Annual Report 2014

Vectors, Environment and Society
TDR/VES/15.1

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INTRODUCTION

Vectors, Environment and Society (VES) was created within TDR to specifically address cross-cutting issues across diseases and sectors focusing on vector-borne diseases and vector control interventions at the interface of the natural and human environment. The unit develops and evaluates innovative and improved vector control strategies in the context of climate and environmental changes, and explores optimal ways to engage with different types of communities to scale up tools and strategies for the prevention of major vector-borne and other poverty-related diseases. This includes vector ecology and biology, vector control technologies, community-based interventions, as well as environmental and climate change.

This report covers the VES activities and achievements for 2014, the plans for 2015, and projections for the next (2016-2017 biennium).

Figure 1. Results chain for research on vectors, environment and society.
OBJECTIVES AND EXPECTED RESULTS FOR 2014-2015 ACTIVITIES

The Expected Results (ER) for 2014-2015 are:

- ER.1. Enhance access to control interventions through community engagement for the prevention of major vector-borne diseases and other poverty related diseases in Africa.
- ER.3. Undertake interdisciplinary research towards the understanding, prevention and mitigation of the impact of climate and environmental change on vectors and vector-borne diseases.
- ER.4. Assess the implementation and scale-up of community-based dengue vector control interventions in urban agglomerations of Latin America and the Caribbean.
- ER.5 Demonstrate and substantiate the utility of applying the concept and principles of social Business/social entrepreneurship to infectious diseases of poverty control, to enhance access to health products and health interventions directed at combatting infectious diseases of poverty in the context of social and solidarity economy.

The expected outcomes for 2014-2015 activities are listed in the table in the chapter on progress in 2014 and planned activities for 2015.

KEY ACHIEVEMENTS

- **Evidence, knowledge management and policy-making on childhood fever management and Integrated Community Case Management (ICCM) in peripheral health care settings advanced.**
  
  TDR’s research portfolio on approaches to enhance access to fever management in peripheral health care settings gained international attention and led to major research-to-policy uptake at an evidence symposium on Integrated Community Case Management (ICCM), organized by UNICEF, in March 2014. The studies were also reviewed and summarized in a special issue of the Journal Global Health on “Current scientific evidence and future directions for Integrated Community Case Management in Africa”.

- **Evidence, knowledge management and policy-making on community-based vector control for dengue and Chagas disease.**
  
  The TDR-IDRC research initiative “Towards Improved Chagas and Dengue Disease Control through Innovative Ecosystem Management and Community-Directed Interventions: An Eco-Bio-Social Research Programme on Chagas and Dengue Disease Control in Latin America and the Caribbean” concluded in 2014. Data analysis, a special issue of the Transactions of the Royal Society of Tropical Medicprogress ine and Hygiene, and three video productions showcased effective new methods.
• Guidance framework published for testing efficacy and safety of genetically-modified mosquitoes for malaria and dengue control and for addressing ethical, legal, social and regulatory issues

Commissioned by TDR and the Foundation for the National Institutes of Health (FNIH), the published framework fosters quality and consistency among processes for testing and regulating new genetic technologies by proposing standards of efficacy and safety testing comparable to those used for trials of other new public health tools. It was drafted by four different working groups (efficacy; safety; ethical, legal and social; and regulation), each of which received input from experts in the field and the public during its production.

PROGRESS IN 2014 AND PLANNED ACTIVITIES FOR 2015

Expected Results – Vectors, environment and society research

<table>
<thead>
<tr>
<th>Expected results (2014-2015)</th>
<th>Indicators and targets</th>
</tr>
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<tbody>
<tr>
<td><strong>Outcome 1</strong>: Increase access, especially for poor communities in low- and middle-income countries, to health intervention and effective health services to combat diseases.</td>
<td>Case studies published on the uptake of CBI approach in various settings</td>
</tr>
<tr>
<td></td>
<td>• During 2014, several single-site analyses on TDR funded CBI research were published.</td>
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<tr>
<td><strong>Outputs:</strong></td>
<td></td>
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<tr>
<td>Research reports, publications and strategies to strengthen primary health care, focusing on fever management of severe childhood illnesses in peripheral settings.</td>
<td>By 2014, 6 studies published</td>
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<tr>
<td></td>
<td>• Publications delayed as research portfolio on fever management in peripheral health care settings ongoing in 4 African countries (Burkina Faso, Malawi, Nigeria and Uganda). Publications expected in 2015.</td>
</tr>
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<td>Review and assessment of incentives for motivation and retention of Community Health Workers (CHWs), including testing of innovative and sustainable options.</td>
<td>By 2014, 6 reviews / studies published</td>
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<td></td>
<td>• Realist review completed and published in online manual on community health workers. Multi-country research (in DR Congo, Ghana, Senegal and Uganda) completed in 2014 and presented at Global Symposium for Health Systems Research</td>
</tr>
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<td>Testing of the public health benefit of a treatment package for integrated Community Case Management (iCCM) of malaria and pneumonia, focusing on mortality.</td>
<td>By 2015, 3 country studies published</td>
</tr>
<tr>
<td></td>
<td>• Two studies (Ghana, Uganda) published in 2012, publication on Burkina Faso under way.</td>
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<td></td>
<td>• The three TDR studies were featured in 2014 as the only RCTs in a major evidence review symposium on iCCM.</td>
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<tr>
<td>Knowledge generation and management on community-based interventions</td>
<td>By 2014, 8 systematic reviews on community-based interventions for the prevention and control of infectious diseases of poverty published.</td>
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<tr>
<td></td>
<td>• These were published as a highly accessed special issue in Diseases of Poverty in 2014.</td>
</tr>
<tr>
<td><strong>Outcome 2</strong>: Policies and strategies influenced by new evidence from community-based vector control</td>
<td>By 2014, 8 research studies published for 7 Latin American countries</td>
</tr>
<tr>
<td></td>
<td>• Eight studies published in a special issue of Transactions of the Royal Society for Tropical Medicine and Hygiene (Jan 2015).</td>
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</tbody>
</table>
### Expected results (2014-2015) | Indicators and targets
--- | ---
**Outputs:**
Cross-disciplinary research framework for eco-bio-social (EBS) studies and toolkit for EBS research | By 2014, EBS framework developed in Latin America
- Research framework developed and applied in research initiative in Latin America and the Caribbean. Published in BMC Infectious Diseases (2014).

