GreenCityLabHuế

Status quo report

Nature-based solutions in the city of Hue

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Contents

List of figures

List of tables

List of acronyms and abbreviations

ACVN	Association of Cities in Vietnam
ADB	Asian Development Bank
Bac Trung Nam Ldt.	Bac Trung Nam Company for Consultant and Investment Construction
Bee Association	Beekeppers Association of Thua Thien Hue
BMBF	German Federal Ministry of Education and Research
CCCO Binh Dinh	Binh Dinh Province's Climate Change Coordination Office
CODES	Centre for Community Development and Social Work
DOC	Institute for Construction Planning, Thua Thien Hue Department of Construction
DONRE	Environmental Protection Agency, Thua Thien Hue Department of Natural Resources and Environment
Eurasia Foundation VN	Eurasia Foundation and Association - for the development of special education in Viet-Nam
F. of Architecture	Faculty of Architecture, Hue University of Sciences, Hue University
F. of Environment	Department of Environment, Hue University of Sciences, Hue University
F. of Environmental S.	Environmental Resource Management, Faculty of Environmental Science, Hue University of Sciences, Hue University
F. of Forestry	Faculty of Forestry, University of Agriculture and Forestry, Hue University
F. of Forestry/CCCSC	Centre for Climate Change Study in Central Vietnam, University of Agriculture and Forestry, Hue University
F. of Geography	Faculty of Geography, Hue University of Pedagogy
F. of Public Health	Environmental and Occupational Health, Faculty of Public Health, Hue University of Medicine and Pharmacy

Farmer Association Kim Long Ward	Farmer Association in Kim Long Ward
GBI	Green-blue infrastructure
HEPCO	Hue Urban Environment and Public Works Joint Stock Company
HMCC	Hue Museum of Royal Antiquities, Hue Monuments Conservation Centre
HUB	Humboldt-Universität zu Berlin
HueIDS	Hue Institute for Development Studies
HUSC	Faculty of Architecture of University of Sciences, Hue University
IPCC	Intergovernmental Panel on Climate Change
IREN	Environmental Management and Climate Change, Institute of Resources and Environment, Hue University
MISR	Mientrung Institute for Scientific Research
NBS	Nature-based solutions
NDVI	Normalised Difference Vegetation Index
NGO	Non-Governmental Organisation
SDG	Sustainable Development Goals
TITC	Tourism Information Technology Centre
UfU	Independent Institute for Environmental Issues
UNESCO	United Nations Educational Scientific and Cultural Organisation
WWF	World Wide Fund

Summary

Urban areas are both drivers of global warming and especially affected by its impacts. That is why the enhancement and expansion of urban green and blue infrastructures (GBI), i.e., elements of nature-based solutions (NBS), gain importance in strategic urban planning as measures of adaptation. Additionally, access to GBI is strongly related to issues of quality of life, environmental justice, human health and well-being. The GreenCityLabHuế project aims to create a multi-disciplinary research and experimentation space for the discussion, development, and evaluation of concepts for the (re-)creation of GBI elements in the city of Hue, Central Vietnam.

Hue is one of the oldest urban areas in Vietnam. The city encompasses an area of about 71 km² and is one of the most densely populated Vietnamese cities with 5,076 person/km². With about 12.9 m²/person, the green space per capita is comparatively high in Hue. However, green (and blue) spaces are not equally distributed across the city – with access to green areas being particularly limited in the historical centre of the city – giving rise to the implementation of new GBI elements. This need has also been recognised in the context of urban expansion, as Hue experiences trends of repopulation and urban growth that result in high demand for living space and thus in the construction of new suburban residential areas. Policies indicate that these newly developed areas shall have higher green space ratios compared to the core city, to improve the overall proportion of green spaces in the city of Hue.

Based on co-creation and co-learning, the GreenCityLabHuế project suggests a typology of 64 GBI elements for consideration in Hue, including amongst others different types of private, commercial and institutional GBI elements, allotments and community gardens, recreational parks and gardens, and agricultural GBI. Whilst most of these key elements are common in both (Central) Vietnam and Germany (and in Europe), some types were identified that are unique to the city of Hue, including blue-green gardens, garden cafes, and garden houses. This typology, in combination with an analysis of the relevant policy framework and a review of former, recent and proposed projects for the implementation of NBS in Hue will serve as the basis for the modelling of land-use change scenarios for the city, and for the evaluation of the benefits of enhancing GBI across Hue.

Alongside the implementation of new green (and blue) areas, the necessity to preserve, maintain and improve existing elements of GBI has also been recognised. This includes, e.g., the maintenance of street tree density through annual tree planting campaigns, as particularly matured trees are under pressure due to climate change. A preliminary assessment of climate change impacts indicates generally warmer future conditions and an increasing total precipitation; the city of Hue will likely face low to moderate increases in near-surface air temperature (both annual averaged and extreme), and a moderate to high increase in precipitation. These estimated impacts will likely exacerbate existing environmental challenges in Hue including flooding and heat stress. Other

pressing environmental issues, especially in the denser core city and university area, is air and noise pollution.

The enhancement of Hue's GBI shall address the aforementioned environmental challenges by improving the provisioning of ecosystem services and by increasing the city's resilience towards extreme weather events and climate change. However, also the economic and societal benefits of GBI are targeted, including the positioning of Hue as (eco-)tourism destination, the creation of job opportunities, establishment of competitive advantages over other Vietnamese cities, the improvement of quality of life through the creation of public spaces, and the increase of public awareness towards the benefits of green and blue elements as NBS.

Tóm tắt

Khu vực đô thị không chỉ đóng góp trực tiếp vào tình trạng ấm lên toàn cầu đang diễn ra hàng ngày mà còn chịu tác động đặc biệt mạnh mẽ từ tình trạng đó. Điều này lí giải tạo sao việc cải thiện và mở rộng các công trình, cơ sở hạ tầng xanh trong đô thị (GBI – green blue infrastructure), như các yếu tố của các giải pháp dựa vào tự nhiên (NBS – nature-based solutions), có vai trò quan trọng trong quy hoạch đô thị chiến lược như là những biện pháp của việc thích ứng. Thêm vào đó, GBI liên quan mật thiết đến các vấn đề về chất lượng cuộc sống, sự công bằng trong môi trường, sức khỏe và hạnh phúc con người. Mục tiêu của dự án GreenCityLabHuế nhằm tạo nên một không gian nghiên cứu, thử nghiệm đa ngành phục vụ cho quá trình thảo luận, phát triển và đánh giá những chủ đề phù hợp cho việc tạo nên các loại hình GBI phù hợp cho thành phố Huế, Việt Nam.

Huế là một trong những khu vực đô thị cổ nhất ở Việt Nam. Thành phố bao quanh bởi một diện tích khoảng 71 km² và là một trong những thành phố có mật độ cao nhất Việt Nam với 5,076 người/km². Với khoảng 12.9 m²/người, không gian xanh trên đầu người là tương đối cao ở Huế. Tuy vậy, diện tích những không gian xanh này trên thực tế không được phân bố đồng đều trên phạm vi toàn thành phố - đặc biệt là sự hạn chế các không gian xanh tại các khu vực lịch sử trong thành phố - đặt ra sự cần thiết cho việc hình thành những loại hình GBI mới. Sự cần thiết này càng rõ ràng hơn trong bối cảnh sự mở rộng ngày càng nhanh của đô thị vì Huế đang trải qua xu hướng tái cơ cấu dân số và phát triển đô thị dẫn đến nhu cầu ngày càng cao về không gian sống, từ đó hình thành các khu vực dân cư mới ở những vùng phụ cân xung quanh thành phố. Bên cạnh đó, những chính sách cũng cho thấy rằng những khu vực phát triển mới cần có tỉ lệ không gian xanh cao hơn so với khu vực trung tâm nhằm tăng tỉ lệ không gian xanh chung trên toàn thành phố Huế.

Dựa trên quá trình đồng sáng tạo và đồng nghiên cứu, dự án GreenCityLabHuế đề xuất một điển hình gồm 64 loại hình GBI cần xem xét trong phạm vi thành phố Huế, bao gồm những loại khác của các loại hình GBI tư nhân, thương mại và thiết chế, giao khoán và vườn cộng đồng, vườn và công viên giải trí, GBI trong nông nghiệp. Trong khi phần lớn các loại hình chính phổ biến tại Việt Nam (khu vực miền Trung) và tại Đức (kể cả châu Âu) thì một số loại hình khác mang tính đặc thù, riêng biệt chỉ có ở thành phố Huế, trong đó có thể kể đến những khu vườn kết hợp giữa cây xanh và mặt nước, café vườn và nhà vườn. Loại hình này cùng với việc phân tích các khung chính sách liên quan, xem xét những dự án đã được thực hiện trước đây, những dự án hiện tại và đã được đề xuất nhằm thực hiện NBS tại thành phố Huế sẽ là cơ sở cho việc mô hình hóa các kịch bản thay đổi sử dụng đất cho thành phố và đánh giá những lợi ích của việc cải thiện GBI trên toàn thành phố.

Bên cạnh việc hình thành mới những khu vực xanh, việc bảo tồn, duy trì và cải thiện các loại hình GBI sẵn có là cần thiết. Việc này bao gồm duy trì mật độ cây xanh thông qua các chiến dịch trồng cây hằng năm, đặc biệt đối với những cây lâu năm dưới tác động của biến đổi khí hậu. Một đánh giá sơ bộ những tác động của biến đổi khí hậu cho thấy bối cảnh chung về điều kiện khí hậu trong tương lai sẽ ấm hơn và sự gia tăng về tổng lượng mưa; thành phố Huế có khả năng sẽ đối mặt với

sự gia tăng nhiệt độ ở lớp không khí gần mặt đất từ thấp đến trung bình (kể cả nhiệt độ trung bình năm và đỉnh nhiệt) và lượng mưa sẽ tăng từ mức trung bình đến cao. Những đánh giá ước tính này đưa ra cảnh báo về việc những thách thức về môi trường của thành phố Huế có khả năng sẽ trầm trọng hơn bao gồm cả tình trạng ngập lụt và gánh nặng nhiệt. Đặc biệt, tại khu vực trung tâm thành phố và những cụm trường đại học, những vấn đề môi trường khác được nhấn mạnh có liên quan nhiều hơn về ô nhiễm không khí và tiếng ồn.

Cải thiện GBI của thành phố Huế có thể góp phần giải quyết những thách thức về môi trường đã được nhắc đến trước đây thông qua nâng cấp việc cung cấp các dịch vụ sinh thái và tăng cường khả năng chống chịu của thành phố trước những hiện tượng thời tiết cực đoan và biến đổi khí hậu. Tuy nhiên, các lợi ích về kinh tế và xã hội của GBI cũng được xác định rõ ràng, trong đó, Huế sẽ trở thành điểm đến du lịch (sinh thái), tạo thêm nhiều cơ hội việc làm, hình thành các lợi thế cạnh tranh so với những thành phố ở những vùng miền khác, nâng cao chất lượng cuộc sống thông qua việc xây dựng mới các không gian công cộng và nâng cao nhận thức của cộng đồng hướng đến những lợi ích của các yếu tố xanh NBS.

Zusammenfassung

Städte zählen einerseits zu den wesentlichen Treibern des globalen Klimawandels, andererseits sind diese besonders durch diesen gefährdet. Aus diesem Grund wächst die Bedeutung urbaner grün-blauer Infrastrukturen (GBI) in der strategischen Planung städtischer Räume, da sie als Bestandteile naturbasierter Lösungen (NBS) wichtige Elemente der Klimawandelfolgenanpassung darstellen. GBI sind darüber hinaus stark mit der Aufenthaltsqualität, der Umweltgerechtigkeit, der Gesundheit und dem menschlichen Wohlbefinden in Städten verbunden. Das Projekt GreenCityLabHué zielt auf die Schaffung eines multidisziplinären Forschungs- und Experimentierraumes zur Diskussion, Evaluation und Umsetzung von Konzepten zur Schaffung solcher GBI-Elemente in der Stadt Hue, Vietnam.

Die Kernstadt von Hue umfasst eine Fläche von ca. 71 km², sie gehört zu den ältesten und am dichtesten besiedelten Städten Vietnams mit 5.076 Einwohner/km². Im Vergleich mit anderen vietnamesischen Städten ist der Grünanteil mit ca. 12,9 m²/Einwohner vergleichsweise hoch, die räumliche Verteilung von Grünflächen (wie auch von blauen Infrastrukturelementen) ist jedoch sehr ungleichmäßig. Insbesondere im historischen Zentrum ist der Zugang zu urbanem Grün stark limitiert – die ungleiche Verteilung von Grün im Stadtgebiet erfordert daher die Schaffung zusätzlicher Grünanlagen. Diese Notwendigkeit wird auch im Kontext der urbanen Expansion erkannt: Die Stadt Hue ist durch ein anhaltendes Bevölkerungswachstum gekennzeichnet. In der Folge ist eine hohe Wohnraum-Nachfrage zu verzeichnen, woraus die Ausweisung neuer Wohnbaugebiete im suburbanen Raum resultierte. Zur Erhöhung des Grünanteils bezogen auf die Gesamtstadt zielen Entwicklungsleitlinien auf die Erhöhung des Grünanteils in diesen neu errichteten Stadtteilen im Vergleich zur Kernstadt.

Zur Berücksichtigung bei der Implementierung neuer Grünflächen schlägt das Projekt GreenCityLabHué eine auf Co-Creation und Co-Learning aufbauende Typologie von 64 GBI-Elementen vor. Diese schließen verschiedene Typen von privaten, kommerziellen oder institutionellen Grüns, Kleingärten, Gemeinschaftsgrünanlagen, Erholungsparks und -gärten, und landwirtschaftliche GBI ein. Die erfassten Elemente umfassen dabei gemeinsame, sowohl für (Zentral-)Vietnam als auch für Deutschland (bzw. Europa) typische GBI-Elemente, wie auch für Hue einzigartige Infrastrukturen. Zu letzteren zählen beispielsweise grün-blaue Gärten, Cafés mit Gartenflair, und die für Hue traditionellen Gartenhäuser. Im weiteren Projekt dient die entwickelte Typologie in Kombination mit einer Analyse relevanter Planungs- und Entwicklungsleitlinien sowie der Sichtung vorausgegangener, aktueller und zukünftiger Projekte zur Implementierung von NBS als Grundlage für die Umsetzung von Landnutzungsänderungsszenarien und für die Evaluation der Nutzen-Effekte, welche durch die Verbesserung der GBI in der Stadt Hue entstehen.

Neben der Schaffung neuer bzw. zusätzlicher GBI wird darüber hinaus auch der Schutz und die Verbesserung bestehender GBI als wichtiger Beitrag anerkannt. Dies umfasst beispielsweise die

Aufrechterhaltung der Straßenbaumanzahl bzw. -dichte durch jährliche Baumpflanzungskampagnen, da insbesondere alte Straßenbäume durch die Folgen des Klimawandels gefährdet sind. Erste Klimawandelfolgenabschätzungen deuten darauf hin, dass generell wärmere Bedingungen und eine Erhöhung der jährlichen Niederschlagssumme zu erwarten sind. Für die Stadt Hue wird eine niedrige bis moderate Zunahme der bodennahen Lufttemperatur (sowohl bezogen auf das Jahresmittel wie auch auf die Extremtemperaturen) sowie eine moderate bis vergleichsweise hohe Zunahme der Jahresniederschläge prognostiziert. Bereits heute signifikante Naturgefahren – Hochwasser und Hitzestress – werden daher durch den Klimawandel höchstwahrscheinlich verstärkt. Luftverschmutzung und Lärmbelastung stellen weitere Umweltherausforderungen dar, vor allem im dichten Zentrum der Kernstadt und dem Universitätsgelände.

Die Erweiterung der GBI in Hue adressiert die zuvor genannten Umweltprobleme durch eine optimierte Bereitstellung von Ökosystemdienstleistungen und der Erhöhung der urbanen Resilienz gegenüber Extremwetterereignissen und Klimawandel. Darüber hinaus werden auch die ökonomischen und sozialen Vorteile der GBI als NBS anvisiert, welche unter anderem die Positionierung der Stadt Hue als (öko-)touristische Destination, die Schaffung von Beschäftigungsmöglichkeiten, die Etablierung eines kompetitiven Vorteils gegenüber anderen vietnamesischen Städten, die Verbesserung der Lebensqualität durch Schaffung öffentlicher Räume und die Förderung der öffentlichen Wahrnehmung von grün-blauen Infrastrukturen umfassen.

1 Introduction

Global warming and urbanisation are closely interconnected. Cities are both drivers of global warming and especially affected by its impacts. The need for climate mitigation and adaptation as well as building resilience is therefore becoming essential for urban policy. In this context, NBS in urban and regional planning are gaining increasing importance. NBS refer to the sustainable management and use of nature for tackling environmental and societal challenges such as climate change, the urban heat island effect and air pollution, while at the same time providing multiple benefits and human well-being (European Commission 2015, Cohen-Shacham et al. 2016). They include the enhancement and expansion of GBI. According to the European Commission green infrastructure or GBI can be defined as “a strategically planned network of high quality natural and semi-natural areas with other environmental features, which is designed and managed to deliver a wide range of ecosystem services and protect biodiversity in both rural and urban settings” (European Commission 2013: 7). GBI planning also helps to reduce dependence on 'grey' (built) infrastructure that is often more expensive to build and maintain. It is therefore a smart investment for cities, especially in developing countries.

Taking this into account, the project GreenCityLabHuế aims to create a multi-level, multi-disciplinary space for research and experimentation to develop, visualise, evaluate and discuss ideas and concepts for the (re-)creation and expansion of GBI in the city of Hue, Central Vietnam. In cooperation with the Vietnamese project partners and stakeholders from science, administration, politics, and civil society, and under consideration of existing urban development plans, the project consortium develops shared expertise, common concepts and a database to facilitate the coordinated, strategic development of a network of (semi-)natural areas across the city of Hue. Integrating GBI and thus NBS into Hue’s city planning may help to protect various ecosystem services, thereby increasing the social and ecological resilience of the city of Hue and its surrounding region, e.g., regarding climate change impacts. During the definition phase, the project explicitly aims at: (i) acquiring and providing information on existing and potential GBI, (ii) developing land use scenarios based on narratives and visions of stakeholders, (iii) supporting participatory processes, capacity-building, co-learning and co-creation, (iv) inspiring other Vietnamese cities to improve climate resilience, and (v) providing the basis for the subsequent research and development project.

For many years, interventions have been applied in Vietnam which are inspired by nature and the functions of ecosystems to tackle environmental and societal challenges, even if these measures have not been directly described as NBS. Although NBS are not new in Vietnam, the methodology behind this approach appears to be novel for local actors (CCCO Binh Dinh). Moreover, Vietnamese officials understand actions for the protection, sustainable management, and restoration of ecosystems as part of the package of measures to implement strategies for green growth or sustainable development in order to reduce CO_2 emissions and thus implement the Paris Agreement. They do not perceive these measures as NBS (Prime Minster 2016). In summary, there

are differences between Vietnamese and European terminology and methodology of NBS, but the underlying interventions or measures are similar. In comparison, the common understanding of green infrastructure or GBI is similar in Vietnam and Europe. Both definitions emphasis that GBI consists of a planned network of green and blue spaces to protect biodiversity and provide multiple ecosystem services and associated benefits (European Commission 2013, Vinh and Huong 2017). But compared to Europe, there is currently no specific policy focusing exclusively on GBI in Vietnam (e.g. EU Strategy on Green Infrastructure, European Parliament resolution on green infrastructure from December 12, 2013). However, the term GBI or its functions have been incorporated into national policies such as the National Green Growth Strategy from September 25, 2012 or the Sustainable Development Strategy from April 12, 2012.

With the following report on the status quo and the future development of GBI in the city of Hue, the first project objective has been achieved. Besides providing detailed information on existing and potential green and blue spaces in the city of Hue, including their allocation within the urban area, and their benefits for the region, the report contains a brief description of the co-created typology on GBI elements, so-called case study typology, a description of the policy framework and main stakeholders and decision-makers for GBI planning and urban development in the city of Hue as well as user preferences addressing urban green areas, climate change and inclusion. Thus, the report forms an important basis for the achievement of the other project objectives set. Information used in compiling the report has been obtained from the analysis of grey literature (e.g. planning documents, reports from the Asian Development Bank), 21 stakeholder interviews conducted in October 2019, the analysis of the status quo using available geodata, including a GIS data classification, and a field survey conducted by the HUSC to identify representative GBI elements in the city of Hue.

2 Methodical approach

The report on the status quo of NBS in Hue comprises data collected through five methods: semi-structured expert interviews, assessment of climate change trends, field survey, analysis of geodata, and literature review. Following a multidisciplinary approach, the analysis of the data is based on various disciplines such as natural sciences, namely geography and urban ecology, and social sciences, namely environmental policy and environmental planning.

Semi-structured expert interviews

A great amount of information stemmed from a series of 21 semi-structured expert interviews with 23 experts carried out during field research in Hue in October 2019. The interviewees represent relevant stakeholders of NBS and GBI in Hue, covering the sectors academia (8 interviews), public sector (6 interviews), civil society (3 interviews), and others (3 interviews). The appendix contains an extensive list of the interview partners including the abbreviations used to indicate the source of the respective institution (Appendix I). The selection of the experts for the interviews was mainly based on recommendations and contacts of the MISR as well as snowball system with recommendations from the already interviewed experts. In selecting the interviewees, care was taken to cover all relevant sectors and to have a gender balance. The interview length averaged one to one and a half hours. The interviews were recorded, transcribed, and assessed by means of qualitative data analysis. Overall, it can be stated, that the qualitative expert interviews provided profound insights into NBS in the city of Hue. However, interviews involve the difficulty of potential selection bias.

Assessment of climate change trends

Current and future climatic conditions were modelled using WorldClim data (Hijmans et al. 2005). A set of three bioclimatic variables will initially be considered in this status quo analysis: (i) the annual average temperature; (ii) the maximum temperature of the warmest month of the year; and (iii) the total annual precipitation. Particularly the latter is considered to highlight changes in extreme heat conditions. Whilst it is not suitable to derive changes in the frequency and intensity of heat spells, it is nonetheless considered as proxy indicator for particularly pronounced changes in heat, and associated risks.

Current climatic conditions are based on long-term measurements for the period 1960 to 1990. Future conditions are derived from averaging six downscaled global climate models from the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment, including (i) Beijing Climate Centre Climate System Model Version 1.1 (BCC-CSM 1.1; cf. Wu et al. 2013, Xin et al. 2013); (ii) Community Climate System Model Version 4 (CCSM4; cf. Gent et al. 2011); (iii) CNRM-CM5 (Voldoire et al. 2013); (iv) Goddard Institute for Space Studies General Circulation Model (GISS-E2-R; cf. Schmidt et al. 2014); (v) HadGEM2-ES (Collins et al. 2008); (vi) Model for Interdisciplinary Research on Climate (MIROC5; cf. Watanabe et al. 2010). For each of the aforementioned variables, two sets of estimates were processed: (a) predictions for the year 2050 as the average for the period

2041 to 2060, and for the year 2070 as the average for the period 2061 to 2080; and (b) for each year, two representative concentration pathways were considered: RCP2.6 as a best-case scenario with peaking CO_2 emissions in 2020s and considerable decline thereafter, resulting in a limited mean average warming of about 1°C until 2070 at global scale, and RCP8.5 as a worst-case scenario that corresponds to a failure in climate change mitigation action, resulting in a global average warming of about 3.7°C until 2070. This status quo report considers these two RCPs to derive likely extremes of expected climate change impact, that consequently also contain more likely trends.

Development of a case study typology

The case study typology (see supplementary document) was developed in a co-creation and co-learning process, including feedback loops, between the Vietnamese partner HUSC and the German partner HUB. Two important documents on GBI, “A typology of urban green spaces, ecosystem services provisioning services and demands” by Cvejić et al. (2015) and “Reflections about blue ecosystem services in cities” by Haase (2015), form the basis for the typology and were complemented by few additional elements. All GBI elements were listed in a table and supplemented by a short description of the element as well as exemplary picture. Next, the Vietnamese partner was asked (i) to indicate elements that are also considered as GBI in the city of Hue, and illustrate them exemplary with images, (ii) to add elements that are considered as GBI in the city of Hue but are not listed, and (iii) to indicate opposing definitions of terms if applicable. Based on their experiences and the consultation with local architects and urban planners, the partner identified relevant, irrelevant and Hue-specific GBI elements. Subsequently, HUB reviewed the entries and made some minor adjustments to them (e.g. combing similar GBI examples in one category). In a further feedback loop, the case study typology was then completed.

