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Sustainability and Promotion of Inland Waterway Transportation Projects in Colombia: Case of the Magdalena River

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***Abstract*—**Inland Waterway Transportation (IWT) is playing an important role in national transport systems, water transportation is considered to be safe, energy efficient and environmentally friendly mode of transport, all benefits of IWT cause national awareness increase, for instance the Colombian government is planning to restore the navigability of the most important river of the country, the Magdalena's River navigability, embrace waterway transportation in Colombia could strength competitiveness while reduce most of the transport externalities. However, the current situation of the Magdalena is deplorable, the most important river of Colombia has been abandoned for decades and the solution is beyond of a single administrative entity. This paper analyzes the outcomes of the Navigation And Inland Waterway Action and Development in Europe program (NAIADES) as a prospective to develop a similar program in Colombia with similar objectives and guidelines, considering sustainability, guarantying the long-term future results and adaptability of the program. Identifying stakeholders and policy experts, a set of individual interviews were carried out; findings support the idea of lack of integration within governmental institutions and lack of importance in marketing promotion as possible drawbacks on the implementation of IWT projects.

***Keywords*—**Inland waterway transportation, Logistics, Sustainability, Multimodal transport systems, Water transportation.

I. Introduction

COLOMBIAN transportation's expenses are higher than in many other countries of Latin America. It is cheaper to move one ton of freight from Colombia to China, than internally [1]; these expenses represent a barrier to develop a competitive industry in the country, as a consequence an effort for reduce them represent a way to create value, by implementing green policies, changing budgetary priorities and achieving efficiency throughout all Colombian transport systems strength logistical efforts of business associations, gaining Economies of scale and scope. Generally, transport activities performance is a fundamental role in growth of welfare`s communities, in Colombia these activities, including transport services represent about 10% of GDP [2], which define the importance of transport activities for national economy.

As described in the first environmental performance review (EPR) of Colombia "the country still lacks a coherent green growth policy framework" [3]. Colombia demands for a reliable, fast, cost-effective, and environmentally friendly multimodal transportation system, water transportation is seen as an alternative and it has been evaluated as an option to reduce transport expenses.

Water transportation is considered to be safe, energy efficient, and environmentally friendly mode of transport [4], [5] is particularly suitable for the movement of high-volume, low-value or not time-sensitive commodities, "principally raw materials and liquid and bulk primary" [6]. Despite all the benefits for using water transportation the mode has been disregarded in Colombia for decades. Recently, IWT are seriously considered not only in developing countries, water transportation is the cheapest way of transport, a low-cost strategy in the transport market that is supported by the maturity of green technologies and the existing waterways in the country.

The Magdalena River is the principal river of Colombia, it was once an important passageway in Colombia connecting the Caribbean with the interior of the country, the river born in the Andes mountain range at 3,685 meters above sea level and runs across a large part of Colombia northward about 1,528 km generating life and serving as an economic life-force for many Colombians that live throughout its basin. Actually, this magnificent river is navigable from Barrancabermeja to Barranquilla, "it moves about 80-90% of hydrocarbons and 10-20% of general cargo" [7], these waterway in the near future will also mobilize coal and bulk cargo.

The National Planning Department of Colombia (DNP) approved an IWT infrastructure project to restore the navigability of the underutilized Magdalena's river [8]. Under the private-public partnership system-PPP, the project will dredge and restore a distance of more than 900 km from the municipality of la Dorada-Caldas to Bocas de Ceniza in the city of Barranquilla; it will provide access to not one but two major ports of Colombia Barranquilla and Cartagena (Fig. 1). The project will expect to spend 2.2 trillion Colombian pesos (about USD $1.2 billion), within the goal to have a navigable waterway 24 hours per day and 365 days a year, allowing to mobilize about 11 billion tone-year of cargo [7].

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Fig. 1 The Magdalena River

This paper is divide in four major sections, briefly an overview of the Magdalena's river situation and the river's investment project, followed by description of the methods used, the research results, recommendations and finally conclusions.

II. Methods

Considering Europe as a referent, the Navigation And Inland Waterway Action and Development in Europe program (NAIADES) was founded, studying how other countries had been settled IWT programs and projects could reduce the chances of the Colombian program's failure, develop a single or multiple strategies, and how the program's focus need to account for economic, social and environmental goals. Supporting the idea of a sustainable IWT strategy in Colombia, developing similar challenges and objectives into a IWT public strategy, a conceptual lesson-drawing framework developed by [9] was observed, the method explored how to transfer both the positive and the negative experiences from public policies, identifying techniques and methods made it by other authors.

