

System Mapping and Analysis of the Blue Economy Using R4S and Practical Application of Systems Change for Resilience of the Blue Economy

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Abstract—This paper explores the application of the Resilience for Social Systems (R4S) Approach to bolster the resilience of the blue economy, with a specific focus on the department of La Guajira, Colombia. The R4S Approach, developed by GOAL in 2016, aims to guide the implementation of humanitarian and development interventions by analyzing socio-economic systems and their reactions to external shocks and stresses. Through a comprehensive application of the R4S Approach, this study examines its effectiveness in informing interventions within the context of the small-scale sustainable fisheries sector in La Guajira and the Wayuu indigenous population, which depends on this system. By comprehensively mapping the dynamics of the system, including its strengths, weaknesses, and interdependencies, this paper showcases how the R4S Approach can effectively contribute to bolstering resilience and supporting the development of vulnerable communities. By sharing the insights and experiences gained from the case study in La Guajira, this research seeks to contribute to the wider discourse on enhancing the resilience of the blue economy and promoting sustainable socio-economic development for vulnerable populations.

Keywords—blue economy, humanitarian, resilience, R4S, fisheries, social systems

I. INTRODUCTION

Shocks and stresses can have a disproportionate impact on social systems, often reversing hard-earned development gains and disproportionately affecting the poorest and most vulnerable populations. The resilience of these vulnerable groups to such risks is intricately linked to the functioning of critical social systems during normal times, as well as during and after crises. These shocks or stresses can manifest gradually or abruptly, occur at local or global scales, and originate from both natural and human systems. What matters is their impact on local systems, which people depend upon to meet their essential needs, including health, livelihoods, education, and more. When local systems function effectively, people can use them to meet their needs and thrive, but if they are compromised by a shock or stress, people are thrown into crises.

The global community faces numerous challenges, including accelerated climate change, unsustainable development choices, growing inequality, poverty, and humanitarian needs, all of which exacerbate the impact of crises. The increasing interconnectedness of people and human systems also heightens the risk of compound and cascading crises, resulting in rising humanitarian needs. To enhance global resilience, targeted and systems-oriented interventions and investments are necessary. These systems need to be adaptive and transformative to move from crisis recovery towards resilience, creating a more sustainable, prosperous, and equitable future [1].

Amidst these challenges, the blue economy presents opportunities to address pressing global issues, such as alleviating poverty and hunger. It plays a pivotal role in ensuring food and nutrition security while providing economic prospects for people living in coastal communities. However, the resilience of the social systems underpinning the blue economy faces significant challenges, often impacted by issues such as climate change and unsustainable development. For instance, the small-scale fishing industry serves as a critical local system for marine-coastal communities, providing essential resources and support for their livelihoods and is particularly impacted by these challenges.

GOAL, a humanitarian organization with 45 years of experience in responding to the needs of people affected by crises, has been actively supporting the resilience of coastal communities through its 'Resilience of the Blue Economy' program for over a decade. GOAL defines crises as situations where local systems are unable to respond or continue functioning when confronted with risk events. GOAL works to deeply understand these shocks and stresses, including conflict, climate change, environmental degradation, rapid unplanned urbanization, weak or unstable governance, inequality, and forced displacement. These are some of the many risks that threaten the health, safety, security, and well-being of vulnerable communities [2].

In 2016, GOAL developed the Resilience for Social Systems (R4S) approach, providing a structured framework for mapping and analyzing local systems' reactions to shocks and stressors, identifying vulnerabilities, and developing humanitarian programming in response. This paper will demonstrate the value of the R4S approach in building the resilience of the Blue Economy. The case study of the small-scale fisheries industry in La Guajira department, Colombia, establishes how the R4S framework enables humanitarian actors to identify vulnerabilities in local systems and develop recommendations and actions to strengthen their capacity to withstand crises, contributing to a more resilient blue economy.

II. BACKGROUND

A. *The Blue Economy and Sustainable Fisheries*

Defined by the World Bank as the "sustainable use of ocean resources to benefit economies, livelihoods, and ocean ecosystem health," [3], the blue economy has the potential to significantly increase sustainable food production, meeting the demands of a growing global population and alleviating the pressure on land-based food systems. With ocean-linked industries estimated to contribute US \$1.5 trillion annually to the global economy, the blue economy plays a vital role in providing over 30 million jobs worldwide and supplying essential protein sources to over three billion people [4].