Analysis of the status quo

For the analysis of the status quo, different data sources were employed to analyse NBS in the city of Hue. The inventory of GBI (Figure 12) is based on land use data for 2014 provided by DONRE and data derived from OpenStreetMap. OpenStreetMap data were used for the subsequent digitalisation of water bodies within the citadel of the city of Hue, green spaces and water bodies in the Imperial City of Hue and larger water bodies south/southeast of the Huong river. For better clarity, the 36 different classes of the original land use dataset were grouped into 10 (Figure 12) or rather 16 (Figure 14) classes. In addition, the Vietnamese partner HUSC has conducted a field survey to identify and locate representative examples of GBI elements described in the case study typology. The results of the field survey were digitalised in ArcGIS in the form of points. Furthermore, the normalised difference vegetation index (NDVI) was calculated based on the PlanetScope image (20th February 2020). The NDVI belongs to a group of vegetation indices and is used, among other things, to assess vegetation condition and cover and thus canopy greenness (Glenn et al. 2008). Following, a first vegetation classification based on the NDVI was carried out. The threshold for the classification was set at 0.15, i.e. pixels with an NDVI value greater 0.15 were classified as vegetation.

Literature review

Further sources of information were derived through the analysis of grey literature including documents like relevant handbooks, public documents, and laws.

3 Information on the city of Hue

3.1 Basic information

The city of Hue is located in the Thua Thien Hue province in central Vietnam. It is the centre of economy, culture and politics of the Thua Thien Hue province.

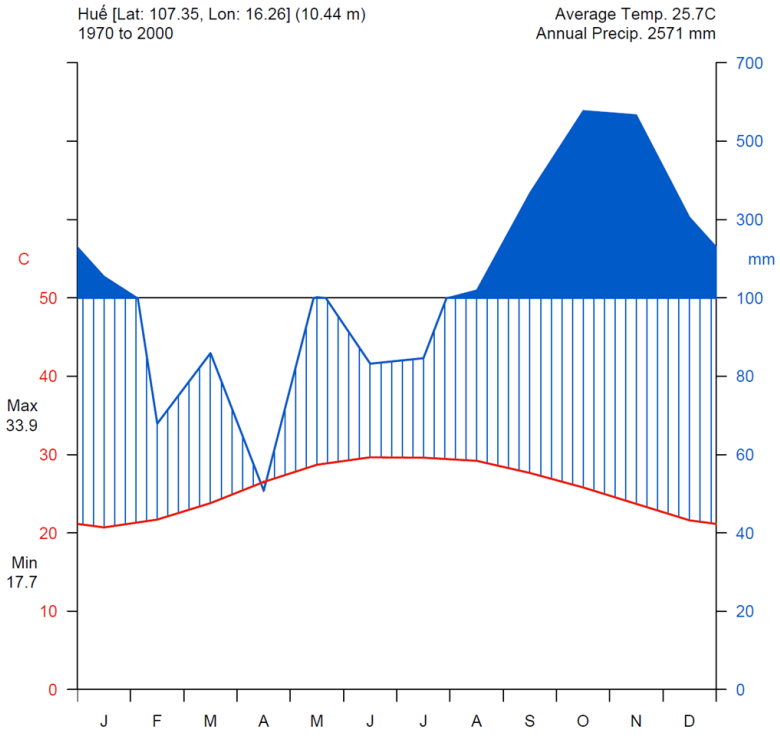
Figure 1. Location of the Thua Thien Hue Province in Vietnam and administrative boundaries of the Thua Thien Hue Province (Nguyen 2017a modified).

Thua Thien Hue province has a province-controlled city (Hue City), two towns (Huong Thuy and Huong Tra) and six districts (Phong Dien, Quang Dien, Phu Vang, Phu Loc, A Luoi and Nam Dong) with 105 communes and 47 urban districts (Figure 1). The Thua Thien Hue province has a population of 1,154,310, with 563,404 people living in urban areas and 590,906 people living in rural areas. Hue City has the total area of 70.67 km² with 27 urban districts, which occupies 1.41 % of the natural area of the province (Portal of Thua Thien Hue Province 2020a).

The city of Hue is located on a narrow plain with a slope from the west to east. The terrain comprises of low eroded hills on deeply weathered sedimentary rocks to the west of the city and depositional plains in the north and east. The historical centre of the city and its surroundings is built on flood plain. The area in the north of the Huong River shows an elevation of 1.8 m to 3.5 m. The elevation in the area south of the Huong River ranges from 2.5 m to flat hills up to 18 m. Areas below

two meters are subject to frequent flooding. Situated 100 km south of the city of Hue is the Hai Van pass, a mountain range marking the meteorological divide between the north and south of Vietnam (HCCWG and Tran 2014).

Thus, Hue City is located in the transitional climate zone, featuring characteristics of a tropical humid monsoon climate. In summer months the average temperature is 29°C to 30°C, with extreme temperature peaks of 38°C to 41°C during June and July. The dry season is from May to September with dry air from southwest winds. In the winter months average temperature ranges between 20°C and 23°C. The rainy season from October to April is influenced by northeast monsoons, causing considerable rainfall (HCCWG and Tran 2014; Fick and Hijmans 2017).



Month	T_{avg}	min T_{avg}	max T_{avg}	P_{avg}
Jan	20.7	17.7	23.7	155.4
Feb	21.7	18.5	24.9	67.9
Mar	23.8	20.3	27.3	85.9
Apr	26.5	22.6	30.4	50.8
May	28.7	24.4	33.0	103.3
Jun	29.7	25.4	33.9	83.2
Jul	29.6	25.4	33.8	84.6
Aug	29.2	25.0	33.4	120.0
Sep	27.7	23.9	31.4	368.6
Oct	25.8	22.7	28.9	578.2
Nov	23.7	20.8	26.6	567.5
Dec	21.5	18.9	24.3	305.9

Figure 2. Walter-Lieth climate diagram for Hue, Thua Thien-Hue, Vietnam for the period 1970 to 2000 using WorldClim data (Fick and Hijmans 2017).

Precipitation rates of Hue City are amongst the highest in Vietnam. Therefore, Thua Thien-Hue province is considered to be the most prone to flooding in Vietnam. Precipitation distribution is unequal across the months and is mainly concentrated in the rainy season, especially during October and November with over 30 % of annual precipitation (Figure 2). The city of Hue also has fairly high humidity with an average annual level of 85 % to 86 %. (HCCWG and Tran 2014).

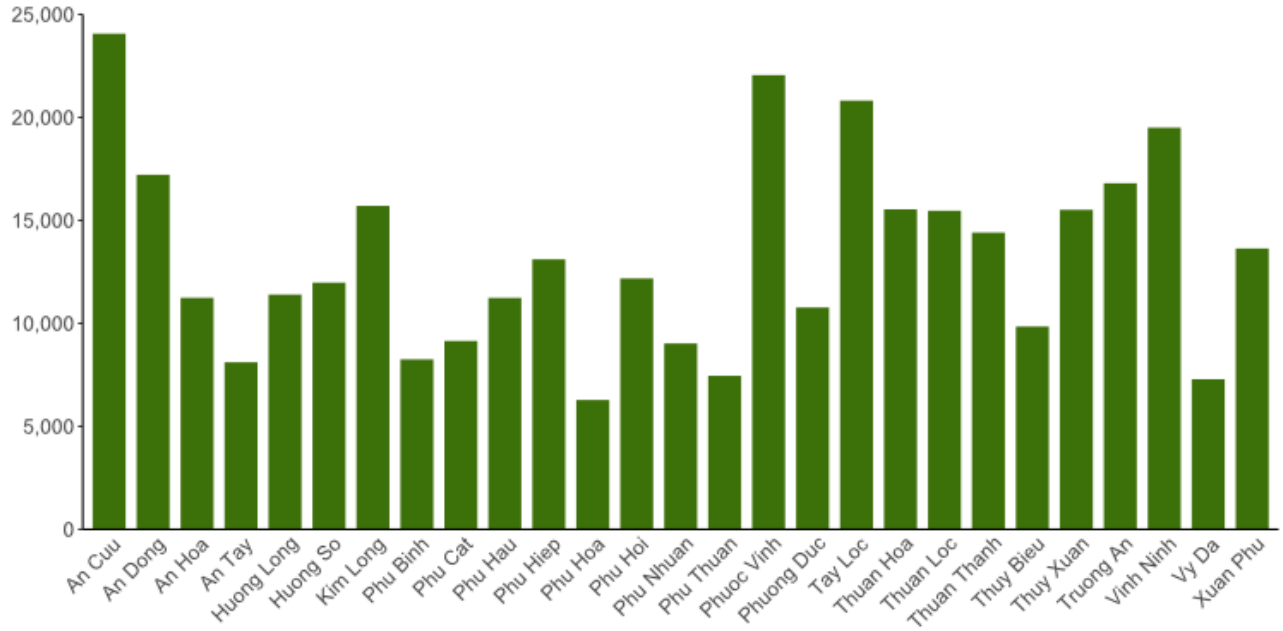


Figure 3. Population in wards of Hue City (Thua Thien Hue Province's Statistical Agency 2019).

Hue City has become one of the most densely populated cities in Vietnam with approximately 5,076 person/km². The population density per ward is shown in Figure 4. Due to the family planning policy, the annual average population growth rate of the city has been remained at 0.87 % in 2018, which is lower than the national average. The Citadel with 520 hectares is also an inhabited area within Hue City, home of more than 66,000 people (Thua Thien Hue Province's Statistical Agency 2019).

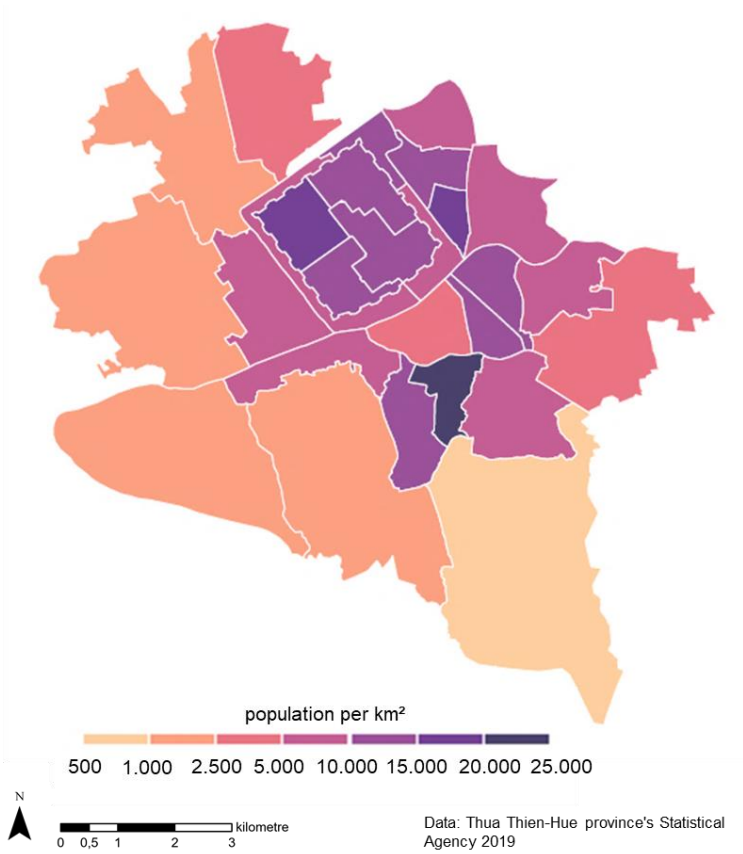


Figure 4. Population density for the different wards of the city of Hue in 2018 (Thua Thien Hue Province's Statistical Agency 2019).

The city of Hue is one of the main educational centres across Vietnam. Hue University, among 14 national key universities, consists of eight universities and four departments. Moreover, Hue City has other private universities, colleges, academies, and specialised institutions such as Phu Xuan University, Hue College of Education, Hue Academy of Music, Hue Industrial College. With about 45,000 full-time students enrolled in Hue University, a tenth of the population is made up of young people (Hue University 2020). Hue City is one of the three main health care centres in

Vietnam, along with Hanoi and Ho Chi Minh City. It has several large general hospitals such as Hue Central Hospital and Hue University Hospital.

Being the former capital of Vietnam from 1802 to 1945 under the Nguyen Dynasty, Hue City is regarded as the national centre of culture, religion and education. The city has been inherited the cultural values and the magnificent buildings of the Imperial City and other monuments which were collectively recognised as World Cultural Heritage by the United Nations Educational Scientific and Cultural Organisation (UNESCO) since 1993. These sites are: the Hue Citadel (in 1993), the Hue Imperial Music (in 2003), the Nguyen Dynasty woodblocks (in 2010), the Nguyen Dynasty imprints (in 2014), and the Poetry on Hue Imperial Architecture (in 2016).

In the period of 2017 to 2018, the agriculture, forestry, and fishery sector accounted for 11.37 %; while the service sector kept creating more job positions and increasing revenue with 49.33 % than the industrial sector with 30.86 %; and product tax accounted for 8.45 %. Tourism, captured in hospitality and services, has been growing at a rapid pace in Hue City. The city hosted 4.8 million tourists in 2019. About 60 % of this revenue was from hotel room rentals, and another 20 % from food service. 15 % of the annual Vietnam tourists visit Hue and the average length of a stay is two days. Over the last ten years tourism shows an 11 % average annual growth rate (Office of People’s Council and People’s Committee 2020).

The revenue from tourism has been making the major contribution to the economic base of Hue for years. Total tourism receipts in 2019 is expected to reach 4,700 to 4,900 billion VND. The region is in a slow transition to a services-based economy with the service sector being the main consistent growth engine for the local economy. To ensure this trend the project "Development of smart urban services in Hue to 2020, vision 2025" in which tourism is a top priority was issued by the People's Committee of Thua Thien Hue province (TITC 2019).

In the period of 2016 to 2020, the annual poverty rate in Hue City continued the slow downward trend with 1.9 % in 2018, which is remarkably lower than the rate of Thua Thien Hue province (4.22 %). Even though the poverty rate in Hue City is relatively low in general, there are numerous wards experiencing poverty namely An Hoa, An Tay, Huong Long, Huong So, Phu Binh, Phu Hau, Phu Hiep, Thuan Loc, Thuy Bieu, Thuy Xuan and Vy Da. The factors of the high poverty rate are mainly due to the low-lying suburban area with precarious conditions and the increase of unemployment after resettling to new accommodations during recent years (Portal of Thua Thien Hue Province 2020b).

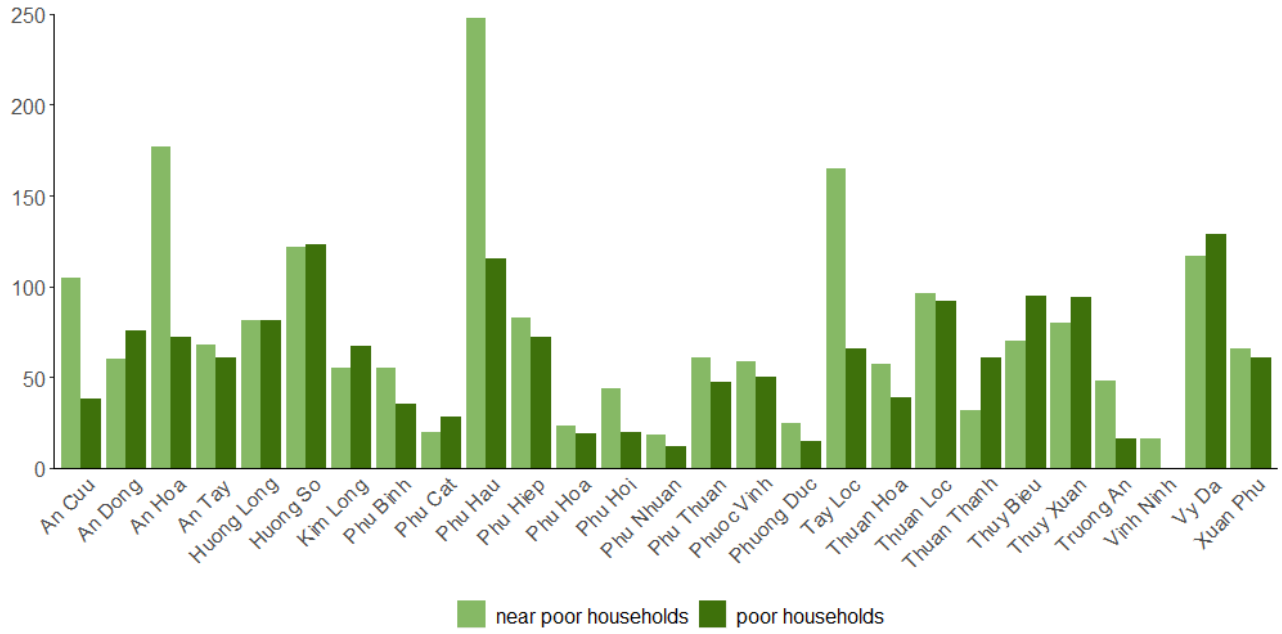


Figure 5. Poor and near poor households in the different wards of the city of Hue in 2018 (Thua Thien Hue Province's Statistical Agency 2019).

3.2 Hue's urban development

Hue is one of the oldest urban areas in Vietnam. In 1636, Hue became the main city of the Inner Realm (South Vietnam) of Nguyen Lords, then the capital city of the Tay Son dynasty (1788-1801) and the Nguyen dynasty (1802-1885), where the central government system of the South dynasty and the Central American Embassy was established in the French colonial period (1885-1945) (Nguyen 2009).

In the nineteenth century, the urban area of Hue was associated with the Hue capital of the Nguyen Dynasty including the centre of Hue Citadel and the surrounding area. Hue in the Nguyen Dynasty was influenced by political factors, without proper administrative and urban management. In 1885, when Hue was conquered by the French. The decision of Governors-General of French Indochina on August 30, 1899 established a specific urban administrative space by creating Hue City. From 1899 to 1921, the suburban areas of Hue were constantly under the impact of urbanisation through the merging of areas into Hue. After three mergers in 1903, 1908 and 1921, Hue City consisted of nine wards. On December 12, 1929, Governors-General of French Indochina decreed to turn Hue City into a Class III city. On November 23, 1934, Emperor Bao Dai issued 41st decree to turn Hue City into a separate administrative area. Since 1935, the lines of division between wards, villages or parts of villages in the city have been abolished. The whole city was divided into eleven wards, located in three adjacent geographical areas (Nguyen 2009).

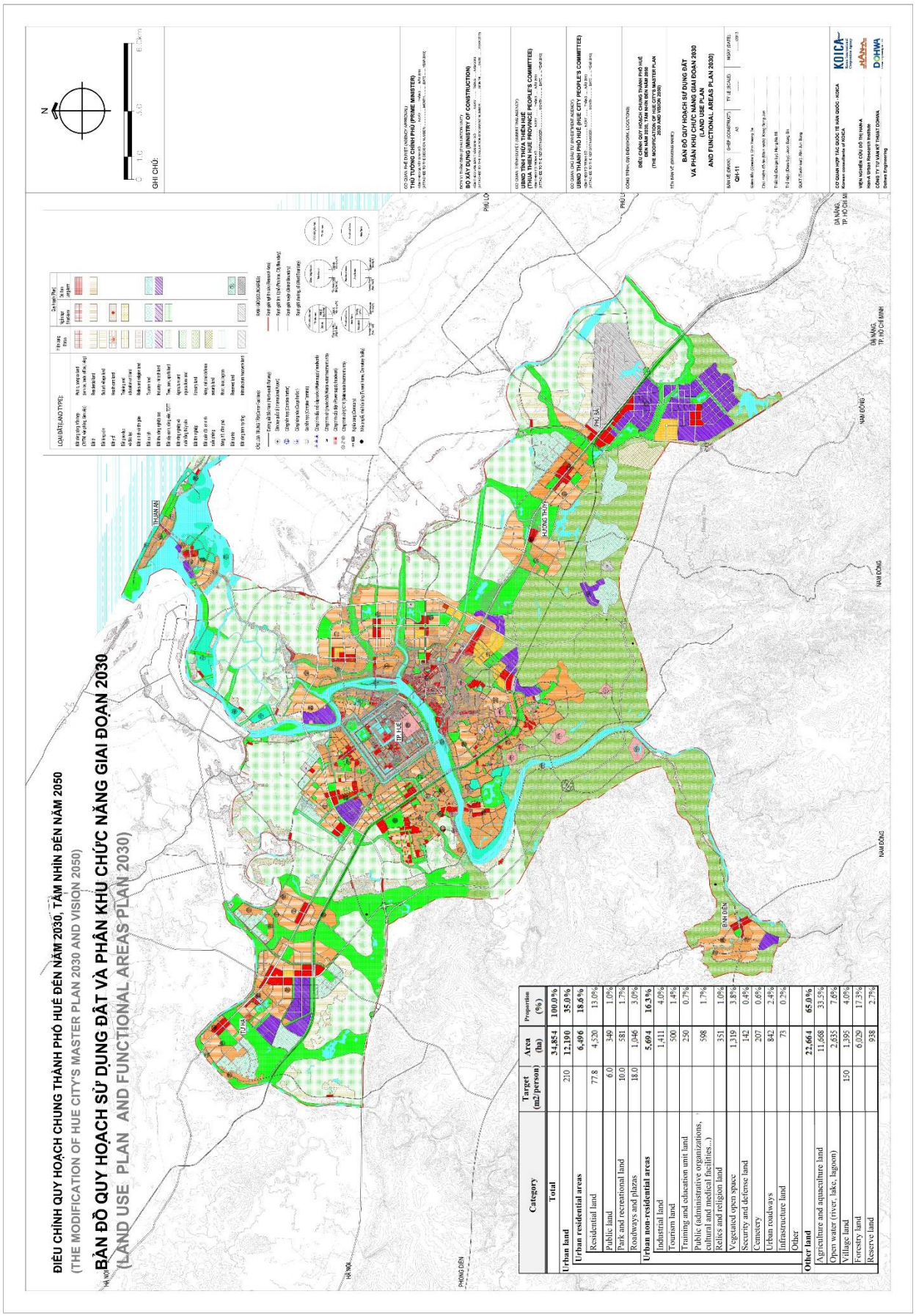
After the August Revolution in 1945, Decree 77 dated December 21, 1945 of the President of the Provisional Government of Vietnam stipulated Hue as a city with an expanded administrative boundary. In March 1947, after re-occupying Hue City, French colonialists reorganised Hue City into 21 wards and ten sampans. After the Geneva Agreement, in the spirit of the Decree No. 57A dated

October 24, 1956 of the Government of the Republic of Vietnam, Hue was an administrative unit of the same level with Thua Thien Province, including 22 wards and eleven sampans on the established administrative boundary (Nguyen 2009).

In 1975, Hue became the provincial city of Thua Thien province. Since the establishment of Binh Tri Thien province from merging the provinces of Thua Thien, Quang Tri, Quang Binh and Vinh Linh area in May 1976, Hue became a Class II city. The continuous process of merging the suburban areas with Hue City at this time lead to many changes in administrative boundaries. On April 14, 1989, the Politburo issued Decision No. 87 QD/TW and followed by the Resolution of the VIII National Assembly, the fifth session, June 30,1989, divided Binh Tri Thien province into three provinces, namely Thua Thien Hue, Quang Tri and Quang Binh. Implementing that policy, on September 29, 1990 Council of Ministers issued Decision No. 345-HDBT to adjust the administrative boundaries in the province and Hue City. Accordingly, eight communes of Hue City moved to Huong Phu town, nine communes moved to Huong Thuy town. Therefore, most of the communes merged with Hue City in 1981 were separated back to their old towns. After adjusting the boundary, Hue City had 18 wards and five communes with a total area of 6,777.2 hectares and a population of 259,838 people (Nguyen 2009).

By November 22, 1995, having two wards divided into four new wards, Hue City had 25 administrative units including 20 wards and five communes. On March 27, 2007, the Prime Minister signed Decree 44/ND-CP adjusting the administrative boundaries of Huong So and Thuy An communes to establish four new wards, namely An Hoa, Huong So and An Dong. An Tay. Up to then, Hue City had 27 administrative units including 24 wards and three communes (Nguyen 2009). On March 25, 2010, the Government issued a Resolution to establish three new wards on the basis of three former communes namely Huong Long, Thuy Xuan and Thuy Bieu, thereby raising the number of wards of the city to 27 as today. Thus, the total area of Hue City is 70.99 km² with a population of 358,754 people (2018) in 27 wards: An Cuu, An Hoa, An Dong, An Tay, Huong So, Kim Long, Phu Binh, Phu Cat, Phu Hau, Phu Hiep, Phu Hoa, Phu Hoi, Phu Nhuan, Phu Thuan, Phuoc Vinh, Phuong Duc, Tay Loc, Thuan Hoa, Thuan Loc, Thuan Thanh, Truong An, Vinh Ninh, Vy Da, Xuan Phu, Huong Long, Thuy Xuan and Thuy Bieu.

On August 24, 2005, the Government of Vietnam issued Decision No. 209/QD-TTG, in which Hue City was upgraded from a Class II to a Class I urban area belonging to Thua Thien Hue province, instead of being directly under the Central Government. On August 30, 2007, the Prime Minister issued Decision No. 143/QD-TTg approving the scheme to develop Hue into a Festival City.



