Final Evaluation of the NETWORK university cooperation Programme in Ecuador (coordinated by ESPOL)

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September 2023
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Acronyms

BIO	Project on Biodiscovery
CACES	Consejo para la Calidad de la Educación Superior
CEAACES	Consejo de Evaluación, Acreditación y Aseguramiento de la Calidad de la Educación Superior
CEDIA	Ecuadorian Corporation for the Development of Research and the Academy
CES	Consejo de Educación Superior
EMAPAG	Municipal Drinking Water and Sewerage Company of Guayaquil EP
EPMAPS	Metropolitan Public Company of Drinking Water and Sanitation of Quito
EPN	Escuela Politécnica Nacional
ESPOL	Escuela Superior Politécnica del Litoral
ETAPA	Telecommunications, Drinking Water, Sewerage and Sanitation Company of Cuenca
IDB	Inter-American Development Bank
IUC	Institutional University Cooperation
IUPWARE	Interuniversity Programme in Water Resources Engineering
IWA	International Water Association
LOES	Ley Orgánica de Educación Superior
MOOC	Massive Open Online Course
NETWORK	Network University
PROMAS	Water and Soil Management Programme
PSU	Programme Support Unit
RBL	Research based learning
REDU	Ecuadorian network of universities for research and postgraduate studies
SENAGUA	Secretary of Water - Ecuador
SENESCYT	Secretaría de Educación Superior, Ciencia, Tecnología e Innovación
UCuenca	Universidad de Cuenca
UGhent	Ghent University
UTN	Universidad Técnica del Norte
WRM	Project on Water Resources Management

Executive Summary

A Network University Cooperation (NETWORK) programme is a national level institutional network aimed at national level impact in a specific thematic domain (priority of the VLIR-UOS country strategy) by the provision of substantial support to a limited number of carefully selected partner universities located in a VLIR-UOS partner country. The overall objective of the Network programme in Ecuador was to deliver highly qualified human resources in natural resources management (biodiscovery and water resources) and to contribute to the sustainable use and conservation of Ecuadorian natural resources. NETWORK Ecuador was organized around three main projects. The first two aimed at enhancing local capacities for biodiscovery and for a sustainable use of water resources management (respectively), and a third one aimed at running a progranmme support unit (phase 1) and applying innovative tools for the consolidation of postgraduate programs and the establishment of linkages with societal stakeholders (phase 2).

The evaluation's primary objective is to evaluate the performance of the NETWORK programme in Ecuador and the prospects for the post-NETWORK period. An evaluation framework was developed with a focus on the six OECD evaluation criteria and the additional sub-criterion on scientific quality requested by VLIR-UOS. Data collection was oriented by the approach of contribution analysis and the methods of outcome harvesting and semi-structured interviews. An impact case was also selected and developed in agreement with NETWORK partner universities. A set of more specific learning questions requested by VLIR-UOS were also addressed as part of the evaluation.

The NETWORK programme in Ecuador was assessed as excellent in the criteria of Relevance, Coherence, Effectiveness (including Scientific Quality), and Efficiency, as Good+ in the criteria of Impact and Sustainability.

The NETWORK programme in Ecuador was highly relevant. The two topics, biodiscovery and water resources management, are relevant to Ecuador development goals, are priorities for VLIR country strategy, and are included in Agenda 2030. The programme provided a response to the shortage of highly qualified academic trained professionals in the water and biodiscovery sectors, by establishing a pioneering and innovative inter-university academic offer with a focus on a research-based learning Master programmes. NETWORK collaborative proposal was a novel experience for university partners in a highly competitive context. The partnership was also able to achieve wide regional coverage because of the partners represented in it. The emphasis of NETWORK on producing research that addressed real life problems and on linking with societal stakeholders was also very relevant and contributes to positioning universities as critical development actors. While the collaborative model opened the way for students form diverse regions to access high-quality postgraduate education, no specific measures were taken to increase the participation of women and other disadvantaged groups.

The programme also demonstrated a high level of coherence in several areas. Several components were well-articulated to address the ultimate goal of contributing to the sustainable use and conservation of Ecuadorian natural resources: the collaborative approach, the research-based learning model, and the emphasis on linkages with societal stakeholders were part of a comprehensive approach to achieve the desired impact. High levels of interconnection and collaboration were also achieved between Ecuadorian universities and between Ecuadorian and Flemish universities. Collaboration within the three projects of the programme was stronger than across projects though some joint activities took place (both research and training). The programme demonstrated the importance of building further on the results achieved by the former IUCs and other VLIR-UOS-funded projects in the country, and of seeking synergies and mutual reinforcement between NETWORK and other VLIR-UOS projects, though there were limited synergies with other donor-funded programmes.

NETWORK has demonstrated to be an effective programme as it achieved most of the objectives proposed in its two phases. It contributed to consolidate a collaborative culture and partners indicated a high level of satisfaction with the collaborative process (at the level of representation, decision making, and communication, among others) which in turn strengthened each partner. The consolidation of the Flemish-Ecuadorian collaboration has translated into more joint research, joint fundraising, and co-teaching, among others. With the consolidation of the research-based learning model, master programmes achieved a high-level continuity (especially the biodiscovery programme), increasing the number of graduates who acknowledge the quality of education received, with access to diverse expertise, the practical research approach and the exchange with students from other regions and from

Belgium as the most valued elements. Despite the high-quality of graduates, the academic and labour market still show a limited capacity of absorption, and private companies lean towards graduates from professional masters as their profile is more attractive. Due to the challenges posed by the context (Covid-19 pandemic and recurrent changes in higher education regulations) it was not possible to set up the inter-university PhD programme and the doctoral school, but institutional support is secured at each university and partners continue working on its design.

The improvement of scientific quality across partners is also notorious, through the set-up of the two Master programmes and the adoption and consolidation of the research-based learning model. Professors were able to increase research productivity as they counted on full-time students who provided support to their projects, and students developed stronger research skills through an active learning process, all of which resulted in an increase of publication rates in international peer-reviewed journals. Moreover, the set-up of both Master programmes generated incentives for universities to increase the academic profile of their staff as having PhDs was a requirement by CES. The enhanced collaboration between partners also resulted in more inter-disciplinary research, more data sharing, new research agendas and opportunities, a higher success in research calls, and further integration of Ecuadorian partners in international research partnerships.

The implementation of the NETWORK programme in Ecuador was highly efficient and was able to optimize resources in a funding and bureaucratic restrictive context. The set-up of joint-Master programmes was a strategic response to the challenges of creating them individually. The collaborative nature of the NETWORK programme fostered the sharing of knowledge and expertise at each university, of equipment and facilities to conduct research, of know-how about management systems and procedures, and of funding opportunities, among others. The cost of running the Master programmes were reduced by establishing the blended learning model (reducing professors and students mobility costs). The decision to centralize both programme management and financing in ESPOL was very strategic, as the university has more flexible procedures and facilities that introduced more agility in the network operation. Despite centralization of functions, programmatic and budget decisions were made with input of all partners, and digitalization supported an efficient coordination. Communication was fluent and efficient both between Ecuadorian partners (though it worked better within the biodiscovery group) and with Flemish counterparts. Flexibility and adaptation in both academic and acquisition processes, supported by VLIR-UOS and Flemish partners, were critical to continue operating under challenging contexts such as the pandemic and the changing regulations by the government.

The NETWORK programme has been a novel experience in Ecuador with expected long-standing impact on partner universities and, to a lesser extent, on the wider environment. The collaborative and research-based learning models were broadly adopted by university partners and expanded to other departments in the universities. The programme led to the creation of strong institutional and individual bonds between universities in Ecuador and with Flemish partners. Not only did NETWORK bring the first joint-Master programmes in Ecuador, setting a precedent at higher education level, opening the way for other universities in the country interested in similar initiatives, but it also inspired and supported the creation of other research networks in the country. Graduates from the Master programmes still face barriers to accessing the labour market as their high-quality training is not enough valued by societal stakeholders and universities lack of resources and positions to offer them. While the articulation with societal stakeholders has increased and the model of addressing real life problems in research conducted by NETWORK members has generated relevant evidence for the Ecuadorian context, engagement and research uptake is still limited. There is a limited culture of cooperation between academia and other stakeholders in society in the joint search of research-informed solutions to industry or policy issues.

The past ten years of the NETWORK programme helped established a solid basis for the continuity of the partnership across universities (both Ecuadorian and Flemish) and the Master programmes. At the institutional level, the ownership of the programme by partners is reflected in leadership support and the adaptation of universities' institutional systems to support collaboration. Strong institutional and individual bonds were created which exceed the NETWORK core circle. The expansion of the network and the creation of the PhD and doctoral school are seen as opportunities to further institutionalize the partnership, continue offering high-quality education, and generate new income. At the financial level, Master programmes have achieved financial autonomy for operation but increasing the base of students is the main sustainability challenge, including the competition with professional master programmes that may be seen as more attractive (they are shorter, easier to integrate with other jobs, and provide more

chances to be employed in the labour market), thus the importance of securing scholarships. The NETWORK has improved its capacity to attract external funding but mainly from VLIR-UOS, and raising funds from societal stakeholders remains a challenge. At the academic level, the joint Master programmes have become part of the academic offer of universities in Ecuador, and several cooperation agreements and research projects are still in place between Ecuadorian and Flemish universities. New research agendas have emerged during the programme as a product of the collaboration and in response to the needs of the context. The internationalization and regionalization of the Master programme is seen as an opportunity to strengthen the academic offer, and overall, the PhD and doctoral school are seen as the next step for academic sustainability.

There are a number of recommendations that could help upscale the achievements of the past ten years as well as inform future similar programmes. First, in order to improve stakeholder engagement and research uptake, stakeholders engagement plans could be developed; translation of research outputs into activities with higher uptake and impact potential (such as policy briefs, short trainings, or conferences) could be encouraged; a culture of innovation and entrepreneurship among students could be fostered; and keeping track of insertion of graduates in the labour market which can become strategic influencers of universities could be explored. Second, the NETWORK model can be consolidated by expanding the collaborative culture and the research-based learning model to other faculties and departments within the universities, by prioritizing the finalization of a strong PhD and doctoral school project and continuing lobbying higher education national authorities to get approval, and by improving the blended learning approach. Third, diversity could be improved by establishing more explicit policies and procedures, as well as gradually incorporating new universities into the network. Fourth, securing funding support for communication and outreach efforts would help increase the visibility of the network. Fifth, efficiency could be improved by exploring more flexible administrative models within partner universities that allow for smooth project implementation and collaborative interventions.

Regarding VLIR-UOS, it could explore an ecosystem approach to further support research uptake in diverse contexts, by supporting both research supply and demand. Moreover, new avenues could be analyzed to support further integration between the NETWORK Master programmes developed in Southern countries and those from Flemish Universities, and support scholarships for postgraduate students in Southern countries to continue their academic trajectories and experience exchange stays in Flemish universities. Finally, VLIR-UOS has an opportunity to more strategically link its local partners in different Southern countries so as to explore collaborative opportunities, and innovative and promising regional and global research initiatives could be supported.

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Acknowledgements

We are grateful to the Ecuador NETWORK members both in Ecuador and in Flanders for taking the time to share their perspectives with us through meetings, interviews and workshops, and generally for providing support to conduct the data collection process. In particular, the evaluation benefited from the leadership and guidance of the two programme coordinators, Paul Herrera Samaniego (ESPOL) and Peter Goethals (UGent) who provided ongoing strategic and logistical support throughout the evaluation process. Support provided by Jenny Ruales (NETWORK focal point at EPN) and Luis Dominguez (Coordinator of the Water Resources Management Group) during the field visits to Quito and Guayaquil was also extremely valuable. Finally, we are also thankful to external stakeholders for providing their views on NETWORK partners' work and their contribution to the advancement of quality higher education in Ecuador as well as to the sustainable use and conservation of Ecuadorian natural resources.

1. Introduction

1.1. Background

A Network University Cooperation (NETWORK) programme is a national level institutional network aimed at national level impact in a specific thematic domain (priority of the VLIR-UOS country strategy) by the provision of substantial support to a limited number of carefully selected partner universities located in a VLIR-UOS partner country. A NETWORK aims at “Empowering local universities to unite themselves and together contribute to national goals in higher education and development”. A NETWORK focuses on harvesting and multiplying opportunities addressing nation-wide needs in the educational and research area. It focuses on cross-institutional interactions such as inter-university collaboration in educational/curriculum development (master, PhD, postgraduate level) and collaborative research, engaging the involved partner institutions in broader international networks via the partnership with Flemish HEI partners. A NETWORK is led by a former Institutional University Cooperation (IUC) partner which serves as the coordinating university.

The overall objective of the Network programme in Ecuador was to deliver highly qualified human resources in natural resources management (biodiscovery and water resources) and to contribute to the sustainable use and conservation of Ecuadorian natural resources. The programme brought together four local partners: ESPOL (coordinating University), UCuenca, EPN, and UTN. In Belgium, the programme is coordinated by the University of Ghent (UGent), and supported by the universities of Brussels, Leuven, Hasselt and Antwerp and the University of Applied Sciences and Arts- Gent (HoGent).

The first phase of the NETWORK (2014-2018) aimed at developing research based joint master programmes, namely one joint master degree in Biodiscovery and one joint master degree in Water Resource Management. During the phase 2 of the programme, the NETWORK focused on consolidating the MSc programs developed during the phase 1, developing doctoral schools and a PhD program, and enhancing the interaction with stakeholders in academic and research levels. Both phases of NETWORK were organised around three projects (see Table 1).

Table 1. Projects in Ecuador NETWORK

Phase	Project	Objective
1	Development of a research-based joint Master’s programme in biodiscovery	Improvement of understanding and use of biodiscovery through research-based master programme delivering professionals, which will allow developing solutions for practical problems of the Ecuadorian society through the sustainable use of natural resources.
1	Development of a research-based joint Master’s programme in water resources management	Enhancement of local capacities for sustainable use of water resources management by delivering highly trained local professionals on WRM, which will allow developing solutions for practical problems of the Ecuadorian society through the sustainable use of natural resources.
1	Development of a Programme Support Unit	Creation of a programme support unit (PSU) at ESPOL to fully organise and operate the NETWORK to coordinate research and academic activities.
2	Enhancing national capacities in biodiscovery	Consolidation of MSc programme on Biodiscovery launched in phase 1 and enhancement of the capacities for demand-based research and stakeholder interactions. The MSc will be consolidated through the incorporation of innovative educational tools including student’s interactions with stakeholders as part of their course activities and thesis. Valorisation managers will be selected at each partner HEI to establish solid linkages with stakeholders for research and tech transfer activities.
2	Enhancing national capacities in water resources management	Consolidation of the impact of the NETWORK trough (a) an increased interaction with stakeholders for a better adoption of proposed scientific-based solutions, (b) increased impact of program graduates through an improved employability for them among water institutions (i.e., knowledge valorisation), and (c) consolidated MSc to achieve international academic standards that promotes programme marketing.

2	Enhancing national capacities in education and outreach innovation	Application of innovative tools for the consolidation of postgraduate programs and the establishment of a solid and permanent link with stakeholders. Innovative tools for education such as MOOCs, e-learning and blended learning will be developed and incorporated into the MSc programs. The platform for a PhD program on natural resources along with an interinstitutional doctoral school will be developed. Staff will be trained in commercialization and tech transfer while linkages with stakeholders will be promoted.

The evaluation's primary objective is to evaluate the performance of the NETWORK programme in Ecuador and the prospects for the post-NETWORK period. The NETWORK will be assessed following the OECD-DAC criteria for development evaluation (coherence, impact, relevance, efficiency, effectiveness, and sustainability) to which VLIR-UOS have added an additional sub-criterion: scientific quality (within *Effectiveness*). The evaluation will analyse aspects related to collaboration in the NETWORK, influence of research and impact at a social level.

1.2. Context

Key social, political, economic, demographic contextual factors in the country

In Latin America and the Caribbean, GDP has decreased from 7% in 2021 to 1.6% in 2023 (IMF, 2023). However, the IMF foresees an increase in the Ecuadorian economy by 2.9% and 2.6% in 2023, due to the international scenario product of the war between Ukraine and Russia, the economic reactivation of China after the outbreaks of Covid-19, and the increase in the reference interest rates of developed countries to curb inflation, among others.

Ecuador has a population of 17,800,000 inhabitants, of which 42% can use safe health services, and 76% access the Internet (World Bank, 2023). The country measures 0.59 (from 0 to 1) in the Human Capital INDEX-HCI. During 2022, there was a 2.5% increase in exports of goods and services, especially from shrimp industries and other food products. Likewise, inflation of 3.7% in December 2022 dropped to 1.9% in May 2023. According to the INEC (2023), the adequate employment rate is 34.9%, the underemployment rate is 20% and unemployment, with a downward trend is 3.8%. 2022 ends with a slight improvement in the rates of poverty (25.2%) and extreme poverty (8.2%) by income at the national level.

According to the Central Bank of Ecuador, the agricultural sector has allowed injecting around USD 4,000 million into the economy, with products such as bananas, cocoa, shrimp and flowers. In 2022 the country also increased migrant remittances to USD 4.770 million, 8.7% more than in 2021. The most benefited provinces are where three of the universities of the NETWORK are located: Azuay (UCuenca), Guayas (ESPOL), and Pichincha (EPN).

Ecuador is a dollarized economy with great challenges that threaten economic recovery in 2023: the volatile price of oil; the climatic phenomenon of El Niño, foreseen for the second half of the year; and, the political instability that led to exceeding 2,000 points in the country risk indicator after President Guillermo Lasso declared the Death Cross (dissolution of the National Assembly) and the National Electoral Council made a new call for elections for the 20th of August 2023. This scenario makes it difficult to finance the Ecuadorian public debt, which according to the Ministry of Economy and Finance (2023) is USD 64,041.40 million, of which, USD 16,071.80 correspond to internal debt.

In May 2023, the Ecuadorian government announced the debt swap for conservation of natural reserves, which generates savings of 1,100 million dollars in debt for the country. The government will invest 450 million for the protection of the Galapagos Islands. The resources will also support Ecuador's work to monitor the health of the oceans, promote sustainable fishing, and strengthen climate resilience (Ministerio de Ambiente, Agua y Transición Ecológica, 2023).

Higher Education

In Ecuador there are 52 public universities and 30 private ones. In recent years, various reforms have been implemented in the higher education system with the aim of improving quality and equity in education, including coverage and access. Some of these reforms included:

- The approval in 2010 of the Organic Law of Higher Education (LOES, in Spanish), which promotes the democratization of access, quality and relevance of higher education.
- As of 2012, free higher education for Ecuadorian students was implemented. In Ecuador, the Constitution of the Republic (2008) establishes in its articles 28 and 356, that public education will be universal and secular at all levels, and free up to the third level of higher education inclusive. Higher education in the country brings together technical institutes, universities and polytechnic schools and the intention of the measure is to increase equal opportunities to access university (Rivera, 2019).
- Policies to strengthen programs and scientific research in higher education institutions, with the generation of scholarships for international postgraduate courses, student loans, research centers, and the promotion of links between universities and the productive sector.
- Quality evaluation and accreditation system of higher education institutions and programs based on established quality standards and promoting continuous improvement in education.

