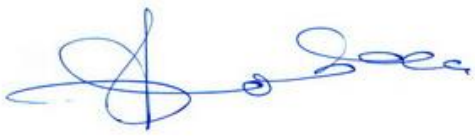
Format for an IUC Extended Concept note

Call Institutional University Cooperation (IUC) 2022

GENERAL INFORMATION

Programme information	
Country and region of the programme	
Vietnam, specifically the South Central Coast and Central Highlands of Vietnam	
Programme title (linked to strategic/thematic focus area)	
Improving livelihoods and living conditions through the sustainable development of the South Central Coast and Central Highlands of Vietnam by enhancing the capacity of Quy Nhon University	
Programme Summary (Focus of proposed strategic area(s) and institutional strengthening activity)	
The programme aims to sustainably boost the livelihoods and living conditions of local farmers in the region by enhancing education and research capacities in agricultural/food/environmental sciences and renewable energy. The regional objectives are (i) building an early flood warning system to enhance the climate change adaptability of local communities/authorities; (ii) enhancing the efficiency of solar-assisted drying and biogas systems with nanomaterial-based solutions; (iii) improving the safety and quality of the avocado/durian crops with sustainable pre-harvest management; (iv) enhancing the value of the avocado/durian crops by applying natural product-based post-harvest processes, and (v) establishing risk assessment/risk management models for dragon fruit/jujube supply chains to maximize benefits for local farmers. The institutional objectives are (i) modernizing and digitalizing student services with an email system, an e-learning system and a library; (ii) establishing a sustainable institutional waste management system and stimulating recycling and waste treatment in Quy Nhon.	
Applying partner university (institution and proposed local coordinator)	
Full name of the institution (+ abbreviation)	Quy Nhon University (QNU)
Name of the local IUC coordinator	Prof. Dr. VU Thi Ngan
Name of the authority of the local university (Rector, Vice-Chancellor, President,...)	Prof. Dr. DO Ngoc My (Rector)
Applying Flemish university (institution and proposed Flemish coordinator)	
Full name of the institution (+ abbreviation)	KU Leuven – University of Leuven (KU Leuven)
Name of Flemish IUC coordinator	Prof. Dr. Kristiaan TEMST
Signature of the authority of the local university (Rector, Vice-Chancellor, President,...)	
 **Prof. Dr. DO Ngoc My**	

Signature of the coordinators (Flemish and local IUC coordinator)	
Flemish IUC Coordinator	**Local IUC Coordinator**
Prof. Dr. Kristiaan TEMST	**Prof. Dr. VU Thi Ngan**

PROGRAMME DESCRIPTION

1. Background & context

How was this extended concept note developed? How did you take into account the comments of the selection commission (selection stage 1 – concept Note South)?

The Extended Concept Note (ECN) is based on the first "Concept Note South" with due consideration for the comments from the first-round selection commission, under the guidance of the local university rector, the Flemish coordinator and the local coordinator. In particular:

1. We have mainstreamed gender throughout all projects and involved Vietnamese gender researchers on the academic staff of QNU's Department of Social Work, which belongs to the Faculty of Social Sciences and Humanities, to help the team better integrate gender equality in all projects and in various dimensions.
2. To strengthen the outreach development-oriented dimension, we have involved the Binh Dinh Institute for Socioeconomics Development Studies (https://vnc.binhdinh.gov.vn/), which has experience working with farmers to study agricultural produce supply chains, in the programme.
3. In this ECN, the programme has been designed to better integrate the societal development and institutional dimensions. We visited various stakeholders – including local farmers, farmers unions, women's unions; the relevant provincial Department of Agricultural and Rural Development (DARD), Department of Natural Resources and Environment (DNRE) and Department of Science and Technology (DOST) in the region (including the provinces of Binh Dinh, Phu Yen, Ninh Thuan, Binh Thuan, Gia Lai, Dak Lak and Dak Nong); and such non-governmental organizations (NGOs) as Red Cross and Rikolto Vietnam – just before the initial COVID outbreak in February-March 2020 and undertook to work with them to tackle urgent local problems, as described in more detail below.
4. COVID-19 led to the cancellation of some planned stakeholder visits, but we have collaborated online. The situation has also significantly affected the learning and communication environment, so we have prioritized the use of digital and disruptive technology to support innovative educational approaches.
5. Visits to farmers unions and local farmers made it clear that fruit production problems have severely affected their living conditions. A new pre-harvest management domain of change has therefore been added to this ECN.
6. Five academic theme-based projects (hereafter mentioned as "research projects") have been developed and will be implemented in close association with end-users (local farmers and residents) and intermediate partners. QNU led the development of these projects in a participative process involving heads and staff of the 11 departments: geography - resource and environment management; physics and materials science; applied biology and agriculture; chemistry; chemical engineering and food technology; engineering and technology; economics and accounting; finance - banking and business administration; mathematics and statistics; information technology; and social work.
7. Two transversal institutional strengthening projects (TISP) on digitalization and waste management have been proposed, involving a wide range of university members at all levels.

In general, this ECN provides a comprehensive overview of the regional situation and current institutional capacity. All interventions will be designed in response to local issues, based on a shared vision of change and understanding among stakeholders and QNU.

Provide a local context analysis, highlighting key development problems, their context, importance and underlying causes. Take into account the transversal themes gender and environment in this analysis. Update the local context analysis. If no important changes took place, you may leave this section unchanged.

QNU is located in the city of Quy Nhon, Binh Dinh province, which is the heart of South Central Coast and Central Highlands of Vietnam, including the 11 provinces of Quang Nam, Quang Ngai, Binh Dinh, Phu Yen, Khanh Hoa, Ninh Thuan, Binh Thuan, Gia Lai, Kon Tum, Dak Lak, and Dak Nong (hereafter mentioned as "the region"). The region spans 8,798,700 hectares, covering around 27% of the country, and is home to around 15 million people or 15.7% of the total population (2019 data). The Central Coast of Vietnam is the region worst affected by natural disasters including typhoons, tropical depressions and floods, with on average 80% of all

deaths and damage to property in Vietnam concentrated there according to the Vietnam Disaster Management Authority (2020 data). Unfavourable local geographical, topographical and meteorological conditions coupled with global climate change have increased annual rainfall, mainly during a short period in the rainy season. Hydroelectric reservoir building projects are also ongoing. Both are major contributing factors to frequent unpredictable flooding, which have catastrophic consequences for local residents and the economy of the region. For example, between 11 October 2020 and 15 November 2020 the region was hit by seven tropical storms, causing severe flooding that left 275 dead, 65 missing and 819 injured. Property was also severely impacted, with 3,276 homes destroyed, 280,766 damaged and 414,451 flooded, while 171,337 hectares of crops were damaged. The loss was estimated at more than 1.1 billion euros. Forecasts and warnings are provided by the national and provincial authorities, but timings and locations are not always accurate, communications are not always up to scratch and there is a lack of tools to predict how many households will be affected. Furthermore, these systems only function at regional level, so localized data is unavailable. So to minimize impacts on humans, environment, housing and agricultural production, this region desperately needs an effective, efficient early warning system for natural disasters, especially floods.

Agriculture is the backbone of the region, with 71% of the population reliant on farming, but it only accounts for 28.4% of gross regional domestic product (5.5 billion euros, 2018 data). The goal is to promote the utilization of renewable energy rather than fossil fuels to create sustainable agriculture. The region has around 2,500 sunshine hours per year, which is harnessed in various agricultural activities, but a lack of renewable energy research applications means this resource is not fully exploited. Biogas production from biomass is an eco-friendly strategy, but current biogas production is inefficient due to a scarcity of advanced technology applications in the region. Raising biogas productivity will increase energy accessibility for farmers and reduce the negative impact of biomass (animal waste), a source of pollutants and hazardous microorganisms, which infect food sources and cause disease. Thus, farmers are ready to use modern technology if scientific research can improve the output of renewable energy.

The region produces many typical high-value crops, such as durian and avocado, but poor pre-harvest management practices and post-harvest preservation methods result in sub-optimal safety and fruit quality. To boost productivity and prolong freshness, farmers tend to overuse plant growth regulators and pesticides at pre-harvest and chemical preservatives at post-harvest. Most are of questionable origin. This reduces product quality and creates a major public health and the environmental risk. The best solution is to apply green sciences and technologies to farming, especially for pre-harvest management and post-harvest preservation. This would improve quality and productivity in sustainable ways that benefit farmers, residents and consumers. Another problem facing fruit production is that regional production does not meet the strong consumer demand for produce that fulfils a certain safety standard. Farming is mostly the domain of smallholders, who, because of the expensive labour-intensive certification process, find it hard to obtain food safety certificates like VietGAP, a common farming produce quality management standard issued by Vietnam's Ministry of Agriculture and Rural Development. Rikolto, a Belgian NGO with its international office in Leuven, Belgium, has now launched campaigns in Vietnam to improve safe food production. When preparing the Concept note South, QNU consulted with Rikolto Vietnam, which is keen to work with us on the implementation of a Participatory Guarantee System (PGS), a reliable and affordable quality assurance mechanism that is widely applied in many countries. This cost-effective mechanism encourages the participation of supply chain stakeholders in the quality monitoring process and enables farmers to bring safe produce to market. Rikolto Vietnam has practical experience of implementing PGS in safe and organic vegetable supply chains in five northern provinces and safe rice supply chains in two southern provinces. It has undertaken to generate synergy with QNU by facilitating PGS and identifying risks in fruit supply chains. Farmers need to learn risk assessment and risk management to be able to extract profit from their produce in supply chains.

In addition, environmental pollution is at an alarming level in the region. The United Nations reports that global consumption has increased sharply, seriously jeopardizing the goal of sustainable consumption and production (Sustainable Development Goal 12). The problem is worse in Quy Nhon city and the region due to sharp growth in sea tourism and a lack of adequate waste treatment and recycling. This means significantly higher volumes of untreated waste are sent to landfill, impacting the environment heavily. More importantly, raising the environmental awareness of residents, and specifically changing their waste disposal habits and behaviour, has not

been given the attention it deserves. People remain largely unaware of the negative health and environmental impacts of poor waste management. Well-educated young residents can be used as pioneers to change this. The University has a large student and staff body, so it is well placed to encourage green living and inspire local communities. QNU is expected to be an excellent role model for good waste management practices (WMP), providing advice on recycling and waste treatment to surrounding provinces and becoming a driving force for societal change. Close relationships are fostered with local authorities, the Quy Nhon Urban Environment Joint Stock Company authorized by the Quy Nhon People's Committee and businesses that recycle various types of domestic solid waste to increase the uptake of good WMP.

Regarding regional labour forces, the interdisciplinary regional workforce is too small and does not have the expertise to deal with the problems the region faces. Frequent natural disasters, problems with food safety, health services and education, and tough social conditions in the region force people to move away. The region accounts for 27% of the country's total surface area, but only 15.7% of its population, so population density is below the national average. Furthermore, boys are prioritised over girls, the traditional mindset in the rural areas. The sons of low-income farming families are often sent to the large cities (Hanoi, Ho Chi Minh City) where education is better, while the daughters are kept to study at local universities/colleges. This could go some way to explaining why 67.9% of QNU students are female, compared with the national average of 54.0% (2019 data). Vietnamese society is rooted in male-oriented and male-dominated Confucian traditions. Helped by NGOs, Vietnamese government has worked hard to improve gender equality, recognizing the equality of both partners in the Marriage and Family Law in 2014 and establishing a broad-based nationwide Vietnam Women's Union network to drive gender equality. However, changing gender norms in Vietnam takes time and requires special attention, especially in rural areas. In 2016 the SNV Netherlands Development Organisation published a study on the economic empowerment of women in rural households in selected central Vietnamese provinces. It concluded that female farmers have less say than men with regard to workload (productive and reproductive tasks), less control over major household expenses (farm equipment), less prestige in the community (with a much lower number of women in leadership positions) and are less likely to be a member of farm production and trade groups (on average, less than 20% of women have joined farmers unions).

As the largest and oldest multi-disciplinary university in the region, QNU's goal is to improve its education and research performance so that it is able to produce well-qualified human resources and provide research-based sustainable solutions to local problems, including gender inequality and environmental issues. In association with local authorities and communities, QNU is expected to play a leading role in creating viable solutions to regional problems and driving regional socioeconomic development.

Provide an institutional context analysis, highlighting strengths and capacity constraints / needs of the institution. Take into account the transversal themes gender and environment in this analysis. Describe the position of your university in the national higher education landscape. Update the institutional context analysis. If no important changes took place, you may leave this section unchanged.

