



Program for capacity building for climate change adaptation in the transport sector

MINISTRY OF TRANSPORT AND INFRASTRUCTURE
Donation No. NDF C32.



Nordic Development Fund



ACRONYMS AND ABBREVIATIONS

CCA Climate Change Adaptation
ANA National Water Authority (Autoridad Nacional del Agua)
IDB Inter-American Development Bank
CC Climate Change
COERCO Corporation of Regional Construction Enterprises (Corporación de Empresas Regionales de la Construcción)
NDF Nordic Development Fund
FOMAV Road Maintenance Fund (Fondo de Mantenimiento Vial)
INETER Nicaraguan Institute of Territorial Studies (Instituto Nicaragüense de Estudios Territoriales)
MARENA Ministry of the Environment and Natural Resources of Nicaragua (Ministerio del Ambiente y los Recursos Naturales de Nicaragua)
MTI Ministry of Transport and Infrastructure (Ministerio de Transporte e Infraestructura)
PAST IDB Support Program for the Transport Sector (Programa de Apoyo al Sector Transporte)
SINAPRED National System for the Prevention, Mitigation and Attention to Disasters (Sistema Nacional para la Prevención, Mitigación y Atención de Desastres)
ToR Terms of reference
UCA Central American University (Universidad Centroamericana)
UGA Environmental Management Unit (Unidad de Gestión Ambiental)
UNI National University of Engineering (Universidad Nacional de Ingeniería)

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Executive summary

The Government of Nicaragua received a donation of 4.4 million euros from the Nordic Development Fund (NDF), “Donation Agreement NDF-C32” for the execution of the program “Capacity Building for Climate Change Adaption in the Transport Sector” by the Ministry of Transport and Infrastructure (MTI).

The objective of the program “**Capacity Building for Climate Change Adaption in the Transport Sector**” is to raise institutional awareness of vulnerability to induced climate change and its risk for road infrastructure, to apply practical and proactive countermeasures in the form of institutional strengthening, to improve the capacity to provide information for decision makers, and to implement pilot projects

The program consisted of five components:

- Component 1. Institutional strengthening
- Component 2. Climate scenarios
- Component 3. Review of standards, design manuals, policies and legal instruments
- Component 4. Pre-investment studies
- Component 5. Pilot projects

OVERALL OUTCOMES OF THE PROGRAM

A Mid-term Evaluation and Final Evaluation of the program were made in accordance with the NDF guidelines. The Final Evaluation concluded that the overall outcomes of the program were **Highly Satisfactory**.

For an in-depth analysis of the achievements of the intervention and to simplify its description and reading, the components were grouped as follows:

Technical assistance for the strengthening of the MTI's human resources (Component 1)

This component cuts across the four other program components. The necessary coordination with the key MTI areas took place, an Institutional Capacity Assessment that included a ma-



Training workshops, postgraduate and master’s degrees were key elements of the program in its objective of supporting institutional strengthening in criteria of Climate Change Adaptation (CCA).

pping of key central government and municipal level stakeholders was made, a Baseline was constructed as to the current state of institutional capacities. After the finalization of the assessment, a HR Strengthening Plan was designed with the following levels of training:

- **Training workshops on specific topics** related to the development of *Climate Change Adaptation (CCA)* capacities of the transport sector. The workshops were aimed at MTI public servants and related institutions, such as the Corporation of Regional Construction Enterprises (COERCO), the Road Maintenance Fund (FOMAV), the NDF, the National Water Authority (ANA), the World Bank (WB), and other sector-related entities. The total number of beneficiaries was 457 officials.

- **Postgraduate and Master’s courses** for staff of various MTI units and divisions and related entities, such as the FOMAV. 17 officials participated in the master’s course and 15 in the postgraduate course.

These activities allowed to close knowledge gaps as identified in the institutional assessment. Now the MTI has trained technical staff with a better knowledge of the topic of CCA and knows why it is important to include it in the road infrastructure.

Applicability of standards, manuals and tools generated or improved by the program with the purpose of responding to climate change impacts in the transport sector (Component 2 and 3)

Two aspects were key during the intervention:

- **Introduction of climate change criteria into the road design and maintenance instruments (standards, design manuals, policies and legal instruments).** The following actions were carried out to this purpose: mapping of instruments, assessment of the legal framework, identification of the chapters about road design and maintenance tools into which the CCA approach needs to be incorporated, proposal for the integration of CCA into instruments, statements of approval by the review com-

Road design and maintenance instruments were reviewed and updated with criteria for Climate Change Adaptation (CCA).

mittees. As a result of all this work, 12 instruments were updated and three new manuals prepared.

- **Climate scenarios, construction and use of tools to prioritize critical points.** The tool serves as a support for decision-making by allowing the user to gather valuable field information. It is necessary to point out

that the evaluation of the tool only takes into consideration aspects of the critical points that are parametrizable or measurable, and are based on an information source. The key variables for vulnerability incorporated in the prioritization tool modules were identified during the development of the Climate Change (CC) scenarios. These were made in accordance with the requirements for

the analysis of climate change impacts in the road infrastructure network, and their resolution (1x1) converts them into the largest scenarios in Nicaragua. It is worthwhile to

note that the NDF also financed the climate change scenarios of the Ministry of the Environment and Natural Resources (MARENA) with the PRECI model with resolution 5x5.