Evidence for EBS approach to strengthen vector-borne disease control | By 2014, 15 studies completed and published
- Fifteen studies completed and published: Six dengue studies in Asia (India, Indonesia, Myanmar, Philippines, Sri Lanka and Thailand) completed in 2012 and published between 2010 and 2013; eight studies in Latin America and the Caribbean (Brazil, Colombia, Ecuador, Mexico and Uruguay for dengue studies and Bolivia, Guatemala and Mexico for Chagas disease studies) completed in January 2014 and results were published in 2014.

**Outcome 3:** Enhanced and effective capacity, understanding, use, uptake, adoption, decision-making on improved adaptation and increased resilience to VBD-related vulnerabilities under climate change | By 2017, 10 countries adopted the methods and tools developed

**Outputs:**
Complex social-ecological conditions of water systems in African drylands identified and characterized for their potential impact for VBDs; VBD risks assessed under various exposure conditions and vulnerability context; knowledge and scientific evidence generated about the impact of climate change on health. | By 2014, research evidence provided
- The 5 research projects approved for funding received WHO Ethics Review Committee (ERC) approval and funds released for them. They are ongoing in 7 African countries (Botswana, Côte d’ivoire, Kenya, Mauritania, South Africa, Tanzania and Zimbabwe) about malaria, schistosomiasis, HAT and RVF.

Decision-support processes and tools for health impact assessment | By 2015, processes and tools developed
- Evidence and knowledge to inform the development of decision-support process and tools for health impact assessment are currently being generated. By 2015, community adaptation strategies (including early warning tools) are expected to be developed.

Capacity and network built for better management of climate and environmental related risks | By 2014, a community of practice established
- Community of practice established with engagement facilitated through a web-based knowledge-sharing platform, VBD-environment.org. One proposal development workshop was held in 2012. Two capacity building workshops held in 2013 and 2014. One online forum for data consultation held in the last quarter of 2014.

**Outcome 4:** National dengue control programmes in Latin America implement evidence-based, sustainable and effective community-based vector control strategies | By 2014, scaling-up of dengue vector control developed in 4 Latin America countries
- Uptake and scale-up ongoing in Brazil, Uruguay and Colombia (2014-16), planned in Mexico (2015-16).
### Expected results (2014-2015)

<table>
<thead>
<tr>
<th>Outputs:</th>
<th>Indicators and targets</th>
</tr>
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| Implementation research on productive dengue vector breeding sites and targeted interventions | By 2015, 4 country studies completed  
  • Dengue vector densities reduced to lower levels (measured through pupae indices in intervention and control areas).  
  • Study portfolio delayed, to be completed during 2016. |
| **Outcome 5**: The application and usefulness of social entrepreneurship for the prevention and control of infectious diseases of poverty demonstrated and substantiated through research | By 2017, the application of social entrepreneurship for the prevention and control of infectious diseases of poverty shown effective and useful  
  • Heuristic value of social innovation and research programme established in collaboration with academic institutions (Oxford University, Capetown U).  
  [http://healthinnovationproject.org](http://healthinnovationproject.org) |
| Outputs:                                                                 |                                                                                         |
| Landscape analysis of i) existing social entrepreneurship initiatives for the prevention and control of infectious diseases of poverty, ii) their success, challenges, and lessons learnt and iii) overall social entrepreneurship stakeholder environment | By 2015, publication of a web-based report  
  • Landscape analysis completed but not yet published. |
| Concept paper and public health based framework related to the application of social entrepreneurship to the prevention and control of infectious diseases of poverty | By 2016, publication of report and peer reviewed journal articles  
  • Case study research under way. |
| Forum for social entrepreneurship on infectious diseases of poverty launched | By 2015, Forum held successfully  
  • Forum to be held in December 2015. |
| **Outcome 6**: Countries using optimized implementation of vector control interventions based on scientific evidence | By 2017, recommendations and policies for better implementation of malaria control through LLINs and IRS taking into account insecticide resistance evolution |
| Outputs:                                                                 |                                                                                         |
| New scientific information on insecticide resistance mechanisms generated to fill critical knowledge gap | By 2016, publication of the study results in a peer review journal  
  • Insecticide resistance mechanisms characterized for the insecticides used for indoor residual spraying (IRS) of insecticide and insecticide treated-nets (ITNs) in the main malaria vectors will be published by 2017. |
| Link between insecticide resistance mechanisms and malaria control failure established | By 2017, publication in peer review journal  
  • On track. |
**Expected result 1: Enhanced access to control interventions through community engagement for the prevention of major vector-borne diseases and other poverty-related diseases in Africa.**

This expected result has four projects.