Located in Quy Nhon, a coastal city, QNU was originally exclusively focused on training local high-school teachers. The University's mission was broadened towards a multi-disciplinary institution in 2003 to respond to the region's demand for the socioeconomic development. QNU has three faculties (Faculty of Natural Sciences, Faculty of Social Sciences and Humanities, and Faculty of Teacher Training) and nine academic departments, running 46 bachelor's, 22 master's and 3 doctoral programmes in pedagogy, social sciences and humanities, engineering and technology, natural sciences and economics. Almost 14,000 students are enrolled (2020 data). Since its foundation 40 years ago, the University has achieved some major milestones and is now ranked 27th in Vietnam by the Ranking Web of University (webometrics.info, accessed 2 December 2020). **In education and training**, almost 90,000 full-time and part-time students (including hundreds of Laotian students) and more than 2,500 postgraduate students have received their degree. Many have held leadership positions in large corporations and governmental bodies. **In research**, QNU has set up trailblazing physics, mathematics and chemistry research groups, contributing to the increase in both quantity and quality of publications in international peer-reviewed journals. Over the past five years, the University has made great strides in publishing and now has a library of more than 350 international and 550 national publications. **In technology transfer**, the Applied Research Institute for Science and Technology (ARIST) was recently set up to promote research links between the

University and local communities to respond to the growing demand for effective sustainable development measures. QNU has developed and successfully transferred technological solutions to local healthcare, chemical engineering and water resource management organizations and businesses.

QNU employs more than 500 academic staff. More than 50 staff members (out of 187 PhDs) have PhDs and postdoctoral experience in natural sciences, information technology and applied mathematics from high-ranked international institutions, proof of QNU's research competency. Despite a good gender balance, far fewer female staff have a PhD (35% compared with 65% among male staff). The proportion of females in leadership positions is even lower (25%).

QNU recently set up a broad-based education, research and cultural exchange network of leading national/international institutions and organizations. There are still many areas where QNU has opportunities to further develop its potential as an educational and technological hub of the region. While progress has been made, QNU still publishes fewer papers in international peer-reviewed journals than the leading Vietnamese universities (81 compared to 450-2545 papers by the top five universities, 2019 data). One of the main reasons is the lack of a professional research environment, due to a shortage of application-oriented projects, inadequate high-quality facilities and limited funding. The ongoing activities mainly focus on fundamental research, with insufficient attention given to application-oriented domains, limiting engagement with local development issues, especially farming.

QNU is not recognized as a top university in the country for education and training, making it difficult to attract talented students. The existing graduate education programmes are limited in terms of interdisciplinarity and responsiveness to demand in such fields as food science, environment and renewable energy. Furthermore, due to underdeveloped ICT infrastructure most education is based on traditional methods, so students are unable to access remote learning and e-learning. COVID-19 makes this more problematical. Most teaching and learning activities have been postponed or cancelled for months, causing tremendous delays. QNU urgently needs to build e-learning capacity, a modern library and online student services. Waste management is another issue. QNU produces more than 5 m^3 of waste per day in its academic and educational activities, office operations, cafeterias and dormitories. Plastic accounts for almost half of all solid waste. QNU's waste management system has not been able to handle this huge volume.

To realize its full potential, QNU must overcome the existing constraints. QNU aspires to play a prominent role in driving change in the region. It needs all the external support it can get to achieve this ambition.

2. Strategy of the institution

Briefly describe the overall institutional strategy. Highlight the institution's vision on its role as university and as a driver of change in society. Refer to other relevant internal policy documents. If no important changes took place, you may leave this section unchanged.

QNU, formerly known as Quy Nhon University of Education, was founded in 1977 and is affiliated with the Ministry of Education and Training (MOET). As the largest public university in the region, the University's mission is training and developing high-quality human resources, fostering talent, conducting scientific research, disseminating knowledge and transferring technology to effectively serve the sustainable development of the country generally and the region specifically, and contributing to the promotion of social progress.

Based on the analysis of the situation in the world, Southeast Asia, Vietnam, and South Central Coast and Central Highlands, and with due regard for its mission, vision and capacity, QNU issued its development strategy plan for 2016-2020, with a vision to 2030, focused on two key points: an interdisciplinary approach to education/research, and application-oriented research closely linked to regional problems. The University initiated a comprehensive restructuring plan in the middle of 2019 to address significant changes and advance to the next stage of development. QNU recently reviewed the achievements and failures over the past five years, with due consideration for changing contexts (such as COVID-19). Action plans were drawn up for 2021-2025, focusing on continued institutional restructuring, enhancing educational capacity to develop an interdisciplinary approach, boosting applied research and technology transfer, and promoting integration and international cooperation in training and research to better serve socioeconomic development in the region.

Elaborate on the capacity of the university to network with external actors: Governments, private sector, communities, civil society organisations, external funders, etc. If no important changes took place, you may leave this section unchanged.

Recognising the pivotal role of QNU in the socioeconomic development of the region, the government, MOET and the Ministry of Science and Technology (MOST) recently launched key development policies and released funding to enhance QNU's education, research and technology transfer capacity. QNU also receives strong support from the Binh Dinh People's Committee and other neighbouring provincial authorities, such as Gia Lai, Dak Lak, Dak Nong, Phu Yen, Ninh Thuan and Binh Thuan. The main goal of this support is to promote QNU as a trailblazer tackling challenges across the region, including providing highly qualified human resources, mitigating environmental pollution, reducing natural disaster risk, and adapting to climate change and sustainable development. A significant increase in the annual number of national, ministerial and provincial research projects run by QNU has gone some way to meeting the demands of local communities.

As well as governmental support, QNU has received ample academic support from networks of research groups at prestigious universities and research institutes in Vietnam, including Vietnam National Universities (Hanoi and Ho Chi Minh City), Da Nang University, Can Tho University and Hue University, and from other countries. QNU has set up bilateral and multilateral education and research cooperation with many international higher education institutions and organisations through VLIR-UOS (SI and TEAM projects), the European Commission (Erasmus+ projects), UNESCO (TWAS, UNESCO-UNITWIN projects), the South Korea Institute of Science and Technology and the Quy Nhon International Center for Interdisciplinary Science and Education. These networks give QNU's lecturers and students the opportunity to broaden their knowledge and access an advanced global educational and research environment.

In recent years, cooperation between QNU and industry has become one of the key drivers of fundamental research that creates practical benefits for local communities. Vietnamese companies, such as Vingroup Innovation Foundation, TMA Solutions and FPT software, provide scholarships to help students fund their education. QNU recently signed a MOU with THADI corporation on agriculture and food technology internships for QNU students, while the Vingroup Innovation Foundation awarded two research grants in applied mathematics and biology.

3. Updated programme strategy

Long term desired change(s): Explain how the proposed IUC programme will contribute to the strategy of the institution. How does this fit with the objectives of institutional university cooperation? What are the ambition(s)/dream(s) of the proposed IUC programme? If there are no important changes compared to the earlier concept note South, you may indicate this and leave this section unchanged.

The mission of the proposed IUC programme is two-fold: addressing the needs of communities and boosting the role of QNU in the sustainable development process in the South Central Coast and Central Highlands of Vietnam. This is consistent with QNU's strategy and vision to become a prestigious multi-disciplinary application-oriented institution at national level. Through the programme, QNU is expected to provide the local communities with advanced technology and high-qualified manpower to tackle the region's socioeconomic problems and achieve sustainable development. That tallies with the general objective of IUC, which is "Empowering the local university as institution to fulfil its role as development actor in society".

The programme ambitions are (i) improving the livelihoods of local farmers and living conditions of local communities in the region and (ii) strengthening QNU's capacities in education, outreach and applied sciences. These ambitions stem from QNU's inadequate capacity in terms of human resources and facilities to tackle the major problems facing the region, as set out above, including low agricultural productivity, poor food safety, low farmers' income and environmental problems. COVID-19 compels QNU to boost its online education and communication resources. Heavy investment is needed in digitization systems at every level, to create digital platforms supporting various activities, not least e-services, e-learning and library services.

Domains of change: What are the key challenges (cf. context/institutional analysis and strategy) the programme wants to tackle (can be both internal and external to the institution)? How to translate them into desired changes (i.e. "domains of change")? How does this contribute to the long term objective(s)? If there are no important changes compared to the earlier concept note South, you may indicate this and leave this section unchanged.

To achieve these ambitions, the programme focuses on seven domains of change: five at regional level and two at institutional level. **At regional level**, the programme aims to (1) create an early flood warning system to enhance local authority flood monitoring capacity in the context of climate change; (2) raise the efficiency of solar energy and biogas applications in farming by adopting novel nanomaterials; (3) improve the safety and quality of avocado and durian crops by managing pre-harvest factors; (4) enhance the value of local fruit by adopting natural product-based post-harvest processes; and (5) increase farmer benefits by conducting research on supply chain risk assessment and risk management of agricultural produce. **At institutional level**, the programme is expected to boost QNU's education and research capacities. The objectives are to (6) modernize and digitalize student services by building a student platform that incorporates all student activities, an e-learning system and a modern library to provide better educational resources to a larger number of students and (7) target sustainable waste management practices cross the whole region, with QNU adopting the role of aspirational pioneer in establishing a sustainable waste management system.

The first domain of change results in proper preparations and prompt responses by both authorities and communities with regard to floods. The authorities must provide early warnings and launch a prompt response, but the community also needs to have sufficient knowledge of the risks and the proper response to flood warnings. This requires the building of an effective flood monitoring and warning system, which is expected to minimize damage and losses in local communities. Women and children are particularly vulnerable, so they benefit the most.

The second domain of change pursues more efficient use of renewable energy sources, such as solar energy and biogas, in the rural areas. Smallholders can harness solar power for crop drying and plant irrigation. More biogas is available and accessible for various uses on livestock farms in rural and remote areas as a low-cost and environmentally friendly solution. Designing novel nanomaterials at an affordable cost is the key challenge here.

The third domain of change is intended to improve fruit safety and quality by enhancing the sustainability of pre-harvest management practices. Avocado and durian are the two most common fruits in the region. However, poor quality and unstable crop yields, with a heavy reliance on chemicals, make these fruits less attractive for

domestic consumption or for export. The use of chemicals has also created a lot of environmental pollution, particularly on farmland and water. These challenges will be tackled by applying good biostimulant management practices to significantly reduce amounts of some pesticides and inorganic fertilizers and mitigate their negative impacts on fruit quality, safety and soil health.

Couple with the third domain of change, the fourth domain of change will be realized by scaling up production and consumption of safe fruit (avocado and durian) in the region, increasing its value. The low economic value of these fruits is due in part to the absence of affordable safe post-harvest methods. This reduces, in general, fruit crop quality and quantity substantially and hits durian and avocado quality and quantity even harder, as they spoil very quickly after ripening. The focus here will therefore be on finding green, affordable ways to prolong the shelf life of durian and avocado using bioactive components extracted from local plants or sea creatures.

The fifth domain of change will be realized when the income of (dragon fruit and jujube) smallholders farming in sustainable conditions increases and they are able to market safe produce at reasonable prices. The major risks in the current fruit supply chain hamper the establishment of long-term relationships between farmers and trading companies, and also affect consumer confidence in fruit quality. PGS is emerging as a potential quality control mechanism for fruit production, but it has not yet been implemented in this region. The proposed research will develop risk assessment and risk management models for the dragon fruit and jujube supply chains using PGS, facilitating an inclusive business model.

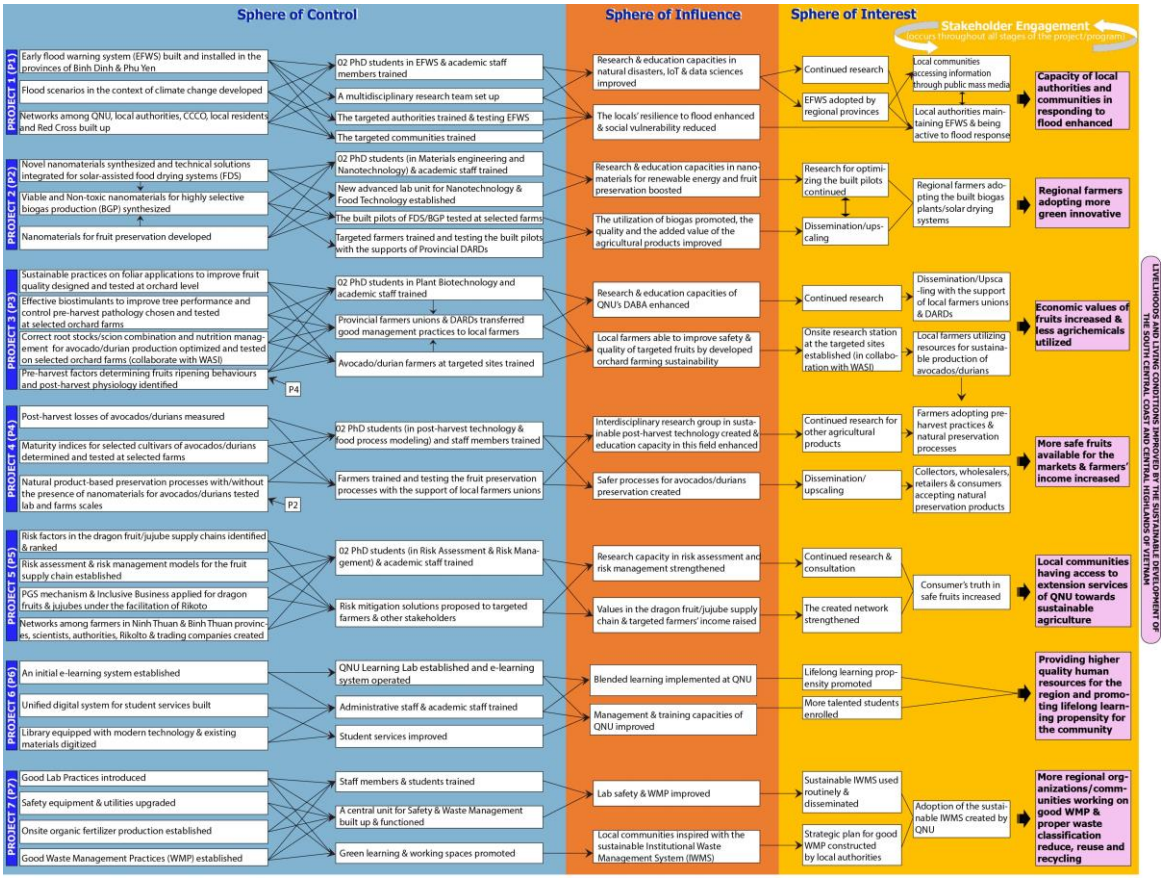
The sixth domain of change has three aims: (i) a scalable, flexible integrated digital platform whose core module is an email system providing individual QNU students with an official email and a universal account to access to all services; (ii) an e-learning system offering alternatives such as distance training and blended learning for traditional training (iii) a modern university library towards digitalization and automation that meets the diverse needs of QNU staff and students, enhancing the education and research performance.