According to the data analyzed, in 2019 some of the results of said reforms were reflected:

There was an increase in the quality of public universities. The annual budget of public universities in Ecuador is derived from 12% value added tax, 10% income tax, and historical donations and bonds that total an average of 1,000 million dollars to be distributed among all public universities each year. Since 2012, the annual budget has been distributed according to institutional quality based on the indicators of the Higher Education Evaluation, Accreditation and Quality Assurance Council (CEAACES), where academic results and publications predominate. Under these premises, the universities with the highest quality are the polytechnic schools of the two main cities of the country: Quito (EPN) and Guayaquil (ESPOL). The universities with the lowest quality are regional and local universities in regions and cities where there are conditions of structural poverty: Esmeraldas, the Amazon and specific areas of the Pacific Coast. In 2013, the universities (public and private) were classified between the letters A to D. By 2018, after improvement and re-evaluation processes, all the universities that were in category D were reclassified to C. Later, in 2019 categories were eliminated and universities were accredited according to the quality of the three functions: teaching, research, and community outreach.

However, private higher education enrollment increased by 10% while public enrollment fell by 3% and students from vulnerable sectors have been affected by the difficulty of accessing higher education. High school completion rate increased to 97% and demographic pressures on access to higher education. Therefore, since 2012, an average of 200,000 students finished high school and seek to achieve a place, above all, in public educational institutions (Ramos, 2023). While students can enter public universities only if they pass standardized exams (in 2022, new SENESCYT regulations offer greater autonomy to universities in relation to entrance exams), private universities diversified the offer and student loans. In addition, due to the exams, the admission of students from vulnerable, rural, low-income and ethnic minority sectors to both public and private higher education was strongly affected.

Regarding Ecuadorians studying abroad, the scholarships included the requirement of returning to the country for a few years, leading young professionals to accumulate debt as they decided not to return due to the increase in unemployment in Ecuador and the increase in opportunities abroad. The lack of competitiveness of wages, the difficulty that scholarship holders face to get a job when they return to the country, and the disparity between the scholarship holder's area of knowledge and the job they get once they finish their studies are critical issues. These factors have affected reaching the objective of training human capital that generates favorable conditions for the productive sector of the country (Vaca, 2021).

While research in higher education institutions has increased, no research agenda aligned with country needs was established. Moreover, the scholarship holders were not institutionalized as professors of the national higher education system (Ramos, 2023). SENESCYT scholarships are focused on postgraduate studies abroad, which means that the research carried out is not necessarily focused on offering solutions to the country's problems. On the other hand, at the end of the studies and returning to the country, there are no follow-up, support and reinsertion mechanisms in the academic system in order to strengthen the academic quality and national research projects. In Ecuador, there is insufficient link between higher education and the external environment, limited quality of academic activity, low levels of self-management, scarce university financing; and lack of social accountability (Silva-Tarqui, 2022).

In this context, CES presented in 2021, together with SENESCYT and CACES, the Plan of the Higher Education System 2021-2026. Its main objectives are to establish mechanisms to improve student access to universities, with more and better opportunities; with the promotion of scientific research and technologies that generate innovations with a social impact; the empowerment of public policies aimed at the needs of the productive and economic sectors, prioritizing sustainable development, among others. In turn, in 2018 and 2019 there have been partial reforms to the Organic Law of Higher Education (LOES) with the common objective of promoting university autonomy, access and research. In addition, the Intercultural University of Nationalities and Indigenous Peoples was created. In 2021, President Guillermo Lasso presented the LOES reform project to the National Assembly, with the aim of strengthening university autonomy, the academic offer and the admission processes. However, it was shelved by a majority vote in the National Assembly in 2023 due to lack of political support and ideological differences regarding issues such as quality and financing.

1.3. Evaluation methodology and process

In this section we describe the evaluation methodology, process and activities. An evaluation framework was developed with a focus on the six OECD evaluation criteria and the additional sub-criterion on scientific quality (within Effectiveness) requested by VLIR-UOS. Data collection was oriented by the approach of contribution analysis and the methods of outcome harvesting and semi-structured interviews. An impact case was also selected and developed in agreement with NETWORK partner universities. A set of more specific learning questions requested by VLIR-UOS were also addressed as part of the evaluation.

Evaluation framework

Table 1. Evaluation framework[1]

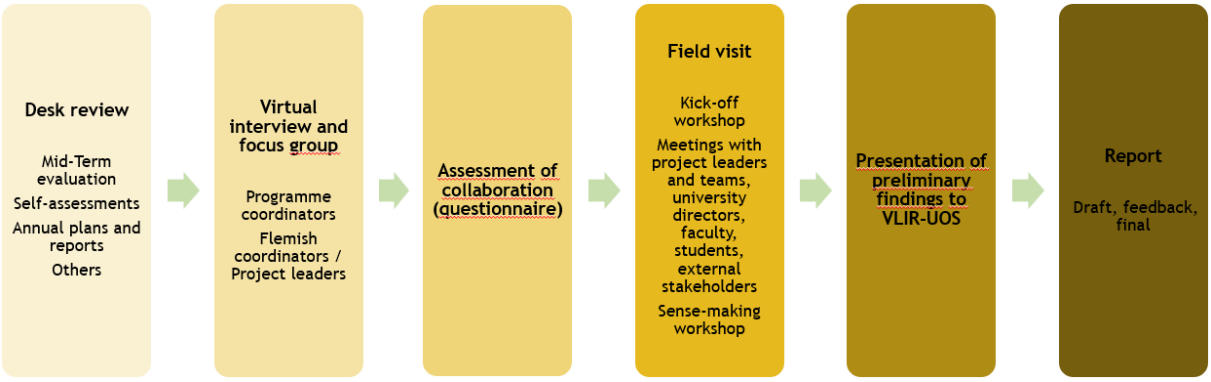
Criterion	Evaluation Question	Judgement criteria
1. Relevance	EQ1. To what extent are the objectives of the programme/project consistent with beneficiaries' requirements, country needs, global priorities and partners' and donors' policies?	1.2. What is the relevance (ex ante) of the formulated outcome(s) and objectives?
		1.2. Extent to which changes in the external context or within the organisation influenced the relevance of the intervention, and how this was handled?
2. Coherence	EQ2. To which extent is the partnership programme coherent, internally and externally? What is the level of synergy and complementarity with other relevant (Belgian) actors?	2.1. Internal coherence
		2.2. External coherence
3. Efficiency	EQ3. To which extent resources/inputs (funds, expertise, time, etc.) are converted to results in an economic manner?	3.1. The cost-effectiveness (the usage of resources in relation to the achievement of objectives)
		3.2. The extent to which organisational management and structures of the programme/project are conducive for efficient implementation.
4. Effectiveness	EQ4. To what extent are the programme' s objectives (expected to be) achieved, taking into account their relative importance?	4.1. The extent to which the programmes outputs and outcomes have been achieved and the likelihood that the predetermined outcomes will be achieved by the end of the implementation period.
		4.2. Inhibiting and facilitating factors and actors
		4.3. Scientific quality
5. Impact	EQ5. To what extent are (potential) positive and negative, primary and secondary long-term effects generated by the programme, directly or indirectly, intended or unintended.	5.1. Changes (intended and unintended, positive and negative) in stakeholders' lives and contexts contributed to by the programme
		5.2. Fostering 'collective impact'

[1] For more information about the evaluation framework, the inception report of the framework assignment can be requested for consultation at the level of VLIR-UOS.

6. Sustainability	EQ6. To what extent will the programme results continue after the programme is completed?	6.1. Level of institutional sustainability
		6.2. Level of financial sustainability
		6.3. Level of academic sustainability

Evaluation process and activities

Figure 1. Evaluation process



The evaluation of NETWORK Ecuador took place between April and September 2023. As shown in Figure1, the process consisted of several activities which are described below:

- **Document review**. During the document review phase, relevant documentation related to NETWORK programme in Ecuador has been reviewed: the Mid Term Evaluation report, the NETWORK Partner Programme and the Programme Management Manual for phase 2, annual plan and reports, among others. In addition, self-assessments submitted by each local partner university, by the Flemish programme coordinator, and by each of three projects were reviewed by the evaluators as a starting point to inform subsequent evaluation work especially the field visit[2] (see Annex A for a list of reviewed documents).
- **Virtual interview and focus groups**. A first virtual interview was conducted with both programmes coordinators, one from Ecuador and one from Flanders in order to get understanding of the programme, its context and the stakeholders involved previous to the fields visit. Due to participants' availability, the focus group with 6 Flemish programme and projects and coordinators and researchers was conducted after the field visit to discuss, validate and complement preliminary findings emerging from the desk review and field visit (see Annex C for a list of attendees).
- **Assessment of the NETWORK collaborative process**. A questionnaire to assess collaboration within the NETWORK was responded by 42 members of the four Ecuadorian partner universities. Participants scored their experience in the NETWORK in six collaborative areas (and related subdimensions): Collaborative context, Collaborative structure, Effective communication, Collaborative attitude, Competent representation in the network structure/process, and Embrace diversity. The results from the assessment were discussed during the field visit.
- **Field visit**. A field visit took place to Quito (June 12th to 14th) and Guayaquil (June 15th to 16th), hosted by EPN and ESPOL respectively. The field visit started with a kick-off workshop with representatives from the four universities (some in-person and some virtual) in which the results of the assessment of the NETWORK collaborative process were discussed and points of attention for the rest of the field visit were shared. The rest of the week continued with interviews and focus groups with representatives of the different universities and the projects: projects coordinators, faculty, students, staff working in labs, and also Directors of the four universities. An entire day was devoted to virtual meetings with representatives of UCuenca and UTN (half-day each). Interviews with external stakeholders were also conducted (representatives of

[2] A review of each self-assessment has been submitted to VLIR-UOS.

national and local government agencies and representatives of public and private companies). The week wrapped up with a sense-making workshop in Guayaquil with the participation of representatives of the four universities (with members of EPN, UCuenca and UTN flying into Guayaquil). The objectives of the sense-making workshop were sharing the preliminary results of the evaluation, validating and/or complement the preliminary results, and identifying areas to continue collecting information. The programme coordinator and focal points of ESPOL of EPN were very present and supportive all throughout the week. More than 60 stakeholders were engaged throughout the week (see Annex C for a list of stakeholders engaged during the field visit).

- **Presentation of preliminary findings to VLIR-UOS.** A virtual meeting with two representatives of VLIR-UOS took place in July to present preliminary findings. The meeting was also attended by the two programme coordinators (representing Ecuadorian and Flemish partners).
- **Draft report and final report**. A draft report was submitted on August 2023 which received feedback from VLIR-UOS and NETWORK members. The present final report was submitted in September 2023.

Limitations

A first limitation on the evaluation was the impossibility to visit each of the four universities. With the time and budget available, but also due to social, climatic and security reasons presented at the time of evaluation, the evaluators were able to visit Quito (EPN) and Guayaquil (ESPOL). Nevertheless, with the disposition of all parties, it was possible to engage representatives of UCuenca and UTN at several stages of the field visit: kick-off workshop (virtually), interviews and focus groups (virtually), and sense-making workshop (in-person in Guayaquil). Thus, evaluators believe that the findings presented in this report are representative of the experience of the four Ecuadorian universities involved in the programme.

A second and main limitation of the evaluation was the limited engagement of external stakeholders, whether they were representatives of the government, private sector, civil society or other universities. With the time available and with limited availability from external stakeholders it was not possible to organize more interviews that would have allowed the evaluators to gain a better understanding of the impact of the NETWORK programme beyond the experience of the members of the universities (whether they were representatives of the programme, students, Directors, staff, and representatives of the Flemish universities). This also affected the level of analysis of the impact case (in terms of identifying changes at the level of societal actors).

Taking into account the limitations described, the evaluators consider that the evaluation provides a reliable but mostly internal picture of the NETWORK programme in Ecuador. Triangulation was done through the combination of written resources with workshops and interviews targeting both internal and external stakeholders. Representatives of the Ecuadorian and Flemish universities had a chance to validate and complement preliminary findings in the sensemaking workshop, and some of them provided feedback to the draft of this report. Moreover, representatives of the programme were requested to provide additional information to answer remaining questions and fill identified gaps after conducting the data collection process.

1.4. Description of impact case

The impact case focuses on the added value of research provided through the network programme on societal actors.

The impact claim is that the programme has been able to provide research results and products that focus on ‘real problems’, that these results were accessible for the stakeholders and have the potential to inform decisions.

The Network programme realized this through project 3 and during its second phase and within 4 subprojects. The main mechanisms to support change were: (i) the creation of permanent linkages involving stakeholders through the research (from design, to execution, validation, and tech transfer), (ii) training researchers in partner universities on demand-based research, (iii) creation of the position of valorisation managers within each subproject that would serve as communication channels with

stakeholders, (iv) the creation of thematic consortia, and (v) learning form Flemish partners in this area. During phase 2, there was an increased engagement with stakeholders and each of the 4 projects were able to develop a specific service/product: an app, a MOOC training, network opportunity, a research database. The impact case will assess changes and the contribution of the mechanisms to change.

1.5. Structure of the evaluation report

The report follows with an analysis of the findings at programme level in section 2, organized by evaluation criteria. Section 3 presents an overview of findings at project level. Section 4 focuses on the impact case. Conclusions and Recommendations are included in sections 5 and 6 respectively.

2. Analysis and findings: programme level

Overview of programme performance

Criterion	Excellent (4)	Good (3)	Weak (2)	Poor (1)
Relevance	X			
Coherence	X			
Effectiveness	X			
Efficiency	X			
Impact		X+		
Sustainability		X+		

2.1. Relevance

The NETWORK programme is highly relevant for Ecuador. The evaluators assess NETWORK performance under this criterion as excellent.

Topics are relevant to Ecuador's development goals, VLIR strategy and Agenda 2030. NETWORK worked on two topics, biodiscovery and water resources management, that are critical for the development of the country. These two topics fall under the priorities of recent government administrations as they are linked to changing the production matrix of Ecuador, which was set as a major goal of the government in 2012: "The current model of economic development in Ecuador relies entirely on national policies aiming to support and enhance the exportation of these products [agri and acui-cultural products]" (self-assessment, project 2, p.15). Moreover, both topics had been identified by VLIR as priority areas in the country (through a strategic mission that took place before the setup of NETWORK to discuss the future of the Flemish cooperation in the country). In addition, by addressing these two key development areas, the programme contributes to achieving the 2030 Agenda for Sustainable Development, especially those related to food security, water and sanitation, and quality education[3].

Provides a response to the shortage (at the time) of highly qualified academic trained professionals in the water and biodiscovery sectors. As indicated in the Introduction, the overall objective of the Network programme in Ecuador was to deliver highly qualified human resources in natural resources management (biodiscovery and water resources). The NETWORK partners identified the gap in academic training offer in these areas and come up with a novel proposal: "When the NETWORK was initially proposed a decade ago, there were no full-time research-based master's programmes in Ecuador, and there was no legal or institutional framework to support such programmes (…) This highlights the main objective of the NETWORK, which is to create the capacity to undertake academic and research projects in water and biological resources" (self-assessment, programme level, Ecuador, p.13). As explained by an interviewee: "In the first world you have a full-time master degrees

[3] Some of the specific Sustainable Development Goals the programme contributes to are: Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture; Goal 3. Ensure healthy lives and promote well-being for all at all ages; Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all; Goal 6. Ensure availability and sustainable management of water and sanitation for all; Goal 12. Ensure sustainable consumption and production patterns; Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development; Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

and students conduct research. In Ecuador, the professional master degree predominated, and students did not develop research skills. The VLIR project is innovative because they come full time and do research, which is very important for the country." (interview, UTN). Moreover, research-based master programmes are relevant because, due to changes in regulations, undergraduates are not required to conduct a final thesis to finish their studies anymore, so they arrive at master programmes with lower research skills. In addition, the demand for training and high-quality professionals in biodiscovery and WRM for the country was also confirmed by market studies conducted by the NETWORK at the beginning of the programme, a demand that came not only from potential students within the partner universities but also from the labour market in need of such profiles. These market studies have been critical to lobby the Higher Education Council (CES) for the approval of both Master programmes during phase 1.

Innovative collaborative model across local universities. The relevance of the programme also lies on its innovative approach. NETWORK has been the first time that local universities embark on such a collaborative process to develop the first nation-wide Master programmes with a network model: "In a highly competitive academic context, the Network programme has built a good practice in inter-university cooperation" (Mid-term evaluation, 2018, p.6). There was a strong agreement among members of the different universities interviewed for this evaluation on the fact that Ecuadorian universities were used to collaborate with foreign institutions (for instance, Flemish universities) but there were no relevant experiences of strategic collaboration at the national level: "Previous to NETWORK, there was not enough to work with country partners" (interview, EPN); "The collaborative model helped break the institutional confinement" (interview, UCuenca).

Pioneer programme that influenced national higher education regulations. The proposed network scheme was pioneering: "It was the first Academic Regulation program in a network with public universities" (interview, UTN). The relevance of this collaborative experience is also seen in the fact it "led to the creation of new higher education regulations that now promote joint academic programmes, making the benefits accessible not only to the NETWORK partner universities but also to other institutions" (self-assessment, programme level, Ecuador, p.12) (more about this is discussed under *Impact*).

Wide regional coverage. The composition of the NETWORK is another indicator of its relevance in the Ecuadorian context as the geographical and biological diversity covered by the partners guarantee a national coverage of the issues related to the two sub-themes: 'Sierra'/mountains (EPN in Quito, UCuenca in Cuenca, and UTN in Ibarra), and the Pacific Coast (ESPOL in Guayaquil), but also with research that has been conducted in other regions such as the Amazonia (East) and Galapagos.

Research-based learning model is aligned with the higher education needs of the country and the respective reform processes. In the last years, CES, SENESCYT and other government agencies ruling on higher education have emphasized the importance of universities doing more research work that aims at addressing development opportunities and challenges faced by the country. The research-based learning (RBL) pedagogical model adopted by NETWORK, with support of Flemish partners (in particular, Martin Valcke from UGent) in the first years of the programme, was instrumental in responding to the country's higher education needs. Through this model, students go through an active learning process in which they learn while doing research supervised by their professors. In addition, this research projects, usually part of students' master thesis, are required to conduct applied research that addresses real problems in the fields of WRM and biodiscovery which also creates an incentive for students to collaborate with stakeholders outside academia (government, private sector, and others) to identify their needs and come up with research-informed solutions. Not only the adoption of RBL was a novel response to the needs of the country but it has also catalyzed a long tale of benefits and changes that are discussed under *Effectiveness*.

Emphasis on linking with societal stakeholders. This approach was novel in the Ecuadorian academic context in which universities have been traditionally focused on teaching due to the scarcity of resources to do research, and when funding was available to do research this was mostly focused on generating academic knowledge rather than having a practical orientation to help address real-life problems: "Universities in Ecuador have traditionally been education institutions with little or no research impact and a limited perceived capacity to contribute to society by means other than teaching. The almost-exclusive teaching role of Ecuadorian universities have contributed to the lack of internal regulations and mechanisms to facilitate interactions with stakeholders, and various joint academia-

stakeholder initiatives have been affected by numerous bureaucratic processes. Therefore, stakeholders have mostly preferred to search for innovation and problem solution in an international research context" (NETWORK Partner Programme phase 2, 2018, p.15). In that regard, the NETWORK proposal was very much aligned with the mission that higher education government authorities expected from universities as key development actors.