Consequently, these paper's objectives are two: first (i) identify the most important limitations and challenges faced by IWT projects in Colombia, and second (ii) analyze the achievements of the Navigation And Inland Waterway Action and Development in Europe (NAIADES) program. The used method combines aspects of a quantitative and a qualitative research (Fig. 2), the first stage in the research involved a quantitative analysis of the NAIADES outcomes, from 2006 to 2012, the analysis entails an evaluation of IWT indicators, reviewing (i) changes in the modal share of IWT in Europe, (ii) investment expenditures on IWT infrastructure projects and, (iii) changes in the total amount of good transported by IWT. The quantitative analysis is complemented with the conclusions expressed in the mid-term progress report on the implementation of NAIADES program.

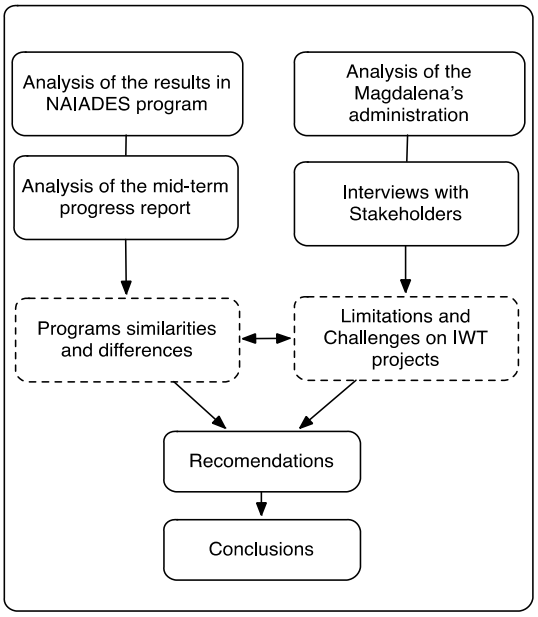

Fig. 2 The Conceptual Method

The second stage of the research involved a comparative analysis between the NAIDAES program and the forthcoming programs in Colombia, accompanied with a set of In-depth interviews, a qualitative analysis employed for comprehend some limitations and challenges faced by IWT projects in Colombia. "A non-probability sampling technique is useful to collect detailed information about a person's thoughts or explore new issues in depth of valuable information in a problem definition" [10].

Reference [11] stated that one of the advantages of using non-probability sampling is the inclusion of important political actors; therefore, the method considered a sample that best represent the diverse stakeholders, especially conducting interviews within policy-makers and Sustainability experts. 10 face-to-face in-depth interviews were carried out, 2 professors of social science, 1 expert of civil engineering, 3 experts of environmental science, 1 senior executive member of CORMAGDELENA, 1 executive member of The Ministry of Transport (MOT), 1 senior executive member of The National Association of Freight Forwarders (ASECARGA) and, 1 executive officer of The National Institute of Roads (INVIAS).

Each interview was divided in two parts; the first part was useful to gather information about the Magdalena's current situation, freely respondents talked about the river's situation, in the second part respondents were asked about limitations and challenges faced by IWT projects in Colombia.

III. Results

In January 2006 the European Commission presented the

policy to promote inland waterway transport in Europe, the Action Program called Navigation And Inland Waterway Action and Development in Europe (NAIADES). The program consider five strategic areas for the development of inland waterway transport in the EU: (i) Improving market conditions, (ii) modernizing the fleet, (iii) developing human resources, (iv) raising image and awareness; and (v) enhancing infrastructure [12].

Concretely the NAIADES program identified the interrelation with other policies such as intermodality or the internalization of external costs and pointed out the advantages of use water transportation. In order to support the implementation of the NAIADES program the Commission established in 2008 a platform of interested IWT stakeholders called PLATINA, it provides technical and organizational assistance by ensuring active participation of key industrial stakeholders, associations and administrations [13].

