development consultancy that is committed to helping policy makers design and implement sustainable reforms for reducing social and economic disadvantage in low-income countries. OPM has over 35 years' experience in providing rigorous analysis, policy advice, management and training services to national governments, international aid agencies and other public sector and non-government organisations. OPM's dedicated M&E team will oversee the design and implementation of the project's M&E. OPM's sectoral teams have solid expertise in designing impactful projects in the sectors relevant to the UK Space Agency. Over its 35-year history, OPM has undertaken over 170 M&E projects in more than 50 countries, including more than 30 evaluations which have used experimental or quasi-experimental design. Key staff – Dr Lucrezia Tincani is a social scientist with a background in natural resource management. She has designed and implemented a range of M&E programmes in a number of low income countries including one for a UK Space Agency funded project in Uganda.

The National Institute of Hygiene Epidemiology (NIHE) in Viet Nam oversees the prevention and control of epidemic and common diseases, including dengue fever. NIHE conducts scientific research in epidemiology, medical microbiology, immunology, and molecular biology; develops new vaccines and biological products for humans; provides the Viet Namese Ministry of Health with strategies for the prevention, control, and elimination of epidemic and common diseases, including dengue fever; conducts different types of specialization training; directs specific national health programs, such as dengue fever control and prevention; provides guidance and strengthens the technical capacity of the national preventive medicine network; and provides technical services on preventive medicine. NIHE has around 350 staff (including 20 professors and 45 PhDs) working in ten technical departments. Key staff – Prof Dang Duc Anh (Director of NIHE) has 30 years' experience working in communicable disease control and international cooperation in infectious disease control. He is the Chief Executive of the national dengue fever control programme in the north of Viet Nam.

The **Pasteur Institute in Ho Chi Minh City (PIHCMC)**, which falls under the Ministry of Health (MoH) of Viet Nam, oversees the prevention and control of infectious diseases, including dengue, in the south of Viet Nam. PIHCMC is responsible for collating surveillance data on the number of dengue cases admitted to hospitals in the southern provinces of Viet Nam and for producing an annual estimate of dengue incidence from district to provincial and regional levels. PIHCMC has experience in conducting research related to dengue epidemiology and vector control. PIHCMC is in the consortium of the "Defeat Dengue" programme, which brings together Institute Pasteur researchers from around the world, working on different aspects of dengue, with the aim of jointly developing a number of innovative tools to control it. **Key staff – Dr Luong Chan Quang (Vice - Head of Communicable disease control and prevention)** has been working in the field of epidemiology, surveillance and control of vector-borne diseases since 1996. He has been directly involved in arbovirus disease surveillance and control, including dengue. He is also very experienced in working with International institutes to conduct epidemiological and clinical trial studies related to dengue.

The **Institute of Meteorology, Hydrology and Climate Change (IMHEN**) is a government research institution under the Ministry of Natural Resources and Environment. Established in 1977, it is now one of the leading research institutes in Viet Nam on conducting applied research and consultancy in the fields of meteorology, hydrology, oceanography and the environment. Apart from its research activities, the institute also provides postgraduate education and training programmes and consultancy services, especially in climate variability and climate change. IMHEN is currently officially assigned the mission to develop and renovate climate change and sea-level rise scenarios for Viet Nam. **Key staff - Associate Professor Hoang Minh Tuyen (Director of Centre for Hydrology and Water resource)** has 33 years' experience in water resources management and impact assessment of climate change on water resources, including the development of a flash flood warning system for Viet Nam.

The team will be organised such that for contractual purposes there will be a UN agencies team led by the UNDP and another team led by HR Wallingford. This is shown in Figure 1. For the purposes of the day-to-day running of the project HR Wallingford will act as the de-facto team leadr for all the partners.



Note:
IMHEN = Institute of Meteorology, Hydrology and Climate change
WHO = World Health Organization
UNDP = United Nations Development Programme
LSHTM = London School of Hygiene and Tropical Medicine
NIHE = National Institute of Hygiene and Epidemiology
MoH = Ministry of Health
MONRE = Ministry of Natural Resources and Environment
MARD = Ministry of Agriculture and Rural Development
OPM = Oxford Policy Management
M&E = Monitoring and Evaluation
Caribou will carry out the overall M&E for the UK Space Agency International Partnership Programme
UNDP will disperse funds from the UK Space Agency to WHO

Figure 1 - Organisation of the project team

2.4) Role of International Partners:

United Nations Development Programme (UNDP): Liaison with Viet Namese stakeholders over the three years of the project; Management and disbursement of funds to the World Health Organization (WHO); Organisation of up to two one-day workshops in Hanoi per year; Disbursement of travel expenses to participants; Provide venue for meetings with project partners; Contribution to monthly project reports; Liaison with relevant government ministries and agencies; Management of the M&E for the pilot studies; Attendance at telephone conferences and workshops in Viet Nam; Integration of future predictions of dengue fever and water availability under future climate change scenarios with climate change adaptation plans.

World Health Organisation (WHO): Direct liaison with relevant government ministries and agencies (e.g. GDPM, NIHE, PIHCMC); Contribution to monthly project reports; Provision of historical dengue data; Management and implementation of capacity building for the health side of the project; Attendance of telephone conferences and workshops in Viet Nam; Liaise with UNDP regarding management of workshops in Viet Nam; Advise on pilot sites for testing dengue forecasting tool in liaison with the Pasteur Institute and NIHE; Development of M&E for pilot studies.

nihePasteur Institute Ho Chi Minh City (PIHCMC) and National Institute of Hygiene and Epidemiology (NIHE): Contribution to monthly project reports; Provision of historical dengue data; M&E for the pilot studies in southern Viet Nam; Attendance at telephone conferences and workshops in Viet Nam; Advice on pilot sites for testing dengue forecasting tool.

Institute of Meteorology, Hydrology and the Environment and Climate Change (IMHEN): Provision of historical hydrological data; Expert advice and input into the development of an Earth-Observation based water level monitoring and water assessment tool; Contribution to monthly project reports; Attendance at telephone conferences and workshops in Viet Nam.

NIHE and PIHCMC will act as WHO's implementing partners for the project. WHO has memoranda of agreements in place with both these organisations. The WHO budget has been built up to include labour costs for NIHE and PIHCMC.

2.5) Impact and Benefits to the cos:

Before 1970, only nine countries had experienced severe dengue epidemics. Today the disease is endemic in more than 140 countries. The UK Space Agency funded HR Wallingford to carry out a short study on the stakeholders' requirements for a dengue forecasting tool in Viet Nam. In July 2017 a team from HR Wallingford visited Viet Nam for two weeks to engage with key beneficiaries and end users. Considering the current trends in dengue epidemics worldwide and in Viet Nam, as well as HR Wallingford's engagement with stakeholders, it is clear that the establishment of a dengue forecasting system would greatly assist WHO, NIHE, PIHCMC, UNDP and the Viet Namese Ministry of Health to put timely dengue control and prevention measures in place. This would significantly help to minimize the burden of disease. Furthermore, the recent emergence of the Zika virus in the region which, like dengue, is also transmitted by *Aedes aegypti* mosquitos, highlights the urgency of a proactive approach. The proposed tool will contribute to strengthen Viet Nam's response to both diseases. Working together with WHO, NIHE and PIHCMC, the Viet Namese public health authorities will be able to identify current areas of high risk of infectious disease epidemics, in order to effectively target resources to ensure effective disease control. As well as providing a tool to forecast dengue fever, this project will also provide the project partners with a method to estimate the likelihood and severity of future dengue outbreaks under a range of climate change, land-use and water management scenarios. This will greatly assist the project partners together with the Viet Namese Ministry of Health to formulate appropriate dengue fever related interventions and policies.

From a water resources perspective, given that seven of the nine major river basins that drain to Viet Nam are transboundary in nature and are shared between two and five countries, the application of EO-based information will help IMHEN and the Viet Namese Ministry of Natural Resources and Environment (MONRE) to improve their water resources monitoring and management in transboundary

river basins, such as the Red River. Further, the identification of hotspots for water resources stress will be a useful tool for IMHEN, to inform local authorities regarding key decisions and procedures for risk assessment on water security.

The nature of the proposed work means that this project can only be successfully delivered by a multidisciplinary team. We will bring together environmental and public health expertise to develop new knowledge and explore novel approaches. New networks and knowledge sharing between different science fields will be beneficial for all the involved project partners. Knowledge sharing workshops and meetings will be organised to disseminate the benefits of the work to stakeholders at a range of levels (e.g. community, regional and national). Institutes and universities that specialise in the fields of public health and water management will benefit through enhanced scientific knowledge transfer, which could include secondments of Viet Namese staff to the international partners to facilitate capacity building and knowledge sharing.

2.6) Impact and Benefits of the Project to the Wider UK Economy:

Dengue fever is the most rapidly spreading, mosquito borne, viral disease in the world. Dengue flourishes in urban poor areas, suburbs and rural areas but also affects more affluent neighbourhoods in tropical and subtropical countries. Since 2000, there has been an increase of over 100% in the number of cases of dengue fever in Viet Nam alone. Dengue occurs in 141 countries and around 390 million people are infected annually. Global warming is likely to allow dengue to spread to new regions, meaning that large parts of Europe and the Andes regions of the Americas, areas that today are too cold for *Aedes aegypti* mosquitoes to survive winter, will also face a serious threat from dengue in decades to come. Antiviral drugs and highly effective vaccines have yet to reach the market, and initial results from trials have not yet delivered a product with significant public health impact. There is potentially a worldwide need for an EO-based warning system for vector borne diseases, including dengue fever. This project will allow UK-based partners to implement cutting edge research that will help improve the efficiency of dengue prevention measures. This new technology could improve the efficiency of future UK-funded aid projects, allowing aid to be better focused. For the project team this opportunity offers a route to implementing an integrated early warning system in dengue and Zika-affected countries worldwide. International development assistance that helps tackle the causes of global problems such as tropical diseases is in the UK's long-term economic interests as it contributes to increased opportunities for sustainable economic growth. The UK contributes to developing countries becoming emerging economies, which then can become the engines of future global growth and prosperity. Whenever the UK's international development spending has played a key role in this process, strong links have been built and powerful overseas trading partnerships have been established. Furthermore, a UK-led operational dengue (and Zika) forecasting system, which highlights the importance of using EO data for real-time monitoring and early warnings, has the potential for commercialisation through vaccine suppliers, donors, and country-level providers of public health, water and climate services. For example, for pharmaceutical companies an early warning system could assist them in testing the effectiveness of any new vaccines in trial sites. The tools could be expanded to new countries for the short-term management of dengue outbreaks and also the long-term coordination of dengue and water resource management to prevent region-wide outbreaks as well as helping them with climate change adaptation planning.