The seventh and final domain of change will be realized with the establishment at QNU of a sustainable institutional waste management system (IWMS), including a waste segregation system (WSS), waste management practices (WMP) and good lab practices (GLP). This domain addresses two goals: (i) improving laboratory safety and waste management at QNU to effectively control waste released to the environment and (ii) inspiring local communities with QNU's sustainable waste management model. In the long run, this institutional model will be disseminated to local communities through networks of QNU alumni, companies, and local authorities.

In conclusion, the realization of all proposed domains of change is expected to improve the livelihoods of the local farmers, living conditions of the local communities, as well as enhancing QNU's interdisciplinary research capability. Each domain of change will be partly realized by one of the projects described in the programme strategy section below.

Programme strategy: Describe how the programme will approach these different challenges or 'domains of change'. Describe how the programme will achieve its objectives through different projects. **This strategy needs to build further on the first programme strategy already developed in the Concept Note South. In addition to a narrative, including a first descriptive overview of projects, also include a visual representation of the Theory of Change at programme level.**

The Theory of Change is visualized below based on seven projects that tackle parts of each respective domain of change. Five research projects (P1-P5) adopt strategic to interdisciplinary approaches involving 11 departments: Geography – Resource and Environmental Management (DGREM), Physics and Materials Science (DOPM), Chemistry (DOCH), Chemical Engineering and Food Technology (DOEF), Applied Biology and Agriculture (DABA), Mathematics and Statistics (DOMS), Information Technology (DOIT), Engineering and Technology (DOET), Economics and Accounting (DOEA), Finance-Banking and Business Administration (DFBA) and Social Work (DOSW). Moreover, these research projects will be in close collaboration with some research intitutes and local authorities, such as Western Highlands Agriculture and Forestry Science Institute (WASI), the provincial DARDs, DNREs and DOSTs. Two institutional projects (P6 and P7) involve all staff and students.



How will the programme realise organisational and institutional change? How will the programme approach this?

Capacity building and strengthening are focused on three different levels of intervention as follows.

At an individual level, at least two PhD students will be recruited for each of the five research projects. They will be given support to accumulate relevant knowledge and skills in agricultural science, food science, environmental science and renewable energy. These PhD students should preferably be QNU academic staff members. So they can use this new knowledge to benefit QNU's education and research activities after graduation. The educational capacities of academic staff and research team members are also improved through co-supervising master's/PhD students with Flemish-based professors and short-term exchanges at Flemish institutions. This facilitates the development of the local institution's human resource and strengthens research group networking between QNU and the Flemish partners. **At an organizational level**, this programme is designed to allocate appropriate funds to enhance departmental infrastructure with a new advanced lab unit for Nanotechnology and Food Technology, the Safety and Waste Management Central Unit, the QNU Learning Lab and upgraded key facilities in agriculture. Similar arrangements are made to set up interdisciplinary research groups that deal with urgent regional problems, enhancing research and training capacity of 11 academic departments. Five of them (DGREM, DOPM, DOCH, DOEF, and DABA) recently merged to form the Faculty of Natural Sciences (FNS) during the restructuring of the University in 2019, facilitating interdisciplinary research and education. **At an institutional level**, research and training capacities are enhanced by the implementation of five research projects facilitating interdisciplinary research and two institutional projects creating a green and modern education and research environment. As well as creating sustainable uptake conditions for research, another challenge is generating sufficient institutional benefits. With that in mind, the programme puts a lot of emphasis on working with end-users as part of capacity building by means of technology transfer and other funding to balance revenue and sustainability. This will create social added value and enhance the identity of QNU, helping raise its regional and national profile. To generate the highest impact for society and for QNU itself, QNU undertakes to critically assess IUC implementation against strategy on an ongoing basis, embracing all leaders involved at every level in the programme over its full 10 years. The success of this programme will generate new opportunities for QNU

to secure external funding and expand collaborations with other partners and international research groups through established networks.

Explain how the programme will create the conditions for the uptake of new knowledge, applications and services outside the Higher Education context.

Beyond the Higher Education context, the uptake conditions are designed for local farmers (end-users), local communities (end-users), local authorities (intermediaries) and NGOs (intermediaries) as four groups of key stakeholders at three levels of knowledge, applications, and services. The following activities will target knowledge uptake: (i) A baseline analysis of relevant knowledge topics, attitudes, gender, policy priorities, and behaviours of the end-users and intermediaries will be conducted to ensure the participatory, demand-driven and needs-oriented character of each project; (ii) MOUs and MOAs with local authorities will be signed to overcome the structural barriers and enable membership of advisory boards; (iii) For more efficient communication with these stakeholders, QNU researchers will be given training/guidance on storytelling, networking and conveying research results in simple science communication. At the level of application, several conditions will be designed: (i) Successful pilots will stimulate upscaling in the region; (ii) Frequent direct communication, hands-on experience, training sections and the workshops are used as a feedback channel to ensure the effective implementation of output; (iii) Integration of local partner organizations (relevant provincial departments of the region, provincial farmers unions) and NGOs (Rikolto and Red Cross) is facilitated by involving their staff in the research projects and the programme's advisory board. These activities ensure direct contact, collaboration, interaction between researchers and end-users, targeted and accessible research outcomes, as well as the dissemination of the results from the beginning of the programme. To create the conditions for extension services: (i) QNU will allow the Center for Economics and Accounting (CEA) to act as an independent accounting unit, managed by a project member in P5, to provide the extension services in risk assessment and risk management on a consultancy basis; (ii) On-site training services in sustainable pre-harvest and post-harvest practices will be delivered in association with the provincial DARDs and Famers Unions (P3 and P4).

Explain how the programme will integrate the transversal theme of **gender**? Explain how the programme will take the actual gender situation (in the institution and broader context) into account in its strategy and explain the potential impact of the programme strategy on the actual gender situation (in the institution and broader context).

This IUC programme will follow the three approaches that Londa Schiebinger, Professor of History of Science at Stanford University, has devised to bring forward equality in science: i.e. fix the organization, fix the number of women and fix the content. **Fix the organization**: QNU undertakes to develop policies to create equal gender opportunities in employment and various decision-making levels throughout the University, (i) Female PhD candidates will be favoured in the case of the same standard of excellence (free pre-training will be provided for female PhD candidates to support their enrolment requirements) and will be considered for key academic staff positions; (ii) Gender equality in various decision-making levels (management/leadership, project/committee members, academic staff and administrative staff) has been taken into account. For example, at programme team and important meetings, there must be at least 40% representation of both sexes. **Fix the number**: The programme helps women to be target beneficiaries: (i) By encouraging current female staff members to actively participate and conduct research in the fields of applied science and technology that are currently perceived as male-dominated, the five research projects (P1-P5) aims to extend the women's influences in those departments at QNU; (ii) The programme aims not only to encourage more women to pursue doctorate degrees, but also promote them to top leadership positions at QNU by encouraging and facilitating their attendance at leadership trainings. The representation of women in leadership at dean/head levels are expected to increase from the current 23% to 35% by the end of the programme; (iii) the Women's Unions will be directly and actively engaged as project counterparts by co-organizing workshops/trainings and advising on gender issues from provincial to communal/group level. Women at the group level will serve as potential trainers in "Training of Trainers" (ToT) modules to empower women through gender-sensitive inclusion in the local communities. **Fix the content**: The programme will mainstream gender as a content component in the project activities: (i) Gender analyses are incorporated in the baseline investigations of each project. The analysis will based on USAID's Women's Empowerment in Agriculture Index (WEAI) methodology and the Gender Parity Index (GPI), which focuses on five

domains of empowerment: decision-making power in agricultural production, access to and decision-making power over productive resources, control over the use of income, leadership in the community and time-use; (ii) Dissemination activities to ease the women's workload will be designed for the targeted communities with the intention of strengthening the technical skills (P2-P4) of the women, as well as their trading and business skills (P5); (iii) A continuous evaluation of gender empowerment and gender equality in the targeted communities will be taken into account for effective adaptation and modification; (iv) All proposed activities will be organized in close association with the wide network of the Women's Unions.

Explain how the programme will integrate the transversal theme of **environment**? Explain how the programme will take the actual environmental situation (in the institution and broader context) into account in its strategy and explain the potential impact of the programme strategy on the environment.

As mentioned in the context analysis, the South Central Coast and Central Highlands of Vietnam suffers severely from natural disasters and is also most affected by floods and storms due to its topographic characteristics. Therefore, this IUC programme would like to address two major regional environmental issues: (i) minimizing the impact of floods and climate change on the environment and human (direct level) and (ii) minimizing negative impacts from human activities to the environment (indirect level).

To integrate the transversal theme of environment in the proposed IUC programme, the actual environmental situation has been considered in terms of its impacts on programme implementation and the impacts of the programme on the environment.

On the one hand, the current environmental situation determines the proposed programme. Firstly, the change in the amount of rainfall affects flood frequency and therefore has an impact on the accuracy and reliability of forecasts provided by the early flood warning system (P1). Moreover, climate change has impacted the amount of sunlight in drying processes using solar energy (P2). Climate change will also affect agricultural harvest calendars and so possibly the research activities. For example, the change in climatic conditions at targeted research sites affects agricultural management practices (P3), maturity indices of fruit cultivars (P4) or risk management models as weather-related risks change (P5).

On the other hand, the implementation of the projects is expected to positively impact the environment. P1: the development of the early flood warning system will minimize the environmental damage caused by floods. P2: the use of the right catalysts in biogas production will reduce toxic and greenhouse gas emissions. P3: management of pre-harvest factors reduces the demand for agricultural chemicals. P4: the employment of natural bioactive substances will eliminate the use of unsafe chemicals in the avocado and durian preservation process. P5: the establishment of the risk assessment and risk management models to effectively manage and operate the PGS mechanism and the Inclusive Business Model, and the risk assessment model with significant support for farmers from Rikolto will raise producer's environmental awareness. P7: the proper implementation of GLP, WSS and WMP will create green learning and working spaces at QNU and stimulate more local communities and organizations to apply the sustainable WMP.

Based on the context analysis, there are clear links between the environmental characteristics and socioeconomic issues in the region. Intensive farming, including misuse of agrichemicals, plant growth regulators overdoses and monoculture, will lead to soil degradation. However, sustainable management on farming systems proposed in P3 and P5 will help conserve soil health, while protecting the livelihoods of local residents. Moreover, the deforestation for increasing agricultural lands resulting in erosion leads to a decrease in soil fertility. The implementation of these two projects can raise awareness among smallholders of the need to protect soil fertility.

It is worth noting that local authorities and communities are expected to generate management capacity to adapt to climate change by applying updated scenarios and solutions on adaptation of climate change (CCCO) after the lifetime of P1.