Coastal regions, particularly fisheries, have emerged as pivotal areas of interest from environmental, social, and economic perspectives. With over three billion people relying on marine and coastal biodiversity for their livelihoods, and more than 200 million individuals directly or indirectly employed in marine fisheries, these regions offer significant development opportunities while also presenting challenges. Coastal industries such as fisheries can provide livelihoods, nutritious food, and economic opportunities, effectively addressing the global challenge of feeding a population projected to reach 9.6 billion by 2050. This plays a crucial part in eliminating hunger, improving health, and reducing poverty. However, achieving a sustainable blue economy faces significant challenges, including the unsustainable extraction of marine resources, the destruction of marine and coastal habitats due to coastal development, deforestation, and mining, marine pollution, climate change, and unfair trade practices [5].

With more than a decade of experience in supporting the Blue Economy in the Latin America and Caribbean Region, GOAL's 'Resilience of the Blue Economy' program seeks to support coastal communities in addressing the multiple challenges and opportunities within the blue economy through an integrated 'Local Systems' approach. This approach encompasses improved livelihoods, increased incomes, food security, protection of biodiversity and ecosystems, inclusion, good governance, climate adaptation and mitigation, and strengthened resilience.

Supported by partners such as Irish Aid, the European Union, the Nordic Development Fund, USAID (United States Agency for International Development), the Faroe Islands Government, the Inter-American Development Bank, and the International Union for the Conservation of Nature, GOAL works to enhance livelihood opportunities and improve the

governance of marine coastal resources for indigenous and afro-descendent communities across nearly 1,500km of coastline in the LAC region. The program directly supports more than 5,000 fishers and their families, resulting in improved food and economic security and increased resilience to climate-related hazards [5].

A critical component of the blue economy is the small-scale fisheries market system. With marine fisheries providing livelihoods for approximately 300 million people and meeting the nutritional needs of three billion individuals who rely on fish as a primary source of animal protein, essential micronutrients, and omega-3 fatty acids, it plays a significant role in employment, income, food security, and nutrition [5]. However, challenges persist within the value chain, leading to extreme poverty levels within fishing communities. These challenges are compounded by various social and environmental factors, including inadequate management resulting in overfishing and vulnerability to climate change [6].

To address these vulnerabilities and enhance the resilience of systems like small-scale fisheries, the R4S system provides critical mapping and analysis, enabling targeted interventions. By strengthening these systems, the communities that depend on them can better adapt to withstand challenges in an ever-changing world.

B. *The Blue Economy in La Guajira, Colombia*

The blue economy holds significant importance in La Guajira, Colombia, due to the region's unique challenges and vulnerabilities. Located in northeastern Colombia, La Guajira is characterized by extreme heat and aridity, experiencing a considerable increase in temperature and a decline in precipitation over the past three decades. The people living in this area face critical issues, including food and water scarcity, limited access to health services, and extreme poverty rates. The situation is further complicated by the humanitarian crisis in neighboring Venezuela, government corruption and mismanagement, and the impact of climate change [7].

These challenges have a particular impact on the Wayuu indigenous community, which experiences elevated levels of food insecurity, malnutrition, and economic hardship, leaving them vulnerable to shocks and stresses [8]. In recent years, the Wayuu people in La Guajira have experienced the impact of climate change, drought, pandemic, and a migration crisis, with fragile social systems incapable of absorbing or adapting to crisis situations. A more resilient blue economy, based on the existing fisheries sector, offers the opportunity for sustained economic opportunity and food and nutrition security for the Wayuu people.

In the wider Caribbean context, the livelihoods of vulnerable Indigenous and African descendent communities residing in coastal areas hinge on the blue economy. According to Beltrán and Villeda, the estimated number of artisanal fishermen inhabiting the coasts of the Pacific Ocean and the Colombian Caribbean Sea is around 160,000 people [9]. In La Guajira, nearly 22,000 people directly or indirectly depend on small-scale fisheries, serving as their primary source of income. Notably, Indigenous women form the majority of those

involved, engaging in daily beach-side activities to sell their products [10].