Category	Target (m2/person)	Area (ha)	Proportion (%)
Total		**34,854**	**100.0%**
Urban land	210	**12,190**	**35.0%**
Urban residential areas		**6,496**	**18.6%**
Residential land	77.8	4,530	13.0%
Public land	6.0	340	1.0%
Park and recreational land	10.0	581	1.7%
Roadways and plazas	18.0	1,046	3.0%
Urban non-residential areas		**5,694**	**16.3%**
Industrial land		1,411	4.0%
Tourism land		500	1.4%
Training and education unit land		250	0.7%
Public (administrative organizations, cultural and medical facilities...)		598	1.7%
Relics and religion land		351	1.0%
Vegetated open space		1,319	3.8%
Security and defense land		142	0.4%
Cemetery		207	0.6%
Urban roadways		842	2.4%
Infrastructure land		73	0.2%
Other			
Other land		**22,664**	**65.0%**
Agriculture and aquaculture land		11,668	33.5%
Open water (river, lake, lagoon)		2,435	7.6%
Village land	150	1,395	4.0%
Forestry land		6,029	17.3%
Reserve land		938	2.7%

Figure 6. Land use plan and functional areas plan 2030 according to Hue City's masterplan (KOICA 2014).

On May 6, 2014, the Government issued Decision No. 649/QD-TTg and thereby approved the adjustment of the general planning of Hue City towards 2030 and with a vision to 2050. The new and growing urban area of Hue City will have an area of approximately 348.54 km² as shown in Figure 6. The boundaries of Hue City are as follows:

- Eastern boundary: to Thuan An coast,
- Western boundary: to Binh Dien,
- Northern boundary: to Bo River – Tu Ha Ward,
- Southern boundary: to Hue bypass road

In recent years, a new urban area has been expanded on the west side of the city by Dan Nam Giao along national highway 49. By 2030, Hue strives to become one of Southeast Asia's major and unique centres for culture, tourism and health and one of the largest national centres for science and technology as well as for multidisciplinary and high-quality education offering a high quality of life. With a vision to 2045, Hue City is to become a festival city and a special cultural, educational, tourism and medical centre of Asia. Being recognised as a heritage city will create more favourable conditions for Hue City to be on a par with the current national centres. This will also be the foundation to attract investment to develop infrastructure and to preserve the heritages of Hue City.

3.3 Urban form

3.3.1 Grey infrastructure

Hue City experiences a trend of rural repopulation and urbanisation (HMCC). There is therefore a strong demand for living space in the city. Contrary to the traditional garden houses a trend towards building smaller and higher houses can be observed (DOC). No high buildings can be found in the northern part of the city. The economic centre is located in the southern part of Hue City (F. of Forestry/CCCSC). Due to the high demand in living space available properties are rare (Farmer Association Kim Long Ward, anonymous). Hence, informal houses and buildings can be found in the city (F. of Environmental S./ Bac Trung Nam Ldt., F. of Geography). Violations are punished with a fine. However, this is rarely the case due to weak controls and an overall lack of transparency about constructions (CODES, Bac Trung Nam Ldt.). Leadership of the provincial government started with programmes and strategies to tackle the issue (DONRE).

The current types of land use and their proportions are listed in Table 1. Complementing data on soil sealing in Hue City is not available.

Table 1. Development in land use in Hue City from 2015 to 2019 (Thua Thien Hue Provincial People's Committee 2016, Thua Thien Hue Provincial People's Committee 2019).

No	Purpose of land use	2015	2019	
		Area (ha)	Area (ha)	Share (%)
1	**Agricultural land**	**2,410.59**	**2,144.47**	**30.34**
1.1	Rice cultivation	996.89	836.79	39.02
1.2	Other annual crops	328.03	281.80	13.14
1.3	Perennial crops	741.71	706.72	32.96
1.4	Special use forest	331.08	292.37	13.63
1.5	Production forest	3.08	3.08	0.14
1.6	Aquaculture	11.88	11.04	0.51
1.7	Other agricultural land	7.53	12.67	0.59
2	**Non-agricultural land**	**4,486.05**	**4,773.07**	**67.54**
2.1	National defense	52.86	50.44	1.06
2.2	Security	14.27	22.76	0.48
2.3	Industrial cluster	25.59	29.59	0.62
2.4	Commercial services	77.34	104.07	2.18
2.5	Production facilities for non-agricultural products	41.33	59.80	1.25
2.6	Mineral extraction	-	1.47	0.03
2.7	Land for infrastructure development at national, provincial, district and commune levels	1,079.27	1,162.31	24.35
2.7.1	*Cultural facilities*	*49.63*	*58.58*	*5.04*
2.7.2	*Medical facilities*	*22.17*	*27.28*	*2.35*
2.7.3	*Educational facilities*	*191.67*	*211.04*	*18.16*
2.7.4	*Sports and recreation facilities*	*33.78*	*33.75*	*2.90*
2.7.5	*Science and technology facilities*	*0.54*	*3.76*	*0.32*
2.7.6	*Social service facilities*	*4.41*	*4.41*	*0.38*
2.7.7	*Transportation*	*704.73*	*726.88*	*62.54*
2.7.8	*Irrigation land*	*55.52*	*71.89*	*6.19*
2.7.9	*Energy facilities*	*10.75*	*11.48*	*0.99*
2.7.10	*Land for telecommunications construction*	*2.44*	*2.42*	*0.21*
2.7.11	*Market*	*9.86*	*10.81*	*0.93*
2.8	Historic and cultural monument	251.35	259.14	5.43
2.9	Urban residential	1,452.08	1,584.27	33.19
2.10	Administrative offices	26.17	32.83	0.69
2.11	Non-commercial offices	4.53	5.02	0.11
2.12	Religious facilities	110.16	114.85	2.41
2.13	Cemeteries, graveyards, funeral homes and cremation sites	627.13	613.36	12.85
2.14	Production of materials for construction and ceramics	13.06	6.78	0.14
2.15	Civic and community gathering	1.69	2.58	0.05
2.16	Public recreation and entertainment	68.83	104.32	2.19
2.17	Spiritual facilities	82.37	79.17	1.66
2.18	Rivers, canals, channels, streams and lakes	520.51	508.96	10.66
2.19	Special use water area	37.33	31.20	0.65
2.20	Other non-agricultural land	0.17	0.17	0.00
3	**Undeveloped land**	**170.74**	**149.77**	**2.12**
Total		**7,067.31**	**7,067.31**	**100.00**

The city does not have a separate drainage system for rainwater, domestic wastewater and industrial wastewater. Even though 92.6 % households have flush toilets, the urban sewerage network covers only 35 % to 40 % of the urbanised area of Hue City and only about 30 % of the population (80 % standard set for a Class I city). The Citadel has a higher connection rate (56 %). Untreated wastewater is being discharged into water bodies throughout the city especially into the Kim Long, Bach Yen, Ngu Ha, An Cuu and Huong rivers before entering the sea. Also, high organic wastewater from slaughterhouses and vegetable markets is discharged without prior treatment. As a result, ecosystems are polluted and degraded, especially the water source of the Huong River. (HCCWG and Tran 2014, ADB 2015).

The street density in 2020 is predicted to be 3.0 to 3.5 km/km² which corresponds to a 1.5-fold increase over 2009 (HCCWG and Tran 2014). Nevertheless, the city's design and transport system does not match the current demand of the actual population (Bac Trung Nam Ldt.). Moving around in the city is difficult since there is no bicycle path and the pedestrian area is not well prepared and maintained. Even though the parking space is also limited due to a lack of space (F. of Architecture), the citizens prefer private transportation. As a result, the public transport system in Hue is quite weak. Only 18 buses are in operation and the ratio of people riding buses every day is 0.025 passengers per inhabitant. Electric shuttle buses have been introduced within the Citadel. These transport mostly tourists from the Nguyen Hoang bus stop to the entrance to the Imperial City and are operated by a private company (ADB 2015).

The dense city centre and university area are burdened with air pollution due to emissions of high traffic volume of motorbikes and cooking during the rush hours (F. of Architecture, F. of Geography). This is the same for the main roads like the National Highway 1A, 49 and the bypass road. Another factor for urban air quality are industrial emissions such as those from the local cement factory (ADB 2015).

3.3.2 Green infrastructure

Hue City attempts to comply with the national regulations regarding the quantity of public green spaces. In 2012, the green infrastructure of the city of Hue consisted of 58 parks and four tree nurseries with the total of 108,812 ha and more than 65,000 trees along the city' streets and the residential areas (Tran et al. 2013). As the greenest city in comparison with other cities in Vietnam, the density of public green spaces per person (12.9 m²/person) (Nguyen 2019) has been much greater than the standard for a city of Class I to II (10-12 m²/person according to the National Standard TCVN 9257:2012[1]).

Due to the rapid urbanisation and population growth, the ratio of green space has been declined significantly in contrast to grey infrastructure. The change of types of green space and their spatial

[1] Greenery planning for public utilities in urban areas - Design standards. Available via https://vanbanphapluat.co/tcvn-9257-2012-quy-hoach-cay-xanh-su-dung-cong-cong-tieu-chuan-thiet-ke.

distribution in Hue City in the period 2005 to 2015, is shown in Figure 7. According to Nguyen and Do (2017) green areas cover a total of 4339.9 ha (correspond to 61.4 % of the total natural area) and include according to Nguyen et al. (2016):

- Forest areas (green), mainly concentrated in south and southwest of the city, in the wards of An Dong and An Tay;
- Agricultural land (yellow), distributed in the north and east of the city, in the wards of An Hoa, Kim Long, Huong Long, Huong So and An Hoa;
- Parks (purple), mostly distributed along the river and in the city centre, in the wards of Thuan Hoa, Thuan Thanh, Phu Hoa, Phu Thuan and Vinh Ninh

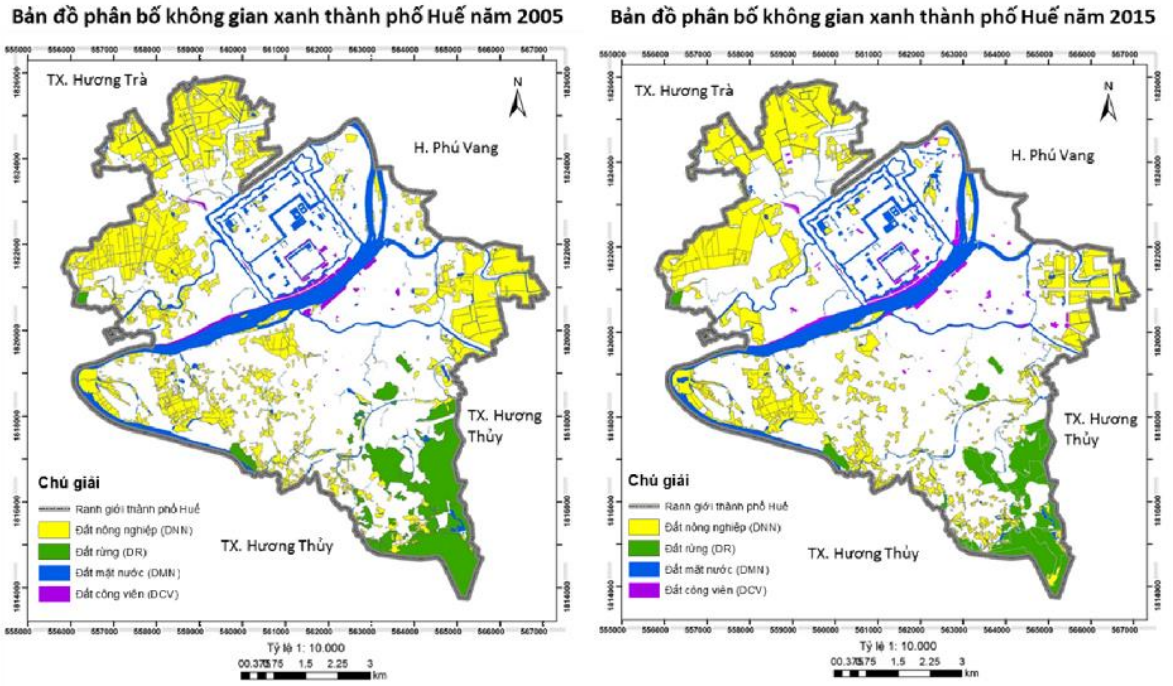


Figure 7. Green space distribution in 2005 (left) and 2015 (right) (Nguyen et al. 2016: 627).

The green space structure had a significant alteration between 2005 and 2015.

- The park area tended to increase continuously over the years by 20.85 ha (36.04 %) in the period of 2005 to 2015. The city of Hue was embellishing and constructing parks in the progress of becoming a "Green city". Unfortunately, the number of parks that met the standard for area size was small. The park area per capita in 2015 was 1.88 m²/person, far below the standard of 6-7.5 m²/person set by the Ministry of Construction (Nguyen et al. 2016).
- The agricultural land witnessed the greatest change with a decline by 248.56 ha (15.10 %) compared to 2005 due to a significant change in the land use structure (Nguyen et al. 2016).
- The total area of forest decreased significantly by 108.08 ha (20.05 %) because of commercial uses or interferences in order to build grey infrastructure (Nguyen et al. 2016).

- Within 10 years, the water surface area also decreased by 3.33 ha (0.47 %) due to illegal encroachment, conversion into agricultural land and infrastructure expansion for urban development (Nguyen et al. 2016).

The flora in the city of Hue is not only rich in quantity, but also rich in abundance of various categories. Overall, the green space is not equally distributed in the city (Bac Trung Nam Ldt.). According to Nguyen (2017b) the existing green areas can be divided into four areas:

- **Green space in the Citadel of Hue:** The region with a high density of UNESCO Heritage sites consists of both man-made and semi-natural green spaces which are arranged in harmony with the heritage sites and residential areas. The man-made green space comprises of vegetation mixed with the heritage site inside the Imperial City, the Purple Forbidden City and the flower gardens, parks, lawns and street greening.
- **Green space outside the Citadel of Hue:** To the west-northeast of the Citadel with the size of 2,280 ha, the semi-natural green space, the main feature of this region, consists of a large agricultural area. This area, however, will be gradually reduced in the next few years for urban development and small-sized man-made flower gardens. Additionally, some green space areas, closely associated with the heritage sites such as Thien Mu pagoda, Van Thanh temple and Vo Thanh temple, need to be considered and evaluated.
- **Green space in the core area south of the Huong River:** The 1,670 ha area south of the Huong River, whose urban areas have been developed in the last 100 years, is the centre of politics, administration and culture in Thua Thien Hue province. Due to the high density of buildings and paved surfaces, the artificial green space is the main type in this region including parks, flower gardens, street greening and green spaces in the heritage sites. For the green space in this region, it is crucial to maintain the existing status to improve the quality of ecosystem services and constantly develop new artificial green spaces in order to balance the pace of urban development.
- **Region of heritage and nature conversation in the southwest of the city:** The southwestern region of the city, with a size of 2,737 ha, has green spaces in the mausoleum area of the Nguyen kings (Tu Duc tomb, Dong Khanh tomb, Duc Duc tomb) and other cultural heritage sites. There is also a large forest area which is under conservation.

Hue City, known as the "Garden City", is well-known for its typical garden houses, which contribute to a large amount of green space in the city. Those are located mostly in the wards of Kim Long, Thuan Thanh, Thuan Hoa and Tay Loc. About 4,228 garden houses with a size of at least 400 m² are located in Hue. The Hue garden houses are characterised by a large number of plantations (50 species per house), which create a high tree density and a corresponding ecosystem. Although the garden houses are considered a unique feature of the city, they are still faced with a loss in size and architecture due to economic motives, changes in function and modernisation trends. Due to the increase in residential areas with modern architecture, these structures with the natural features of

vegetation and water are lost. The same applies to green areas integrated in the layout of properties of French colonial buildings.

Thus, the amount of green space in the centre of Hue City is limited. Moreover, a lack of green spaces for activities is reported, especially small parks for children's playgrounds and sport activities (DONRE/CODES/IREN). Additionally, in existing green spaces toilets and baby changing facilities are missing which leads to people urinating in public. As a result, existing green spaces are not used as frequented as possible (DONRE). Suburban areas to be developed shall have a higher ration of green space to improve the overall proportion of green space in the city (anonymous) and address these problems.

Also, problems associated with the unequal ratio of green spaces are mainly due to the unsystematic urban infrastructure, especially the lack of sidewalks along some streets such as the Tran Phu street, and Dang Huy Tru street. In other areas, the underground infrastructure (drainage system, water supply, underground power lines, etc.), despite the poor quality of the existing pavement system, causes problems in the restoration of the green areas (Dien Bien Phu street, Ba Trieu street). The lack of public awareness is also one of the main factors that inhibit the targeted expansion of urban green spaces. This lack of awareness results in vegetation, especially trees, encroaching existing pavements, in trees being cut down indiscriminately and in a lack of perception of spaces for trees.

Though, urban trees are an important form of green in the city of Hue. The tree canopy covers 80 % of the city, spending shade and securing slopes from landslides while improving the aesthetic of the city (F. of Geography/ F. of Forestry). There are 289 streets with trees (F. of Forestry) with a total of 65,000 trees of 60 different species (anonymous). Due to the harsh climate in Hue with strong heat waves in the dry season and heavy precipitation in the rainy season, as a result of the recent climate change, a large number of trees, especially ancient trees, suffered irreparable damage. In order to maintain the high density of trees, new tree plantings are carried out annually with mostly 5,000 samplings. Further problems are densely built up areas that do not support the abundance of trees and the behaviour of residents towards trees (anonymous). It is reported that trees have been destroyed by locals due to the fact that it is a specific type of tree or the tree is located near residential buildings (F. of Forestry). In other reported cases the wood of the supporting system for young trees is stolen. Thus, it is challenging to plant trees in the city (F. of Forestry/ ACVN). Additionally, support systems are only for new trees, not for trees prone to storms (F. of Forestry)

The "Green Sunday" campaign and the planned "Hue – city with 4 seasons of flowers" are initial steps of the current Hue's authority in order to involve citizens in community work and to make the most of the natural advantages. In 2016, Hue was honoured by the World Wide Fund for Nature (WWF) as "The National Green City".

3.3.3 Blue infrastructure

The largest river system in Thua Thien Hue province is the Huong River system. It consists of the the Huong River and its three tributaries – the Bo, Ta Trach and Huu Trach. Its main course is 104 km long with a basin covering an area of 2,830 km², which is 56 % of the area of the province (HCCWG and Tran 2014). In the western mountainous part slopes over 20 % are found while the eastern part of the city shows slopes of less than 5 % (ADB 2015).

Hue City's water system is formed by the Huong River, its tributaries and a system of 48 lakes of various sizes (HCCWG and Tran 2014). The southern area of the Huong River with its tributaries An Cuu and Nhu Y rivers and Phat Lat canal forms a drainage network. Bach Yen, An Hoa, Ngu Ha, Ho Thanh Hao rivers and lake systems in the northern area of the river form a flood protection system for the capital (Nguyen and Vo 2018). The highest density of blue infrastructure elements is located around the Citadel with a system of up to 48 lakes, ponds and the 3 km long canal of Ngu Ha with the total size of 810,420 m² (Tran 2007, ADB 2015). In addition, surrounding the Citadel, there are the inner and outer Kim Nguu lake. Some important lakes are located in Thuan Loc (Tinh Tam lake, Hoc Hai lake, Sen lake), Thuan Hoa (Vo Sanh lake, Tan Mieu lake), Tay Loc (Moc Duc lake and Huu Bao lake) and Thuan Thanh (HCCWG and Tran 2014).

Hue City features natural lakes which used to be a part of the river system, namely the river of Bach Yen, Kim Long, and artificial lakes which are formed under the Nguyen Dynasty for purposes of landscape embellishment, drainage, ecological balance, the daily activities of the residents and the army (Tran 2007). The water regime of the lakes correlates closely with the precipitation regime. The lowest water levels are reached in the drought period from March to August especially in July and August. The average annual water level in the lakes is about 1.5 to 3 m (Tran 2008). In the past, the lake system played an essential role and fulfilled four functions (in accordance with Feng Shui principles): landscape beautification, water regulation, drainage system and water supply for residential use (Tran 2008).

A significant number of lakes inside the Citadel has been transformed for fish and vegetable production as well as for touristic purposes for example the Tinh Tam lake. Also, lakes have deteriorated or even disappeared due to landslides, agricultural use, illegal interventions, conversion to a landfill and unsystematic construction work (Tran 2008). Between 2005 and 2015 the water surface area also decreased by 3.33 ha (0.47 %) due to illegal encroachment, conversion into agricultural land and infrastructure expansion for urban development (Nguyen et al. 2016).

Nowadays, the city's drainage system is often unable to accommodate the surface run-off during the rainy season (ADB 2015). Flooding occurs more frequent in the southern parts of the city. New development areas such as Xuan Phu feature a good drainage system, but are constructed on low-lying land that was formerly cultivated as rice fields, and are therefore also prone to flooding due to

their topography. Areas that are particularly prone to flooding in the north include those surrounding the Citadel, including Phu Cat, Phu Hiep, and Huong So (ADB 2015).

- In Hue City a trend towards building smaller and higher houses can be observed in contrary to the traditional garden houses
- The urban sewerage network covers 35 % to 40 % of the urbanised area of Hue City and about 30 % of the population
- The green space in Hue City is not equally distributed and can be divided into four main areas
- Hue City features a total of 65,000 trees of 60 different species.
- The area of agricultural land and forest within the city boundaries is decreasing
- The highest density of blue infrastructure elements is located in the area of the Citadel with a system of up to 42 lakes, ponds and the three km long canal of Ngu Ha with the total size of 810,420 m²

3.4 Current societal challenges

The city of Hue is faced with several societal challenges as indicated by the interviewees. These societal challenges comprise the following subjects:

Work situation and the creation of job opportunities

The current work situation associated with a high unemployment rate represents a major societal challenge for the city of Hue (F. of Environmental S., F. of Geography, F. of Forestry/CCCSC, DOC). In 2018, the unemployment rate of the city of Hue was 33.02 % and 15.09 % for rural areas in the Thua Thien-Hue Province (Thua Thien Hue Province's Statistical Agency 2019). Local experts observe a brain drain due to missing job opportunities for qualified students (F. of Environmental S., F. of Geography, DOC) while noticing students doing lower-level jobs (F. of Geography). Despite the rather low level of income (DOC), Hue City has generally a good standard of living (Bac Trung Nam Ldt.). However, the potential vulnerability of low-income people has to be emphasised (F. of Environment).

Harmonisation of traditional and modern architecture and design

In the given context, one expert pointed out a strong orientation towards modern construction methods (DOC). Given the fact that modern houses have a significant difference in microclimate, namely 3°C difference between the traditional garden house and the typical modern house (F. of Geography), the need arises to harmonise traditional and modern forms of construction (DOC). Furthermore, one local expert raised the question how to achieve adequate conservation of heritage sites like the Citadel (HueIDS).

Shift from an agricultural to a service-based economy

Hue is undergoing a shift from an agricultural to a service-based economy that raises issues like: How to handle the transition to a service-based economy? How to deal with the situation of reduced areas for agriculture? What job opportunities are available for farmers? (Bac Trung Nam Ldt.). One of the stated reasons for that development is an increasing demand for housing space due to a slowly increasing population (DOC), the trend of living in urban areas as well as living alone and not transgenerational anymore (F. of Environmental S.). That shift leads to a displacement of marginalised groups like farmers living in Hue who are forced to leave the city to look for job opportunities somewhere else (Bac Trung Nam Ldt.).

Climate change

In this line, climate change with the related hazards for the city of Hue was also mentioned as a current societal challenge and will be specified in chapter 3.5.

Resettlement of the people living along the historic wall

During the interviews not indicated as a societal challenge, but standing out for their potential social impact, is the current living condition of about 4,000 families living on and along the wall of the citadel who are planned to be relocated to different wards in the suburbs.

In addition to these major societal challenges, several further issues were expressed during the interviews: changes in behaviour and lifestyle (F. of Geography); social problems in social flashpoints like drug addiction in the ward An Cuu (DONRE, Farmer Association Kim Long Ward); a rather low awareness of the own behaviour related to climate change (IREN), and a disconnection with nature and the environment (Bac Trung Nam Ldt.).

- Hue's current major societal challenges are:
  - The work situation and the creation of job opportunities
  - The harmonisation of traditional and modern architecture and design
  - The shift from an agricultural to a service-based economy
  - climate change
  - the resettlement of the people living along the historic wall

3.5 Climate change

3.5.1 Current conditions

For the whole region, mean current annual average temperature T_{avg} is equal to 24.9±1.16°C, and mean current maximum temperature of the year's warmest month T_{mwm} is equal to 34.18±1.59°C (**Fehler! Verweisquelle konnte nicht gefunden werden.**). In the region, T_{avg} as well as T_{mwm} decline from the (north-)eastern coast in (south-)westerly direction, following the region's orography (Figure 8).