1. **Research portfolio to strengthen primary health care through better-informed community-based management of uncomplicated and severe fevers.**

   This research portfolio consists of four studies in Nigeria, Malawi, Uganda and Burkina Faso to assess the implementation process (successes and weaknesses) and feasibility of the community-based intervention (CBI) process for strengthening Primary Health Care (PHC) in rural areas of Africa, focusing on prevention, diagnosis, treatment and referral of severe childhood illnesses associated with fever. The intervention research phase, with EU support, is now underway, and the full study is planned to be completed by September 2015. The study measures time and private costs of management of malaria before the intervention and the feasibility (training, supervision, time allocation, referral compliance, coverage) of the intervention. The intervention involves community provision of rapid diagnosis and oral treatment for uncomplicated malaria with artemisinin-combination treatment (ACTs) and assessment and treatment of suspected severe malaria with rectal artesunate. Community-based diagnosis and treatment is anticipated to reduce the time to diagnosis (malaria or not) and treatment, reduce the length of time a malaria-positive child is febrile and infective (and hence reduce transmission), and in the case of patients who have progressed to severe malaria that there will be reduced time to treatment and referral. A common database has been developed (to enable data analysis and pooling of pre-intervention compared with intervention data), case record forms have been agreed and finalized (clinical and economic), together with training materials and drug accountability forms. TDR has involved an experienced statistician from the University of Gothenburg in Sweden.

**Plans for 2015**

A consultant will be hired to finalize the work before September 2015, and the intervention research phase will be completed by the end of the malaria season in each participating country. The data analysis workshop to review the results and prepare for publication is now planned for June and will be hosted by the Ministry of Health in Uganda, to review the results of the multi-country studies.

2. **Evidence on incentives for community health workers (CHWs)**

   This research includes a review and assessment of incentives for motivation and retention of community health workers, including testing of innovative and sustainable options. A realist review commissioned to the School of Public Health, University of Cape Town, and South Africa reviewed not only narrowly defined financial incentives but also many possible factors that may increase or shape the motivation of CHWs. The study concluded that it is important to understand why efforts to incentivize CHWs seem to fail over time. It is clear that many of the ‘best practices’ for incentivizing CHWs to apply, remain in, and do well at their work require an effective and responsive health system. A revised version of the realist review on incentives for community health workers entitled “Incentivize Community Health Worker Performance and Retention” was published in an online reference guide with case studies for program managers and policymakers: Henry Perry and Lauren Crigler, Editors, Developing and Strengthening Community Health Worker Programs at Scale.

   In addition, during 2014 a multi-country research initiative was completed to explore the current use of strategies for attraction, retention, and performance management of CHWs in five African countries (DR Congo, Ghana, Senegal, Uganda and Zimbabwe). The study concluded that human resource management practices (or lack of them) will affect the ability of the programme to attract and retain CHWs and to enable them to work effectively in their volunteer roles. The research work was presented at the Third Global Symposium on Health Systems Research in Cape Town, South Africa in 2014 [http://hsr2014.healthsystemsresearch.org/](http://hsr2014.healthsystemsresearch.org/) on the science and practice of people-centred health systems.
Plans for 2015

Publication of the multi-country study is planned for 2015 in the journal Human Resources for Health.

3. Integrated Community Case Management (iCCM) strategy of malaria and pneumonia

This TDR research portfolio is testing the public health benefit of a treatment package for iCCM of malaria and pneumonia, focusing on the potential effect on the reduction of overall and childhood mortality. This research portfolio consists of three randomized control trials (RCTs) in Burkina Faso, Ghana and Uganda, carried out since 2008 in close cooperation with the global effort on iCCM led by WHO’s Global Malaria Programme and UNICEF. The Ghana sub-study showed that mortality in children under 5 could be reduced by 30% through community case management of malaria with ACTs, and by 44% by community case management of both malaria and pneumonia with ACTs and antibiotics, compared to areas where no community case management is implemented (published by Chinbuah et al.). Impact of Community Management of Fever (Using Antimalarials with or without Antibiotics) on Childhood Mortality: A cluster-randomised controlled trial in Ghana. Am. J. Trop. Med. Hyg. 87 (sup 5), 2012, pp11-20. The Uganda study has been completed and a preliminary final report was submitted to TDR in August 2012. The study contributed to a multi-country analysis of the impact on under-five mortality. The Burkina Faso study undertaken to compare the additional benefit in terms of all cause childhood mortality reduction of community case management of malaria and pneumonia compared to malaria only is now complete. The study demonstrated that community case management and pneumonia was feasible on a large scale in rural district. The three TDR studies were featured as the only RCTs in a major evidence review symposium on iCCM, led by UNICEF, in Accra, Ghana, in March 2014.

Plans for 2015

Single-site publication on iCCM for Burkina Faso, meta-analysis of data, further promotion and advocacy for iCCM as a viable public health strategy.

4. Knowledge generation and management

Disease control and public health programmes are increasingly advocating community-based delivery strategies and interventions. These depend, to a large degree, on trained community volunteers, e.g., community health workers whose performance in various areas of health care such as maternal and child health has been the subject of rigorous recent systematic reviews. A thematic series of eight papers commissioned by TDR, with funding support from the European Commission. In July 2014, these were published as a series of 8 systematic reviews on community-based interventions for the prevention and control of infectious diseases of poverty was published in the journal Infectious Diseases of Poverty. The series (eds. Prof Xiao-Nong Zhou, J. Sommerfeld), was commissioned to a leading systematic review group in the South (Aga Khan University, Karachi, Pakistan). http://www.idpjournal.com/series/cbi The series provided an overview on infectious diseases of poverty and integrated community-based interventions, described the analytical framework and the methodology used to guide the systematic reviews, reported findings for the effectiveness of community-based interventions for the prevention and control of helminthic NTDs, non-helminthic NTDs, malaria, HIV/AIDS and tuberculosis and proposed a way forward.

Expected Result 2: Design and implement community-based ecosystem management and environmentally friendly vector control interventions for the prevention of dengue and Chagas disease.