Wayuu fishing in the Guajira region represents a substantial portion of the landings in the Colombian continental Caribbean, ranging between 24% and 31% of the total catch, even though the area accounts for only 5% of the entire Caribbean coastline (AUNAP, 2014). However, despite the significance of their trade, the Wayuu population, including the fishers, live mostly in rural areas and face challenging living conditions. While small-scale fisheries offer economic opportunities and food security, the socio-economic systems supporting them must demonstrate resilience to withstand shocks and stressors. Identifying and mitigating key challenges, such as climate change, overfishing, and supply chain issues, becomes crucial, along with embracing inclusive strategies for blue growth.

To address these challenges and enhance the resilience of the blue economy in La Guajira, GOAL's R4S approach provides a framework to identify risk factors within the critical socio-economic systems of small-scale fisheries. By developing targeted recommendations for risk mitigation, the Blue Economy can be strengthened, enhancing the Wayuu people's capacity to endure crises.

C. The R4S Approach

The R4S (Resilience for Social Systems) approach developed by GOAL aims to analyze and improve the resilience of socio-economic systems. GOAL recognizes that societies are comprised of socio-economic systems that serve their populations, and effectively addressing recurring crises and building resilience requires an integrated systems approach. When socio-economic systems are fragile and marginalized populations are present, communities are more susceptible to external shocks and stresses. Strengthening these systems through coordination among stakeholders can enhance resilience and promote inclusive development.

R4S is an innovative approach that employs systems thinking and social and behavior change techniques to design interventions for more resilient and inclusive societies. It helps understand the interactions and interconnections of various systems and assess the potential impacts of risk scenarios. By applying R4S, stakeholders can anticipate how natural hazards, conflicts, and long-term stresses can affect economic shocks, people's exposure to additional shocks, agricultural productivity, food and nutrition security, income levels, and access to healthcare and education.

The R4S Approach offers a structured step-by-step process for assessing the resilience of complex socio-economic systems. One of its main innovations is a mapping tool that improves understanding and facilitates analysis of these systems. Additionally, R4S provides guidance on analyzing determinant factors of resilient systems, including Connectivity, Diversity, Redundancy, Governance, Participation, and Learning.

The R4S Approach is structured into five components: identification and selection of critical socio-economic systems, mapping the status of selected systems, identification of principal risk scenarios, resilience analysis and synthesis

considering six Determinant Factors of Resilience (DFRs), and participatory monitoring, evaluation, accountability, and learning. Overall, this approach aims to enhance understanding of the dynamics of socio-economic systems to enable programming that addresses the root causes of constraints, rather than merely treating symptoms [11].

The R4S approach is a valuable strategy for building the resilience of the blue economy in mapping the interlinking socio-economic systems, identifying key areas of vulnerability, and developing strategies to mitigate the risk factors created by shocks and stresses. By utilizing the R4S Approach, stakeholders in the blue economy can assess and analyze the current resilience state of critical socio-economic systems within marine-coastal areas to create targeted programming for building resilience.

III. CASE STUDY

Recently, GOAL comprehensively applied the R4S Approach in Colombia, informing interventions and demonstrating the applicability of the approach for practitioners. Recognizing the potential for expanding projects to build the resilience of the blue economy in La Guajira, GOAL identified numerous coastal communities heavily reliant on small-scale fishing as their primary livelihood. The fishing sector is highly susceptible to climate change, but evidence suggests that trends can be reversed, and growth in the blue economy offers substantial potential to improve livelihoods, conserve marine coastal zones, and ensure food security.

In the context of these challenges, the study aimed to understand and address bottlenecks within the artisanal fishing system and analyze its current state of resilience. The objective was to provide recommendations to build or strengthen the resilience and performance of the system. Additionally, the study sought to better comprehend the factors and barriers affecting the socioeconomic system in environments prone to threats and stressors.

The data collection process involved both primary and secondary sources, with consultation instruments designed for the most relevant actors in the mapped system, including artisanal fishers, intermediaries, and support and regulatory actors. This comprehensive study was conducted during the first quarter of the year 2021, focusing on the territories of Riohacha, Manaure, and Uribia in La Guajira, Colombia.

The primary goal was to recommend actions that would improve the state of the system and benefit the target group, the artisans. The analysis produced three maps of the system: a map of the current system, a map of vulnerability to stressors, and an ideal map of the system. Additionally, a causal circuit diagram was developed that outlines the dynamics of the actors and their functions in their current state and their relationship with the various stressors.