Covid-19 pandemic revealed the relevance of the hybrid pedagogic model. A characteristic of the programme which unexpectedly became very relevant during the pandemic context was the virtual modality of the Master programmes. The initial effort to set-up a blended learning infrastructure (both with in-person and e-learning components) that allow the implementation of the inter-university collaborative master programmes (to reduce costs of professors' mobility and allow for participation of students form different universities and geographic areas) paid back when the pandemic hit as the programme and the universities (including staff, professors and students) were in a better position to navigate the pandemic outbreak and to continue providing high quality postgraduate education to students. Even if several adjustments had to be made for the Master programmes to adapt to a fully virtual modality, the universities were a step ahead in terms of their experience with e-learning programmes. An important effect of implementing this blended model was that it facilitated the participation of students from different geographic areas (not only the ones where partner universities are located) thus representing a key element to support diversity and inclusion in post-graduate education (more about this is discussed in the *Findings on learning questions*).

Gender equity did not receive specific attention, and more could have been done to generate opportunities for other vulnerable individuals and excluded groups. Despite the commitment to gender equity included in the Partner Programme Phase 2[4], and that the assessment of the collaborative process by partners indicated that the NETWORK embraced diversity (including addressing power asymmetries within the network (see *Effectiveness*), no specific actions were taken to attract women students in the Master programmes: "From the beginning, a specific strategy for promoting gender equity was not formulated as the balance between genders was already quite favorable and has been sustained over time. Although there is a noticeable gender imbalance between the Biosciences (more women) and Water Resources (more men) areas, the overall balance is good." (self-assessment, programme level, Ecuador, p.14). This is a missed opportunity to increase their participation in male dominated STEM careers (science, technology, engineering, and math). Regarding other vulnerable individuals and excluded groups, while the network and the virtual modalities, and a few available scholarships, created opportunities for students living outside metropolitan areas to access high-quality education, partners feel that more efforts are needed to continue broadening the possibilities of these individuals and groups to benefit from post-graduate educational access.

2.2. Coherence

The programme demonstrated a high level of coherence in several areas. Therefore, the evaluators assess NETWORK performance under this criterion as excellent.

Programme components well-articulated to address ultimate goals. The theory of change[5] of the programme articulates components in a coherent way to contribute to the ultimate goal of contributing to the sustainable use and conservation of Ecuadorian natural resources. To achieve this, and base on the diagnostic that there is a shortage of qualified professionals in the biodiscovery and WRM sectors, the programme aimed to train highly qualified human resources in natural resources management (biodiscovery and water resources) which could also contribute to produce high quality research to inform decision making: "By enhancing the academic offer on postgraduate programmes related to natural resources, the number of highly qualified individuals will increase and the sustainable use of natural resources with focus on improving the wellbeing of the people from Ecuador will be further promoted. This will be complemented by the OO2, as knowledge generation will be done through

[4] "The network commits to promote gender equality in several ways: 1) Empowering women in research environments during the implementation and operation of the two masters' programs, 2) reconciling the academic and the private life of women when necessary (pregnancy, maternity, etc.), 3) promoting also gender and scientific excellence, 4) promoting research in the domains of the program associated to gender, and 5) increasing the participation of women in science technology and innovation" (p.18).

[5] Evaluators have not had access to an official ToC of the programme in Ecuador. For this section, we have rebuilt a ToC by linking all the different components of the programme.

demand-based research, so stakeholders can be an active part of the Network research and education activities" (NETWORK Partner Programme phase 2, 2018, p.12).

Given the lack of full-time academic master programmes in these areas, there was a unique opportunity to set up the two Master programmes, for which relevant and interconnected activities were implemented at different levels (strategic, programmatic, administrative, etc): meetings with higher education government authorities to get approval of the programmes, adoption of a pedagogic model (research-based learning), training of faculty, joint curricula development, adaptation of universities' regulations and procedures, harmonization of procedures and academic calendars, centralization of administrative and funding management, among others. In addition, research projects and teaching materials reinforced each other, as the former will generate inputs for classes, and training in classes will improve skills for conducting research.

High levels of interconnection and collaboration achieved between Ecuadorian partners and between Ecuadorian partners and Flemish partners. Strong and fluent collaboration among Ecuadorian and with Flemish partners were critical to develop a coherent programme that aligned the interests and contributions of all partners involved. While the first years of the programme represented a learning curve in terms of coherence between partner universities both at the administrative and academic level, affecting the learning experience of the first cohorts of students: "In the beginning, the sharing of information among professors was complicated, but then the process could be facilitated. It was defined that it was not necessary for everyone [professors] to participate in each course" (interview, EPN), the collaboration throughout the years resulted in an incremental consolidation of the NETWORK and both Master programmes.

Collaboration within projects was stronger than across projects. Each project has achieved a good level of collaboration between partners. However, less collaboration took place across projects, especially between projects 1 and 2, even though they both contribute to a better management of natural resources in the country: "The ties and alignment were the strongest within the projects. I think we could have done a better job on the integration among the subprojects, but in a certain sense, the three lines were somehow distant. Although several joint and integrated activities were set up and very successful, these were not yet systematic by the end of the project" (self-assessment, programme level, Belgium, p.8). Some of the exceptions were the joint research about the identification of the Covid-19 virus in drinking water. In addition, projects 1 and 2 have also collaborated with project on education and outreach innovation, for instance, through the design of MOOCs in their respective areas, or the conduction of training activities for researchers to learn about tech transfer, commercialization and how to better engage stakeholders in research processes.

Programme builds further on the results achieved by the former IUC's at ESPOL and UCuenca, and other VLIR—UOS-funded projects. The NETWORK programme shows the importance of building further on results achieved through other VLIR-UOS projects, not the least the IUC projects. Within these projects relevant capacity was built (both at educational level and with regards to research), infrastructure was improved (ICT, laboratories) and international relations and networks with Flemish universities were strengthened. In fact, NETWORK was a strategic response to continue supporting institutional partnerships and bringing higher education partners in Ecuador together in a novel experience stimulating inter-institutional cooperation. For the universities, it was a way to continue receiving support and develop a novel academic proposal.

Mutual strengthening between NETWORK and other VLIR-UOS projects. Synergies between Flemish and Ecuadorian academic programmes was encouraged by VLIR-UOS and became more relevant as capacities of Ecuadorian universities were strengthening through IUC and other capacity developing initiatives. For instance, the collaboration of Flemish partners in the development and implementation of the master programmes in Ecuador later promoted the integration of joint academic activities between the Master programme and Flemish master programmes such as the Interuniversity Programme in Water Resources Engineering (IUPWARE) and Ocean and Lakes: "On the one hand, there was a kind of improvement of the education related these topics [WRM] in Ecuador, and on the other hand VLIR-UOS requested a stronger anchoring of these master programmes in Flanders in VLIR-UOS funded countries, and specifically in Ecuador" (interview with programme coordinators). Moreover, since the Master programmes developed by NETWORK partners provide an opportunity to integrate research work in the curricula and as part of master thesis (following the research-based learning

model), it has fostered collaboration between Ecuadorian and Flemish partners in the form of joint funding proposals presented to VLIR-UOS.

Limited synergy with other donor-funded programmes. While synergy was mainly looked from within the VLIR-UOS context and funding opportunities, less synergy has taken place with other donors, especially from the Belgium donor landscape, with some exceptions such as the Erasmus+ EU-project Watermas (cooperation between Ucuenca, ESPOL and UGent, in cooperation with several universities in Cuba and Europe) that promoted the inclusion of Climate Change on the WRM Master's programme curricula, the project Linking global change with soil and water conservation in the high Andes (ParamoSUS) funded by ARES (Wallonia, Belgium), or the King Boudewijn Fund–Fund Elisabeth and Amélie supported project between HOGENT, IKIAM and ESPOL, focused on small-scale biological water treatments of small familial farms enabling reuse of the water and valorisation of the formed biomass.

Incipient synergies with national education and research networks. At the national level, synergy and complementarity was sought with national education networks such the Network of Ecuadorian Universities (REDU) to which NETWORK partners contributed to set-up, with network projects funded by the Ecuadorian Corporation for the Development of Research and the Academy (CEDIA) on education, biosciences, and water management, and with network projects on education, biosciences, and water management funded by Senescyt (Partner Programme phase 2, 2018).

2.3. Effectiveness

NETWORK in Ecuador has demonstrated to be an effective programme as it achieved most of the objectives proposed in its two phases. Therefore, the evaluators assess NETWORK performance under this criterion as excellent.

Consolidation of collaborative culture. Above all, it has consolidated a network of local universities who have learned and came to appreciate collaboration in a highly competitive context, to the extent that the majority of representatives from the different universities recognized it as a cultural shift: "The VLIR Network Ecuador has facilitated a fundamental change in the culture of collaboration in partner universities" (self-assessment, programme level, Ecuador, p.5). There has been a gradual and positive attitude change towards networking among partner universities: "We went from competing to complement each other" (interview, UTN).

High level of satisfaction with the collaborative process among partners. The assessment of the collaborative process (see Annex D) has shown that representatives of the different universities were highly satisfied with how they performed as a network in several areas, with the collaborative structure (including having a result driven structure as well as accountability processes), the collaborative attitude (including shared leadership, transparency and an ongoing effort to improve working relationships), and embracement of diversity (including addressing power asymmetries within the network and appreciation of complementarity strengths through the different universities involved), being the best scored dimensions of the collaboration: "This network model has facilitated the integration and interdisciplinary academic and scientific exchange. We consider this initiative as an academic collaboration catalyser" (self-assessment, partner university). In addition: "academic cooperation is widely recognized as having significant added value for all parties involved. By collaborating, institutions can combine strengths and resources to tackle global challenges that can only be addressed through cooperation. If this cooperation is local and international, it also promotes knowledge exchange, cultural understanding, and the development of long-term relationships between institutions and individuals. In addition to these benefits, academic cooperation can also improve the quality of education and training by providing opportunities for students and faculty to learn from diverse perspectives and experiences, leading to the development of new skills" (self-assessment, programme level, Ecuador, p.14).

Increasing consolidation of the NETWORK strengthens each partner based on its own expertise. NETWORK was able to take advantage of each partners' strengths and put them at the service of the group, in a process of mutual reinforcement: the NETWORK strengthened itself based on the contribution of partners and partners became stronger by participating in the NETWORK. The latter was notorious in the case UTN, a university that had less research tradition and whose professors were able to strengthen their research capacity as they interact and learn from professors and about processes in universities with more research tradition.

Outstanding continuity of master programmes, especially on biodiscovery. The set up and consolidation of the two Master programmes, with a continuity that is not common in the country (seven cohorts of the biodiscovery programme and three cohorts of the WRM programme), is one of the indicators of effectiveness of NETWORK, as well as an example of how NETWORK and partners strengthening reinforce each other: the collaborative model allowed universities to come up with an innovative and appealing academic offer for its students, with enriched syllabus (product of the contribution of several partner universities), novel learning models (research-based and blended learning), and an expanded pool of equipment for both professors and students to conduct research their research, among others.

Increased number of graduates, quality of education and effects on students. By 2023 of the 94 students that enrolled in NETWORK Master programmes (combining WRM and biodiscovery), 73 have graduated (self-assessment, programme level, Ecuador). Regarding the students, the majority of those interviewed during the evaluation highly appreciated the possibility that the Masters' network model created in terms of having access to diverse university cultures and experts in diverse domains who came together under the same programme) through the co-teaching model: "The way of doing research in each university adds a lot, because it gives me a broader look at how to do it or complement it" (student, WRM Master programme). The possibility to interact with a diverse range of students was also highlighted: "In my case, it was quite important to share this academic stage with colleagues from different parts of the country and who also studied engineering such as: Geology, Environmental, Civil, Renewable Resources, as well as science careers such as: Mathematics and Physics. This diversity of backgrounds greatly encouraged to identify how we solve problems from other points of view" (graduate, WRM Master programme). However, students interviewed during the evaluation have suggested that it would have been important to have more time for joint practices (with their peers from other universities both form Ecuador and Flanders), though the impact of the Covid-19 pandemic in this aspect cannot be underestimated. In many cases, students have experienced the Master programmes as a step towards a PhD in their academic trajectories, and NETWORK partners have been supportive in helping them achieve scholarships to study in foreign universities (especially Flemish).

Students experience of collaboration with Flemish universities. Students also benefited from the interaction with Flemish professors and students both in in-person and e-learning classes, field visits in Ecuador, and in some cases by enjoying academic stays in Flanders through exchange processes: "Student mobility (PhD and master students) between Ecuador and Belgium (both directions) was enhanced as students could be linked to NETWORK activities (participating in field work and case studies, participation in network activities such as conferences and seminars, identification of new PhD subjects, etc)" (Mid-Term Evaluation, 2018, p.25). Another graduate highlighted the cultural interaction: "The exchange with foreign students was very positive to break the culture barrier" (graduate, WRM Master programme). The research-based learning model contributed to train "more autonomous students (…) with more capacities to link theory and practice" (interview, EPN). Also, Belgian PhD, master and bachelor[6] students benefited from this exchange: "Also for our students it's really interesting to have the collaborations with Ecuador. Since the beginning of the project, about 20 students have already been going to Ecuador for doing their internship (in a company or university) and they always come back very positive. The international experience we can give to the students is really important" (interview, Flemish partner).

High-quality training to join the academic and labour market but still limited capacity of absorption. Students also appreciated the active learning approach, essential to the research-based learning model, as it allowed to develop applied knowledge and learned about tools to perform in academic and labour market: "A large number of tools were shared with us that I have been able to apply in my workplace (EPMAPS), for example, in the spatial visualization of environmental variables through Geographic Information Systems, as well such as the statistical analysis of time series of: precipitation, temperature, flow, pressure, solar radiation, relative humidity, wind, soil humidity temperature. These tools can be used in a large number of projects such as: humidity forecast of soil and its applications such as: identifying areas with a high probability of soil propagation or areas of possible landslides" (interview, graduate WRM Master programme). However, despite the high-quality training received by students in the Master programmes they still face challenges to get jobs in the

[6] For instance, 19 HOGENT professional bachelor in Chemistry students have done their internship in Ecuador. Some of these internships resulted/contributed to A1 publications.

biodiscovery or WRM industries, which demonstrates both the lack of capacity and of interest of the labour market to absorb high-qualified professionals (also highlighted in the Mid-Term Evaluation). In addition, the academic sector also shows limited capacity to absorb the graduates it trained due to the lack of resources and positions to be offered, which encourages most of students to seek continue their career-paths by pursuing studies abroad (see *Impact* for more about the discussion about labour market and knowledge ecosystems in Ecuador).

Increase of professors' research productivity. Regarding the professors, there is an extended consensus among those interviewed in the evaluation that they have also benefited largely from collaborating with their peers from different universities (for teaching, researching, publishing and fundraising), learning new teaching methods, and having access to a pool of full-time students that provided support to their research processes: "It is about each professor who does research having his/her own team and thus producing more" (interview, ESPOL) (see *Scientific quality*). Professors also benefit from accessing equipment available in other universities and liaising with Flemish professors and universities. All this results in an enhancement of their research productivity which is also reflected in higher publications rates (see *Scientific quality*).

Consolidation of Flemish-Ecuadorian collaboration and mutual benefits. The consolidation of the NETWORK throughout the years was seen not only at the national level, among Ecuadorian universities, but also between these and their Flemish partners. Indeed, professors and researchers from both countries have developed a trust relationship which they labeled as "mutual learning between peers". That is, far from being a vertical relationship through which Northern parties set conditions and dictate the pace of the collaboration, a central feature of NETWORK is the horizontal relationship between Northern and Southern partners in a context of mutual trust and based on appreciation of each other's strengths which translates in joint research, joint fundraising, co-teaching and sending students to have study and research visits in both countries: "We have a lot of partners which we can really say we are on equal terms now" (interview, Flemish partner). As explained, the international bonds that are central to NETWORK were not only beneficial to students and professors from Ecuador, but also to their Flemish partners: "We may have a specialist in UGent, or very high-level technology and we know how to use it, but we don't know how to apply it in the context of Ecuador, how to convince the farmer to change, how to identify animals (…). We learned a lot from each other, and we published very nice papers because of this joint" (interview with programme coordinators). In addition, the consolidated bonds allowed several Ecuadorian NETWORK members to continue training in Flemish universities: "Some of these trainings resulting on master and doctoral candidates following graduate programmes at Flemish universities after scholarship applications to national and European funds" (self-assessment, WRM project, p.5).

Strengthening of the research-based learning education model. This active learning model, developed in the first years of the programme with the strategic guidance of Flemish partners (especially of Dr. Martin Valcke from UGent) allows students to learn about biodiscovery and WRM areas while they conduct research in specific fields. 59 new courses have been developed (combining both Master programmes) that incorporate this model (self-assessment, programme level, Ecuador). By applying this model, students were asked to choose a research topic of interests and carry on through their learning experience as the different classes will contribute to their research project, with the expectation of concluding their Master's experience with a publication in high-quality research journals. Moreover, the NETWORK model enriched students' research experience as their thesis were co-tutored by two professors from different partner universities and by having access to equipment in different universities. In addition, the research-based learning model also gave students the chance to apply knowledge gained in concrete research processes which in most of the cases include interaction with stakeholders outside the academia. Moreover, the programme helped acquire equipment to support research and education at partner universities (15 different equipments were acquired during the programme according to the self-assessment by WRM project): Thus, the whole research process in universities was strengthened, enhancing the quality of both the process and its outputs (see *Scientific quality*).

Increasing but still challenging articulation with non-academic stakeholders. Collaboration with other stakeholders was a core feature of the programme, with was addressed with further emphasis in its second phase, especially with the support of project 3. Not only the programme generated a vast amount of evidence to inform policy and industry-related decisions, but it also supported government agencies natural resources management, developed capacities of external stakeholders (e.g. private and public water companies' operators and technical staff) and convened spaces for multi-stakeholders

discussion (e.g. national workshops, webinars during the pandemic, and thematic consortia). In total, 27 extension/outreach activities were conducted, reaching 910 stakeholders (self-assessment, programme level, Ecuador). Project 2 on WRM was more successful on building these synergies with stakeholders, with the development of specific training activities for private and public water companies, the support provided by UTN to water treatment planning to the local government of Ibarra, and the Water and Soil Management Programme (PROMAS)'s consolidation of the study of medicinal plants and microorganisms, as well as the water management in the Cuenca region, being paradigmatic examples. However, despite the many efforts of the programme and its partners, uptake of evidence by stakeholders for decision making is still challenging, mainly due to a lack of culture of collaboration between academia and stakeholders which does not create incentives for stakeholders to demand research-informed ideas. Moreover, while the NETWORK had planned to identify valorization managers within each partner university to maintain an active communication channel between academia and stakeholders, interviews during the field visit suggested limited progress was made in that regard.

