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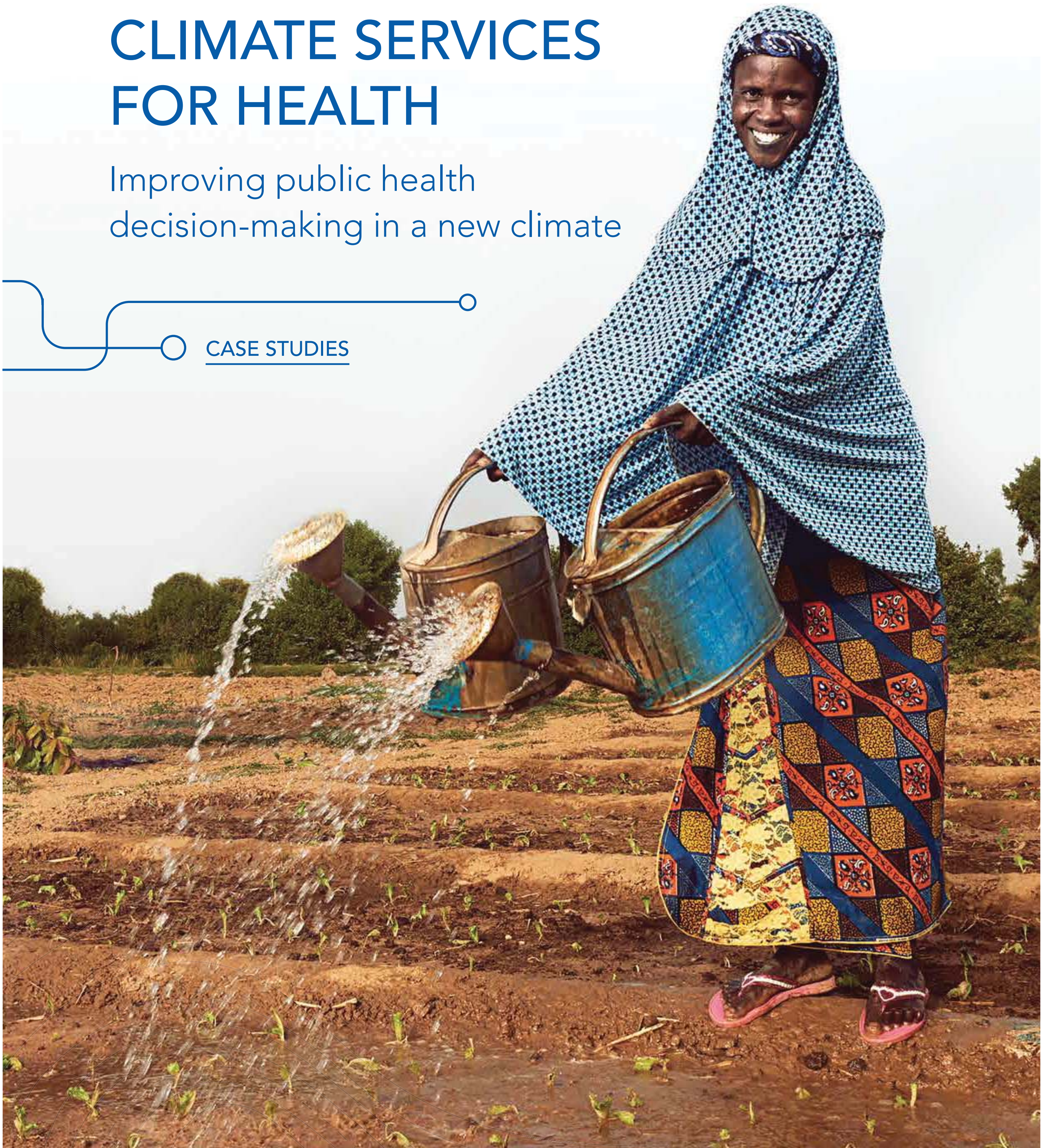

Enabling Environment
Capacity Building
Research
Product & Service Development
Application
Data Collection and Management
Integrated Surveillance
Indicators and Thresholds
Forecasts

