HYDROMETEOROLOGICAL AND CLIMATE SERVICES MODERNISATION PLAN FOR **NICARAGUA**

Strengthening INETER as the leading organisation in generating and supplying knowledge and information supporting management of the risks and effects of climate change.

JANUARY 2019

COLLABORATION BETWEEN
THE GOVERNMENT OF NICARAGUA
AND THE WORLD BANK

WORLD BANK GROUP

GFDRR
Global Facility for Disaster Reduction and Recovery

EXECUTIVE SUMMARY

Hydrometeorological phenomena such as hurricanes, flooding, drought and landslides have significant influence on the population and economy of Nicaragua. Between 1994 and 2013, the average number of deaths due to hydrometeorological disasters was 160 per year, with average annual losses of 301.75 million dollars —purchasing power parity[1]—, which is equivalent to an average annual loss per unit of GDP of 1.71%[2].

In Nicaragua, extreme rainfall is the most common natural phenomenon, with the highest social impact. The greatest source of damage and loss of life is linked to hurricanes that generate storms that lead to flooding, erosion and landslides. In 2007, hurricane Felix caused damages and loss equivalent to 14.4% of GDP; and in 2011, tropical depression 12E caused damages equivalent to 6.8% of GDP. Landslides represented almost 75% of all deaths related to natural disasters in Nicaragua in the period 1990-2014[3]. In comparison, floods and sudden swellings represented approximately 15% and 3%, respectively.

Also during the years of *El Niño*, the probability and intensity of droughts increased. For instance, in 2014, Nicaragua underwent one of the worst droughts ever recorded with approximately half a million people affected and a resurgence of the cases of malnourishment in several areas of the Dry Corridor[4]. 90% of agricultural production in the country depends on rainfall and only 10% is cultivated using irrigation, which shows that a significant part of the economy y depends on climate conditions.

In order to react on time, make informed decisions and prevent impacts, monitoring and analysis of meteorological, hydrological and climate conditions are required. This includes drafting forecasts for the coming hours and days, as well as weekly, monthly, seasonal and year-on-year weather prospects, and their interpretation and implementation in the management of water resources, agriculture or energy production, for instance. The main users of this information and services are the water industries (ANA[5], ENACAL[6], Nuevo FISE[7] and MARENA[8]), the management of disaster risk (SINAPRED[9]) and agriculture (MAG[10], INTA[11] and UPANIC[12]).

Other users include the health, tourism and the sea and land transport industries, the construction business, engineering companies, insurance companies and the media. The National Territorial Studies Institute (INETER) is the main supplier of hydrometeorological and climate services required by different economic sectors and the population at large.

In the current conditions, the supply of hydrometeorological and climate information for different

[1] Purchasing Power Parity (PPP) converts different currencies to a common currency and, in the conversion process, balances their purchasing power by eliminating price level differences between countries.
[2] Germanwatch: Global Climate Risk Index 2014.
[3] See http://www.preventionweb.net/countries/nic/data/
[4] United Nations Food and Agriculture Organisation (FAO), Study characterising the Central American Dry Corridor. Book I, December 2012.
[5] National Water Authority.
[6] Aqueducts and Sewage System Company of Nicaragua.
[7] New Social Investment Emergency Fund.
[8] Ministry of the Environment and Natural Resources.
[9] National System for the Prevention, Mitigation and Attention to Disasters.
[10] Ministry of Agriculture and Farming.
[11] National Institute for Agricultural and Farm Technology.
[12] Agricultural and Farm Producers Union of Nicaragua.

socioeconomic sectors and the country's ability to analyse and forecast are insufficient. Bridging the gap in the existing hydrometeorological and climate services is a priority. Otherwise, the safety of the population will be limited and industries that are sensitive to hydrometeorological phenomena such as agriculture won't have the information necessary to respond to such events.

In order to strengthen the generation of products and improve the services provided to users, a Modernisation Plan has been devised that will provide a short, middle and long term strategy. With a large number of partners and projects related to hydrometeorology, this plan also serves to coordinate the activities carried out by different projects with different financing sources and between the participating institutions.

Ultimately, this plan will serve to support the resilient development of Nicaragua to climate variability and change by means of strengthening and integrating the quality and availability of climate, meteorological and hydrological information and services.