2.7) Impact of Funding: (Max 200 words)

Engagement with a range of stakeholders via workshops and face-to-face interviews in Viet Nam in July 2017 confirmed that this project will fill a gap in public health. The aim of the project is to provide health benefits to the Viet Namese people and more widely, to other countries affected by dengue, as well as Zika. The project adopts a transdisciplinary approach, bringing together a diverse range of research and private sector organisations and UN agencies in Viet Nam and the UK. An EO-based solution will be developed, utilising research that has yet to be applied in an operational context. This project would not go ahead without the support of this programme as the consortium members'

governance bodies would not be able to approve full funding for it. For UN agencies such work cannot be carried out without a funding stream and private sector and research organisations require the experience of such a project in order to build a business case for commercial spinoffs . Commercial exploitation by the team is a possibility in the future, following the development of the proposed dengue early warning system and demonstration of its value in the pilot areas. It has the potential to be used worldwide.

Section 3) Understanding the Requirement

3.1) Nature of the Problem: Describe the nature and extent of the problem to be addressed.

The WHO recently ranked dengue fever as the fastest spreading vector-borne viral disease, with epidemic potential in the world, registering a 30-fold increase in disease incidence over the past 50 years[14]. Several studies have emphasised the significant links between weather variability and infectious diseases, highlighting the potential for developing early warning systems for epidemics. Currently there is no operational early warning system in Viet Nam that uses EO products and climate forecasting linked to water availability to allow the prediction of dengue outbreaks several months in advance. Engagement with some 40 key stakeholders by the project team in July 2017 indicated that such a system would be feasible, reliable and of great value.

Dengue fever in Viet Nam poses an enormous public health problem in terms of morbidity and mortality for patients, but also in terms of the economic and social costs to individuals and society. Dengue is an endemic disease in Viet Nam, with epidemic cycles that are associated with social determinants such as rapid urbanisation, limited access to basic services, the rapid movement of people and goods, and climate variability and change.

This proposal is particularly timely, as the extent of this year's dengue fever outbreak in Viet Nam is unprecedented. According to statistics released by the director of the Ho Chi Minh City Department of Preventive Medicine, there has been a 10% increase in the cases of dengue fever recorded at hospitals across the country since the beginning of this year, relative to the same period in 2016. The National Hospital for Tropical Diseases in Hanoi has seen a 400% increase in the numbers of dengue patient admissions in between January and July 2017, compared to the same period last year.

According to the Viet Namese Ministry of Health, "*global warming, El Niño, uncontrolled urbanisation and migration have hampered dengue prevention efforts*"[15]. WHO[16] has called for a more proactive approach to tackle the disease rather than a response-driven one. Viet Nam needs to put appropriate measures in place for preparing in advance for a dengue outbreak. The early warning system our project aims to develop will significantly add to the country's efforts towards proactively using resources to eliminate the health and socio-economic impacts of dengue.

The Zika virus is also spread by the *Aedes aegypti* and *Aedes albopictus* species of mosquito. The first autochthonous cases of Zika were detected in Viet Nam in 2016. Although the number of cases to date has been limited, Viet Nam's National Hospital of Tropical Diseases has indicated that the probability of Zika spreading is very high as the *Aedes aegypti* species of mosquito is extremely common in most provinces and cities. The proposed EO-based dengue early warning system could also be used to predict Zika outbreaks.

Water resources in Viet Nam are under increasing stress due to overexploitation, salinisation, contamination and climate change, exposing a large population to various water-related risks and challenging decision makers to better manage an increasing water demand. Owing to Viet Nam's

[14] http://www.who.int/mediacentre/news/releases/2013/ntds_report_20130116/en/

[15] http://english.vietnamnet.vn/fms/society/180386/health-ministry-urges-proactive-prevention-of-dengue-fever.html

[16] http://www.wpro.who.int/emerging_diseases/documents/ActionAgainstDengue.pdf.pdf

transboundary river basins, conflicts often arise in relation to the allocation of water. The water availability module developed as part of the dengue early warning system will have an additional benefit in that it will assist assessment of the state of water resources in transboundary river basins. A stakeholder engagement meeting with IMHEN at their office in Hanoi in July 2017 confirmed that this module would help to fulfil this need, thus improving their water management capability (see Annex 1 for a letter of support from IMHEN).

3.2) End User: Who is/are the end user(s) and what is their specific need?

The WHO, Ministry of Health (MoH) (General Department of Preventative Medicine (GDPM)), Pasteur Institute Ho Chi Minh City (PIHCMC); National Institute of Hygiene and Epidemiology (NIHE) require a probabilistic dengue (and Zika) forecasting tool with up to a three-month lead time linked to climate and water availability to facilitate the public health response to moderate an impending outbreak in Viet Nam. If successful, WHO could adapt and extend the tool in other dengue affected countries worldwide. There is also a need for capacity building, which will form an important component of this project. The GDPM operates a disease early warning centre based on surveillance ***not*** forecast information. They stated at a meeting in July 2017 that they would be prepared to operate a dengue early warning system based on forecast climate information.

MoH, WHO, UNDP, NIHE require information on how dengue and Zika will change under future climate change scenarios for a range of time horizons to allow them to formulate effective policies and strategies.

IMHEN and UNDP require forecasts of water availability both at a monthly temporal scale and also under a range of climate change scenarios to enable them to improve the management of water resources, especially in transboundary river basins.

Local governments in Viet Nam have a responsibility to take measures to control mosquitos. A dengue early warning tool would assist local authorities to increase the efficiency of their response and target limited resources to those areas most at risk.

Community and village health workers brings health care as close to where people live and work as possible and constitute the first element of the healthcare process. The tools produced will help them to provide a more focused response to dengue outbreaks.

At risk communities require information to help them prevent mosquito bites, clear breeding sites from around the home, thereby reducing ongoing transmission, and to seek treatment early to reduce the chance of developing severe disease or death. Well defined triggers together with a dengue early warning system could help them to achieve this.

Letters of support from the project partners and the beneficiaries are included in Annex 1.

3.3) Satellite/ Space Technology Solution: Justify why space technology is an appropriate solution.

EO data can help countries understand the dynamics of the multiple environmental stressors on the health and water sectors, especially in regions with poor or non-existent ground monitoring, and there is a clear need for this in Viet Nam. Climate change, land-use change and water security are interrelated and have direct implications for public health and the prediction of vector-borne diseases. However, the evidence base for the impact of multiple stressors on the spread of mosquito-borne diseases is only just emerging and by using remote sensing data this work will make a major contribution to this. In data-scarce countries like Viet Nam, the use of EO data and space technology can make it possible to enhance the on-the-ground collection of data, especially in the remotest areas of the country. When compared to ground stations (e.g. weather stations), remote-sensing products enable a more accurate representation of the spatial variation of meteorological parameters, which may vary significantly at the local scale, particularly in regions with high elevation variation. EO data also enables scalability of the solution up to national or even international level.

In recent years, space technology has improved data collection and monitoring of meteorological variables (e.g. rainfall, temperature, humidity, land use), as well as vegetation and soil indicators, which

have been used to link weather conditions with abundance of the dengue virus mosquito vector[17], and to map dengue risk levels[18]. Advances in space technology have significant potential for disease vector monitoring and related epidemiological applications[19], and have been recently used to predict the risk of dengue incidence and to provide useful information for modelling vector distribution and expansion[20].

Given that seven of the nine major river basins that drain to Viet Nam are transboundary and shared between multiple countries, a monitoring system supported by remote sensing can provide important information to the Viet Namese Government on water availability, distribution and awareness of the impacts of upstream, cross-border hydropower dams. Based on different remote sensing technologies, it is possible to develop a set of tools that enables water resources monitoring by developing a case study in the Red River Basin. For Viet Nam, it is important to have an accurate description of the current water resources situation as well as a projection of the potential changes caused by seasonal and climate-induced variability. The water resources module will feed directly into the dengue fever forecasting tool. This project will help to bridge the gap between academic and operational application of EO technologies, as presently space solutions are very rarely used by practitioners and decision makers in the health sector.

3.4) Applying Space Technology as a Solution:

Open access sources of EO-data will be used to obtain vegetation, land cover, evapotranspiration, surface water extent, water level, digital terrain and other relevant data required. Missions such as Sentinel-2A and 2B spatial, the Advanced Land Observing Satellite (ALOS), and many others provide sources of freely available data at spatial resolutions and revisit (satellite-overpass) periods of 10 days that are suitable for the proposed application. From a sustainability perspective the tools produced will be designed to be inter-operable and extensible so that they can be used with a range of open EO-data sources and can utilise new EO-data sources when new satellites are launched. We will also provide support in building the scientific and technological capacity in Viet Nam to ensure the project is sustainable via training courses, secondments and co-development of tools with Viet Namese counterparts.

Section 4) Technical Description

4.1) The Solution: Describe your proposed solution and how it meets the user need described above.

The project will develop a suite of innovative tools that will allow beneficiaries to: Issue alerts for dengue (with a view to developing the same for Zika); and provide assessments of vector-borne disease risk under future climate and land-use change scenarios. In addition, forecasts of water scarcity will be made and incorporated in the dengue early warning tool. The integrated suite will combine data from EO-based sources, climate forecasting and land-surface modelling. The project brings together an interdisciplinary team of environmental and health scientists to:

- Create new understanding of the relationships between stressors (i.e. the hydrological-climate system) and human health;
- Develop the first early warning system to improve dengue (and Zika) epidemic prevention and increase disease control capacity; and

[17] Moreno-Madriñán, M. et al. (2014). Correlating remote sensing data with the abundance of pupae of the dengue virus mosquito vector, *Aedes aegypti*, in central Mexico. ISPRS Int. J. Geo-Inf. 3, 732–749

[18] Machault, V. et al. (2014). Mapping entomological dengue risk levels in Martinique using high-resolution remote-sensing environmental data. ISPRS Int. J. Geo-Inf. 3, 1352–1371

[19] Goetz, S.J. et al. (2000). Advances in satellite remote sensing of environmental variables for epidemiological applications. Adv. Parasitol., 47, 289–307

[20] Rogers, D.J. et al. (2014). Using global maps to predict the risk of dengue in Europe. Acta Trop. 129, 1–14.

- Benefit local authorities' planning by providing scenarios of the main stressors and their impacts on water and health security.

4.2) Tools and Techniques: What tools and techniques will you deploy?

The architecture of the solution will rely on open and non-proprietary software, where possible, and on flexible hardware solutions such as cloud-based virtual storage and application processing. The aim is to mitigate some of the cost and dependency of using proprietary tools and technologies with the additional intention of allowing stakeholders a degree of flexibility over specific parts of the implementation.

It is planned to make use of open-source operating systems and data processing layers (such as, but not limited to: LINUX, POSTGIS, Mongo RDF, etc.) and widely known development languages and tools (such as Java, Python, Javascript, HTML, XML, XSL, CSS, etc.) By maintaining the software stack at a high level of independence the reliance on proprietary third party software and the knowledge of such software in the future is reduced. Moreover, the opportunity to replicate the generic design in other parts of the world and for other diseases is increased.

The project operates through eight linked Work Packages (WPs). The overview of the WPs is given in Figure 2. The first four WPs cover the tools and techniques that will be employed and are described below.

