VULNERABILITY & ADAPTATION ASSESSMENT TOOLKIT: HEALTH

User Manual

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Ministry of Social Security, National Solidarity, and Environment and Sustainable Development
(Environment and Sustainable Development Division)
Republic of Mauritius

Vulnerability & Adaptation Assessment (VAA) Toolkit (Mauritius): User Manual for Health

About this manual

This VAA-Health User Reference Toolkit manual forms part of a family of toolkits to assess vulnerability of climate change for the Health Sector. The user reference has been written from an application developer's perspective. A fundamental conceptual and operational knowledge of Excel is assumed.

Disclaimer

Data used has been obtained from reliable sources. The Ministry of Social Security, National Solidarity, and Environment and Sustainable Development (Environment and Sustainable Development Division) assumes no responsibility for errors and omissions in the data provided. Users are, however, kindly asked to report any errors or deficiencies in this product to the Ministry. The choices of calculation made in this tool are derived from TNC Report (2016).

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VAA-Health Toolkit

1. Introduction

This document refers to a user-friendly toolkit developed to assess vulnerability and adaptation in the health sector – also known as VAA-Health Toolkit for the Republic of Mauritius. The VAA for the health sector was assessed in the Third National Communications (TNC) Report (2016) for the various climate change-related impacts observed in the health sector in Mauritius.

The VAA-Health Toolkit performs basic calculations taking the indicators of the Environmental Vulnerability Index (EVI) under different health related issues. Applicable health and related indicators were shortlisted, besides some common indicators about climate. Users of the VAA-Health Toolkit can adjust the indicators by choosing appropriate parameters/assumptions to suit their needs of the vulnerability assessment.

With the significant warming trend of about 1.2°C, a decreasing trend in rainfall amount of about 8% and a projected rise of sea-level ranging between 52 cm and 98 cm by the end of the century if no mitigating action is taken (IPCC, 2013), the risk from natural disasters arising from extreme events such as cyclones, flood and droughts are expected to increase. Already, according to the World Risk Report 2016, Mauritius is ranked as the 13th country with the highest disaster risk and 7th on the list of countries most exposed to natural hazards (UNU-EHS, 2015). The vulnerability of RoM is projected to increase with these phenomena impacting adversely on its socio-economic and environmental sectors. The assessment of the vulnerability made on the basis of climate trend projections of the regional climate model COSMO-CLM, developed under the Disaster Risk Reduction Strategic Framework and Action Plan 2013 (DRR, 2013), predicts temperature to increase, with a range (depending on the seasons and scenarios) between 1°C and 2˚C for the period 2061-2070, with respect to the period 1996-2005 (TNC, 2016).

The threatening impacts of climate change are increasingly being felt with an accelerated sea level rise, accentuated beach erosion, increase in frequency and intensity of extreme weather events, decreasing rainfall patterns as well as recurrent flash floods. The climate challenges ahead for Mauritius should not be underlooked, especially when considering the facts that water supply by 2030 may not be sufficient to satisfy projected demand, agricultural production may decline by as much as 30% and that several beaches, that are so important for our tourism industry may slowly disappear, thus severely undermining one of our major economic pillars and depriving the economic value of this sector, worth over USD 50 million by 2050.

2. Overview of the Health sector

RoM has a strong health system from primary to secondary and tertiary health care, which aims to ensure equitable access to health care for the population (MoH, 2016). The healthcare industry in Mauritius has evolved significantly over the years. RoM is developing a strong foundation in several areas such as medical tourism, alternative medicine, wellness, manufacturing of medical devices and pharmaceuticals and clinical trials.

Mauritius' healthcare infrastructure includes 5 major public hospitals, 5 specialized public hospitals, 17 private multi-specialty clinics, 11 private specialized clinics and 29 medical laboratories. The Government has announced plans to upgrade its healthcare infrastructure and tenders are issued on a regular basis for medical equipment as well as for the procurement of pharmaceuticals and disposables. In the public sector, primary health care, curative health care services and hi-tech medicine are provided free of user cost to the entire population. Public hospitals are free in Mauritius. The public sector provides services to 85% of the total health care requirements of the population while the private health institutions cater for the remaining 15%.

The total expenditure on health for year 2015 was US$ 271.3 million. The per capita public expenditure on health for RoM is around US$ 214.8 or 2.4% of GDP. The estimated private expenditure on health is around MUR 7.90 billion. According to the National Health Accounts Report 2015, the health sector in Mauritius is an industry worth USD 600 million. Non-communicable diseases such as diabetes and cardiovascular disease account for 80% of total health expenditure and this demand is expected to increase in the coming years.