PREPARING THE MODERNISATION PLAN

The Plan results from an analysis of the limitations and gaps that exist between: a) services currently provided and the technical and institutional capacities of INETER as main supplier; and b) the needs of users.

The main limitations and challenges include:

1. INETER works under an inflexible legal framework that hinders its mission, especially at internal level between the different technical areas.

2. The physical premises of INETER are affected by a seismic fault, which places current and future staff and monitoring and analysis equipment at risk. Moreover, its current physical distribution makes it impossible to operate as a National Hydrometeorological Service.

3. The human and financial resources available at INETER are insufficient to satisfy the demand from users and to develop new services. The technical ability of the professional and technical staff is very limited, both in amount and level of qualification. In the area of meteorology at INETER there are 68 people working in technical and professional positions, out of which only one person has a high technical level in meteorology. None of the professional workers specialises in meteorology or has a Master's or Doctorate degree. The situation is similar in the case of hydrology: INETER has 13 civil and agricultural engineers and 12 technical staff in areas related to hydrology and hydrography. No professional workers specialise in hydrology.

4. INETER has limited interaction at institutional level with the industries to which its users belong or with the end users. There are minimal cooperation agreements in place with other institutions.

5. Current infrastructure for meteorological and hydrological monitoring is limited, not only in the Atlantic region but also in the western region of the country. Measuring equipment has become obsolete and a limited number of stations only

transmit real-time information. Limited budgets for maintenance and investment have led to its progressive wear of the infrastructure for observation. For instance, the 2016 operational and maintenance budget stood at 11% of what international practice recommends.

6. Efficiency in operating, running and maintaining the infrastructure for observation is limited. The meteorological and hydrological equipment is not calibrated periodically to count on reliable quality information. There is no calibration and maintenance programme in place (this includes the meteorological radar and calibration for rain estimates).

7. There is limited capacity for meteorological forecasting using models adapted to the weather conditions in Nicaragua and using modern tools including remote sensors, both in regard to a shortfall in qualified human resources and in regard to processing equipment and observation networks with automatic stations and real-time data transfer. No data integration is carried out with quality control for hydrometeorological and climate models and forecasts.

8. INETER has no real-time access to satellite images required to monitor meteorological and environmental conditions and the issuing of relevant warnings and forecasts.

9. Access to information and the number of services provided by INETER to its users is currently limited. INETER doesn't currently have access to an integrated hydrometeorological and climate database for internal use and to assist users promptly. Furthermore, a large amount of information is only available analogically and, therefore, isn't available for analysis. There is the added risk of losing such information.

10. There is hardly any participation from users in defining any meteorological, hydrological and climate products and services. Efficacy regarding the communication of services is limited, as well as the ability of users to interpret the information correctly.

11. INETER does not have a hydrological modelling programme in place to improve early warning systems against flooding and the management of water resources, as demanded by several groups of users in the country. The network of hydrometrical stations for hydrological modelling is limited and there are areas where this information is not available. Hydrology professionals are also scarce.

12. Early warning systems (EWS) for a more relevant prevention of flooding and landslides do not yet include rainfall forecasts in their prediction models. Communication of the information regarding EWS to the communities of users is limited.

13. There are no seasonal and year-on-year climate forecasts available for the agricultural and farming, water, energy and environmental industries, which are suitable to manage drought, especially in the Dry Corridor. There are no tools currently available to monitor drought, such as an estimate of soil humidity using satellite data.

14. There is an increasing demand for climate information from public and private institutional users and from the general population. INETER doesn't yet have in place a climate service programme to respond to such demand for information with the participation of different groups of users.

15. Aeronautical meteorology services for aviation provided by INETER to the several airports in the country are partially reimbursed by the air transport authority. Return of costs is not carried out according to the current agreement and on the basis of the recommendations of the International Civil Aviation Organisation (ICAO) and the World Meteorological Organisation (WMO).

CONTENT OF THE MODERNISATION PLAN

The Modernisation Plan is a description of the modernisation goals for meteorological, hydrological and climate services (MHCS) and the results expected, presented within a timeframe of specific actions and activities.

Furthermore, the Plan is a useful tool to manage the expectations of the stakeholders and serves also to communicate the plans and to coordinate resources with all institutions involved. As such, the plan has a strategic nature and, therefore, does not include a detailed implementation plan with execution times, specifications or reference terms or prior agreements with the users.

