Urban Climate Resilience in Southeast Asia Partnership (UCRSEA)

IDRC Grant Number: 107776-001

Partner organisations involved in the project

- Centre for Environment and Community Research, Vietnam
- Centre for Natural Resources and Environmental Studies, Vietnam National University, Vietnam
- Centre for Peace and Conflict Studies, Chulalongkorn University, Thailand
- Department of Urban Environment, National University of Laos, Lao People's Democratic Republic
- Faculty of Environment and Resources Studies, Mahasarakham University, Thailand
- Geography Department, University of Yangon, Myanmar
- Graduate Program in Development Studies, Royal University of Phnom Penh, Cambodia
- Mercy Corps Myanmar
- Ministry of the Environment, General Department of Administration for Nature Conservation and Protection, Cambodia
- Rajamangala University of Technology Lanna, Thailand
- Regional Centre for Social Science and Sustainable Development, Faculty of Social Sciences, Chiang Mai University, Thailand
- Renewable Energy Association Myanmar
- Research Group on Wellbeing and Sustainable Development, Khon Kaen University, Thailand

Lead organisations

- Thailand Environment Institute Foundation (TEI)
- Asian Institute, Munk School of Global Affairs, University of Toronto

Location of study:

Cambodia (Battambang and Koh Kong), Myanmar (Bago and Dawei), Thailand (Khon Kaen and Mukdahan), Vietnam (Ninh Binh and Lao Cai)

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I. Executive Summary

The Urban Climate Resilience in Southeast Asia Partnership (UCRSEA), a five-year project, led by the Thailand Environment Institute and the Asian Institute, Munk School of Global Affairs, University of Toronto, was designed to fill a critical knowledge gap in understanding the implications of urbanisation and the growing risks posed by climate change in secondary cities of Southeast Asia. With an objective to strengthen research capacity of multiple actors in the Mekong region and Canada, UCRSEA research focused on the core issues around people-centred vulnerability and building urban climate resilience. In collaboration with partners from multi-disciplinary academia, non-governmental organisations, and government, UCRSEA built and expanded a strong, regional network to develop and test innovative conceptual and methodological frameworks in urban climate resilience and vulnerability assessment.

Southeast Asia is one of the most rapidly urbanising regions. With a much faster growth rate, urbanisation in small- and medium-sized cities is increasing the exposure and susceptibility of urban residents to disasters and climate-related shocks. UCRSEA recognised the urgent need to better understand the range of vulnerabilities faced by urban dwellers and for secondary cities to fully engage in resilience building activities. Eight secondary cities in Cambodia, Myanmar, Thailand and Vietnam were selected for evidence-based research conducted by researchers and graduate students from Southeast Asia and Canada. Research findings provide representations of contemporary urbanisation and patterns driven by economic development through setting up of special economic zone, such as Dawei and Mukdahan, and poverty reduction through the tourism sector, such as Trang An heritage site in Vietnam. It also provides critical case studies drawing on complex social-ecological-technological systems thinking and approaches to better understand failures and successes in institutional arrangements and governance, contributing to vulnerabilities and resilience, such as in Battambang, Khon Kaen, and Phu Hao commune in Ninh Binh province.

UCRSEA focused on the interactions between urbanisation and climate change and observed how new risks and patterns of vulnerability were created. Addressing the risks and uncertainties of climate change and challenges of urbanisation will require more adaptive approaches and new forms of governance that highlight the importance of citizen rights and accountable institutions, and a shift towards more learning oriented, flexible and adaptive policy processes. With this recognition, UCRSEA provided space for dialogues and discussions to generate new knowledge, informing policy planning and contributed to strengthening urban climate resilience through local multi-stakeholders engagement, particularly state actors and decision-makers. In addition, the partners, junior researchers and graduate students from the Mekong countries gained and shared new knowledge and understandings through participating in a range of regional workshops and capacity-building trainings, developed new research skills to address emerging issues of urbanisation and climate change, and produced a substantial number of research outputs, including peer reviewed journal articles, book chapters, vulnerability assessment reports, research and policy briefs and media releases.

II. The Research Problem

Rationale

The design of UCRSEA was based on previous experiences of the lead organisations working in Southeast Asia on a number of multidisciplinary research and action projects. The issues of urbanisation and climate change are important challenges for cities to achieve sustainable development goals.