The series of activities executed by the program allowed the MTI to update its currently used normative instruments (standards, manuals and policies), and to obtain a tool to prioritize investment based on vulnerability to *Climate Change* (CC). In addition, the MTI now possesses high quality climate scenarios providing information on the behavior of climate in the country over the next 30 years.

Pilot projects that incorporate CCA aspects (Component 4 and 5)

Pre-investment studies and designs started with the screening and selecting of 30 critical points with the help of the tool developed in Component 3, followed by field visits to these selected

points. Studies and design were made for the *Climate Change Adaptation* (CCA) works at the 30 selected critical points. Out of the 30 prioritized points, three pilot projects were selected, for whose construction the NDF allocated 1.6 million euros. The selected projects were:

- El Cuá - San José de Bocay. (El Golfo)
- Intersection Guanacaste - Intersection Nandaime.
- Gualilica Bridge (sector 3)

Thanks to the program activities, the MTI now has 30 studies and designs of critical or vulnerable points. In addition, the implementation of the pilot projects incorporating CCA works, which were transformed into climate change resilient road infrastructure, has left important learning experiences to improve replications in future projects.

Introduction

Extreme events related to Climate Change (CC) have had significant impacts on all social and economic sectors in Nicaragua, transport being one of the most affected sectors. It is the MTI's responsibility to direct, administer and supervise, directly or by delegation, the maintenance and development of the transport infrastructure¹.

However, prior to the intervention program the Ministry lacked the tools and technical and methodological capacity to take *Climate Change* (CC) impacts into account in the planning of its investments, since its regulations and standards were obsolete and CC relevant aspects were not included in its road planning system².

Likewise, municipalities and contractors also had deficient capacities in this regard, while other government agencies (FOMAV, COERCO, ANA, Nicaraguan Institute for territorial Studies (INETER), MARENA, National System for the Prevention, Mitigation and Attention to Disasters (SINAPRED) and the National University

of Engineering (UNI), the Nicaraguan Autonomous University (UNAN) and the Central American University (UCA) were well-developed in this field

In this context, the Nicaraguan Government received a loan from the Inter-American Development Bank (IDB) to execute, through the MTI, the comprehensive program for multiannual investments "Support Program for the Transport Sector in its different phases (PAST I, II, III)". Additionally, the Nicaraguan Government received a donation of 4.4 million euros by the Nordic Development Fund (NDF), "Donation Agreement NDF-C32", to execute the program "Capacity Building for Climate Change Adaptation in

¹ According to Law 290, article 25

² Donation Agreement NDF C32, Annex 1

the Transport Sector”. Its objective is to support component 4 of PAST III: Reduction of the vulnerability of the road network to climate change.

The objective of the program “**Capacity Building for Climate Change Adaptation in the Transport Sector**”, executed by the MTI, is to raise institutional awareness of vulnerability to induced climate change and its risk for road infrastructure, to apply practical and proactive countermeasures in the form of institutional strengthening, to improve the capacity to provide information for decision makers, and to implement pilot projects.

During its implementation, the program was technically assisted by the Consortium IDOM-NCG-METEOSIM-CONDISA; it was managed by the MTI’s Environmental Management Unit (UGA), acting as administrator of the contract with the consortium. Due to the program’s focus on institutional strengthening, other departments of the Ministry played relevant roles as well. Institutions such as the Nicaraguan Institute for Territorial Studies (INETER) and the Road Maintenance Fund (FOMAV) also played an active part in some components.

PROGRAM COMPONENTS

Component 1. Institutional Strengthening. The objective of this component was the institutional strengthening in terms of building capacities for *Climate Change Adaptation (CCA)* of the transport sector. This component was considered transversal to the other four components of the consortium’s technical proposal.