In the medical tourism sector Mauritius attracted more than 16,000 foreign patients in 2016 for treatment in specialty areas such as cosmetic surgery and procedures, cardiology, fertility treatment and orthopedics. Several global companies have invested in specialty centers to cater for growing healthcare needs of national and international patients. There are also significant opportunities in pharmaceutical manufacturing, medical devices and clinical trials. Preferential access to the European and African markets for Mauritian exports has attracted several international companies to set up medical devices and pharmaceutical manufacturing facilities in Mauritius. It should be noted that exports of most medical devices and pharmaceuticals from Mauritius to the United States are also duty-free. Furthermore, there are 4 companies currently conducting clinical trials in the country.

After the epidemic of chikungunya in 2005 and 2006, only 10 cases, all imported, have been reported between 2007 and 2014. Mauritius has experienced outbreaks of dengue fever for two consecutive years in 2014 and 2015. Outbreaks or occasional epidemics of vector borne diseases such as chikungunya, dengue, and new emerging influenza-like illnesses including Zika virus fever are major forthcoming challenges. With climate change and its related effects, these can be expected to be more frequent.

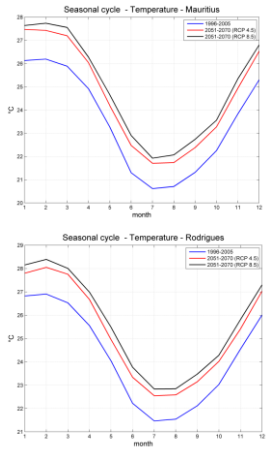
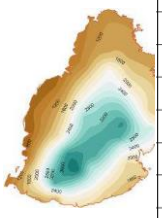
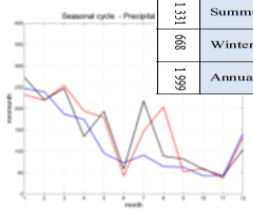
3. Climate, Climate variability and IPCC Forecasts

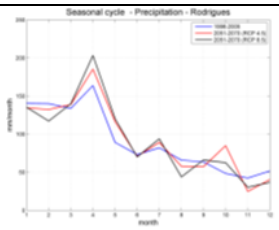
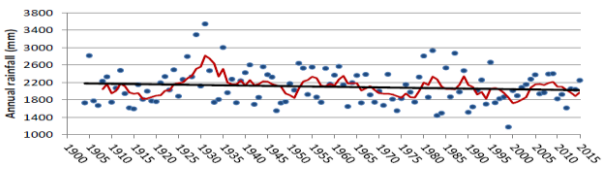
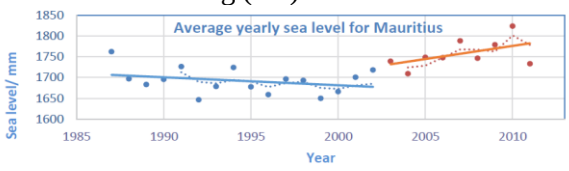
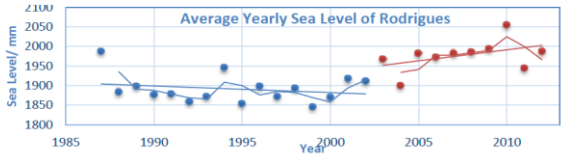
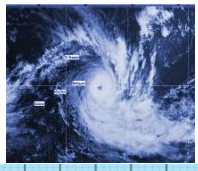
The various islands constituting the Republic of Mauritius (RoM) all enjoy a mild tropical maritime climate throughout the year. With the months of May and October described as transitional months, RoM observes two seasons:

- a warm humid summer extending from November to April and
- a relatively cool dry winter from June to September.

RoM, is located in the tropical cyclone belt of the South Western Indian Ocean (SWIO) where rapid formations of high intensity tropical cyclones and super cyclones have been observed. Table 3.1 shows the trend and projections (including future climate scenario for the region forecasted using IPCC regional models) of key weather parameters (for details see TNC, 2016). Table A1 (Appendix A) contains a list of climate change impact indicators for RoM.