Southeast Asia is going through rapid urbanisation. As part of the urbanisation process, urban population will increase dramatically. By 2030, it's projected that the urban population in Southeast Asia will rise from 280 million people to 373 million people. Although urbanisation is a complex process driven by a range of factors, it is recognised that economic development is driving rapid urbanisation across the region. Southeast Asia has experienced remarkable economic growth in the last decades, shifting from predominately agriculture-based to industrialised economies. While urbanisation is dominated by large primate cities, secondary cities are growing at a much faster rate.

These trends have important implications for climate change and sustainable development. Most urban centres are geographically located in low-lying, floodplain, riverine, delta or coastal areas and as urban areas continue to expand they are growing into high-risk locations. Drastic transformation of ecological landscapes, waterways, wetlands and agricultural areas leads to changing hydrological patterns and regimes. Little consideration of weather-related and climate change challenges is taken into urban design and development, and in many instances urban land use plans are not enforced effectively. Issues of unregulated land use change, inadequate infrastructure, pollution and contamination, inequality, and poverty are characteristics of cities in developing countries of Southeast Asia. The fast pace of urbanisation means that cities are unable to keep up with provision and maintenance of critical urban systems and infrastructure; thus lowering coping thresholds to changing weather patterns.

Being one of the most rapidly urbanising regions in the world, Southeast Asia is also highly vulnerable to climate change and disasters. Ineffective institutional capacity and weak governance characterise local governments in this region. But a number of reasons also explain why local governments in cities across Southeast Asia are often unsuccessful at addressing critical urban issues, disaster risk reduction and climate actions. These include poor coordination, lack of monitoring and evaluation, rigidity, lack of transparency, corruption, and processes through which well-connected individuals can dominate community-level planning.

As the region becomes more physically, socially, and economically connected, the vulnerabilities and impacts of climate shocks are not only determined by location, but cascade through these inter-linked and inter-locked systems that transcend administrative and political boundaries. Climate vulnerability and urban poverty are increasingly shaped by access to, and control over, these systems and through system fragility and, in some cases, failure.

The interactions between urbanisation and climate change create new risks and patterns of vulnerabilities that will require more adaptive approaches than the traditional emergency relief methods such as 'predict and respond'. New forms of governance that highlight the importance of citizen rights and accountable institutions, and a shift towards more learning oriented, flexible and adaptive policy processes are needed to address the risks and uncertainties of climate change. The challenge lies in how governance actors and institutions can improve adaptive capacities to climate change. In urban areas characterised by a diversity of ethnicity, class, and interest, supporting social justice through collective adaptation means that actions must be framed in terms of rights and governance. The ways in which urban actors can create new mechanisms of collective decision-making, engagement, and linkages to formal state institutions, remains a pressing concern.

Previous experience of TEI in implementing urban climate resilience projects in Southeast Asia and engaging with cross-sectoral, multi-stakeholders contributed to the development of the UCRSEA conceptual framework, research questions and approaches. To address complex problems of urbanisation and climate change, understanding vulnerabilities of urban residents is crucial to inform responses. While the nature of the climate change problem is not easily defined, the science to address it is uncertain, and the equity of policy solutions is contested, it is suggested that the best approach is to create intellectual and practical spaces that permit informed open dialogue around these issues. In collaboration with Asian Institute, Munk School of Global Affairs, University of Toronto, UCRSEA was designed to address a number of issues and challenges, including raising public awareness and capacity building of academics and researchers to urban climate resilience.

The overall objective of the project was to enhance the economic and social resilience of cities in Southeast Asia, paying close attention to the important connections between urbanisation, the effects of climate change, public awareness, and societal well-being. The specific objective of the project was to provide vulnerable people in transitional states with the space to learn about and share in decisions about protecting themselves from the economic, social, and physical impacts of climate change.

This project aimed to build public space for discussion on strengthening urban resilience to climate change and support a network of Canadian and Southeast Asian academics and practitioners to develop, refine, and apply tools for assessing vulnerability and building climate-resilient local governance across the region. Project partners were to conduct research in two cities in each of Cambodia, Myanmar, Thailand and Vietnam, implement educational outreach, and develop policy recommendations. The project also aimed to train graduate students, junior researchers and NGOs to develop research skills and work on urban climate resilience issues with policy relevance. The dissemination of research findings was planned to be through both traditional scholarly venues and an interactive, multi-lingual website allowing innovative forms of research communication and policy advocacy.