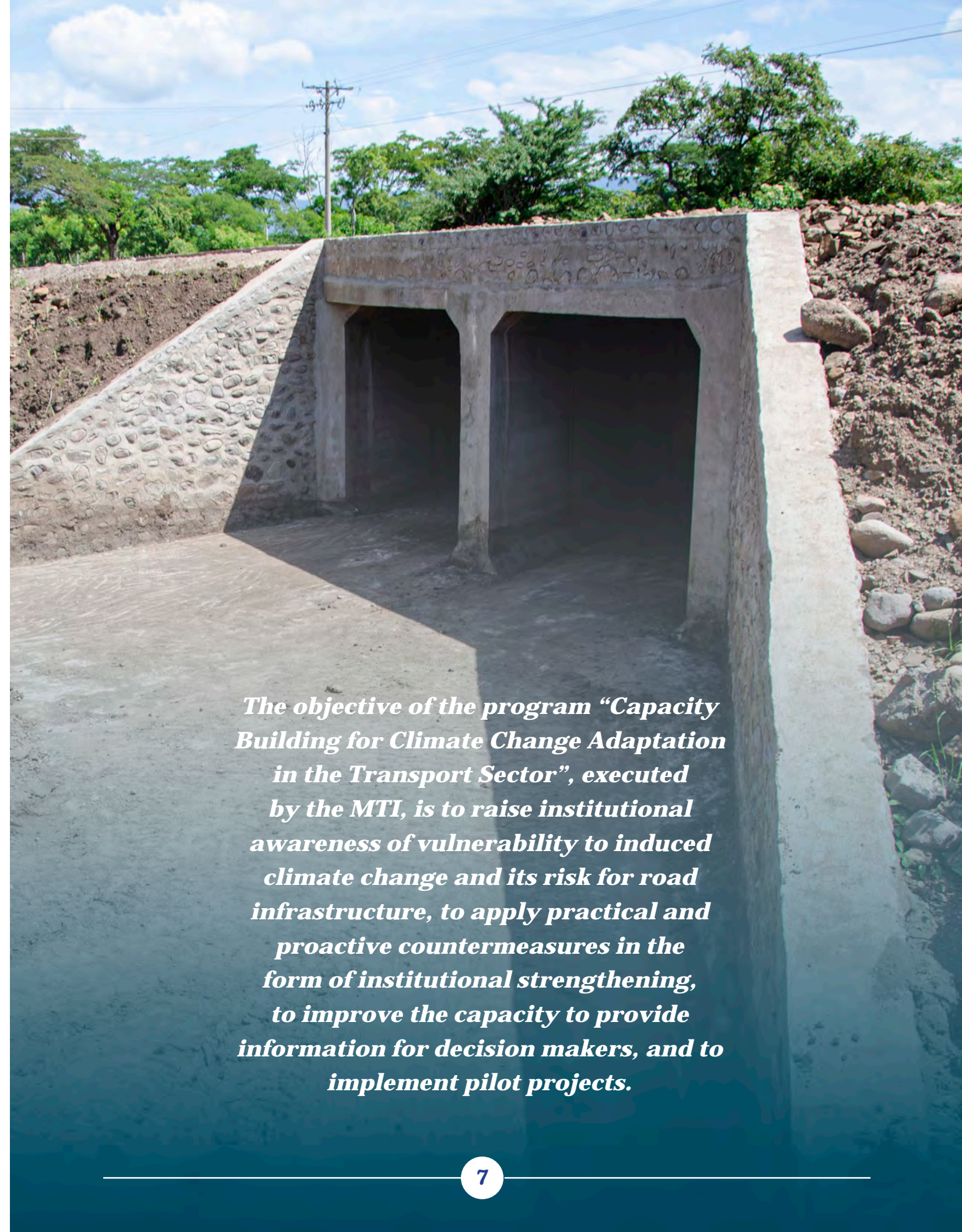
Component 2. Climate scenarios. The objective of this component was to develop regionalized *Climate Change (CC)* scenarios to meet the requirements for the analysis of CC impacts on the transport infrastructure.

Component 3. Review of standards, design manuals, policies and legal instruments. The objective of this scenario was to provide the country with more climate change resistant roads by incorporating aspects into the instruments for planning and decision-making that are key for the adaptation of the road infrastructure to CC.


Component 4. Pre-investment studies. The objective of this component was to carry out pre-investment studies, designs and terms of reference for at least 30 critical points identified in the study “Mapping of national road infrastructure points vulnerable to CC effects, instrumentation defined and implemented”.

Component 5. Pilot projects. The objective of this component was to develop the supervision services of at least three prioritized pilot projects selected from the group of 30 projects designed by the consortium, on the basis of the outcomes and methodology of component 4 of the present contract.

The intention of this publication is to disseminate the program’s most relevant final results, its achievements and lessons learned. It draws on various information sources related to the program, including its Systematization of Experiences and its Final Evaluation.



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Overall program outcomes

*The final evaluation concluded that the overall outcomes of the program were **Highly Satisfactory**, as the technical teams of **MTI, INETER, FOMAV** and other institutions have acquired capacities for adaptation management and the use of important tools to take decisions and execute **Climate Change Adaptation (CCA)** projects. In addition, they broadened their knowledge on climate change vulnerability.*



Training workshop on manuals and design standards in hydrotechnics.



Workshop on road network vulnerability to climate change.

RELEVANCE

As to its Relevance, the program was **Highly Satisfactory**, since it responded to the country's needs. There is a high level of correspondence and the alignment between the program objective and its components with the objectives of other national public policies, for example: i) National Development Plan (PNDH) 2012 – 2016, with the policy for road, harbor and airport infrastructure as part of Policy 3.1: social, productive, energetic, transport and tourism infrastructure for the transformation of Nicaragua; ii) National Climate Change Adaptation Plan, the Program for Capacity-Building and the Modeling of climate scenarios, forming part of the strategy: Mitigation, Adaptation and Risk Management in the face of Climate Change of policy III.12 of the PNDH.

In addition, the objectives and outcomes of the program are coherent with the objectives and strategies of the MTI's Environmental and Climate Change Adaptation Policy (2012), and are aligned with the prioritized areas and objectives of the (NDF) and the IDB.

EFFICACY

The level of program efficacy was evaluated as **Highly Satisfactorily**. The evaluation found a high number of products and outcomes that contributed to reaching its objectives by making important achievements in the different areas of the overall objective:

1. A significant number of the MTI's and other institutions' human talent have strengthened their capacities and raised their awareness of the importance of applying *Climate Change Adaptation (CCA)* measures in the different phases of the road infrastructure project cycle.
2. The country now possesses climate scenarios for the next 30 years, containing important and abundant information generated during their creation.
3. Technical and methodological instruments for planning and decision-making were updated with the incorporation of new procedures for the application of CCA measures in road infrastructure works.
4. Important findings, lessons learned and recommendations were obtained in the implementation of the works at the three critical points where pilot projects were executed.

EFFICIENCY

As to efficiency, the physical execution and the operative mechanisms were evaluated as **Highly Satisfactory**, given a 94% level of achievement of products that are considered to be very useful for the respective entities. On the other hand, all operative mechanisms were implemented as established in the agreement (budget, purchase plan, planning of activities, audits, mid-term and final evaluation). The hiring processes were valued as **Satisfactory**, as four of the seven processes experienced delays compared to the calendar planned.