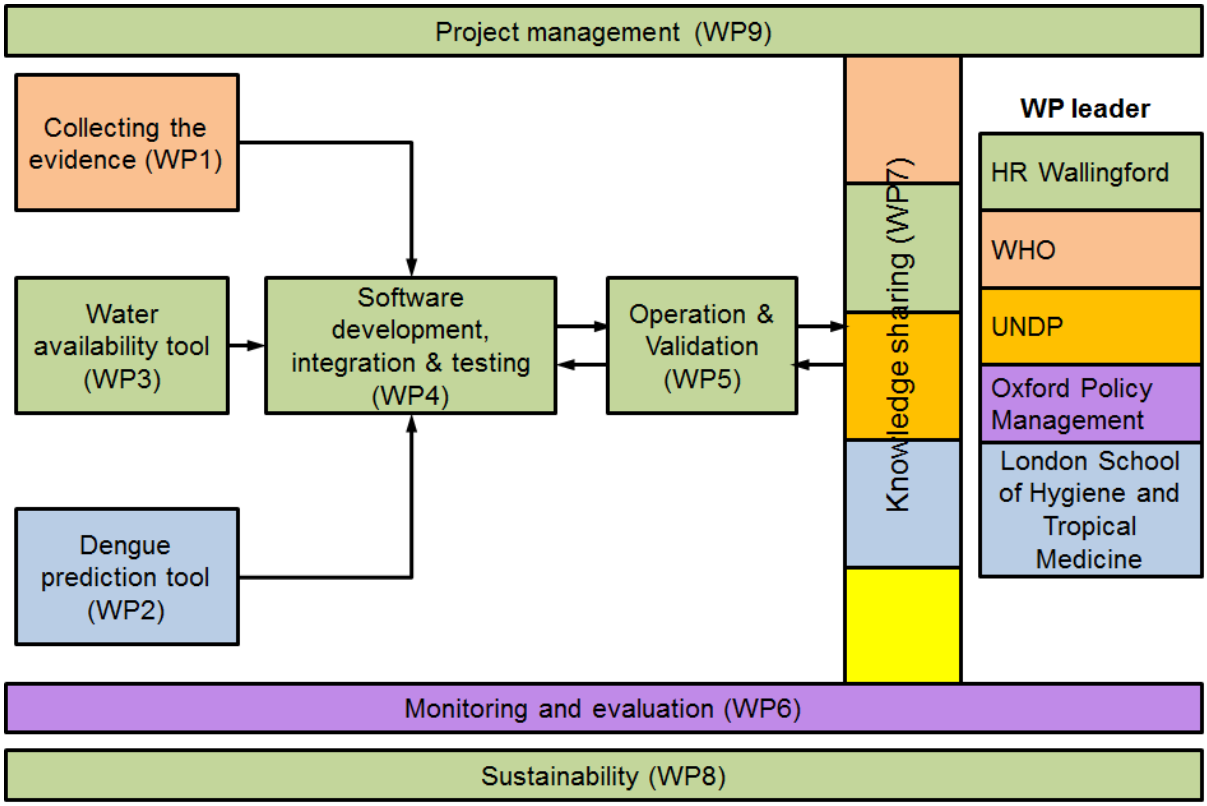


Figure 2 Overview of the project Work Packages (WP)

WP1: Data collection, review and integration:

We will identify key data sets relating to the local and regional impacts of multiple stressors and extreme events on dengue fever transmission including water availability. Existing research on dengue fever and climate stressors in Viet Nam will be reviewed. EO-based products will be used to identify hotspots for water resources stress. Existing data relevant to the incidence and expansion of dengue fever will be collected from the Viet Nam Ministry of Health passive surveillance system, and hotspots of disease incidence analysed. Key EO-based products that can be used to relate vector habitat characteristics and dengue disease outbreaks will be developed (e.g. Leaf Area Index, Normalised Difference Vegetation Index, water body temperature). The relationship between disease cases and EO

variables such as temperature, rainfall, humidity, Leaf Area Index and water availability will be quantified using an empirical model.

WP2: Development of a dengue early warning system:

WP2.1: Dengue forecasting for sub-seasonal to seasonal lead times: The integrated system built in WP3.1 will provide an assessment of the water resource situation. This will feed into new statistical forecasting models of disease incidence (e.g. based on a spatio-temporal Bayesian hierarchical mixed modelling approach[21,22,23]). This dengue early warning system model will integrate the water stress forecast from WP3.1 with a range of other covariates important for dengue transmission to forecasts of dengue incidence up to six months in advance. These forecasts will be directly relevant to water management activities. The additional variables such as water stress, related to the surveillance of the *Aedes aegypti* mosquito vectors, will be included to strengthen the model in order to enhance its ability to forecast dengue outbreaks and associated morbidity.

In line with the WHO "Regional Action Plan on Dengue Prevention and Control for the Western Pacific", WHO will support the surveillance of adult mosquitoes by using Gravid Aedes Traps (GAT) and other methods. GAT will be distributed to selected households in the provinces that the dengue system will be piloted, and mosquito samples will be monitored on a weekly basis, providing information on the density of the vector. This is the main responsibility of WHO which will be done through Government implementing partners. Results from the adult mosquito surveillance programme will be used as input to the model in parallel with data on historical dengue outbreaks.

A fully integrated dengue warning system will be developed that will include:

- The water stress early warning system from WP3.1 to detect mosquito breeding sites;
- Forecasts of meteorological variables (e.g. temperature, rainfall, relative humidity), which determine mosquito survival and virus incubation rates when paired with existing validated mosquito models;
- Existing high resolution risk maps for Aedes mosquitoes[24], which estimate long-term average risk;
- Socio-economic indicators related to urbanisation, poverty and water storage practices, from census data;
- The spatiotemporal trends in historical dengue incidence to account for prior immunity to dengue in human populations;
- Field information on adult mosquito density and dengue virus subtypes being circulated, to optimize the forecasting capacity of dengue outbreaks and associated morbidity, and to serve for monitoring and evaluation of the early warning system.

Spatio-temporally explicit models will be used to fit non-linear and interactive relationships between each of the covariates and the historical dengue incidence (1993-2010) for all 63 provinces of Viet Nam. Once fitted, the model will provide predictions of: (a) Weekly dengue incidence including uncertainty; (b) Probability of exceeding the outbreak threshold; (c) Projected incidence under different water management scenarios (as determined in consultation with stakeholders).

These model forecasts will provide an important evidence base for public health and environmental management policymakers in Viet Nam. This inter-sectorial approach will allow two parallel approaches

[21] Lowe R, et al. (2017). Climate services for health: predicting the evolution of the 2016 dengue season in Machala, Ecuador. Lancet Planetary Health

[22] Lowe R, et al. (2014). Dengue outlook for the World Cup in Brazil: an early warning model framework driven by real-time seasonal climate forecasts. Lancet Infectious Diseases, 14(7)

[23] Lowe R, et al. (2013). The development of an early warning system for climate-sensitive disease risk with a focus on dengue epidemics in Southeast Brazil. Statistics in Medicine, 32(5): 864–883

[24] Kraemer M.U., et al. (2015). The global distribution of the arbovirus vectors *Aedes aegypti and Ae. albopictus*. Elife, 4:e08347.

to outbreak management: i) conventional public health vector control measures and preparation of dengue treatment wards and ii) modified environmental management practices to reduce mosquito breeding habitats to decrease the potential for dengue transmission. This will provide a framework to directly ameliorate the effects of water-stress disasters such as drought or flood on Viet Nam's most important vector-borne disease.

WP2.2: Dengue prediction for policy planning (i.e. climate change timescales up to 2100): Major factors causing dengue epidemics include population growth, urbanization, lack of effective mosquito control, and movement of new dengue virus subtypes between different areas. WP3.2 will: (a) Develop key datasets relating to the impacts of stressors like climate change, water use and demand, land-use change (including urbanisation) and demographic, societal, and public health factors; (b) Understand and quantify the impacts of water availability and water stress on disease incidence; (c) Identify the main stressors at the disease incidence hotspots.

WP3 - Development of a water availability forecasting system:

We will develop an integrated modelling system that will combine: Earth Observations, climate forecasting and land-surface modelling. This system will: (a) generate water stress assessments; and (b) project longer term impacts of multiple stressors on water resources that will feed into the dengue prediction tool.

WP3.1 – Water availability forecasting: The UK Met Office climate forecasts (monthly-to-seasonal timescales) will be used to drive a land-surface model, whose outputs combined with EO datasets will be translated to indicators of water stress such as commonly used indicators of drought (e.g. Standardized Precipitation Index). Satellite based synthetic aperture radar data will be used to estimate river water levels and to measure channel width, slope, and flow velocity to estimate discharges. This technique is particularly useful in transboundary river basins. The system will include three EO-based components (i.e. land-use, weather and water resources) and will generate monthly forecasts of water stress. The system will be calibrated against historical data. The water availability forecasts will be fed in to the dengue prediction tool (see WP3).

WP3.2- Water availability prediction under climate change: Datasets will be developed to assess the impacts of multiple stressors in relation to water security. The stressors that will be examined are water use and demand, land-use change (including urbanisation) and climate change. Future projections of land-use change and water demand with historical climatology; Climate change scenarios with land use and water demand kept constant at today's levels; and a combination of land-use change and climate change scenarios will be considered. We will identify the main stressors on water-resources hotspots up to the year 2100.

WP3.3 Climate change, extreme weather events and public health: Floods, droughts and other extreme weather events negatively impact human health. Under a changing climate, the frequency and intensity of extreme events is expected to increase in South-East Asia. WP2.3 will: (a) Develop empirical relationships between trends in climate, EO-data and indicators of increased health risks focusing on vector-borne diseases; (b) Quantitatively analyse the impacts of extreme events in human health; (c) Develop statistical relationships of climate/disease and use these to estimate changes under future climate change; (d) Map climate – vector-borne disease relationships in time and space to estimate how distributions may change.

WP4: Software development, integration and testing:

WP4 will develop a novel, open-source, light and user-friendly plug-in dengue early warning system that will be used to integrate multiple data sets and a series of models and services. The open-source nature of the product will enable the beneficiaries to use the tool to support decision-making and will encourage the development of a support network that can maintain it, ensuring the product's sustainability. The platform will be designed to assimilate various data sources including EO

information, climate, and ground-based observations (e.g. data from rainfall gauges). A simplified overview of the system is shown in Figure 3. An overview of the flow of data and processes included in the dengue early warning system are shown in Figure 4.

The main processing chain will be developed using the more traditional waterfall approach due to its complex components and component interactions. Functional and technical specifications will be drawn up for the main components and the integrated system, according to that laid out in the user requirements document. Unit and system testing activities will be undertaken as part of this work package as well as integration testing and, if required, volume testing. The portrayal components will, if feasible, be developed in a more interated fashion with high user involvement.