UCRSEA conceptual framework and research questions

The UCRSEA Partnership project was designed to address a critical gap in understanding the role of urbanisation in the growing risks posed by climate change in the countries of Southeast Asia. Three interlinked research questions were proposed as a conceptual framework to guide research and discussions conducted under the project:

1. How will climate change impact the poverty and vulnerability of urban residents in Southeast Asia?
2. What does knowledge, from both academic literature and action research, tell us about creating climate resilient urban governance that is both inclusive and equitable?
3. How can we strengthen the agency of individuals, groups, and institutions to improve economic and physical and social well-being in urban areas, particularly in response to climate change?

Cities are complex social-ecological systems (SES) with multi-scalar, dynamic, interactive urban systems, and under UCRSEA, urbanisation is viewed as a transformative process in terms of poverty, vulnerability, growth and climate impacts. *The first research question* was to understand and better assess urban poverty as a result of urbanisation, and subsequently how urbanisation contributes to vulnerabilities. As cities are associated with increasing levels of inequality and current definitions and measurements of poverty in urban areas are widely critiqued as being inaccurate and incomplete (Mitlin and Satterthwaite 2013). At the same time, climate change creates new sources of vulnerability that put those who are not currently poor at risk. The nature of urbanization creates a new set of dependencies on complex systems of water, food, energy, and transport, and these systems are often beyond the capacity of individuals and administrations to manage (Friend and Moench 2013). The disruptions caused by climate change create vulnerabilities, thus threatening ambitions for equitable sustainable development. There is a need to develop practical methodological frameworks for assessing current urban poverty and well-being as well as future vulnerability to ensure effective public policy for poverty reduction, economic growth, social inclusion, and disaster risk reduction.

The second research question was to address the challenge of creating public spaces where informed and inclusive discussion to take place in different political contexts. It is recognised that both urbanisation and climate change pose complex governance challenges. The resilience approach argues that the risks and uncertainties of climate change require a shift from policy and planning processes of 'prediction and action', towards more learning oriented, flexible and adaptive processes (Tyler and Moench 2012; Lebel et al. 2006). As such, there is a need for more informed, deliberative governance processes that bring together diverse disciplines and experience to create flexible, adaptive, and learning-oriented institutions (Folke et al. 2005; Munton 2003). The emphasis of this research question was for researchers to approach the problems of urbanisation and climate change using the process of Shared Learning Dialogues (SLDs) (Reed et al. 2013, Tyler and Moench 2012). SLDs represent a process whereby different stakeholders and different knowledge, including scientific disciplines and local and indigenous knowledge, are brought together in a facilitated, informed public

dialogue that assesses trends and trajectories, emerging vulnerabilities, and future climate change risks. In this way, SLDs put urbanisation and climate change in the public domain, while promoting social learning and innovation.

The third question focused on the challenge of how to strengthen adaptive capacity of urban actors to respond to climate impacts and the role of institutions in supporting social justice through collective adaptation measures. Poor coordination, lack of monitoring and evaluation, rigidity, and lack of transparency are some of the characters of local governments in Southeast Asia. Actions to improve adaptive capacity and disaster preparedness must be framed in terms of rights and good governance. Urban actors must create new mechanisms of collective decision-making and engagement as an approach to increase adaptive capacity. This research question aimed to guide researchers to approach the issues of urban governance through collective actions that address urban climate problems.

The three research questions were intended to cover critical knowledge gaps in understanding vulnerability, urban poverty and building climate resilience. There is a pressing need to better address global environmental challenges, like climate change, and urban futures, not only in the Mekong region, but also in urbanising areas of the Global South. Furthermore, as a region the Greater Mekong Subregion (GMS) is becoming more regionalised and connected through economic integration and transport infrastructure, driving much of the region's urbanisation process, understanding how climate vulnerability transcends and cascades across administrative and political boundaries is critical for sustainable and equitable urban development. The commitment of UCRSEA to build evidence-based knowledge and practices was to contribute not only to influence policy change at the local level, but also to tackle global challenges. With an aim to build and deepen knowledge, 8 cities were selected to enable researchers to document case studies, engage with key stakeholders and decision-makers and develop impact pathways to influence change. To contribute to better understanding of climate vulnerability at the regional level, one of the criteria was 'Regional Connection' to help guide city selection. Cities with regional connections in terms of migration, transport infrastructure, communication and regional investment would represent the challenges of regional integration and regionalisation.