In the region, highest T_{avg} at commune level (>25.6°C) are observed in township Lang Co, commune Vinh Hien, and commune Loc An, located in the eastern part. Lowest T_{avg} (<21.8°C) are observed in the communes located in the mountainous areas in the western parts of the region (township A Luoi, commune Hong Trung, commune Bac Son, commune Dong Son, commune Hong Thai, commune Hong Kim). Within Hue, current T_{avg} ranges from 25.48°C to 25.6°C (25.57±0.042°C), i.e., no substantial differences in T_{avg} can be found within the city.

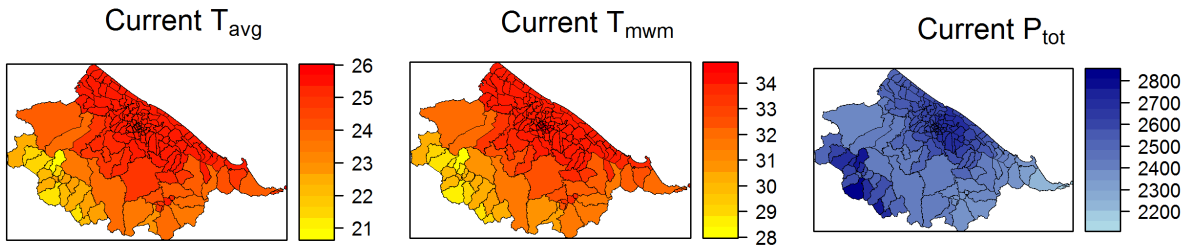


Figure 8. Current climatic conditions based on the period 1960-1990, averaged at commune level: mean annual average temperature T_{avg} in (°C, left), maximum temperature of the warmest month T_{mwm} in (°C, middle), and total annual precipitation P_{tot} (mm, right).

In regard to the current conditions of T_{mwm}, highest values of more than 34°C are observed within the city of Hue, particularly within the communes in the north-east of the city (ward An Dong, ward An Cuu, ward Xuan Phu and others). Overall, in the city of Hue, the total range of T_{mwm} is small with 34.29°C to 34.4°C (34.38±0.038°C), resulting in only marginal differences in the city (Figure 8); differences to observed peak temperatures likely result from the urban heat island effect, that is not considered in the climate data. Similar to T_{avg}, communes located in the western mountain ranges feature the lowest mean values for T_{mwm}, e.g., commune Hong Kim and commune Hong Thai with $T_{mwm} < 29$°C.

Table 2. Estimates of current climate conditions, averaged at commune level, based on the period 1960-1990.

Parameter	**Variable**		
	T_{avg} [1]	T_{mwm} [2]	P_{tot} [3]
Minimum	20.97	28.38	2155
Mean	24.90	33.37	2576
Median	25.49	34.18	2598
Maximum	25.70	34.40	2810
Standard deviation	1.16	1.59	115.34

[1] Annual average temperature

[2] Maximum temperature of the warmest month of the year

[3] Total annual precipitation.

Mean total annual precipitation P_{tot} for the region is equal to 2576±115.34mm (**Fehler! Verweisquelle konnte nicht gefunden werden.**). It is highest in the mountainous areas in the west and in the north-eastern areas; inland and towards the south-east, P_{tot} declines. Under current conditions, highest values of $P_{tot} > 2700$mm are observed in the communes Hong Thai, Dong Son, Hong Kim, and A Dot located in the west, as well as in ward Xuan Phu and ward An Dong located in the north-east of the city of Hue. Range of precipitation in Hue City is approximately 2637.38mm to 2702mm (2676.06±17.559mm). Lowest P_{tot} are currently observed in the south-east of the region, in ward Hoa Hiep Bac and township Lang Co, with $P_{tot} < 2200$mm (Figure 8).

3.5.2 Future conditions

Estimated changes in T_{avg}, T_{mwm}, and P_{tot}, averaged at the level of communes, for each year and RCP scenario are summarised in Table 3.

Table 3. Estimates of trends in climatic conditions, averaged at commune level, for the years 2050 and 2070 and RCP scenarios RCP2.6 and RCP8.5.

Variable	Year	RCP	Parameter				
			Minimum	Mean	Median	Maximum	Standard deviation
T_{avg}[1]	2050	2.6	1.07	1.13	1.14	1.18	0.031
		8.5	1.66	1.74	1.74	1.83	0.040
	2070	2.6	1.11	1.16	1.16	1.21	0.027
		8.5	2.42	2.52	2.52	2.65	0.052
T_{mwm}[2]	2050	2.6	1.18	1.26	1.24	1.43	0.058
		8.5	1.83	1.93	1.89	2.20	0.095
	2070	2.6	1.24	1.34	1.32	1.55	0.081
		8.5	2.79	2.95	2.90	3.30	0.132
P_{tot}[3]	2050	2.6	108.10	129.40	131.00	141.20	8.161
		8.5	38.97	58.40	60.19	79.33	8.514
	2070	2.6	74.53	119.80	127.21	140.41	18.320
		8.5	71.92	136.75	146.12	165.86	25.390

[1] Annual average temperature

[2] Maximum temperature of the warmest month of the year

[3] Total annual precipitation.

Looking at Table 3, it becomes clear that in the region, depending on the RCP scenario (with RCP8.5 generally resulting in higher increases in temperature compared to RCP2.6), T_{avg}, averaged at commune level, will increase by about 1.07°C up to 1.83°C until 2050, and by about 1.11°C up to 2.65°C until 2070. Highest increases are expected for the mountainous area in the west of the region, whilst for the coastal area, particularly in the south-east, lower increases are to be expected (Figure 9 and Figure 10). Within the city of Hue itself, increases in T_{avg}, averaged at communes level, are estimated at 1.06°C to 1.17°C (1.10±0.038°C, RCP2.6) up to 1.67°C to 1.78°C (1.71±0.037°C, RCP8.5) until 2050, and 1.12°C to 1.21°C (1.14±0.032°C, RCP2.6) up to 2.45°C to 2.53°C (2.49±0.031°C, RCP8.5) until 2070.

A similar pattern can be observed for T_{mwm}, with extreme temperatures in Hue increasing by about 1.23°C to 1.26°C (1.24±0.008°C, RCP2.6) up to 1.85°C to 1.90°C (1.87±0.013°C, RCP8.5) until 2050, and by about 1.24°C to 1.33°C (1.28±0.020°C, RCP2.6) up to 2.83°C to 2.94°C (2.87±0.026°C, RCP8.5) until 2070. Overall, in the region, T_{mwm} is expected to increase by 1.18°C to 2.20°C until 2050, and by 1.24°C to 3.30°C until 2070. It needs to be noted that changes in temperatures due to heat island effects are not yet considered in these estimates but need to be determined.

In regard to P_{tot}, increasing precipitation sums are estimated, resulting in overall wetter conditions. It is expected that, under both RCP scenarios, increases of P_{tot} are highest in the coastal area including the city of Hue itself, and substantially lower in the mountain ranges in the western part of the region (Figure 9 and Figure 10). However, it should be noted that until the 2050 period, RCP2.6 estimates higher increases in precipitation compared to RCP8.5; averaged at regional level, until 2050, precipitation is expected to increase by 108.10mm to 141.20mm under RCP2.6, but only by 38.97mm to 79.33mm under RCP8.5. However, until 2070, changes in precipitation are of comparable magnitude under both RCP scenarios, with estimated increases of 74.53mm to 140.41mm under RCP2.6, and of 71.92mm to 165.86mm under RCP8.5 (Table 3).

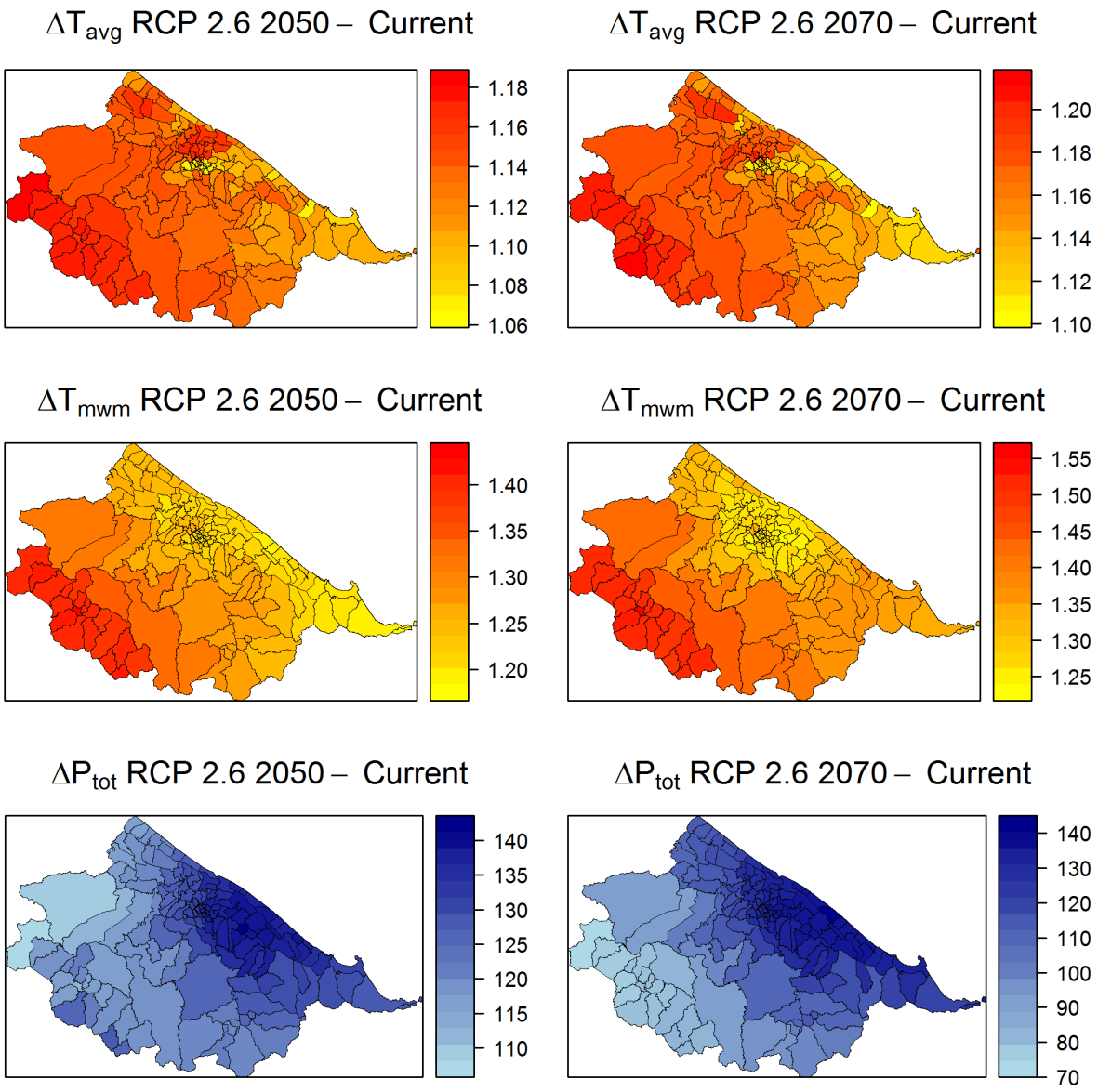


Figure 9. Future climate conditions under RCP2.6, expressed as difference to current conditions and averaged at commune level, for the years 2050 (left) and 2070 (right).

For Hue, changes in P_{tot} until 2050 are estimated at 131.92mm to 138.74mm (135.71±2.251mm) for RCP2.6, and at 59.15mm to 64.21mm (61.93±1.682mm) for RCP8.5. Similar to regional trends, changes in precipitation until 2050 are thus more drastic for the city of Hue under RCP2.6, for which the estimated changes are comparatively high, whilst under RCP8.5, only moderate increases in precipitation are anticipated for the city. Until 2070, precipitation is expected to increase by 126.88mm to 135.88mm (131.90±2.941mm) under RCP2.6, and by 148.5mm to 159.76mm (154.52±3.635mm) under RCP8.5. Under both RCP, estimated changes until 2070 are comparatively high when compared to the overall region.

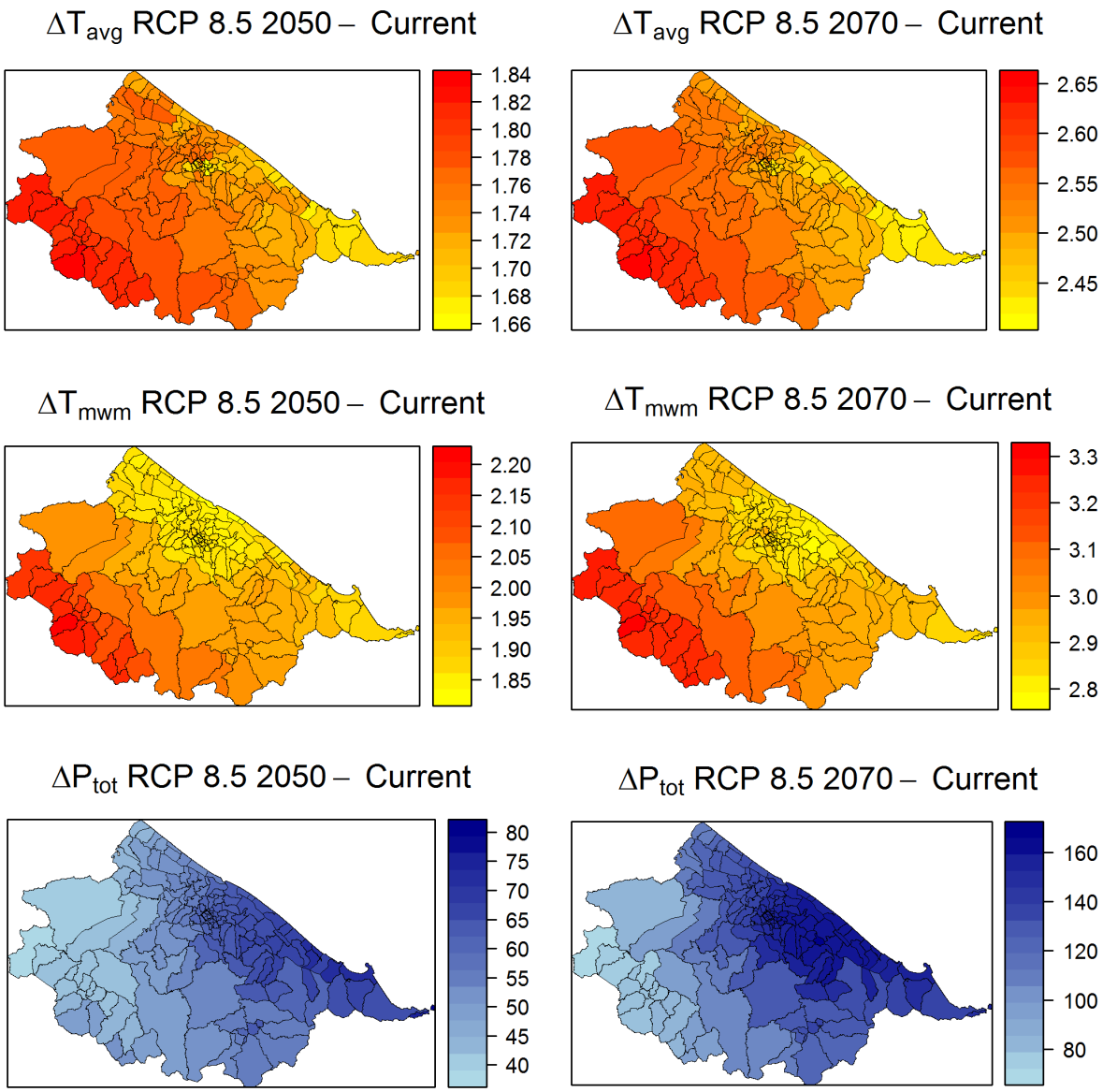


Figure 10. Future climate conditions under RCP8.5, expressed as difference to current conditions and averaged at commune level, for the years 2050 (left) and 2070 (right).

To obtain a more integrative perspective of estimated climate change, the chosen indicators were subsequently grouped per year and RCP scenario using k-medoids clustering for the spatially explicit identification of relevant combined trends. Here, four combined trends as shown in Figure 11 can be detected: comparatively low increase in temperatures, but high increase of total precipitation; comparatively high increase in temperatures, but low increase of total precipitation; and two moderate trends with low to moderate increase in temperatures combined with either a relatively higher or lower increase in precipitation.

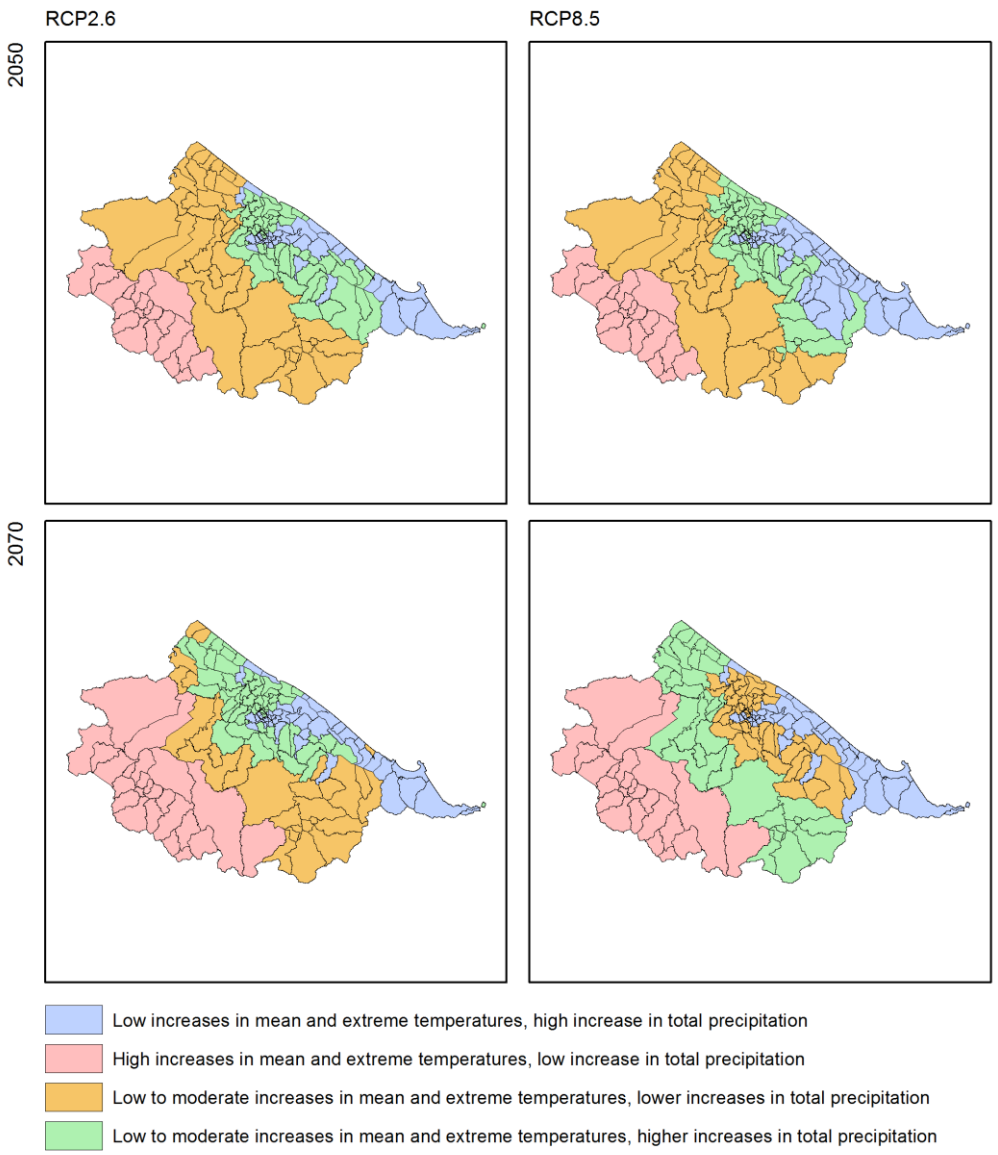


Figure 11. Combined trends in climatic indicators for the years 2050 and 2070, and for RCP scenarios RCP2.6 and RCP8.5 respectively.

3.5.3 Major climate change impacts

In addition to the climate change trends assessment and description of the current and future conditions, the interviewees pointed out several major impacts posed by climate change that Hue City is facing:

- flooding along with inundation (DOC, F. of Environment, F. of Environmental S., F. of Forestry/CCCSC, DONRE, HMCC);
- heat stress (Bac Trung Nam Ldt., F. of Environment, DONRE, Farmer Association Kim Long Ward, IREN);
- air pollution (DOC, F. of Geography, HueIDS, IREN);
- seasonal changes (F. of Forestry, DONRE).

Further impacts and challenges due to climate change named by the interviewees are: the risk of fire, especially for the historical buildings like the Citadel (HMCC); general environmental pollution of the water and canals (F. of Architecture), a decrease in biodiversity (DONRE); and a missing disaster risk management (F. of Environmental S.).

- Preliminary assessment of impacts of climate change on climatic parameters near-surface air temperature and precipitation using indicators annual average temperature, maximum temperature of the warmest month, and total precipitation
- Estimation of future conditions from averaging six CMIP5 downscales global climate models using RCP2.6 and RCP8 for elicitation of best-case and worst-case scenarios
- Trends indicate generally warmer conditions and increasing total precipitation for the region:
  - Annual average near-surface air temperature to increase by approximately 1.07°C up to 1.83°C until 2050, and by about 1.11°C up to 2.65°C until 2070
  - Extreme temperatures, proxied by the maximum temperature of the warmest month, to increase by approximately 1.18°C to 2.20°C until 2050, and by 1.24°C to 3.30°C until 2070
  - Annual total precipitation to increase by approximately 38.97mm to 79.33mm (RCP8.5) up to 108.10mm to 141.20mm (RCP2.6) until 2050, and by 74.53mm to 140.41mm (RCP2.6) to 71.92mm to 165.86mm (RCP8.5), respectively
- City of Hue will likely face low/low-to-moderate increases in air temperature (both annual averaged and extreme), and moderate to high increase in precipitation when compared to the rest of the region. Heat island effects will likely exacerbate estimated trends but are not yet considered.
- Natural hazards will likely be exacerbated by climate change. This includes increases in heat spells and resulting heat stress as well as flooding. Air quality might be affected simultaneously.

4 Status quo analysis of NBS in the city of Hue

4.1 Case study typology

The case study typology (see the supplementary document), based on co-creation and co-learning, illustrates important GBI elements as they are understood by the Vietnamese and German project partners. Besides identifying relevant GBI elements in the context of the city of Hue, a common comprehension with regards to the concepts NBS and GBI has been created to understand various perceptions of both terms within the project partners. In the following, NBS are understood as interventions or measures that are inspired by nature and the functions of ecosystems to tackle environmental and societal challenges. They comprise among others the enhancement and expansion of GBI, a planned network of green and blue spaces to protect biodiversity and provide multiple ecosystem services and associated benefits (European Commission 2013, Vinh and Huong 2017).

The case study typology consists of 64 GBI elements grouped into ten categories:

- Green Infrastructure on building structures (8)
- Private, commercial, industrial and institutional GBI and GBI connected to grey infrastructure (12)
- Allotment and community gardens (2)
- Recreational parks and gardens (14)
- Agricultural GBI (5)
- Other GBI (3)
- Type of vegetation (6)
- Blue Infrastructure on building structure (1)
- Natural or semi-natural water bodies and hydrographic networks (6)
- Constructed wetlands/water bodies and built structures for water management (7)

In general, most of the initially proposed GBI elements, which are typical for GBI in Europe, are also found in the city of Hue. However, there are elements that are relevant in Europe that are irrelevant in the city of Hue such as cemeteries, camping areas, urban grassland, community gardens, fountains and pipe systems, as they either do not exist or are rarely seen. At this point it must be mentioned that cemeteries cover large areas in the south and west of the city (see section 4.2), but are obviously not considered GBI by the Vietnamese partner. In addition, the HUSC identified green roofs and ground-based green walls as elements that can be found within the cityscape of Hue but are not favoured because water retained, especially during the rainy season, can enter the house when waterproofing is lacking or limited. Other GBI elements appear in the city of Hue, but are not very common such as vegetated pergolas, railroad banks (in urban areas), permeable pavement

and wetlands. However, there are elements that are specific to the city. These include in particular green-blue gardens (e.g. Tịnh Tam lake), garden cafes and feng shui gardens/garden houses.