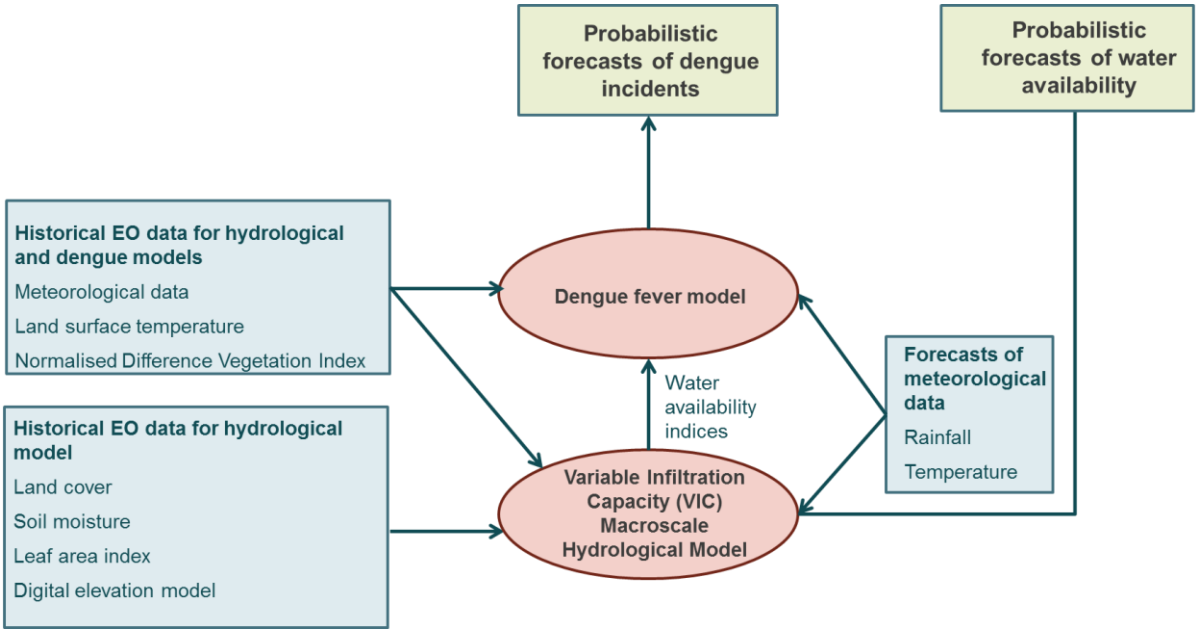


Figure 3 System overview

4.3) Innovation:

This is the first time a dengue (and Zika) prediction tool will have been designed that links EO products and hydro-meteorological variables to vector-borne disease incidence at a local scale. The proposed integrated system will be linked to new statistical forecasting models of dengue outbreaks. The most vulnerable areas will be identified and the way forecast impacts are communicated to society will be enhanced. For the first time, an EO-based forecasting system will allow decision makers to identify areas of high risk for disease epidemics before an outbreak occurs, in order to target resources to reduce epidemic spreading and increase disease control. As an added benefit, the work will also help to improve water management in Viet Nam's transboundary river basins where there is a paucity of hydro-meteorological information. The interdisciplinary approach proposed here will lead to a better understanding of the nexus of public health, climate and water resources across multiple temporal and spatial scales in Viet Nam. It will increase the country's resilience and enhance local adaptive capacity. The integrated system will make it possible to attribute different levels of risk and impacts to different stressors. The work will also provide important analysis that can increase the understanding of climate change-related health risks during a period when Viet Nam will be developing an updated National Adaptation Plan in line with its Paris Agreement obligations.

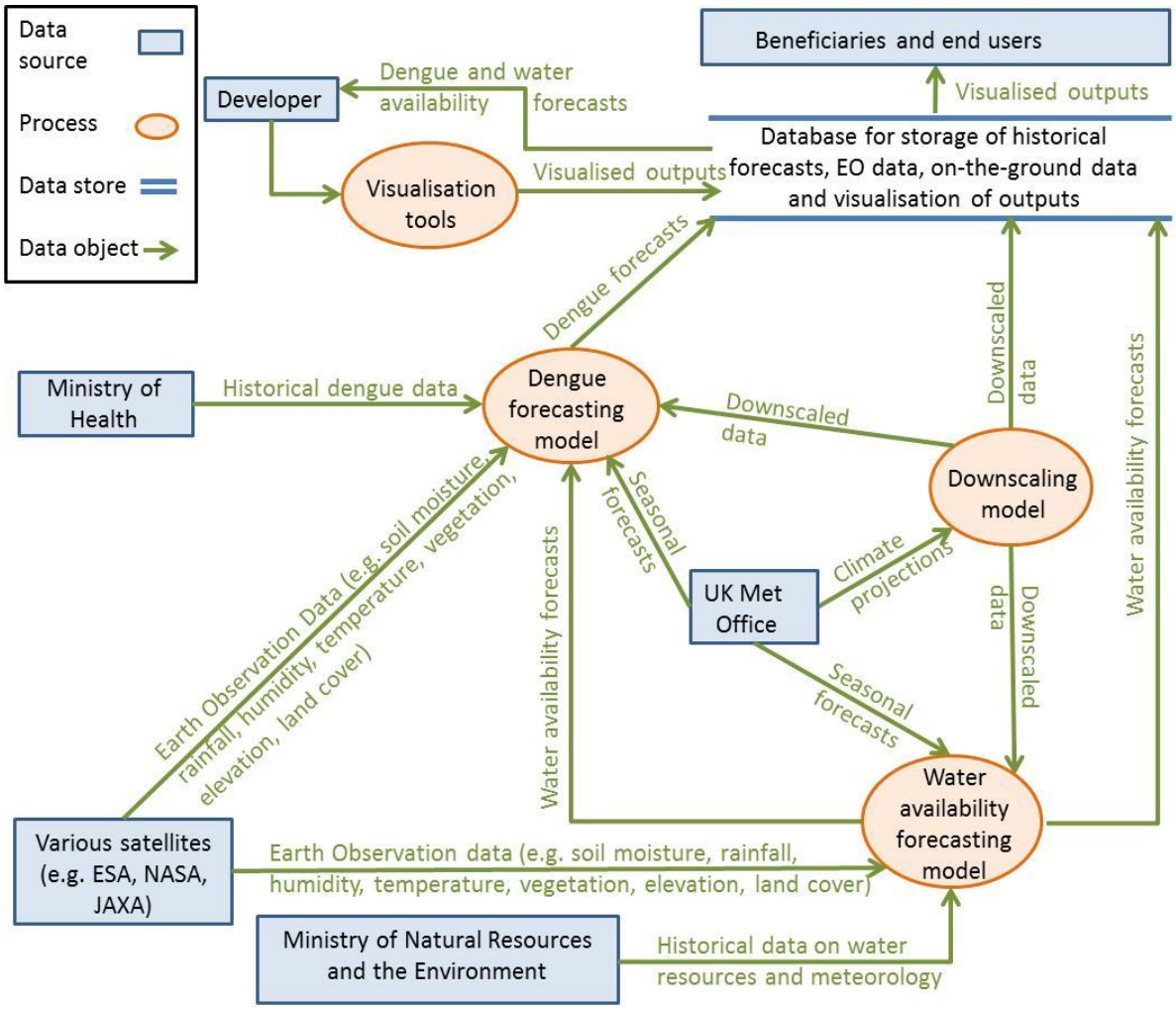


Figure 4 Data flows and processes for the proposed dengue and water availability forecasting tools

4.4) Risks and Limitations:

A number of risks to the success of the proposed solution exist. We address the most significant and propose associated mitigations.

(i) **Data availability -** The timely availability of the required data from various sources is key to the success of any forecasting system. We will identify and catalogue the data sources required along with their timescales, availability and acceptable margins along with any possible replacement data sources (and consequent increases in uncertainty in downgrading a forecast). Building the facility to enable switching data sources to a downgraded replacement will provide resilience in that some forecasts will be available albeit possibly at a lower level of confidence.

A lack of access to required datasets is a risk to a project's success anywhere in the world. Forming a partnership with international agencies such as the UNDP and WHO who have access to the data and/or memoranda of understanding with the relevant ministries to supply relevant data should minimise this risk as far as is practicable.

(ii) **Usability -** Tools produced by the project must be easy to use, interpret and maintain. As such, the project team will include experienced software developers and usability experts. Tools will be developed to make use of HTTP/HTTPS technology for user interfaces allowing easy translation into different languages and maintainable applications which are easy to deploy on different platforms.

There is a possibility of political instability during the project causing delays, cancellation or increased costs. Our team comprises two UN organisations (WHO and UNDP) that are well respected worldwide. They work closely and have partnerships with 100s of non-governmental and governmental

organisations. This will help ensure partial independence from government support. The WHO and UNDP also have formal agreements with the key ministries in Viet Nam.

A lack of local support for the project could minimise the take-up of the dengue forecasting tool by end users. In July 2017, as part of a short study funded by the UK Space Agency, a team from HR Wallingford engaged with a wide range of stakeholders during a 14 day visit to Viet Nam. There is an enthusiastic ground swell of support for the project as evidenced by the letters of support in Annex 1. Engagement with local networks via the UNDP, WHO, NGOs and government ministries will help to maintain this support as will the UNDP's and WHO's memoranda of understanding with key government ministries.

From a sustainability point of view there is a danger that the Government of Viet Nam may have insufficient funds to operate and maintain the dengue forecasting tool. This risk will be minimised via the use of non-proprietary software tools, a generic architecture to minimise maintenance costs and the use of freely and easily accessible EO data.

4.5) Testing the Solution: How will you test the solution with stakeholders?

WP5: Operation and validation:

The dengue early warning system will be piloted and user acceptance tested in four high-risk yet contrasting provinces. The WHO will distribute mosquito traps to households in the pilot provinces, and mosquito density will be monitored on a weekly basis. Field information will also be collected on dengue virus subtypes, to optimize the forecasting capacity of dengue outbreaks and associated morbidity, and to serve for monitoring and evaluation of the early warning system. National government ministries will participate in workshops and specify their needs for better-informed decision-making on the effects of extreme weather events on the public health sector. Planners at local and district level will be invited to input their requirements for better mitigation of the impacts of future events. The project will also identify the best way to further translate the produced forecasts into indicators of disease risk in order to detect the most vulnerable areas and enhance the way forecast impacts are communicated to society.

Section 5) Project Details

5.1) Key Project Aims:

- Develop an early warning system to improve dengue epidemic prevention and increase disease control capacity;
- Create better understanding of the relationships between environmental stressors, the hydrological-climate system and dengue incidence; and
- Benefit local authorities' planning by providing scenarios of the main stressors and their impacts on dengue incidence.

5.2) Key Objectives of the Project:

- The production of timely forecasts of dengue epidemics with at least a three-month lead time distributed to all national dengue response authorities;
- 50 Government actors reporting improved understanding of the drivers of dengue epidemics;
- At least 30% of community members reporting improved understanding of the drivers of dengue epidemics;
- Advice on the likelihood and prevention of dengue epidemics provided by at least 50 community health workers; and
- At least 50 sector specialists in Viet Nam regularly accessing the knowledge products produced.