EFFECTS

As to the effects, the evaluation determined that the program has contributed to the strengthening of MTI's institutional human capital and to its awareness of the need to take into account various *Climate Change Adaptation (CCA)* measures in all cycle phases of road infrastructure projects executed by the institution.

The development of climate scenarios strengthened the capacities of the MTI and INETER and equipped them with knowledge and tools for the inclusion of vulnerability criteria to *Climate Change (CC)* as a fundamental parameter that

measures executed and supervised at three prioritized critical points not only solved problems on roads related to floods, landslides, etc., thereby guaranteeing the security of families residing in the immediate surroundings; they also served as laboratories for the application of knowledge acquired in other components. The process has left lessons learned and recommendations for new programs or projects.

SUSTAINABILITY

As to the program's sustainability, the continuation over time of the positive effects and risks generated by the intervention were evaluated.

The works with Climate Change Adaptation (CCA) measures executed and supervised at three prioritized critical points not only solved problems on roads related to floods, landslides, etc., thereby guaranteeing the security of families residing in the immediate surroundings; they also served as laboratories for the application of knowledge acquired in other components.

has to be taken into account in the design and planning of more resilient roadwork, as well as to estimate in advance the possible physical impacts of CC on the road network.

By updating its legal and operational framework the MTI has improved its strategic positioning in the sector and strengthened its institutional mission and vision.

The generation of studies and designs, as well as the execution of three pilot projects has allowed MTI technical staff with review and contract monitoring responsibilities to increase their ownership of CCA measures. The works with CCA

On the basis of the documents consulted and interviews made, the level of sustainability of the program is **Satisfactory**. It is key that the technical staff apply their knowledge and use the reviewed manuals, standards and policies to formulate new terms of reference with CCA parameters, and apply the tools for the prioritization of critical points or vulnerable sites.

However, it has to be taken into account that the incorporation of CC vulnerability factors into the design and execution of projects implies, in many cases, an increment in costs. If the decision-makers understand that the economic costs

of the works will rise, but the mid- and long-term benefits will be greater, then damages and negative impacts can be avoided and steps can be taken towards the sustainability of the program's efforts. In this sense, the technical staff has to generate demonstrable information so that decision-makers get a correct idea of these increased construction costs for CC resilient roads, bridges and gutters. From a financial point of view, a key factor for the sustainability of the program actions is the continued implementation of projects at other critical points.

For an in-depth analysis of the achievements of the intervention, lessons learned, relevant conclusions drawn from the implementation of the different program components, and in order to simplify its description and reading, the actions were grouped as follows:

1. Technical assistance for the strengthening of the MTI's human talent (Component 1)
2. Applicability of standards, manuals and tools generated or improved by the program to respond to climate change impacts in the transport sector (Component 2 and 3)
3. Pilot projects that incorporate CCA (Component 4 and 5)



Pilot project Empalme Guanacaste - Nandaime.

COMPONENT 1

Technical assistance for the strengthening of the MTI's human talent



The program identifies the problems of Climate Change Adaptation (CCA), in order to develop knowledge and tools that strengthen the institutional capacities to face this phenomenon.



Workshop of introduction to the tool of the red flags of the World Bank.

A) SITUATION PRIOR TO THE IMPLEMENTATION OF THE PROGRAM

In its Annex 1, “Project Description”, Donation Agreement NFD C32 identifies the problem of *Climate Change Adaptation (CCA)*, pointing out the following: “The MTI lacks methodology to consider the phenomenon of *Climate Change (CC)* when it plans its investments. Its knowledge basis on CCA is insufficient and it needs technical capacity and tools, as its regulations and standards are obsolete and *Climate Change (CC)* aspects are not part of its current road planning system”.

On the other hand, the Assessment of Institutional Capacities made by the consortium in charge of the technical assistance identifies important opportunities for capacity building, as it determined that the MTI possesses basic capacities in relation to CC but lacks staff with advanced knowledge on CCA topics.

B) SITUATION DURING THE IMPLEMENTATION OF THE PROGRAM

The necessary coordination with the key MTI areas took place, an Institutional Capacity Assessment that included a mapping of key central government and municipal level stakeholders was made, a Baseline was constructed as to the current state of institutional capacities. After the finalization of the assessment, a HR Strengthening Plan was designed which established the following levels of training:

- Training workshops on specific topics related to problems of developing CCA capacities of the transport sector. The workshops were aimed at MTI public servants and related institutions, such as COERCO, FOMAV, NDF, ANA, WB, and other sector-related entities. The total number of beneficiaries was 457 officials.
- Postgraduate and Master's courses for staff of various MTI units and divisions and related entities, such as the FOMAV. 17 officials participated in the master's course and 15 in the postgraduate course.



Climate Change Adaptation (CCA) works at the critical point El Golfo, El Cua-San José de Bocay.

C) SITUATION AFTER THE IMPLEMENTATION OF THE PROGRAM

The series of activities led to the following improvements:

- Closing of knowledge gaps identified in the institutional assessment based on the mapping of sector-related stakeholders, and the subsequent implementation of an institutional strengthening plan.
- The MTI's technical staff has improved its awareness of *Climate Change Adaptation* (CCA) criteria and is applying the knowledge acquired during the training processes in workshops, postgraduate and master's stu-

dies. Direct beneficiaries of the workshops are 457 officials, 17 officials in postgraduate studies and 15 officials in master's studies.