Taking into account the similarities and differences described above, the case study typology will be essential in the development of stakeholder-based narratives and the subsequent modelling of land use change scenarios. Based on the co-created typology the narratives and scenarios can now incorporate GBI elements that have been identified as relevant in the city of Hue and also take into account the preferences of Hue's residents. Moreover, the project consortium can draw on experience and knowledge from Europe and EU projects on NBS for those elements that exist both in Europe and the city in Hue. While green roofs and ground-based green walls are not favoured by the city of Hue due to problems in technical realisation (lack of or limited waterproofing), they have great potential in terms of climate regulation (e.g. evapotranspiration and shading) (Alexandri and Jones 2008, Bowler et al. 2010) and, to some extent, water regulation and air purification (Pugh et al. 2012, Suszanowicz and Kolasa-Wiecek 2019). Hence, it would be interesting to find technical solutions and best practice methods to adapt green roofs and green walls to the climatic conditions of the city (especially to the high rainfall in the rainy season) and thus improve the acceptance by the public. Green roofs and green walls are promising NBS to increase the share of green areas in densely populated urban areas where the scope for expanding green spaces is limited (Tam et al. 2011).

- Development of a case study typology, based on co-creation and co-learning, to identify relevant GBI elements in the city of Hue
- Case study typology:
  - Most elements exist both in Europe and the city in Hue
  - Unique GBI in the city of Hue include green-blue gardens, garden cafes and feng shui gardens/garden houses
  - Green roofs and walls are not favoured for technical reasons
- Case study typology as a basis for the development of stakeholder-based narratives and the subsequent modelling of land use change scenarios
- Potential for further research:
  - Role of cemeteries as GBI
  - Improvement of technical implementation of green roofs and walls to benefit from the ecosystem services they can provide

4.2 Analysis of the status quo in the city of Hue

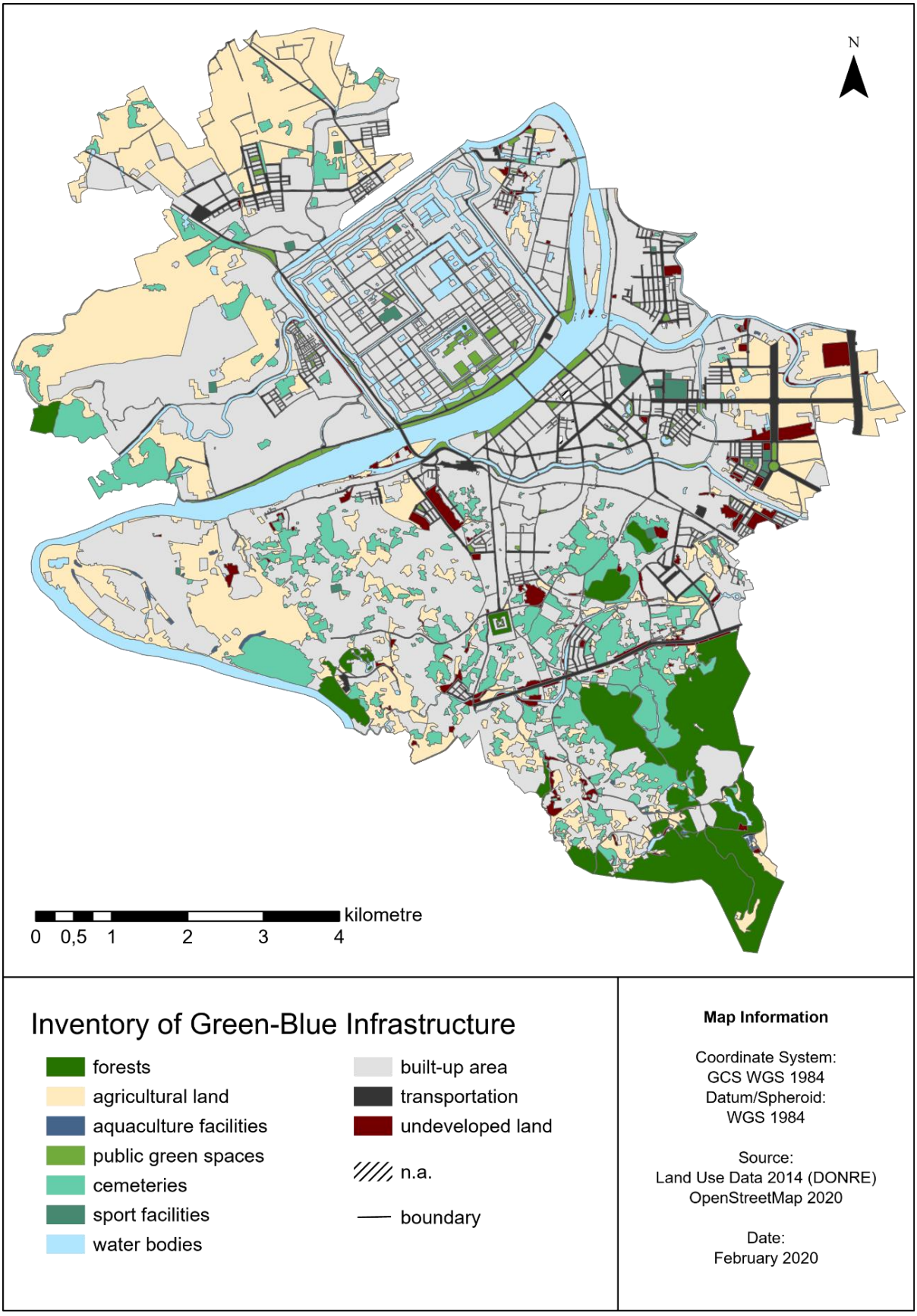


Figure 12. Inventory of green-blue infrastructure in the city of Hue derived from land use data from 2014 provided by DONRE and OpenStreetMap data.

The inventory of GBI (Figure 12) represents the spatial distribution of green, blue and open spaces as well as built-up area in the city of Hue. Although land use data form the basis of the inventory, it is actually a combination of land use and land cover. Nevertheless, the map provides a good overview of the distribution and share of GBI in the city of Hue, which will be described in more detail in the following.

Most of the forest areas are located in the south, more precisely in the An Tay ward. Smaller forest areas can be found in An Cuu, Thuy Bieu, Huong Long and Truong An. In total, about 6 % of the city consists of forests (Figure 13). Agricultural land is mainly concentrated in the outskirts and covers almost 20 % of the city area. The wards with the largest share of agricultural land are Huong So and An Hoa in the north, Huong Long and Thuy Bieu in the west and An Dong in the east. Aquaculture facilities belonging to the agricultural sector and blue infrastructure play a comparatively smaller role in relation to the area covered by the GBI. They account for 0.1 % of the area of the city of Hue. Facilities are mainly located in the Thuy Bieu and Xuan Phu wards. Most public green spaces are concentrated along the Huong River, within the citadel, especially in the Imperial City of Hue, and in new residential areas. The proportion of public green spaces is quite low, at just over 1 %. Even though the Vietnamese partner did not consider cemeteries to be GBI, some of them contain larger amounts of green and open spaces (Figure 14) and were therefore include in the inventory of GBI. Against this background cemeteries and their public perception are very interesting for further research. Cemeteries make up about 8 % of the city. Large areas of cemeteries are located in the Thuy Xuan and An Tay wards (south of the city). Moreover, they can be found in An Cuu, Truong An, Thuy Bieu and Huong Long. Sport facilities only cover 0.4 % of the city area and are spread all over the city. Water bodies are an essential part of the city of Hue. They cover almost 10 % of the city and determine the urban landscape around and within the citadel, where there are many channels, lakes and ponds. Natural or semi-natural water bodies include the Huong River, the An Cuu and Nhu Y rivers south the Huong River and the Bach Yen River north of the Huong River. The main stream of the city, the Huong River, divides the area into a northern part with the old city centre and a southern part with the new city centre. In general, public green spaces and forests are not fairly distributed. Few wards benefit from the various ecosystem services provided by either public green spaces or forests. In order to fully assess environmental justice, socio-economic data are needed in addition to the spatial distribution.

Beside the city-wide inventory of GBI additional information on GBI were derived from the field survey conducted by HUSC. Results of the field survey are important as only a certain proportion of GBI elements described in the case study typology could be illustrated in the map (Figure 12). Many elements are too detailed to be visualised (e.g. balcony green, green roofs, institutional green space) if only the land use dataset is used. Therefore, in addition to the aforementioned map, the location of representative examples of GBI identified by the HUSC are listed below:

- ***Green Infrastructure on building structures:*** Atriums are located in some houses in the An Cuu, Phuoc Vinh and Truong An wards and in some old, traditional houses in the Phu Cat ward. Balconies are widespread in the city of Hue. They are located in residential areas in Xuan Phu (here mainly in the new residential area To Huu), Tay Loc, Truong An, Phu Nhuan, Phuoc Vinh, Phu Hiep, Kim Long, Vy Dạ and in the new residential area An Cuu City in An Dong. Façade-bound and ground-based green walls can be found in cafés and restaurants in particular. For instance, some cafés and restaurants in the new residential area To Huu in the Phu Hoi ward and certain cafés along the An Cuu river have façade-bound green walls and some cafés and restaurants in the Vy Dạ ward as well as cafés within the citadel and along the Nguyen Hue street have ground-based green walls. Green roofs can be found on houses in the five districts Xuan Phu, Thuan Thanh, An Cuu, Kim Long and Vinh Ninh. As already mentioned, vegetated pergolas are not very common, but can most likely be found in the Imperial City of Hue, in some cafés within the citadel and in the Ly Tu Trọng park.
- ***Allotment and community gardens:*** Allotment gardens can be found within the citadel of the city of Hue in particular.
- ***Recreational parks and gardens:*** Urban parks are mainly located along the Huong River. In addition, they can be occasionally found in the citadel (apart from the Imperial City of Hue) and in new development areas such as the Manor Crown Hue. The historic parks/gardens are particularly located within the citadel, especially in the Imperial City of Hue (e.g. Co Hạ royal garden). The two historic parks/gardens Tomb of Tu Duc and Dan Nam Giao can be found in the south of the city. The Tinh Tam lake is the most representative example of a green-blue garden in the city of Hue and is centrally located in the citadel. Institutional green space is most likely to be found near educational and cultural facilities as well as administrative offices (e.g. Hue Industrial College, Hue University of Sciences and the culture centre at the Hung Vuong roundabout). Most new development areas, e.g. the Manor Crown Hue, have pocket parks. Representative green inner courtyard for the city of Hue include the sites Hue University of Sciences and Saigon Morin hotel, among others.
- ***Agricultural GBI:*** Arable land is located in the Huong Long ward in the west of the city and in the north of Hen island. Small farms/agricultural gardens can be found within the citadel along the historic wall and in the west of the Thuy Bieu ward near the Huong River.
- ***Natural or semi-natural water bodies and hydrographic networks//Constructed wetlands/water bodies and built structures for water management:*** Natural or semi-natural water bodies can be mainly found south the Huong River and outside the citadel. Rather artificial or anthropogenic water bodies are located within and around the citadel (e.g. Dong Ba channel and Dao river). The ponds of the citadel and rice/paddy fields in the Xuan Phu ward serve as retention basins during the flood season or rainy season, respectively. River embankments can be found along the Huong, An Cuu and Dong Ba rivers.

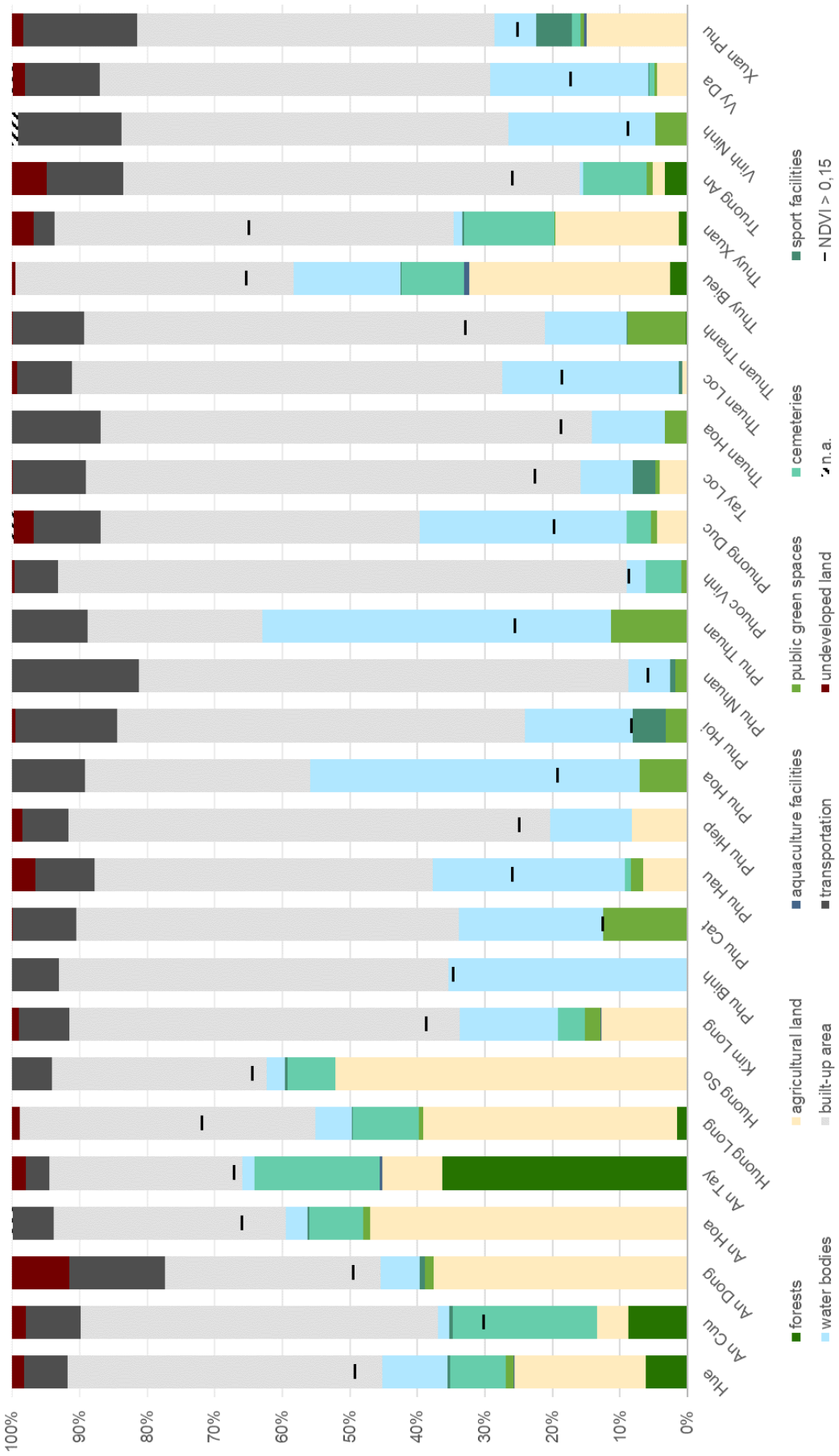


Figure 13. Share of green-blue infrastructure and vegetation (NDVI > 0.15) in the city of Hue and in each ward.

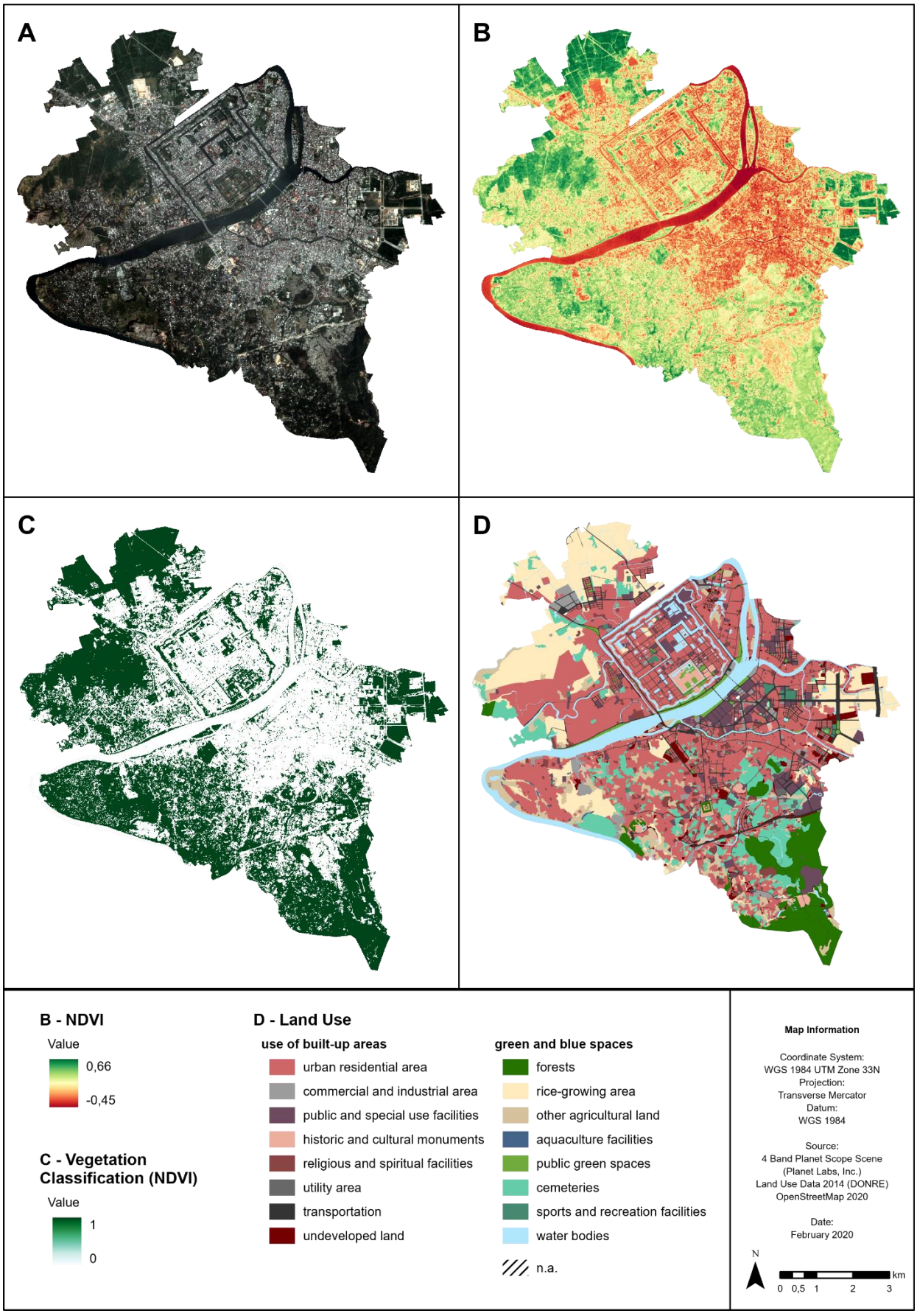


Figure 14. PlanetScope satellite image of the city of Hue on 20th February 2020 (A), the Earth observation indicator normalised difference vegetation index (NDVI) calculated based on the PlanetScope image (B), vegetation classification based on the NDVI (C) and land use map (D).

In addition to the distribution of GBI based on land use data and the field survey, a satellite image was used to calculate the NDVI and later to carry out an initial vegetation classification (Figure 14, C). In most wards the proportion of areas with a NDVI above 0.15 (= vegetated areas) correlates with the proportion of GBI, i.e. wards with high GBI share also have large vegetated areas (Figure 13). Whereby water bodies do not necessarily increase the proportion of areas with a NDVI above 0.15, only if they contain a lot of water plants floating on the surface e.g. lotus plants in the Tịnh Tam lake. Thus, wards such as Phuong Duc and Thuan Loc with high shares of built-up area and water bodies only have small areas with vegetation. The NDVI and the vegetation classification reveal GBI (Figure 14, B and C) that is not covered in the inventory of GBI (Figure 12), e.g. vegetation such as trees and green verge along streets. It also uncovers the high amount of green of certain land uses, in particular historic and cultural monuments. For further research, it would be interesting to use the NDVI to determine the proportion of green space for specific land uses, e.g. for educational facilities, religious and spiritual facilities, historic and cultural monument as well as for urban residential areas in the city centre and in the outskirts.

Potential areas for the implementation of NBS in the city of Hue differ depending on whether GBI should be expanded or enhanced. The most suitable areas for expanding GBI are those marked as undeveloped land (Figure 12) or the new and growing urban areas in the Huong So, An Hoa, Thuy Xuan and Huong Long wards (Bac Trung Nam Ldt.). In densely populated areas or in special zones (the possibilities for construction are limited) such as the citadel, along the Huong River, the Vong Canh Hill and the Thien An Hill (F. of Forestry, CCCSC), priority should be given to enhancing GBI.

- Inventory of GBI presents the distribution of green, blue and open spaces in the city of Hue based on land use data from 2014
- Share of GBI in the urban area: forests 6 %, agricultural land 19.5 %, aquaculture facilities 0.1 %, public green spaces 1 %, cemeteries 8 %, sport facilities 0.4 % and water bodies 10 %
- Forests and public green spaces not fairly distributed (spatial distribution)
- Potentials for the expansion of NBS: undeveloped land as well as new and growing urban areas in the Huong So, An Hoa, Thuy Xuan and Huong Long
- Potentials for the enhancement of NBS: densely populated areas and special zones, e.g. within the citadel
- Potential for further research:
    - Determining the proportion of green space of certain land uses
    - Determining ecosystem services of cemeteries for the city of Hue

4.3 Benefits of NBS for the city of Hue

An increased implementation of NBS in the city of Hue offers several benefits as stated by the experts during the interviews. These benefits can be categorised into social, environmental, and economic benefits while taking into consideration that they are interrelated and interdependent at the same time.

Social benefits:

- creating a different atmosphere and generating personal benefits (F. of Environment, IREN); creating a peaceful, friendly and joyful surrounding (IREN);
- improving and creating public space for the community, for recreational purposes and in particular for children (CODES, F. of Architecture);
- beautifying the cityscape (DOC, F. of Forestry);
- creating better living conditions (F. of Environment);
- improving the safety of green spaces (DONRE);
- fulfilling of the Sustainable Development Goals (SDG) (anonymous).

Environmental benefits:

- improving the environment (Bac Trung Nam Ldt., F. of Architecture, F. of Forestry, HEPCO, HueIDS, IREN);
- building resilience against extreme weather events, in particular storms and floods (ACVN, DOC, F. of Environment);
- cooling effects of the urban area (DOC, F. of Forestry);
- protecting and improving water quality (DONRE, HEPCO);
- reducing air pollution and dust formation (F. of Forestry);
- reducing noise pollution (F. of Forestry);
- reducing emissions for example due to less energy consumption for air conditioning (HEPCO).

Economic benefits:

- further development of tourism and Hue as an eco-tourism site (Bac Trung Nam Ldt., F. of Environment, F. of Environmental S., HueIDS, IREN) and thereby creating income and job opportunities (Bac Trung Nam Ldt.);
- conserving heritage sites (Bac Trung Nam Ldt.);
- increasing the attractiveness of the city for inhabitants and tourists (F. of Environmental S.);
- strengthen one of Hue's key assets – Hue as a green city – and thereby creating a competitive advantage over other Vietnamese cities such as Hanoi and Ho Chi Minh City (HEPCO).

- Social and environmental benefits slightly predominate the possible benefits of NBS for Hue City
- The most relevant social benefits: the improvement of the city in general and the enhancement of public space
- The most relevant environmental benefits: the general improvement of the environment and the building of resilience
- NBS are vital for the further development of local tourism and the promotion of Hue as an eco-tourism site

4.4 Former, current and future projects relating to NBS

The following tables represent a selection of former, current and future projects and programmes relating to NBS. The information contained in the tables was compiled by the MISR.

4.4.1 Former projects

Table 4. List of former projects relating to NBS.

Project activities	Host organisation	Coordinating organisation	Period	Source	Funded by
Embellishment and improvement of the Citadel of Hue.	Central Budget		2010-2013	Decision 2237/QĐ-UBND	Central budget
Development and implementation of a scheme to conserve O Lau estuary wetlands.	Department of Agriculture and Rural Development	Department of Natural Resources and Environment;	2012-2015	Decision No.2293/QĐ-UBND	
Establishment and implementation of a project to restore Ru Cha mangrove forest.	Department of Natural Resources and Environment;	Department of Agriculture and Rural Development	2012-2015	Decision No.2293/QĐ-UBND	
Review and adjustment in the planning of residential areas to identify vulnerable areas and offer adaptive solutions.	Department of Construction Department of Planning and Investment	People's Committees of districts, towns and cities	2014-2015	Decision No.962/QĐ-UBND	Other sources according to budget decentralisation
Support in the implementation of solutions to tackle climate change and to ensure local sustainable development.	People's Committees of districts, towns and cities	Departments and agencies related	2014-2016	Decision No.962/QĐ-UBND	Other sources according to budget decentralisation
Establishment of a database system for land and natural resources, the environment and climate change.	Department of Natural Resources and Environment	Department of Communication and Information	2014-2018	Decision No.962/QĐ-UBND	Other sources according to budget decentralisation
Development of a project to restore important natural ecosystems.	Department of Agriculture and Rural Development	Departments, agencies and People's Committees of districts, towns and cities	2015	Decision No.962/QĐ-UBND	Other sources according to budget decentralisation

Project activities	Host organisation	Coordinating organisation	Period	Source	Funded by
Development of a programme to strengthen the management of agricultural and forestry land.	Department of Natural Resources and Environment	People's Committees of districts, towns and Hue City. Department of Agriculture and Rural Development	Q2-2018	Plan No. 113/KH-UBND	
Drawing up a list of those constructions and projects in which land has to be reclaimed; Change in land use for rice cultivation; protection forests and special-use forests.	Department of Natural Resources and Environment	People's Committees of districts, towns and Hue City.	Q2-2018	Plan No. 113/KH-UBND	

4.4.2 Current and future projects

Table 5. List of current and future projects relating to NBS.