The research initiative on dengue and Chagas disease in seven Latin American countries was successfully completed during 2014. A scaling up project is in preparation in four countries. Following a fifth and final Community-of-Practice (CoP) workshop organized in collaboration with PAHO and the University of Uruguay and held in 2013 in Montevideo, Uruguay, all participating teams submitted final reports;
likewise the grant agreement with IDRC on this activity was completed.

This was a five-year research and capacity building programme involving eight research studies carried out between 2008 and 2013 in seven countries of Latin America (Bolivia, Brazil, Colombia, Ecuador, Guatemala, Mexico, Uruguay). Multi-disciplinary research groups from seven leading Latin American research institutions participated in the effort, forming a Community-of-Practice (CoP) for ecohealth research on vector-borne diseases, with a focus on dengue in urban and peri-urban and on Chagas disease in rural settings. Based on a common core protocol and standardized data collection instruments, the research teams undertook an eco-bio-social situation analysis to characterize and map the ecosystem, vector ecology, the social context, including stakeholder environment, and community dynamics as well as gender implications.

The projects on dengue were all carried out in urban contexts, in medium size to large urban agglomerations of Latin America (Acapulco/Mexico, Fortaleza/Brazil, Girardot/Colombia, Machala/Ecuador, Salto/Uruguay) where dengue vector control measures, routinely carried out – without community participation - by municipal or other governmental control services, usually consist of space spraying and/or larviciding. The research approach used was based on the current assumption that “larval surveys” used since the 1940’s in dengue vector surveillance are useful to inform on the presence or absence of dengue vectors in the community but should be complemented by occasional pupal productivity surveys to identify productive container types for “targeted interventions”. For such targeted interventions, new and innovative dengue vector control tools have been developed and tested, particularly a) window and door screens (with insecticide treated netting material) and b) water container covers using a similar design but with a flexible opening (Colombia); both devices were highly appreciated by the population and vector control services. Violence and social segregation was a major barrier towards vector control operations particularly when aggravated by traffic with illicit substances. Nonetheless, social mobilization and the partnership approach with public services were achievable with few exceptions even under difficult circumstances. Based on preliminary results, the eco-system interventions in the five study sites indicate to significantly reduce vector densities compared to the routine programmes, notably in Mexico, Colombia and Brazil but also in Uruguay and Ecuador. The ecohealth approach applied across all study areas appeared to be a novel and innovative approach. Policy makers and practitioners were active part of the research initiative and committed to scaling up the interventions at city levels. Ecohealth research teams in those countries where governments committed to funding the intervention will continue to be part of the research initiative.

The projects on Chagas disease were carried out in rural research sites of Bolivia, Guatemala and Mexico, in areas where the socio-ecological setting is characterized by poverty where social and environmental determinants lead to transmission in domestic and peri-domestic contexts. The Chagas disease portfolio showed that an eco-health approach can in fact improve and innovate traditional Chagas disease interventions based on insecticide spraying. These domestic and peri-domestic transmission contexts can be addressed through participatory multi-stakeholder processes which combine routine IRS with improvement of housing conditions, management of domestic and peri-domestic animals and general environmental hygiene.

**Plans for 2015**

Publication of a special issue of the Transactions of the Royal Society for Tropical Medicine and Hygiene (TRSTMH) on the research initiative
Expected Result 3: Undertake interdisciplinary research towards the understanding, prevention and mitigation of the impact of climate and environmental change on vectors and vector-borne diseases

This four-year research initiative entitled “Population health vulnerabilities to vector-borne diseases: increasing resilience under climate change conditions in Africa” is being implemented by TDR in collaboration with IDRC, the WHO Public Health and Environment (PHE) Department and the AFRO Programme for the Protection of Human Environment (PHE). The research initiative provides a holistic research perspective to elucidate how environmental and socio-economic change affects transmission dynamics and disease burden of vector-borne diseases through changes in vector ecology, human ecology, social organization, demography and health systems. A second technical progress report by TDR was approved by IDRC in July 2014.

Implementation of this research initiative is through five research projects in Cote d’Ivoire, Kenya, South Africa, Tanzania, Botswana, Mauritania and Zimbabwe that are focused on major vector-borne diseases (malaria, schistosomiasis, human African trypanosomiasis and Rift Valley fever). The project activities are on-track. Capacity building efforts, facilitated by partners (PHE/AFRO, HQ/PHE and IRI) and experts/consultants, were undertaken during 2014. SPT (Special Project Team) review of Year 1 technical progress by the research teams was completed in Oct 2014, with all projects being recommended and approved for Year 2 funding and implementation.

Progress in 2014

Generation of knowledge and evidence on the impact of vector-borne diseases under climate change conditions on vulnerable populations.

Project 1. Social, environmental and climate change impact of vector-borne diseases in arid areas of Southern Africa (South Africa, Zimbabwe and Botswana). Data collection is on-going to determine the temporal trends of the burden of malaria and schistosomiasis (including vector mosquitoes and intermediate snail hosts) and to determine the community perceptions of vector-borne disease (VBDs) climate change. Participatory Rural Appraisal (PRA) workshops have been held in all project sites. Social data for livelihood and disease exposure analysis have been collected.

Project 2. Early warning systems for improved human health and resilience to climate sensitive vector-borne diseases in Kenya. This is a longitudinal study aimed at collecting relevant data from the designated study areas. Data collection started with desk reviews regarding existing models on VBDs, climate change, hydrological ecosystems, vector bionomics, gender, socio-economic and political factors. This was followed by mapping the study area and baseline surveys to collect data relevant for developing decision support tools.