- The MTI has public servants trained on the use of tools, norms and standards that incorporate the CCA approach.
- At the levels of individual as well as institutional performance, the knowledge foundations are laid for the application of Disaster Risk Management (DRM) and CCA throughout the cycle of road infrastructure projects. To this end, it is key to carry out *Climate Change* (CC) vulnerability studies and any other necessary studies, depending on the critical point where the works will be carried out.

- In spite of the efforts undertaken, it was impossible to involve certain key stakeholders such as contractors and municipalities, which according to the program objectives should have had a higher level of participation.
- Cooperation agreements were established with sector-related institutions: MARENA, INETER, FOMAV, SINAPRED and ANA, which formed the program's Steering Committee. However, both mechanisms, agreements and committee, could not be fully exploited, as throughout the program coordination was upheld only with INETER.

LESSONS LEARNED

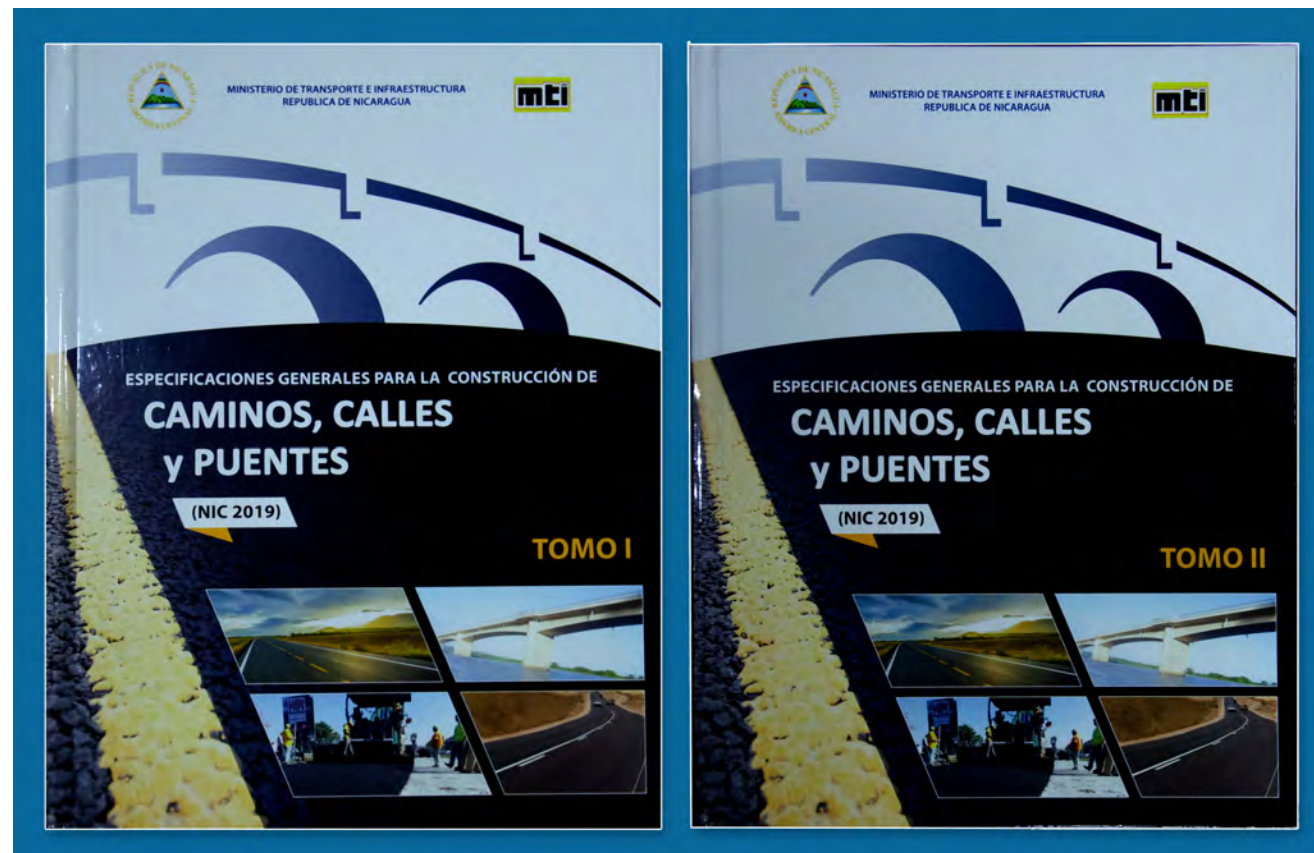
- Effectiveness in the application of CCA criteria depends on the strengthening of the competencies of all stakeholders, e.g. contractors, municipalities, FOMAV, among others.
- Effective institutional coordination is based on the identification of common interests, benefits for those involved in the actions, processes and projected outcomes.
- The participatory definition of the study plans of the master's and postgraduate studies ensured the plans were demand-based, thereby increasing the efficacy in the performance of the trainees.
- Systematic follow-up by the MTI on all training and education processes will guarantee higher attendance levels and a greater institutional commitment, leading to better results of the strengthening process.

CONCLUSIONS

- The training workshops and academic services implemented by the program have generated awareness and improved the institutional and individual capacity for the incorporation of CCA criteria in road infrastructure.
- Institutional competencies for the monitoring and evaluation of the application of CCA criteria in road infrastructure were created.
- It was found that in the training processes there is room for improving logistical aspects, a more balanced distribution between contact hours and virtual classrooms, and linking theory to practice.