Given its institutional competences, the Plan focuses mostly on strengthening INETER. However, its scope is wider. Although this institution plays a very active role, its purpose extends to coordinating value chains for meteorological, hydrological and climate services that include other institutions that collect data and user groups. Therefore, the strengthening of meteorological, hydrological and climate services is a cross-sectoral activity that should involve several institutions from the public and economic sectors and the general population, establishing a true national hydrometeorological and climate-related system.

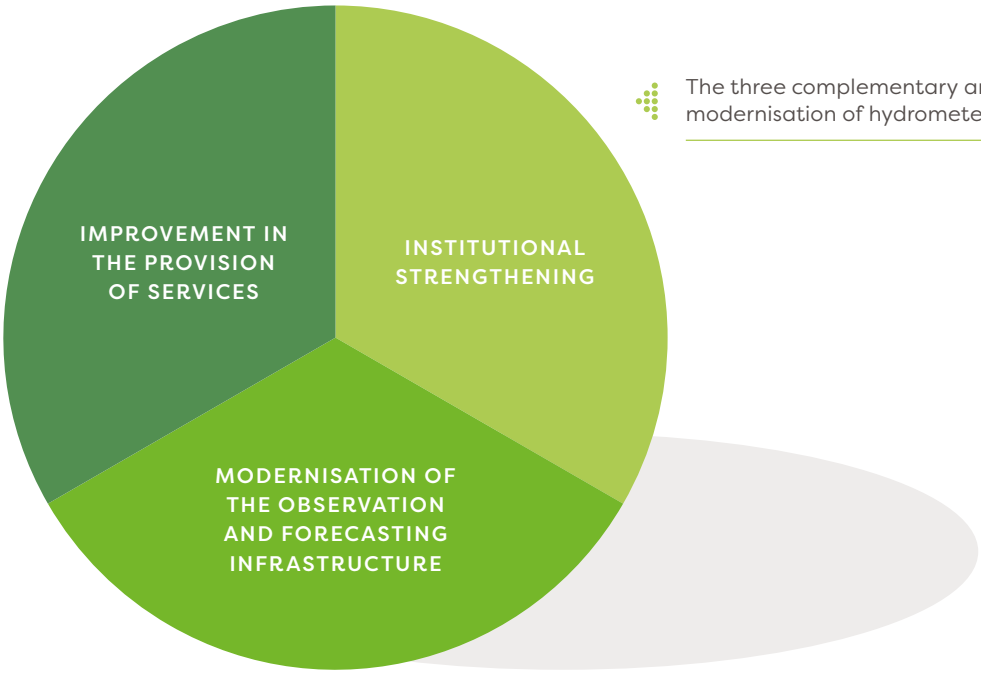
The experience in many countries that have undertaken such a process has shown that the modernisation of hydrometeorological services must tackle three areas in a complementary manner:

A) Institutional strengthening.

B) Modernisation of the observation and forecasting infrastructure.

C) Improvement in the provision of services.

The plan puts forward **22 activities grouped into three areas and is structured along a 6-year period**, with activities to be implemented in the short (1 to 3 years) and middle term (4 to 6 years). Below is a summarised description of the 22 activities proposed and the expected results.



The three complementary areas towards the modernisation of hydrometeorological services.

A INSTITUTIONAL STRENGTHENING

1. IMPROVEMENT IN THE ORGANISATIONAL STRUCTURE AND OPERATION OF INETER

Review the organisational structure of INETER in regard to its operation and functions (meteorological, hydrological and other related departments). The aim is to turn it into a modern institution with a flexible operation that responds to the current and future challenges faced by Nicaragua and in following with WMO recommendations. Additionally, the recommendation is made to renew the physical premises of INETER in such a way that allows it to undertake its role in a safe and efficient manner in fulfilling its mission.

RESULTS EXPECTED: An institution with an efficient and flexible structure with safe working spaces that are functional and fully equipped for the operation and internal collaboration within INETER as well as laboratories equipped for the calibration and maintenance of equipment for observation networks.

2. IMPROVEMENT IN COORDINATION / EXTERNAL COOPERATION AT INETER

The proposal is made to review the functions and scope of the external cooperation office at INETER, as well as its participation in the coordination of the Modernisation Plan led by INETER with the institutions involved, as well as coordinating other international cooperation activities related to the Modernisation Plan.