4. Updated stakeholder analysis

In order for a programme to have impact, a thorough understanding of the key stakeholders is essential. Please update the previous stakeholder analysis and focus on stakeholders that are deemed crucial for creating effective uptake of results outside the university and the stakeholders deemed crucial to achieve genuine institutional change.		
Stakeholder	**Analysis**	**Engagement strategy**
Local Farmers (Direct beneficiaries)	(i) They are keenly interested in research-related activities proposed in P1-5 and have a major influence on the success of the whole programme; (ii) Their benefits from P1-5 are high selectivity of biogas system and green solutions for drying agricultural products, higher quality and economic value of produce, higher income and cleaner environmental conditions from results of P1-5.	(i) They are respondents in the baseline study surveys/interviews in accordance with P2-5; (ii) They are early adopters (P2-5) in the prototype trial/selected orchards; (iii) They actively participate in research-related activities, on-site trainings, workshops, TOTs, etc; (iv) They provide feedback on further improvements.
Local residents (Direct beneficiaries)	(i) They have a major influence on research-related activities in P1 and P5; (ii) Their lives will improve due to the better physical environment, more safe food and less suffering from natural disasters.	(i) They are respondents in the baseline investigations for P1; (ii) They use the communication and dissemination tool in EFWS at communal level and are trained to find solutions to difficult situations (P1); (iii) In P5, local residents at research locations participate directly in the PGS quality control system.
Provincial DARDs (Intermediaries)	(i) They are crucial stakeholders in facilitating uptake (P2-5); (ii) They have a major influence as advisors with regard to technical solutions adapted by regional farmers; (iii) Their staff capacity will be improved in P1-4.	(i) They have shared insights into the current situation from the formulation stage; (i) MOUs and MOAs will be signed so that the structural barriers can be tackled together in the advisory board; (ii) Their staff will be involved in research studies; (iii) They have more opportunities to do their social duty.
Provincial DNRE (Intermediaries, indirect beneficiaries)	(i) They are important stakeholders in changing land use management data, the natural disaster policy-making process and climate change adaption (P1); (ii) They will be given tools to assess the impacts of biogas production on the environment (P2).	
Provincial DOST (Intermediaries)	(i) They are key stakeholders in facilitating technology transfer of the novel outputs; (ii) They collaborate to augment local developmental directions in science and technology; (iii) They work to improve the science and the technology.	
Provincial Steering Committee for Natural Disaster Prevention and Control (PSC-NDPC)	As end-users of P1, they manage and operate the early flood warning system and new automatic water level stations from P1.	(i) They help install the infrastructure for EFWS; (ii) They are trained to use EFWS and software/databases of results and in the final stages of the IUC they will be responsible for using and maintaining that systems/software; (iii) They work with the government in dialogue to develop natural disaster warning and prevention policies.

Local Farmers Unions	They are critical stakeholders in uptake (P2-5), as a link between researchers and farmers in Gia Lai, Dak Lak and Dak Nong for good pre-harvest management practices (P3) and new post-harvest methods (P4); applying green innovations in Binh Dinh and Gia Lai (P2); implementing pilot productions in Ninh Thuan and Binh Thuan (P5).	They are potential indirect beneficiaries by inspiring farmers and holding workshops and trainings on new techniques.
Trading companies	(i) They are crucial actors in the PGS-applied supply chains (P5); (ii) They improve the collaboration between companies and local farmers, build loyalty and guarantee a stable market.	They agree and facilitate the proposed supply chains and engage with the inclusive business.
Waste treatment/recycling companies	(i) They are crucial actors in P7; (ii) They will have the chance to expand their business to the surrounding regions.	They oversee waste treatment and recycling from QNU and other communities.
QNU staff and students	They are (i) key stakeholders in performing research activities, such as conducting uptake activities and executing TISPs; (ii) direct beneficiaries of upgraded facilities, developed network, enhanced research and education capacity; (iii) direct beneficiaries of institutional modernization of student services, library, and sustainable IWMS; (iv) beneficiaries of upgraded education programmes, dynamic and effective research culture; a safer and modernized study and living environment.	(i) Conducting research to deal with local problems; (ii) QNU staff members co-supervise PhD/master's students; (iii) QNU staff participate in training courses and design e-lectures in P6; (iv) Provide inspiration for WMP and GLP in P7; (v) Participate in WMP and GLP workshops and training courses; (vi) Students can use the enhanced student services; (vii) Staff and students benefit from the e-learning system and modern library.
QNU Rector's Board, University Council and Administrative Offices	(i) They play a vital role in implementing all the activities by supporting and issuing rules, guidelines and other policies; consulting the local governments in making policies for sustainable development; (ii) All aspects of QNU's capacity will be improved.	(i) They support the performance of all activities, especially in institutional development; (ii) They lead policy-making meetings in the context of the IUC programme.
Flemish partners	(i) They are key stakeholders and play a decisive role in cooperating, consulting, and supporting the programme based on their expertise; (ii) They ensure greater impact, technology transfer and a wider international network.	(i) They co-supervise PhD students; (ii) They exchange knowledge, skills and staff; (iii) They provide training courses and advice.

Synergy and/or complementarity with Belgian development actors: Highlight complementarity or synergy with the actions of other **Belgian organisations** funded by the Belgian development cooperation (*see call: Background documents per country*).

Project 5 will be implemented in close collaboration with Rikolto Vietnam to develop and promote sustainable agricultural production and business cultures in the South Central Coast region, with a focus on local fruit production. We spoke with Rikolto Vietnam representatives during the formulation stage. Rikolto has not worked in this region before or indeed on any fruit projects in Vietnam. Therefore, there will be good synergy and complementarity between our IUC programme and this Belgian development organization.

Synergy and/or complementarity with other actors: Highlight complementarity and/or synergy with initiatives taken in the same domain by other organisations (local, regional, etc.).

Project 1 is complementary to several finished projects/sub-projects funded by the World Bank (resilient reconstruction of damaged public use and preventive infrastructure at provincial level in Binh Dinh and Phu Yen, 2018-2019); Rockefeller (Quy Nhon City was one of the 11 Asian cities to benefit from the Asian Cities Climate Change Resilience Network, 2008-2013); and the Asian Development Bank (Integrated rural development sector project in Central Provinces, 2015-2019). Synergy will be created on this project in particular with the Red Cross in the coastal provinces with regard to disaster risk reduction and climate change adaptation. Project 2 is complementary to the "Low carbon agriculture support" project funded by the Asian Development Bank (2013-2019) to promote the use of biogas by upgrading/building biogas systems for a selected animal farms and households in Binh Dinh. There will be synergy and complementarity between Project 7 and the project to improve the management capacity and environmental protection awareness of local communities and build a socialized collection, classification and treatment model to minimize plastic waste in four coastal communes and wards of Quy Nhon Bay, co-funded by UNDP, GEF, SGP and the Quy Nhon People's Committee. The work of the SNV Netherlands Development Organization, which supports women's empowerment in rural Vietnamese households in this region, complements all of our work in gender dimension.

Synergy and/or complementarity with other VLIR-UOS activities: Highlight complementarity and/or synergy with other VLIR-UOS funded activities (TEAM projects, Global Minds, ICP's, etc.).

The two completed South Initiative (SI) projects to develop advanced master's curricula for solid state physics, and theoretical and physical chemistry have enhanced the education and research capacities of QNU in these domains. QNU's ongoing TEAM project (2016-2020) uses materials science to provide innovative solutions to turn floodwater into drinking water and treat wastewater from shrimp farms. The implementation of these VLIR-UOS interventions not only enhances the education and research capacity of QNU staff members but also offers them great opportunities to experience and explore European culture, particularly research culture. The proposed activities in the IUC programme therefore support the VLIR-UOS activities. Importantly, the successful implementation of the two SI projects and the positive outputs of the TEAM project are very important factors in the success of the IUC programme, enabling QNU to realize its ambition to be a driver of societal change.

5. Risk analysis

Risks + potential impact	**Probability (1-4)**	**Potential impact (1-5)**	**Response**
- PhD students may not continue to work in the field of study after graduation. - Trained staff may leave their job after the programme lifetime.	2	2	- PhD students are preferable to QNU academic staff and local residents. Therefore, they will remain active as staff members after the end of the programme and function as bridges between QNU, local farmers and the authorities. - A professional work environment has been established to inspire them to pursue an academic career. - QNU has good remuneration policies to retain and attract excellent staff.
End-users and beneficiaries may not continuously apply the results and benefits of the programme.	1	5	- Stakeholders will be involved from the very beginning of the programme (formulation stage). - Stakeholder's expectations will be identified and met. - Key stakeholder awareness of safe agricultural production and environmental protection will be raised by means of various continuous activities.
Non-continuation of research activities after its lifetime due to the shortage of the financial support.	1	3	Based on the networks established and human resources trained as part of the implementation of the programme, QNU staff will actively seek other sources of funding from local authorities, private enterprises and NGOs so that research can continue.
Difficulty in expanding outputs of the programme at regional scale.	2	2	- Work with early adopters to organize training sessions and workshops to share experience. - An on-site research station, collaborating with WASI, will provide permanent support for end-users after the programme lifetime.
Availability of academic staff from Flemish partners to support the programme implementation.	1	2	- A detailed plan will be provided well in advance. - Matchmaking should be well-organized to maximize the participation of all Flemish partners
Female PhD students may take maternity leave during their study.	3	1	Along with the research team, master's students will do the fieldwork, supervised daily by PhD students.
Difficulty in recruiting qualified local PhD students.	1	3	Announce the recruitment process at an early stage to attract potential candidates.
Lack of English proficiency among staff for training courses and academic exchanges	2	2	- Staff on individual projects should have an appropriate self-study plan to gain the proficiency in English needed throughout the programme. - Online learning resources for self-study should be provided. - QNU funds to enable staff to follow English courses (IELTS, TOEFL…).
Cultural or technical resistance by QNU administrative staff	2	2	- Student service procedures will be standardized before establishing digitalized systems.

and local authorities to the use digitalized systems			- User-friendly interfaces and system operation manuals will be developed. - Additional training will be provided if necessary. - Internal mandatory policies will be issued for the use of digitalized systems at QNU.
Sudden extreme weather in the region preventing outdoor activities from being done.	2	2	- Maintain close contact with Central Steering Committee for Natural Disasters Prevention and Control. - Scenarios will be proposed to deal with these events.
Difficulty in expanding outreach to end-users.	1	1	- Sociologists should be actively involved in the implementation of the programme. - Scientific communications should be emphasized by all project members.
Availability and willingness of intermediaries to participate in implementing the programme.	2	3	- Intermediaries should be informed and involved from the start of the programme. - Civil society organizations should be promoted, with a link between local and national levels.
Lack of local trainers conversant with value-chain development and market-based solutions in agriculture	2	2	- Locals should be involved from the start should be given frequent updates. - Cooperate with Binh Dinh Institute for Socioeconomics Development Studies, which has experience to study agricultural produce supply chains.
- Harsh tropical conditions could affect the performance of outdoor devices and activities, making programme implementation more expensive.	2	3	Devices should be able to withstand the local conditions.

6. Institutional embeddedness

Link with university management: explain how the programme will assure a continuous link with and involvement of the university management.

First, we confirm that this IUC programme has been warmly welcomed by senior QNU management, including the Rector's Board and the University Council. Two programme members (Prof. NGUYEN Tien Trung, Dr. NGUYEN Le Tuan) were recently elected to the University Council. The Rector (Prof. DO Ngoc My) has confirmed that the local coordinator (Prof. VU Thi Ngan) has the right of direct access to senior QNU management to raise any issues related to the IUC programme. Moreover, the project leaders are tenured staff members in leadership positions such as vice deans/heads/directors and key staff members of the different departments/central offices/institutes, so they are always able to access senior management.

More importantly, the programme is completely in line with QNU's institutional development strategy and the national strategy of Vietnam in terms of university autonomy, university internationalization, training quality enhancement, environmental protection and economic development.

At the beginning of the programme, the local steering committee will be formed with the participation of the rector, the heads of all functional units, the project leaders and the programme manager. This committee will be chaired by the local coordinator. This means that the IUC programme has a strong direct connection to QNU's top management. Specifically, the University's strategy and action plans will be reviewed annually for adjustment based on the assessment of the IUC implementation.

Flemish support: explain the programme's vision/approach on creating broad Flemish support (inter-institutional cooperation) at the level of the Flemish universities and university colleges.

The support of Flemish universities and colleges is vital to the success of the programme. Specifically, Flanders-based professors and experts are essential to work on the research with QNU's PhD students/staff members and to provide QNU with advice on the implementation of the projects. These professors and experts are expected to come from a variety of Flemish universities and colleges. The involvement of Flemish partners will be encouraged through the favourable allocation of activities under the programme, so that there will be plenty of opportunities for academic and cultural exchanges between QNU and Flemish higher educational institutions during the lifetime of the programme. Details of proposed activities (role of participants, actions to be taken, action steps, etc.), risk management and risk resolution will be clarified at an early stage in order to facilitate the implementation of the proposed activities.

Based on the needs identified in this ECN, we will approach the best-placed Flemish researchers in the relevant fields, regardless of their university affiliation in the matchmaking phase.

Positioning of Programme Support Unit (PSU): explain how (where in the organisation) the PSU will be organised and any particular focus areas / accents regarding the PSU the programme wants to realise.

The Programme Support Unit (PSU) consists of the Flemish coordinator (Prof. Kristiaan TEMST), the local coordinator (LC, Prof. VU Thi Ngan), the programme manager and the ICOS.