Table 3.1: Trend and Projections of key weather indicators (TNC, 2016)

Indicator (TNC)	*Past and Present Trend (MMS)*	*Projections*
Temperature 	The mean temperature over Mauritius is 24.7°C during summer and 21.0°C during winter. The temperature difference between the two seasons is relatively small and it varies from place to place and is usually larger over coastal areas when compared to the Central Plateau. Records over the period 1951-2014 show a significant warming trend of about 1.2 °C in both Mauritius and Rodrigues. Analysis of temperature records indicate that the observed rate of temperature change is on average 0.020°C/yr and 0.023°C/yr for Mauritius for the period 1951-2014 and for Rodrigues for the period 1961-2014, respectively.	IPCC reckons an increase in mean annual temperature of up to 3.8°C by 2100; Projections made on the basis of RCP 4.5 and RCP 8.5 (the business as usual scenario and the worst case scenario, resp.) indicate an increase in temperature of up to 2 °C over Mauritius and Rodrigues for the period 2051-2070.
Rainfall  January 268 February 335 March 264 April 210 May 148 June 110 July 129 August 105 September 100 October 76 November 79 December 175 Summer 1331 Winter 668 Annual 1999 	From the mean monthly rainfall data for the period 1981-2010, February is the wettest month and October is the driest. Records over the period 1951-2014 show a decreasing trend in rainfall amount of about 8% for Mauritius and a change in precipitation pattern. For Rodrigues, which is a water scarce island, a downward trend has also been observed in the rainfall compared to the data of the 1960's. The trend and the 5-year moving average for the long-term variations in annual rainfall over Mauritius indicate a steady decreasing trend over the period 1904 to 2015.	A declining trend in total annual rainfall, but an increase in the frequency of intense rainfall episodes (Gastineau and Soden, 2009); Projections for RCP 4.5 and RCP 8.5 scenarios, does not show significant variation with respect to the present rainfall pattern. There will be a shift in rainfall distribution, over Mauritius (e.g., from March to October season). Further reduction in amount of water by 13% by 2050.

	The Central Plateau, the main recharge zone of  the island, has endured a decrease from a maximum of ~4000 m m/year (1951-1980) to ~3800 mm/year with more pronounced drying to the North and the West.	For Rodrigues, the interpretation of the model projections is quite complex as no clear long-term-trend could be identified. However, wide variations emerge across seasons, with a projected decrease in rainfall over the summer months and a likely increase over the transition months.
Sea level	Analysis of sea level data indicates an accelerated rise of 5.6 mm/yr and 5.1 mm/yr for, strikingly, for both Mauritius and Rodrigues, respectively since 2003, much higher than the global average of 3.2 mm/yr. The local mean sea level rose by 2.1 mm/year since mid-90's. The average yearly sea level for the period (1987 to 2011) along with the trend line and the 2-year moving average for Mauritius and those for Rodrigues clearly demarcates into a period when sea level was decreasing (blue) and a period when it is increasing (red).  	Sea level rise (SLR) of 18 – 59 cm by 2100; SLR of about 35 cm if the rate remains constant over the next 90 years;
Cyclones  	Cyclone season is normally from November to mid-May. For the cyclone seasons from 1975-76 to 2014-15, data show that: a) mean number of named tropical storms/cyclones in the SWIO has not changed; b) frequency of storms reaching at least tropical cyclone strength has increased; c) rate of intensification of tropical storms has increased, and a higher number of explosive intensification has been observed over the last 15 years; d) no change in latitudinal cyclogenesis has been observed. For cyclones which reach Category 5 intensity wind gusts can attain over 345 km/h. An increase in the intensity and the rate of intensification is also evident since 1975.	An increase in the intensity and rate of intensification of tropical (Lal et al, 2002);

4. Change: Vulnerabilities, Impacts, and Projections on the Health sector

Table A1 (Appendix A) contains a list of climate change impact indicators for RoM.

Mauritius

The end-determinant of the extent of health impacts of climate change on development is the interplay of geography, political governance, health infrastructure and socio-demographic profiles. As Mauritius does not have a landmass for re-locating vulnerable population, it may be disproportionately impacted.

Globally, a number of health conditions have been linked to climatic risk factors such as heat waves leading to stroke; rise in diarrheal diseases and vector-borne diseases like malaria and dengue; food insecurity; water insecurity, and malnutrition (WHO, 2015). Mauritius is prone to both local and imported cases of dengue and chikungunya viral fevers.

Circumstantial information links the rise in temperature in Mauritius to increase in vector-borne diseases. For example, an increase in vector-borne diseases was observed for the first time in 2006 with an epidemic of some 9,000 cases of chikungunya fevers. This was followed by epidemics of dengue observed for the first time in 2009 recording some 300 cases island-wide with successive outbreaks in the years 2011, 2014 and 2015 (Figure 4.1). These outbreaks coincided with the gradual increase in temperature from 1950 to 2005 as observed by the Mauritius Meteorological Services (Ministry of Health statistics report for 2015). These circumstantial evidences taken against the globally-projected dengue rise (Fock, 1995) argues for climate change as a possible cause of vector-borne diseases in Mauritius.