RESULTS EXPECTED: Well-defined functions and scope of the external cooperation office at INETER, with staff trained towards establishing links and coordination with international cooperation as well as cooperation with National Meteorological and Hydrology Systems (NMHS) in the region and WMO programmes as well as other international institutions through the Chancellor's Office.

3. IMPROVEMENT OF THE OFFICE OF ATTENTION TO USERS

Special attention must be paid to this area. The recommendation is to update its functions and to extend its scope and access to the information requested by the users, as well as monitoring and assessing the services offered by means of user satisfaction evaluations. Similarly, a recommendation is made to relocate this office within the INETER structure, placing it at the level of the External Cooperation Office in order to make it more visible. It is suggested that it should follow the WMO guide in regard to supplying NMHS services to users.

RESULTS EXPECTED: Improved communication with users in their demands for information and products, and the development and implementation of quick mechanisms to provide access to the information and products requested (see section related to user services in activity 16, regarding the establishment of user committees.)

4. STAFF TRAINING AND QUALIFICATION PROGRAMME

Training and qualification of professional and technical staff is an area that should be strengthened at INETER and other related institutions. In order to develop the syllabus, the recommendation is made to quantify precisely the number of professional and technical staff and areas and specialisations for which training is required and to define the modalities of training (universities/training centres, online/in-person training, training at work, periods staying at NMHS/research facilities). In regard to the training of professional staff in the areas of meteorology and hydrology with the support of local universities, the recommendation is made to establish an initial agreement which should be expressed before the National University Council (CNU) in order to formalise it. Similarly, the recommendation is made for the training of specialists to be based on the guide provided by the WMO.

RESULTS EXPECTED: In the middle term (6 years), 20 meteorologists (10 professional and 10 technical staff) will have been trained; also, 20 hydrologists (10 professional and 10 technical staff), 5 specialists in climate forecasting and climate products; 5 specialists in remote sensors, including the exploitation of radar products, to strengthen the operation of INETER and other participating institutions. In the short term (1-3) years, the personnel skills will be strengthened by means of short-duration courses in priority areas (numerical forecasting, radar products, climate forecasting and others) with the support of the "National Centre for Atmospheric Research (NCAR)" and local universities.

B MODERNISATION OF THE OBSERVATION AND FORECASTING INFRASTRUCTURE

5. OPTIMISATION OF HYDROMETEOROLOGICAL AND CLIMATE NETWORKS

The recommendation is made to optimise the hydrometeorological observation network. This includes coordination in terms of space coverage, the instruments required, data formats and transmission protocols, operation and maintenance for suitable obtaining, standardisation and use of the data observed. The recommendation is to undertake this strategy within networks between INETER and other organisations working together towards improving data consistency and quality. This also includes a network of subterranean water and water quality.

RESULTS EXPECTED: A strategic plan has been devised towards the modernisation of the observation network, to establish and start running modern equipment at different stages that affords the possibility for INETER to completely and suitably monitor meteorological and hydrological conditions, which is an indispensable element towards activating early warning systems on time and supporting the productive sectors.

6. ACCESS TO REAL-TIME SATELLITE INFORMATION

The recommendation is made to constantly monitor atmospheric and environmental conditions in real time by means of establishing equipment to receive satellite images directly from a stationary orbit and a polar orbit towards preparing forecasts and for timely warnings. The suggestion is made to increase the capacity of the telecom network to disseminate satellite images and products to users.

RESULTS EXPECTED: Substantially improved atmospheric and environmental monitoring and hydrometeorological forecasting through access to real-time satellite information that allows for warnings issued in a more suitable manner.

7. IMPROVEMENT IN THE MANAGEMENT OF DATA COLLECTION AND INTEGRATION INTO AN INFORMATION SYSTEM

The proposal is made to implement the MCH management system from WMO as a system for the integrated collection, quality control and database management regarding meteorological, hydrological and climate data. The suggestion is made to implement and run the MCH with the support of a specialist, including the training of the administrators of the database management system (DBMS). This activity also includes a review of the implementation of regulation UNE 500-540.

RESULTS EXPECTED: Strengthening of the role played by INETER as NMHS, offering truthful and faster access to real-time or deferred quality information for the Meteorology and Hydrology Offices at INETER for more precise and suitable forecasting. Faster access to online data and products for institutions and user groups, establishing official protocols.