A. Mapping the Current System¹

The study mapped the artisanal fisheries market system in La Guajira, Colombia under three main functions: the transaction chain, support functions, and regulatory functions.

¹ Appendix A – System Map

These functions together form the structure through which the entire system operates.

The transaction chain is a key aspect of the system, consisting of four stages: production, intermediation, distribution, and consumption. At the production stage, Wayuu artisanal fishers play a central role, utilizing various fishing methods and gear to catch fish. These fishers form the backbone of the system, providing the essential raw material. Moving along the chain, the intermediation stage involves several actors, including informal vendors, fishmongers, wholesale intermediaries, collection centers, and sausage processors. They facilitate the movement of fish from the producers to the end consumers. In the distribution stage, restaurants, municipal and departmental markets become the key players, supplying the final consumers. Lastly, the consumption stage involves local consumers and national consumers/tourists who rely on the products supplied by the system.

Support functions are crucial for the smooth functioning of the transaction chain. They enable and facilitate various aspects of the system. Support actors include suppliers of inputs and services, entities providing training, technical assistance, and research, as well as financial services like credits for the fishers.

Regulatory functions form another essential component of the system, driving behavior and decision-making within the transaction chain. These functions encompass the regulation of natural resources, governance, and various business operational regulations, such as market rules, tax regulations, and health standards. Effective regulatory mechanisms are crucial for ensuring sustainable resource management and compliance within the system.

B. Risk Scenario

Based on the comprehensive mapping of the current system, a potential risk scenario for the artisanal fisheries market system in La Guajira was identified, whereby the system could face a potential collapse due to existing stressors. These stressors include overfishing, illegal fishing practices, pollution of maritime waters, and a lack of proper wastewater treatment. The collapse of the system poses a significant threat to the distribution and availability of fishing resources, directly impacting the income, food security, and overall well-being of the artisanal fishers and the broader Wayuu population.

C. Vulnerability Map²

The vulnerability mapping exercise aimed to identify the potential vulnerabilities that different actors may experience in the face of stressors. The mapping approach provided a holistic view of the system's dynamics, enabling a thorough evaluation of how different actors are impacted and their capacity to cope with the potential risk scenario.

Based on the vulnerability assessment, the artisanal fisheries market system in La Guajira exhibits varying degrees of vulnerability among its different actors. Wayuu artisanal fishers emerge as highly vulnerable due to their high sensitivity and exposure to stressors such as poverty, pollution, and unsustainable fishing practices. Their limited capacity to cope

with these challenges is evident in their lack of necessary equipment, safety gear, and poor-quality boats.

Fishery processors, local consumers, boat owners, fishers' associations, and the Wayuu people, fall under the category of medium vulnerability. They are negatively affected by fluctuations in product quality, volumes, and operational costs, impacting their well-being and income. Boat owners, in particular, face a higher exposure risk due to their equipment's unsuitability for high seas navigation, leading to potential safety hazards.

On the other hand, several actors exhibit low vulnerability in the system. Wholesale brokers, informal sellers, municipal markets, departmental markets, local workshops, and various institutions and organizations responsible for regulatory and protection functions fall under this category. They are indirectly affected by stressors like contamination and bad fishing practices. These actors rely on others in the transaction chain, whose vulnerability is relatively higher, to carry out their activities.

D. Resilience Assessment

The resilience of the artisanal fisheries market system in La Guajira, Colombia, was assessed through six key determining factors: connectivity, diversity, redundancy, governance, participation, and learning. The findings revealed that the overall resilience of the system falls within the range of minimal to low, signifying the need for collaborative efforts with all actors involved to enhance its adaptability and sustainability.

The system's connectivity level is low, as the connections between actors in the transaction chain are weak, primarily focused on the commercial exchange of products. There is a lack of comprehensive strategies to address the challenges faced by the system, impacting the overall effectiveness of responses to stressors.

Regarding diversity, the system exhibits limited variations in fishing results, leading fishers to adapt to unfavorable conditions using alternative gear and methods. However, the overall diversity among fishers remains low, and they often find themselves in vulnerable conditions with limited options for diversifying their livelihoods. The system's focus on daily tasks without considering conservation and resource preservation results in limited participation in the benefits offered by the market.

The redundancy within the system is minimal, as the artisanal fishing activity heavily relies on a small group of highly vulnerable actors, such as experienced fishers passing down their knowledge and skills to younger generations. While this heritage of expertise holds value, the system's overreliance on a few actors leaves it susceptible to disruptions.