The programme manager (PM) will be recruited from QNU's Office of Research Affairs and International Relations, based on his or her experience in project management, finance, accounting, filing and administration, as well as thoroughness and ability to inspiration. The PM will work full-time on this programme to ensure activities, administration and funding go smoothly, with integrity and transparency. As an experienced staff member of the Office of Research Affairs and International Relations, the PM will work closely with QNU's management, including financial management, and will have a close working relationship with the rector. This should help the PM to manage the programme and attract funding to enable sustainable development.

The PSU will have a separate office next to the Office of Research Affairs and International Relations, making it easier for LC and PM to coordinate project teams and stay in close contact with QNU's senior management. Overall, the PSU has the full responsibility for the implementation of the programme.

7. Project identification

7.1. Project 1: Developing an early flood warning system to improve the adaptive capability of the local authorities and communities in the context of climate change (P1)

Objectives: State the objectives of the project. What do you want to realise through the project (medium-term (5 year) objectives). To what long term objectives will the project contribute (can be both internal and external to the university)

Medium-term objectives: (i) Improving the locals' flood resilience and reducing social vulnerability for Binh Dinh and Phu Yen provinces by building and implementing a highly accurate early flood warning system (EFWS) and developing flood scenarios in the context of climate change; (ii) enhancing the research and education capacities of QNU staff in the fields of natural disasters, IoT and data science through research activities and PhD training.
Long-term objectives: Enhancing the capacity of local authorities and communities to respond to natural disasters, especially floods, in order to minimize loss of life and damage to property by improving flood forecasting and warning in the South Central Coast and Central Highlands.

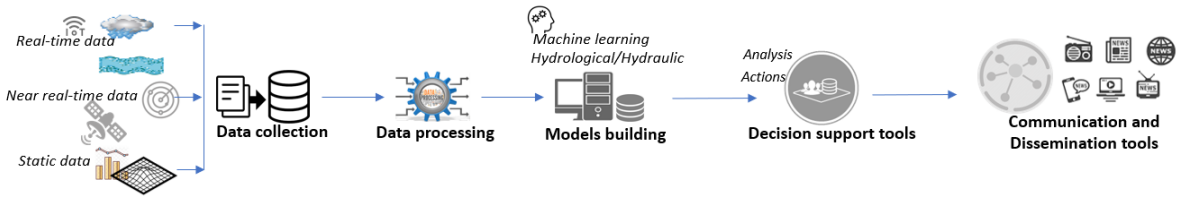
Explain the link with the context analysis, the programme objectives and the other projects. Detail the context analysis if needed (e.g. the specific theme, specific challenges of the departments involved, the local/sectoral context, etc.).

Binh Dinh and Phu Yen provinces are heavily affected by natural disasters on a regular basis. One typical and severe natural disaster that the region frequently encounters is flooding, which is often caused by short lag time of the flood flows, with an increase in the frequency and intensity each year. Various completed projects/sub-projects funded by different actors (Chapter 4), 40% of rainfall stations and 53% of water level stations have operated in an automatic way. Flood warning capacity has been partially improved and flood maps have been established at provincial level, enhancing local authorities' capacity to mitigate flood damages. However, these projects have not included warning systems to ensure the accuracy and timeliness of flood forecasting in the area. Moreover, specific forecasts and warnings are still lacking at commune level and lead-time is too short (a few hours). As the result, local communities that would be affected by a flood do not have enough time or information to evacuate before and during the flood. An EFWS is expected to deal with the problems, enabling earlier and more accurate data analysis up to commune level, quick communication to local communities and fast forecasting of the highly affected areas, helping local authorities identify safe zones for migration.

In addition, this project links with the other projects as follows: The EFWS provides timely information for the local residents through the flood database to support the planning of agricultural areas, helping them take the initiative in planning agricultural production and improving crop value (Projects 3, 4 and 5).

Describe the strategy of the project: how will it reach its objective(s)?

To realize the proposed objectives, this project utilizes the following strategies:
1. The EFWS will be built and installed in the provinces of Binh Dinh and Phu Yen. The components of the EFWS are demonstrated in the model below:



Data collection: Different types of input data include (i) Real-time data (the water level of the river from IoT devices which will be accumulated within the framework of this project); (ii) Near real-time data (rainfall from Satellite (GSMAP, GPM) and radar data; Meteorological data from NOAA meteorological stations; Hydrological data from ground stations and (iii) Static data (Digital Elevation Model, land use/land cover, evaporation, precipitations, dams, irrigation and hydropower reservoirs...) are collected and synchronized in the data processing

system. **Data processing:** The data will be standardized so it is available in various forms, enabling effective data processing. **Model building:** Different types of model, such as machine learning-based models, hydrologic models and hydraulic models, will be built to have better and more reliable forecasting and warning. **Decision support tools**: Based on the output of the models, a geomatics-based toolkit in spatial analysis, data sharing, fast forecasting of flood, flood-affected household identification and safe areas for evacuation will be created for decision making. **Communication and dissemination tools:** Various means of communication (text message, social networks, etc.), especially a new app, will be used to send alerts to the communities. 2. Flood scenarios in the context of climate change will be developed, with due consideration for the impact of socioeconomic planning, and regularly updated by integrating topographic and land use change, etc. 3. An interdisciplinary research group will be set up, incorporating the relevant fields by securing the participation of staff at five departments, training PhD students and using an equipped high-performance computer facility for data processing, modelling and the geomatics-based toolkit. 4. Building networks integrating QNU, local authorities (PSC-NDPC, CCCO, etc.) and local communities to ensure efficient project implementation. 5. Exploitation and dissemination activities by local project teams will be given special attention to enhance locals' flood resilience and reduce social vulnerability, particular for children and women. The extensive nationals and local network of the Red Cross will be capitalized upon to disseminate information about the EFWS system and organize training sessions for the locals.	
Analysis of end-users / final beneficiaries: identify the end-users of the project results and describe the uptake strategy of the project (incl. structural barriers for end-users).	
Local authorities are end-users of this project. The EFWS will improve their adaptive capability in the context of climate change. To improve the uptake of the project results, the PSC-NDPC will be involved from the very beginning of the project and provided with the facilities and knowledge needed to operate and maintain the EFWS; CCCO will also receive regularly updated flood scenarios and adaptability solutions regarding climate change. **Local communities** are direct beneficiaries. Regular flood forecasts and warnings will be issued to villages, communes and wards affected by flooding through local authorities during stormy seasons. **QNU** is the final beneficiary, with the enhancement of education and research capacities in the fields of natural disasters, IoT and data sciences through research activities and PhD co-supervision.	
Presentation of the project team: present the project team, the available expertise and the expertise sought for.	
Proposed local project leader	Dr. NGO Anh Tu, Department of Geography – Resource and Environmental Management (DGREM), Research interest: Geography Information System, Flood Risk and Remote Sensing.
Local project team	Dr. NGUYEN Thi Huyen, Dr. NGUYEN Huu Xuan, MSc. PHAN Thi Le Thuy, DGREM, Research interest: Flood, Climate Change and Sustainability; Dr. HUYNH Nguyen Bao Phuong, Dr. NGUYEN Duc Thien, DOET, Research interest: IoT; Dr. HO Van Lam, Dr. LE Xuan Vinh, DOIT, Research interest: AI and Data Science; Prof. PHAN Thanh Nam, Dr. TRAN Ngoc Nguyen, DOMS, Research interest: Applied Mathematics and Control; Dr. CAO Tan Binh, CEA, Research interest: Statistics MSc. NGUYEN Thi Thuy Dung, DOEA, Research interest: Development Economics.
Overview of available domains of expertise in the project team	The team is composed of academic staff from five departments with a range of expertise. Some team members have conducted applied research in their own fields and have significant experience.
Comments on the expertise sought for at level of the Flemish HEIs	The project needs experts in modern methodologies for data collection, data processing and model building for the early flood warning system at the Flemish HEIs.

7.2. Project 2: Enhancing the performance of the solar-assisted drying system and biogas production by using novel nanomaterials and technical solutions (P2)

Objectives: State the objectives of the project. What do you want to realise through the project (medium-term (5 year) objectives). To what long term objectives will the project contribute (can be both internal and external to the university)

Medium–term objectives: (i) Improving the quality and the added value of the agricultural produce by developing solar-assisted food drying systems and non-toxic protective fruit coatings; (ii) promoting the utilization of biogas by developing high-performance biogas plants to reduce the environmental pollution caused by livestock farming in the areas targeted; and (iii) boosting the research and education capacities in nanomaterials for renewable energy and fruit preservation. **Long-term objectives**: Higher adoption rate among regional farmers of green innovations to improve the durability and profitability of their husbandry and farming activities, thereby improving the living conditions in the rural areas.

Explain the link with the context analysis, the programme objectives and the other projects. Detail the context analysis if needed (e.g. the specific theme, specific challenges of the departments involved, the local/sectoral context, etc.).

At present, agricultural produce in rural and coastal areas are commonly dried by sunlight. Despite its simplicity and low investment cost (directly drying on ground or plastic sheets), this technique requires intense and direct sunlight (problematic during the rainy season) and drying conditions are uncontrollable, causing product quality to vary significantly. In addition, drying largely yielded products during harvesting time is a massive task. Therefore, local farmers would benefit from affordable alternatives that can be used efficiently in different weather conditions. Examples may be found in recent advances in nanotechnology such as thermo-plasmonic nanomaterials, which are currently being investigated by QNU's DOPM. The integration of nanomaterials in conventional drying systems is a promising approach to reduce the workload and control the quality, increasing the economic value of the local agricultural produce.

Biogas production is commonly used to handle animal waste from husbandry activities, as it bypasses negative environmental impacts and produces a renewable source of energy. However, the biogas plants at the selected farms can only produce electricity for basic daily activities. Moreover, the current biogas production process is neither easy to control nor selective. The biogas therefore contains a substantial amount of H_2S, CO_2 and water vapour, which causes fetidity, destroys metallic components and lowers the ignition temperature, preventing farmers from using it for daily activities. Furthermore, there is no effective solution for the post-treatment of the solid and liquid biogas residues. All these obstacles require careful analysis and more research is needed to explore sustainable solutions. The chemical components of the biogas and productivity in the region around Binh Dinh has not yet been studied. Therefore, it is imperative to use a multi-gas detector to investigate the biogas composition and develop nanomaterials and microbes to ameliorate selectivity and productivity. In synergy with Project 4, the integration of nanomaterials into natural biofilms for fruit preservation with the aim of enhancing their mechanical/chemical stability as well as antimicrobial activity will be investigated. Some benign nanomaterials, such as silver or titanium dioxide, are found to have antimicrobial activities. They disintegrate bacteria cell walls rather than experiencing internal cell degradation as natural compounds. These complementary approaches are expected to prolong the fruit preservation time. This project relies on the power of novel nanomaterials along with technological solutions to address current challenges in agriculture, making a major contribution to the programme objectives.

Describe the strategy of the project: how will it reach its objective(s)

To realize the proposed objectives, this project utilizes the following strategies:

1. Baseline investigation of the reality of the proposed issues at Binh Dinh and Gia Lai provinces with the participation of local authorities, selected households and farms (potential end-users) to identify obstacles to existing drying and biogas systems. **For each considered issue, a specific strategy will be applied**:

2. **Solar-assisted food drying systems**: Along with the continuation of thermo-plasmonic materials research, attention will be also invested in looking for other nanomaterials with a high photothermal conversion efficiency, such as oxide semiconductors. To make drying systems viable in less intense and indirect sunlight, they will be

integrated into promising materials (e.g., embedding nanomaterials on plastic sheets or glass greenhouses). To reduce the workload and better control the drying conditions, automatic drying systems integrating nanomaterials will be built.

3. **Biogas utilization**: (i) To control biogas productivity and selectivity, microbes and nanomaterials will be synthesized and developed at lab scale. The former is to moderate anaerobic processes by generating enzymes while the latter is capable of suppressing toxic gases such as Fe_2O_3, TiO_2, degenerated ZnO and 2D quantum dots; (ii) To investigate the controllability and selectivity of developed microbes and synthesized nanomaterials, household biogas systems will be installed as a pilot study in the Nhon Tan High-Tech Oriented Agricultural Experiment Zone (QNU). At the same time, a multi-gas detector will be developed and integrated into this system to investigate the biogas composition. Further tests will be carried out at selected households.

4. **Nanomaterials for fruit preservation**: In synergy with Project 4, benign nanomaterials with antimicrobial activities such as silver, TiO_2 nanoparticles and 2D quantum dots, will be developed at lab scale for fruit preservation. Promising materials will be embedded into biofilms to test the mechanical/chemical stability and antimicrobial activities to prolong the shelf life of durian and avocado.

5. Scaling up the synthesis of the most effective nanomaterials, and sub-culturing microbes toward wide application will be performed in collaboration with chemical companies.