Project 3. Predicting vulnerability and improving resilience of the Maasai communities to vector-borne infections: an ecohealth approach in the Maasai Steppe ecosystem. This project seeks to understand how various environmental factors, including climate and land cover, influence current tsetse and trypanosomiasis distribution, and to use this knowledge together with future predictions of climate and land-cover to predict where future hotspots of infection are likely to occur. The researchers are also working with local Maasai communities to understand their level of knowledge and adaptation strategies both to the disease and to climate variability. The researchers have started developing downscaled climate models in collaboration with their partners at the University of Cape Town (UCT) and expect to have preliminary downscaled models, based on decadal data. The field teams have now collected tsetse flies over two months. The social survey instruments for the study have been finalized for social data collections and community engagement.

Project 4. Human African trypanosomiasis: alleviating the effects of climate change through understanding human-vector-parasite interactions. The Tanzania sociology study is moving well ahead of schedule with the completion of the Knowledge Attitudes and Practice (KAP) survey. The simulation and theoretical studies have also been proceeding well. Major advances have been made in understanding
the relationship between climate and tsetse population dynamics. There had been significant advances in obtaining meteorological data from both Zimbabwe and Tanzania.

**Project 5. Vulnerability and resilience to malaria and schistosomiasis in northern and southern fringes of the Sahelian belt.** Rainy season data collection had been completed in both Kaedi and Korhogo. Data consolidation and analysis is ongoing.

**Commissioned systematic reviews.** As part of this research initiative, TDR commissioned a series of systematic reviews covering climate change and major cross-cutting issues for publication as WHO monographs. The first review in this series is entitled *Adaptation and Risk Management Strategies for Climate Change Effects on Vector-borne Diseases* (authored by Kimberly Fornace et al.). The draft manuscript is currently being peer-reviewed by the SPT.

**Capacity building**

A second capacity building workshop was held in 2014 and hosted by the Nelson Mandela African Institute for Science and Technology, Arusha, Tanzania. The objective was to provide the research teams with the requisite know-how to generate and use the evidence necessary to reduce population health vulnerabilities to VBDs under climate change conditions in Africa. The workshop provided the technical background for the research teams as they: use climate data and climate change scenarios, apply the concepts and use of methods for assessing social and economic drivers of vulnerability and opportunities for adaptation to climate change, build their capacity towards achieving influence and impact for the benefit of the vulnerable communities and to inform better policies and programmes. A site visit to one of the Maasai communities in the Simanjiro District was one of the major highlights of the workshop activities.

Aside from experts in the field of vector-borne diseases, entomology, climate and environment, additional technical support is now available in the following areas: Economic drivers of vulnerability and exposure to VBDs; and Monitoring and Evaluation.

An online forum for data consultation was organized to provide an informal setting to foster the interaction and engagement among researchers and experts/consultants using the web-based knowledge sharing platform, VBD-environment.org. This forum serves as a cooperative platform for constructive feedback on data from Year 1 of project implementation. This activity was conducted in three phases (1 Oct-19 Dec/2014): 1) Phase 1 – preparation and sharing of background documents by the research teams; 2) Phase 2 – review and feedback from experts/facilitators; and 3) Phase 3 – inter-team cross-feedback.

[VBD-environment.org](http://www.vbd-environment.org) was launched during the second capacity building workshop in 2014. This is a web-based knowledge sharing platform to facilitate the organization of the researchers, experts/consultants, partners and relevant stakeholders into a network for sharing, learning and interacting within the context of a shared repertoire of resources (e.g., tools, experiences, ways of addressing challenges, reports, etc.). VBD-environment.org was used in the recently concluded SPT online review process as well as the online forum for data consultation.

**Plans for 2015**

Generation of knowledge and evidence on the impact of vector-borne diseases under climate change conditions on vulnerable populations.

**Project 1. Social, environmental and climate change impact of vector-borne diseases in arid areas of Southern Africa (South Africa, Zimbabwe and Botswana).** Collection of data on climate factors for Botswana, South Africa and Zimbabwe will continue in 2015. Likewise, the collection of data on environmental social and institutional determinants of health in the 3 study communities and the collection of VBD epidemiology.
Project 2. Early warning systems for improved human health and resilience to climate sensitive vector-borne diseases in Kenya. Vector dynamics data and RVF sero-prevalence data will be collected from sampling points in the study area alongside remotely sensed climatic data. These data sets will be used in the MaxEnt modelling. Plans are underway to undertake a retrospective data analysis to check the relationship between climatic and landscape data on the RVF outbreaks. The climate and landscape data have already been downloaded. RVF outbreak data is still being extracted from medical records in health facilities in the study area. Meteorological data - rainfall and temperature of the study area (spanning 10 years back; 2004 – June 2014). Data for the months of July – December 2014 will be collected at the beginning of 2015. Hydrological data including Lake Baringo water levels and River Perkerra discharge data spanning 10 years (2004-2014) as well. Hydrological data for the months of July – December 2014 will be collected at the beginning of 2015.

Project 3. Predicting vulnerability and improving resilience of the Maasai communities to vector-borne infections: an ecohealth approach in the Maasai Steppe ecosystem. The researchers plan to install their own meteorological stations in our study area, to more finely track the influence of climate variables on tsetse and trypanosome abundance and prevalence. Collection of tsetse flies will continue in Year 2, and the results will be used in models of climate and land cover impacts to tsetse and trypanosomiasis abundance and prevalence. Vulnerability assessments are planned during second half of the project year. By January 2015, the researchers expect to have preliminary predictive maps of distribution based on the intensive sampling and preliminary climate and land cover data. The researchers will use these predictions to inform a larger, extensive sampling strategy across a broader area.