In terms of governance, the system's structure demonstrates a low level of organization, with traditional leaders exerting considerable influence over decision-making. However, the lack of well-structured governance mechanisms hampers joint organizational strategies and regulations for the activity, hindering collaborative efforts among actors.

² Appendix B – Vulnerability Map

Participation within the system is also limited, particularly for the most vulnerable actors, such as artisanal fishers. They receive minimal benefits and representation, with better conditions and opportunities primarily benefiting a select group of actors. The absence of direct connections for joint actions undermines the potential for collective benefits and improvement.

The learning aspect of the system indicates some knowledge-sharing among artisanal fishers, but the reliance on external support remains prevalent. While experience shapes coping strategies, a more structured approach to learning and technical knowledge is needed to bolster the system's resilience. The lack of direct linkage between competent authorities and artisanal fishers further impedes the system's ability to navigate challenges effectively.

E. Ideal Map³

In the ideal map of the artisanal fishing system in La Guajira, positive changes and benefits are envisioned through a series of recommended actions based on the study's findings. These actions, implemented by both internal and external actors, aim to strengthen relationships and capacities within the system to access fairer and more competitive markets that benefit artisanal fishers.

One of the key actions involves encouraging the creation of fishing units, associations, and collection centers equipped with the necessary tools and inputs for sustainable fishing. This move not only fosters better prices for catches but also reduces the reliance on informal vendors, leading to a more stable and profitable market chain.

Diversification of income through processing businesses is another crucial step, which holds the potential to increase profitability and open up new markets. By transforming their products, artisanal fishers can access better opportunities nationwide, securing sustainable incomes and economic growth for the fishing communities.

Improving the equipment, fishing gear, and methods used by the fishers is essential for enhancing overall efficiency and profitability. By adopting better tools and techniques, fishers can optimize their efforts and reduce wastage, leading to increased income and resource conservation.

To ensure successful implementation of these actions, building solid relationships with actors providing technical assistance and community education is imperative. Through effective governance and resource management, fishers can make informed decisions, leading to sustainable fishing practices and long-term benefits. Furthermore, the key stressors, including overfishing, illegal fishing practices, pollution of maritime waters, and a lack of proper wastewater treatment, would be addressed under enhanced governance and management for coastal marine resources and more robust oversight.

Furthermore, promoting knowledge management through research and academia plays a pivotal role in informing actions that will positively impact both fishers and the delicate

ecosystems they depend upon. The scientific understanding of the region's challenges and potential solutions will guide decision-making for the betterment of the artisanal fishing system.

Lastly, establishing direct and trustworthy relationships with regulatory actors is vital to enforce current regulations and laws that protect fishing resources. By adhering to sustainable practices and complying with guidelines, the artisanal fishing system can achieve resilience and secure the well-being of fishing communities.

F. Recommendations

Based on the findings of the systemic study, a series of actions have been recommended to strengthen the system and the target group, improving their quality of life, well-being, and resilience. The recommendations were provided in three dimensions, environmental, social, and economic.

The environmental recommendations include promoting knowledge management and applied research to guide decision-making regarding fishing resources, establishing mechanisms for environmental management and governance of resources; This includes, fishers employing good and responsible fishing practices, meaning, fisher's needs and challenges should be considered in the decision-making of governance and management of coastal marine resources, and they should have timely information of existing regulations. Additionally, fishers should strategically diversify the species they catch to ensure both commercial viability and alleviate pressure on specific species. Furthermore, early warning systems should be operational for principal hazards. Finally, fishers should employ effective strategies and cutting-edge technologies to minimize pollution of coastal marine resources, including the implementation of artificial reefs, decarbonization of transportation, and the promotion of a circular economy.

The social recommendations are providing access to necessary infrastructure, equipment, knowledge, and procedures in place to ensure quality, safety, market, and food standards are met; Clear legal and regulatory framework for the fisheries market supported by strong market coordination and oversight from market actors; equitable participation of women, youth and vulnerable groups across fisheries as well as a focus on social responsibility to improve access to basic services at the community level; functional traceability system adopted across the market system.

Finally, the economic recommendations include transparent and accessible market information supporting effective marketing strategies; relevant and accessible financial services; relevant and accessible business development services; and stable and equitable commercial relationships (between fishers, intermediaries, buyers and supporting service providers and suppliers).