6. To boost the education and research capacities in the relevant fields at QNU and efficiently conduct all proposed research activities, a cross-disciplinary research group will be created based on small existing research groups in Physics, Chemistry, Biology and Engineering, the establishment of a new advanced lab unit in Nanotechnology and Food Technology, and the training of new PhD students.

Analysis of end-users / final beneficiaries: identity the end-users of the project results and describe the uptake strategy of the project (incl. structural barriers for end-users).

Local farmers in Binh Dinh and Gia Lai, the end-users, will have access to the improved solar-assisted drying and biogas production techniques. To encourage local farmers to apply the novel solutions, various exploitation and dissemination activities will be organized in close association with the provincial DARDs, farmers unions, women's unions and relevant companies in Binh Dinh and Gia Lai. This will help overcome local farmers' reluctance to implement new techniques. The **provincial DNREs**, an indirect beneficiary, will benefit from the multi-gas detectors because of better environment management. As final beneficiaries, QNU's academic staff members strengthen their research and education capacities in the fields of renewable energy materials, biochemistry and technical engineering via academic exchange, co-supervision of PhD students with Flemish-based professors and implementation of this research project while the students of the Solid State Physics master programme will benefit from the experienced staff and advanced laboratories.

Presentation of the project team: present the project team, the available expertise and the expertise sought for.

Proposed local project leader	Dr. PHAN Thanh Hai, Department of Physics and Materials Science (DOPM), Research interest: Nanomaterials
Local project team	Prof. NGUYEN Minh Vuong, Dr. LE Thi Ngoc Loan, Dr. HOANG Nhat Hieu, Dr. LE Thi Thao Vien, DOPM, Research interest: Nanomaterials; Dr. TRUONG Thi Hue, DABA, Research interest: Biochemistry; Dr. NGUYEN Duy Thong, DOET, Research interest: Electronics; Dr. DO Van Can, DOET, Research interest: Electric Engineering; Dr. HOANG Thi Hoai Huong, DOEA, Research interest: Agricultural Economics; Dr. NGUYEN Viet Cuong, Head of Environmental Protection Sub-department, Binh Dinh, Department of Natural Resources and Environment (DNRE).
Overview of available domains of expertise in the project team	The multi-disciplinary team has expertise in nanomaterials, electronic technology, biochemistry and economics, and experience in both research and management. Most of them earned their PhD degree at highly ranked universities abroad.
Comments on the expertise sought for at the level of Flemish HEIs	The project is looking for experts in the fields of nanomaterials, biogas processing and preservation/post-harvest technologies.

7.3. Project 3: Improving the safety and quality of avocado and durian crops by managing pre-harvest factors (P3)

Objectives: State the objectives of the project. What do you want to realise through the project (medium-term (5 year) objectives). To what long term objectives will the project contribute (can be both internal and external to the university)

The medium-term objectives of the project are (i) to develop sustainable fruit (avocado or durian) production by means of effective management of pre-harvest factors for local farmers to improve fruit safety and quality; (ii) to strengthen research and education capacities of the QNU's Department of Applied Biology and Agriculture. **In terms of long-term objectives**, the project is expected to increase the economic value of avocado and durian by creating high-quality products and reducing agrichemical inputs.

Explain the link with the context analysis, the programme objectives and the other projects. Detail the context analysis if needed (e.g. the specific theme, specific challenges of the departments involved, the local/sectoral context, etc.).

Durian and avocado are popular tropical and subtropical fruits of high economic importance in Vietnam. These fruits are highly nutritious and rich in energy, vitamins, minerals and antioxidants. However, fruit quality is variable at all points in a supply chain, including pre-harvest, post-harvest and distribution to customers. To obtain and maintain high quality fruit, many aspects need to be taken into consideration. Most importantly, several pre-harvest factors, including cultural regime, environment and biological factors, should be taken into account to ensure high yield and high-quality fruits. Understanding these factors and how they can be controlled can help improve fruit quality and minimize post-harvest losses.

The region of the programme has two of eight fruit production zones in the country in which avocado and durian appear as the main fruits in Gia Lai, Dak Lak, Dak Nong and Khanh Hoa provinces. However, poor fruit quality is one of the main reasons why these staple fruits remain less attractive to the domestic market and struggle to enter world markets. It is reported that the increasing amounts of indiscriminate and excessive inputs of pesticides, chemical fertilizers and plant growth regulators in Vietnam have adverse impacts on fruit quality. The long-term exposure to these chemicals not only has numerous negative health effects on humans but also leads to severe soil degradation in conventional farming systems. Notably, these unsustainable agrochemical-based practices create dramatic alteration of the soil microbiome which is an important player of soil health and crop nutrient availability. Given these problems, sustainable production is necessary to increase fruit quality and safety. By integrating environmental-friendly agricultural practices to improve soil health, tree performance and fruit quality, the project is designed to improve stakeholder's knowledge of sustainable fruit production through the proper implementation of biostimulants and biocontrol agents such as plant growth-promoting rhizobacteria (PGPR)-based products and novel bacterial endophytes. The project will provide new opportunities to better link fruit production access to local and international markets.

This project is closely linked to post-harvest biological treatments to maintain fruit quality (Project 4), and it may add value to supply chain increment (Project 5). It is also connected to Project 1 in determining the relation of regional climate conditions to fruit quality, soil health and plant nutrition management.

Describe the strategy of the project: how will it reach its objective(s)?

To attain the project objectives, the main strategies are defined as follows:

1. To evaluate current fruit farming systems for the targeted areas, a baseline investigation will be conducted mainly on climatic/environmental condition, variety, season, soil condition, irrigation level, pest and pathogen as well as care during growing season and harvest losses/damages. Pathogen will be isolated and identified at each target site in order to develop mitigation strategies.

2. To enhance fruit quality and productivity as well as potential of postharvest quality, field experiments at selected orchards will be conducted by manipulating certain pre-harvest foliar applications. These sprays include various minerals (KNO_3, Na_3BO_3), biostimulants/plant protectors (paclobutrazol, phytomelatonin rich/microalgal extracts, etc.). Important insights into these applications such as endogenous phytohormonal biosynthesis, fruit quality parameters, antioxidant mechanisms and decay incidence will be provided to standardise and/or optimise the appropriate application time, protocol and dose, ensuring the optimal fruit quality and yield.

3. To evaluate soil microbiome diversity, (i) soil samples from the selected fields (either conventional or sustainable farms) will be collected and the microorganisms will be isolated; (ii) the isolate's taxonomical identification based on 16S rRNA and microbial diversity analyses using metagenomics approach will be used.
4. To rank candidate PGPR/endophytes as biostimulants, *in vitro* screening and assessment PGP and antifungal activities will be established and carried out on selected farms and consumer-preferred varieties. Effective PGPR behaviour of selected isolates will be chosen, to subsequently perform greenhouse and field trials. Additional activities, including characterisation of pathways activated upon PGPR inoculation will also be performed in order to identify genetic markers that could be used in future breeding programmes.
5. To increase the sustainability of the selected orchard farms, sustainable practices for other pre-harvest factors will be designed and tested: (i) the optimisation of the correct root stock/scion combinations adaptable to regional climatic conditions and (ii) the standardisation of crop nutrient management.
6. Pre-harvest factors determining fruits ripening behaviours and post-harvest physiology are identified in synergy with Project 4.
7. Assessments of genotypes from germplasm collections will take advantage of implemented bioassays and field trials to assess response to pathogens, biostimulants and fertilisers. Directed somaclonal variation and epigenetic modifications to increase improved traits in varieties currently used by farmers will be implemented.

Analysis of end-users / final beneficiaries: identity the end-users of the project results and describe the uptake strategy of the project (incl. structural barriers for end-users).

Local farmers at various targeted research locations in four provinces in the region will be the **end-users** of this project. This clarification was made through stakeholder analysis (Chapter 4), especially advisory board meetings at the formulation stage (some meetings were held as early as February 2020). **Structural barriers** including policy priorities in technology transfer, agricultural land planned for sustainable production, existing conflicts between the local farmers and provincial DARDs will be assessed for successful uptake of local farmers. Moreover, early adopters will be identified in each management practice to ensure that dissemination activities can be targeted accordingly and effectively in the selected areas, with the direct support of relevant farmers unions (intermediaries). **Dissemination activities** will include: (i) on-site guiding, training and practice by PhD students and the research team; (ii) training/technical workshops for local farmers in targeted areas in close association with provincial DARDs; (iii) a ToT module with a preference for women as trainers; (iv) a strong sustainable crop production hub at QNU to provide extension services to farmers, facilitating more efficient sustainable management practices. **Regional farmers** will be the final beneficiary due to the reduction in use or elimination of agricultural chemicals. Lastly, expertise in crop science, biochemistry, plant physiology, plant pathology, and plant genetics and breeding at **QNU** will be strengthened and new expertise in plant biotechnology will be developed.

Presentation of the project team: present the project team, the available expertise and the expertise sought for.

Proposed local project leader	Dr. HUYNH Thi Thanh Tra, Department of Applied Biology and Agriculture (DABA), Research interest: Plant Pathology and Soil Fertility
Local project team	The project team includes seven academic staff of DABA and a representative of WASI: Prof. VO Minh Thu, Dr. NGUYEN Thanh Liem, Research interest: Plant Physiology, Plant Genetics and Breeding; Dr. TRUONG Thi Hue, Research interest: Biochemistry, Molecular Biology; Dr. BUI Hong Hai, Research interest: Cell Biology, Postharvest Technology; MSc. NGUYEN Thi Y Thanh, Research interest: Plant Protection; MSc. HO Tan and MSc. PHAN Hoai Vy, Research interest: Crop System; Dr. HOANG Manh Cuong, Office Head, WASI.
Overview of available domains of expertise in the project team	The local project team consists of a wide range of expertise on Plant Physiology, Biochemistry, Crop Science, Plant Pathology, Soil Fertility, Post-harvest Technology and Plant Protection.
Comments on the expertise sought for at level of the Flemish HEIs	Expertise of Plant Biotechnology, Crop System and Microbiology is sought from Flemish HEIs.

7.4. Project 4: Research on post-harvest preservation using natural bioactive compounds to improve the value of local fruit (P4)

Objectives: State the objectives of the project. What do you want to realise through the project (medium-term (5 year) objectives).To what long term objectives will the project contribute (can be both internal and external to the university)
Medium-term objectives are (i) to create safer avocado and durian preservation processes by utilizing natural bioactive compounds with or without nanomaterials to prolong their shelf life; (ii) to establish an interdisciplinary sustainable post-harvest technology research group and strengthen educational capacity for the food technology bachelor programme. **The long-term objective** is to increase the local farmers' income and supply more safe local fruits to the national and international markets.
Explain the link with the context analysis, the programme objectives and the other projects. Detail the context analysis if needed (e.g. the specific theme, specific challenges of the departments involved, the local/sectoral context, etc.).
In addition to enhancing quality of avocado and durian through sustainable pre-harvest management, post-harvest quality maintenance of the fruit is also very important to improve the economic value of the fruit. Qualitative losses in avocado and durian are difficult to measure while quantitative losses are susceptible to mismanagement in the post-harvest distribution chain (harvesting, handling, packaging, storage and transportation). Although the maturity of the harvested fruits is an important factor in their shelf life, the local farmers have inadequate knowledge of fruit's physiological maturity and thus have difficulty deciding the optimal picking date. An understanding of the meaning and measurement of maturity is therefore important to post-harvest handling. Various approaches such as cold storage, controlled atmosphere, modified atmosphere packaging and antimicrobial packaging have been used around the world to extend fruit shelf life. However, in this region most fruits are stored in conventional conditions or chemical preservatives of doubtful origin are used, which in turn limits their shelf life or affects their quality and so also public health. Although cold storage technology offers good maintenance for post-harvest preservation, it is not commonly applied by regional farmers due to the high cost, while advances in coating materials in *antimicrobial packaging* have not been effectively exploited. This project aims to use natural products such as chitosan, natural plant extracts, other agricultural residue, and/or nanomaterials for *antimicrobial packaging.* Chitosan, a bioactive polymer obtained from the hard outer skeleton of a shellfish, such as crab, lobster, and shrimp, can prolong the shelf life of fruits due to its antibacterial and antifungal activities. There is a large supply of chitosan in the coastal provinces of the region, such as Binh Dinh, Phu Yen and Khanh Hoa, facilitating its utilization as edible biofilm for fruit preservation. Moreover, many local plants appear to have natural biologically active substances, such as coffee beans containing chlorogenic acid with antimicrobial and antioxidant properties and leaves of the Lamiaceae family containing carvacrol with antibacterial/antifungal properties. Another important group of plant metabolites is essential oils (EOs), many of which have strong antimicrobial activities, including in their vapor phase. The EOs embedded in chitosan can therefore also be applied to the packaging to protect the fruit. Moreover, it has been reported that the incorporation of nanomaterials into chitosan-based food-packaging systems can improve the stability of biofilms and better inhibit the growth of spoilage and pathogenic microorganisms, thereby maintaining fruit quality and extending its shelf life. This project is in synergy with Project 2 to developing safe nanomaterials embedded in biofilms for preservation. By applying green preservation to prolong fruit shelf life, the quality and safety secured by the pre-harvest processes in Project 3 will be maintained. Farmers' income will be increased as post-harvest losses are reduced and the value of fresh produce in the fruit supply chain is added (linked with Project 5).
Describe the strategy of the project: how will it reach its objective(s)?
To achieve the proposed objectives, interdisciplinary research in the fields of food science, chemistry of natural products, and biomolecular/process modelling will be performed. 1. Design versatile tools (surveys, experimental design and modelling) for the assessment of the post-harvest losses of avocado and durian in supply chains.