UCRSEA provided opportunities for strengthening capacity of urban actors and building a regional network of academics, practitioners and decision-makers to tackle urban climate resilience challenges. At the start of UCRSEA, the concepts of climate vulnerability and urban resilience and urban climate resilience approaches were introduced to the project partners. With diverse backgrounds and experiences the concepts and approaches were new and unfamiliar to the partners. Subsequently, time was dedicated to discussions unpacking the concepts and research approaches. Throughout the project, the three research questions and conceptual framework were discussed and debated among the project partners, networks of academics, researchers and postgraduate students. A vulnerability assessment toolkit was developed to help guide the partners and postgraduate students assess urban climate vulnerability. A series of regional workshops and meetings were organised throughout the project, providing

opportunities for exchanges and sharing of key learning, knowledge and experiences.

Evolution of the research questions

As the project progressed, it became clear that different partners interpreted the research questions differently and addressed different elements of the research questions, depending on the local contexts of selected sites and background and interests of the partners. Differences in approaches and understanding of the concepts were evident between university academic and NGO partners. However, more efforts were put into *the first research question* around understanding climate vulnerability. As a result, research and studies conducted by Southeast Asian partners and postgraduate students covered multiple stressors, multi-level drivers as well as multiple pathways of vulnerability, using diverse methods. Focusing on social-ecological systems in the urban and development contexts, studies across the Mekong region portrayed vulnerability of local communities as negative outcomes due to increasing exposure to a range of external stressors, including floods, degrading water quality and pollution, as results of expanding urbanisation, industrialisation and tourism. Some of the studies also discussed inherent vulnerability of local communities focusing on the interaction of social, economic and political factors, governance failures or the livelihoods of individuals and families. However, the linkages between urbanisation and urban poverty and between urban poverty and vulnerability were not explicitly addressed and discussed by the partners.

The second research question on facilitated public dialogue was promoted and supported by UCRSEA to be implemented as a process of assessing vulnerability. While the partners agreed on the importance of informed policy planning and decisions through multi-stakeholder engagement, structured and facilitated public dialogues to generate knowledge and understanding of vulnerability were less explored. Different approaches to engage with local multi-stakeholders were undertaken depending on background of the partners and local contexts. Although the project encouraged the partners to use the Shared Learning Dialogue approach to engage with multi-stakeholders in vulnerability assessments, university academics and researchers were less inclined to apply the approach than NGOs/practitioners. Methods undertaken academic partners were more traditional and conventional, using interviews with individuals and questionnaires. While these methods would provide detailed information of community- or household-level data, they do not promote learning among the stakeholders.

Much effort was also put into addressing *the third research question* on how to strengthen capacity of urban actors to improve resilience. This involved using the Air Beam device as a tool for stakeholder engagement, awareness and advocacy and real time air quality monitoring. Introduced by Professor Dylan Jones (Department of Physics, University of Toronto) in 2016, the AirBeam device is a detector that can be used to measure fine particulate matter (PM2.5) among other parameters such as air temperature and humidity. Real-time measurements are recorded and communicated using the AirCasting Android app via Bluetooth. Data is crowdsourced to generate maps (see http://aircasting.org). Several devices were purchased by the University of Toronto and on loan to the country partners.

With guidance and technical support from Prof Dylan Jones, the partners participated in a training workshop and learned how to use the device in early 2017. The partners designed project activities using the Airbeam to engage with key stakeholders and selected sites for data collection. Activities included air quality monitoring in selected areas for database or comparison, awareness raising and advocacy, and teaching and training of school and university students. UCRSEA supported Citizen Science approach as a process to strengthen capacity of urban actors. The Citizen Science approach was largely explored and adopted by NGO partners. The academic partners used the device in a more traditional way, through teaching of their university students.