These recommendations have been incorporated into GOAL's humanitarian programming for the region, enabling the organization to develop comprehensive and inclusive

³ Appendix C – Ideal Map

interventions aimed at building the resilience of the blue economy and supporting the Wayuu people.

IV. CONCLUSION

In conclusion, the R4S Approach developed by GOAL is a valuable framework for building the resilience of the Blue Economy. The case study of La Guajira demonstrates that by analyzing and understanding the complex socio-economic systems within marine-coastal areas, the R4S Approach enabled the identification of vulnerabilities and potential risks faced by the fisheries system, as well as the development of strategies to mitigate the impact of shocks and stresses.

The process of mapping and analyzing the system vulnerabilities and using this knowledge to inform humanitarian programming and action is a crucial step in moving a vulnerable community away from crisis and towards resilience. The success of the recommended actions will be determined by a comprehensive MEAL (Monitoring, Evaluation, Accountability & Learning) strategy developed under the R4S framework, the results of which are outside of the scope of this paper but recommended for analysis in future studies in resilience for the blue economy.

The recommendations of the R4S study in La Guajira encompass environmental, social, and economic dimensions, emphasizing the need for responsible fishing practices, environmental management, equitable participation, access to infrastructure and resources, market coordination, and financial services. By implementing these recommendations, La Guajira's blue economy should become more inclusive, sustainable, and resilient, ensuring the long-term well-being of fishing communities and the conservation of marine coastal areas.

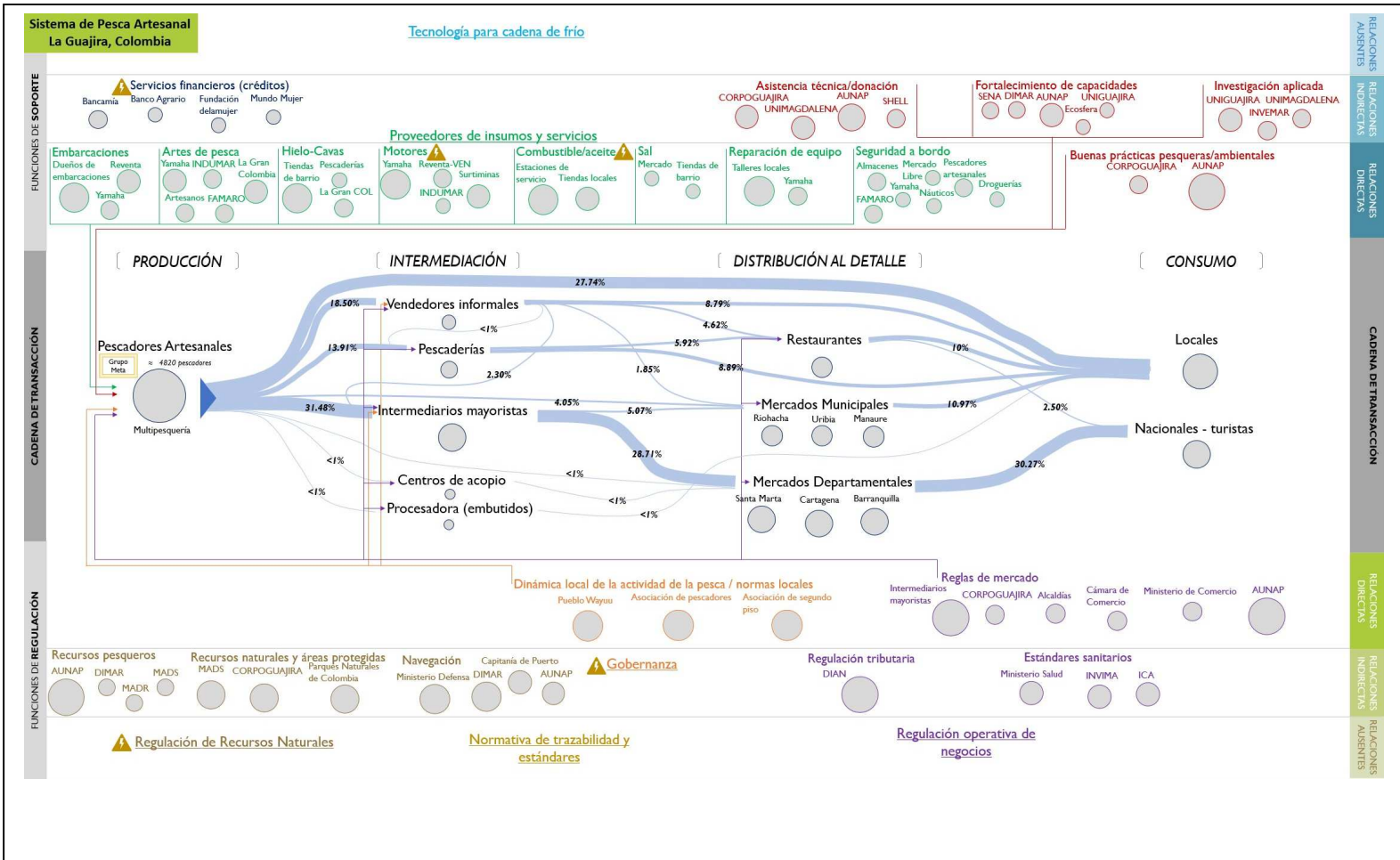
Overall, the R4S Approach offers a practical and structured process to assess, analyze, and enhance the resilience of socio-economic systems within the blue economy. By adopting this approach, stakeholders can foster more inclusive and resilient coastal communities, drive economic growth, conserve marine resources, and ensure food and nutrition security. It is through the integration of such comprehensive strategies that we can navigate the challenges posed by shocks and stresses, creating a