Project 4. Human African trypanosomiasis: alleviating the effects of climate change through understanding human-vector-parasite interactions. The second year will be devoted to collation, analysis and writing up of the sociology study data. The data analysis on fly population dynamics will be completed and will allow for the optimisation of the cost-effective use of insecticide-treated cattle and of trypanocides by local cattle owners in marginal areas – particularly where these areas border game reserves and national park. Entomological field studies are expected to move ahead in Zimbabwe, with a major thrust in sampling of tsetse at, and around, Rekomitjie Research Station in the Zambezi Valley. Work towards obtaining meteorological data from both Zimbabwe and Tanzania from various sources will continue in 2015. The Climate Systems Analysis Group (CSAG) will provide access to meteorological data from Kariba. These collections will continue; the work at CSAG during the second year will include analysis of these valuable new data.

Project 5. Vulnerability and resilience to malaria and schistosomiasis in northern and southern fringes of the Sahelian belt. The plan for 2015 is to continue with the collection of dry season data. The researchers plan to complete analysis of the data, share and discuss the results with all stakeholders and seek the participation of the communities for the development/implementation of resilience tools and strategies.

Commissioned systematic reviews. Three additional reviews are expected to be commissioned and completed. These are on the following topics: Health and climate change in dryland socio-ecological systems; Health, biodiversity, traditional knowledge and climate change adaptation; and, Global change, social determinants and zoonotic diseases.

Capacity building

A third capacity building workshop will be held in Geneva, Switzerland, on 6-10 July 2015.

The VBD-environment.org will be further developed with a more visible ‘public space’ to expand the reach of the current ‘private’ knowledge-sharing platform. The objective is to make the work of the TDR-IDRC Research Initiative more accessible to a wider audience and other stakeholders for better dissemination of information.
Expected Result 4: Assess the implementation and scale-up of community-based dengue vector control interventions in urban agglomerations of Latin America and the Caribbean.

During 2012 and 2013, cluster randomized controlled trials were conducted in three Latin American cities - Fortaleza (Brazil), Acapulco (Mexico) and Girardot (Colombia) - and in one city of Uruguay (Salto) to test the efficacy of a novel *Aedes aegypti* intervention package. The study protocols were standardized across cities and involved a clustered design comparing ten control and ten intervention areas consisting of 100 households each. In control clusters, routine vector control activities were performed. Intervention clusters included insecticide treated window and door screens (Mexico and Colombia) and targeted interventions in the productive water container types (in Brazil community directed waste management and covering of large containers with plastic lids or ITN materials; in Colombia covering washing tanks with a novel device of ITN material in an aluminium frame; in Mexico judicious and environmentally friendly use of bio-rational larvicides of targeted water containers).

In the intervention clusters, the activities were organized through community participation in close collaboration with vector control personnel and supported by small enterprises who produced and fixed the window/door/container cover screens as well as by local politicians who facilitated the partnership model of “working together”. Main quantitative outcome metrics were: the significant reduction of vector densities (measured mainly through pupae per person index and indoor adult vector collections); people’s satisfaction with the intervention (determined through household surveys and focus group discussions) and acceptable costs (estimated through documentation of all direct costs arising during the intervention). As a follow up (Phase 3) of the TDR/IDRC research initiative “Towards Improved Dengue Disease Control through Innovative Ecosystem Management and Community-directed Interventions: An eco-bio-social Research Programme in Latin America and the Caribbean,” the overall objective of this research activity is to test novel locally tailored and ecosystem-specific tools of dengue vector management applied to extensive urban areas for their ability to reduce dengue morbidity and mortality in the community as well as for cost-effectiveness and feasibility.

**Progress in 2014**

During 2014, a joint core protocol was developed to scale up implementation research activities initiated in negotiation with dengue control programmes in Brazil, Colombia and Mexico. The joint core protocol was adapted by research teams in Brazil, Colombia, Mexico and Uruguay. While the research in Brazil (in Goiania and Belo Horizonte), in Uruguay (Salto) and Colombia (Girardot) is now ongoing, further negotiations with national and State-level governments to fund the intervention in Merida (Mexico) are underway.

The specific objectives are: 1) To document and analyse the process (favouring and limiting factors) of implementing a new intervention package in large urban environments by mobilizing a number of partners (e.g. communities, vector control services, local society and politicians, local industry) and implementing new tools. 2) To quantify the impact of the new intervention package on dengue morbidity (reported incidence) and mortality (registered dengue deaths) after adjusting for dengue infections in patients living in intervention areas but having acquired the infection outside the intervention area. 3) To estimate total and incremental costs of the intervention as well as potential cost savings by reducing dengue morbidity and mortality in the intervention areas compared to control (where traditional vector control will be implemented) areas and to establish the incremental cost-effectiveness of the intervention. 4) To study the acceptance of the interventions by local communities, national programme managers, representatives of local enterprises and other stakeholders of the programme.
Outcome measures include:

- Impact on dengue transmission: Reported dengue incidence (determined through passive disease surveillance)
- Community acceptance: Acceptance scores (Measured through surveys and FGDs)
- Improved interaction of partners/stakeholders: Partnership scores (Measured through stakeholder interviews & FGDs)
- Cost-effectiveness: Cost per dengue case averted: cost savings due to averted cases (Determined through cost of interventions vs. disease reduction comparing before-after and intervention vs. control areas)
- As opposed to phase 2 studies, the impact on vector populations (mainly larval and/or adult indices) is a secondary outcome measure as an explanatory factor for transmission reduction.