INTEGRATED SURVEILLANCE

VECTOR-VIRUS MICROCLIMATE SURVEILLANCE SYSTEM FOR DENGUE CONTROL IN MACHALA, ECUADOR

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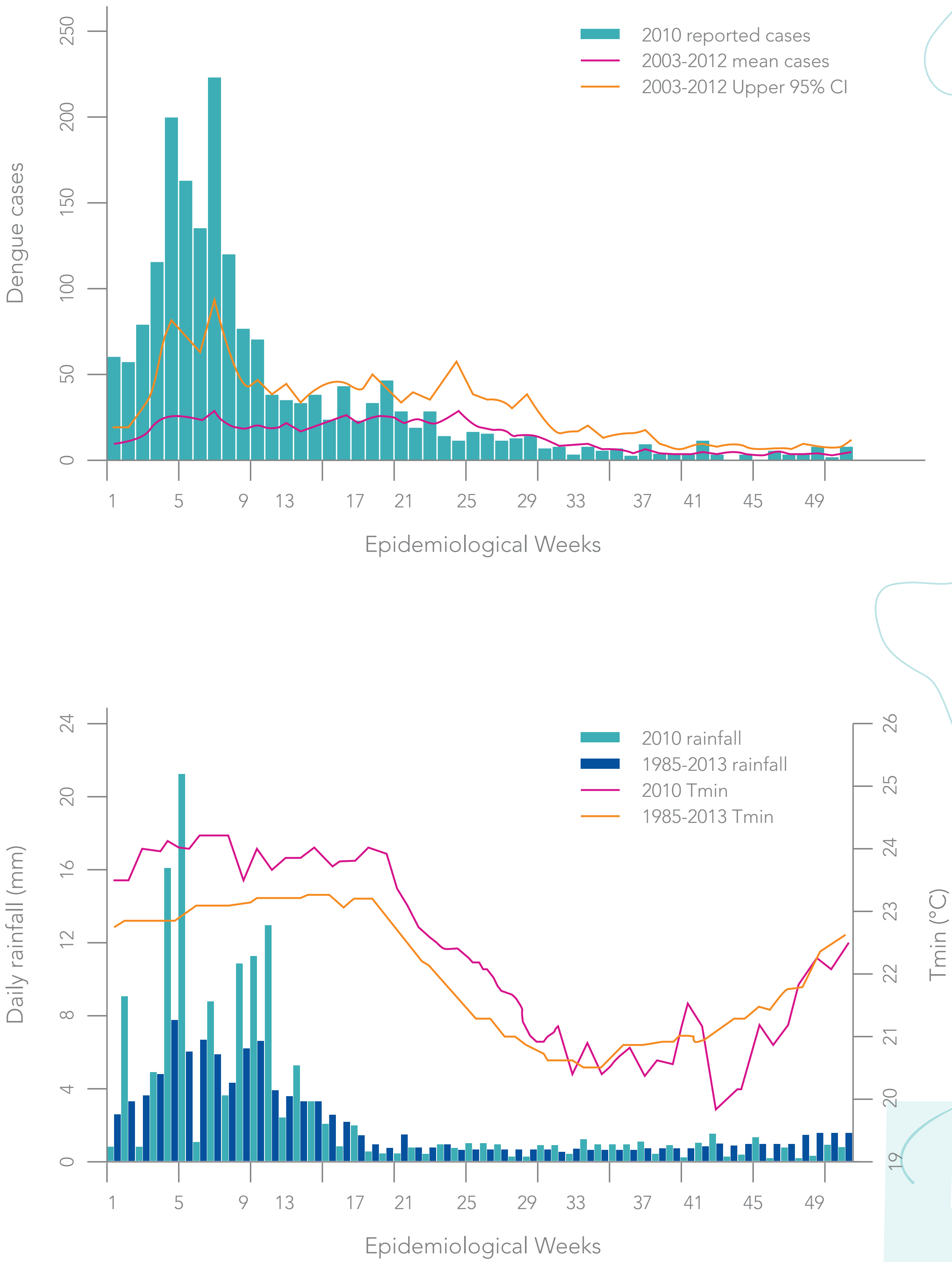
CONTEXT

Dengue fever, a mosquito-borne viral illness, is hyper-endemic in coastal Ecuador, requiring tremendous mobilization of resources by the public health sector each year during the rainy season. The National Institute of Meteorology and Hydrology (INAMHI), the Ministry of Health (MSP) of Ecuador, and an international research team have co-developed an integrated dengue–climate research and surveillance platform. The team has generated the evidence base for the effects of climate on dengue fever and strengthened the local research and surveillance capacities. These efforts provide the foundation for a dengue early warning system (EWS) and other climate services that are tailored for the public health sector, ultimately improving the ability of decision-makers to incorporate climate information into public health planning.