5.3) Key Performance Indicators (KPIs):

KPI	Measurable Metric
KPI 1: Accurate and timely forecasts of dengue epidemics distributed to communities	Proportion of community members (gender-disaggregated) satisfied with forecasts received
KPI 2: Female community members' understanding of the drivers of dengue epidemics improves as much as or more than men's understanding over the course of the project (gender related target)	Proportion of community members (gender-disaggregated) reporting improved understanding
KPI 3: The capacity of Viet Namese government is strengthened, allowing the dengue forecasting platform to be adopted by the MoH (SDG 3.9.d target)	Number of MOH, UNDP, WHO staff using results from the Dengue Fever platform.
KPI 4: 15% higher MoH response rate to dengue outbreaks	Proportion of dengue warnings acted upon by the Viet Namese government
KPI 5: : At least 10% reduction of the incidence of dengue fever by 2020 (SDG 3.3. target)	Dengue incidence rate per 1,000 people

5.4) Work Package and Resource Breakdown:

Work Package
WP1 – Evidence collection and data integration
WP2 – Development of a dengue forecasting method
WP3 – Development of a water availability forecasting method
WP4 –Software development, integration and testing
WP5 – Operation and validation
WP6 – Monitoring and Evaluation (M&E)
WP7 – Knowledge sharing
WP8 – Sustainability
WP9 – Project management
Total

The Table below shows how the grant received from the UK Space Agency is divided between the HR Wallingford led team and the UN agencies and their partners.

5.5) Risk Register: Include a risk register based on the format below, adding more rows as needed

No.	Risks identified	Proposed (planned) mitigation	Prob (1-5)	Impact (1-5)	Rating 1-25 (Prob x Impact)
1.	Political instability in UK or Viet Nam during the project causing delays, cancellation or increased costs	Work closely with the non-governmental actors to ensure partial independence from government support	1	4	4
2.	Lack of local support could minimise take-up by government, and other organisations	The engagement by HR Wallingford with a wide range of stakeholders during a 14 day visit to Viet Nam in July 2017 indicated that there is an enthusiastic ground swell of support. Engagement with local networks via UNDP, WHO, NGOs and government ministries will help to maintain this	1	4	4

		position. UNDP and WHO have memoranda of understanding with key NGOs and ministries which will aid with local support			
3.	**Government funds alone are insufficient** to operate, sustain, and maintain the service	Choice of open source models and a generic architecture to minimise maintenance and evolution costs	2	4	8
4.	**Data availability** Lack of availability of the required data from the various sources	• Engagement with existing local partners and international agencies such as UNDP and WHO who have access to the data and/or memoranda of understanding with the relevant ministries; • Identification and cataloguing of the data sources required along with their timescales, availability and acceptable margins along with possible replacements; • Interoperable design to allow switching between data sources.	2	3	6
5.	**Usability** Applications are too difficult to use, interpret or maintain	• Inclusion of experienced software developers and usability experts in project team; • Modular design of system components; • Use of HTTP/HTTPS technology for user interfaces allowing easy translation into different languages, maintainability and deployability.	2	3	6

Section 6) Monitoring and Evaluation

6.1) Impacts on Target Country:

The ability to provide early warnings of dengue epidemics at a province level is invaluable for reducing or containing an epidemic and for giving local authorities and communities the time to combat mosquito populations. If the Ministry of Health were warned about a dengue outbreak several months in advance, they could more effectively mobilise resources to strengthen mosquito control and surveillance. As a result, one of our key impact indicators is the proportion of dengue warnings that are acted upon by the Viet Namese government, a metric that we expect to improve significantly over the project lifetime.

In addition, the project will map areas vulnerable to dengue outbreak. This will also allow local communities to mobilise to eliminate mosquito-breeding sites thus reducing incidents of vector-borne diseases such as dengue. In combination with better outbreak response, we expect the incidence of dengue fever to go down by at least 10% over the project lifetime (**SDG target 3.3**).

Over the long term, the project will therefore both strengthen the capacity of Viet Nam for early warning, risk reduction and management of national and global health risks **(SDG target 3.9**), as well as contribute to increased resilience to future dengue and Zika epidemics by shaping policies related to disease prevention, water and health security at the higher level and informing decision making at the local level. Our log frame will track the extent to which national strategic planning on disease prevention is shaped by our project -- for example whether Viet Nam's National Adaptation Plan is updated to reflect an improved understanding of the drivers of dengue epidemics.

There are further *indirect* impacts which we have not included in our log frame, but are likely to occur beyond the lifetime of the project. These include:

- Enable water resources management authorities to better manage the risks posed by water scarcity and adapt to future droughts because they are able to plan and forecast them in advance;
- An improved understanding of risk will lead to more confident investment decisions by WHO, UNDP and the Viet Namese government and increased resilience to future events;
- Increased knowledge of public health, water, and climate service providers on multiple stressors (e.g. climate change, land use change, pop growth) can lead to improved assessment methods which in turn can improve economic policy around health and water management.

Why this problem is important enough to warrant the project:

Dengue: This proposal is especially pertinent because in recent years the incidents of dengue fever have been increasing in Viet Nam, owing to changes in the duration of the rainy season and increases in temperature as a result of climate change. In 2016 the cumulative number of cases increased by 25% compared to the same period in 2015. In June 2017 it was reported that Hanoi had experienced a 400% increase in dengue fever cases compared to 2016. Dengue fever now occurs in areas of Viet Nam where previously it was almost unknown. Considering the current regional trends in dengue epidemics, the setting up of a seasonal dengue forecasting system utilising EO-based information to provide probabilistic predictions of dengue outbreaks with a three-month lead time would greatly assist the Viet Namese Government to put cost effective early actions in place. Furthermore, the recent emergence of Zika virus disease in the region (Zika, like dengue, is also transmitted by *Aedes aegypti* mosquitos), necessitates a proactive approach and the proposed tool can contribute to strengthen Viet Nam's response to both diseases.

Water Resources: Seven of the nine major river basins that drain to Viet Nam are transboundary in nature and are shared between two and five countries. It is estimated that some two-thirds of Viet Nam's water resources comes from neighbouring countries making water management challenging. In recent years countries upstream of Viet Nam have increased their water use and Viet Nam is currently facing increasingly negative impacts from the water policies of upstream countries, especially in relation to dam-building activities. For example, on the Mekong, China has constructed at least ten large reservoirs, while a number of large irrigation schemes and hydropower dams have been built in Laos and 10 large reservoirs have been built in Thailand. As climate change is expected to strongly affect the country's water resources, causing more severe flooding, drought, and sea level rise, the above issues are likely to be seriously intensified. At the moment, Viet Nam has very little or no data from countries in the upper course of the Red and Mekong river basins.

6.2) M&E Strategy: Explain your M&E methodology.

The M&E Work Package (WP6) will be led by OPM, who have considerable experience in designing and implementing monitoring systems and evaluations. The work package has several objectives including:

- Carefully tracking progress via specific monitoring indicators that will help us understand if and how project activities are contributing to intended results. This will include showing the quantitative improvements against the relevant UN SDGs.
- The insights gained from the monitoring data and the evaluations will be fed back into the programme to allow learning and adaptive programming.
- The evaluation activities in project sites and control areas will assess the added value of the project against a 'business-as-usual' scenario.
- Assessing the cost-effectiveness of the project will provide important information about the cost of replicating or scaling up the proposed approach elsewhere.

OPM, through a collaborative team process, will design the monitoring system for the project which includes the development of a detailed project log frame and indicator set, the design of data collection and analysis tools using Excel templates, and the definition of team roles and responsibilities for data collection and analysis. WHO and UNDP, together with NIHE, PIHCMC and IMHEN will be responsible collecting the monitoring data along with several other output and outcome indicators in the log frame,

including documenting changes in the national policy related to dengue management. In some cases this exercise may involve short focus group discussions with communities. Data on progress will be collected on a quarterly or semi-annual basis (as set out in log frame) and will be reported on in the quarterly reporting to UK Space Agency. OPM will support the compilation of this monitoring data as needed. The regular provision on important metrics such as the users' satisfaction with the service will allow the consortium to learn and adjust activities as necessary, in order to ensure the intended results are achieved.

OPM will design and supervise the **Impact Evaluation** that will measure changes in the knowledge of and use of **dengue prevention and control techniques** by communities, above baseline levels, and compared to a control group. One month before data collection begins, a Terms of Reference for the planned work will be submitted to UKSA for review, outlining the scope, objectives, timing and logistics for data collection. Sub-contractors will carry out a detailed household survey w at the start of the project to act as a baseline, as well as one at the end of the project (i.e. the endline). These will be used to quantify changes in community understanding of the drivers of dengue epidemics and changes in disease control behaviour. The household survey will be administered to 500 households in the four pilot provinces, and 500 households in the neighbouring provinces (counterfactual). There are 63 provinces in total in Viet Nam and the worst affected by dengue have populations of around 500,000 people, hence the need for extensive household surveys. OPM will ensure that the **counterfactual** for the impacts observed are a set of comparable provinces with a similar historical exposure to dengue epidemics and receiving similar support under existing government and WHO dengue prevention programmes. OPM will design all survey tools and train the survey enumerators, who will be hired and supervised by UNDP. UNDP will lead on the data analysis of the survey results with support from OPM.

A **process evaluation** is also planned at government level to better understand the factors affecting policy planning on dengue prevention and affecting likely take-up of the platform after project end. Around 30 to 40 stakeholders will be interviewed at baseline and at endline to document changes over the project lifetime.

Finally, OPM will undertake a **cost-effectiveness analysis (CEA)** on the project at midline and endline to define how much it costs to deliver the SDG-related targets of the project. The cost of a reasonable alternative for achieving the same results under a 'business-as-usual' scenario will also be costed, in order to compare this to the cost-effectiveness of the proposed approach. OPM will define the appropriate scope and indicators for the CEA analysis together with partners, and will report on the results in the midline and endline evaluation report.

M&E budget: The sum of M&E activities will be funded through a budget line covering OPM's advisory services, funds earmarked for various partners to collect monitoring data in-country, and funds ear-marked for UNDP to hire and supervise enumerators for the evaluation activities. By implementing the M&E activities through the Viet Namese partners, OPM will also develop the M&E capability of the partners, which is in line with the ODA's development ethos.

The UNDP has indicated that it will pilot a "smarter crowdsourcing" method to monitor the improved understanding of dengue amongst communities using a bespoke Smartphone app that can be used by communities and community-based health workers. Viet Nam has rapidly increasing levels of internet connected mobile phone penetration. More than 30% of people currently access the internet using a mobile phone, with penetration rates being far higher in the densely populated urban areas that are often the centre of dengue outbreaks. The project will aim to harness mobile phone connectivity both for the implementation and M&E. The project will work with local IT firms to design and pilot communications campaigns utilising social media to provide information on dengue prevention and action to complement government efforts for dengue control. Such methods have been used successfully for Zika in South America[25]. It will also explore options to utilise big data and targeted

[25] http://thegovlab.org/smarter-crowdsourcing-for-zika/

internet based marketing and polling to receive community level data during dengue outbreaks and to test effectiveness of communications activities. The UNDP has experience of such techniques in that has been partnering with GovLab on a number of big data innovations[26]. Infectious disease epidemiology has already witnessed an impact from the use of big data for infectious disease surveillance and inference[27]. This work will seek to uses these innovations for the M&E.