Applicability of standards, manuals and tools

GENERATED OR IMPROVED BY THE PROGRAM TO RESPOND TO CLIMATE CHANGE IMPACTS IN THE TRANSPORT SECTOR



A) SITUATION PRIOR TO THE IMPLEMENTATION OF THE PROGRAM

The MTI lacked updated normative instruments and standards to face climate change vulnerability. In general, these instruments had not been updated for the last 5 to 10 years, and *Climate Change Adaptation (CCA)* criteria were not included in the planning system nor in the design of the road infrastructure.

The assessment found that the MTI had software tools for landslides, structures and bridges. As to the identification and prioritization of critical points, it had also received assistance from the Japan International Development Agency (JICA) and the IDB through specific studies and tools; however, these had not been used to create or build institutional capacities.

B) SITUATION DURING THE IMPLEMENTATION OF THE PROGRAM

The following actions were executed to develop component 3:

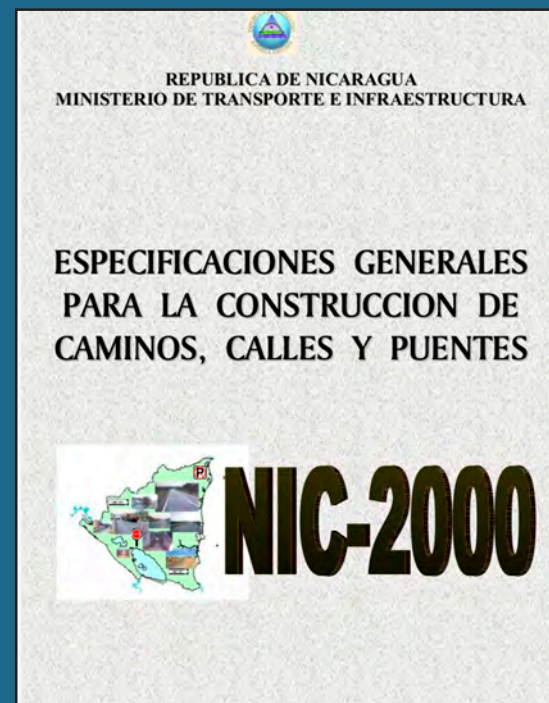
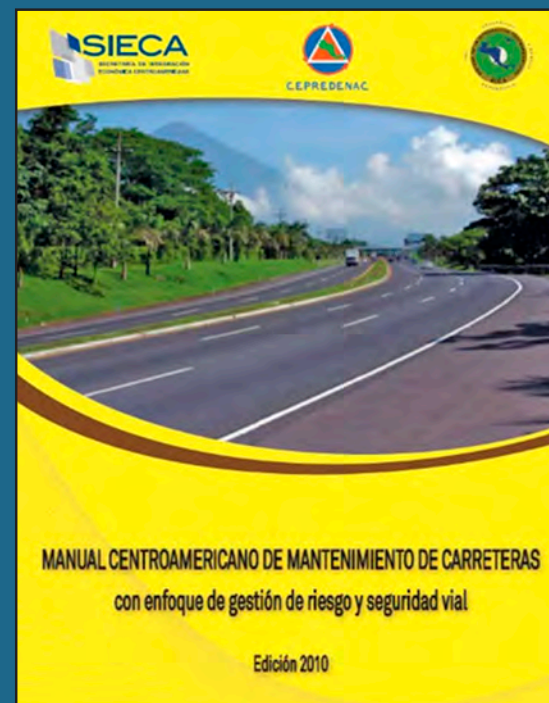
1. Review of technical standards, manuals and design and maintenance criteria, and integration of CCA criteria in the planning, design and operation of road infrastructure.
2. Formulation, design and validation of methodological guidelines for intervention, training and institutional capacity building on the topic of climate change adaptation.
3. Development of a methodological instrument to identify and prioritize vulnerable points of the national road network, according to sensitivity in the face of climate change.

³MTI. 2017. Report on the proposal of up to three (3) pilot construction projects for Climate Change Adaptation (CCA). Ministry of Transport and Infrastructure.

4. Proposal for new legal instruments and/or reforms of existing ones to support decision-making in the sector (policies, laws, decrees, among others).

During the program implementation, two aspects were key:

1. **Introduction of climate change criteria into the road design and maintenance instruments (standards, design manuals, policies and legal instruments) and the preparation of new manuals.** The following steps (methodology) were carried out to this purpose: mapping of instruments, assessment of the legal framework, identification of the chapters about road design and maintenance tools into which the CCA approach needs to be incorporated, proposal for the integration of CCA into instruments, statements of approval by the review committees. As a result of all this work, 12 instruments were updated and three new manuals prepared.
2. **Climate scenarios, construction and use of tools to prioritize critical points.** The tool serves as a support for decision-making by allowing the user to gather valuable field information. It is necessary to point out that the evaluation of the tool only takes into consideration aspects of the critical points that are parametrisable or measurable, and are based on an information source³. The key variables for vulnerability incorporated in the prioritization tool modules were identified during the development of the climate change scenarios. These were made in accordance with the requirements for the analysis of climate change impacts in the road infrastructure network, and their resolution (1x1) converts them into the largest scenarios in Nicaragua. It is worthwhile to note that the



A sample of manuals and other updated normative instruments with program support.

NDF also financed the climate change scenarios of the Ministry of the Environment and Natural Resources (MARENA) with the PRE-CI model with resolution 5x5.