Machala, a city located in southern coastal Ecuador, has been a strategic dengue research site since 2010, following one of the largest dengue epidemics on record (Figure 5.5). That year, over 17 000 cases of dengue were reported in the country, with more than 2000 cases in Machala, resulting in a local incidence rate more than three times the baseline rate from 2003 to 2009 *(15)*. The epidemic rapidly surpassed the capacity of local public health services, highlighting the need for alternative prevention and control strategies.

Figure 5.5 Time series of dengue and local climatic conditions in 2010 and historically in Machala, Ecuador. (A) Weekly reported cases of dengue in 2010 and weekly average cases from 2003 to 2012; (B) weekly averages of rainfall and minimum air temperature (Tmin) in 2010 compared to the climatology (1986 to 2013 average conditions. Reproduced with permission from Stewart Ibarra et al 2014 *(15)*.



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NEW APPROACHES

Initial collaborative research efforts led by INAMHI and partners indicated the potential to develop a dengue EWS. Studies showed that the size and timing of dengue outbreaks were associated with a combination of climate and non-climatic factors, including the El Niño Southern Oscillation (ENSO), local climate, the virus serotypes in circulation and mosquito abundance *(16)*. The research team identified key local climatic conditions that likely triggered outbreaks, as observed in 2010 *(15)*. Studies also showed that dengue risk was associated with social vulnerability factors such as housing conditions, demographics, risk perceptions and knowledge *(15, 17)*. Investigators on the team improved the seasonal climate forecasts in the region, generating forecasts with good predictive ability that could be used in dengue forecasts *(18)*. The Latin America Observatory (OLE2), a regional network of climate centres, has provided critical technical support and a means of rapidly disseminating climate products and tools *(19)*.

Figure 5.6 Active surveillance of lab-validated dengue cases (right) and Aedes aegypti (left) in Machala, Ecuador, provides epidemiological information that is paired with local microclimate data to better understand triggers of dengue outbreaks. Photo credit: W. Feuz/2014.

In 2013, the team gained additional support from the Global Emerging Infections Surveillance and Response System (GEIS) to establish an integrated vector–virus–microclimate surveillance system (Figure 5.6). This comprehensive surveillance system is generating fine-scale spatiotemporal data on microclimate, virus and vector dynamics, nutritional status, and sociodemographic risk factors, allowing investigators to determine the true burden of dengue illness and local climate and non-climate triggers. Epidemiological data is generated through passive surveillance of dengue cases from sentinel clinics, combined with active cluster-based surveillance (Ibarra S. et al. in prep). Microclimate information is generated by five weather sensors and an automated full meteorological station operated by INAMHI. An epidemiological–climate data repository is currently stored and shared with partners using a secure cloud-based server managed by the research team.

BENEFITS AND LESSONS

Important outcomes include improved surveillance infrastructure and field-validated protocols, recommendations for targeted seasonal vector control interventions, high-resolution climate and epidemiological data, exploratory predictive models, risk maps, improved seasonal climate forecasts, and knowledge translation through climate–health forums, press releases, social media outlets (e.g. Dengue REDDES on Facebook) and climate–weather bulletins for the health sector. Team members are providing technical support for the design of the national vector surveillance and febrile surveillance programmes. The surveillance system and previous studies provide the foundation to develop an operational dengue EWS, at seasonal and monthly scales. At a seasonal scale, a climate risk indicator may forecast hot spot regions and levels of dengue, providing useful information for communication and social mobilization measures at sub-regional levels, informing budgeting and resource allocation. At the monthly or weekly scale, real-time local climate, vector and virus surveillance can alert authorities to anomalous increases in key parameters, triggering local measures by the public health and municipal government.

An important component of the ongoing partnership is the tailored trainings to the public health sector and local scientific community, which have included topics in bioethics, research integrity, tools for dengue diagnosis and surveillance, GIS for public health, and disease risk modelling. Trainings provide the foundation for a long-term collaboration with stakeholders, while enhancing transdisciplinary research capacities at local institutions. One of the key lessons learned is the importance of strong institutional partnerships that are developed by building trust and the reputation of the team through long-term engagement in a flexible, innovative and collaborative environment. Finally, through the process of co-development, the team ensures that research and operational activities are driven by national strategic priorities (Plan de Buen Vivir), increasing the likelihood that the public health sectors will utilize climate–health tools that allow decision-makers to more efficiently and effectively allocate resources for dengue control, saving lives and public resources.

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