A. Analysis of NAIADES's Achievements

IWT serves to European economy by delivering freight through cost-efficient and safe transport services with minimal impact on the environment, the European IWT system has a "navigable network of over 40,000 km" [14]. "This network is unequally spread over the EU, with some regions completely lacking inland waterways and some others having a very long waterway system, such as the regions of the Netherlands" [15] The total share of the waterway transport was constantly decreasing over the past 30 years, "water transportation is constantly decreasing, from 12% in 1970 to 7% in the year 2000" [5]. The European market in 2006 was 5.7% with just a small increase over the last years reaching in 2012 to 6.7%. Table I summarizes the total share of IWT in EU from 2006 to 2012.

TABLE I
MODAL SPLIT OF IWT IN EU (TOTAL SHARE)

	2006	2007	2008	2009	2010	2011	2012
EU* (28 countries)	0,057	0,058	0,059	0,059	0,067	0,061	0,067

*Data from Main tables and Database Eurostat [16].

The financial crisis of 2007-2008 was a responsible factor of the inactivity on IWT's investments, as summarizes in Table II, the total investment and maintenance expenditures on IWT has not a clear tendency, lately the amount have decrease over the time.

TABLE II
INVESTMENT AND MAINTENANCE EXPENDITURES ON INLAND WATERWAYS TRANSPORT INFRASTRUCTURE (MILLION EURO)

	2006	2007	2008	2009	2010	2011	2012
EU* (28 countries)	1024	651,3	813,3	1688	2260	667,8	917,2

*Data from Main tables and Database Eurostat [16].

From 2008 to 2013 owed to the normal economic market growth the total goods transported by inland waterways showed a slight increase (Table III), however the total amount still remains low, showing a low interest on IWT within European industry.

TABLE III
GOODS TRANSPORT BY INLAND WATERWAYS (THOUSANDS OF TONNES)

	2008	2009	2010	2011	2012	2013
EU*	509901	421266	525062	521252	526402	527654

*Data from Main tables and Database Eurostat [16].

B. Conclusions of the Mid-Term Progress Report on the Implementation of NAIADES Program

The mid-term progress report on the implementation of NAIADES program is part of the evaluation process of public policies in Europe, the principal conclusions of [13] are part of the analysis of the NAIADES I program achievements, the five most important conclusions of the report are: (i) The program was not equipped with a dedicated EU budget, (ii) Only *infrastructure* can make use of already existing funding programs, (iii) There are no financial means for e.g. market incentives, support to fleet modernization or promotion and awareness campaigns or to activities that require European co-ordination, harmonized solutions and a permanent follow-up, (iv) It is widely acknowledged that the lack of dedicated resources turned out as disadvantage for the implementation of the program, and (v) In order to further exploit the potential of inland waterway transport, the strengthening of its market position, its integration into co-modal transport chains, enhanced nodal interoperability, the deployment of new technologies including River Information Services (RIS) and their interoperability with other intelligent transport systems will gain increasing importance.

C. Analysis of Cormagdalena's Forthcoming Programs and Current Administration

"In the Cormagdalena's 21 years of existence, the river's navigability has not improved… Cormagdalena has been marred by failed projects and investigations into its contracts and practices" [17]. The Magdalena's responsibilities are fragmented and diluted, there are about 800 public entities and organizations with environmental and political competence over the Magdalena river [18], only the national environmental entity Cormagdalena has the authority to coordinate and promote the river, it has financial and administrative autonomy to develop environmental plans and programs over the 129 riverside municipalities, Cormagdalena is part of the 34 Regional Autonomous Corporations (RACs) in Colombia which are responsible for enforcing environmental regulations in Colombia. Unfortunately, "a wide variety of environmental regulations in Colombia are not consistently enforced and significant financial and jurisdictional battles are taking place between RACs and municipalities" [19]. Cormagdalena's objectives areas listed in the constitution and summarized here: (i) Improve river navigation, transportation and port activities, (ii) Work toward environmental conservation of the river and surrounding areas, (iii) Manage hydropower generation and distribution, and (iv) Regulate fishing and other renewable natural resources.

Expressed in the Vision of Cormagdalena's 2019 [18] these objectives will be attained by the implementation of individual programs in the following areas: (i) Navigation and port activity, (ii) Erosion and Flooding Control, (iii) River

Exploitation, (iv) Environment and Natural resources program and, (v) Land-use and environmental planning; Each one of these programs respond similar to the NAIADES strategic areas, comparing them by using a sustainable framework, result in 3 differences (Framework for infrastructure charging, establishment of promotion centers, developing human resources, and fleet modernization), the complete analysis of similarities and differences between Cormagdalena's programs and the NAIADES program is showed in Fig. 3.