The MTI focuses on the effective identification and prioritization of critical points and on optimizing efforts at these critical points. It has

created synergies with different actors, e.g. in 2003 with the Japan International Development Agency (JICA), which gave assistance to the Government of Nicaragua by mapping vulnerable points through the “Study on the reduction of the vulnerability of the main roads of the Republic of Nicaragua”. In the year 2014, the MTI received

the IDB’s assistance to carry out the “Mapping of national road infrastructure points vulnerable to climate change effects, instrumentation defined and implemented.” On the basis of this study’s results, the JICA mapping of critical points, that had made a final selection of 292, was updated; subsequently, the MTI filtered these points and finally defined 259 vulnerable sites.

In the framework of this program, the 259 vulnerable sites identified were processed with the tool evaluating their vulnerability to landslides, flooding by rainwater or rivers, coastal hazards and risks of extreme temperatures. The result of this work is a list of 30 critical points for priority action for the consortium to make the corresponding studies and designs. This tool assigns a vulnerability index with a score in descending order, indicating that priority attention should be given to the points with a greater vulnerability to extreme hydrometeorological events.

C) SITUATION AFTER THE IMPLEMENTATION OF THE PROGRAM

The series of activities executed in these components have made it possible:

- For the MTI to obtain a tool (methodology) that allows it to prioritize investments based on climate change vulnerability, as well as to possess normative instruments (standards, manuals and policies) updated and in use.
- To incorporate the climate change vulnerability approach into the ToR for the design, construction and supervision of new projects by using updated standards, design manuals, policies and legal instruments.
- For the MTI to possess high-quality climate scenarios that provide information on the behavior of the climate in the country over the next 30 years.

CONCLUSIONS

- The development of this process has been evaluated positively by key informers, who consider that its specific objectives have been fulfilled satisfactorily, since the tools and instruments were reviewed, approved and are in use. An example is the identification of the 259 critical points and the use of the tool to prioritize the 30 critical points where pre-investment and design studies incorporating *Climate Change Adaptation (CCA)* took place.
- The methodology developed to create and improve normative instruments was very effective.
- The participatory work of the institution and the involvement of authorities facilitated the creation of scenarios and instruments and a better utilization of results.

LESSONS LEARNED

- Broader dissemination of the new instruments within the MTI and among the sector-related entities would facilitate a higher level of ownership by stakeholders.
- A training plan structured on the basis of knowledge gaps identified among stakeholders will guarantee the further continuation of the institutional strengthening on *Climate Change Adaptation (CCA)* achieved by the program.
- Standards, manuals and tools are dynamic work instruments, due to which it is necessary to regularly assess the need for their updating.

Pilot projects

THAT INCORPORATE CLIMATE CHANGE ADAPTATION ASPECTS (ACC)



A) SITUATION PRIOR TO THE IMPLEMENTATION OF THE PROGRAM

The studies, designs, and resulting road infrastructure works made prior to the program lacked certain building parameters to guarantee their resilience to climate change. As a consequence, it became necessary to frequently execute maintenance works at the same critical points, which caused maintenance costs to rise.

B) SITUATION DURING THE IMPLEMENTATION OF THE PROGRAM

Pre-investment studies and designs entailed an orderly process of activities. The first step consisted of screening and selecting of 30 critical points with the help of the tool developed in Component 3.

The second step comprised field visits to these 30 selected points, during which social or economic variables that could possibly increment vulnerability were verified *in situ*.

As a third step, studies and designs were made for the *Climate Change Adaptation* (CCA) works at the 30 critical points. These were based on the report on the studies about climate change impact on the road infrastructure, climate change adaptation measures proposed for the transport sector and instruments modified in component 3.

Out of the 30 points prioritized by the MTI's methodology for CC vulnerability analysis, three pilot projects were selected, for whose construction the NDF allocated 1.6 million euros. The selected projects were:

- El Cuá - San José de Bocay. (El Golfo)
- Intersection Guanacaste - Intersection Nandaime.
- Gualilica Bridge (sector 3).

The overall scope of the works was determined by the specific problems of each critical point, thereby ensuring that constructions will contribute to reducing their vulnerability considerably.





Evaluation of the work of Climate Change Adaptation in El Golfo, El Cua- San José de Bocay.

C) SITUATION AFTER THE IMPLEMENTATION OF THE PROGRAM

As a result of the program activities:

- The MTI now has 30 studies and designs of critical points.
- The three pilot projects incorporate climate change adaptation works thus representing climate change resilient road infrastructure.

The implementation of the three pilot projects has left important learning experiences to improve replications in future projects.

CONCLUSIONS

- El Golfo Pilot Project: It was successful, since the *Climate Change Adaptation* (CCA) criteria were incorporated, the systematic process of stakeholder (contractors – supervisor - MTI) monitoring and control was

complied with; the contractor identified the problem of the design and solved it expeditiously; together with the stakeholders they arranged everything for the implementation (staff, equipment, machinery and financial resources). During the construction period, the works were not affected by any climate-related factors.



- Guanacaste Pilot Project: CCA works were executed according to the designs, incorporating the adjustments identified during the initial phase. It was necessary to include additional works to protect the slopes and pedestrians circulating in the project area. The identified social issue was solved.
- Gualilica Pilot Project: major challenges turned up during the construction process, among these climate factors, which were speedily overcome to reach the construction target.