8. RECOVERING HISTORICAL CLIMATE AND HYDROMETRIC DATA

The proposal is made to recover historical climate and hydrological data by means of a conceptual design of the process, compiling, verifying and safeguarding the original files and data storage. The first stage of this recovery will be preserving the files electronically and at a second stage, digitalising the information to integrate it with the database management system at INETER.

RESULTS EXPECTED: Development of a system to recover and digitalise information for an improved preservation of the historical climate and hydrological information of Nicaragua and supplying information with longer, more extensive series in order to study variability, climate change and other applications.

9. CALIBRATION AND MAINTENANCE OF HYDROMETEOROLOGICAL OBSERVATION EQUIPMENT

Establishing and executing a calibration and maintenance plan regarding automatic stations and manual meteorological and hydrological instruments by means of a fully equipped calibration laboratory and operational procedures. Training of all staff on procedures and equipment so they are able to undertake calibration and maintenance.

RESULTS EXPECTED: Availability of uninterrupted high-quality data by maintaining functional and calibrated equipment, with trained staff, calibrated instruments and the resources needed.

10. IMPLEMENTATION OF NUMERICAL MODELS TO IMPROVE METEOROLOGICAL FORECASTING

The recommendation is made to assess the feasibility of the "Weather Research Forecasting (WRF)" model as the numerical model that will be implemented. Form a basic team at INETER comprising 2 or 3 meteorologists and 2 computing specialists. Adapt any computational equipment to process the WRF model or hire cloud services and increase speed and bandwidth. Consulting with experts who have experience with the WRF model and preparing forecasts.

RESULTS EXPECTED: More reliable and suitable forecasts are prepared by implementing numerical models that are calibrated to the weather conditions in Nicaragua using suitable computing and communications systems.

11. IMPLEMENTATION OF A FORECASTING VISUALISATION SYSTEM

The recommendation is made to implement and train staff in the use of a visualisation system that standardises meteorological information from different sources and in different formats to prepare diagnostics of the state of the weather and the corresponding forecasts. Technical support from the NMHS in the region or other research institutions with expertise in such systems by means of technical stays or the assistance from experts at INETER.

RESULTS EXPECTED: Significant improvement of meteorological and hydrological forecasting by having trained staff who is up to date with the techniques and procedures of visualisation systems to prepare forecasts correctly.

12. DEVELOPMENT, IMPLEMENTATION AND OPTIMISATION OF HYDROLOGICAL FORECASTING MODELS

In order to implement this activity, the recommendation is made to assess the hydrological modelling systems and hydrological forecasting systems available in Nicaragua and their sustainability. The suggestion is made to contact a contractor or organisation to implement and optimise the forecasting system in collaboration with local hydrologists and INETER, with a detailed training plan regarding the model or models selected. The recommendation is made to have two objectives regarding the hydrological models: improving EWS and supporting the management of water resources in Nicaragua.

RESULTS EXPECTED: Sustainable hydrological models are implemented and optimised with regard to weather conditions in Nicaragua, offering suitable and reliable information towards improving EWS and supporting the management of water resources in the country.

13. DEVELOPING A NATIONAL RAINFALL ESTIMATE GRID

Holistic rainfall estimates using software that brings together data from (calibrated) radar, satellite and automatic stations for different time periods as required (hourly, daily, weekly, monthly), with staff training. This grid must be designed with the support of an expert and in collaboration with a team of hydrologists and meteorologists as well as the community of users.

RESULTS EXPECTED: A national rainfall estimate grid is prepared to provide rainfall information over space and time as required by hydrological models and the needs of a variety of users in the water, agricultural, environmental and other industries.

14. IMPROVING LANDSLIDE PREDICTION MODELS

Improve monitoring of rainfall conditions by using automatic stations and satellite and radar estimates. Model landslide processes using a multi-parameter approach that considers the critical factors that influence landslides (rainfall amount and intensity, type of ground, slope, etc.) to define warning thresholds.

RESULTS EXPECTED: Landslide prediction models have been devised, implemented and optimised for specific regions, offering the National Disaster Prevention, Mitigation and Assistance System (SINAPRED) valuable information to activate EWS in a suitable manner whenever necessary.