6.3) Knowledge Sharing:

Knowledge Sharing will be covered by WP7. WHO and UNDP have access to multi-lingual global networks such as the Global Development Hub (see www.globaldevhub.org) via which the UNDP disseminates information.

WHO networks, via which knowledge can be shared, include: online communities of practice and regional networks and the international scientific meetings and forums of the United Nations. The Pasteur Institute, which is part of the team, has access to the Pasteur International Network, which aims to improve public health and is located in 26 countries on five continents. This network provides an excellent basis for knowledge sharing worldwide.

The capacity building WP will operate at different levels: government, research organisations and community workers. The project aims to build the capacity of government agencies responsible for issuing water and health early warning systems and to improve their ability to support those affected, by training stakeholders and beneficiaries on how to use the services and issue warnings. At a community level, WHO already engages frequently in community-level capacity building and will lead the efforts of this WP, through cooperation with Viet Namese Government counterparts and implementing partners.

The following dissemination and knowledge activities will also take place as part of the project:

- The results of the project will be disseminated to beneficiaries through publications in the international literature and conference presentations. Although the focus of the project is on Viet Nam and dengue fever, the principles and conclusions will be relevant for other countries and vector-borne diseases. The team has a track record of publishing in high-impact, relevant journals such as: The Lancet; Tropical Medicine & International Health; International Journal of Environmental Research and Public Health;
- Secondment of Viet Namese staff to UK-based organisations will be considered. HR Wallingford, the Met Office and the London School of Hygiene and Tropical Medicine regularly host practitioners and researchers on secondments lasting from a few weeks to several months;
- Knowledge-sharing workshops in Viet Nam;
- Community-based outreach that encourages widespread use of the early warning system;
- Dissemination of information, results, and recommendations to the community. This can be supported by a number of methods including SMS messages for the hardest to reach;
- Design of an information dissemination system for climate predictions to beneficiaries; and
- Use of WHO's and UNDP's worldwide reach via their networks and websites. The UNDP is the most universal actor in the area of technical development assistance and capacity development in 177 countries[28]. These networks will be invaluable in sharing the knowledge generated by the project.

6.4) Sustainability of the Project:

This work is pertinent because in recent years the incidence of dengue fever has increased in Viet Nam, owing to changes in the duration of the rainy season and increases in temperature as a result of climate

[26] http://www.asia-pacific.undp.org/content/rbap/en/home/ourwork/development-impact/innovation.html

[27] Lee E.C. et al. (2016) Mind the scales: Harnessing spatial big data for infectious disease surveillance and inference; Journal of Infect Dis, Vol 214, Iss, 1 December 2016, pp409–413

[28] http://www.undp.org/content/dam/undp/library/capacity-development/English/UNDP%20Knowledge%20Strategy%20Report%202502-2%20LR%202,7MB.pdf

change. In 2016 there were approximately 122,000 cases of dengue fever including 43 deaths reported in Viet Nam. In 2016 compared to the same period in 2015, the cumulative number of cases increased by 25%. Dengue fever now occurs in areas of Viet Nam where previously it was almost unknown.

The project team comprises the WHO, UNDP and key government actors such as the Ministry of Health's General Department of Preventive Medicine. They will facilitate continuation of the dengue forecasting system once the grant funding ends. The implementation of a dengue fever prediction tool is in line with WHO's Western Regional Action Plan (WRAP) for Dengue Control (2016), which has been endorsed by Viet Nam (see letter of support Annex 1). The Ministry of Health's General Department of Preventive Medicine (GDPM) has stated that it will integrate the tools produced by this work into their current dengue early warning and surveillance procedures (see letter of support in Annex 1).

Viet Nam's National Dengue Control Programme was established in 1999, and the Viet Namese Government funds allocated for this programme range from US$1 million to US$5 million per year, excluding the contributions made by local government. The level of funding required to operate and maintain (e.g. staff time and maintenance) the dengue forecasting tool produced by this project is estimated to be relatively small in the context of the National Dengue Control Programme (e.g. US$2,000 to US$5,000 per year). The tool will be designed to use open access, freely available EO-based and other freely available data sources to minimise the operation and maintenance costs and increase its sustainability.

Ideally the dengue forecasting tool would need to be re-calibrated as new data becomes available in the future. This re-calibration would form the majority of the operation and maintenance costs. However, if funds were not available to re-calibrate the tool it could still be used, albeit with a decrease in accuracy. The tool utilises UK Met Office seasonal forecasts. If these, for whatever reason, were no longer available in the future, this could be mitigated by the use of freely available ones from the US National Oceanic and Atmospheric Administration (NOAA).

The total global annual cost of dengue fever has been estimated to be almost US$9 billion per year, which compares to the estimated global annual cost of US$3 billion for cholera and US$2 billion for gastroenteritis[29]. In Viet Nam it has been estimated that the average cost per case of dengue is between approximately US$80 and US$200 for an adult and slightly higher for a child[30]. If the forecasting tool had been available in 2016 and led to reduction in the number of dengue cases by 10% (i.e. 12,200 cases), assuming operating costs of US$5,000 p.a., the tool would have had a benefit: cost ratio of between approximately 195:1 and 488:1. These figures demonstrate the economic benefits of the proposed tool and why there is such a high level of support from the Government of Viet Nam, UNDP and WHO (see letters of support in Annex 1). These benefit: cost figures could apply to many other countries in the world. The average global cost of all types of cases of dengue has been estimated to be US$151 and for fatal cases this rises to US$84,000[31]. Given that in 2013 it was estimated that there were 58.4 million people infected by dengue, an effective forecasting tool that helps to reduce infection could reduce this cost by 100s of millions of dollars. By putting a value on the size of the dengue problem, these estimates will help governments and donors make better-informed decisions around their dengue programmes, and to demonstrate the value and sustainability of the proposed forecasting tool.

Workshops and face-to-face meetings organised by HR Wallingford with the Viet Namese Ministry of Health and in particular the General Department for Preventive Medicine (GDPM) took place in July 2017. An outcome of these meetings was the statement that the dengue forecasting tool will be

[29] Shephard, D.S. et al. (2016) The global economic burden of dengue : A systematic analysis, Lancet infect Dis.

[30] Pham L.D. et al. (2016) Economic report on the cost of dengue fever in Viet Nam: case of a provincial hospital https://doi.org/10.2147/CEOR.S124023

[31] Shephard, D.S. et al. (2016) The global economic burden of dengue : A systematic analysis, Lancet infect Dis.

maintained/updated after the project ends by GDPM, with support from the WHO. The Government of Viet Nam will then roll out the early warning system on a national scale. The WHO will help incorporate the best practices and lessons learned from the proposed activities into recommendations and technical guidelines that the Government of Viet Nam can use in its dengue control programmes.

In terms of an expansion strategy, this work has the potential to be implemented in Viet Nam's neighbours (e.g. Cambodia, Laos, Malaysia, Myanmar, Philippines and Thailand), where the WHO is promoting dengue control via the WRAP. As part of the work the project team will identify potential value-added service implementations in other domains such as other vector-borne diseases and will promote them. There is potential to generate revenue by the team implementing the tools developed not only in the region but worldwide via the 194 WHO member states. The project team also has links to key beneficiaries in South America. This is particularly relevant because the same tool could potentially be used to forecast Zika. Recently the UNDP estimated that the social and economic cost of the recent spread of the Zika virus in Latin America and the Caribbean will total an estimated US$7 to US$18 billion between 2015 and 2017[32]. If the tool could be used to predict Zika the benefit: cost ratio could be even higher than that yielded by a similar reduction in dengue cases.

The incidence of dengue has increased 30-fold over the past 50 years. It has been estimated that by 2061 to 2080, the global land area suitable for *Aedes aegypti* and *Aedes albopictus*, the species of mosquito that spread dengue, will increase by 8% under moderate and 13% under high greenhouse gas emissions pathways. The annual number of people exposed to the mosquito was projected to increase by 8% to 12% when only considering climate change; by 59% to 65% when considering climate change and a development pathway associated with population growth that peaks mid-century and then declines; and by 127% to 134% when considering climate change and a development pathway associated with high population growth[33]. In the context of climate change the tools produced will assist with increasing the understanding of climate change-related health risks, during a period when Viet Nam will be developing an updated National Adaptation Plan in line with its Paris Agreement obligations (see UNDP's letter of support in Annex 1). The ability to put suitable climate change adaptation measures in place for dengue could save millions of US$. This part of the work has no ongoing costs.

A consortium agreement and/or contractual agreements will be put in place between partners within 60 days of issuing the grant. The agreements will set out the responsibilities of the signing parties and ensure the Funds are managed appropriately and used properly and for the purposes for which they are intended. The agreement will define the principles of the relationship between the parties, the financial provisions, the duties and obligations of the parties, the responsibilities and limitation of liability, the intellectual property rights and the supply of information and materials between the parties.

The costs of running the system are relatively low, and a breakdown of these costs is provided in the table below. The Viet Namese Government has a dengue surveillance centre and it is likely any forecasting system would be run by them. The annual costs are to cover some data and staff costs. Setting up the system in another country would require funding from an international funding agency or donor.

Note: The system could operate using freely available NOAA forecasts which would significantly reduce the operational costs.

The minimum leave behind will be a forecasting tool for dengue fever that will allow beneficiaries to:

- Issue alerts for dengue outbreaks in Viet Nam with a minimum of a four month lead time;

[32] UNDP (2017) A Socio-economic Impact Assessment of the Zika Virus in Latin America and the Caribbean: with a focus on Brazil, Colombia and Suriname

[33] Ebi, K & Nealson, K. (2016) Dengue in a changing climate, Environmental Research 151 (2016) 115–123

- Provide assessments of vector-borne disease risk under future climate and land-use change scenarios.

If in future the Ministry of Health is unable to pay the ~US$10,000 per year maintenance costs, the system could be modified to use freely available NOAA weather forecasts, bringing the maintainance costs down to ~US2,000. If the Ministry of Health is unable to pay the ~US$2,000 yearly costs, in country partners will still have a dengue forecasting system they can still use; however, there is a danger that the system will gradually become out of date. This is because the dengue model statistical relationships may need re-calibration as new data become available.

6.5) Narrative Theory of Change:

This project will map the areas that are most vulnerable to dengue outbreaks and provide timely forecasts of dengue epidemics, distributed to at least 50 health workers, provincial governments and the Ministry of Health and at least 3,000 community members across four pilot provinces. This will be achieved using the UK Space Agency IPP funding (and partner contributions), the expertise of the consortium and community health workers.

Ultimately, the project aims to provide forecasts of dengue fever and improve the proportion of dengue warnings that are acted upon by the Viet Namese government by providing early warnings of dengue epidemics at a province level. In the pilot provinces, we expect the incidence of dengue fever to go down over the project lifetime (SDG target 3.3), because local communities will be better able to mobilise to eliminate mosquito-breeding sites in response to early warnings of dengue epidemics. At national level, the project will strengthen the capacity of Viet Nam for early warning, risk reduction and management of national and global health risks (SDG target 3.9); as well as contribute to increased resilience to future dengue and Zika epidemics by shaping policies related to disease prevention and control under future climate-change scenarios.