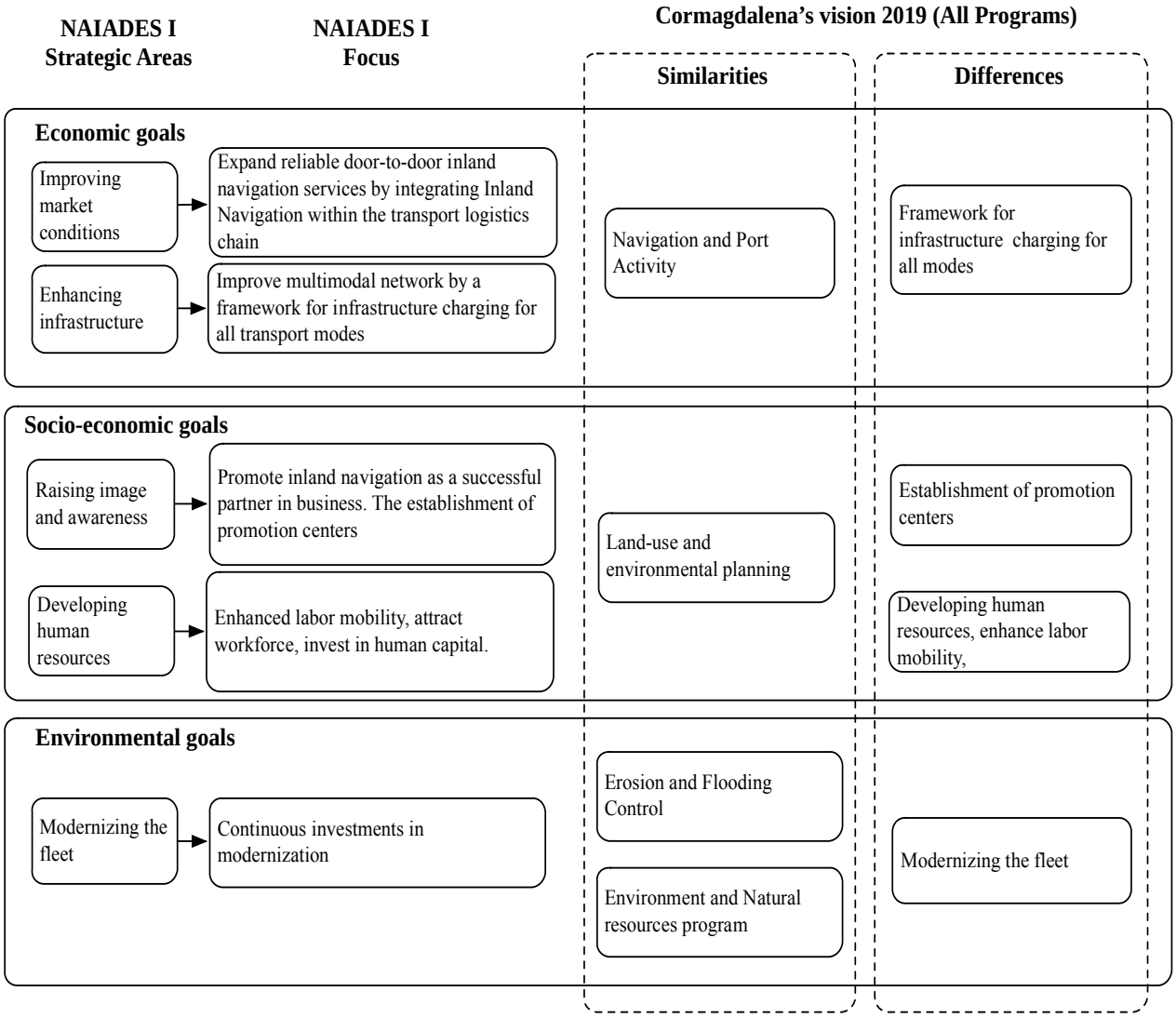

Fig. 3 Similarities and Differences between programs

D.Results from the in-Depth Interviews

Several criteria emerged from interviewees, they expressed their opinions and suggestions based on their point of view to better implement IWT projects in Colombia. Results are classified in two elements limitations and challenges; all of them are listed here:

1) Limitations

All limitations expressed were: (i) Lack of integration inside governmental institutions, (ii) Absence of IWT contribution to life support systems and environmental conditions, and (iii) Loss of private interest on IWT, owned to the amount of capital and the formalities for participation on logistic ports and terminals.