PhD programme not yet developed. Finally, the set-up of the PhD programme on Natural Resources (combining both biodiscovery and WRM) and the interuniversity doctoral school is one of the major objectives that were not possible to achieve within the programme timeframe. Although a market study has been conducted to gain insight into the profile of potential doctoral students, the absence of necessary regulations in Ecuador to establish doctoral schools and the outbreak of the Covid-19 (with subsequent budget cuts in public higher education) have made it difficult to achieve the objective. In particular, interaction with the Higher Education Council (CES), responsible for approving the doctoral programme and school, was significantly reduced during the two years of Covid-19, which have delayed its approval. However, NETWORK partners continue making progress in terms of the PhD programme and the doctoral school desired structure and operation (a meeting devoted to this was held in parallel to the evaluation field visit in Guayaquil) to get approval from the Higher Education Council (CES in Spanish) and other relevant government agencies. The PhD programme and the Doctoral School would be an important milestone for the sustainability of the NETWORK as it would mean another stage of collaboration among partners and would capitalize the progress made with the Master programmes in terms of offering high-quality education and building research-capacity in biodiscovery and WRM. Another objective not achieved yet is the internationalization of the Master programmes, which would also represent an important sustainability strategy.

2.4. Scientific quality[7]

NETWORK invested in universities as key development of stakeholders through the production of high-qualified research. The NETWORK programme made a great contribution to enhance research capacity on biodiscovery and WRM in Ecuador, building on previous efforts through the IUCs: "At ESPOL and the University of Cuenca, the IUCs enabled the formation of truly important research capabilities. However, these were not fully sustainable due to the lack of academic programmes such as masters and doctoral degrees, which would have allowed for the integration of more human resources into research" (self-assessment, programme level, Ecuador, p.15). In addition, the programme emphasized the importance of research for the development of the country, aligned with recent governments' mission for higher education. For that, universities had to go beyond their historical teaching role and postgraduate education would have to adopt a stronger emphasis on research compared with the more extended "professional" approach.

The set-up of the two Master programmes and the adoption and consolidation of the research-based learning model generated a long tale of positive results related to improvement of research capacity within the NETWORK:

It created a win-win situation for both professors and students that improved scientific production and quality. The former benefit from having additional support from students to conduct their own research projects thus expanding their capacity to publish their research, and the latter benefit from a close guidance by a diverse range of experts in their fields of interest (also increasing the chances of being published) and their support to continue their academic trajectories abroad: "At the start of the NETWORK, universities had good research capabilities, but the research was limited as professors were responsible for developing proposals, managing research, and conducting research itself with

[7] This criterion has been assessed together with the Effectiveness, as indicated in the evaluation framework, Thus, evaluators have assessed NETOWRK performance under this criterion as Excellent.

limited support from undergraduate students. This resulted in a low number of academic publications and slow progress in research. The NETWORK has created a better structure to take advantage of the capacities developed in previous IUCs. This has been achieved mainly through more and better human resources, such as postgraduate students, who support the development of research" (self-assessment, programme level, Ecuador, p.15).

The set-up of both Master programmes generated incentives for universities to increase the academic profile of their staff. National higher education regulations require having at least 70% of Master faculty with a PhD to approve Master programmes. While research capacity was improved across partners, that improvement was especially notorious in the case of UTN as research gained more prevalence in the work of professors who, before joining NETWORK, were mostly focused on teaching. Half-way the programme, UTN started to hire more staff with PhD which enabled their participation as a hosting university in the second phase of the programme. Moreover, NETWORK created the incentives and provided the environment for researchers (both professors and students) to implement their research agendas and interests as they collaborate with and learn from their peers (both national and Flemish) with have a more extended research trajectory.

The research-based model combined with the NETWORK inter-university model enabled greater research collaboration among universities. This enhanced collaboration resulted in more inter-disciplinary research (e.g. detection of Covid-19 virus in water), the discovery and adoption of new research areas and research agendas, the identification of new research project opportunities, and the generation of data to be shared with and used in several research projects: "Particularly in research we found that we can be partners and have more impact. In sciences and academic programs, the more you collaborate you have more impact" (interview with programme coordinators). The inter-university collaborative model also allowed NETWORK partners (both students and professors) to share equipment to conduct their research, equipment that was also acquired with programme funding, thus expanding the research capacity of the NETWORK.

Increase research productivity. An increment on the level of scientific production was also notorious among NETWORK partners, achieving a higher rate of articles published in international peer-reviewed journals: while 20 articles were published during phase 1, 58 articles were published during phase 2 (self-assessment, programme level, Ecuador), with many of them being published in top journals: "This indicator have been relevant to attain the support of each participant university" (self-assessment, WRM project, p.5). The collaborative approach to research is part of the added value of the articles: "That also allowed us to have something of success factor when we send a publication or we look for a grant: when we send an application, we submit something for a journal for example, it is not just about us (interview with programme coordinators). An increased research capacity also resulted in the strengthening of research centers and labs at each university: "The research in the UTN has been strengthened, specifically in the Laboratory of Environmental Research (LABINAM)" (self-assessment, partner university). In some cases, these centers and labs benefited from the incorporation of highly qualified Master students or graduates.

Increase research innovation. The research based learning model combined with a cross-cutting emphasis on innovation and outreach (with support of project 3) allowed NETWORK partners to innovate in their research fields, thus creating space for initiatives such as the Fusarium Sensor Ec App (that allow farmers to interact with experts from the NETWORK universities to detect the presence of Fusarium R4T in banana plantations) or the MOOCs on WRM, food safety, and biodiscovery conservation to develop.

Higher success in research calls and integration in international research partnerships. The increased research capacity and the collaborative approach to research also resulted in a higher rate of success in research calls for proposal among NETWORK partners, as the joint approach (both between Ecuadorian partners and between them and Flemish partners) revealed to be attractive to research grant makers. The improvement of research capacities at local level opened the door for an increasing recognition and integration of Ecuadorian researchers in international research groups mainly through their linkages with Flemish partners.

2.5. Efficiency

The implementation of the NETWORK programme in Ecuador was highly efficient and was able to optimize resources in a funding and bureaucratic restrictive context (including the impact of the pandemic). Therefore, the evaluators assess NETWORK performance under this criterion as excellent.

The collaborative effort to set-up NETWORK was in itself a strategic response to the challenges of creating Master programmes individually: "At that time, the network members quickly realized that developing Master's programmes individually would have been prohibitively expensive. Therefore, the alternative of creating them through the NETWORK resulted in significant cost savings and provided sufficient resources, particularly human resources, to make it possible. This is because each university did not have enough specialized professors to accomplish this on their own" (self-assessment, programme level, Ecuador, p.13).

The collaborative nature of the NETWORK programme also enabled to optimize university resources:

- **The knowledge and expertise hosted at each university** was put at the service of the NETWORK especially for the creation of joint curriculum for the Master programmes, the co-teaching model, and the conduction of joint research projects.
- **Equipment and laboratories were also shared between partners**, which allowed researchers and students to continue their research in different locations/universities as they needed it.
- **The investment on a hybrid learning modality form the beginning** of the programme was also an efficient response to the impossibility of costing professors traveling to each university to dictate in-person classes at other universities or students traveling to spend long stays at different locations, and was very rewarded as it helped mitigate the impact in the operation of the Master programmes when the pandemic of Covid-19 hit.
- Linked to the hybrid modality, NETWORK partners also made a **strategic and informed decision regarding how professors and students mobility** would take place in the Master programmes: "At the beginning of NETWORK, Professor Martin Valcke (Ugent) was mentioning about Erasmus, we discussed about this, and we had some concerns if we really were prepared for mobility. Then we decided to do market research on how we could implement this mobility in Ecuador, and the results said that it was not possible. So, we decided to implement our model where students don't move for classes, but they move for research. It was a more productive way" (interview with programme coordinators)
- **Know-how about management systems, higher education bureaucracy, regulations for post-graduate programmes, access to funding** (national and international) and scholarships was also shared between NETWORK members: "The management systems in our institution have been improved by taking as a reference how management processes are carried out by other partner universities" (self-assessment, partner university). Moreover, EPN and UTN benefited from ESPOL and UCuenca's knowledge of VLIR-UOS procedures as they have been IUC grantees.

In addition, NETWORK partners made the **strategic decision of centralizing both programme management and financial management** which was critical to optimize resources in a highly bureaucratic context:

- During phase 1 of the programme, programme management was designed as a 'third project' (together with the two master programmes). A Programme Support Unit (PSU) was created at ESPOL aimed at organising and operating the VLIR-UOS-NETWORK including research and academic activities. Procedures were developed together with monitoring processes, monthly academic committee meetings, and website coordination, among others. There is a general consensus among interviewees and in programme reports that PSIU performed with high-quality standards contributing to efficiency in programme management.
- Financial management was provided by ESPOL-TECH, a public enterprise attached to ESPOL.

- Together with PSU and the financial management, the coordination of the programme (in Ecuador) and the three project leaders were also based at ESPOL, which greatly facilitated accessibility and quick communication.

Despite programme and financial management centralization, there was a consensus among interviewees on **decisions being made by consensus underpinned by fluent communication**: "The communication within the programme was very fluent and transparent. Decisions were always taken in consensus with other partner universities of VLIR network program and with Belgian partners" (self-assessment, partner university). Regarding budget allocation, decisions were made in a participatory manner contributing to transparency: "Given the intertwined nature of the planned activities, distribution of the budget at predefined percentages was considered to be inefficient. Nonetheless, an equitable distribution of investments will be sought by the administration of the programme during annual evaluation meetings to avoid over-concentration of resources in any given partner" (The Programme Management Manual, 2018, p.12). However, some university partners have expressed in their self-assessments that communication related to the programme budget could be improved so that everyone within the NETWORK has a good overview of the state of affairs, at all times. According to one of the programme coordinators: "Overall, we think the budget was extremely efficient used if you look at the diversity and number of activities" (self-assessment, programme level, Belgium).

The training for NETWORK members conducted at the beginning of the programme also helped create recognition among members and common understanding of the governance, management and financing processes. The provision of time and budget to invest in network building in the first years of the programme (from training between universities, to joint traveling and in-person meetings, among others) was critical for a more efficient implementation. The trainings for NETWORK members conducted at the beginning of the programme helped create the conditions for the Master programmes to operate (training on course design, research-based education, development of learning materials, among others), though the first cohorts of the Masters worked as pilots in after which coordination aspects (co- planning, co-teaching, timeframes, and evaluation schemes, among others) were gradually adjusted. The Programme Management Manual was developed "in order to ensure a common understanding of the relevant rules and the requirements for all actors involved in every stage of management and control, from the development through contracting, implementation, reporting and verification of expenditure of each project" (2018, p.4). Established procedures were underpinned by more informal networking, described as 'soft diplomacy' in the Mid-Term evaluation.

A clear division of roles and responsibilities also contributed to an efficient management of the programme, especially among programme coordinators (Ecuador and Flanders), focal points at each partner university, and project leaders. Distribution of responsibilities among the two programme coordinators in Ecuador and Flanders was very-well planned and implement, being a key tandem in the promotion of the NETWORK's goals and achievement of its objectives. However, some communication bottlenecks were experienced between project leaders and focal points and other project members within the universities with differences by project (two self-assessment by partner universities have expressed that these bottlenecks were more often in the WRM group compared to the biodiscovery group which ran more smoothly). Also, according to the Mid-Term Evaluation, the role of NETWORK advisors was not very clear for members during phase 1 of the programme, though no references were made to this during the final evaluation (nor in more recent programme documentation). The Annual Steering Committees (formed by the Ecuadorian and Flemish coordinators, the representatives of local universities, and the VLIR representatives) have proven to be helpful in monitoring the progress of the programme and discussing any relevant issues.

Digitalization supported efficient coordination. Coordination of activities across the NETWORK was also facilitated by the increasing digitalization of the NETWORK operation, especially during the pandemic: "It is worth noting that during Phase 2, and especially since the beginning of the COVID-19 pandemic in 2020, the use of digital media greatly facilitated the coordination and execution of the project. A culture of using digital media to quickly organize meetings developed, which proved to be very useful" (self-assessment, programme level, Ecuador); "Despite initial delays and budgetary challenges, these changes were ultimately beneficial. In fact, the use of technology to digitize certain processes enabled the network to operate with fewer resources than initially required" (self-assessment, programme level, Belgium). However, the pandemic also created an additional burden for university

staff who at times could not join scheduled meetings as they had to catch up with research and academic workload.

Collaboration between Ecuadorian and Flemish partners was also described as efficient: “The collaboration among Ecuadorian and Belgian universities in the network was established through the utilization of each institution’s unique strengths, including human resources, capabilities, equipment, infrastructure, and experience. Joint meetings with project leaders and focal points demonstrated that all members worked as a cohesive team” (self-assessment, programme level, Belgium). In particular, communication between both parts was assessed as flexible and efficient: [There was] rather a need-oriented communication in relation to Flemish partners, e.g., in case of visits that were organised to Belgium and viceversa. Communication was functional and efficient, rather than regular. I had not the idea that we wasted our time on ‘mandatory’ meetings, and I think this was a major reason for high level of attendance” (self-assessment, programme level, Belgium).

Flexibility and adaptation in both academic and acquisition processes. NETWORK partners in Ecuador demonstrated great creativity and disposition to make the Master programmes work as they had to coordinate different academic calendars (Sierra and coast), align planning processes, evaluation schemes, and graduation timeframes: “Even considering different administrative regulations at each local institution, internal procedures were successfully adapted for running the master programs” (self-assessment, partner university). The programme was also able to respond to changes of national regulations: “Changes in National regulations pushed the CES (Ecuador's Council of Higher Education) to shorten the authorized length of master's programs to one cohort only, requesting universities to adapt their programs to the new regulations. We acknowledge that the changes in regulations were positive, but the programme amendment and the approval was indeed a long process. We took advantage of the changes and converted one of the MSc courses into a MOOC” (self-assessment, biodiversity project, p.5).

Indeed, during phase 2 of the programme, the operating rules of ESPOLTECH became more complex and bureaucratic because of changes in national regulations: “One solution found was to execute at least part of the funds through a foundation that ESPOL maintains in operation and that is governed by more flexible operating rules [FUNDESPOL]” (self-assessment, programme level, Ecuador, p.8). Moreover, during the second phase of the programme, when acquiring equipment from Ecuador proved to be very difficult, NETWORK also counted with the support and flexibility form VLIR-UOS and the Flemish partners which at times will pursue the needed equipment by partners in Ecuador at a lower bureaucratic cost which made equipment arrive on time to conduct research. Overall, the programme was successful in adapted to changes in the context: “As an established network, we were able to find alternative solutions for academic and administrative issues when facing unexpected situations” (self-assessment, partner university).

Overall, it has been acknowledged by interviewees that programme management and coordination of activities improved after the recommendations made in the Mid-Term evaluation.

NETWORK partners were also active in the search for funds for the programme, including for scholarships for students to participate in the Master programmes and financing of research theses:

- Regarding scholarships, the programme looked for solutions when it became clear that Senescyt would not provide scholarships for the first cohorts of students, a situation that continued when the pandemic hit. This also resulted in the development of a scholarship policy to support students to cover part of the mandatory tuition and mobility expenses (especially at ESPOL and EPN).
- In addition, NETWORK sought to save funds from students’ tuition fees.
- In the Coherence section we have shared how the programme benefited from synergies with other VLIR-UOS programmes and, to a lesser extent, from other international funding.
- Funding from the private sector and government agencies was also sought. Especially through phase 2 of the programme, but with limited success (see *Sustainability*).

2.6. Impact

The NETWORK programme has been a novel experience in Ecuador with expected long-standing impact on partner universities and, to a lesser extent, on the wider environment. Therefore, the evaluators assess NETWORK performance under this criterion as good+.

Impact on NETWORK partners

NETWORK has introduced a collaborative culture between public universities in a highly competitive context. It has been the first time that Master programmes were carried out with an inter-university approach, which generated incentives for partner universities involved to adapt processes and structures and socialize expertise, resources and know-how to support its successful implementation. The benefits of investing in collaboration have been acknowledged at the level of research processes (including inter-disciplinarity and a higher rate of publication in peer-reviewed journals, among others), identification of new research areas and opportunities, and grant applications, among others: "Collaboration became recognized as the primary asset for achieving concrete results in research and joint academic programs" (self-assessment, programme level, Ecuador, p.5). Overall, there has been a positive attitude change towards networking among partner universities, to the extent that is has become a reference for other areas and disciplines within universities.

The research-based learning model, was broadly adopted by university partners as a way of combining high-quality education with high-quality research outputs, enriching both the students' experience and the productivity of researchers in universities as both students and professors support each in their projects. As it happened with the network model, and as an indicator of progress compared to the Mid-Term Evaluation which found that there was limited spill-over beyond NETWORK specific members, throughout phase 2 the research-based learning model has also been expanded to other areas in partner universities: "At the beginning, students only did a final work and not research. We currently have several Master programmes with the research-based learning model: three departments out of four already have incorporated research and are already thinking about the PhD" (interviewee, EPN). The research-based learning model is in itself a strategy to improve the quality of research and professionals in the country.

Creation of strong institutional and individual bonds. NETWORK has helped create and strengthen professional and inter-personal bonds between universities and individuals both Ecuadorian and Flemish, which are expected to transcend the programme to continue and become stronger through ongoing and new research projects, areas and groups (also see *Sustainability*)

Enhancement of English skills. It has been pointed especially by Flemish interviewees that the programme has helped develop English language skills among Ecuadorian partners, which has also contributed to more fluent communication and understanding among parties: "Let me track back to my first teaching in 2002: the big difference is now that actually within our Master programmes and the NETWORK, English, with a very few exceptions, is not a problem anymore" (interview, Flemish partner).

Impact on the wider environment

First joint-Master programme in Ecuador. The joint-Master programmes established by the NETWORK have been the first of their kind in the country: "As of 2011, it is worth noting that the only networks of Ecuadorian universities in existence were created for specific purposes related to university management at the political level or for accessing certain services, such as the CEDIA (Ecuadorian Corporation for the Development of Advanced Internet)8. Moreover, there was no indication of any academic initiatives aimed at providing joint educational programs during that period" (self-assessment, programme level, Ecuador, p.4). Moreover, when the joint-Master programmes were proposed by NETWORK to the Higher Education Council (CES in Spanish) for approval in the early years of the programme, there were no higher education regulations to approve it. Getting approval required both strategy and persistency from NETWORK partners, and a lot of lobby work: "Representatives of the four partner universities and even representatives of our Legal Departments used to attend meetings with CES" (interview, EPN). All interviewees agreed that it was a huge effort to find the gaps in the higher

[8] Note this is different from Ecuadorian Corporation for the Development of Research and the Academy, also CEDIA, created in 2017.

education legal framework to get the Master programmes approved: “we had to be creative to find flexibility in the law” (interview, CES President). In the end, both master programmes were approved as “innovative” educational programmes. Lobby efforts also led to CES approving distance learning models, an essential component of the Master programmes.