2. Conduct a post-harvest physiology study for avocado/durian to determine their maturity indices. Also, pathogenic microorganisms abundant on the surface of the local avocado/durian are identified through 16S (bacteria) or internal transcribed spacer (fungi) sequencing and provide insight into fruit spoilage mechanisms.
3. Conduct research on the natural bioactive compounds extracted from local plants and available natural products and evaluate their bactericidal and fungicidal properties using standard growth inhibition assays against the most common fruit pathogens to learn about potential bioactive compounds as additional ingredients for chitosan-based biofilms. Molecular mechanisms of the action of the antimicrobials on the pathogens will be studied by using both modelling and experimental methods.
4. Characterize the gas exchange during fruit respiration when using chitosan-based biofilms with/without embedding potential bioactive compounds.
5. To identify the optimal storage conditions, lab research and process modelling will be designed. Accordingly, the preservation process model will be tested at lab scale and farm scale.
6. In synergy with Project 2, the nanomaterials will be added to the biofilms to improve their performance. Strategies 4 and 5 will therefore be employed. Moreover, the stability of the biofilm embedded with nanomaterials will be investigated and tested.
7. Due to the special morphological characteristics of durian (the dehiscence of durian starts at the stylar end and progresses to the stem end), biofilms will not be effective enough on their own to prolong the shelf life of durian. Use of agricultural residue (sugarcane fibre, coir and rice straw) as a mechanical protection can prevent the durian from dehiscence during their ripening progress, coupled with the coating technique.

Analysis of end-users / final beneficiaries: identity the end-users of the project results and describe the uptake strategy of the project (incl. structural barriers for end-users).

The end-users of this project are **local farmers**, who will use the natural compound-based preservation processes to improve their incomes and living conditions. The **local farmers unions** will be intermediaries for the technology transfer. Other potential users for the new safe fruit preservation methods, such as collectors, wholesalers and retailers, will be involved in the project implementation from the post-harvest loss assessment stage until application is deemed successful. For the effective uptake of the project results, on-site postharvest training and demonstration for local farmers and collectors will be established.

Lastly, expertise in food technology, natural compound chemistry and biomolecular modelling at QNU will be strengthened while new expertise in post-harvest and process modelling will be developed through this project. Accordingly, undergraduate students of the food technology programme will benefit from better education quality.

Presentation of the project team: present the project team, the available expertise and the expertise sought for.

Proposed local project leader	Dr. HOANG Duc An, Vice Director of Applied Research Institute for Science and Technology (ARIST), Department of Chemical Engineering and Food Technology (DOEF), Research interest: Food Technology
Local project team	Dr. LE Duy Thanh, DOEF, Research interest: Food Technology; Dr. NGUYEN Le Tuan, Dr. DIEP Thi Lan Phuong, MSc. VO Thi Thanh Tuyen, DOCH, Research interest: Natural Product Chemistry; Prof. VU Thi Ngan, Prof. NGUYEN Tien Trung, DOCH, Research interest: Computational Chemistry and Modelling.
Overview of available domains of expertise in the project team	The local team includes four available domains of expertise: food technology, natural product chemistry, computational chemistry, and modelling and chemical engineering.
Comments on the expertise sought for at level of the Flemish HEIs	To strengthen the available domains of expertise, we seek for similar expertise from the Flemish HEIs. More importantly, we seek expertise in post-harvest technology and food process modelling to train PhD students and assist us in establishing new expertise in QNU.

7.5. Project 5: Establishing risk assessment and risk management models for the dragon fruit and jujube supply chains (P5)

Objectives: State the objectives of the project. What do you want to realise through the project (medium-term (5 year) objectives). To what long term objectives will the project contribute (can be both internal and external to the university)

The mid-term objectives of this project are (i) to increase the income of the targeted local farmers and the value in the dragon fruit and jujube supply chains by establishing risk assessment and risk management models for these supply chains; and (ii) to strengthen the research capacity of QNU staff in risk assessment and risk management. **The long-term objective** of this project is to improve the supply chain sustainability of dragon fruit, jujube and other fruit in the region through the University's extension services in agricultural risk assessment and risk management.

Explain the link with the context analysis, the programme objectives and the other projects. Detail the context analysis if needed (e.g. the specific theme, specific challenges of the departments involved, the local/sectoral context, etc.).

Fruit production in Vietnam has increased steadily with ever-increasing land use over the years. However, the fruit value chains are not particularly efficient. Farmers must sell their products at prices determined by traders due to their lack of market information and trading strategies. Before reaching consumers, their crops pass through many intermediaries (small retailers, dealers, wholesalers and distributors) due to traditional trade practices. This makes the fruit supply chains in Vietnam longer and more complex than in developed countries, leading to low levels of traceability and stability in terms of the fruit quality and benefit for farmers. Dragon fruit and jujube are tropical agricultural produce suitable for the harsh climate conditions in Ninh Thuan and Binh Thuan and fit into the region's climate adaptation strategy. Dragon fruit is the leading fruit export of Vietnam and is identified as the first among 11 fruits with a competitive advantage in the regional agricultural developmental strategy. Jujube is a high nutritious fruit but has a low economic value for farmers at present, due to consumer scepticism as to its safety. Like most Vietnamese fruits, the major issue in the dragon fruit and jujube supply chains is the frequent imbalance between supply and demand, which leads to unsustainable production and the instability of the local farmers' income. In addition, farmers, the first actor in the supply chain, lack knowledge of quality control as well as responsibility for their agricultural products. To ensure the livelihood of these farmers, they need to be included in a company's supply chain as producers or employees in a sustainable way. This fits in well with the Inclusive Business approach of the United Nations Development Programme. Moreover, improving the quality control of the fruits requires the direct involvement of key supply chain stakeholders in the quality management system. The PGS mechanism, which stands out from other quality assurance systems because of its low cost and reduced administrative burden, follows this approach precisely. For the past 10 years, the PGS mechanism has been implemented in seven provinces and nine districts in Vietnam, involving approximately 840 farmers, with positive results in terms of produce safety, environmental sustainability, community building and higher income for farmers. However, this mechanism has not yet been applied for fruits in Vietnam. PGS is expected to connect all actors in the supply chain and promote their roles in quality control, so that the added value will be shared in more sustainable ways. Taking all things into account, it is highly desirable to establish risk assessment and risk management models for the fruit supply chains based on the Inclusive Business model and PGS mechanism to better control fruit quality and increase the stability of the farmers' income.

This project will be linked to Project 1 by collaborating on analysing regional climate parameters as risk factors in the fruit supply chains. This project team will provide expertise for Projects 3 and 4 to analyse the risks of the pre-harvest and post-harvest practices in avocado and durian supply chains.

Describe the strategy of the project: how will it reach its objective(s)?

To achieve the project objectives, the following strategies will be implemented:

1. To build the risk assessment model of the dragon fruit and jujube supply chains, the following actions will be taken: (i) identifying possible risks by conducting expert interviews/surveys, (ii) ranking the identified risks according to their weighted risk priority number using the fuzzy Analytic Network Process model, and

(iii) analysing the cost and profit shares among actors in the actual supply chain and the relation to their risks by establishing and solving the proposed mathematical models. The risk of the current dragon fruit and jujube supply chains will be characterized and disseminated to the farmers and interested companies.

2. The dragon fruit and jujube supply chains, for which the PGS mechanism is applied and the Inclusive Business model is facilitated, will be proposed. This includes the identification of a business model that is inclusive and potentially leads to the lower risk for farmers and potential companies agreeing to the identified business model and engaging with inclusiveness. To facilitate the inclusive business model, various approaches will be applied, such as classification of fruit quality, increasing traceability and diversification of buyers/sale channels.

3. The proposed supply chains for the fruit will be implemented by connecting selected farms with the identified companies and other actors (Pilot 1), before assessing the risks and analysing the costs and profits distribution among the various actors. Accordingly, risk management models will be proposed for these supply chains, including risk monitoring and mitigation. In particular, Interpretive Structural Modelling will be used to illustrate the correlation between those risk mitigations to create various risk scenarios. The efficiency of the promising scenarios will be tested in the next pilots to optimize the risk assessment and risk management models.

4. In the first five years, the risk assessment and risk management models for the dragon fruit and jujube supply chains will be completed and scaled up in Ninh Thuan and Binh Thuan provinces.

5. This project will be implemented in synergy and complementary with Rikolto Vietnam.

6. In the long run, risk assessment and risk management models for the dragon fruit and jujube supply chains will be optimized for other provinces where the two fruits are cultivated. Furthermore, study will be continued for other agricultural produce in the region.

Analysis of end-users / final beneficiaries: identity the end-users of the project results and describe the uptake strategy of the project (incl. structural barriers for end-users).

Local fruit farmers (end-users): Thanks to inclusive business, the added value of the local fruit supply chains will be increased to augment farmers' income in a sustainable way. **Consumers** (indirect beneficiaries) are benefited by improved accessibility to safe fruit at reasonable prices. There will be dissemination activities (building mobile apps, workshops, orchard tours, etc.) for local communities to improve traceability. **The companies** participating in the inclusive business model will be successful in securing a stable, qualified supply of fruit thanks to their loyalty to local farmers. **Rikolto Vietnam** (indirect beneficiary) will adopt the risk assessment and risk management models for the selected fruits to develop their PGS for the fruit supply chains in Vietnam. The close collaboration with QNU will help it to expand their operation in the South Central Coast and Central Highlands, where Rikolto Vietnam does not yet have a presence. The success of the project will strengthen **QNU**'s research and education capacities in the domains of agribusiness, risk assessment and risk management. This project will create a valuable opportunity for QNU to put research into practice and provide practical guidance for local communities.

Presentation of the project team: present the project team, the available expertise and the expertise sought for.

Proposed local project leader	Dr. TRUONG Thi Thanh Phuong, Department of Economics and Accounting (DOEA), Research interest: Optimization in Economics
Local project team	Dr. BUI Hong Hai, DABA, Research interest: Agriculture; Dr. TRAN Ngoc Nguyen, Dr. NGUYEN Van Thanh, DOMS, Research interest: Applied Mathematics; Dr. CAO Tan Binh, CEA, Research interest: Statistics; Dr. NGUYEN Hoang Phong, MSc. HOANG Thi Bich Ngoc, DFBA, Research interest: Risk Management, Suppy Chain Management; Dr. DAO Quyet Thang, MSc. NGUYEN Thi Thuy Giang, MSc. LE My Kim, MSc. TRAN Le Dieu Linh, DOEA, Research interest: Development Economics.
Overview of available domains of expertise in the project team	The project team has expertise in agricultural economics, supply chain, data analysis, optimization in economics, and tropical cultivation techniques.
Comments on the expertise sought for at level of the Flemish HEIs	To strengthen the available domains of expertise, we seek for similar expertise from the Flemish HEIs. More importantly, they are expected to support the local team risk assessment and risk management for the fruit supply chain.

7.6. Project 6: Improving institutional capacity for the internal service delivery of e-services to students, e-learning and library (P6)

Objectives: State the objectives of the project. What do you want to realise through the project (medium-term (5 year) objectives). To what long term objectives will the project contribute (can be both internal and external to the university)

Mid-term objectives of the project are to (i) implement the modern blended learning environment by enhancing the competencies of QNU's staff members, and (ii) improve the governance and training capacities of the University by upgrading administrative services and modernizing the library.

For the long-term, the project aims to provide high-quality education and to promote lifelong learning propensity for the regional communities, thereby providing higher quality human resources for the region.

Explain the link with the context analysis, the programme objectives and the other projects. Detail the context analysis if needed (e.g. the specific theme, specific challenges of the departments involved, the local/sectoral context, etc.).

Presently, several digitizing administrative services are available to QNU students at a basic level, while other services (academic support services, career services, housing and parking services, etc.) are still operated in traditional ways. These are time-consuming and inconvenient for students.

E-learning has been identified as an essential component for QNU in the context of the fourth industrial revolution, and a vital solution to respond to unanticipated circumstances, such as the ongoing worldwide COVID-19 pandemic. COVID-19 has had severe impacts on the education and training sector in Vietnam, forcing schools to close for months. Online classes have been the most favourable proposed adaptation measure. Although QNU has made ceaseless efforts to deliver online courses to short-course students, the lack of an online learning management system, the limited number of lecturers trained in online teaching, the lack of digital learning materials and infrastructure challenges have prevented QNU from implementing online learning for campus students. In fact, training activities at QNU were suspended for five weeks during the pandemic, affecting school year schedules and resulting in graduation being postponed. This makes the establishment of an e-learning system and e-library at QNU more urgent than ever.