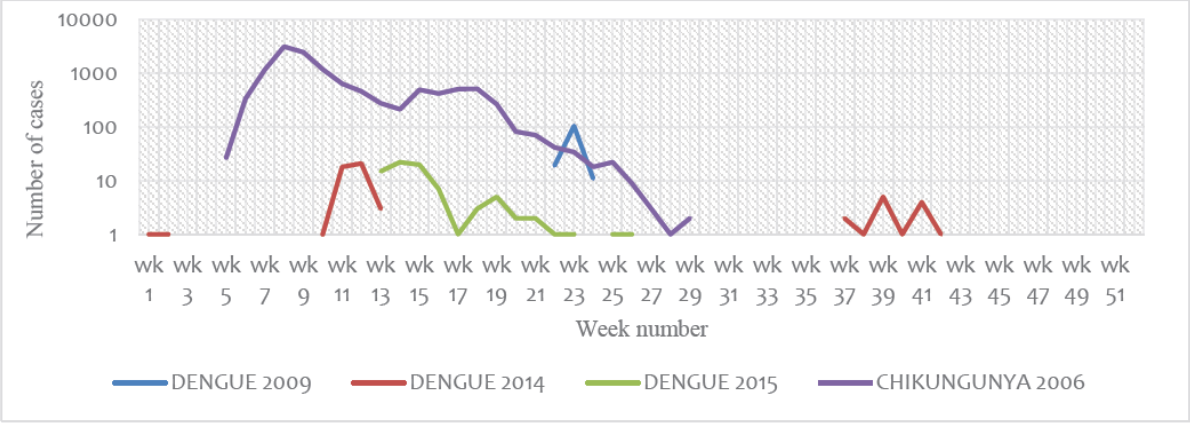


Figure 4.1: Epidemics of vector-borne diseases in Mauritius
(Source: Ministry of Health and Quality of Life)

Additional circumstantial evidence is obtained from observations on climate-sensitive diseases that include the annual occurrence of episodes of conjunctivitis and gastroenteritis in the summer months and annual cases of respiratory diseases in the winter months. For example for the period 2010 to 2015, an average of 35 000 cases of gastroenteritis and some 600 000 cases

of respiratory diseases were registered annually. Additionally, for the same period of observation, some 2 500 cases of mental illness were also noted. These observations highlight the high prevalence of climate sensitive diseases that may be amplified by climate change.

Climate change may increase the vulnerability of the health sector in the coming decades leading to higher disease burden with associated health cost and impaired socio-economic development in the Republic of Mauritius. Climate change may lead to an increase in communicable diseases and may exacerbate the effects of the already high prevalence of non-communicable diseases that is affecting some 80% of the population. The net effect may be an increase in the rate of cardiovascular diseases, strokes and renal diseases thus creating a situation of double burden of communicable and non-communicable diseases, including injuries and worsening of nutrition and food security. The health sector will bear spill-over effects from other sectors, for which preventive action is needed.

Rodrigues

Climate change will lead to negative health impacts.

For Rodrigues the re-location of its vulnerable population may pose serious difficulties and disproportionately impact the island population, with resulting impacts of its health.

The circumstantial evidence from Mauritius and elsewhere argues for the fact that climate change may induce epidemic-prone diseases in Rodrigues. It will also increase the vulnerability in the health sector requiring increased health care services. As health is inextricably linked to development, the adverse impact of climate change may have profound socio-economic impacts on the island.

5. Adaptation Strategies proposed under the TNC

Mauritius

In order to address the challenges posed by the health impacts of climate change and concomitantly attain the Sustainable Development Goals by 2035, GoM, in collaboration with other relevant entities, may adopt a three-pronged approach (Table 5.1).

Table 5.1: Adaptation policies related to the reduction of vulnerabilities of Health sector (TNC, 2016)

Action proposed	Means of implementation and expected results
Strengthen climate-resilient health systems	This is essential for enhanced preparedness to cope with the anticipated surge in burdens from climate-sensitive diseases such as vector-borne diseases, respiratory and diarrheal diseases; diseases and injuries associated with extreme events; worsening of food security and nutrition, and mental health disorder including post-traumatic stress. Anticipated strategies will include expansion and strengthening of new public health infrastructure, development of public policy as well as institutional and professional capacity development
Strengthen preventive measures to avert disease burden attributable to climate change	This objective may be achieved through enhanced surveillance in the form of early warning system for the monitoring, surveillance and management of health events. A series of actions could include (a) contingency planning, (b) identification of vulnerable exposed communities for monitoring, forecasting and predicting possible adverse health effects, and (c) the adoption of healthy life-style and nutrition habits by promoting health promotion strategies
Target response for triggering effective and timely response	In order to reduce the incidence of morbidity and mortality from disease burden associated with climatic changes, action could include (a) dedication of trained health care workers (b) procurement of essential medicines, emergency supplies kits, and (c) expansion of possible range of currently available vaccines