Precedent at national higher education level. The results of this effort have not only been beneficial for NETWORK partners, but it also set a precedent in higher education programmes becoming a reference and opening the way for other universities in the country interested in offering joint-Master programmes: “This achievement was significant in that it led to national regulatory changes that facilitated the approval and promotion of this type of programme (…) As a result, the experience of the local-international collaboration built through this programme has been presented and recognized as a benchmark in Ecuador at various academic forums held from 2013 to the present” (self-assessment, programme level, Ecuador, p.4).

Inspiration and support to creation of other research networks. The self-assessment at programme level by Ecuador programme coordinator also adds that “The establishment of the VLIR Network Ecuador has had a significant impact, as it has inspired other similar initiatives over the past decade”. One example is REDU (Ecuadorian Network of Universities for Research and Postgraduate Studies), “which drew from the experience gained at the beginning of the programme. Members of the VLIR NETWORK Ecuador played a vital role in founding REDU, with the Southern coordinator of the VLIR-Network invited to serve as the coordinator of postgraduate studies in REDU, a position he held for two years. As of 2023, REDU has 35 affiliated Ecuadorian universities focused on promoting joint master’s programmes and research collaborations across a wide range of topics” (self-assessment, programme level, Ecuador, p.4). Another example is CEDIA (Ecuadorian Corporation for the Development of Research and the Academy), created in 2017 to promote the exploration and results of innovative projects that link Ecuadorian institution.

Increased recognition of the importance of research in national academia. The focus on research in Master programmes was also novel in the Ecuadorian context and had an impact in how universities “I think the country started to talk more about research based on academic programmes. At that time, we had of course research, but not with this academic structure (…) I think we had an impact in masters based on research and how to be a model for other universities. At some point universities were more graduate universities and teaching universities, no research universities. And it changed” (interview with programme coordinators).

Limited openness to other universities. Besides the impact of the NETWORK experience in other networks that came after it, it has to be acknowledged that the NETWORK itself has not been opened to other universities in the country, “being implemented by a sort of ‘elite’ group in which the best Ecuadorian universities are participating (…) the needs in these areas outside this group of universities remain completely unattended” (Mid-Term Evaluation, 2018, p.36). Despite some ad-hoc collaboration with other universities in Galapagos and the Amazonia, the endogenous situation described in 2018 still stands. However, NETWORK partner universities are aware of this, and the expectations are to further collaborate with a number of universities in other provinces and attract students from these universities.

Limited students’ access to labour market. One of the assumptions of the NETWORK programme was that while more Master graduates will enter the labour market, companies will start realising the benefits of these profiles and start hiring them (Mid-Term Evaluation, 2018). By 2023, the two Master programmes saw 73 graduates (self-assessment, programme level, Ecuador). While some graduates from these programs now contribute to public and private organizations that promote the management of biological and water resources in Ecuador, thereby raising the level of technical and scientific expertise in these areas, this number is still limited. The capacity of the labour market to absorb high-qualify graduates still remains low. In addition, the academic sector also shows limited capacity to absorb the graduates it trained due to the lack of resources and positions to be offered. This situation disincentivizes graduates who have to find alternatives for their career-paths being continuing an academic career abroad one of the preferred options, thus generating a brain-drain that affects the knowledge capacity of the country.

Limited engagement of societal stakeholders. While the programme expected to establish strong linkages with private and public non-academic stakeholders through the provision of applied research to help address their needs and those of the country regarding biodiscovery and WRM, with some

exceptions (such as MOOC for Drinking Water operators in private and public water companies and the contribution to local government of Ibarra's WRM plans), research uptake has been limited (see also *Impact case*).

2.7. Sustainability

The past ten years the NETWORK programme helped established a **solid basis for the continuity of the partnership across universities (both Ecuadorian and Flemish) and the Master programmes.** Some opportunities are being explored to help build in the successes of the programme, such as the approval of the PhD programme and the Doctoral School. Achieving sustainability at the financial level will require securing additional funding from a diversity of sources. Therefore, the evaluators assess NETWORK performance under this criterion as good+.

Institutional sustainability

Consolidation of collaborative culture across partners. One of the main successes of the programme that suggests the continuity of the partnership at the institutional level is the development of a culture of collaboration among partner universities and individuals involved in NETWORK: "The networking spirit is there, and the added value of cooperation has ended up in their DNA" (self-assessment, programme level, Belgium, p.7). As discussed in previous sections, NETWORK introduced a collaborative culture where previously this was highly competitive: "This statement is based on the strong internalization of the idea that the benefits of working collaboratively far exceed what can be achieved when working individually, even though group work requires more coordination and communication" (self-assessment, programme level, Ecuador, p.10). Indeed, most of programme documents and the big majority of people engaged in the evaluation have indicated a strong desire, interest and commitment to continue the collaboration: "At the end of the project, a genuine interest to support the NETWORK can be internally observed at participant institutions (…)."

Ownership of the programme by partners reflected in leadership support. The programme is now adopted at departmental and faculty level and considered as part of the academic offer of participant institutions, being supported by all the corresponding units (e.g. Graduates' office)" (self-assessment, project 2, p.14). This commitment is also seen at the highest authority level: "The partner universities have taken ownership of the program at all levels. The rectors, vice-rectors, and deans of all partner universities have expressed interest in the programme and have been continuously monitoring the development of the interinstitutional master's programme and its associated research (…) It's worth noting that over the last decade, members of the VLIR-Ecuador network have also risen to positions of authority in partner universities, such as deans, department heads, or even vice-rectors, which has facilitated their support" (self-assessment, programme level, Ecuador. P.11). The commitment to NETWORK by the main authorities at universities has been reflected at different moments in the past years, especially when they had to make exceptions to specific internal regulations to accommodate the redesign of the joint Master programmes as national regulations changed. Several partner university members have indicated that the establishment of the educational collaborative model by NETWORK has also served as an inspiration for other faculties within partner universities. In addition, "the rectors of the four universities in the network have signed an agreement approving the proposal for the doctoral school" (interview, UTN).

Adaptation of institutional systems to support collaboration. Partner universities in Ecuador have now developed corresponding administrative systems and procedures that enable collaboration, especially for the operation of the joint master programmes (e.g., inter-university academic planning). The level of institutionalization is higher at ESPOL as the university centralized the programme management (through the PSU), the financial management (through ESPOL-TECH), provided the three main coordinators (programme level and the three projects), and also the first programme coordinator of NETWORK performed as Vice rector of ESPOL for the 2017-2022 term (after which he resumed his position as the NETWORK coordinator). On the challenging side, while the past years served to adapt systems and procedures in each university, public universities still operate with rigid administrative systems which might hamper mobilization of sufficient resources internally for coordination and collaboration once the project is finished, but which are required in a joint programme.

Strong institutional and individual bonds that exceed the NETWORK core circle. Relationships built between NETWORK partners (universities and individuals both in Ecuador and Flanders) are also

a key indicator of the continuity of efforts to keep working together in different activities, mostly associated with research: “It is not only an academic network but also a human one” (interview, UTN). With the years, as people got to know each other better, linkages between partner universities started to go beyond NETWORK focal points or specific research groups and started to diversify in different directions exceeding the NETWORK sphere and expanding to other universities’ areas and staff. Thus, there is not only a ‘top-down interest’ in collaboration (from authorities and administrative level) but also a ‘bottom-up interest’ coming from university members involved in the programme who had experienced its benefits: “The interest of researchers and professors who participate of the programme provides a bottom-up support that engage the institutions to maintain the collaboration” (self-assessment, project 2, p.14). An important consideration has been made by one of the programme coordinators which is encouraging thinking about sustainability: “people are still active in these universities, there are quite so young people involved” (interview with programme coordinators).

Bonds between Flemish and Ecuadorian partners have also consolidated and expanded both at institutional and individual level: “When I started, we were about five or maximum ten professors at UGent in Ecuador, and I think currently is between 40 and 50 university professors only in UGent. If we count in Flanders, I think there are more than 100 professors from the five universities and university colleges which are now directly or indirectly linked to the NETWORK. There has also been an enormous growth in the diversity of cooperation areas, not only water and biodiscovery but many other disciplines, it’s very wide (…) New people came in and it remains in a dynamic network, there are always new opportunities, new ideas that rise on” (interview with programme coordinators).

Opportunities to further institutionalization: expansion of the network and Doctoral school. Among the opportunities that can help achieve further institutionalization of the collaboration between NETWORK partners and the sustainability of the partnership, it has been mentioned that partners have thought about the expansion of the network with other universities and regions in Ecuador. Moreover, the approval of the PhD programme on natural resources and the Doctoral school is a pending milestone which would certainly contribute to the institutional sustainability of the partnership.

Cooperation with non-academic stakeholders will require more effort. This has been a key objective of NETWORK, especially since phase 2, to the extent that a specific new project was created to support building linkages with these stakeholders (from research design, execution, validation, and tech transfer). It was expected that in the long term, stakeholders will notice the benefits of working with the academia and will start providing significant funding for contributing to the NETWORK sustainability. However, some interesting experiences (e.g. MOOCs for private and public water companies, support to government water plan in Ibarra), and some support received by international NGOs and funding organizations, the programme revealed the difficulties orienting research and training towards industry, innovation and technology transference, as well as the little demand that currently exists for these services by non-academic stakeholder. Moreover, there is no evidence that the promising idea of having valorization managers in each project group to help link NETWORK research and activities to stakeholders’ needs, included in phase 2 proposal, has not been implemented properly (even though the self-assessment of project 3 indicates that three valorization managers were linked to each research group).

Financial sustainability

Financial autonomy for operation of Master programmes. The Master programmes implemented by NETWORK have an operating budget that does not come from the programme but “from other resources created by partner universities, such as the payment of professors or scholarships, which have been established considering the benefits that these academic programmes generate to them, mainly scientific publications” (self-assessment, programme level, Ecuador, p.11). With this picture, the expectation is that “[Master programmes] operation will not be affected once the funding provided by VLIR ends” (self-assessment, programme level, Ecuador, p.10).

Moreover, by the end of phase 1, NETWORK partners learned that Master programmes operated at a third of the cost while achieving three times the results of a regular postgraduate program in Ecuador due to the cost-effective mechanisms of capacity sharing, and that they even expected programme costs to be further reduced with the incorporation of UTN as an active member of the Master programmes in phase 2.

Enrollment of students as the main sustainability challenge. Also, by the end of Phase 1, partners also learned the Master programmes could be self-sustainable if they could secure tuition funds from 15 students (NETWORK Partner Programme Phase 2). This situation means that "the biggest challenge for the continuity of the joint masters is the influx of students" (Mid-Term Evaluation, 2018, p.8). The cost and length of the Master programmes (two years compared to shorter more professional masters) and the fact that "the master does not automatically lead to more (or more rewarding) job opportunities" (Mid-Term Evaluation, 2018, p.8) constitute big barriers to increase students' enrollment.

The need to secure scholarships. Scholarships then become critical to increase the appeal of the Master programmes among potential students. However, the lack of government funding for scholarships for graduate studies in Ecuador (only offered to study abroad) has obliged university partners to come up with their own scholarship schemes and regulations, as well as to use the NETWORK to leverage complementary funds.

NETWORK has improved its capacity to attract external funding but mainly from VLIR-UOS. Research-wise, it has been successful in obtaining funds from open calls. During phase 1, a total of 9 research proposals were approved for funding (for more than 1,3 million EUR), of which 8 funded by VLIR-UOS (Mid-Term Evaluation, 2018). Although the amount obtained during Phase II was lower than Phase I, 4 research projects have been successfully funded by external agencies, resulting in approximately US $ 400,000 for research: "This amount is significant in Ecuadorian standards, specially under the limited funding that was available during the Covid-19 years" (self-assessment, programme level, Ecuador, p.5).

Difficulties raising funds from societal stakeholders. Complementary funding and support from local stakeholders (public and private) were expected to be pursued during phase two of the programme, especially through the establishment of the position of valorization managers and the offer of training and consultancy services. However, opportunities to attract funding from public and private stakeholders has not yet been fully explored and have had limited success (with the MOOC for drinking water operators supported by the international private company Veolia as one of the main exceptions). Expanding the pool of funding from private and public stakeholders would help increase the number of scholarships for students to join the Master programmes (see *Impact case*).

Academic sustainability

The joint Master programmes have become part of the academic offer of the NETWORK partners in Ecuador. Through the research-based learning and the collaboration among partner universities, Master programmes has proven to supports research activities and projects implemented at each university and increase academic production. In addition, research centres and labs have been created and consolidated within partner universities as a mean to retain academic talent trained in the Master programmes. Both authorities and researchers and universities have come to acknowledge the benefits of this approach. On the one hand, the research based-learning model, with students supporting research projects, is a cost-effective way of improving research performance (including publication rates). Universities have demonstrated their commitment to continue sustaining this model by establishing scholarships schemes to support students' enrolment in Master programmes. On the other hand, joint-research between other members of the NETWORK has also proven to be an effective way of expanding research areas, achieve higher rates of publication in peer-reviewed journals, and access research funds. Relationships among researchers have been strengthened through the years, thus making collaboration at research level likely to continue.

Several cooperation agreements and research projects are still in place. Research projects generated as part of the Master programmes and the collaboration among NETWORK members, which is partially and indirectly supported with funds from VLIR, are also nourished by other projects and programmes financed by other means, especially those that bring together Ecuadorian and Flemish partners: "There are already many initiatives taken to further cooperate via other ways of funding, and also some activities will be integrated with international master programmes of the Flemish partners. In this manner, student exchange will be further warranted" (self-assessment, programme level, Belgium, p.10). Examples of the continuation of joint research after NETWORK are:

- The Erasmus+ postdoc EU-project: Hydrocore (cooperation of Ugent with Ucuenca), a continuation and extension of earlier work done in several case studies in Ecuador, which

focuses on the optimization of the design and operation of hydropower plants in a context of climate change and biodiscovery conservation. The project started in July 2023 and lasts for 3 years.

- G-STIC: International climate finance call for proposals 2021: COCO2 – More coffee and less CO2 (cooperation between ESPOL, Consortium of Provincial Autonomous Governments of Ecuador, and Pontificia Universidad Católica del Perú)[9]
- G-STIC: International climate finance call for proposals 2021: OPTImized approaches to assess and Mitigate greenhouse gaS emissions from river basins (OPTIMIS) (cooperation between ESPOL, Ucuenca en Ugent)[10]
- G-STIC: International climate finance call for proposals 2022: project related to dredging and mangroves (cooperation between industrial partners from Flanders and ESPOL, with linkages to UAntwerp and UGent)[11]

Opportunity to expand research agendas. NETWORK members see an opportunity to continue research collaboration by integrating new related topics: "Incorporating new topics such as circular economy and valuing ecosystem services into the NETWORK's topics offers numerous advantages, as it allows collaboration with a wider group of researchers and students, which in turn can broaden the scope and impact of the programme. This potential can be fully realized if the network can leverage its capacity to attract and involve new actors, mainly non-academic, both locally and internationally. To achieve this, the network must actively seek out and engage with these actors, forging strong partnerships and collaborations that will bring new perspectives and resources" (self-assessment, programme level, Ecuador, p.16). Moreover, it has been suggested that a stronger South-South collaboration, even with other VLIR-UOS funded networks, can become a vehicle for sustainability of research collaboration. According to one interviewee, this had been proposed by VLIR-UOS at early stage of the programme, "but now we are much more prepared for it" (interview, programme coordinator).

Continuity of researchers and faculty. Most of the professors of the Master programmes at the universities are tenured staff which means they are likely to continue being part of the universities which is important in the search of opportunities to continue the joint programme. The funding of professors from Belgium to teach courses in the Master programs is expected to continue seamlessly, as virtual delivery capacity has been developed, eliminating the need for travel to Ecuador and reducing associated costs.

Competition with professional master programmes is a challenge. One major challenge to the sustainability of the Master programmes is a recent national regulatory change that took place in 2022, which eliminates the differentiation between full-time research-based master programmes and part-time professional master programmes that do not require a thesis for completion. In addition, "in the labour market, the MSc programmes are not higher valued than a professional master, so there is no added value for the student. In general, in the private and public sectors, experience is preferred to specialised education" (Mid-Term Evaluation, 2018, p.34). Moreover, as expressed in the Partner Programme Phase 2, "during last years, foreign universities increasingly offer a number of master programs in Ecuador, some of them of one-year length. These programs could result more attractive to Ecuadorian students in comparison to national programs, which are requested (according to current legislation) to have a minimum length of two years" (2018, p.48). Improving the communication and dissemination of Master programmes has been pointed by a current student as an important action to attract new candidates.

I**nternationalization and regionalization of the Master programme as a way to attract students.** To avoid the drain of students to other academic offers, NETWORK partners are exploring new incentives: "To mitigate this impact, during the last year of the NETWORK, a series of actions have been planned to deepen the ties of the Master programmes with similar one in Belgium, making them more international, more attractive and sustainable over time" (self-assessment, programme level, Ecuador, p.10). An opportunity to secure academic sustainability is seen in the internationalisation of the current Master programmes and future PhD programme. The double degree and the academic credits exchange between Ecuadorian and Flemish universities have started to be discussed: "In the coming

[9] Webpage: https://www.climate-action-programme.be/project/carbon-neutral-coffee/
[10] Webpage: https://www.climate-action-programme.be/project/monitoring-ghg-emissions-from-rivers/
[11]Webpage:https://www.climate-action-programme.be/project/improving-carbon-sequestration-through-the-regeneration-of-mangrove-forests-in-ecuador/

months, we will take significant steps towards achieving these goals, including visits to potential international academic partners starting with Belgium, for which a mission has been organized in the third week of march 2023. To increase the participation of international professors, we want to explore some innovative pedagogical approaches such as COIL or collaborative course design" (self-assessment, programme level, Ecuador, p.16). However, no concrete progress has been made yet and bureaucratic procedures and approvals (both in Ecuador and Belgium) may constitute a barrier. Desires to further formalized international mobility among students have also been expressed by both Ecuadorian and Flemish professors, especially to extend the stay of students in the recipient countries (e.g., to make it a full semester). Master and doctoral students from Ecuador's neighbouring countries are also seen as an opportunity for programme regionalisation.

PhD and doctoral school as the next step for academic sustainability. A natural step for the continuity of academic work between NETWORK partners is the PhD programme on natural resources and the Doctoral School which are still under design. Several students graduated from the Master programmes have expressed interest in pursuing a doctoral programme (and NETWORK partners have been supporting them in pursuing their PhDs in Belgium). The continuity of the Master programmes is important for the realization of the PhD programme.