In conclusion, UCRSEA research provided evidence of how on-going urbanisation and development of urban systems and infrastructure created socio-economic and environmental challenges that contributed to increasing vulnerabilities of local communities across the region. The current economic development, growth and transitions in secondary cities in Southeast Asia have led to socio-economic disparities, aggravated uneven impacts of climate-related shocks and crises, and created new forms of vulnerability. The research illustrated the relationships between climate risks, urban development and vulnerability dynamics. However, for future research, the linkages between urbanisation and urban poverty need further investigation to deepen the understanding of urban governance, equity and justice, and better frame vulnerability of urban residents to climate change. Future research also needs to identify and further investigate politically marginalised community groups in urban areas. Reflecting on the complexity of urbanising areas, diverse community groups such as those in the informal economy sector (e.g. street vendors), ethnic minority and different religious groups, need to be included in research and decision-making and planning processes. Furthermore, as a region, Southeast Asia is becoming more socially, economically and physically connected, understanding vulnerability that is not place-based but cascading across scales and political and administrative boundaries is critical for shaping regional urban futures, sustainability and long-term climate preparedness. For instance there is a need to better assess and understand the vulnerability of international migrant labourers and workers (such as millions of Cambodian and Burmese factory and construction workers in Thailand) whose families rely on remittances that are usually derived from urban sources. When migrant workers are faced with climate-related shocks and crises (e.g. during a flood disaster) and unable to work and send money home, the vulnerability of individuals at the household level across international borders is less understood.

Much of the UCRSEA research discussed and demonstrated the urgent need for city governments responsible for managing urbanising areas to better connect with individuals and communities, particularly those who are directly impacted by both urbanisation and climate change, for urban and economic development planning, disaster risk reduction and building urban climate resilience. However, meaningful participation in planning and decision-making processes as well as providing space for multi-stakeholder dialogues and debates are still lacking in this region. Evidently the issues of urban governance and institutional capacity remain and pose a major challenge for climate preparedness and urban resilience in Southeast Asia's secondary cities. There is a critical gap in the role that academics and

researchers can play in promoting cross-learning and improving access to information for empowerment of local stakeholders. To empower those who can serve as actors of governance, future research design for building urban climate resilience needs to strategically focus on establishing an enabling environment for local civil society, non-governmental and community-based or grass-root organisations to address emerging issues of climate impacts, urbanisation and social vulnerability.

III. Progress Towards Milestones

Over the last five years, outcomes-based milestones with financial payments were tracked. UCRSEA complied with the technical and financial milestones established in the grant agreement.

Key milestones achieved by the end of Project Year 1 (Aug14-Jul15) include;

- The first Partners Annual Workshop was organised in Bangkok in January 2015, bringing all of the partners from the Mekong countries and Canada together to discuss the UCRSEA conceptual framework and three research questions and project management and governance structure. New committees were established during the workshop; Executive Committee, Southeast Asian Student Selection Committee, Canadian Student Funding Committee, Ethics Committee, Vulnerability Assessment Committee in addition to the Project Management Committee (PMC) and the International Advisory Board. The partners also identified potential partners in Laos to be contacted and invited to join UCRSEA and developed City Selection Criteria for selecting cities, where research would take place.
- The partners selected and agreed on 8 cities, Battambang, Koh Kong, Ninh Binh, Lao Cai, Khon Kaen, Mukdahan, Dawei and Bago.
- Two new partners joined UCRSEA, Faculty of Environment and Resource Studies, Mahasarakam University (Thailand) and Center for Environment and Community Research, Vietnam.
- First Southeast Asian student applicant selected and awarded a full PhD scholarship. The candidate from Cambodia started a PhD programme at the Faculty of Social Sciences, Chiang Mai University, Thailand (Table 1).
- Three graduate students from Canada started their summer research internships (two to Myanmar and one to Thailand). Two Canadian doctoral students also started their field research in Thailand and Cambodia.
- UCRSEA website and Facebook page were set up and launched, http://urbanclimateresiliencesea.apps01.yorku.ca, and https://www.facebook.com/ucrsea, and UCRSEA logo was made.
- A case study of urban-based environmental disasters in the region, authored by Canadian graduate student, Esther Lambert (http://urbanclimateresiliencesea.apps01.yorku.ca/wp-content/uploads/2015/04/urban- disasters-report-lambert.pdf).
- Extensive meetings and academic seminars were held in all four countries to build capacity of the project partners and expand UCRSEA networks.