The implementation of the VAA strategies (Table 5.2) is expected to reduce vulnerability to climate change, and decrease morbidity and mortality. The avoided cost of these strategies includes reduced health expenditure and private insurance premium or out of pocket expenses for the vulnerable. The resulting added co-benefits include increase in life expectancy and a healthy population. These benefits may catalyse economic growth and social stability.

Table 5.2: VAA strategies for addressing current problems and transforming development challenges into new opportunities for achieving the development goals in the health sector (TNC, 2016)

Sector	Development challenges	Goals	VAA strategies	
			To address current problems	To create new opportunities
Health	i) Increase in climate-sensitive-vector-borne and epidemic-prone diseases ii) Extreme events and related health impacts (e.g. respiratory and epidemic diseases) iii) Disaster-induced injuries and diseases iv) Worsening of nutrition and food security and safety	Strengthen climate-resilient health system for preparedness	**H1.** Strengthen infrastructure to monitor and control diseases and manage patients	**HN1.** Formulate climate-sensitive public health policy
		Strengthen preventive measures to avert disease burden attributable to climate change	**H2.** Surveillance of diseases, monitoring of vector density and abnormal levels of climate-sensitive environmental hazards	**HN2.** Health promotion for education, risk communication and dissemination of information on preventive strategies
		Targeted response for triggering timely response to reduce incidence of disease, morbidity and mortality	**H3.** Train and dedicate staff for managing increase in disease burden attributable to climate change	**HN3.**Stock piling of medicine and essential medical supplies

Note[1]: H1 etc. refer to proposed strategies to address current problems
Note[2]:HN1 etc. refer to strategies for creating new opportunities while addressing the current problems

An integrated approach that identifies the intervention options, which turn challenges into opportunities, the corresponding required investments, and the resulting policy-induced avoided costs and added benefits in the human health sector are given in Table 5.3 below.

Rodrigues

In order to address the challenges posed by health impacts of climate change and concomitantly attain the Sustainable Development Goals by 2035 in Rodrigues, RoM, through the Rodrigues Regional Assembly and in collaboration with other relevant entities, could adopt the three-pronged approach as in the case of Mauritius and given in Table 5.1.

In the health sector in Rodrigues, the development challenges, goals and the VAA strategies to address current problems and create new opportunities are very similar to those of Mauritius. In particular, the implementation of the VAA strategies is expected to reduce vulnerability to climate change, and decrease morbidity and mortality in Rodrigues (Table 5.2).

An integrated approach that identifies the intervention options, which turn challenges into opportunities, the corresponding required investments, and the resulting policy-induced avoided costs and added benefits in the health sector are given in Table 5.4 below.

Human Health - *Transforming challenges into opportunities* (Mauritius)

Strategies (H1etc.) and corresponding actions (H1.1 etc.) and investments from Households (*H*), Government (*G*) and Private sector (*P*) with resulting policy-induced avoided costs and added benefits