15. IMPROVEMENT IN CLIMATE FORECASTING

The proposal is made to improve monthly, seasonal and year-on-year climate forecasts by using a multi-model approach that offers good results. This activity is accompanied by the professional training and qualification of INETER staff regarding climate forecasting and the collaboration of national institutions as well as regional climate centres of the WMO and international institutions regarding climate research.

RESULTS EXPECTED: Improved climate forecasting models that provide more precise and suitable monthly and seasonal forecasts for drought management, water resources management and applications in agriculture and the environmental sector, among others, for decision-making in each sector concerned.

C IMPROVEMENT IN THE PROVISION OF SERVICES

16. ESTABLISHING COMMITTEES OF USERS AND A HIERARCHY OF PRODUCTS AND SERVICES

Establishing committees of users (agriculture and farming, water, disaster risk management, health, energy, transport, tourism, etc.) to:

1) Define relevant climate and hydrological products and services.
2) Establish fast and effective means of communication.
3) Exchange information and operations and maintain a standard in the observation networks.

Conceptual design of a policy of priority products and services with the specific actions and resources required.

RESULTS EXPECTED: Committees of users have been established by INETER and different groups of users that make it possible to establish a systematic means for dialogue and coordination towards defining hydrometeorological and climate products and services that are relevant to the different industries. A document has been drafted with a conceptual design for a policy of priority products and services.

17. RECOVERING COSTS AND IMPROVEMENT OF SERVICES FOR AVIATION

Reviewing and updating cost recovery for the services provided to civil aviation in accordance with current rules and regulations in Nicaragua and the recommendations of the ICAO and WMO. Reviewing and updating the professional competence of aeronautical meteorology technical staff with the help of experts on this issue in the region.

RESULTS EXPECTED: Aeronautical meteorological services provided by INETER to aviation will have been reviewed and updated in accordance with current regulations and the rules of ICAO and WMO, making it possible to fully recover the costs incurred.

18. STRENGTHENING EARLY WARNING SYSTEMS

In order to improve early warning systems (EWS), a joint proposal is made with SINAPRED to use a start-to-finish approach, incorporating the numerical weather prediction tool to EWS. Combined with a solid real-time observation system that extends the execution period of forecasts, warnings may reach vulnerable communities in a timely manner. Similarly, communications and skills to interpret and implement hydrometeorological information will be improved.

RESULTS EXPECTED: More precise and suitable hydrometeorological forecasts are implemented that afford SINAPRED more time and better information to activate EWS and protection measures regarding the population and economic industries.

19. IMPROVEMENT OF CLIMATE SERVICES FOR PRIORITY SECTORS

Improvement of monthly and seasonal rainfall and temperature forecasts in a format, language and method of delivery that is suitable to each user. Development and calibration of a soil humidity monitoring model that uses satellite information and hydrological models with timely field verifications. Monitoring droughts using indexes such as SPI, SPEI, NDVI, monthly or annual total precipitation per deciles and monitoring of soil humidity. Creation of a technical advising group regarding drought and a workshop on best practices in other countries.

RESULTS EXPECTED: Climate services have been suitably developed and implemented that are relevant to users and contribute to increasing agriculture and food production and supporting the development of other economic industries in Nicaragua.

20. VARIABILITY AND CLIMATE CHANGE STUDIES TO SUPPORT WEATHER RESILIENCE PROGRAMMES

Preparation and availability of high-quality climate and hydrological information that extends over space and time for studies regarding vulnerable industries (water, agriculture, energy). A basic study carried out to identify local and regional trends, with an understanding of the factors involved per season, year-on-year and per decade, as well as an analysis of the changes expected per sectors, with the participation of users.

RESULTS EXPECTED: Quality long-series climate information has been provided that allows for undertaking variability and climate change studies guided towards vulnerable sectors such as the water, agriculture and energy industries.

21. TRAINING OF USERS

The recommendation is made to periodically establish a training programme for end users in different sectors. Courses should include case analysis and the analysis and interpretation of hydrometeorological and climate products towards their implementation in decision-making. The recommendation is also made to educate and train the general population in regard to monitoring, warnings, probabilistic forecasts and getting prepared and being aware in regard to flooding and landslides.

RESULTS EXPECTED: Activities have been implemented to train users and the general public that improve the communication and visibility of INETER with users from the productive industries and the population at large.