Plans for 2015

Roll out of the scaled up intervention phase in participating sites. The intervention package in each site is being developed together with the national control programmes and local industry. In summary, the components are:

1. Window and door screens in a (usually) metallic frame to be developed and installed by local commercial enterprises or, alternatively, insecticide treated window curtains locally tailored by women cooperatives. The screens can be insecticide treated or –where levels of insecticide resistance are high- untreated. In Colombia additionally the washing water tanks (main vector producers) will be covered with similar devices (tested in phase 2 by Mexico and Colombia)

2. Targeted interventions in the most productive container types, which have been determined by pupal-productivity surveys. In Brazil covering unprotected elevated water containers and waste disposal through community actions lead by control agents; in Mexico judicious and environmentally friendly use of biorational larvicides of targeted water containers in residential and public spaces i.e. catch basins and waste disposal through community actions lead by an intersectorial program “Recycle for your commonweal”; in Colombia covering the large wash basins (tested in Colombia, Mexico, Brazil in phase 2 studies).

3. Involvement of communities and other stakeholders applying the methodologies tested particularly in Brazil in phase 2 studies.

Expected Result 5: Social innovation in health care delivery related to infectious diseases of poverty

Many new health technologies exist or are being developed through Research and Development (R&D), however, a myriad of access issues hampers their delivery in resource-poor settings. TDR’s current strategic focus on implementation research calls for innovative approaches to health care delivery and ensuring access to essential health products and services. Implementing prevention and control efforts against infectious diseases of poverty in such settings necessitates social innovation addressing the various social, cultural economic and health systems-related bottlenecks of health care delivery.

Social innovation involves the creative invention of new interdisciplin ary approaches to complex social problems, including those in healthcare. The more direct outcome of these innovations should be strengthened health systems by enabling health care delivery to be more inclusive in terms of equity or access; more affordable; and ultimately effective in achieving the desired health outcomes. Social entrepreneurship is a specific type of innovation that describes for-profit organizations pursuing social objectives and delivering social goods; profits are re-invested into further development of social goods.
and services. Social innovation and entrepreneurship in health often address intractable delivery problems that have failed to respond to conventional solutions and established paradigms.

They use a multisectoral approach bringing together the community, public institutions, NGOs and private sector. These initiatives can instigate deep shifts in systems, organisational structures and culture -which allow for their sustainability and impactful change. Yet a number of questions remain to be answered to ensure that these approaches are effective and can be integrated in operational research before being put into practice.

In line with its strategic emphasis TDR and its 2012 Global Report for Research on Infectious Diseases of Poverty 2012 (Chapter 4: Innovation and new technologies to tackle infectious diseases of poverty http://www.who.int/entity/tdr/capacity/global_report/2012/chapitre4_web.pdf?ua=1) this TDR Project aims at validating and various forms of social innovation, including but not limited to social entrepreneurship for the prevention and control of infectious diseases of poverty.

**Progress in 2014**

In early 2014, a preliminary landscape analysis of existing programmes and actors in social entrepreneurship for infectious diseases of poverty was completed. Key international players promoting and conducting research on social innovation and social enterprises have been identified and contacted. As part of the stakeholder consultation process, TDR attended three major international meetings on social entrepreneurship in Wiesbaden (organized by the Nobel Peace Prize Muhammad Yunus), Strasbourg (European Union conference) and Oxford (Skoll forum for social entrepreneurship) to better understand the landscape and also explore and negotiate potential collaborations.

The landscape analysis indicated that a great number of social enterprises and entrepreneurs exist, some of which are working in the area of infectious diseases prevention and control. There is a need for better understanding enabling and limiting factors in order to facilitate application and scale up what works. Difficulties in measuring impact highlighted the need for more research on the subject.

TDR intends to ground this activity in academically rigid research and has consequently established in 2014 a research partnership with two leading academic centres in social innovation: the Bertha Centre for Social Innovation and Entrepreneurship at the University of Cape Town Graduate School of Business – the only institution in low- and middle-income countries to promote and conduct research on social innovation and entrepreneurship; and the Skoll Centre for Social Entrepreneurship at Oxford University’s Said Business School – whose long and world-wide experience will support Cape Town University to extend its activities on social innovation beyond Africa.

The research partnership has two main objectives: 1) Generate new knowledge on existing social innovations related to health care delivery in infectious diseases of poverty in Africa, Asia and Latin America through the following approach: i) Identification of social innovations in low-resource settings which have been effective in improving health outcomes for infectious diseases of poverty; ii) case study research on the nature of the innovation, the inventor and the organisational structure delivering the innovation. 2) To provide exposure of selected effective social innovations to policy-makers by developing a fellowship programme between leading academic institutions to support social innovators in low-resource settings to grow and scale their efforts.

As part of the evolving discussion with partners of a heuristic framework it was decided that the initiative should not be limited to social entrepreneurship models but be targeted at all types of social innovation in health care delivery related to infectious diseases of poverty. These can be processes (e.g., innovative services or approaches to care), products, market mechanisms, role or behavioural practices or community-based health services. In order to conduct case study research, a nomination network is being established and a nomination call to identify ‘social innovators’ was launched at the end of 2014.
Plans for 2015

Nominations should be received by end of the first quarter of 2015 and 20-25 case studies should be selected thereafter. Case study research will be conducted by both partners following an established framework. These will then be published and disseminated through various means (publications and videos, website, conferences, international meetings, etc.). A Global South Innovators Fellowship will be launched at the end of 2015 by the partners to provide training and exposure to funders and policymakers. An expert meeting will be held to discuss social innovation and entrepreneurship in health care delivery for infectious diseases of poverty in the context of the Sustainable Development Goals (SDGs). This will help to identify and highlight specific research priorities.

In addition to the research partnership with Oxford University and the University of Cape Town, TDR is a member of the United Nations Inter-Agency Task Force on Social and Solidarity Economy and is contributing to a WHO-wide working group on innovation.

Expected Result 6: Assess insecticide resistance mechanisms in malaria vectors and their impact on control failure in Africa.