3. Brief assessment per project[12]

Table 2. Scores by project based on self-assessments[13]

	Project 1 BIO	Project 2 WRM	Project 3 EDU
Sustainability (Q3)			
Finance/economic sustainability	3	2	4
Level of ownership	4	4	4
Results will continue	4[14]	4	4
Partnership (Q3)			
Quality of comm within the project/programme	4	4	4
Academic interest and commitment	3.5	4	4
Project management (Q5)			
Value for money	4	4	4
Working relations with PSU	3.5	4	4
Active involvement	4	4	4
Mutual trust and joint decision making	4	4	4

Source: Self-assessments by NETWORK projects

Table 2 is highly aligned with the assessment provided for the programme level. Overall, collaboration ('Partnership') and efficiency ('Project management') are considered as major assets both at the programme and project levels, while sustainability is seen as more challenging. For this reason, evaluators accept the scores provided by each project self-assessment, though we suggest revisiting two specific scores:

- Project 3, finance/economic sustainability. Outreach and engagement efforts to achieve the objective of stakeholders benefiting from the NETWORK's research and activities do require extensive funding which is not secured by the end of the programme.
- Project 2, partnership. Self-assessments by partners suggest that coordination of the biodiscovery group has been more efficient compared to the WRM group, where communication among members was less fluent and decisions were not always clear to all partners.

[12] To avoid duplication of information, this section focuses on the specificities of each project. Other findings that cut-across the programme level are addressed in the section that discusses findings at programme level.
[13] These scores correspond to projects in phase 2. In this section, the focus is on phase 2. However, projects 1 and 2 of phase 2 are a continuation of projects initiated in phase 1. Project 3 in phase 2 is specific to the second phase and is included in this section. An analysis of project 3 in phase 1 has been integrated as part of the discussion about project management, especially as part of the Efficiency evaluative criterion.
[14] This score had not been provided in the original self-assessment report. It has been added ex post the evaluation draft report as part of the local partners' feedback.

Finally, the difference between the score given to finance/economic sustainability by project 1 and 2 can be based on the fact that the Master programme on biodiscovery has achieved much more continuity (seven cohorts) compared to the one on WRM (three cohorts), due to the differences in how CES' decisions and regulations have affected each Master programme (only one cohort was approved by CES when the programme started, and it was not until the pandemic it was possible to set up the second cohort). As a consequence, the Master programme on biodiscovery is seen as more consolidated and sustainable.

3.1. Project 1. Development of a research-based joint Master's programme in biodiscovery[15]

This project aimed at improving the understanding and use of biodiscovery through a research-based master programme that would deliver highly trained local professionals on biodiscovery which would allow developing solutions to develop solutions for practical problems of the Ecuadorian society through the sustainable use of natural resources.

The project is highly relevant for the development of Ecuador. The government of Ecuador has previously acknowledged the country's need to move towards innovation and generation of new products as well as improvement of the national higher education to re-activate the country's oil-dependent economy. In the same way, the food, health and environment management sectors are demanding new research-driven knowledge in biodiscovery for the integral use of the biodiscovery and natural resources found in Ecuadorian lands. Moreover, biodiscovery was the most relevant theme proposed in the Ecuadorian strategy document developed by VLIR for both Flemish and Ecuadorian universities (Mid-Term Evaluation, 2018).

The project has sought to contribute to a more strategic and sustainable use of natural resources in the country by training human talent in innovative topics related to biodiscovery and by establishing strong permanent links with external stakeholders in the biodiscovery sector. In particular, the Master programme in bioscience/biodiscovery, started in phase 1 after hard efforts were made to get approval from the Higher Education Council (CES in Spanish) in 2015 and consolidated during phase 2 (with seven cohorts in a row, an outstanding achievement for master programmes in Ecuador) addresses these issues through a research-based learning approach that provides students with the tools needed to find in nature sustainable solutions for various issues in the country and region while generating potential additional sources of income for people. Master's theses conducted by students are directed by researchers from at least two NETWORK partner universities and have addressed local and regional issues through the sustainable and innovative use of natural resources.

In addition, this project complements NETWORK's project on WRM, as many biodiscovery strategies can be aimed at the preservation of the biological resources in water and monitoring of the water quality. For instance, both projects have worked together in the development of strategies for monitoring invasive species in Ecuadorian lakes. The project has also benefited from synergies with the NETWORK's third project on education and outreach innovation through the support to design the MOOC on biodiscovery conservation. An integrated interuniversity biodiscovery database of Ecuadorian Natural products is also in place and accessible for students and stakeholders.

Also, during phase 2 more efforts have been put into encouraging research projects' interactions with stakeholders (e.g. the cocoa fermentation project performed in the Amazonas and Costa regions), an issue that revealed challenging during phase 1 as there is a limited culture of conducting demand-based research at universities and of collaboration between academia, NGOs, private sector and government stakeholders in the country, which affects research uptake by stakeholders. For that, the project also learned from Flemish partners who have successfully carried out various joint academia-stakeholder activities and technology transfer work.

Four main strategies have been developed to achieve further interaction with stakeholders during phase 2. First, students were encouraged to carry out their thesis at the stakeholder's facilities for which various interdisciplinary projects were developed between the partner universities and the industry. Second, training for stakeholders on biodiscovery has been developed. Third, with the support of Flemish

[15] See master programme website: http://www.vlirnetworkecuador.com/maestria-en-biociencias-aplicadas/, and project website: https://www.biodiversitynet.org/

partners links were established with the Belgian NGO Rikolto (based in Leuven), organization that has facilitated access to small farmers in several biodiscovery research projects conducted by NETWORK's partners in Ecuador. Fourth, two thematic consortia as platforms for knowledge exchange with stakeholders were created: the Consortium for Food Safety (INOAL in Spanish), aimed at identifying, characterizing and mitigating main dangers associated with food consumption in the country, and the Consortium for Pharmacopoeia and Natural Products (FAPRONAT in Spanish), aimed at studying properties of natural products and put them at the service of academic knowledge and its possible industrialization. However, one interviewee which is member of both consortia indicated that participation of stakeholders outside academia is still very limited.

3.2. Project 2. Enhancing national capacities in water resources management[16]

This project aimed at enhancing of local capacities for sustainable use of water resources management (WRM) through a research-based master programme that would deliver highly trained local professionals on WRM position the partner universities as reference institutions for education and research for the water sector in their region of influence, being able to provide innovative scientifically sound solutions towards the sustainability of water resources in Ecuador.

The project is highly relevant for the development of Ecuador as agriculture and aquaculture, after oil exports, represent the major contributors of economical income for the country. The project tackles the urgent need to develop local capabilities to promote more sustainable water use in the country and is aligned with governmental policies establishing the sustainable management of water resources as a national priority, as well as it contributes to the treatment of water for health and the reduction of chronic malnutrition. It is also aligned with the VLIR-UOS country strategy for Ecuador, which established that Water Quality and Quantity are topics of academic and scientific interest under the broad field of the Biodiscovery/Natural Resources themes.

Compared to project 1, the Master on WRM has had less continuity (three cohorts by 2023), which is explained by differences in how CES's decisions and regulations have affected each Master programme (only one cohort was approved by CES when the programme started, and it was not until the pandemic it was possible to set up the second cohort). The project was able to develop local capabilities through the international collaboration between Ecuadorian and Flemish researchers, incorporating the use of modern technologies such as environmental DNA, nutrient recovery, and environmental modelling to generate relevant evidence about the status and trends of water resources in Ecuador which has been transferred to decision makers and other relevant stakeholders trough databases, webinars, conferences and workshops. For instance, UTN researchers supported decision makers from the government of Ibarra in the use of the NETWORK's research database for their planning in water treatment.

Strong complementarity was achieved with other VLIR funded initiatives, both in research projects such as those aiming to promote the use of environmental DNA on river monitoring, achieve nutrient recovery from agricultural effluents, and the development online training materials for water professionals.

Compared to the project on Biodiscovery, the project benefited from a more established relationships between the partners universities and stakeholders in the water sector (both in Ecuador and abroad) (see *Impact case*). Not only water public companies in Guayaquil, Quito and Cuenca have supported their employees to join the programme (e.g. EPMAPS in Quito) or participate as "free-students" in specific master courses (a modality of programme registration that the higher education laws currently allow, even opening the possibility that these students become regular students to obtain their master degrees in the future): "We requested that some officials in the company could be involved in the master programme" (interview, public water company representative) but also 13 water companies (e.g. from public companies such as PortoAguas from Portoviejo to the French transnational private company Veolia) have participated in the MOOC on to train drinking water operators to improve the quality of drinking water production supported by Veolia and developed by one ESPOL former student studying a PhD in UGent with the support of Ecuadorian professors and project 3. In addition, the extensive research conducted by UTN on the Yahuarcocha lake has informed the water management plan of the local government.

[16] See master programme website: http://www.vlirnetworkecuador.com/maestria-en-gestion-de-recursos-hidricos/

Relevant joint initiatives include a project AVSF (France) aiming to implement actions in Ecuador supported by France Development Funds (AFD) for better management of flood prone areas, the implementation of Wastewater Based Epidemiology monitoring in Guayaquil for Covid-19 response with the support of the World Bank and the Municipal Drinking Water and Sewerage Company of Guayaquil EP (EMAPAG-EP), the advice to the Secretary of Water of Ecuador (SENAGUA) for the development of a biomonitoring manual for water quality assessment in Ecuador, the project Linking global change with soil and water conservation in the high Andes (ParamoSUS) funded by ARES (Wallonia, Belgium), as well as Rikolto's project CREA aiming to the reactivation of the agricultural sector after pandemic in Ecuador. Though students' thesis, data from more than six case studies has also been gathered trough consultation with water institutions and joint field campaigns (e.g., Daule-Peripa reservoir, Guayas basin, Antisana Water Conservation Area, Napo basin, Galápagos islands, Portoviejo basin, among others).

Moreover, the involvement of participant universities in an EU ERASMUS+ project Watermas (UCuenca, ESPOL and UGent) promoted the inclusion of Climate Change on the program curricula and provided additional opportunities for student's international mobility. The collaboration of Flemish partners in the development and implementation of the master program later promoted the integration of joint academic activities between the Master programme and Flemish master programs such as the Interuniversity Programme in Water Resources Engineering (IUPWARE) (e.g., the "Integrated Project") and Ocean and Lakes (e.g., the "Monsoon School"). Both programmes have performed short visits to Ecuador to implement case-based academic projects for their students, incorporating the Ecuadorian students on planned activities.

Relationships with stakeholders in the water sector were also sought through the organisation of national workshops, webinars and congresses, with the participation of representatives of ministries, municipalities, industries and NGOs. For instance, a national workshop was co-organized with International Water Association (IWA) and Inter-American Development Bank (IDB) in Guayaquil which brought together around 300 water professionals between national and foreigners. In addition, through complementarities with project 3, a survey was launched to propose the creation of a thematic network within the Ecuadorian Network of Universities for Research and Postgraduate Studies (REDU in Spanish) to focus on integrated management of water resources.

3.3. Project 3. Enhancing national capacities in education and outreach innovation

Following the recommendations made by the Mid-Term Evaluation in 2018, a third project was incorporated into phase of the programme, aimed at developing and applying innovative tools to consolidate both postgraduate programmes and establishing solid and permanent linkages with stakeholders. The project would help develop and integrate innovative tools for education such as MOOCs, e-learning and blended learning into the Master programmes, as well as train staff from partner universities in commercialization, tech transfer and research-based learning (RBL). Finally, a platform for a PhD programme on natural resources along with an interinstitutional doctoral school was expected to be developed.

The project is highly relevant for the country and for the NETWORK programme in particular. First, after the implementation of videoconferencing systems in phase 1, the incorporation and improvement of innovative education digital tools and methodologies such as MOOCS, e-learning and blended learning helped enhance the quality of the inter-university master programmes due to their blended characteristics, thus helping "enhance the learning experience while reaching a higher teaching impact" (Partner Programme Phase 2, 2018). Moreover, developing in-house capacity to address these needs for innovation would help avoid hiring costly external providers. Second, this project became even more relevant with the outbreak of the pandemic of Covid-19 which obliged educational institutions to come up with strategies to keep operating both at the educational and administrative level: "Before pandemic, participant professors were trained on the use of TICS for course management. After pandemics, all our professors are fluent in the use of TICS for higher education" (self-assessment, WRM project, p.4).

Third, a more professionalized e-learning approach helped catch the interest of prospective students and reach a broader audience countrywide, contributing to the increase on the number of natural resources professionals with postgraduate degrees, especially those living in areas that are far from where the NETWORK partner universities are located. In that way, the master programmes also became

more inclusive and diverse in terms of both students, professors and topics addressed in classes: “A notorious advantage of the emergency adopted hybrid-modality of teaching was the fact that students from remote areas in the country were able to follow the courses and successfully complete the program. This modality of education is now being explored in order to expand the coverage of the program to those candidates who cannot afford living expenses at the cities where the university campuses are (Guayaquil, Cuenca, Quito, Ibarra)” (self-assessment WRM project, p.6).

Project 3 was conceived as a cross-cutting axis of the entire programme. As such, it provided strategic and operational support for projects 1 and 2 in different areas: “It allowed for important discussions to be raised for the success of the other two projects, regarding the need for innovation in education and the need to implement mechanisms to link with various organizations in society. These were two topics that, in the context of the pandemic and with very limited economic resources, became highly relevant” (self-assessment, project 3).

- Helped those projects improve outreach to and engagement of relevant stakeholders in the biodiscovery and water sectors in both research and training activities, such as the development of MOOCs on biodiscovery conservation and on WRM. The latter aimed at training water operators from public and private water companies and was a success as 13 public and private companies participated by allowing their employees to participate on it but also providing their facilities for employees to practice what they learned in the MOOC.
- Supported tech transfer and research-based solutions to exterrnal stakeholders based on NETWORK research projects, which have seen a greater progress during phase 2, e.g., in the areas of coffee (UCuenca), Cacao (EPN and ESPOL), Banana (ESPOL), among other sectors.
- Supported the development of the integrated interuniversity biodiscovery database of Ecuadorian Natural products, which helped document evidence produced by projects 1 and 2 as well as by other stakeholders and make them accessible to the public, thus helping improve the transfer of research results to society.
- Supported the development of innovative tools to help address problems in the natural resources sector. A paradigmatic example was the development of the Fusarium Sensor Ec App that allow farmers to interact with experts from the NETWORK universities to detect the presence of Fusarium R4T in banana plantations. Fourth, project 3 organized training activities to support researchers from partner universities further develop their capacities on tech transfer, of which “Ideacamp 2022” is a good example. Developed in collaboration with the Entrepreneurship and Innovation Center at ESPOL (i3Lab), the training programme aimed providing researchers from partner universities with tools that help them develop research-based business models, prototypes and market strategies. This 3-month programme of 12 workshops held on a hybrid format and registered the participation of 25 researchers from the NETWORK partners. Furthermore, several NETWORK members participated in a mission to Belgium at the end of 2022, aimed at learning from partner Belgian universities' experiences in this area.

While project 3 was successful in helping the programme develop innovative tools to enhance its educational offer and engage external stakeholders, a remaining challenge is coming up with innovative ideas to increase demand-based research, that is establish a relationship with external stakeholders in which they are approach universities to work together on evidence-informed solutions to their challenges (whether they are at the policy or industry level) and are willing to invest on research-informed ideas.

Finally, project 3 facilitated the adaptation of the entire NETWORK programme to the new scenario product of the pandemic outbreak which included the reduction of financial support resulting from budget cuts across the entire higher education system. The project was a key support for professors, students and universities’ staff who needed new ideas and mechanisms to innovate and keep courses relevant and functionable.

One of the objectives not achieved by the project (and the programme in general) was the development of the PhD programme on Natural Resources and the interuniversity doctoral school which were expected to take off in phase 2. Although a market study has been conducted to gain insight into the profile of potential doctoral students, the absence of necessary regulations in Ecuador to establish doctoral schools and the outbreak of the Covid-19 have made it difficult to achieve the objective. In particular, interaction with the Higher Education Council (CES), responsible for approving the doctoral programme and school, was significantly reduced during the two years of Covid-19, which have delayed

its approval. However, NETWORK continue making progress in terms of the PhD programme and the doctoral school desired structure and operation (a meeting devoted to this was held in parallel to the evaluation field visit in Guayaquil) to get approval from the Higher Education Council (CES in Spanish) and other relevant government agencies.

4. Impact case

The NETWORK in Ecuador started with a few key premises: foster collaboration among a selected group of Ecuadorian universities, create the first joint Master programmes in the country, adopt a research-based learning model, and provide research-informed solutions to the needs of the societal stakeholders in the areas of biodiscovery and WRM. The impact addressed in this section focused on the fourth of those principles (though it also touches on the other three given the interconnection of the programme's components).

The research-based learning model adopted by the Master programmes had the objective of improving research capacities with an emphasis on research with potential to inform decisions, that is, a focus on "real problems". The diagnostic was that: "Most of the time, MSc programs are conceived by doing a pure academic-based national analysis with little assessment of national developmental issues. Additionally, during the programs students don't interact with stakeholders and their thesis provide results that cannot be immediately transferred to society (Partner Programme Phase 2, p.54). The consequence is that "the research performed by the universities is therefore not utilized in the proper way, and in some cases the stakeholders do not know what has been done" (p.27).

In order to establish more permanent linkages with stakeholders and foster research uptake, NETWORK partners came up with a set of strategies;

- The introduction of project 3 in education and outreach innovation in phase 2 of the programme would help NETWORK partners establish solid and permanent linkages with stakeholders who would be involved throughout the research process (from design, to execution, validation, and tech transfer) "to make sure that our research targets a specific demand that will assure the rapid incorporation of our results into the society" (Partner Programme Phase 2, p.57).
- Training to enhance demand-based research capabilities among NETWORK researchers.
- Creation of the position of valorization managers to be selected within each partner university to maintain an active communication channel between academia and stakeholders.
- Creation of thematic consortia.
- Learning from Flemish partners who had a last-long tradition of engaging with non-academic stakeholders through a variety of approaches.

As a result of these actions, natural resources management would improve this fostering productivity and a sustainable use and conservation of Ecuadorian natural resources.

While the interaction of stakeholders was limited during phase 1 of the programme, phase 2 saw an increase engagement of stakeholders translated in more research projects that targeted their needs. For the purpose of this case study, we have selected four NETWORK paradigmatic projects and activities that sought to address stakeholders needs. These projects have been selected based on its diversity as they were conducted as part of the different projects within NETWORK (biodiscovery, WRM and, education and outreach innovation), were led by different partner universities (including Flemish partners), targeted or were conducted by different stakeholders (private companies, local government agencies, farmers, international organisations), were conducted by senior researchers, by students or by both, and adopted different approaches (MOOCs, technical assistance, development of apps).

It is important to consider that, as explained in the *Limitations* section of this report, external stakeholders were engaged in the field visit to a very limited extent. In the cases presented below, we were able to engage external stakeholders only in projects C (one manager of water public company) and D (one representative of Ibarra local government). For the other two projects we relied on conversations with NETOWRK members as well as information available in the public domain.

Project A: App Fusarium Sensor Ec[17]

[17] Evidence source: interview with Freddy Magdama (ESPOL).