	Strategies	Action List	Investment	Avoided costs	Added benefits
H1	Infrastructure to monitor and control diseases and manage patients	**H1.1.**Upgrade capacity of health facilities to cope with surge of climate-sensitive diseases and conditions **H1.2.** Create an observatory fpr climate-related illnesses and a department for vector-borne and climate-sensitive diseases	*H:* Taxation *G:* equipment, labour *P:* Tax contribution	*H:* infections, death and health cost *G:* health costs(staff, medicines) *P:*productivity loss, insurance	*H:*well-being, life expectancy *G:*budget surplus (lower deficit), tax revenues *P:* revenues and profit
H2	Formulate climate-sensitive public health policy	**H2.1.** Formulate public health policy on health impacts of climate change **H2.2** Forge inter-ministerial collaboration through climate health panel **H2.3.**Develop and implement protocols to monitor performance indicators	*H:* N/A *G:* Labour and consultancies *P: time* (in-kind)	*H:*out of pocket expenses *G:*public spending *P:* health insurance (no increase)	*H:*social cohesion *G:*budget surplus (lower deficit) *P:*N/A
H3	Surveillance, monitoring and control of vectors, diseases and environmental hazards	**H3.1.**Implement Early Warning System of surveillance to monitor trend of vectors, environmental hazards and climate-sensitive disease and conditions **H3.2.**Introduce new techniques for the control of mosquitoes	*H:* Cost of air conditioning and mosquito repellents *G:* research funding, media and communication *P: research* funding	*H:* reduced malpractice and health cost *G:*public spending *P:*health insurance (no increase)	*H:*well-being, life expectancy *G:*budget surplus (lower deficit), tax revenues *P:*N/A
H4	Health promotion for education and communication dissemination on preventive strategies	**H4.1.**Develop Information, Education and Communication plans to address perceptual and behavioural obstacles to climate change **H4.2.**Promote healthy life-style, nutrition habits and vector control strategies	*H: N/A* *G:* cost of designing, printing and dissemination *P:* advertising cost	*H:* infections, death and health cost *G:*public spending *P:*productivity loss, health insurance	*H:*well-being, healthy lifestyle, income *G:*tourism arrivals/revenues *P:* tourism arrivals, revenues and profit
H5	Train and dedicate staff for managing increase in disease burden attributable to climate change	**H5.1.**Develop curricula for life-long learning, in collaboration with academia **H5.2.** Train and dedicate workforce for managing climate-sensitive health conditions	*H: tuition* fee *G:*labour, expert/trainer, tuition fee/scholarship *P:* tuition fee	*H:* out of pocket expenses *G:* public spending on vulnerable groups *P:*insurance pay on vulnerable group	*H:*healthy family *G:*informed consumer *P:*healthy employees
H6	Stock piling of medicine and essential medical supplies	**H6.1.**maitain a stock of emergency medical supplies **H62.**Expand the range of vaccines	*H: N/A* *G*: cost of building recreation centers and nutritionist salaries *P: nutritionist* salaries	*H:*non communicable disease cost *G:*Public spending *P:*productivity loss, health insurance	*H:*reduce heart disease and obesity *G:*reduce health expenditure *P:*saving on insurance premium

Health - *Transforming challenges into opportunities* (Rodrigues)
Strategies (A1etc.) and corresponding actions (A1.1 etc.) and investments from Households (*H*), Government (*G*) and Private sector (*P*) with resulting policy-induced avoided costs and added benefits

	Strategies	Action List	Investment	Avoided costs	Added benefits
H1	Infrastructure to monitor and control diseases and manage patients	**H1.1.**Upgrade capacity of health facilities to cope with surge of climate-sensitive diseases and conditions **H1.2.**Create department climate-sensitive diseases	*H:* Taxation *G:* equipment, labour *P:*Tax contribution	*H:* infections, death and health cost *G:* health costs(staff, medicines) *P:*productivity loss, insurance	*H:*well-being, life expectancy *G:*budget surplus (lower deficit), tax revenues *P:* revenues and profit
H2	Formulate climate-sensitive public health policy	**H2.1.**Formulate public health policy on health impacts of climate change **H2.2** Forge interministerial collaboration through climate health panel **H2.3.**Develop and implement protocols to monitor performance indicators	*H:* Taxation *G:*Labour and consultancies *P:* time (in-kind)	*H:*out of pocket expenses *G:*public spending *P:* health insurance (no increase)	*H:*social cohesion *G:*budget surplus (lower deficit) *P:*N/A
H3	Surveillance, monitoring and control of vectors, diseases and environmental hazards	**H3.1.**Implement Early Warning System of surveillance to monitor trend of vectors, environmental hazards and climate-sensitive disease and conditions **H3.2.**Introduce new techniques for the control of mosquitoes	*H:* Cost of air conditioning and mosquito repellents *G:*research funding *P:* research funding	*H:*reduced malpractice and health cost *G:*public spending *P:*health insurance (no increase)	*H:*well-being, life expectancy *G:*budget surplus (lower deficit), tax revenues *P:*N/A
H4	Health promotion for education and communication dissemination on preventive strategies	**H4.1.**Develop Information, Education and Communication plans to address perceptual and behavioural obstacles to climate change **H4.2.**Promote healthy life-style, nutrition habits and vector control strategies	*H:* Community involvement *G:*cost of designing, printing and dissemination *P:*advertising cost	*H:*infections, death and health cost *G:*public spending *P:*productivity loss, health insurance	*H:*well-being, healthy lifestyle, income *G:*tourism arrivals/revenues *P:* tourism arrivals, revenues and profit
H5	Train and dedicate staff for managing increase in disease burden attributable to climate change	**H5.1.**Introduce Continued Medical Education, CME for life-long learning, **H5.2.** Train and dedicate workforce for managing climate-sensitive health conditions	*H:* tuition fee *G:*labour, expert/trainer, tuition fee/scholarship *P:* tuition fee	*H:*out of pocket expenses *G:*public spending on vulnerable groups *P:*insurance pay on vulnerable group	*H:*healthy family *G:*informed consumer *P:*healthy employees
H6	Stock piling of medicine, essential medical supplies and human resource deployment	**H6.2.**maitain a stock of emergency medical supplies **H6.3.**Expand the range of vaccines **H6.4**.Deployment of human resources	*H:* N/A *G*: cost of building recreation centers and nutritionist salaries *P:* Nutritionist salaries	*H:*non communicable disease cost *G:*Public spending *P:*productivity loss, health insurance	*H:*reduce heart disease and obesity *G:*reduce health expenditure *P:*saving on insurance premium