Project activities	Host organisation	Coordinating organisation	Period	Source	Funded by
Spatial planning along the banks of the Huong River.	Management Board of KOICA Project	Departments, Agencies and People's Committees of districts, towns and cities	2014-2020	Decision 649/QĐ-UBND	KOICA
Planning for green spaces, parks and open spaces.	Management Board of KOICA Project	Departments, Agencies and People's Committees of districts, towns and cities	2014-2020	Decision 649/QĐ-UBND	KOICA
Establishment of an investment project to modernise road systems for climate change adaptation.	Department of Transportation; People's Committees of districts, towns and cities	Department of Planning and investment	2014-2020	Decision No. 962/QĐ-UBND	State resources
Implementation of the National Target Programme to remedy pollution and improve the environment.	Department of Natural Resources and Environment	Departments, Agencies and People's Committees of districts, towns and cities	2014-2015; 2016-2020	Decision No. 962/QĐ-UBND	State resources
Implementation of a National Target Programme on climate change.	Department of Natural Resources and Environment	Departments, Agencies and People's Committees of districts, towns and cities	2015; 2016-2020	Decision No. 962/QĐ-UBND	State resources

Project activities	Host organisation	Coordinating organisation	Period	Source	Funded by
Improvement of ponds, lakes and canals: The province has included ODA mobilisation subprojects, including: (i) Dredging and embankment of the Ke Van River (ii) Dredging and embankment of lakes in the Citadel of Hue (iii) Improvement and upgrading of the Lap River (iii) establishment of an ecological canal in the centre of An Van Duong New Urban Area (iv) Dredging and embankment of the An Hoa River (v) Dredging and embellishment of Ho Thanh Hao (vi) Embellishment and embankment of the Dong Ba River bank (vii) Construction and embellishment of embankments along the two banks of the An Cuu River (viii) Embankment of the Nhu Y River.	Thua Thien Hue Provincial People's Committee via the Department of Planning and Investment	Hue City People's Committee	2016-2020	Plan No. 110/KH-UBND	State resources[2]; ODA from multilateral donors (ADB, WB, OFID) and bilateral donors (Japan Korea, Hungary)[3]; Government bonds; Bonds issued by Thua Thien Hue province; Investment from private sector[4]
Construction of new roads to strengthen connections to tourist destinations and the opening of new green districts based on faster growth in the service sector.	Thua Thien Hue Provincial People's Committee via the Department of Planning and Investment	Hue City People's Committee	2016-2020	Plan No. 110/KH-UBND	State resources; ODA from multilateral donors (ADB, WB, OFID) and bilateral donors (Japan Korea, Hungary)[3]; Government bonds; Bonds issued by Thua Thien Hue province; Investment from private sector[4]
Establishment of a project on the development programme of Class II cities (green cities) – Thua Thien Hue subproject .	Department of Planning and Investment		2016-2021	Decision of 894/QĐ-UBND	ADB capital; Domestic reciprocal capital (local budget)
Creation of a scheme for the “Green Sunday "Take action for a green - clean - bright province"” campaign.	Thua Thien Hue Province Youth Union	People's Committess at all levels Thua Thien Hue Province Youth Union Relevant departments, boards and branches	Since 2019 on a weekly basis	Decision of 139/QĐ-UBND	Central budget; Local budget; International aid capital; Mobilized capital from community society; Other legal capital

[2] Shared urban technical infrastructure project with unrecoverable capital.

[3] Technical and social infrastructure projects inside and outside Hue city area.

[4] Project can recover capital as water supply, health care, education, environmental treatment and other services.

Project activities	Host organisation	Coordinating organisation	Period	Source	Funded by
Advancing the project of adjusting administrative boundaries to expand Hue City and reorganise Hue City Districts.	People's Committee of Thua Thien Hue Province	Ministry of Home Affairs	Q2-2020	Action program of the Government to implement Resolution No. 54-NQ / TW dated December 10, 2019	Other lawful financial sources
Approval and advance of the planning of Thua Thien Hue province in the period of 2021-2030, with a 2050 vision being associated with the adjustment of sectoral planning in accordance with the planning law and overall planning of national and regional planning.	People's Committee of Thua Thien Hue Province	Ministry of Planning and Investment coordinate with related Ministries, agencies	2020-2021	Action program of the Government to implement Resolution No. 54-NQ / TW dated December 10, 2019	Other lawful financial sources
Preparation of profiles for urban development areas in Hue City and surrounding areas.	Department of Construction	Departments, agencies, branches and related agencies	2020-2021	Decision 3342/QĐ-UBND	State resources; Resources from individuals, non-state enterprises, local and foreign investment[5] [6]
Restoration of the landscape, the ancient capital, all major monument and cultural works in the Citadel (Hoang Thanh), the old town of Gia Hoi, Chi Lang and Bao Vinh; preservation of the old town, the old urban centre, the garden house and the Phuoc Tich ancient village.	Ministry of Culture, Sports and Tourism	Ministries, agencies belong to Government, People's Committee of Thua Thien Hue Province	2020-2025	Action program of the Government to implement Resolution No. 54-NQ / TW dated December 10, 2019	State resources; Funding sources and other lawful financial sources
Creation of a scheme to develop the urban centre of Thua Thien Hue directly under the central government, under the premise of preserving and promoting the value of Hue's ancient heritage and cultural identity.	Department of Construction	Departments, agencies, branches and related agencies	2021-2022	Decision 3342/QĐ-UBND	State resources; Resources from individuals, non-state enterprises, local and foreign investment[5] [6]
Investment in the internal traffic system that links urban centres; prioritisation of Hue-Thuan An and Hue roads to Phu Bai airport, Hue City belt road 3, Construction of bridges across Huong River and infrastructure at some beaches. Upgrading of a number of important inner-city roads in Hue City, Huong Thuy town, Huong Tra town, Thuan	Ministry of Transportation	Ministries, agencies belong to Government, People's Committee of Thua Thien Hue Province	2021-2025	Action program of the Government to implement Resolution No. 54-NQ / TW dated December 10, 2019	State resources; Funding sources and other lawful financial sources

[5] Capital in the form of joint venture, BOT, BT, PPP, etc..

[6] Mechanisms to attract and direct FDI capital into fields that can absorb capital quickly and create a breakthrough in development,

Project activities	Host organisation	Coordinating organisation	Period	Source	Funded by
An town, Sia and the main traffic of Phong Dien and Quang Dien districts					
Complete relocation of households in region 1 belonging to the Hue monuments complex before 2022; gradually restoration of the ancient landscape; restoration of all major monument works in the Citadel area (Hoang Thanh), cultural works and the ancient quarters Gia Hoi, Chi Lang and Bao Vinh; preservation of the old town, the urban area, the communal house, the garden house and the Phuoc Tich old village; investment in the development of tourism infrastructure, recreational areas, parks, culture, big tourist resorts and cultural institutions for heritage, culture and festival.	Ministry of Culture, Sports and Tourism	Ministries, agencies belong to Government, People's Committee of Thua Thien Hue Province	2021-2025; 2026-2030; On a yearly basis	Action program of the Government to implement Resolution No. 54-NQ / TW dated December 10, 2019	State resources; Funding sources and other lawful financial sources

5 Policy framework for NBS in Hue City

5.1 Legal documents and plans for NBS in Hue City

The legal documents and plans among others laws, policies, and programmes set the framework for NBS in a city or rural area, making them of particular significance. Therefore, they have to be viewed and evaluated in-depth in order to find possible starting points for the promotion and integration of NBS and GBI. This is a highly complex task and the following section attempt to provide a first overview of the relevant legal documents, divided into general legal documents relevant for NBS in Hue City and legal documents and plans to adapt and mitigate climate change in Thua Thien Hue province.

5.1.1 General legal documents relevant for NBS in Hue City

The Thua Thien province legal documents are strongly shaped by the aim of making Hue City a central government city. This aim and others involve a lot of development in the city and rural area of Thua Thien, offering numerous possibilities to integrate NBS.

Conclusion No. 48-KL/TW dated May 25, 2009

The Conclusion No. 48-KL/TW dated May 25, 2009, of the Politburo (10th period), on the construction and development of Thua Thien Hue province and Hue urban region towards 2020 states that by 2020 the Thua Thien Hue province deserves to be a national, regional and international urban centre, becoming one of the major economic, cultural, scientific-technological, medical, and training centres of Southeast Asia. Therefore, restoring, embellishing, protecting and promoting the heritage of the Imperial Capital Hue is one of the major responsibilities of the Party Committee, authorities, people of Thua Thien Hue and the whole country. Thus, this conclusion plays a crucial role in the development of the Thua Thien Hue Province.

Decision 818/QD-TTg dated June 7, 2010

The Decision 818/QD-TTg dated June 7, 2010, approves the scheme on adjusting the conservation planning and the promotion of the value of Hue’s ancient ruins for the period 2010 to 2020. This decision emphasised amongst others that the complex of Hue’s Monuments have been recognised by UNESCO as a Cultural Heritage of humanity and the Hue Royal Music is an invaluable asset of the nation. Maintaining the integrity of Hue's cultural heritage means to preserve the cultural assets of the nation, and at the same time to preserve and enrich the treasures of human culture. In addition, the protection and embellishment of the urban architectural landscape and the natural landscape planning is inseparable from the architectural landscape and natural landscapes of Hue’s Monuments. The preservation and promotion of the value of Hue’s complex monuments must be done simultaneously and synchronously in all three domains, namely tangible cultural heritage, intangible cultural heritage, cultural landscape and urban landscape and nature. Furthermore, Decision 818/QD-TTg states the preservation and promotion of the value of Hue’s complex

monuments must be associated with economic growth and the development of cultural tourism while developing a restructuring of the provincial economy and promoting advantages and standards for the integration and sustainable development.

Decision 649/QD-TTg dated May 6, 2014

In 2014, the Decision 649/QD-TTg, dated May 6, 2014, approved the adjustment of the general planning of Hue City towards 2030 and with a vision to 2050. In this Decision, details for urban planning and socio-economic activities in Hue City are formulated to conduct the Conclusion No. 48-KL/TW dated May 25, 2009 (see above). The scope of planning adjustment covers the existing Hue City (70.67 km^2) and the urban development-oriented area within the towns of Huong Thuy, Huong Tra and part of Phu Vang district (Thuan An town and neighbouring communes) (about 348,54 km^2).

The boundaries of this urban development are:

- Eastern boundary: to Thuan An coast,
- Western boundary: to Binh Dien,
- Northern boundary: to Bo River – Tu Ha Ward,
- Southern boundary: to Hue bypass road.

The development objectives include:

- Preserving and promoting the heritage of the ancient capital Hue,
- Building a city with a rational organisational structure consisting of spatial planning, urban architecture in harmony with nature, modern technical infrastructure, while fulfilling the role and functions of urban areas with special ecological features, natural landscapes and national cultural heritage of international importance,
- Transforming Hue City and areas designated for development into a central metropolitan area of the Thua Thien Hue province,
- Transforming Thua Thien Hue into a city directly under the Central Government.

The vision to 2050 includes:

- Developing the city of Hue into one of the 6 national cities in the Vietnamese urban system, one of the three cultural cities of Southeast Asia as "Festival City" and "Tourist Centre",
- Building a vibrant historic city to make Hue a culturally creative city,
- Promoting and developing a high-quality knowledge industry in order to make Hue a knowledge-based industrial city.

As the Decision 649/QD-TTg states, all this with the aim to develop an exemplary environmental city in harmony with nature.

Resolution No. 54-NQ/TW dated December 10, 2019

In 2019, the Politburo issued the Resolution No. 54-NQ/TW dated December 10, 2019, on the construction and development of Thua Thien Hue to 2030, with a vision to 2045. The provincial

government is following the resolution that mainly includes the development of Thua Thien Hue to become a city directly under the Central Government by 2025 based on preserving and promoting the value of the heritage of the ancient capital and Hue's cultural identity. Additionally, the resolution intends the development of key economic sectors like tourism, information technology and communication, industry and high-tech agriculture. Thus, it is an important and meaningful task for socio-economic, political, defence and security purposes, not only in Thua Thien Hue but also in the central key economic zone and the country. The development of Thua Thien Hue must be based on the effective utilisation and promotion of the potentials and advantages of the province and the region. Therefore, the harmonious combination between unique cultural and historical heritages with the natural landscape, diverse and abundant natural resources, the gateway position of the East-West economic corridor and the people of Hue are of particular relevance. The resolution intends by 2030, Thua Thien Hue shall be one of the major and unique centres of Southeast Asia while by 2045, Thua Thien Hue is a festival city, a special cultural, educational, tourist and health centre of Asia.

To become a city directly under the Central Government, the Provincial Party Committee, the People's Council and the People's Committee of Thua Thien Hue Province have issued several further legal documents (see Appendix II: Relevant planning documents, policies and programmes Figure 16).

5.1.2 Legal documents and plans to adapt and mitigate climate change in Thua Thien Hue province

For Thua Thien Hue climate change and related effects as natural disasters are strongly influencing economic development and poverty, posing a major obstacle to achieve the province's socio-economic goals. To tackle this problem the Thua Thien Hue Province's People Committee issued several documents and plans on climate change adaptation and mitigation to increase the resilience of Hue City and the province.

Plan No. 78/KH-UBND dated 18 June 2013

Plan No. 78/KH-UBND of June 18, 2013 aims to implement the national strategy for sustainable development in Thua Thien Hue province by 2020, by defining the following four priorities and orientations:

- Promote and raise awareness of sustainable development among public authorities and agencies at all levels, enterprises, social organisations and the entire population;
- Sustainable development focuses on people and thus maximises the human factor as the subject, the main resource and the goal of sustainable development;
- Sustainable development based on green growth implies to (i) maintain reasonable economic growth associated with environmental protection and social security, (ii) develop fields of culture, tourism, health, education, science and technology, and (iii) maintain national defence, security, social order and safety;

- Sustainable development has to be based on focused and key developments, i.e., mobilising resources to invest in infrastructure related to the establishment of an urban civilised lifestyle to achieve sustainable urbanisation, pursuing the development of a new countryside, and, as the general objective, designing Thua Thien Hue to become an eco-urban landscape and a place of heritage, culture and environmental friendliness.

The province's socio-economic development is linked to the Millennium Development Goals announced by the Socialist Republic of Vietnam. People's quality of life has already improved, and the environment ensures to minimise negative impacts by socio-economic development and the impacts of climate change.

Decision No. 313/QD-UBND dated February 5, 2013

On February 5, 2013, the Thua Thien Hue Provincial People's Committee issued Decision No. 313/QD-UBND to approve the action plan to address climate change in Thua Thien Hue province by 2020. The overall objective of the Climate Change Action Plan is to implement the National Target Programme to respond to climate change in Thua Thien Hue province by serving socio-economic development in the direction of green and sustainable growth, contributing to hunger eradication and poverty alleviation, thus protecting people's lives, and preventing and reducing hazards posed by climate change. The provincial action plan to cope with climate change is the basis for developing, planning or supplementing the planning of industries and neighbourhoods which are integrated in climate change response in the 2020 socio-economic development strategy as well as in subsequent guidelines. The framework of action to respond to climate change in Thua Thien Hue province by 2020 includes 65 projects and programmes, of which the priority period for implementation (2012 to 2015) is constituted of twelve project groups, schemes and programmes. The total capital expected to be mobilised for the implementation of programmes and projects under the action plan to respond to climate change of the province is 4,562,334 billion VND. Capital sources are allocated as follows: 50 % foreign capital and 50 % domestic capital (including about 30% from the central budget, about 10 % from the local budget, about 10 % from other sources).

Plan No. 91/KH-UBND dated August 7, 2015

Plan No. 91/KH-UBND dated August 7, 2015 on the implementation of the national strategy on green growth towards 2020 in Thua Thien Hue province includes some adjustments in which the following points are addressed: (i) Promoting, educating and raising awareness of green growth among public authorities and agencies at all levels, enterprises, social organisations and the entire population, (ii) green growth must make use of the province's potential strengths in culture, heritage, landscape, tourism, healthcare, education, science and technology and therefore developing tourism and services is key and creates a driving force for economic growth, (iii) green growth is based on an increasing investment in the conservation, development and efficient use of natural capital, the reduction of greenhouse gas emissions and the improvement of environmental quality, as well as

the preservation, promotion and development of the historical cultural values and traditions, and (iv) green growth must be created by and directed towards people by contributing to job creation, quickly reducing the poverty rate and improving the quality of life. It is therefore necessary to improve opportunities for everyone to participate in the process of development as well as the access to social services.

The general goal is to develop Thua Thien Hue to become a heritage, cultural, ecological and environmentally friendly urban region with economic sectors that are developing towards greening, i.e., an economical and efficient use of energy and natural resources as well as the improvement of people's quality of life coupled with an environmentally friendly lifestyle. There are many specific objectives:

- Develop the local legal basis system for economical and efficient use of energy and natural resources to implement green growth.
- Change production and consumption patterns in an environmentally friendly manner and thus develop green industry, green agriculture, and green services as well as prevent and effectively handle environmental pollution.
- Stimulate fundamental changes in cultural development, health care, education, science and technology in order to improve the quality of life and promote an environmentally friendly lifestyle.
- Accelerate the process of sustainable urbanisation (target marks by 2020: 95 % of urban centres and 70 % of industrial parks have waste water treatment systems as well as solid waste collection and treatment systems fulfilling prescribed standards, 100 % of medical waste is collected and treated according to environmental standards, public green spaces in urban areas exceed 5 m^2 per capita).
- Formulate, review, adjust and supplement urban construction planning according to a sustainable approach.
- Build the city of Hue to comply with green urban index system
- Continue to (i) implement and organise the monitoring and evaluation of the results of the Action Programme No. 62/CTr-UBND dated August 31, 2011 of the Provincial People's Committee, and (ii) implement the Resolution No. 04-NQ/TU dated July 29, 2011 of Provincial Party Committee on building and developing Thua Thien Hue City under the central government. The urban system in the Programme is built towards reaching the average level of resistance prescribed by the green urban index system.

Decision No. 2260/QD-UBND dated September 28, 2016

According to the classification of natural disasters in the Decision No. 2260/QD-UBND, dated September 28, 2016, there are eight types of natural disaster affecting Thua Thien Hue province: (i) Tropical depressions and storms, (ii) tornados, lightning, hail and mist; (iii) heavy rain, flood and flash

floods, (iv) landslides and land subsidences due to floods or runoff, (v) harmful cold, hoarfrost, hot weather, droughts and saltwater intrusion, (vi) high water and high tide, (vii) strong winds at sea , and (viii) earthquakes and tsunamis.

Decision No. 04/2017/QD-UBND dated January 16, 2017

To manage the collaboration between departments on climate change adaptation, the Decision No. 04/2017/QD-UBND, dated January 16, 2017, about the regulation on interdisciplinary coordination, development, appraisal and implementation of project guidelines on climate change adaptation and mitigation in Thua Thien Hue province was enacted. The Article 5 is about the order of elaboration, appraisal and compilation of approval proposals:

1. Department of Natural Resources and Environment (DONRE):

DONRE assumes the prime responsibility and coordinates with the Department of Planning and Investment, the Department of Finance and concerned departments, branches and localities. Besides DONRE organises the evaluation and definition of a list of projects according to criteria for evaluation of priority projects under the SP-RCC, issued by the Prime Minster together with Decision No. 1719/QD-TTg, dated October 4, 2011, in order to determine a list of projects (in order of priority) of annual investment (local capital, capital sources of the government or foreign funding). DONRE either submit results of the evaluation, expert knowledge and cost estimates of climate change programmes and projects to the Provincial People's Committee or advise the Provincial People's Committee to submit the results to the relevant ministry or the government for approval (with remarks regarding the order of priority for each project).

2. Local departments and boards:

Once a climate change project has been approved by the competent authority or an investment decision has been made, the authority is responsible for the preparation of the dossier and the content of the project according to the priority project evaluation criteria in Decision No. 1719/QD-TTg. issued by the Prime Minister on October 4, 2011. Project documents are then sent to the Departments of Planning and Investment, Finance, Natural Resources and Environment. The Department of Natural Resources and Environment shall evaluate the content of the programme and project and forwards corresponding remarks to the Department of Planning and Investment.

3. Department of Planning and Investment:

The provincial or municipal Planning and Investment Services guide the elaboration of project details, capital plans and assignments in the investment period based on the list of projects (in order of priority) approved by competent authorities and on investment policies. The Planning and Investment Services take on the prime responsibility and coordinate with the Department of Natural Resources and Environment, the Department of Finance and the relevant units in appraising project contents. The elaborated project details, capital plans and assignments are submitted to the Provincial People's Committee or recommended to the Provincial People's Committee to decide on

investments, to receive investments, or to submit to the Ministry. Finally, the government decides to invest under its supervision.

4. Department of Finance:

The Department of Finance takes primary responsibility for evaluating detailed project cost estimates and coordinate them with the agencies concerned. Balance allocations for the project or advice on sources of capital in accordance with the regulations submitted to the Provincial People's Committee for approval or to the responsible authorities for approval.

Plan No. 200/KH-UBND dated October 5, 2017

Plan No. 200/KH-UBND dated October 5, 2017 aims to mobilise community resources and enlist the support and funding of international organisations for environmental protection and climate change adaptation in Thua Thien Hue province for the period 2017 to 2022. The purposes of the Plan are determined as follows: Firstly, strengthen environmental protection and proactively adapt to climate change, thereby contributing to sustainable development, poverty reduction and improvement of the quality of life. In addition, enhance promotion, education and advocacy of environmental protection and climate change adaptation to improve (i) the capacity and sense of responsibility of the community to participate in environmental protection, (ii) the effective and economical use of natural resources, (iii) biodiversity protection, (iv) environmentally friendly life styles, (v) clean and renewable energy, and (vi) sustainable production and consumption. Moreover, it promotes and enhances the role of the community in environmental protection and climate change adaptation. Secondly, develop the community's strength in building a model of environmental protection through the encouragement of the authorities, creating favourable conditions and empowering the community to take initiative in specific fields. Besides the plan aims to strengthen the control and outreach of the community in solving a number of environmental issues in order to create better opportunities for local economic benefits. Finally, the plan aims to take advantage of the support of international organisations in order to foster environmental protection and climate change adaptation, focusing on the implementation of Programme No. 22/CTr-TU dated April 19, 2017 of Thua Thien Hue Provincial Party Committee related to environmental problems.

The Appendix II: Relevant planning documents, policies and programmes

Figure 17, can give more details about further legal documents related to climate change adaptation in Thua Thien Hue province.

Summarising the documents and plans, reference points for NBS and GBI could only be found indirectly and their integration remains a possible task for the future. Regarding climate change adaptation and mitigation, several legal documents and plans have been issued and the integration into urban planning and socio-economic development can be noted to a certain degree. Thus, it appears that, besides the target to become a city directly under the central government, it is a clear target to make Hue City and the province of Thua Thien Hue more resilient. According to the series

of interviews, the most important plan for the development and implementation of NBS is the master plan (Decision 649/QD-TTg) (F. of Environmental S., CCCO Binh Dinh). In this plan, possible areas for NBS can be identified (CCCO Binh Dinh). However, the master plan was described as very weak and overall, not successful as the majority could not be realised (F. of Environmental S.). A missing policy described by the interviewees was a policy for the construction process (F. of Architecture), the regulation on environmental planning (F. of Forestry), and a plan for landscape planning (DONRE). Additionally, it was pointed out that polices are often not followed in practice (CODES), requiring stricter enforcement. Nevertheless, there is reason to believe that environmental planning, and hence, possibly also NBS and GBI will gain in importance as there is the political backing by the current chairman of Thua Thien Hue Provincial People's Committee, Mr. Phan Ngoc Tho, and the current mayor of Hue, Hoang Hai Minh. Both are great supporters for environmental and climate protection (CODES, F. of Forestry). As mentioned before, this section can also be seen as a first overview of the relevant policy for the implementation of NBS that needs in-depth research.