Stakeholders involved	Description	Changes/Impact
Lead university: ESPOL Partners: Agrocalidad (private company), Prefecture of Guayas Target: farmers	App[18] that allows actors in the banana production chain to interact with ESPOL experts on issues related to the prevention of Fusarium oxysporum f. sp. cubense (Foc R4T). Farmers can send photos of the plants of their crops, so that ESPOL experts can analyze the possibility of the presence of the pathogen. Then, suspected cases can be confirmed in the Agrocalidad laboratories and in those of the Ecuadorian Diagnostic Network, made up of the Center for Biotechnological Research of Ecuador (CIBE-ESPOL) and the National Institute of Agricultural Research (INIAP). If a suspicious case is detected, a decision-making flowchart is applied.	At the time of conducted the interview with the lead researcher, usage of the app was incipient. According to the researcher, usability of the app depended on farmers being properly trained in the use of the app. While guidelines have been provided to users to operate the app, other capacity sharing efforts have been missing,

Project B: IWA-IDB Innovation Conference on Sustainable Use of Water: Cities, Industry and Agriculture[19]

Stakeholders involved	Description	Impact
Lead university: ESPOL and UGent Partners: International Water Association, Inter-American Development Bank Target: municipalities, industrial users, agriculture, policymakers, regulators, environmental and social organizations, equipment and technology suppliers, consultants, researchers and academicians, financial institutions, and underserved populations	In 2019, IWA and IADB, ESPOL and UGent co-convened in Guayaquil an international conference an international conference focused on implementation of innovation for sustainability in the real-world venues of cities, industry, and agriculture. Perspectives were shared perspectives and collaboration was encouraged among the many stakeholders who play a role in the use of water—municipalities, industrial users, agriculture, policymakers, regulators, environmental and social organizations, equipment and technology suppliers, consultants, researchers and academicians, financial institutions, and underserved populations.	The conference, attended by around 300 water professionals, was the first step towards the creation of the Ecuadorian National Chapter of the IWA[20]. Since then, a national network was started with 70 water professionals from Ecuador. Among other activities, IWA-Ecuador partnered with Ecuador NETWORK partners (both Ecuadorian and Flemish) in the 'ProAgua Webinar Series', which convened not only researchers but also private sector and government agencies representatives, contributing to expand NETWORK's work beyond academic parameters. The series addressed the following topics: 'The current status of domestic wastewater treatment in three cities of Ecuador', 'Modeling of river basins in Ecuador', 'Food contamination and the relationship with human health in Ecuador0, and 'Sustainable Use of Water in Industry'.

Project C: MOOC for operators of the drinking water system in Ecuador[21]

[18] https://www.espol.edu.ec/es/noticias/fusarium-sensor-ec-app-espol-prevenci%C3%B3n-fusarium-raza-4
[19] https://www.globalsustainablewater.org/
[20] The call to join IWA Ecuador National Chapter is available here: https://www.globalsustainablewater.org/iwa-membership-promotion.html
[21] Related publications are: The personalized and inclusive MOOC : using learning characteristics and quality principles in instructional design, and Toward a more personalized MOOC : data analysis to identify drinking water production operators' learning characteristics: an Ecuador case.

Stakeholders involved	Description	Impact
Lead university: ESPOL Partner: VEOLIA Target: Water companies, Managers and operators of water treatment plants, Water company professionals	Developed by one ESPOL former student studying a PhD in UGent with the support of Ecuadorian professors and project 3, and supported by VEOLIA, this 6-weeks MOOC aimed at training drinking water operators to improve the quality of drinking water production. MOOC developers visited water companies to understand how operators learn to do their work, and based on that, design a MOOC that was adapted to their need and companies' contexts.	The first pilot of the MOOC counted with the participation of 13 private and public water companies from different regions in Ecuador and reached 90 water operators.

Project D: Research database contribution to the water management plan of the Yahuarcocha lake (Ibarra)

Stakeholders involved	Description	Impact
Lead university: UTN Partner and target: Direction of Environment of the Municipality of Ibarra	Lake Yahuarcocha is a lake ecosystem of great environmental and socioeconomic importance for the province of Imbabura, due to the ecosystem services it provides for the use of raw materials and the development of recreational and tourist activities. UTN researchers (including NETWORK Master programme students from Ecuador and Belgium) have conducted extensive research on the Yahuarcocha lake. These studies became available at UTN database and informed the water management plan of the local government. While the local government has not contributed financially to research studies, it has supported the logistics (providing boats, fuel, etc).	According to the Director of Environment of the Municipality of Ibarra: "The research theses have been the basis for the lagoon micro-watershed management plan of the municipality". UTN research was critical to help local government address knowledge gaps and monitoring capacity due to the lack of resources.

The four cases presented are a sample of the most mentioned experiences of linkages with stakeholders during the evaluation field visit as well as in the programme documents and reports. The cases not only account for NETWORK efforts to engage external stakeholders and take a research-informed approach to problems faced by the society, and that stakeholders at different levels are getting access to research-based evidence to incorporate them in their work. However, with the exception of the local government of Ibarra, there is not enough evidence to suggest that research generated by NETWORK partners is being incorporated in decision making of stakeholders.

Moreover, the sample of cases is also representative of the relative higher success of the WRM project compare with the biodiscovery project when it comes to stakeholders' engagement (see also Brief assessment per project). An explanation to this situation was shared by one of the interviewees: "Maybe in the water sector you can find more companies and organizations with more technical needs. In the case of biosciences, you can find farmers with a lot of different needs but at the end they are mostly concerned with poverty and production" (interview, Flemish partner). Moreover, since most of these initiatives took place in phase 2, they showed the importance of having incorporated their project to help liaise with stakeholders.

However, from the cases presented and the full data collected throughout the evaluation, it can be concluded that while the model of addressing real life problems in research conducted by NETWORK members has generated relevant evidence for the Ecuadorian context in the areas of WRM and biodiscovery, engagement and research uptake is still limited in the context of NETWORK. Indeed, there is a limited culture of cooperation between academia and other stakeholders in society in the joint search of research-informed solutions to industry or policy issues. On the one hand, universities in Ecuador have traditionally focused more on teaching (partly explained by the scarcity of funding for research), while the emphasis on research is relatively recent with NETWORK being a cutting-edge initiative. On the other hand, private companies and government agencies are more reluctant to invest on research-informed ideas: “It is difficult for the company to understand that the generation of products costs and cannot be free because it is we are public universities” (interview, EPN). This overall situation suggests that the knowledge ecosystem in Ecuador demonstrates weaknesses to generate incentives for the supply of high-qualify evidence (evidence producers) but even more difficulties to generate incentives for the demand for research-based solutions (evidence users).

As per the strategies sought by NETWORK, it can be said that even if project 3 represented an improvement in terms of liaising with stakeholders (helping emphasize the importance these linkages for research uptake), the entire programme lacked a thorough strategy to disseminate research findings to stakeholders in the field. The training of researchers on demand-based research and tech transfer mainly took place as part of the “Ideacamp 2022” (see project 3 brief assessment) developed in collaboration with the Entrepreneurship and Innovation Center at ESPOL (i3Lab) and counted with the participation of 25 researchers for three months. However, it happened at almost the end of the programme and new editions did not take place after it, and there is no evidence or similar trainings being embedded in partner universities: “Lack of expertise in technology transfer skills at participant universities constrains the impact of current research outcomes in national water resources. Therefore, proper training is needed for tech transfer officers to promote the adoption of proposals” (Partner Programme Phase 2, 2018, p.42). The position of valorization managers was not properly established in the universities/projects (at least to the extent of the knowledge of the evaluators, (even though the self-assessment of project 3 indicates that three valorization managers were linked to each research group). Thematic consortia were created as part of project 1 (see brief assessment of the project) but were not successful in engaging stakeholders outside the academia. The visits and conversations that took place with Flemish partners to learn from their experience linking with societal stakeholders (including thematic consortia and demand-based research) have informed the four previous strategies.

5. Findings on the learning questions

How to support PhD trajectories, with a focus on optimising diversity/inclusivity (gender and Leave No One Behind)?

The Network programme did not have a PhD component. The evaluators focused on measures to support diversity of students’ enrollment in Master programmes (though no concrete data about enrollment by different students’ groups exist). Three different strategies implemented by NETWORK Ecuador helped attract a more diverse students base to the Master programmes. The first strategy was to include UTN as part of the NETWORK, a university that at that time was category B (using the classification for Ecuadorian universities that was used between 2010 and 2018). The reason behind including UTN was to help it develop institutional and research capacities, something that UTN members have said has been of great importance to further develop the university. The second strategy was to establish a scholarship scheme which required that each university should provide at least two NETWORK scholarships to students (which in some cases were complemented with scholarships provided by each university’s own scheme). Scholarships are highly important for students to access postgraduate studies in Ecuador because the government does not provide them (only for study abroad). Scholarships covered not only tuition but also mobility between universities. The third strategy was the result of the Master programmes hybrid modality (combining in-person and e-learning activities) which indirectly generated opportunities for students outside of the main epicenters (where the partner universities are located) to receive high-quality postgraduate education.

Despite the commitment to gender equity included in the Partner Programme Phase 2[22], no specific actions were taken to attract women students in the Master programmes: "From the beginning, a specific strategy for promoting gender equity was not formulated as the balance between genders was already quite favorable and has been sustained over time. Although there is a noticeable gender imbalance between the Biosciences (more women) and Water Resources (more men) areas, the overall balance is good." (self-assessment, programme level, Ecuador, p.14). This is a missed opportunity to increase their participation in male dominated STEM careers (science, technology, engineering, and math). In addition, while the network and the virtual modalities, and a few available scholarships, created opportunities for students living outside metropolitan areas to access high-quality education, partners feel that more efforts are needed to continue broadening the possibilities of vulnerable individuals and excluded groups to benefit from post-graduate educational access.

What factors and measures, at VLIR/IUC level and/or at partner institute level, support effective coordination of programmes?

A few strategic decisions supported the effective coordination of Ecuador NETWORK. First, partnering with universities who had a previous experience of being VLIR-UOS grantees greatly facilitated the understanding of VLIR-UOS expectations and processes, which also helped share these learnings with other partners in the NETWORK who did not have such experience. Second, the allocation of funds for investment in network building at the beginning of the programme (e.g., for training, meeting, and mobility) also helped create a common understanding of the governance, management and financing processes. This is especially important among programme and project coordinators and focal points. Third, the centralization of programme and funding management in one university (ESPOL), even if decisions at both levels were made in a participatory way, proved to be highly efficient in a highly bureaucratic context (especially considering that all NETWORK partners were public universities). Fourth, communication between Ecuadorian and Flemish partners was action oriented (that is, when there was something relevant to address or decisions to be made) which helped alleviate the load of inefficient meetings. Fifth, adaptiveness and flexibility, supported by VLIR-UOS and Flemish partners, has proven to be critical for an effective coordination, not only to adapt the programme activities and timeframes to the challenges posed by the pandemic, but also to let universities propose the best way to manage funds and acquisitions (e.g. purchase of equipment by Belgian partners overcame restrictive regulations in Ecuador) in a highly restrictive and bureaucratic context.

How to ensure uptake of research results or new educational practices by political and societal actors and end-users?

The findings are primarily based on the impact case which shows that results/impact so far is limited and that two factors are hampering: lack of an overall strategy at the level of the Network Programme (in line with existing strategies, if any at the level of the participating universities) and lack of incentives for the stakeholders. The adoption of the research-based learning model (supported by Flemish partners in the early years of the programme) with a focus on projects and thesis that address their stakeholders needs and questions, the creation of a specific project to help engage stakeholders in research processes, and the establishment of valorization managers to maintain an active communication channel between research projects and stakeholders, were meant to be good strategies to ensure research uptake by end users.

However, with exceptions, the features of the Ecuadorian context (scarce culture of linkages between academia and non-academic stakeholders, especially of demand-based research) made it difficult for these strategies to succeed. Research conducted at local level (e.g., research on Yahuarcocha lake in Ibarra, see *Impact case*) or the use of research to deliver services and products (e.g., MOOCs for water operators, see Impact case) revealed good strategies to support research uptake by societal stakeholders (local government and water companies, respectively). Generating incentives for private companies and government agencies to support their staff to participate in academic programmes is also a good strategy to enhance their technical capacity which they bring back to the fields in which their

[22] "The network commits to promote gender equality in several ways: 1) Empowering women in research environments during the implementation and operation of the two masters' programs, 2) reconciling the academic and the private life of women when necessary (pregnancy, maternity, etc.), 3) promoting also gender and scientific excellence, 4) promoting research in the domains of the program associated to gender, and 5) increasing the participation of women in science technology and innovation" (p.18).

organisations perform. The creation of multi-stakeholders' thematic consortia is a promising strategy, but it has had limited success so far.

6. Conclusions

The NETWORK programme in Ecuador was highly relevant. The two topics, biodiscovery and water resources management, are relevant to Ecuador development goals, are priorities for VLIR country strategy, and are included in Agenda 2030. The programme provided a response to the shortage of highly qualified academic trained professionals in the water and biodiscovery sectors, by establishing a pioneering and innovative inter-university academic offer with a focus on a research-based learning Master programmes. This model aligned well with the higher education needs of the country. NETWORK collaborative proposal was a novel experience for university partners in a highly competitive context. The partnership was also able to achieve wide regional coverage because of the partners represented in it. The emphasis of NETWORK on producing research that addressed real life problems and on linking with societal stakeholders was also very relevant and contributes to positioning universities as critical development actors. The blended education model that was set up from the beginning of the joint-master programmes proved to be very relevant when the Covid-19 pandemic broke out as it allowed the master programmes to continue operating. While the collaborative model opened the way for students form diverse regions to access high-quality postgraduate education, no specific measures were taken to increase the participation of women and other disadvantaged groups.

The programme also demonstrated a high level of coherence in several areas. Several components were well-articulated to address the ultimate goal of contributing to the sustainable use and conservation of Ecuadorian natural resources: the collaborative approach, the research-based learning model, and the emphasis on linkages with societal stakeholders were part of a comprehensive approach to achieve the desired impact. High levels of interconnection and collaboration were also achieved between Ecuadorian universities and between Ecuadorian and Flemish universities, being critical to develop a coherent programme that accommodates the interests and contributions of all partners involved. Collaboration within the three projects of the programme was stronger than across projects though some joint activities took place (both research and training). The programme demonstrated the importance of building further on the results achieved by the former IUCs and other VLIR-UOS-funded projects in the country, and of seeking synergies and mutual reinforcement between NETWORK and other VLIR-UOS projects, though there were limited synergies with other donor-funded programme, and with other national education and research networks.

NETWORK has demonstrated itself to be an effective programme as it achieved most of the objectives proposed in its two phases. The programme contributed to consolidate a collaborative culture and partners indicated a high level of satisfaction with the collaborative process (at the level of representation, decision making, and communication, among others) which in turn strengthened each partner. The consolidation of the Flemish-Ecuadorian collaboration was also a result of the programme, which has translated into more joint research, joint fundraising, and co-teaching, among others. With the consolidation of the research-based learning model, master programmes achieved a high-level continuity (especially the biodiscovery programme), increasing the number of graduates who acknowledge the quality of education received, with access to diverse expertise, the practical research approach and the exchange with students from other regions and from Belgium as the most valued elements. Despite the high-quality of graduates, the academic and labour market still show a limited capacity of absorption, and private companies lean towards graduates from professional masters as their profile is more attractive. Due to the challenges posed by the context (Covid-19 pandemic and recurrent changes in higher education regulations) it was not possible to set up the inter-university PhD programme and the doctoral school, but institutional support is secured at each university and partners continue working on its design.

The improvement of scientific quality across partners is also notorious, through the set-up of the two Master programmes and the adoption and consolidation of the research-based learning model. Professors were able to increase research productivity as they counted on full-time students who provided support to their projects, and students developed stronger research skills through an active learning process, all of which resulted in an increase of publication rates in international peer-reviewed journals. Moreover, the set-up of both Master programmes generated incentives for universities to increase the academic profile of their staff as having PhDs was a requirement by CES. The enhanced collaboration between partners also resulted in more inter-disciplinary research (and more data sharing),

in new research agendas and opportunities, a higher success in research calls, and further integration of Ecuadorian partners in international research partnerships.

The implementation of the NETWORK programme in Ecuador was highly efficient and was able to optimize resources in a funding and bureaucratic restrictive context. The set-up of joint-Master programmes was a strategic response to the challenges of creating them individually. The collaborative nature of the NETWORK programme also enabled to optimize university resources by sharing knowledge and expertise at each university, equipment and facilities to conduct research, and know-how about management systems and procedures, and access to funding, among others. The cost of running the Master programmes were reduced by establishing the blended learning model (reducing professors and students mobility costs). The decision to centralize both programme management and financing in ESPOL was very strategic, as the university has more flexible procedures and facilities that introduced more agility in the network operation. Despite centralization of functions, programmatic and budget decisions were made with input of all partners, and digitalization supported an efficient coordination. The training on research-based leanring and joint curricula development for NETWORK members conducted at the beginning of the programme also helped create recognition among members and mutual understanding of the roles and responsibilities, governance, management and financing processes. Communication was fluent and efficient both between Ecuadorian partners (though it worked better within the biodiscovery group) and with Flemish counterparts. Flexibility and adaptation in both academic and acquisition processes, supported by VLIR-UOS and Flemish partners, were critical to continue operating under challenging contexts such as the pandemic and the changing regulations by the government.

The NETWORK program has been a novel experience in Ecuador with expected long-standing impact on partner universities and, to a lesser extent, on the wider environment. The collaborative and research-based learning models were broadly adopted by university partners and expanded to other departments in the universities. The programme led to the creation of strong institutional and individual bonds between universities in Ecuador and with Flemish partners. Not only did NETWORK bring the first joint-Master programmes in Ecuador, setting a precedent at higher education level, opening the way for other universities in the country interested in similar initiatives, but it also inspired and supported the creation of other research networks in the country. There was a limited openness to invite other universities in the country to join NETWORK. Graduates from the Master programmes still face barriers to accessing the labour market as their high-quality training is not enough valued by societal stakeholders (especially private companies) and universities lack of resources and positions to offer them. While the articulation with societal stakeholders has increased and the model of addressing real life problems in research conducted by NETWORK members has generated relevant evidence for the Ecuadorian context, engagement and research uptake is still limited. There is a limited culture of cooperation between academia and other stakeholders in society in the joint search of research-informed solutions to industry or policy issues: on the one hand, universities have limited time and skills to coordinate this engagement and societal stakeholders do not see the value in engaging with academic research, and on the other hand, there are limited spaces in which universities and societal stakeholders actually interact.

The past ten years of the NETWORK programme helped established a solid basis for the continuity of the partnership across universities (both Ecuadorian and Flemish) and the Master programmes. At the institutional level, the ownership of the programme by partners is reflected in leadership support and the adaptation of universities' institutional systems to support collaboration. Strong institutional and individual bonds were created which exceed the NETWORK core circle. The expansion of the network and the creation of the PhD and doctoral school are seen as opportunities to further institutionalize the partnership, continue offering high-quality education, and generate new income. Achieving stronger cooperation with non-academic stakeholders will require more strategy and time commitment by the universities. At the financial level, Master programmes have achieved financial autonomy for operation but increasing the base of students is the main sustainability challenge, including the competition with professional master programmes that may be seen as more attractive (they are shorter, easier to integrate with other jobs, and provide more chances to be employed in the labour market), thus the importance of securing scholarships. The NETWORK has improved its capacity to attract external funding but mainly from VLIR-UOS, and raising funds from societal stakeholders remains a challenge. At the academic level, the joint Master programmes have become part of the academic offer of universities in Ecuador, and several cooperation agreements and research projects are still in place between Ecuadorian and Flemish universities. New research agendas have emerged during the programme as a product of the collaboration and in response to the needs of the context. The

internationalization and regionalization of the Master programme is seen as an opportunity to strengthen the academic offer, and overall, the PhD and doctoral school are seen as the next step for academic sustainability.