more sustainable and resilient future for the blue economy and its associated communities.

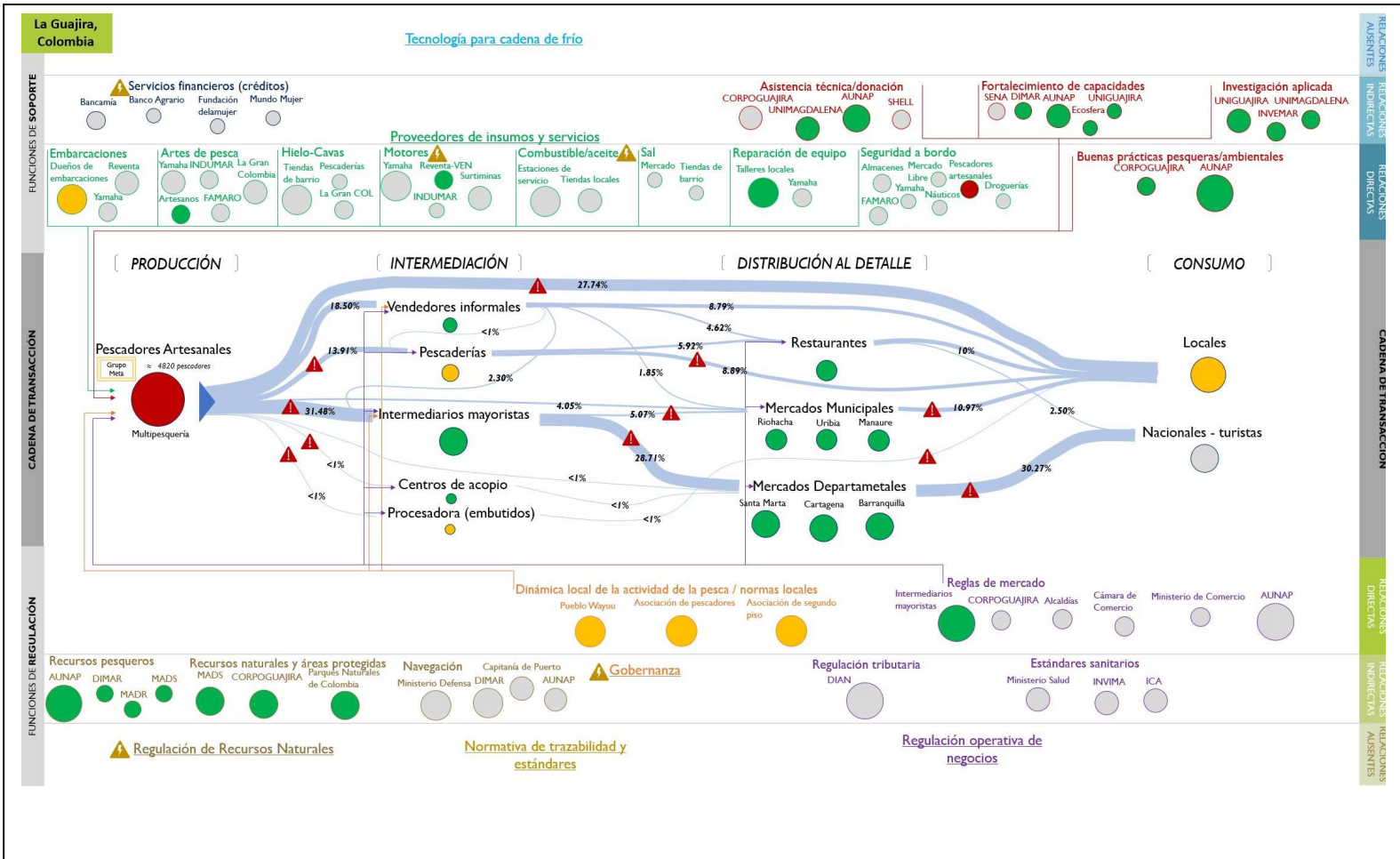
REFERENCES

- [1] *GAR Special Report 2023: Mapping resilience for the sustainable development goals* (2023) UNDRR. Available at: <https://www.undrr.org/gar/gar2023-special-report> (Accessed: 31 July 2023).
- [2] *Annual Report 2022: From Crisis to Resilience* (2023) GOAL Global. Available at: https://www.goalglobal.org/annual-reports/?utm_content=255824536&utm_medium=social&utm_source=linkedin&utm_hss_channel=lcp-1189538 (Accessed: 31 July 2023).
- [3] P.G. Patil, J. Virdin, C.S. Colgan, M.G. Hussain, P. Failler, and T. Vegh (2018). *Toward a Blue Economy: A Pathway for Sustainable Growth in Bangladesh*. Washington, DC: The World Bank Group.
- [4] "The High Level Panel for a Sustainable Ocean Economy" (2020) in. Available at: <https://oceanpanel.org/> (Accessed: 31 July 2023).
- [5] *Blue Economy Discussion Paper* (2022) GOAL Global. Available at: https://www.goalglobal.org/wp-content/uploads/2022/06/GOAL-Global-Blue-Economy-Discussion-Paper_June-2022.pdf (Accessed: 31 July 2023).
- [6] GOAL Global (2016) *Resilience of the blue economy*, UNCTAD. Available at: <https://unctad.org/system/files/non-official-document/ditced-31062022-UNOC-side-GOAL-brochure-v1.pdf> (Accessed: 31 July 2023).