- The planned development in Hue City offers numerous possibilities to integrate NBS
- Reference points for NBS and GBI could only be found indirectly and their integration remains a possible task for the future
- Climate change adaption and mitigation needs to be further mainstreamed
- There is the political backing by the current leaders, both being great supporters for environmental and climate protection
- Scientific analysis of the relevant policy for NBS in Hue is a highly complex task that needs further in-depth research

5.2 Key actors for NBS in Hue City

The development of NBS is a crosscutting issue that requires a multidisciplinary and multi-stakeholder framework. Thus, an effective implementation of NBS strongly depends on the relation of the stakeholder from various disciplines and sectors that are usually not used to work closely. This is also the case in Hue City. In the following section, Hue's key actors for NBS are briefly described together with a figure showing its relationship in a stakeholder map (Figure 15).

Executive body – Thua Thien Hue Provincial People's Committee

Generally, the provincial government is the coordinator between the central government and the local government to convey the orientations, conclusions, decisions, and resolutions into action plans. The provincial government is also the unit to mobilise the resources for investment in urban development according to the requirements of the central government. Legally, the Thua Thien Hue Provincial People's Committee issues a decision to establish a Steering Committee to coordinate the exchange between stakeholders, in which one defined department will be the main host to

consult for the provincial government. This makes the support of the Thua Thien Hue Provincial People's Committee decisive for the implementation of NBS projects in the city of Hue.

Provincial Departments

The provincial departments are the specialised units that assist the Provincial People's Committee in formulating projects, programmes, and plans. In addition, they implement the plans according to their field of expertise while ensuring the legal basis for activities. Therefore, the departments support the Provincial People's Committee in proposing ministries, central governments and, related agencies to mobilise resources for implementation. The departments hold the primary responsibility for the implementation of the plans that they are realising in coordination with other relevant departments. In addition, their duties include the review and guidance of local authorities to review, adjust and supplement plans in alignment with the urban development objectives. Regarding the development and implementation of NBS in Hue, the most relevant departments are the Department of Planning and Investment (DPI), the Department of Construction, the Department of Natural Resources and Environment (DONRE) and the Department of Agriculture and Rural Development. Depending on the specific NBS, other departments like the Department of Tourism and the Department of Transportation can also be relevant for its implementation.

City Government

The city government manages specialised departments to carry out the plans according to the instructions from the Provincial People's Committee. The city government also mobilises resources to ensure the city's development as provided under the approved plan. Furthermore, the city government directs and manages local governments to manage the database systems, providing information on the socio-economic development of the city. For developing and implementing NBS in Hue City, the Urban Management Office and the Natural Resources and Environment Office are key actors. In addition, the respective local government(s) must be involved for relevant projects in the respective ward(s).

Public Agencies

The public agencies are the independent state economic entities under the direct management of the provincial government. They are responsible for specific sectors of the province. These entities have state capital and operate as a state company. The Green Tree Company and the Hue City Environment and Water Improvement System (HEPCO) are identified as key actors for NBS in the city of Hue. Similar to the departments, the specific NBS determines the ultimate key actors, for instance the Hue Monuments Conservation Centre (HMCC), the Hue Water Supply Company (HueWACO) and others can also be relevant.

Scientific Institutions

Scientific institutions act among other things as advisors to the Provincial People's Committee. These units review provincial planning projects and development policies. Academic experts can

participate in the development of policies and projects. Hue's academic landscape is quite diverse, covering several scientific fields. The NBS key actors from Hue Universities are the Faculty of Environment, Hue University of Sciences; the Faculty of Architecture, Hue University of Sciences; and the Institute of Environmental and Occupational Health, Hue University. Considering relevant local institutions, the Hue Institute for Development Studies (HueIDS), the Mientrung Institute for Scientific Research (MISR), the Institute of Resources and Environment (IREN) as well as the Institute of Construction Planning seem to be crucial for NBS in Hue. Also, these actors can be supplemented by others like the University of Agriculture and Forestry, Hue University (HUAF) depending on the development of the specific NBS.

Civil Society

Civil society entities, also known as non-governmental organisations (NGOs), usually have a social mission functioning in a specific field such as women, youth, animals, nature, and others. They often advocate the voice of the community and help them to identify problems that need urgent improvement. In addition, NGOs help communities to review planning projects or to organise meetings with local governments and associations. Thus, these units play an important role in the community well-being and are also essential for the development of NBS. So far, the NGO Centre for Community Development and Social Work (CODES) is identified as a key actor for the development and implementation of NBS in Hue and will be certainly supplemented by other actors such as the Centre for Social Research and Development (CSRD) and local associations.

Local People

The voice of the local people is very important in planning, as they are the ones who are directly influenced by the implementation of plans and projects. Reaching people's consensus is a major challenge for the conduction of infrastructure projects. Therefore, participation processes are conducted that are discussed in further detail in section 5.5 Participation in .

A detailed description of the stakeholders for NBS in Hue can be found in the supplementary document "Nature-based solutions in the city of Hue – An in-depth description of key stakeholders with regards to the development of nature-based solutions in the city of Hue".

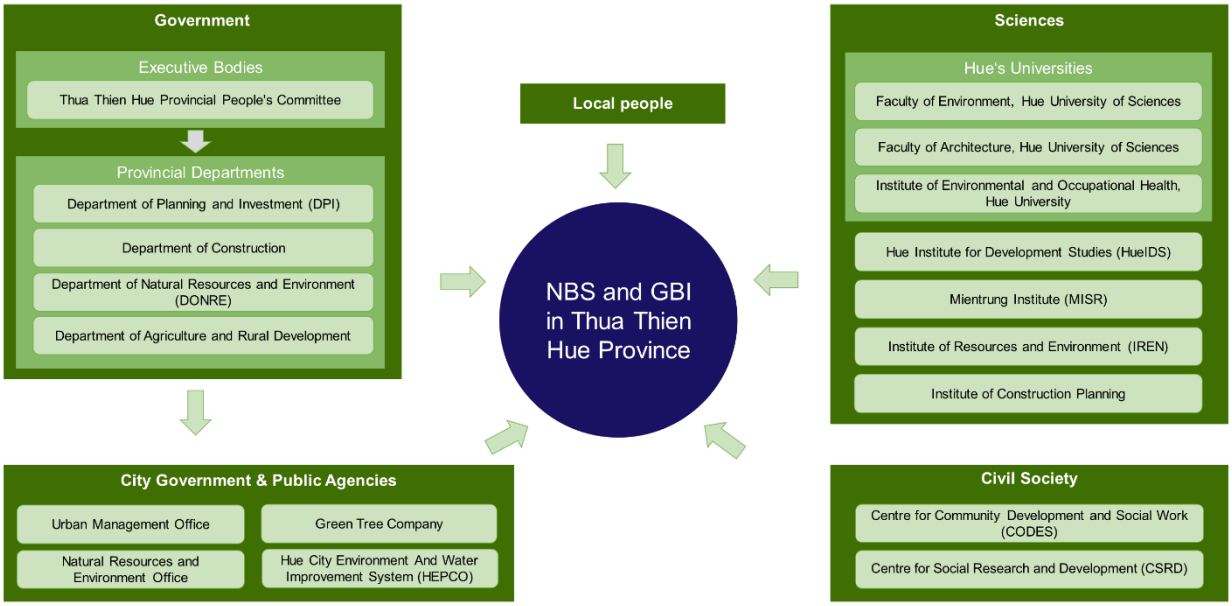


Figure 15. Stakeholder map of key actors for NBS in Hue City, Vietnam.

Based on the interviews a first stakeholder map of the key actors for NBS in Hue City could be developed (Figure 15). Its actors and precise relations have to be tested in practice and adapted accordingly. Nevertheless, the stakeholder map already demonstrates the large number of stakeholders and their diverse background, making an effective collaboration on NBS and GBI a challenging task.

This challenge became very evident when one interviewee shared his personal observation of the coordination between the different departments regarding planting trees for infrastructure projects: “When planning, trees are the last thing after cables and everything” (F. of Forestry). This means the ones who take care of green spaces and trees are the last one to be called for the development of an infrastructure project and they only have the chance to set a plant where some space is left (F. of Forestry). This approach is often ineffective for the infrastructure and in particular for the green space. The integration of green space in infrastructure projects needs integral thinking and collaboration. Therefore, the coordination between the different departments involved needs to be harmonised and environmental planning needs to be integrated into urban planning (F. of Forestry). Furthermore, the knowledge transfer between science on the one hand and politics as well as public administration on the other hand was described as weak and can be strengthened (F. of Public Health). Moreover, were pointed out that the diverse stakeholders do not understand each other well as their knowledge and awareness differ and lacking environmental planning generally (F. of Forestry, DONRE). This also underlines the need of further education and capacity training. To sum up, these tasks require effective coordination (mechanisms) and platforms where the complex task of developing and implementing NBS can be dealt and the stakeholders involved can regularly get together to build up trust and a culture of collaboration.

- The support of the Thua Thien Hue Provincial People's Committee decisive for the implementation of NBS projects
- The large number of stakeholders and their diverse background, making an effective collaboration on NBS and GBI a challenging task
- The coordination between the different departments involved needs to be harmonised and environmental planning needs to be integrated into urban planning
- This requires effective coordination (mechanisms) and platforms as well as further education and capacity training
- The knowledge transfer between science and politics/public administration can be strengthened

5.3 Implementation and barriers of NBS in Hue City

The identification of possible barriers is crucial for an effective implementation of NBS. In the context of GBI according to Brears (2018), there are seven categories that can be used to classify barriers. They contain barriers for the implementation of NBS in Hue City as identified by the interviewees:

Economic (e.g. difficulty in quantifying benefits, high land values):

- none stated.

Financial (e.g. lack of financial resources):

- lack of financial resources (DOC, F. of Public Health, CCCO Binh Dinh).

Institutional (e.g. lock-in of traditional practices, lack of resources):

- lack of coordination between the relevant stakeholders for NBS, imbalance of environmental matters (F. of Architecture, F. of Forestry, DONRE);
- lack of policy for construction (F. of Architecture, CCCO Binh Dinh).

Regulatory (e.g. regulatory standards):

- lack of a definition of green infrastructure (DONRE);
- lack of regulation to mainstream environmental matters (F. of Forestry);
- weak control and lack of legal penalty (F. of Architecture).

Infrastructural (e.g. lack of physical space, inadequate sizing):

- lack of land and other spaces (e.g. roofs, walls) (DONRE).

Awareness and knowledge (e.g. lack of understanding, short-term thinking):

- awareness about climate change and environmental issues among the stakeholders and the public (ACVN, F. of Architecture, DONRE, anonymous);
- lack of consensus between stakeholders as well as between the government and the public regarding environmental matters (DONRE, HEPCO);

- lack of experts, advisor and expert knowledge (F. of Architecture).

Mental (e.g. perception, fear, interactional injustice, racism):

- Hue is a conservative city, making urban planning challenging (F. of Forestry).

Apart from the barriers presented, there is a good momentum for the implementation of NBS in Hue especially due to the political backing by the chairman of Thua Thien Hue Province's People Committee, Mr. Phan Ngoc Tho, and the mayor of Hue, Hoang Hai Minh, that a both great supporters for environmental and climate protection (CODES, F. of Forestry).

- Major barriers for the implementation of NBS are: a lack of financial resources, a lack of coordination between the relevant stakeholders, raising awareness about climate change and environmental issues among the stakeholders and the public
- The institutional set up including financial resources must be strengthened and a large focus on awareness building must be set to successfully promote and implement NBS in Hue City

5.4 Financing NBS in Hue City

Financial resources and effective financial mechanisms are key to a successful implementation of NBS. Based on the interviews a few crucial points could be gathered that can help to develop a first overview about financing NBS.

In general, the provincial and city budget for environmental matters is very limited (F. of Environmental S., F. of Forestry, anonymous). This is mainly resulting from the national strategy and a limited national budget for GBI as the focus lies rather on economic growth (ACVN). Furthermore, Hue City is classified as a non-central city and hence is generally not receiving much funding nor attention from the national government (F. of Environmental S.). For this and other reasons, international finance plays a special role and "green projects" have been mainly funded by international donors, especially by Japan and Korea (CCCO Binh Dinh, F. of Architecture, F. of Environmental S., F. of Forestry). In addition to that, for the realisation of GBI projects are public-private partnerships of special importance (ACVN, F. of Forestry) besides mobilising local funding (ACVN). In fact, two interviewees underlined the private sector and its responsibility in contributing to environmental projects (CCCO Binh Dinh, F. of Forestry). Beyond that, the mobilisation of local funds and labour is commonly applied in Vietnam as community-based activities and is very powerful. Examples for (planned) community-based activities in Hue are several mangrove forest plantings, the four-seasonal city campaign as well as the "Green Sunday" and the "say-NO"-campaign about plastic bottles. Finally, for an effective implementation, the budget should be defined in accordance with the policies and strategies, which is often lacking in Vietnam (ACVN).

- Finance mechanisms for environmental projects are very limited
- Due to a lack of public funds, international investments, public-private partnerships and the mobilisation of local funds and labour are crucial for financing NBS projects
- The budget should be defined in accordance with the policies and strategies

5.5 Participation in Hue City

Participation plays a special role for the effective implementation of NBS and allows public interests to be taken into account while at the same time strengthening a project through local knowledge. The initial exchange with the 23 interviewed experts regarding the role of participation in general and its role for an effective implementation of NBS shows that participation in Hue City is performed on a rather low level and often remains on the level of information (ACVN, F. of Forestry, IREN). Furthermore, participation is described as a process that is mainly applied top-down (F. of Architecture) and therewith prone to social conflicts (CODES).

There is also a long tradition of paying the public for their participation (Bac Trung Nam Ldt., CODES). According to an NGO representative, this can generate counterproductive effects such as participation only based on monetary reason running the risk of destructive contributions (CODES). In fact, the local NGO CODES operating in the social sector, decided to not follow this tradition anymore and reports about good results of the conduction of participation processes without financial reimbursement. One mentioned example of participation with relation to GBI was the involvement of locals in the development of the Lim Bridge (IREN). According to the interviewee, the participation process was “a lot of work and only little outcome”, but generated helpful contributions to the project (IREN).

A few of the experts expressed the need to focus more on people’s needs and to intensify participation (ACVN, Bac Trung Nam Ldt., DOC, CODES). One interviewee went even a step further and suggested to start projects from the demand of people living in the area (DOC). Another expert reported from the case that Hue has to record wilful damages against certain trees species by residents and underlined the need to develop together with residents a common ground and consensus on the chosen tree species in order to reduce damages (F. of Forestry). The expert from the nationally operating Association of Cities in Vietnam (ACVN) noticed that local people are very eager to join the development of urban projects (ACVN). In the wake of discussion, the importance of campaigning to increase participation was thematised, as well as the special value of launching a pilot project or a study tour to demonstrate projects to the public (DONRE).

In order to develop and conduct fitting participation processes and appealing campaigns for NBS further research could be fruitful. Considering limited financial resources for NBS and the importance

of alternative financing mechanisms like mobilising local funds and labour as well as the need to raise awareness about climate change in the public, participation gains additional relevance.

- Participation is performed on a rather low level and often remains on the level of information
- There is a social need and responsibility to involve locals that can generate great benefits
- Further research about participation processes and campaigns could be fruitful to relate them to NBS

5.6 Lessons learned from Quy Nhon City

Beyond interviewing 21 local experts from the relevant sectors, one interviewee expanded on this perspective by sharing experiences from the implementation of NBS in another Vietnamese city. In the city Quy Nhon a plan was developed to restore nature by enhancing the local mangrove forest and creating new parks – as part of the international project URBAN GreenUP[7]. The lessons learned from that experience are briefly discussed in this section[8], as they contain valuable reference points.

Development of an own NBS approach

A major issue the city of Quy Nhon had to deal with was the development of an own understanding and definition of NBS. Especially because NBS like planting a mangrove forest are nothing new and are traditionally practised all over Vietnam. Hence, new questions had to be asked: "How to conduct the NBS, how to raise money from private and public entities to finance NBS, and how to involve relevant stakeholders?" Therefore, Dr. Coung shared, the city of Quy Nhon had to find their own approach for NBS in order to adopt an international approach to the local context of a Vietnamese city. In this context Dr. Coung pointed out, simply copying and pasting a concept or project from abroad causes problems as the local situation is complex and differs from place to place.

The Climate Change Coordination Office as a coordination mechanism

According to the interview with Dr. Cuong, the Climate Change Coordination Office (CCCO) that is operating on the city level and belonging to the community directory is "very important" for the implementation of NBS in the city of Quy Nhon. They have to work with a large number of departments and local people, for instance, to collect necessary data or to pay for jobs. The CCCO enables the city of Quy Nhon to fulfil these challenging tasks, creating a fluent workflow for the management of NBS.

Focusing on a few concrete NBS

[7] URBAN GreenUP is a project funded under the European Union's Horizon 2020 programme. Its objective is the development, application and replication of Renaturing Urban Plans in a number of European and non-European partner cities with the aim to mitigate the effects of climate change, improve air quality and water management, as well as to increase the sustainability of our cities through innovative nature-based solutions. (URBAN GreenUP)

[8] This section, 5.6, is based on the interview with Dr. Coung (I21).

Experiences with the implementation of NBS in Quy Nhon city showed, that the topic of climate change and the diverse preventive and adaptive measures, such as NBS, are generally very abstract and complex topics. To deal with that Quy Nhon city concentrated only on two concrete NBS financed by two different sectors. This helped them to approach the complex topic also for the public.

Application of different funding approaches

In practice, the approach of following different ways to fund NBS has proven its worth. In the case of Quy Nhon, one project is financed by an international fund, whereas the other is realised through private funds by locals. This approach allowed the Quy Nhon city to study the different finance mechanisms to develop general learnings for financing future projects. According to Dr. Coung, it is important to understand and be able to deal well with the different funding types from public, private and international sources as their combination can balance and be combined to finance NBS. In this context, private funds are especially important. If the NBS project achieves personal benefits and clearly communicates them to stakeholders, it is easy to motivate the public to contribute financially or with working time, as it has been the case for Quy Nhon. Funds from the local economy play a subordinate role as they have not been used to implement NBS so far.

Learning by doing

Being a few years ahead with the implementation of NBS, Quy Nhon's experiences shows that the best way to learn how to develop and promote NBS is by carrying out real projects. Based on Dr. Coung's observations, it is important to respond to local conditions and these conditions are different everywhere as mentioned before. Thus, theory helped only to a certain degree and the practice delivered them vital learnings for an effective implementation of NBS.

Quy Nhon city's lessons learned to implement NBS effectively are:

1. Development of an own NBS approach
2. The Climate Change Coordination Office as a coordination mechanism
3. Focusing on a few concrete NBS
4. Application of different funding approaches
5. Learning by doing

6 Awareness of climate change and social aspects for NBS in Hue City

6.1 Awareness of climate change

Environmentally friendly behaviour depends strongly on personal awareness of climate change. To learn about the current awareness of climate change of people living in Hue, the experts were asked about their first assessment. They largely agreed that academics are to a great extent aware of climate change. Different opinions were shared regarding the public: Whereas some interviewees have the impression that the general public lacks information on environmental issues and thus sees only a little public awareness (F. of Public Health, F. of Geography, anonymous); other experts see the public as very concerned and aware of climate change (F. of Environment, F. of Geography). According to an interviewee, this awareness also results from the situation that many people in the city of Hue are affected by climate change, as by diseases due to air pollution, and hence are very sensitised for current environmental changes (F. of Environment). At the same time, there are people that may not know that they are affected by climate change and do not even know the term climate change, but they are well aware of the environmental changes that have been occurred in the past as they are rather old and work outside and thus are experiencing the changes such as fishermen and farmers (Farmer Association Kim Long Ward, IREN). This holds less true for younger people and people living in air-conditioned houses (Farmer Association Kim Long Ward, IREN). Looking at the rural area in Vietnam in general, the awareness of climate change is still rather low, and information and education is needed (ACVN). Whether the awareness is high or low, “green education” is needed for the public (F. of Public Health, HueIDS), and also for public employees (ACVN). Beside essential practical approaches that should be spread, there is also a value in connecting the people closer to the park and the green by thematising how to treat green spaces and showing possible activities in the park (Bac Trung Nam Ldt.). Launching awareness-raising campaigns were attributed a special importance to promote awareness for climate change and to sensitise for individual contributions (F. of Public Health, F. of Environmental S., DONRE).

- The degree of awareness of climate change is mixed
- Information and education are clearly needed to raise further awareness
- Awareness-raising campaigns are very powerful

6.2 Social aspects

Since the social side is fundamental for NBS, the interviews thematised several social aspects, while pointing out that the assembly of facts cannot be seen as comprehensive as it is based on a small database.

Hue was mainly described as a conservative city that initiate changes only very carefully (F. of Forestry). One interviewee shared, Hue has its own identity, being very persistent, smart, and connecting the old and the new (ACVN). A high degree of identification with the city could been noticed, such as describing Hue as “the ideal place for living” (F. of Public Health). One of the major reasons for the high degree of identification is because Hue is a very green city (F. of Public Health).

Religion is very central to the people in Hue and Vietnam overall. In the given context, the interviewees named especially Buddhism and Feng Shui (DOC, HMCC). Buddhism was described as living in harmony with nature, while Feng Shui rather determines how to design buildings for spiritual reasons such as the citadel (HMCC) or the traditional garden house (DOC). In any case, diverse religions and their culture are influencing daily life and religious acts are regularly carried out. Very popular and also on a regular basis happening is the burning of papers and little offerings, which in fact, causes some problems for the public company that takes care of the cleaning as the waste usually remains on the streets and sometimes even causes fire (F. of Forestry, HEPCO).

6.2.1 Preferences and barriers for leisure activities by age groups

During the interviews the experts were asked for their assessments regarding the preferences and barriers for leisure activities for people living in Hue, coming to the following results that can give a first impression:

Older generation:

- pursues less money-consuming activities, characterised by the past and the wish to save money for better living conditions in the future (Bac Trung Nam Ldt.);
- like to do sport outdoor, e.g. along the Huong River and around bridges (F. of Public Health, Farmer Association Kim Long Ward);
- like to travel (Bac Trung Nam Ldt.).

Middle-aged generation:

- spends a lot of time working (F. of Public Health);
- like to do sport outdoor, especially in the morning, e.g. near the river and around bridges (Bac Trung Nam Ldt., Farmer Association Kim Long Ward, IREN);
- like bicycling (Bac Trung Nam Ldt., Farmer Association Kim Long Ward);
- like to relax and spend time with the family at home (F. of Public Health).

Younger generation:

- spends a lot of time at home and indoor (F. of Public Health, F. of Geography); as it lacks outdoor activities especially for young children (F. of Geography)
- like to travel (Bac Trung Nam Ldt., F. of Public Health);
- like to spend time at coffee shops (F. of Public Health);
- like gaming (F. of Public Health);

- like to play football (HEPCO).

The park along the Huong River (F. of Environment, IREN), the wooden bridge (IREN) as well as the walking streets (IREN) were mentioned as spaces for young children. One interviewee pointed out that it would be nice for adolescents to create some more facilities and private spaces along the Huong River (F. of Environmental S.). In this line of thought, it can be questioning if the younger generation would spend so much time at coffee places if they would have alternative public spaces?

Further general preferences by the people of Hue:

- spend a lot of time at home, e.g. for TV, cooking, etc. (F. of Public Health, F. of Geography), due to a cultural habit and the need of saving money (Bac Trung Nam Ldt., F. of Geography) and a lack of offers (F. of Geography);
- camping and trekking in the wood (F. of Public Health, F. of Environmental S.);
- most popular green spaces are the Houng River and the citadel and its surrounding, (F. of Public Health);
- taking a walk, e.g. in the walking area (F. of Public Health);
- like the nature and the green sides of Hue (F. of Public Health).

In addition to that, some gender-specific differences were given. Women were described as closer connected to nature and the environment and pursuing childcare and the household stronger as men do (F. of Public Health, F. of Environment). Men were characterised as being less connected and taking less care of the environment as woman do while working more (F. of Environment).

Besides these preferences, several barriers have been mentioned during the interviews that have an influence on the use of public green spaces.

Barriers:

- a lack of safety in parks against raids (anonymous);
- a lack of public toilets in the parks (F. of Public Health);
- the fear of animals (e.g. snakes) and the aversion to mosquitos (Eurasia Foundation VN, anonymous);
- the superstitiousness about certain types of trees that e.g. induce some people to damage trees (anonymous);
- the strong sun, that induces quite a lot of people to cover up their skin to protect from sunlight (F. of Environment).

Considering the presented preferences, an offer on more public green spaces can be seen as a clear gain to Hue’s society that can support connecting the people to the environment and therewith stimulate needed awareness.