Cross-sectoral considerations

Cross-sectoral considerations (Table 5.5) are now taken into account to identify and highlight entry points for interventions that will lead to increase efficiency of budget allocation and policy implementation. The strategies that more markedly contribute to the overall development include capacity building and awareness-raising, along with improved data collection and analysis. In addition, ecosystem restoration (terrestrial and marine) was identified as an ideal intervention in six of the seven sectors analysed. The main benefits identified when considering cross-sectoral dynamics include a reduction in public spending (with several instances in which avoided costs emerge) along with an increase of public revenues (e.g. tax revenues, through increased economic activity); employment creation (across all sectors and interventions); improved well-being (with better health and a reduction of injuries and diseases); and an amelioration of leisure opportunities (both for the local population and for tourists).

Table 5.5: Policy interventions and their inclusion in sectoral strategies (TNC, 2016)

	Sustainable land use planning	Ecosystem restoration	Resource efficiency	Integrated water management	Climate resilient infrastructure	Eco-tourism	Institutional capacity and support	Awareness raising	R&D and data analysis
Agriculture	√	√		√			√	√	√
Coastal areas and tourism	√	√	√	√	√	√		√	√
Water		√	√	√				√	√
Biodiversity	√	√				√		√	√
Fisheries	√	√					√	√	√
Health					√		√	√	√
Infrastructure		√		√	√	√	√	√	√

Table 5.6 highlights some of the more outstanding opportunities emerging from cross-sectoral linkages for the Health sector.

The upgrading of the health system for the monitoring of climate-sensitive disease surveillance and food security would benefit households and the tourism sector, in addition to the private sector (through higher labour productivity). Policies implemented in other sectors can have a positive impact on the health sector. These may include better water and land use management and may avoid the growth of carriers of vector-borne diseases.

Table 5.6: Strategies and opportunities emerging from cross sectoral linkage for the Health sector (TNC, 2016)

Mauritius	Rodrigues
Strategies Upgrade the health system for the monitoring of climate-sensitive disease surveillance and food security ***Direct Cross cutting issues/ benefits*** would benefit households and the tourism sector, in addition to the private sector (through higher labor productivity ***Other benefits and remarks*** Policies implemented in other sectors can have a positive impact on the health sector include better water and land use management, to avoid the growth of carriers of vector borne diseases	***Strategies*** Strengthen preventive measures to avert disease burden attributable to climate change; target response for triggering effective and timely response in order to reduce incidence of morbidity and mortality from disease burden associated with climatic changes.

6. VAA-Agriculture Toolkit

The structure, methodology, and components/modules of the VAA-Health Toolkit has been described in the main User Manual.

7. References

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8. Appendices

Appendix A

Key Climate Change Impact indicators for RoM

Table A1: Key CC Impact indicators for RoM (source: DRR Report, 2016)