These impacts will be achieved through three change pathways:

1) **Timely early warnings of dengue epidemics, up to three months in advance at a province level will be provided to at least 50 health workers and at least 3,000 community members across four pilot provinces –** This will use tools that incorporate EO-based data on meteorological variables (e.g. rainfall, temperature, humidity, land use), vegetation and soil indicators, and water availability. These early warnings will be provided disseminated by the Ministry of Health and community-level health workers to pilot communities. Both provincial governments and health workers will have been trained in the forecasts, reporting an improved understanding of the drivers of dengue epidemics by project end. The current WHO dengue prevention programme will continue in the four pilot provinces, which entails the monitoring of mosquito density and training on dengue prevention techniques. The early warnings of dengue epidemics in combination with the WHO training provided are likely to improve preventative measures and reduce the incidence of dengue fever by at least 10% over the project lifetime. The expected improvement is only set at 10% because there will be other economic and social factors that constrain a community's ability to prevent, as well as respond to a dengue epidemic.
2) **Timely early warnings of dengue epidemics several months in advance will also allow national and provincial governments to more effectively mobilise resources to strengthen mosquito control and surveillance activities.** We therefore expect the proportion of dengue warnings that are acted upon by the Viet Namese government to improve by 20% over the project lifetime. This percentage is conservative because other financial and political factors constrain government responsiveness. WHO has stated that if the tools developed are found to be successful then the resources allocated to dengue response in Viet Nam will increase.
3) **Mapping the areas, both provincial and commune, most vulnerable to dengue outbreaks and training provincial staff and health workers in how to analyse and interpret the modelling of dengue epidemics will strengthen the capacity of Viet Nam for early warning, risk reduction and management**

of national and global health risks (SDG target 3.9). These are expected to improve Viet Namese policy on disease prevention and control. We expect that WHO and UNDP will adopt the dengue forecasting platform nationally by project end. Over the long term, these will contribute to increased resilience to future dengue and Zika epidemics.

In parallel to these activities, the project will build a solid evidence base, thanks to the M&E activities, to document what has worked well and under which circumstances. These insights will be shared with Viet Namese and international sector specialists through various knowledge products. These will both improve WHO and government understanding of how to best control and prevent dengue epidemics, as well as facilitate scaling up of the model to national level beyond project end.

6.6) Diagrammatic Theory of Change: See section 6.9

6.7) Logframe: See section 6.10

6.8) Impacts on Gender Equality:

Dengue fever is particularly dangerous for pregnant women because the virus can be transmitted to the baby during pregnancy or birth. Pregnant women infected with dengue face a greater probability of stillbirth, prematurity, and babies with a low birth weight. The Zika virus is also spread by the same mosquitoes, *Aedes aegypti* and *Aedes albopictus*. The implementation of a dengue early warning system will help public health authorities to prepare for and minimize epidemics of dengue, as well as Zika. Dengue and Zika are not gender-neutral viruses. In many low-income countries a large proportion of single parent families have been affected, the majority of which are headed by women. These households are more likely to experience perpetual cycles of poverty as a result of the economic shock of disease, and, where children are born with potential disabilities, women-headed households are often further isolated by limited support or social protection.

Dengue prevention measures often entail maintaining a clean environment around the home. In the past, dengue control health service workers have been met with reluctance because their attitude was deemed disrespectful towards women, as it was perceived that they consider women incapable of maintaining and clean and disease-free household[34]. If, however, communities are made aware of the dengue risk to their communities (thanks to satellite modelling) these dengue prevention measures are more likely to be effective, and dengue incidence is likely to fall, without women feeling disrespected.

A drought management study in Viet Nam[35] showed that women are more severely affected by drought than men, as they are often the ones responsible for water collection and transportation. During a drought women have to often walk very long distances to access drinking water.

The project will ensure that particularly women will benefit from it by ensuring that health workers deliberately approach women when explaining the drivers and likelihood of dengue epidemics to communities.

The benefits of the project for women will be tracked, by aiming for female community members to score at least as high if not higher than men on the following log-frame indicators:

- Proportion of community members (gender-disaggregated) reporting an improved understanding of the drivers of dengue epidemics, thanks to the project (comparing project areas with control areas);
- Proportion of community members (gender-disaggregated) satisfied with forecasts received;
- Proportion of community members (gender-disaggregated) adopting dengue prevention techniques.

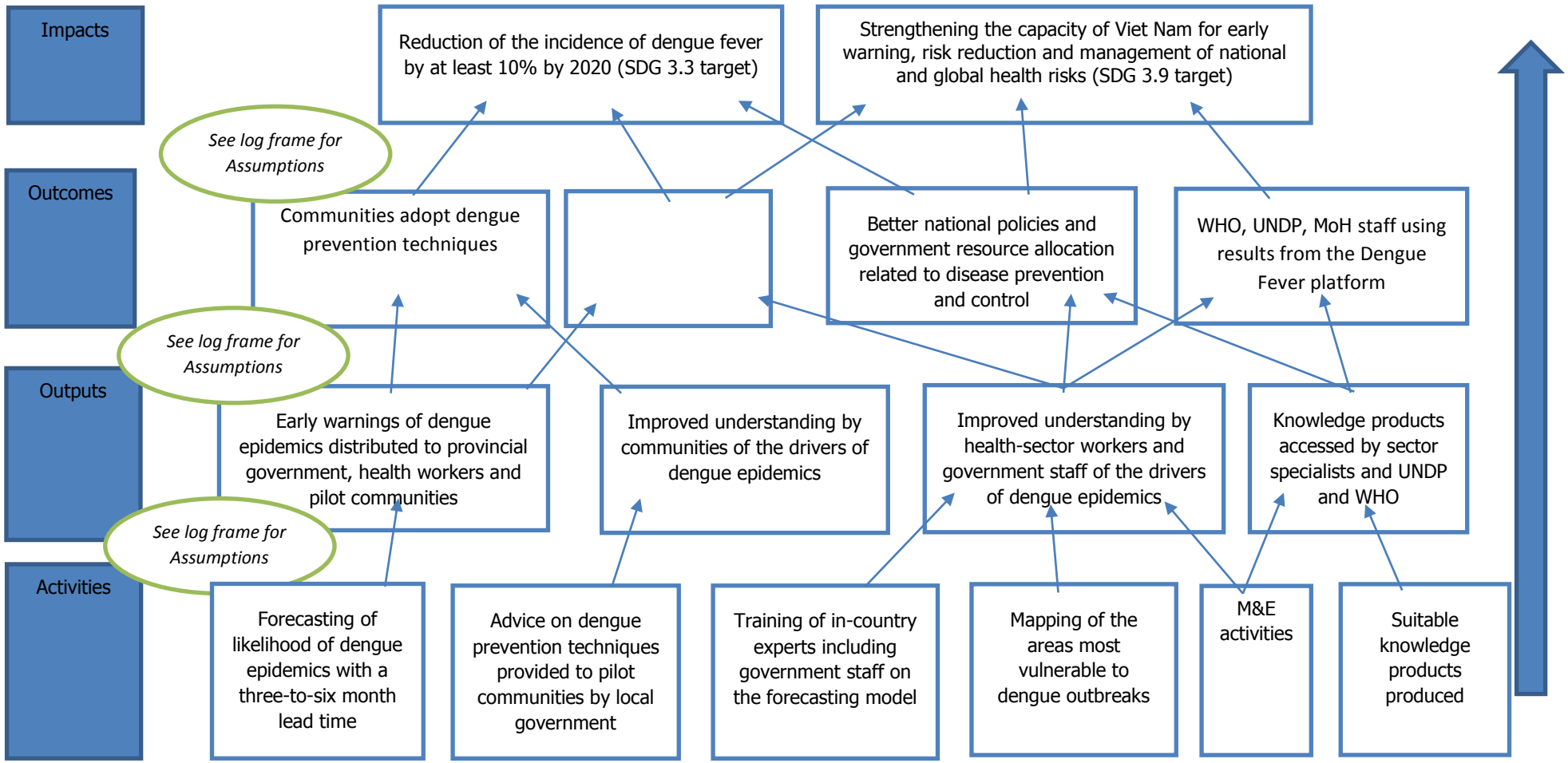
The project includes at least one gender-related KPI that encompasses the above points.

[34] http://www.wpro.who.int/topics/gender_issues/Takingsexandgenderintoaccount.pdf

[35] http://www.who.int/globalchange/publications/reports/final_who_gender.pdf

During the implementation of the project we will strive for gender balance within the project team and also for activities such as capability building workshops, will aim to ensure gender balance amongst the participants.

6.9) Theory of Change



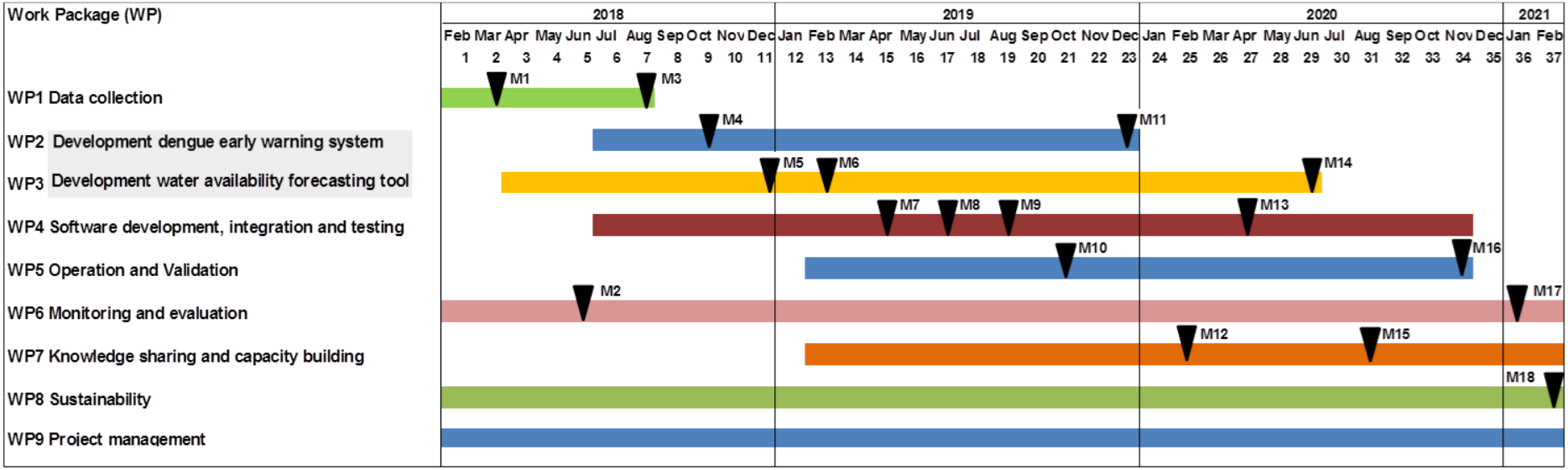
6.10) Logical Framework (Log Frame)