2) Challenges

All Challenges expressed were: (i) Necessity to address sustainable goals within IWT projects, and (ii) Necessity of integration with other modes of transport

IV. Discussion

The analysis showed the financial crisis of 2008-2009 as an important factor of the lower share of IWT in Europe; the absence of a dedicated EU budget lead to unsatisfactory

results of NAIADES I program, a dedicated budget is an important economic factor for IWT results, it turns important also the total amount of capital financial incentives in market promotion.

The analysis of both the negative and positive outcomes of the NAIADES I program aided to increase the understanding for implementing an IWT program. A Comparison was useful to identify similarities and differences between programs, the comparison showed that socio-economic benefits are possible objective to attain.

Confirmed by interviewees, it is necessary to develop a new organizational structure for The Magdalena's Administration, an important limitation of IWT implementation in Colombia is the lack of integration inside governmental institutions, more than 800 entities with environmental authority over the Magdalena River is a huge number of political interests.

V. Conclusions and Recommendations

A forthcoming strategy in Colombia is therefore a long-term action plan, using a conceptual framework in a policy transfer is an opportunity for policy-makers to better meet long-term sustainability goals and objectives. A combination of the limitations and challenges with the differences and similarities between programs generate the next recommendations on IWT projects:

A. Lack of Integration inside Governmental Institutions:

Change in the current administration of the Magdalena's river: A new organizational structure with more autonomy and control will improve the overall organization's behavior, the program's performance demand an integrated coordination among their environmental institutions, it is recommended a new autonomous organizational entity capable to eliminate all the conflicts between RAC's and support coordination among stakeholders. The Magdalena's Administration demands for a leader entity, a regulator, promoter and coordinator, Cormagdalena's transformation is an opportunity for reducing corruption and disorganization; a possible solution is by gradually reducing the amount of public entities. Finally, all the externalities caused by other modes of transport, such as emissions, pollution, noise, and accidents; might persuade policy-makers to generate a taxation strategy, charging more for using less environmental modes of transport, extending more economic benefits for using IWT.

B. Absence of IWT Contribution to Life Support Systems and Environmental Conditions

Promoting waterways as a supporter for urban and rural regeneration: In order to create a region's life support system derived by commercial waterways is necessary to develop public-private investment projects, strength institutional capacity of regional authorities on IWT labor, developing human resources, enhancing labor mobility and facilitation in the engagement of the private sector.

C. Loss of Private Interest on IWT, Owned to the Amount of Capital and the Formalities for Participation on Logistic Ports and Terminals

Developing economic clusters near to riverside communities: IWT does not have the autonomy of the road transport to develop door-to-door transportation services. Under the regulation of Cormagdalena's administration, logistic terminals are usually created within the framework of regional development policies and national strategies, expanding reliable door-to-door inland navigation services by improving market conditions or freight distribution clusters has the potential to reduce an array of costs through external economies of agglomeration. Understanding the link between economic growth and market observation should eventually increase attention on fleet modernization, logistic chains integrations and strategic alliances, the Magdalena River has many advantages over other forms of transportation, an IWT program must include market promotion. Rise attention and promotion within local industries, work hand by hand with local and subnational levels is an opportunity to increase IWT usage, developing riverside municipalities by increasing tourism and developing logistic zones might serve as a life's support systems.

D. Necessity to Address Sustainable Goals within IWT Projects

Better meet environmental conditions: Despite the well sound environmental programs expressed in Cormagdalena's vision, dredging activities should be complemented with a reforestation strategy on the river basin, this will reduce the total amount of the river's maintenance, preventing sediments flows into the river. In similar conditions the river's administration should increase environmental control over the most contaminated points at the river, where the Cauca and the Bogota Rivers flows into the Magdalena.

E. Necessity of Integration with Other Modes of Transport

Integration with other modes of transport and with the freight Transport-planning process: Based on large-scale systems, Transport-planning might serve as an adequate analysis tool for planned or forecast scenarios on Inland waterway transportation. Adopting *Strategic transport planning* and *Integrated planning* as tools to develop environmentally sound projects lead to win-win situations, for navigation and ecology.

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