Based on an understanding that the library is crucial for teaching, learning and research, QNU leaders are paying much attention to upgrading the library. However, changes have not met the demand of the staff and students due to the limited resources. In detail, although an annual grant (about 16,000 USD per year) is spent to update materials, most resources are printed versions, with few digital resources. The library does not have a digital repository, and it is mostly managed manually using an antiquated system (since the 2000s). Besides, the investment in a new library management system is still at an early stage, and the organization of the library space currently does not meet the diverse needs of users. As a result, the library attracts few students (less than 30 students per day borrow books) and has not assisted much in training, learning and researching activities.

Taking these issues into account, it is highly desirable to implement modern blended learning and upgrade administrative services and the library. The implementation of this project is expected to pave the way for enhanced education and research capacities at QNU, which in turn provides high quality human resources for the region.

This project is closely linked to other projects, serving to support the operation and dissemination of the programme. When the e-learning system is accomplished, other projects can take advantage to offer online learning/training and online consulting services. For example, this project will collaborate with Project 7, creating courses related to waste segregation and lab safety.

Describe the strategy of the project: how will it reach its objective(s)?

To achieve the objectives of the project, three strategies are indicated:

1. To modernize student services, two systems will be installed. The first is an email system that can serve more than 14,000 students. The second is an e-services platform, providing the essential student services of the Student Affairs Office and Centre for Student Support and Business Relations. In order to do that, the operation of

these two offices must be investigated and standardized. Gradual updates, optimization and integration of more services will be conducted to complement these systems and ensure they run smoothly. 2. To create and put an e-learning system into operation, a series of activities are proposed. First, investigating and releasing regulations and policies will facilitate the participation of lecturers and students in online teaching and learning activities. Technical infrastructure for an e-learning system will also be built. Furthermore, the QNU Learning Lab will be established, providing short training courses for online learning/teaching and assisting QNU's online learning sector. At the initial stage, the QNU Learning Lab will build an e-learning system with limited interactivity and a small number of soft skills and general knowledge courses. Later, this system will be upgraded to operate at a complex interactivity level and provide a larger number of courses, including major ones. 3. Upgrading the library will focus on four main issues: (i) building the digital repository (ii) upgrading the management technology, (iii) investing in a library management system and (iv) ameliorating the learning environment. The two first issues will be carried out within the framework of the IUC programme, while the others will be co-funded by QNU and the IUC Programme. In detail, to possess a digital repository, it is necessary to digitize existing materials. In addition, we need to upgrade the library management system (software and hardware), and gradually use RFID technology in library management. The new library management system will enable QNU's library to cooperate with other university libraries and to support communities through collaboration and sharing with public libraries. Simultaneously, the library space will be reorganized to serve most diverse purposes, including a reading space, team rooms and multimedia areas.	
Analysis of end-users / final beneficiaries: identify the end-users of the project results and describe the uptake strategy of the project (incl. structural barriers for end-users).	
This institutional project will bring numerous benefits for **QNU students and staff**. The implementation of online student administrative services and the e-learning system will reduce processing time and improve working and studying efficiency. Moreover, the modernization of the library will allow them to have access to more updated materials, facilitate e-learning and enhance research activities. The project results contribute to the modernization of QNU's management and governance. It may take time and effort to run the installed systems smoothly. Furthermore, the internet infrastructure has still not met the e-learning requirements for the majority of students from rural areas, significantly hindering their online learning opportunities. These structural barriers will be taken into account during the project implementation.	
Presentation of the project team: present the project team, the available expertise and the expertise sought for.	
Proposed local project leader	Dr. NGUYEN Thanh Binh, Deputy Head of Department of Information Technology (DOIT), Research interest: Web of Data and Computer Science.
Local project team	Dr. NGUYEN Thanh Dat, Director of Centre of Information Technology Communication; Dr. HO Van Phi, Head of Political Student Affair Office; MSc. LE Thanh Hai, Head of Library; MSc. NGUYEN Khac Khanh, Director of Centre Student Services and Business Relationship; MSc. TRAN Dinh Luyen, DOIT; MSc. TRAN Hoang Viet, Technician of Administration Office; MSc. NGUYEN Thi Hoang My, Administrative staff, Research Affairs and International Relations Office.
Overview of available domains of expertise in the project team	The local project team has experience in developing, deploying and managing ICT systems of QN. The team includes heads/directors of the involved offices/centre, who facilitate the effective implementation and operation of the developed systems.
Comments on the expertise sought for at level of the Flemish HEIs	The project is looking for experts in building and deploying e-learning, library and institutional ITC system.

7.7. Project 7: Establishing a sustainable institutional waste management system at Quy Nhon University (P7)

Objectives: State the objectives of the project. What do you want to realise through the project (medium-term (5 year) objectives). To what long term objectives will the project contribute (can be both internal and external to the university)
The medium-term objectives of the proposed project are two-fold (i) to improve laboratory safety and waste management at QNU with the introduction of good laboratory practices (GLP), good waste management practices (WMP) and the upgrade of safety equipment and facilities and (ii) to inspire local communities with the sustainable institutional waste management system (IWMS). **The long-term objective of this project is** to stimulate more local organizations and communities working on sustainable waste management and proper waste classification, reduce, reuse and recycling.
Explain the link with the context analysis, the programme objectives and the other projects. Detail the context analysis if needed (e.g. the specific theme, specific challenges of the departments involved, the local/sectoral context, etc.).
As mentioned in Chapter 2, the proposed project has strong links with the local context and the programme objectives. With around 15,000 people, QNU generates around 5 m^3 per day of solid waste, besides wastewater and air pollutants, from educational and research activities, and office operations, especially activities in the laboratories and dormitories. However, the current IWMS has not been able to handle this daily amount because it mainly depends on the local provincial waste management system, which does not run in accordance with good practices. Solid waste from QNU is collected and transported to landfill by an external agency (Quy Nhon Urban Environment Joint Stock Company). The toxic liquids from the laboratories are collected and put into bins/containers before being sent to the treatment company. It is worth noting that the abovementioned measures are not effective and have many shortcomings since waste is not classified at source, causing the following serious environmental issues: (i) waste of resources, because many waste components such as paper, plastic bottles, metals and organic waste could be classified for recycling and reuse, (ii) environmental pollution since common waste contains hazardous compounds and will likely cause many metabolic processes and dangerous reactions, generating odours and toxic gases, and (iii) waste of land and water resources, as this requires a large area of land to bury waste. Moreover, poor lab services, in terms of chemical and waste categorization and safety control, lead to unnecessary expenditure and negative environmental impacts. Additionally, there is a lack of safety and security training courses for students and staff members, and general rules for QNU students and staff are not properly followed in their responses to waste management. Therefore, it is urgent to work on waste management and labs services to make QNU a clean and safe place to work and study. Through waste management, awareness of QNU students and staff will be raised to keep the surrounding environment clean and green. It is noted that QNU students come from different places in the region. Hence, the establishment and smooth operation of the sustainable IWMS is expected to effectively inspire and expand to neighbouring areas through the students. Moreover, the project will create a good environment for research activities of Projects 2, 3 and 4 in the wet laboratories.
Describe the strategy of the project: how will it reach its objective(s)?
To achieve the objectives of the proposed project, the following strategies will be employed: 1. Conduct baseline investigations (survey, focus group and interview) to identify the waste disposal behaviour of QNU staff and students, and their needs/willingness to implement GLP and good WMP at the early stage. 2. Upgrade safety equipment and utilities to handle hazardous waste better and improve the laboratory safety such as installation of fume hoods, glove boxes and emergency washing equipment. Particularly, the WSS will be established with labelled bins and containers distributed throughout the campus for different types of waste throughout QNU. 3. Organize training sessions on GLP and WMP for QNU staff and students to raise their awareness of the negative impacts of improper laboratory practices and bad waste management.

4. Set up a central unit for Safety and Waste Management which is responsible for the IWMS and laboratory security, creating safe and green learning and working spaces.
5. Establish proper institutional regulations for working in offices and laboratories through online tests and strictly controlling the waste disposal throughout QNU.
6. To minimize the waste released to the environment, (i) sign a MOU/MOA with Quy Nhon Urban Environment Joint Stock Company authorized by the Quy Nhon People's Committee in waste management and waste treatment; (ii) work with treatment companies, such as Tetra Park Vietnam JC Co. and Green Recycling Company Limited, which are working on recycling of various types of domestic solid waste.
8. Build an on-site organic waste treatment system to produce organic fertilizers, reducing the amount of organic solid waste.
9. Conduct performance analyses to identify why it might be difficult for QNU staff and students to implement GLP and good WMP during the project lifetime.
10. As a long-term objective, dissemination campaigns on the sustainable IWMS and benefits of GLP and good WMP are designed and implemented. Moreover, a ToT module on the implementation of good WMP will be organized for the local communities.

Analysis of end-users / final beneficiaries: identity the end-users of the project results and describe the uptake strategy of the project (incl. structural barriers for end-users).

End-users / final beneficiaries: (i) QNU students and staff members are direct beneficiaries of the project results since they will be benefited by working and studying in a safe and green environment, especially those working in laboratories, and by the implementation of GLP, and (ii) local residents and organizations, who will apply the sustainable waste management system that was created by QNU, are the final beneficiaries of the project results. **The uptake strategy of the project:** (i) Disseminate the project's results to raise the environmental awareness of local residents and (ii) share the experience of the implementation of WSS, WMP and GLP with the society and local universities through the networks with QNU alumni, companies and local authorities. It may take a lot of time and effort to convince the public of the necessity of implementing WSS, WMP and GLP. However, the fee for waste collection will be based on the amount of waste rather than the average per household or capita as mentioned in the amended Law in Environmental Protection (just approved by the Vietnamese government in November 2020 and applicable starting June 2021), will promote people to classify and reduce waste generated at source.

Presentation of the project team: present the project team, the available expertise and the expertise sought for.

Proposed local project leader	Dr. NGUYEN Van Thang, Vice Head of Research Affairs and International Relations Office, Research Interest: Chemistry and Materials Science.
Local project team	Dr. NGUYEN Le Tuan, Dean of Faculty of Natural Sciences; MSc. NGUYEN Ngoc Anh, Vice Head of Administration Office; Dr. NGUYEN Tan Lam, MSc. TRAN Thi Thu Hien, DOEF, Research interest: Environmental Chemistry; MSc. NGUYEN Thi Tuong Vi, DERM, Research interst: Environment Management; MSc. NGUYEN Thi Phuong Hien, BSc. BUI Thanh Trang, Technicians in laboratories.
Overview of available domains of expertise in the project team	The proposed project team includes managers, academic staff and technicians who are all needed to successfully implement this institutional project. Particularly, managers are responsible for making decisions and consulting to craft policies for higher management and governance. Furthermore, the project team has staff members who have experience in waste and laboratory management.
Comments on the expertise sought for at level of the Flemish HEIs	The project needs experts at the Flemish HEIs to (i) share their successful experience in the implementation of WSS, WMP and GLP; (ii) offer intensive training courses on safety and laboratory practice to QNU staff members and students; (iii) provide consultancy in the lab organization for GLP; and (iv) support design treatment models for organic waste and wastewater in a sustainable manner.

8. Budget indications

Total annual budget[1] applied for during Phase 1 IUC Cooperation: 600,000 EUR

Indicative project budget repartition[2]:

Title of project	Type[3]	Indicative % of project budget
Project 1: Developing an early flood warning system to improve the adaptive capability of the local authorities and community in the context of climate change	Academic theme-based project	16.7%
Project 2: Enhancing the performance of the solar-assisted drying system and biogas production by using novel nanomaterials and technical solutions	Academic theme-based project	15.8%
Project 3: Improving the safety and quality of avocado and durian crops by managing pre-harvest factors	Academic theme-based project	15.0%
Project 4: Research on post-harvest preservation using natural bioactive compounds to improve the value of local fruit	Academic theme-based project	15.8%
Project 5: Establishing risk assessment and risk management models for the dragon fruit and jujube supply chains	Academic theme-based project	15.0%
Project 6: Improving institutional capacity for the internal service delivery of e-services to students, e-learning and library	Transversal institutional strengthening project	11.7%
Project 7: Establishing a sustainable institutional waste management system at Quy Nhon University	Transversal institutional strengthening project	10.0%
Total		**100%**

[1] See budget section in the call document. Annual IUC budget in Phase 1 is a fixed amount.
[2] A part of the programme budget will be needed for the PSU. In this section we only want to see the relative weight of the different projects.
[3] 2 types of projects: academic theme-based projects or Transversal Institutional Strengthening Projects (TISP)

DOCUMENTS TO BE SUBMITTED

Annex 2: CVs potential project leaders	*The format is included and to be followed, except if indications are included that own data formats can be added*