7. Recommendations

Recommendations for future inter-university networking and partnerships

To improve stakeholder engagement and research uptake

Develop stakeholder engagement plans (including stakeholders mappings) to support research uptake at the programme and project level (prioritizing linkages at regional/local level). One of the challenges of NETWORK programme in Ecuador was to establish stronger relationships with stakeholders to foster research uptake. Stakeholders' engagement plans could be developed at programme and project level to help partners be more intentional in the identification of potential research users (stakeholder mapping) and strategic in their actions. Monitoring, Evaluation and Learning plans could also be developed to keep track of achievements in terms of stakeholders' engagement and research uptake as well as to allow continuous improvement. Engagement plans could be co-designed between partners (even with sub-plans at regional level or for universities' areas of influence), and outreach or extension areas in universities could be involved too. Positions like the one of valorization managers could be responsible for their implementation (by giving them enough legitimacy and resources to perform as brokers between universities and stakeholders), and progress in the plans (monitoring) could be reported to a project team such as the one established for outreach in Ecuador (project 3), which could also be in charge of socializing achievements and lessons with other projects and partners (learning).

Encourage the translation of research outputs in activities with higher uptake and impact potential such as policy briefs, short trainings, or conferences. During phase 2 of the programme, and with support of project 3, partners started to package their research outputs in products that can facilitate consumption by intended end users. The MOOC for drinking water operators in public and private water companies is a good example. Other products such as policy briefs based on larger research projects could also be explored as means to translate research evidence into more friendly outputs for less specialized audiences. Students could be trained and asked to contribute to these policy briefs as part of their training in the Master.

Foster a culture of innovation and entrepreneurship among students, encouraging them to use their scientific knowledge to create new products and solutions that benefit society (e.g., entrepreneurship or incubation training programs). The research-based learning combined with an emphasis on addressing real life problems has been very successful in the NETWORK programme. The knowledge gained by students can be complemented with ad-hoc courses or training activities to further support the development of more targeted products and services for societal stakeholders which can be based on their research projects.

Develop a monitoring plan to keep track of the insertion of graduates in the labour market to account for the impact of the Master programmes and because they can be strategic influencers and partners of the NETWORK. Having a better understanding of the trajectories of graduates is important to demonstrate the contribution of the academic programmes. Moreover, these graduates can become strategic nexus between universities and their working spaces to facilitate collaborative arrangements and support research uptake. Current former students working in water public and private companies are examples of the potential that exists to support companies' buy in for collaboration with universities.

To consolidate the NETWORK model

Consolidate the collaborative culture and the research-based learning model and continue expanding them to other faculties and departments within the universities. These two features of the programme have proven to be highly effective and are already part of the NETWORK partners' working ethos and procedures. Moreover, these approaches have been expanded to other faculties, departments and disciplines in universities (outside NETWORK partners). NETWORK partners can become inspirers of this model for their colleagues by sharing lessons learned throughout the programme as well as concrete and practical advice on how to consolidate the approach.

Prioritize the finalization of a strong PhD and doctoral school project and continue lobbying higher education national authorities to get approval. By the end of the programme the PhD and doctoral school proposal was still under design. It would be important to prioritize its consolidation and to resume lobbying with CES building on the momentum of successful joint-Master programmes. In addition, emphasis should be put on securing support for scholarships as PhD programmes are much longer and costly than Masters.

Continue improving the blended learning approach. Efforts to set up an e-learning infrastructure and generate internal capacity (of both faculty and admin staff) to be able to offer a blended academic programme have proven to be highly successful to support the collaborative model and attract a broader pool of students to the Master programmes. Virtual learning is in continuous evolution, and it would be important that universities keep up to date with new trends in the field and introduce improvements in their approach to improve both the teaching and learning experience.

To increase diversity

Establish more explicit policies and procedures to ensure broader diversity and inclusion in the network and its activities. While the collaborative Master progarmmes were a way of allowing a more diverse base of students to access high-quality postgraduate education, more specific policies and procedures could be developed to allow more women and disadvantaged groups to benefit from this training. Support to develop these policies and procedures could be sought from existing units responsible for diversity and inclusion in universities, and clear oversight and monitoring responsibilities should be assigned in order to secure their implementation.

Expand the scope of NETWORK by gradually incorporating new universities. To increase the transformative potential of universities in society, more universities could be invited to join the NETWORK, adopting a similar strategy to the one that supported UTN further develop the talent of its human resources. The incorporation of these new universities can be gradual, starting with participation in specific activities and research projects, and generating institutional bonds and commitment, until the conditions are realized for them to join current or future Master programmes as partners. Moreover, establishing more permanent and strategic linkages with other research and education networks in the country (e.g., by inviting them to NETWORK partners' activities) can also expose NETWORK members to new ideas, opportunities, and stakeholders.

To increase visibility of the network

Secure funding support for communication and outreach efforts to increase the visibility of the network, including the support from a communication responsible at programme, project or university level. Increasing the visibility of the NETWORK is not only important to increase research uptake chances but also to attract new students to the Master programmes to broaden the income base to support continuous operation. Communication of the academic offer, the pool of professors, research projects conducted by students, or opportunities such as exchanges with Flemish universities, can raise interest among undergraduate and graduate students, and professionals.

To increase efficiency

Encourage more flexible administrative models within partner universities that allow for smooth project implementation and collaborative interventions. The NETWORK experience has proven that partners with more flexible operational models can help dynamize the network procedures and activities. While public universities have to follow the heavy bureaucratic procedures that rule state agencies, ESPOL has shown (with ESPOLTECH and FUNDESPOL) that there are creative ways to gain agility, and this can be inspirational for other universities in the network and beyond. Leadership across universities could be invited to learn about more flexible administrative models in the context of NETWORK so they could explore how these may be adapted to their own contexts.

Other recommendations for VLIR-UOS

Adopt an ecosystem approach to further support research uptake in diverse contexts, by supporting both research supply and demand. IUC and NETWORK programmes in Ecuador were designed to

support universities to improve research capacities and collaborate with each other in joint academic efforts (support to research supply). The assumption was that universities would be able to create stronger linkages with stakeholders by mapping their needs and providing research-based solutions. However, the linkages between academia and societal stakeholder are still weak in countries like Ecuador. VLIR could take a more holistic approach to strengthen knowledge ecosystems that not only support knowledge producers but also knowledge users (research demand), thus contributing to bridge the gap.

Explore avenues to support further integration between the NETWORK Master programmes developed in Southern countries and those from Flemish Universities, and support scholarships for postgraduate students in Southern countries to continue their academic trajectories and experience exchange stays in Flemish universities. One of the main assets of NETWORK programmes is the strengthening of bonds between Southern and Flemish partners. There is a strong appetite across both sides to continue working together, for which support to the internationalization of Master programmes in Ecuador could be explored, as well as continue supporting outstanding students to benefit from the knowledge and cultural experience that studying abroad means.

Connect NETWORKS' partners in different Southern countries so they can explore collaborative opportunities, and support innovative and promising regional and global research initiatives. By the time NETWORK programmes get to their end, country partners will have come a long way in terms of collaboration at national level. While there are opportunities to continue expanding networks in their own countries, there is also an opportunity for VLIR-UOS to support collaboration across networks in Southern countries, prioritizing regional partnerships. These efforts could build on successful collaborative research experiences that took place in the past years of the programme.

Annexes

A. List of documents consulted

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Programme documentation

- Mid Term Evaluation report. 2018
- Partner Programme Phase 2. 2018.
- Programme Management Manual for phase 2. 2018.
- Self-assessments reports: programme level (Ecuador and Belgium), Project level (Biodiscovery, Water Resources Management, and Education and Outreach Innovation), and partner level (EPN, UCuenca, UTN).

B. Field visit programme

The field visit took place between June 12th and 16th. Two universities were visited, EPN and Guayaquil, while interviews with UCuenca and UTN were conducted virtually, except for the restitution workshop for which all partners travelled to Guayaquil.

Day	Activities
1	Kick-off workshop (morning) Interviews with EPN staff and students/graduates Meeting with universities' rectors (afternoon)
2	Interviews with EPN staff and students/graduates Visit to EPN laboratories
3	Interviews with UTN staff (morning) Interviews with UCuenca staff and students/graduates (afternoon)
4	Interviews with ESPOL staff and students/graduates
5	Additional interviews with ESPOL staff Restitution workshop

C. List of people consulted/interviewed

Prior to the visit

Name	University	Position
Peter Goethals	Ghent University	Programme Coordinator NETWORK
Paul Herrera	ESPOL	Programme Coordinator NETWORK

Field visit to Ecuador

Kick-off workshop 12/6

Name	University	Position
Patricia Lorena Haro Ruiz	EPN	Vice Dean FICA
Xavier Zapata Ríos	EPN	Dean FICA
Edwin Vera	EPN	Head of DECAB
Sebastián Páez	EPN	Coordinator MCIGRH
Jenny Ruales	EPN	NETWORK Focal Point
Carla Manciati	EPN	Head of Department of Civil and Environmental Engineer (FICA)
Paul Herrera	ESPOL	Coordinator NETWORK
Luis Domínguez*	ESPOL	Coordinator MCIGRH
Diego Mora*	UCuenca	Coordinator MCIGRH
Johanna Ortiz*	UCuenca	
Fabián Tamaliz*	UCuenca	NETOWRK Focal Point
Rebeca Parra*	ESPOL	
Elizabeth Velarde*	UTN	NETWORK Focal Point
Felipe Cisneros*	UCuenca	Former coordinator MCIGRH

*online

Interviews and focus groups

Name	University	Position	Date
Luis Felipe Gualco*	EPN	Student WRM Master programme	12/6
Diego Escobar*	EPN/EPMAPS	Student WRM Master programme / employee at water company	12/6
Braulio Lahuatte*	FONAG	Employee	12/6
Teresa Muñoz*	EPMAPS	Head of Water Resources	12/6
Rafael Osorio*	EPMAPS	Head of Water Resources	12/6
Cecilia Paredes	EPN	Director Postgraduate studies 2019-2022	12/6
Florinella Muñoz	EPN	Rector	12/6
María Augusta Hermida	UCuenca	Rector	12/6
Miguel Naranjo	UTN	Recto	12/6
Leonardo Ortega	EPN	Director Postgraduate studies	12/6
Alexandra Alvarado	EPN	Vicerector of Research, Innovation and Extension	12/6
Jenny Ruales	EPN	NETWORK Focal Point	12/6
Patricia Lorena Haro Ruiz	EPN	Projecto on WRM Vice dean FICA	13/6
Xavier Zapata Ríos	EPN	Projecto on WRMDean FICA	13/6
Sebastián Páez	EPN	Project on WRMCoordinator WRM Master programme	13/6
Jenny Ruales	EPN	EPN Punto focal NETWORK	13/6
Carla Manciati	EPN	Project on WRM Head of Dapartment of Environmental and Civil Engineering, FICA	13/6
Pablo Beltrán	Higher Education Council (CES)	President	13/6
Omar Bonilla	EPN	Dean of Chemistral and Agroindustrial Engineering	13/6

Alexandra Alvarado	EPN	Vicerector of of Research, Innovation and Extension	13/6
Leonardo Ortega	EPN	Director of postgraduate studies	13/6
Edwin Vera	EPN	Head DECAB	13/6
Mary Casa	EPN	Coordinator Biodiscovery Master programme	13/6
José Villacís	EPN	Student of Biodiscovery Master programme (first cohort)	13/6
Michael Villacís	EPN	Student of Biodiscovery Master programme (seventh cohort)	13/6
Alexis Mayla	EPN	Student of Biodiscovery Master programme (seventh cohort)	13/6
Joselyn Olmos	EPN	Student of Biodiscovery Master programme (seventh cohort)	13/6
Pedro Maldonado	EPN	Professor Biodiscovery Master programme	13/6
Karen Portilla*	UTN	Professor WRM Master programme	14/6
Santiago Cabrera*	UTN	Professor WRM Master programme	14/6
Gabriel Jácome*	UTN	Professor WRM Master programme	14/6
Roberto Ortega*	Municipality of Ibarra	Director of Environment	14/6
Álvaro Piedra*	UTN	Student WRM Master programme	14/6
Marcelo Cevallos	UTN	Dean Faculty of Engineering in Agricultural and Environmental Sciences FormerRector UTN Former CES President	
Elizabeth Velarde*	UTN	NETWORK Focal Point and Coordinator WRM Master programme	14/6
Tania Oña*	UTN	Coordinator Biodiscovery Master programme	14/6
Guillermina Paula*	UCuenca	Professor WRM Master programme	14/6
Giselle Soto*	UCuenca	Student Biodiscovery programme	14/6
María Cristina Ochoa Aviles*	UCuenca	Graduated Biodiscovery Master programme Professor UCuenca	14/6
Oscar Morales*	UCuenca	Student WRM Master programme (first cohort)	14/6
Eduardo Chica*	UCuenca	Dean Faculty of Agricultural Sciences Professor Biodiscovery Master programme	14/6
Lorena Siguenza*	UCuenca	Dean Faculty of Engineeringad de Ingeniería Professor WRM Master programme Former Director of Postgraduate studies	14/6
Jessica Calle*	UCuenca	LAb technician Graduated Biodiscovery Master programme	14/6
Rosana Valdivieso*	UCuenca	Academic and administrativa coordnation in Biodiscovery	14/6

		and WRM Master programmes	
Marco Ramirez*	UCuenca	Professor WRM Master programme	14/6
Ruben Jerves*	UCuenca	Professor WRM Master programme	14/6
Freddy Magdama	ESPOL	Researcher Biodiscovery Master Programme, CADS	15/6
Diego David*	PortoAguas	Manager	15/6
Martín Bustamante*	ESPOL / UGent	Graduated WRM Master Programme PhD student	15/6
Cecilia Paredes	ESPOL	Rector	15/6
Katherine Chiluiza	ESPOL	Former dean of postgraduate studies	15/6
Lady Bravo*	ESPOL	Graduated WRM Master programme	15/6
Boris Apolo*	ESPOL	Graduated WRM Master programme	15/6
Marianela Paustizaca	ESPOL	Vice-dean FSNM	15/6
Rebeca Parra	ESPOL	Coordinator WRM Master programme	15/6
Luis Domínguez	ESPOL	Coordinator of WRM Project	16/6
Juan Manuel Cevallos*	ESPOL	Coordinator of Biodiscovery Project	16/6
Indira Nolivos	ESPOL	Professor and researcher WRM Master programme	16/6
Mijail Arias	ESPOL	Professor and researcher WRM Master programme	16/6
Carlos Monsalve	ESPOL	Vicerector of Research, Development and Innovation	16/6

*online

Restitution workshop 16/6

Name	University	Position
Edwin Vera	EPN	Head of DECAB
Tania Oña	UTN	Coordinator Biodiscovery Master programmeBiodiscovery
Jenny Ruales	EPN	NETWORK Focal Point
Santiago Cabrera	UTN	Professor of Master in WRM PhD student at KU LEUVEN
Paul Herrera	ESPOL	Coordinator NETWORK
Luis Domínguez	ESPOL	Coordinator WRM Master programme Coordinator of WRM Project
Diego Mora	UCuenca	Coordinator WRM Master programme
Johanna Ortiz	UCuenca	
Fabián Tamaliz	UCuenca	NETWORK Focal Point
Juan Manuel Cevallos*	ESPOL	Coordinator of Biodiscovery Project
Elizabeth Velarde	UTN	NETWORK Focal Point
Felipe Cisneros	UCuenca	Former coordinator WRM Master programme

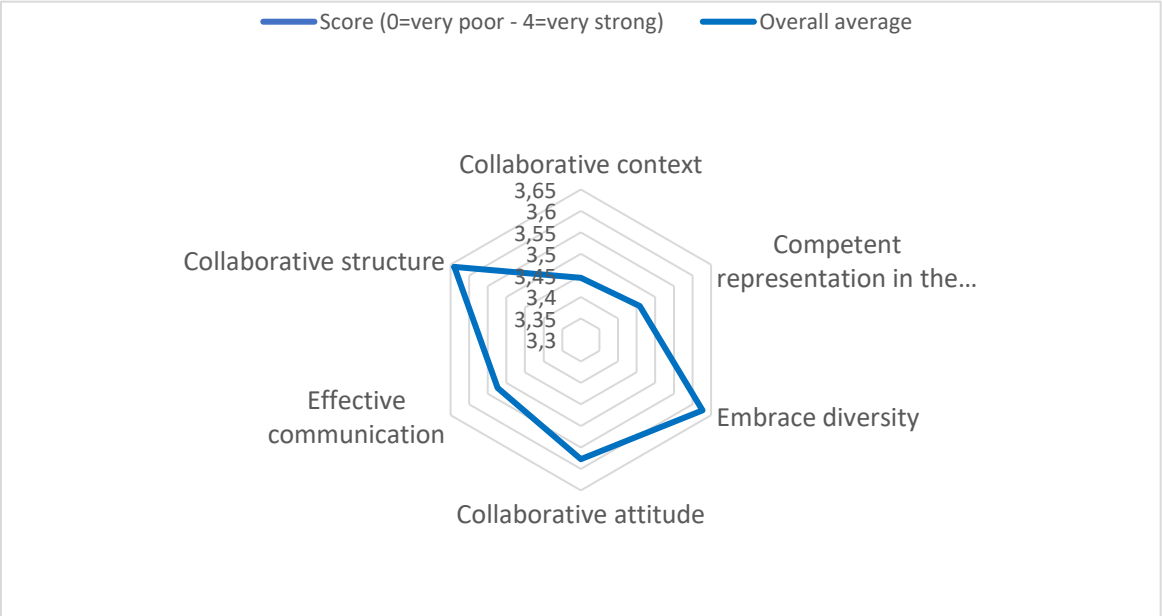
*online

Meeting with Flemish coordinators / project leaders

Name	University	Position
Peter Goethals	Gent University	Programme Coordinator NETWORK
Guido Wyseure	KULeuven	Subproject leader Water Resources

Christine Van der heyden	HoGent	Co-Subproject leader Water Resources
Wim Vanden Berghe	UAntwerp	Subproject leader Biodiscovery
Andrée De Cock	UGent	Team member Ghent University coordination team (Scientific coordination and water management)
Annick Verheylezoon	UGent	ICOS, administrative Support at Ghent University for NETWORK

D. Overall scores for the assessment of the collaborative process[23]



[23] Based on 42 responses by representatives of the four Ecuadorian universities.

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Publisher: Kristien Verbrugghen, VLIR-UOS, Julien Dillensplein 1, box 1A, 1060 Brussels, Belgium
D/2024/10.960/07

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