	SMART targets by 2020	Indicators (quantitative and qualitative)	Means of Verification	Assumptions
Impacts	1. At least 10% reduction of the incidence of dengue fever (KPI 5; SDG target 3.3); 2. 15% higher MoH response rate to dengue outbreaks (KPI 4)	1. Dengue incidence rate per 1000 people; 2. % of dengue warnings acted upon by the Viet Namese government	1. Annual Ministry of Health statistics on dengue incidence; 2. Annual Ministry Dengue outbreak response report	• Baseline data on dengue incidence exists and will be made available; • A dengue outbreak needs to occur in the pilot provinces over the project timeline
Outcomes	1. At least 50% of community adopting dengue prevention techniques 2. Better national policies and government resource allocation related to disease prevention and control; 3. The capacity of Viet Namese government is strengthened, allowing the dengue forecasting platform to be adopted by the MoH (KPI 3; SDG target 3.9)MOH, WHO and UNDP adopt the dengue forecasting platform;	1. Proportion of community members (gender-disaggregated) adopting dengue prevention techniques; 2. Viet Nam's National Adaptation Plan updated to reflect an improved understanding of the drivers of dengue epidemics Number of MOH, UNDP, WHO staff using results from the Dengue Fever platform.	1. Baseline and Endline Evaluation reports on extent of dengue prevention techniques, and government planning processes; 2. Annual analysis of changes in Government policy and budgets; 3. Annual analysis of WHO and UNDP policies	• The community outreach provided must be designed in an effective manner to shift attitudes and behaviours; • Decision makers within WHO, UNDP and government are willing and empowered to adjust policies and planning within the project timeframe
Outputs	*1.* Accurate and timely forecasts of dengue epidemics distributed to provincial government, health workers and pilot communities (KPI 1) ; 2. 50 Government actors reporting improved understanding of the drivers of dengue epidemics; 3. At least 30% of community members reporting improved understanding of the drivers of dengue epidemics (KPI 2); 4. Advice on the likelihood and prevention of dengue epidemics provided by at least 50	1. Number of forecasts produced;Number of government actors reporting improved understanding; 2. Proportion of community members reporting improved understanding (gender-disaggregated); 3. Proportion of community members satisfied with advice received (gender-disaggregated); 4. 5. Number of dengue response authorities accessing knowledge products online and	1. Quarterly data on the number of forecasts produced 2. Baseline and endline evaluation of changes in levels of understanding government; 3. Baseline and endline evaluation of changes in levels of understanding of communities 4. Six monthly focus group	• Adequate support is secured from community workers and local authorities; • Advice, and forecasts provided are accurate and useful for farmers; • Technologies and methodologies provide yield expected benefits

	health workers; 5. At least 50 sector specialists accessing the knowledge products produced	at conferences	discussion (or mobile survey) on user satisfaction; 5. Quarterly stats on number of knowledge products downloaded;	
Activities	• Model development and calibration • Monthly assessments of water availability • Under a range of climate and land-use change scenarios, identify the most vulnerable areas in terms of likelihood of dengue outbreak water scarcity and disease density • Training and capacity building for stakeholders and beneficiaries, on how to use the service and issue warnings			
Inputs	• Staff time by project partners to develop the tools • Staff time by government agencies and stakeholders to define requirements • M&E personnel to support the monitoring and learning of the project			

Section 7) Gantt chart: This has also been enclosed our application as a Microsoft Project file

A simplified Gantt chart is provided below. A more sophisticated programme has also been developed using Microsoft Project which can be provided to the UK Space Agency if it is required.



ANNEX IV

OFFEROR'S LETTER TO UNDP

CONFIRMING INTEREST AND AVAILABILITY

FOR THE INDIVIDUAL CONTRACTOR (IC) ASSIGNMENT

Date _____

(Name of Resident Representative/Bureau Director)

United Nations Development Programme

(Specify complete office address)

Dear Sir/Madam:

I hereby declare that:

A) I have read, understood and hereby accept the Terms of Reference describing the duties and responsibilities of [*indicate title of assignment*] under the [*state project title*];

B) I have also read, understood and hereby accept UNDP's General Conditions of Contract for the Services of the Individual Contractors;

C) I hereby propose my services and I confirm my interest in performing the assignment through the submission of my CV which I have duly signed and attached hereto as Annex 1;

D) In compliance with the requirements of the Terms of Reference, I hereby confirm that I am available for the entire duration of the assignment, and I shall perform the services in the manner described in my proposed approach/methodology which I have attached hereto as Annex 3 [delete this item if the TOR does not require submission of this document];

E) I hereby propose to complete the services based on the following payment rate: *[please check the box corresponding to the preferred option]:*

☐ An all-inclusive daily fee of [*state amount in words and in numbers indicating currency]*

☐ A total lump sum of [*state amount in words and in numbers, indicating exact currency]*, payable in the manner described in the Terms of Reference.

F) For your evaluation, the breakdown of the abovementioned all-inclusive amount is attached hereto as Annex V;

G) I recognize that the payment of the abovementioned amounts due to me shall be based on my delivery of outputs within the timeframe specified in the TOR, which shall be subject to UNDP's review, acceptance and payment certification procedures;

H) This offer shall remain valid for a total period of _____ days [*minimum of 90 days*] after the submission deadline;

I) I confirm that I have no first degree relative (mother, father, son, daughter, spouse/partner, brother or sister) currently employed with any UN agency or office *[disclose the name of the relative, the UN office employing the relative, and the relationship if, any such relationship exists];*

J) If I am selected for this assignment, I shall *[please check the appropriate box]:*

☐ Sign an Individual Contract with UNDP;

☐ Request my employer *[state name of company/organization/institution]* to sign with UNDP a Reimbursable Loan Agreement (RLA), for and on my behalf. The contact person and details of my employer for this purpose are as follows:

_____

K) I hereby confirm that *[check all that applies]*:

☐ At the time of this submission, I have no active Individual Contract or any form of engagement with any Business Unit of UNDP;

☐ I am currently engaged with UNDP and/or other entities for the following work:

Assignment	Contract Type	UNDP Business Unit / Name of Institution/Company	Contract Duration	Contract Amount

☐ I am also anticipating conclusion of the following work from UNDP and/or other entities for which I have submitted a proposal:

Assignment	Contract Type	Name of Institution/ Company	Contract Duration	Contract Amount

L) I fully understand and recognize that UNDP is not bound to accept this proposal, and I also understand and accept that I shall bear all costs associated with its preparation and submission and that UNDP will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the selection process.

M) ***If you are a former staff member of the United Nations recently separated, please add this section to your letter:*** I hereby confirm that I have complied with the minimum break in service required before I can be eligible for an Individual Contract.

N) I also fully understand that, if I am engaged as an Individual Contractor, I have no expectations nor entitlements whatsoever to be re-instated or re-employed as a staff member.

O) Are any of your relatives employed by UNDP, any other UN organization or any other public international organization?

YES ☐ NO ☐ If the answer is "yes", give the following information:

Name	Relationship	Name of International Organization

P) Do you have any objections to our making enquiries of your present employer?

YES ☐ NO ☐

Q) Are you now, or have you ever been a permanent civil servant in your government's employ?

YES ☐ NO ☐ If answer is "yes", WHEN?

R) REFERENCES: List three persons, not related to you, who are familiar with your character and qualifications.

Full Name	Full Address	Business or Occupation

S) Have you been arrested, indicted, or summoned into court as a defendant in a criminal proceeding, or convicted, fined or imprisoned for the violation of any law (excluding minor traffic violations)?

YES ☐ NO ☐ If "yes", give full particulars of each case in an attached statement.

I certify that the statements made by me in answer to the foregoing questions are true, complete and correct to the best of my knowledge and belief. I understand that any misrepresentation or material omission made on a Personal History form or other document requested by the Organization may result in the termination of the service contract or special services agreement without notice.

DATE: _____ SIGNATURE: _____

NB. You will be requested to supply documentary evidence which support the statements you have made above. Do not, however, send any documentary evidence until you have been asked to do so and, in any event, do not submit the original texts of references or testimonials unless they have been obtained for the sole use of UNDP.

Annexes *[please check all that applies]*:

☐ CV shall include Education/Qualification, Processional Certification, Employment Records /Experience

☐ Breakdown of Costs Supporting the Final All-Inclusive Price as per Template

GUIDELINES FOR CV PREPARATION

WE REQUEST THAT YOU USE THE FOLLOWING CHECKLIST WHEN PREPARING

Your CV:

Limit the CV to 3 or 4 pages

NAME (First, Middle Initial, Family Name)

Address:

City, Region/State, Province, Postal Code

Country:

Telephone, Facsimile and other numbers

Internet Address:

Sex, Date of Birth, Nationality, Other Citizenship, Marital Status

Company associated with (if applicable, include company name, contact person and phone number)

SUMMARY OF EXPERTISE

Field(s) of expertise (be as specific as possible)

Particular development competencies-thematic (e.g. Women in Development, NGOs, Privatization, Sustainable Development) or technical (e.g. project design/evaluation)

Credentials/education/training, relevant to the expertise

LANGUAGES

Mother Tongue:

Indicate written and verbal proficiency of your English:

SUMMARY OF RELEVANT WORK EXPERIENCE

Provide an overview of work history in reverse chronological order. Provide dates, your function/title, the area of work and the major accomplishments include honorarium/salary. References (name and contact email address) must be provided for each assignment undertaken by the consultant that UNDP may contact.

UN SYSTEM EXPERIENCE

If applicable, provide details of work done for the UN System including WB. Provide names and email address of UN staff who were your main contacts. Include honorarium/salary.

UNIVERSITY DEGREES

List the degree(s) and major area of study. Indicate the date (in reverse chronological order) and the name of the institution where the degree was obtained.

PUBLICATIONS

Provide total number of Publications and list the titles of 5 major publications (if any)

MISCELLANEOUS

Indicate the minimum and maximum time you would be available for consultancies and any other factors, including impediments or restrictions that should be taken into account in connection with your work with this assignment.

Annex V

FINANCIAL OFFER

Having examined the Solicitation Documents, I, the undersigned, offer to provide all the services in the TOR for the sum of ……VND

This is a lump sum offer covering all associated costs for the required service (fee, meal, accommodation, travel, taxes etc).

Cost breakdown:

No.	Description	Quantity	Unit Rate (VND)	Total
1	Consultancy fee			
2	Out of pocket expenses			
2.1	Travel			
2.2	Per diem			
2.3	Full medical examination and Statement of Fitness to work for consultants from and above 65 years of age and involve travel – (required before issuing contract).			
2.5	Others (pls. specify)…….			
	TOTAL			

***** *Individual Consultants/Contractors who are over 65 years of age with assignments that require travel and are required,* ***at their own cost****, to undergo a full medical examination including x-rays and obtaining medical clearance from* ***an UN-approved doctor*** *prior to taking up their assignment.*

I undertake, if my proposal is accepted, to commence and complete delivery of all services specified in the contract within the time frame stipulated.

I agree to abide by this proposal for a period of 120 days from the submission deadline of the proposals.

Dated this day /month of year

Signature

(The costs should only cover the requirements identified in the Terms of Reference (TOR) Travel expenses are not required if the consultant will be working from home).