- [7] Rosenthal, H. (2022) *People of resilience: Colombia's Wayuu Indigenous community confronts a malnutrition crisis amid covid-19*, Human Rights Watch. Available at: <https://www.hrw.org/video-photos/interactive/2020/08/13/people-resilience-colombias-wayuu-indigenous-community> (Accessed: 31 July 2023).
- [8] Puerta Silva, C., Torres Muriel, E., Amaya Epiayú, R. C., Dorado González, A., Epiayú, F., Frías Epiayú, E., Ipuana Guariyú, Á., Ramírez Boscán, M., & Romero Epiayú, J. (2020). *If the coronavirus doesn't kill us, hunger will: Regional absenteeism and the Wayuu permanent humanitarian crisis*. *Regions and Cohesion*, 10(3), 140-155. Retrieved Jul 31, 2023, from <https://doi.org/10.3167/reco.2020.100312>.
- [9] Beltrán, C. S., & Villaneda, A. (2000). *Perfil de la pesca y acuicultura de Colombia*. Bogotá.
- [10] Ramírez, J. G. (2015). *Evidenciando la necesidad de gestión en la pesca artesanal de Colombia: el caso de la pesca Wayuu en La Guajira, Caribe colombiano*. AUNAP - Avances de acuicultura y pesca en Colombia.
- [11] McCaul, B., Cáceres Flores, G. and Sahady, S. (2019) *Resilience for Social Systems (R4S) Approach User Guidance Manual*. Available at: <http://resiliencenexus.org/wp-content/uploads/2019/05/2019-R4S-ToolkitD01-1.pdf> (Accessed: 31 July 2023).

APPENDIX A – SYSTEM MAP



APPENDIX B – VULNERABILITY MAP



APPENDIX C – IDEAL MAP