Control of malaria vectors relies heavily on insecticide-treated nets (ITNs) and indoor residual spraying (IRS). The success of these control methods is threatened by resistance of the malaria vectors to insecticides. The main goal of this study is to assess the effect of insecticide resistance mechanism(s) on malaria vector control tools in Mali, Benin and Nigeria with different epidemiological settings using long-lasting insecticide nets (LLINs) or indoor residual spraying (IRS). The study will be implemented by compiling existing data on insecticide resistance and detection of underline resistance mechanisms in specific settings. Ownership and utilization of LLNs and IRS and community perceptions of their effectiveness will be investigated followed with assessment of entomological and parasitological parameters in areas with and without insecticide resistance. The effects of intervention type (i.e. LLIN/IRS) on the entomological and parasitological outcomes will be assessed by fitting: i) logistic regression models on binary or binomial outcomes (e.g. sporozoite rates, HBI, parous rates, proportion of mosquitoes with endophagic behaviour, parasitaemia positivity rates); ii) multinomial models for categorical outcomes (e.g. vector composition); and iii) negative binomial models for counts (e.g. vector densities, malaria incidence rates). Intervention type will be treated as a categorical covariate. The models will be formulated within the Bayesian framework and fitted in Openbugs. Data to be generated from this study could inform control policy and improve knowledge on IRS/LLINs performances in areas where malaria vectors have developed different mechanisms of resistance to insecticides.

The project was approved by the WHO Ethics Review Committee in early January 2015, the agreement with the principal investigator was processed the same month and the field data collection started in January.
NEW EXPECTED RESULTS FOR 2015 AND 2016-2017

TDR research activities need to reflect the emerging health agenda of the United Nations’ Sustainable Development Goals (SDGs). Health is an integral part of SDG goals and targets, since sustainable economic and social development is not possible without health, particularly in low- and middle-income countries. In this context, research on infectious diseases of poor countries has to be transformed to better take into account the multi-faceted dynamics of economic, social and environmental determinants of health.

Consequently, VES objectives are proposed to be re-organized as “Global and Sustainable Health”. This approach means that research on infectious diseases and in particular vector-borne diseases will not be restricted to vector control or community participation or preventive chemotherapy, but investigated in a holistic way to achieve sustainable and responsible disease reduction in the context and at the interface of society and the environment. VES expected results were reorganized accordingly and four main ER topics were retained. Each topic has strong links with the others and the projects included in each topic are not independent.

The proposed new VES expected results were designed according to the JCB, STAC and SRC recommendations, after a wide consultation with WHO partners such as Global Malaria Programme (GMP), Neglected Tropical Diseases Department (NTD), Public Health and Environment (PHE) and the Regional offices (PAHO, AFRO, SEAR and WPRO), as well as a TDR Forum organized by the Knowledge Management Unit and external discussions. The projects were refined with the VES Scientific Working Group that met in February 2015.

Proposed Workplan for 2015 and 2016-2017

Environmental change and vector-borne diseases

- IDRC/TDR research initiative on population health vulnerabilities to vector-borne diseases: increasing resilience under climate change conditions in Africa (currently ER.3, 2012-2016).
- Environmental health services for the prevention and control of vector-borne diseases in South-East Asian countries (UD funds, start 2016).
- Biodiversity loss and vector-borne diseases (Strategic Development Funds, to be developed during 2016).

Expected Outcomes

- Policies and strategies influenced by new evidence about climate and environmental change impact on VBDs (2012-2016)
- Policies and strategies influenced by new evidence about environmental health services that can prevent and control vector-borne diseases in SE Asia (2016-2017)
- Policies and strategies influenced by new evidence about biodiversity loss impact on infectious diseases in poor countries (2016-2017)
Emerging challenges in the prevention and control of vector-borne diseases

- Scientific evidence on human and vector behaviour changes to address the problem of residual malaria (UD Funds, start in 2015).
- Alternative methods and innovative tools to control vectors of diseases in poor countries (Strategic Funding, start in 2015)
- Implementation of a regional network on surveillance, diagnostic and vector control of vector-borne emerging diseases in the Caribbean region (Strategic Funds, start in 2015).

Expected outcomes

- Policies, strategies and public health practice influenced by new evidence about impact of insecticide resistance on malaria control failure (2014-2016)
- Policies, strategies and public health practice influenced by new evidence about residual malaria (2015-2016)
- Research priorities defined from expert review and workshop on alternative and feasible vector control options, replaced in contexts (2015-2016)
- Conceptualization and formalization of a network on surveillance and diagnostic of emerging diseases in the Caribbean Region, and exchange of information and collaborative research on vectors (2015-2016)

Community and social dynamics

- Improved Dengue and Chagas Disease control through innovative eco-bio-social approaches with innovative ecosystem management and community interventions (currently ER.2 and ER.4, 2012-2016).
- Urban health issues in the prevention and control of vector-borne diseases (UD Funds, start in 2016).

Expected outcomes

- Policies and strategies influenced by new evidence from community-based vector control interventions in general (2008-2014) and in particular in urban agglomerations (2014-2016)
- Policies and strategies influenced by new evidence about community-based strategies for enhanced access to control interventions (2012-2016)
- The application and usefulness of social business/social entrepreneurship for the prevention and control of infectious diseases of poverty demonstrated and substantiated through framework development, landscape analysis and research (2014-2016)
- Policies, strategies and public health practice influenced by new evidence about urban health (2015-2016).
Gender equity and vector-borne diseases

- Development of a training course for capacity building on gender-based analysis in vector-borne disease research using an innovative global classroom approach (start in 2015).

Expected outcomes

- Ten to 12 projects funded for improving the career of women scientists in LMIC. (2014-2015).
## TDR Funding in 2014

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