6.2.2 Social trends

In order to develop an understanding of Hue's society and current changes, the interviewed experts were asked to share social trends and general changes in behaviour, habits, and lifestyle that they observe, with the following summarised answers:

- increased/increasing consumption, especially of plastics ("what were wrapped in banana leaves before is now covered by plastic") (Farmer Association Kim Long Ward);
- progressing digitalisation (F. of Architecture), increasing the use of electronic devices (HEPCO);
- shrinking households in terms of number of residents, causing an increasing demand for houses (F. of Geography);
- increasing use of air-conditioning, causing increasing higher electricity bills (F. of Geography);
- increasing demand for greenhouses or rather house with an increasing share of windows (DOC);
- increasing ownership and use of an own car (F. of Geography);
- increasing amount of people doing sports outside (IREN);

Especially concerning the younger generation:

- increasing interest in an environmentally friendly living space like, e.g. considering to bicycle (IREN, anonymous);
- heeding of recycling, the 3Rs (Reduce, Reuse & Recycle) and the Green Sundays (DONRE, Farmer Association Kim Long Ward);
- increasing demand for spending time outside instead at home (IREN);
- increasing use of coffee shop (F. of Geography);
- increasing mobility to travel around (F. of Geography).

Standing out of the results of the social trends but also of others, is the strong presence of the younger generation that is partially involved by the global movement towards the development of more sustainable lifestyles.

6.2.3 Social innovations

During the interviews, two projects in the city of Hue could be identified that can be classified as social innovations. According to Howaldt and Schwarz (2010) social innovations are new social practices aiming to meet social needs in a better way than the existing solutions. Due to its social approach, there are possible connections to NBS and the projects are therefore briefly presented here:

- Urban farming project: The Farming Association Kim Long Ward is running a community garden owned by six families that harvest and sell together organic farming (Farmer Association Kim Long Ward).
- Urban beekeeping project: The Beekeepers Association of Thua Thien Hue is keeping bees in the urban area of Hue with a small of supporters (five hobby beekeeper) (Bee Association).

Another social aspect is the inclusiveness of cities, especially in terms of an easily accessible city for people with disabilities. In this regard, the experts notice a lack and described the city as being challenging for disabled people (F. of Public Health, F. of Geography). Nevertheless, there are a few examples of inclusive construction in Hue like the Lim Bridge (Eurasia Foundation VN). Other social aspects were not mentioned and thematised at this point.

- Hue being a green city is one of the major reasons for the high degree of identification of the residents
- In terms of preferences there are some generational and gender-specific differences
- Spending time at home is quite common and often due to a lack of offers, especially for young children
- There are several barriers that have an influence on the use of public green space
- An offer on more public green spaces can be seen as a clear gain to Hue’s society that can support connecting the people to the environment and therewith stimulate needed awareness
- Strong focus on the younger generation that is partially involved by the global movement towards the development of more sustainable lifestyles
- There are some social innovations like the urban farming project and urban beekeeping project
- Inclusiveness of cities is very limited

7 Discussion

By 2030, the city of Hue strives to become one of the major and unique centres of Southeast Asia for culture, tourism, and health, as well as one of the largest national centres for science and technology, multidisciplinary and high-quality education, and all this while preserving the city's heritage. The pursuit of these goals has one thing in common, namely the improvement of the quality of life of Hue's residents. However, climate change and its impacts are hampering the achievement of the aforementioned aims since Hue City is one of the areas in Vietnam most affected by climate change. A development that considers NBS as a measure to adapt to and mitigate climate change could ensure that the main objectives are met.

According to our study, a preliminary assessment of climate change impacts indicates generally warmer conditions and an increasing total precipitation for the region. The city of Hue will likely face increases in near-surface air temperature (both annual averaged and extreme), and an increase in precipitation. The overall public awareness of climate change is mixed, with some local experts interviewed indicating a lack of awareness, while others believe that the public is aware of it. Therefore, more targeted information and education on climate change and environmental issues are recommended, especially as many people in the city of Hue are affected by its impacts such as flooding, urban heat stress as well as air and noise pollution. This would also promote acceptance and support for the implementation of NBS, as awareness were identified as a major barrier. Results of our research show that several projects in Thua Thien Hue province are addressing the problem of flooding but projects dealing with urban heat stress and air pollution are rare and have not received as much attention so far. Even though heat stress and air pollution are major impacts of climate change in the city of Hue, especially in the denser inner city and university area. In addition, these are crucial topics for the public due to the direct effects on health.

The analysis of the green infrastructure showed that Hue is already a relatively green city with 12.9 m² public green space per capita in accordance with standards for a Class I city, but with a quiet low park area with 1.88 m² per capita (standard 6-7.5 m² per capita). In addition, the existing green is not evenly distributed among the city with access to green areas being particularly limited in the historical centre of the city. Thus, the promotion of further public green spaces that are evenly distributed among the city would be beneficial for environmental as well as social reasons. Agricultural land and forest areas are reported to decrease. Today, about 6 % of the city consists of forests. Agricultural land is mainly concentrated in the outskirts and covers almost 20 % of the city area. According to the co-created case study typology cemeteries are not considered GBI in the city of Hue. However, since cemeteries cover large areas in the south and west of the city and account for about 8 % of the city, these areas, their potential for ecosystem services and public perception are interesting for further research. Sports facilities only cover close to 0.5 % of the city area and are widely spread. About 4,228 traditional garden houses with a size of at least 400 m² contribute to a

certain amount of private green space. With the presence of other GBI elements that are also included in the case study typology, such as green atriums, façade-bound and ground-based green walls, green roofs and vegetated pergolas, it can be assumed that awareness for these elements is present. However, they have not been considered in an overall concept of GBI to adapt to urban heat stress and reduce air pollution. At present, about 65,000 trees of about 60 species along the streets of Hue improve not only the (micro-)climate and air quality of the city, but also its aesthetics. But an annual planting of 5,000 seedlings is necessary to maintain this number due to losses caused by climate change impacts in Hue. An initial vegetation classification based on the NDVI showed that the share of GBI correlates with classified vegetated areas in most wards but also revealed the high amount of green of certain land uses, in particular historic and cultural monuments. Determining the proportion of green space for specific land uses, e.g. for educational facilities and urban residential areas in the city centre and in the outskirts, using the NDVI could be an interesting starting point for future research and thus for the implementation of NBS within different land uses. Besides green infrastructure, blue infrastructure is also quite prominent in Hue, almost 10 % of the city area is covered by water bodies, with the highest density of blue infrastructure elements located around the citadel. The inventory of GBI of this report provides an essential basis for the discussion, development, and evaluation of concepts for the enhancement and (re-)creation of GBI elements in the city of Hue.

The overall concept of NBS is not a new concept in general and for the stakeholders in Hue. However, it is not yet systematically considered in urban planning. The first analysis of the policy framework for NBS in Hue City showed that reference points for NBS and GBI could only be found indirectly. Therefore, their integration remains a possible task for the future. The planned development in Hue City, in particular its urban expansion, opens up numerous possibilities to integrate NBS, especially in the light of improving the ratio of green space. However, the situation in Hue is complex and needs individual solutions adapted to the local circumstances. Moreover, experts emphasise that joint capacity building among stakeholders is needed and best stimulated through practice. Therefore, a case study approach with adaptations to individual local situations, which includes all levels of the implementation of measures for all levels of stakeholders, is necessary to understand the basic features of this concept and to make the full scope of benefits visible.

The promotion and implementation of NBS needs coordination and participation. Due to the number of stakeholders from various fields involved with key actors like Thua Thien Hue Provincial People’s Committee, Provincial Departments, City Government, Public Agencies, Scientific Institutions, Civil Society and local people, the promotion of NBS requires effective coordination (mechanisms) and platforms as well as further education and capacity training. Major barriers for the implementation of NBS are a lack of financial resources, a lack of coordination between the relevant stakeholders and missing awareness about climate change and environmental issues among the stakeholders and

the public. The political backing by the current leaders (chairman of Thua Thien Hue Provincial People's Committee, Mr. Phan Ngoc Tho, and the mayor of Hue, Hoang Hai Minh), both being great supporters for environmental and climate protection, is crucial in order to overcome these barriers. Also, the coordination between the different departments involved needs to be harmonised and environmental planning needs to be integrated into urban planning to be effective. The knowledge transfer between science and politics needs to be strengthened. Furthermore, participation plays a special role for the effective implementation of NBS to consider the public interests while strengthening a project through local knowledge. Therefore, the GreenCityLabHuế can function as a first coordination mechanism for these processes described.

Significant for the further development of GBI are economic and societal benefits of GBI for Hue that comprise the positioning of Hue as (eco-)tourism destination, the creation of job opportunities, the establishment of competitive advantages over other Vietnamese cities, the improvement of quality of life through the creation of public green spaces, and the increase of public awareness towards the benefits of green and blue elements as NBS. These benefits should be considered when NBS for the city of Hue are developed.

A comprehensive understanding of the range of finance mechanisms can strengthen the implementation of NBS. The provincial and city budget for environmental matters is very limited, and since Hue is still a non-central city, it does not receive much funding from the national government. For this reason, international funding plays a special role as "green projects" have been mainly funded by international donors. Also, a culture of the private sector and private persons contributing to social projects can be found in Vietnam. This mobilisation of local funds and labour is commonly applied in Vietnam as community-based activities and is very powerful. Its potential could be strengthened through participative processes. Therefore, the capacity for the combination of funding mechanisms and funds from different sources is needed for the effective financing of NBS and should be further explored.

Hue is a conservative city where change comes slowly. A special feature of the city besides the UNESCO heritage sites are the traditional garden houses, which contribute to a large amount of private green space in the city and feature Feng Shui gardens as well as cooling effects for the surrounding area. Though, there is a trend towards building smaller and higher houses in order to cope with the demand for living space. The harmonisation of these traditional and modern architecture forms is a major societal challenge. Urban green is becoming more and more popular with urban dwellers. For instance, few garden cafes and restaurants displaying green walls. Policies indicate that these newly developed housing areas shall have higher green space ratios compared to the core city to improve the overall proportion of green spaces in the city of Hue. Therefore, the construction of buildings should allow the implementation of green roofs and walls due to various advantages for urban climate and air quality. So far green roofs and ground-based green walls are elements that can be found within the cityscape of Hue but are not favoured because of potential

damage to the structure when waterproofing is lacking or limited. In addition to mitigating effects of urban heat stress and air pollution, the promotion of NBS has the potential to provide public (green) space for outdoor leisure and sporting activities, especially for the younger generation. It appears that younger people want to spend more time outside. Now they spend a lot of time at home and at coffee places since the amount of green space in the centre of Hue City is limited. This is the same for children's playgrounds and space for sports activities. The younger generations are developing more sustainable lifestyles, showing preferences for outdoor sports and its health benefits. In addition, smart public spaces can respond to urban heat stress and improve air quality. The abundance and access to public green space is also a matter of environmental justice in a region with increasing heat stress due to climate change impacts.

8 Conclusion and future research

In the city of Hue ambitious urban development plans are formulated that open up numerous possibilities for the integration of NBS. The integration of NBS is an approved method to tackle climate change impacts which appears to be urgent since Hue is one of the areas in Vietnam most affected by climate change. Despite the richness of green space in Hue City, green (and blue) spaces are not equally distributed across the city. Thus, the promotion of NBS equally distributed among the city would be beneficial for environmental as well as social reasons. In addition, Hue records an increasing trend of repopulation and urban growth that result in high demand for living space and thus in the construction of new suburban residential areas.

NBS are not a new concept in general and for the stakeholders in Hue. However, they are not yet systematically considered in urban planning. A first analysis of the policy framework for NBS in Hue City showed that reference points for NBS and GBI can only be found indirectly. Due to the number of stakeholders from various fields involved the promotion and implementation of NBS needs coordination and participation. The political backing by the current leaders of the Thua Thien Province, Mr. Phan Ngoc Tho, and the city of Hue, Hoang Hai Minh, both being great supporters for environmental and climate protection, is crucial to overcome barriers for implementation and stimulate environmental planning. However, the situation in Hue is complex and needs individual solutions adapted to the local circumstances. A comprehensive understanding of the range of finance mechanisms is needed to strengthen the implementation of NBS. The developed case study typology, based on co-creation and co-learning, showed that most of the elements typical for GBI in Europe can also be found in the city of Hue. However, there are also GBI elements that are specific to the city, e.g. garden houses and green-blue gardens.

The overall public awareness of climate change is mixed. Therefore, more targeted information and education on climate change and environmental issues are recommended, as many people in the city of Hue are affected by climate change impacts such as flooding, urban heat stress as well as air and noise pollution. This would also promote acceptance and support for environmental projects such as the implementation of NBS, as awareness were indicated as a major barrier. Several projects in the Thua Thien Hue province address the problem of flooding. Projects with focus on heat stress reduction and air quality improvement through NBS are yet missing. In addition to the mitigation of heat stress and air pollution, the promotion of NBS has the potential to provide/create public space for outdoor leisure and sports activities, especially for the younger generation.

Based on the results of the report, a number of topics can be identified for further research to promote NBS and thus the expansion and enhancement of GBI in the city of Hue:

- Determining the proportion of green space of certain land uses e.g. for educational facilities, spiritual facilities und historic and cultural monument as well as for urban residential areas in the city centre and on the outskirts;

- The role of cemeteries as GBI as well as determining and communicating the ecosystem services of cemeteries for the city of Hue;
- The capacity of green roofs and walls and the preconditions for an increase of these GBI elements;
- Scientific analysis of the relevant policy for NBS in Hue;
- Financial approaches for the implementing of NBS;
- Designs of participation processes and campaigns for the implementation of NBS.

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Appendix I: List of interview partners

Table 6. List of interview partners.

No	Institution	Name/s and position/s	Sector	Acronym	Date
1	Environmental Resource Management, Faculty of Environmental Science, Hue University of Sciences,Hue University	Dr. Trần Anh Tuấn, Associate Professor and Head of Division	Academia	F. of Environmental S.	14.10.2019
2	Faculty of Geography, Hue University of Pedagogy	Dr. Trần Thị Tuyết Mai, emeritus	Academia	F. of Geography	14.10.2019
3	Centre for Climate Change Study in Central Vietnam, University of Agriculture and Forestry, Hue University	Dr. Hồ Thanh Hà, Director	Academia	F. of Forestry/CCCSC	
4	Hue Institute for Development Studies *project partner institution*	Dr. Cung Trong Cuong, Director Dr. Dang Minh Nam, Deputy Director	Public sector	HueIDS	15.10.2019
5	Centre for Community Development and Social Work	Mr. Le The Nhan, Director Mr. Trung Minh Den, Deputy Director	Civil society	CODES	15.10.2019
6	Faculty of Architecture, Hue University of Sciences, Hue University *project partner institution*	Nguyễn Ngọc Tùng, Vice Head Mr. Tuan Anh, lecturer of Faculty of Architecture	Academia	F. of Architecture	16.10.2019
7	Department of Environment, Hue University	Dr. Đặng Thị Như Ý, Lecturer	Academia	F. of Environment	16.10.2019
8	Environmental Management and Climate Change, Institute of Resources and Environment, Hue University	Dr. Hoang Ngoc Tuong Van, Head of Divison	Academia	IREN	16.10.2019
9	Faculty of Forestry, University of Agriculture and Forestry, Hue University	Dr. Do Xuan Cam, emeritus	Academia	F. of Forestry	17.10.2019
10	Farmer Association in Kim Long Ward	Ms. Trần Thị Đào, Director	Other	Farmer Association Kim Long Ward	17.10.2019
11	Hue Museum of Royal Antiquities, Hue Monuments Conservation Centre	Dr. Huỳnh Thị Anh Vân, Director	Other	HMCC	17.10.2019
12	Eurasia Foundation and Association - for the development of special education in Viet-Nam	Mr. Phạm Văn Tú, Director	Civil society	Eurasia Foundation VN	18.10.2019
13	Institute for Construction Planning, Thua Thien Hue Department of Construction	Mr. Trần Quang Hiếu, researcher	Public sector	DOC	18.10.2019
14	Bac Trung Nam Company for Consultant and Investment Construction	Mr. Nguyen Van Trung, Deputy Director	Public sector	Bac Trung Nam Ldt.	18.10.2019
15	unofficial interview				21.10.2019

16	Beekeppers Association of Thua Thien Hue	Mr. Hoàng Hữu Hè, President	Other	Bee Association	21.10.2019
17	Environmental Protection Agency, Thua Thien Hue Department of Natural Resources and Environment	Mr. Nguyen Viet Hung, Director	Public sector	DONRE	21.10.2019
18	Environmental and Occupational Health, Faculty of Public Health, Hue University of Medicine and Pharmacy	Dr. Dang Thi Anh Thu, Head of Department	Academia	F. of Public Health	22.10.2019
19	Hue Urban Environment and Public Works Joint Stock Company	Mr. Nguyen Hong Son, Chairman of Board of Director	Public sector	HEPCO	22.10.2019
20	Association of Cities in Vietnam	Dr. Nguyen Thi Kim Son, Deputy Director	Civil society	ACVN	23.10.2019
21	Binh Dinh Province's Climate Change Coordination Office	Dr. Nguyen Viet Cuong, Deputy Director	Public sector	CCCO Binh Dinh	24.10.2019

Appendix II: Relevant planning documents, policies and programmes

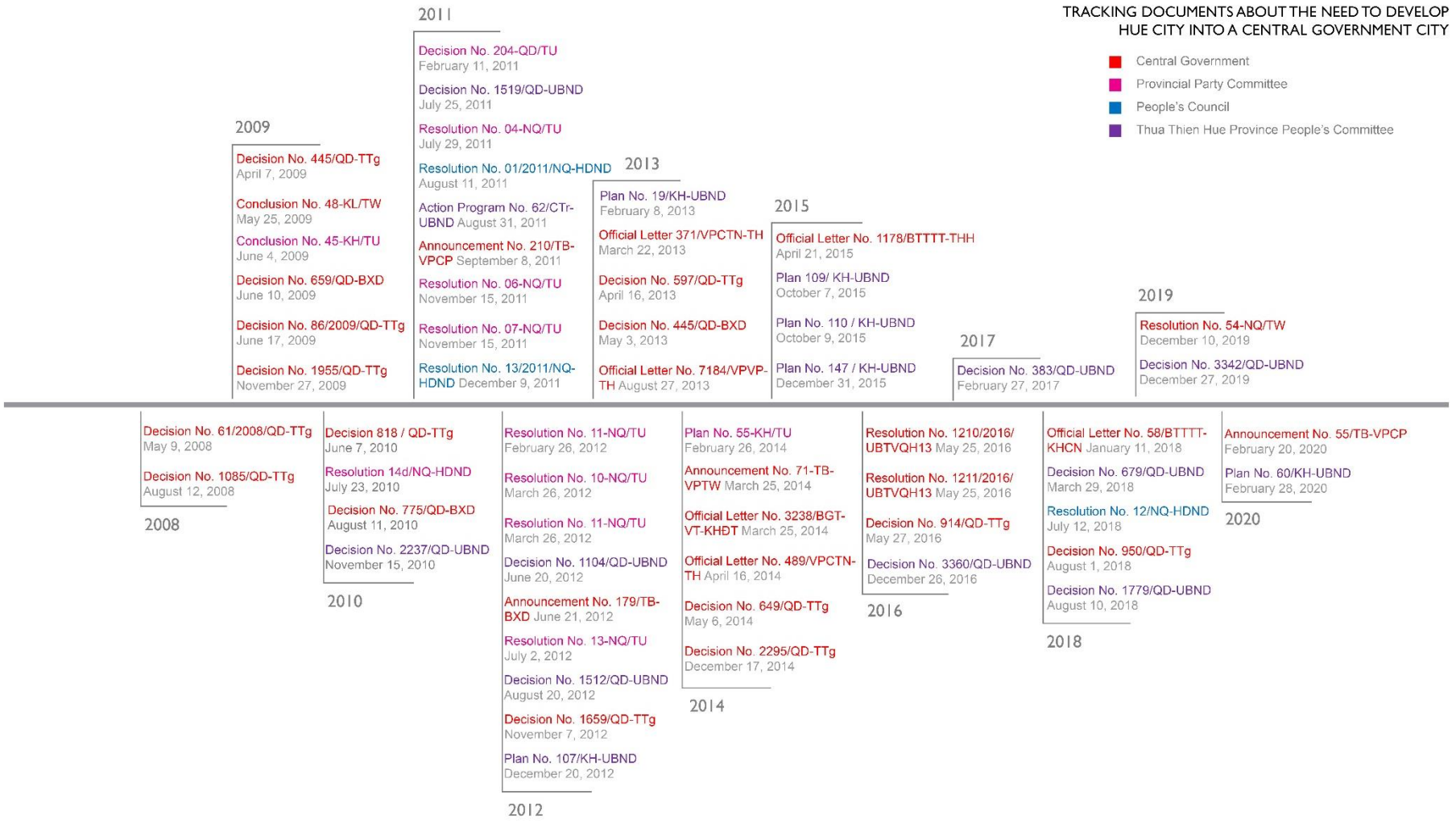

Figure 16. Planning documents, policies and programmes addressing the development of the city of Hue towards a central government city.

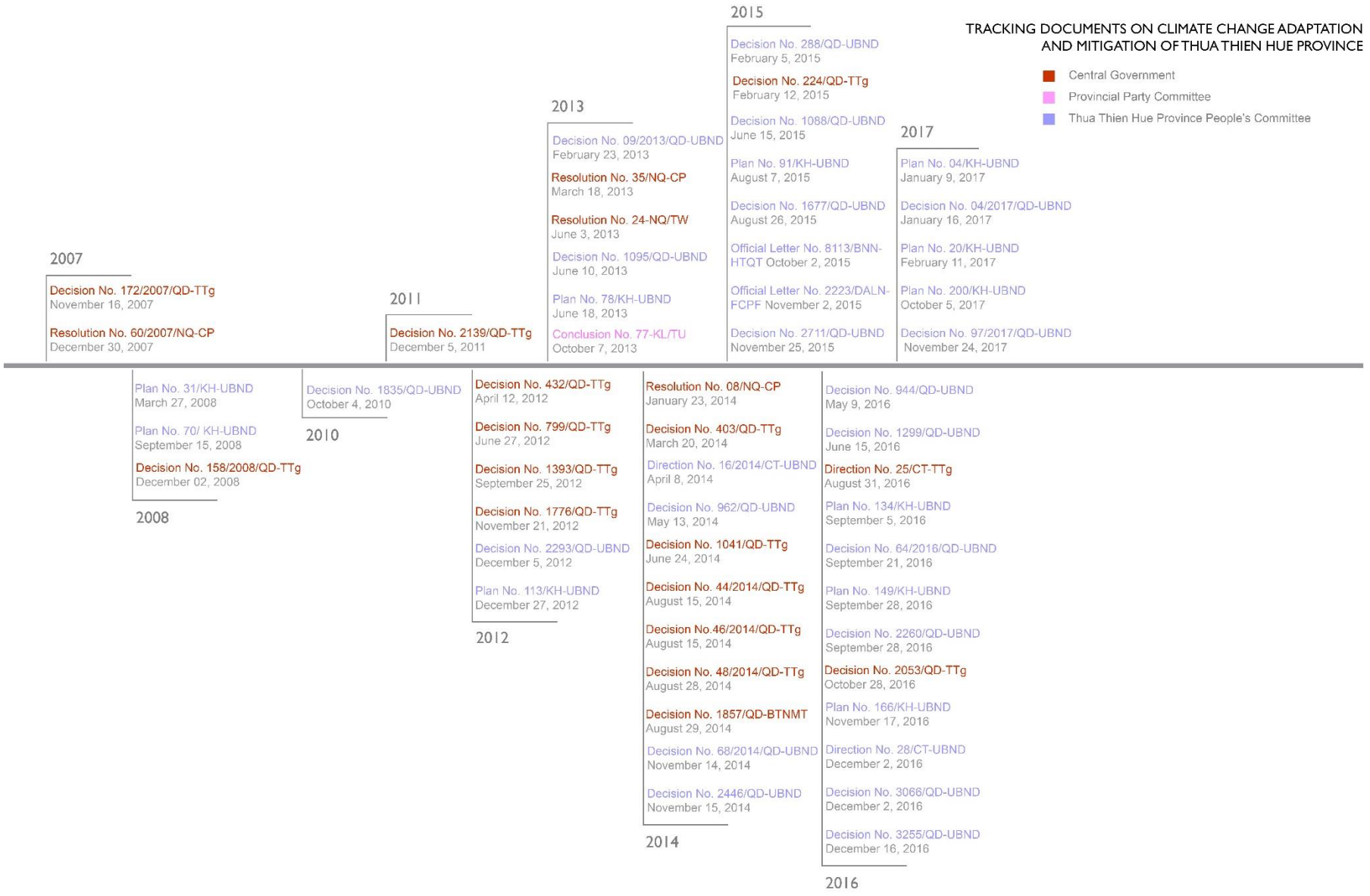

Figure 17. Planning documents, policies and programmes addressing climate change adaptation and mitigation of the Thua Thien Hue province.