LESSONS LEARNED

- When designing projects, it is necessary to make evaluations that reach beyond the site of the critical point. Local stakeholders have to be included, such as the municipalities and communities, especially to examine the problems observed at the critical point. This decision ensures a quality design and the effective execution of the *Climate Change* (CC) adaptation works.
- In addition to solving a road infrastructure problem in the municipality/community, the three pilot projects also have the purpose to serve as a learning experience for MTI public servants. This aspect can be potentiated by incorporating new staff for field visits in order to evaluate the effectiveness of the CCA works on the ground.



Gualilica pilot project, at the entrance of the municipal capital of Limay, department of Esteli.

Synthesis and conclusions

The results reflect a successful execution of the program.

The program is considered relevant for the country's problems of vulnerability in the face of *Climate Change* (CC); it is aligned with the priorities of the MTI, the policies of the Nicaraguan Government and the financing agencies (NDF and IDB). The execution of the program as a whole is conserved successful, as demonstrated by the outcomes achieved.

- The MTI as an institution has strengthened its awareness of the importance of taking into account *Climate Change Adaptation* (CCA) and Disaster Risk Management criteria in the design and construction of road infrastructure. This is reflected by the continuously improved Terms of Reference, the technical specifications demanded for tenders of new projects, and in the Ministry's (pre-investment) studies and designs in the framework of the implementation of the CCA program.



Guanacaste pilot project, Nandaime-Granada junction. Complementary works were incorporated to protect pedestrians and access bridges to homes located on the other side of the channel.

- As to the construction of climate change resilient road infrastructure works, Nicaragua is making big strides forward in comparison to other countries in Central America. The strengthening of capacities, conceived in the design as a cross-cutting approach to all program components, has achieved its purposes: a significant number of MTI technical staff have been trained and are able to implement what they have learned.
- The review of standards, design manuals and policies, and the creation of tools for prioritization with the participation of technical staff of various MTI departments and units, senior authorities of the Ministry, as well as delegates of other institutions, has produced

high-quality documents which are currently being fully used. It is worth highlighting that the program experience was groundbreaking for the country and had a broad national scope.

- The level of inter-institutional coordination does not seem to favor interventions based on a systemic vision of a problem. The interventions at the critical points consider primarily the physical aspects of the issue, which limits the effects and sustainability of the interventions. However, in many cases a coordinated intervention by MTI, MARENA, INETER, SINAPRED, FOMAV and the municipalities is required. Equally, climate change adaptation efforts in the territories have to improve.

- The program could have been more beneficial and at the same, it could have achieved a greater impact, if municipalities, universities and private sector organizations related to road infrastructure had been incorporated and the products achieved had been more broadly disseminated.
- The studies and designs for the 30 critical points were based on the indications of studies requested in the terms of reference. The three pilot projects constitute road infrastructure resilient to climate change effects and thus offer better safety for road users and citizens residing in the surroundings. It should be mentioned that in the case of all three executed works, adjustments to the ori-

ginal designs were necessary to improve the proposed *Climate Change Adaptation (CCA)* solutions. This means that each work needs to be treated with more comprehensive perspectives, in order to reduce the risk of having to increase the budgets to carry out unforeseen expansions or modifications.

Lessons learned

AND TO BE USED IN OTHER EXPERIENCES

A training plan structured on the basis of knowledge gaps identified in advance among stakeholders will guarantee better individual and institutional competencies among stakeholders for the application of *Climate Change Adaptation (CCA)* criteria and the further continuation of the institutional strengthening on *Climate Change (CC)* achieved by the program.

- In order to expand the scope of the capacity building plan, the process requires the MTI's systematic monitoring of all training and education processes, and the institutional commitment to guarantee a better exploitation of the cooperation agreements established.
- The participatory methodological process for the assessment of capacities ensured the effective implementation of the capacity building plan; entities were identified which had the capacity to provide academic services, and corresponding cooperation agreements were signed.

- The methodology implemented for the updating of manuals, standards and tools based on the mapping of instruments, the evaluation of the legal framework, the identification of proposals to improve the instruments, and the approval of the improved instruments was very effective. Accordingly, this methodology can be considered replicable for future updating activities.
- The incorporation of the management level, the creation of specialized competency-based commissions to carry out the supervision and adjustment of manuals, standards and tools, as well as the consortium's supply of specialized and competitive staff, made it possible to effectively comply with the established time-frame and obtain successful results through the execution of the program.

- Building the MTI staff's capacities to use, develop and add new variables of vulnerability to the tool created for the prioritization of critical points, will make it possible to increase its performance levels.
- The original designs of the pilot projects only partly incorporated CCA criteria; for this reason, it is important to take into account the experience of the designing enterprises that did incorporate these aspects. In addition, it is necessary to make assessments beyond the site of the critical point, including local stakeholders such as municipalities and communities, to be able to examine problems that are not easily visible. This decision will contribute to a better quality of the design and improve effectiveness in the execution of CCA works.

- Supervision services should be provided by an entity other than any entity carrying out tasks linked to the works, especially those responsible for the studies and design. Otherwise, the quality of the supervision and, in consequence, the quality of the works is put at risk.
- The recent incorporation of CCA criteria in the projects requires training, monitoring and accompanying contractors in the application of normative instruments and in management arrangements, such as certificates of quality, laboratory tests, permits for the cutting of trees and excavations, etc. ■



The Nordic Development Fund is a joint Nordic development financing institution that supports climate-related projects in Africa, Asia and Latin America

Cover photo: El Golfo, municipio de El Cua-Bocay, Nicaragua



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