Indicator	*Trend (DRR Report)*	*Cases*
Beach Erosion	17% of the beaches are suffering from long term erosion and that 23% are being accreted, the remaining 59% are considered as being stable. A loss of **10 meters** of beaches over the last 8 years has been observed.	At Pointe aux Cannoniers, in the north of the island the shoreline has retreated by 10m and up to 18m within 45 years from 1967, with the volume of sediment loss amounting to 10,000 m^3. Mon Choisy, the shoreline has retreated by 12m on average and 18m at the maximum within the same period of time with a sediment loss of 20,000m^3 loss. Coral condition at Mon Choisy has been noticed to be relatively worse comparing to other coral reefs in Mauritius.
Flash Floods	Some 19-30 km2 of agricultural land, 5-70 km2 of built up land, 2.4-3 km of motorway, 18-29 km of main roads and 68-109 km of secondary roads are at risk of flooding. The damages to building and infrastructures have been estimated to be around USD 2 Billion in 50 years (2070 horizon).	Increase in the frequency of extreme weather events more frequent torrential rains resulting in flash floods, causing 11 deaths in March 2013. During recent heavy rainfall in January 2015, over 250 sites were flooded in Mauritius. During the first five days of May 2017, Mauritius recorded a mean rainfall of 275mm which represents 186% of the long term mean rainfall for the month; the Eastern part recording almost 300% of its normal rainfall. The flash flood of May 2017 affected around 74 households in the Flacq region namely, Central Flacq and Poste de Flacq (Cite Hibiscus, Camp Poorun and Cite Débarcadére).
Landslides	As heavy precipitation events increase, so does the risk of landslide. In Mauritius, 3 mountainous/hilly zones (enclosing 38 localities) are highly prone to landslide. The estimated values of built up areas and roads exposed to landslide are in the order of 7233 Million USD and 196 Million USD respectively.	These are 3 zones are notably regions around Vallee des Pretres-Chitrakoot, Quatre Soeurs-Louis de Rochecouste and Grande Riviere Noire-Chamouny. Regions such as Chitrakoot and Quatre Soeurs have recurrently been affected by landslide events such that in situ infrastructures are prone to damages. More recently the Terre Rouge-Verdun road was damaged due to landslide after a heavy downpour.
Coastal Inundation and Storm Surges	According to the DRR report, 12.2 km2 of built-up land, 11.8 km2 of expansion areas and 60 km of primary and 80 km of secondary roads are identified at risk to inundation as a result of sea surges. The damages to building and infrastructures has been estimated to be around 1.4 Billion USD for inundation in 50 years (2070 horizon).	According to scenarios established in the DRR, the north area of Mauritius is highly exposed to coastal risk, especially the zone between Pointe aux Cannoniers and Cap Malheureux. Analogously, the entire shoreline between Mon Choisy and Baie de l'Arsenal seem to be subject to significant inundation. Besides, high coastal risk appears in correspondence of Port Louis area from Baie du Tombeau to Baie de la Grande Riviere. The same type of problem is found in the south of Flic en Flac, through Baie de Tamarin up to Baie de la Grande and Petite Riviere Noire. Along the southern border, localized issued are in Pointe aux Roches, Pomponette, Riambel and in Mahebourg. Along the eastern coast, high local

		risk has been identified at Trou d'Eau Douce, Poste de Flacq and Roche Noires.
Sea water intrusion	Problem of salinity due to sea water intrusion in the water ponds on farms in the south eastern and south coastal belts.	Areas such as Belle Mare, Palmar, Quatre Soeurs and Deux Frères, Bambous Virieux and Pomponette has been observed.
Forest/Bush Fire	Climate change is projected to increase the extent, intensity and frequency of forest fires in certain regions of Mauritius. Warmer summer temperatures, coupled with decreases in water availability, dry out woody/dry grasses materials in forests/grassland increases the risk of wildfire.	Regions that are regularly plagued by wildfires in Mauritius include: Signal Mountain, La Ferme, Ile D'Ambre, Petit Sable and Ile aux Benitiers.
Coral Bleaching	El Niño Southern Oscillation (ENSO) generated massive bleaching and coral mortality during 1982-1983, 1997-1998, 2002-2003, 2005, and 2010, and contributed to the likely extinction of a coral species. In 1998, the NOAA reported an episode of extremely high ocean temperatures migrated from south to north throughout the Indian Ocean during the first six months of 1998 causing considerable coral reef bleaching in its wake. It was estimated that 16% of the world's coral was lost.	Bleaching has been reported in the Indian Ocean reefs of Mauritius as well as in Seychelles, Reunion, Madagascar and Maldives, amongst others. The coral reefs of Rodrigues which escaped the mass coral-bleaching event of 1997-1998, was affected by the 2016 El-Nino event. Surveys showed occurrences of severe bleaching leading to the mortality of up to 75% of corals at some sites, particularly in the North and West of Rodrigues.
Acidification	Since the beginning of the industrial era, oceanic uptake of CO_2 has resulted in acidification of the ocean; the pH of ocean surface water has decreased by 0.1 pH units (high confidence), corresponding to a 26% increase in acidity. The ocean has absorbed about 30% of the emitted anthropogenic CO_2, causing ocean acidification. According to the Fifth Assessment Report of the IPCC, Earth System Models project a global increase in ocean acidification for all RCP scenarios by the end of the 21st century. The decrease in surface ocean pH is in the range of 0.06 to 0.07 (15 to 17% increase in acidity) for RCP 2.6.	