22. DEVELOPMENT OF PRODUCTS WITH VALUE ADDED FOR THE PRIVATE SECTOR

Development of a conceptual project to supply value-added products and services for the private sectors with means for recovering costs or payment in kind.

RESULTS EXPECTED: A conceptual project has been developed for INETER to provide value-added products for the private sector which focus on cost recovery.

ESTIMATED COSTS OF THE MODERNISATION PLAN

The estimated investment for the Modernisation Plan including investment in the new building for INETER was prepared **taking two scenarios into account**. The first scenario, which covers the basic needs of a NMHS, has an estimated cost of approximately 21.4 million USD distributed across 6 years. This budget would lead to INETER operating successfully in all technical areas. A second scenario, which would lead INETER to operate optimally, would have an estimated cost of 31.3 million USD. Besides extending the hydrometeorological observation network, this scenario includes new equipment such as radars, radio-sounding stations, sea buoys and other equipment. Annual operational and maintenance costs (10% of the investment cost for equipment) for both scenarios at the end of the modernisation period would be 670,000 USD per year for scenario 1 and 1.1 million USD for scenario 2.

ECONOMIC BENEFITS OF THE PLAN

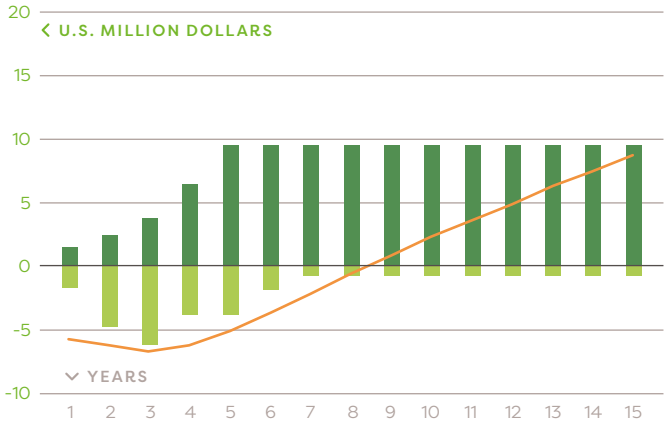
The Hydrometeorological and Climate Services Modernisation Plan for Nicaragua includes an economic analysis that shows the profitability of investment in the middle and long term. The economic analysis carried out includes some of the possible impacts that could be attributed to detailed actions in the modernisation plan for which quantitative information has been obtained, establishing conservative estimates. Therefore, the economic assessment carried out may be considered to be the minimum profit limit.

The results of this economic assessment show that **the contribution of this plan to the economic development of Nicaragua is expected to be high**. The cost-benefit ratio calculated based on the investment expected for the project oscillates between 2 and 4 and, hence the project is expected to be profitable in all scenarios considered on the basis of conservative hypotheses.

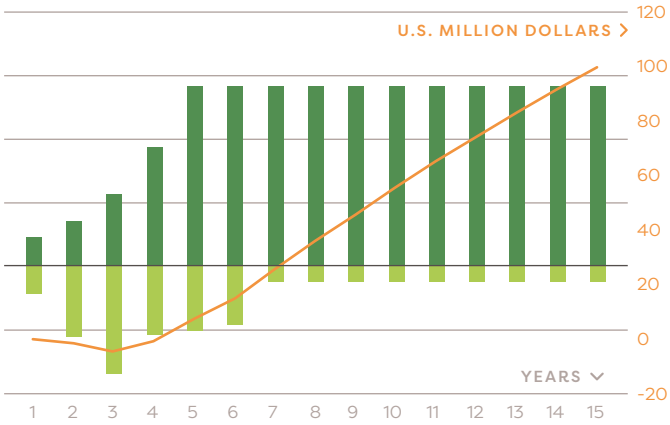
Summary of the CBA for the project under investment scenarios 1 and 2

COSTS BENEFITS CUMULATIVE CURRENT NET VALUE

SCENARIO 1 INVESTMENT COSTS **24.67 MM USD.**
CURRENT NET VALUE **67.68 MM USD.**
COST-BENEFIT RATIO **1:3.7**



SCENARIO 2 INVESTMENT COSTS **36.13 MM USD.**
CURRENT NET VALUE **100.16 MM USD.**
COST-BENEFIT RATIO **1:3.8**



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