At the end of the second year (Aug15-Jul16), key milestones achieved include;

- The Centre for Natural Resources and Environmental Studies (CRES) at Vietnam National University joined the partnership.
- The Second Partners Annual Workshop held in Hanoi in May 2016 introduced the Theory of Change approach to the UCRSEA network.
- Cambodian and Thai country partners carried out situation analyses in their respective cities for preliminary data for vulnerability assessments. Vietnamese country partners developed work plans and prepared for field visits, research and local stakeholders engagement.
- The head of Geography Department, Yangon University was engaged in UCRSEA and agreed to form a small research team to carry out vulnerability assessments in Bago and Dawei.
- One Vietnamese student was selected and awarded a full PhD scholarship. The candidate started a PhD programme at Chiang Mai University in 2016. Four SE Asian student applicants were selected and awarded Field Research Grants (Table 1).
- Partners participated in a number of conferences, workshops and roundtable discussions, including the Asia Pacific Urban Forum, Canadian Council of Southeast Asian studies (Annex C).
- 8 UCRSEA City Briefs were collated based on preliminary data and city situation analyses provided by the partners (UCRSEA City Briefs 2017).
- Partners contributed to a book chapter (Friend and Thinphanga 2016a), peer-reviewed articles (Friend and Moench 2015, Friend 2016a, Jarvie and Friend 2016), a review (Friend 2016b), and op-ed (Friend 2016c).
- A Framework for Climate Vulnerability Assessment in Urbanizing Asia: a Guidebook for the Urban Climate Resilience in Southeast Asia (UCRSEA) Partnership was completed and shared (Friend and Thinphanga 2016b).
- Budget originally allocated for SE Asian PhD students was reallocated for small research teams to carry out short-term research projects in the Mekong countries.
- UCRSEA website renamed as www.ucrsea.ca
- The four Project Management Committee members met every two months, while the Executive Committee members met twice a year for project updates.

During the Project Year 3 period (Aug16-Jul17), key milestones achieved include;

- A joint IPaSS Partnership Grants Midterm report was submitted and approved.
- Three new partner organisations officially joined the UCRSEA network, Department of Urban Environment, National University of Laos, Geography Department, University of Yangon, and Rajamangala University of Technology Lanna.
- Four students from Southeast Asia were selected and awarded Field Research Grants (Table 1).
- A four-day Collaborative City Exchange Trip to Dawei took place in October 2016. The trip was arranged for UCRSEA partners to meet with the research team at Yangon University, visit Dawei and meet with local stakeholders to learn about the impacts of the special economic zone development on local

communities, and to discuss urban futures of Myanmar with Green Economy Green Growth organisation based in Yangon.

- The third Partners Annual Workshop held in Battambang in May 2017 focused on building capacity of UCRSEA partners and students and discussed programmatic Theory of Change and the three research questions and findings. The participants also visited research sites and engaged with urban poor communities. These sites were where the partners from Royal University of Phnom Penh conducted UCRSEA research.
- A number of training and regional workshops were organised for the partners and students across the Mekong region, including Theory of Change workshops held in Cambodia, Thailand and Vietnam, Technical training using the Airbeam device in all four countries, and Partners Writeshop in Bangkok focusing on vulnerability assessments.
- The first regional meeting on Curriculum Development for Universities in the Greater Mekong Subregion was organised in Bangkok in February 2017, bringing together existing UCRSEA academic partners and academics from non-partner universities across the region. The participating universities agreed on a new degree course with cross-disciplinary research agendas and teaching subjects to address the challenges of climate change, urbanisation and sustainability. A follow up regional meeting took place in Siem Reap (Cambodia) in May with participation of academics from Canada to explore subjects and courses on climate change taught in Canadian universities.

In the fourth year, key milestones achieved include;

- One Vietnamese student was selected and awarded Field Research Grant (Table 1).
- Regional Research Exchange and Writeshop held in Khon Kaen in January 2018 brought together academics, researchers, practitioners and students to share their to-date research findings, experience and lessons learned from conducting research in secondary cities in the Mekong region and to discuss theoretical and practical aspects of the UCRSEA conceptual framework from different perspectives. A field trip to research sites in Khon Kaen was also organised for the participants to meet and interact with local stakeholders.
- A regional workshop on Citizen Science and Air quality monitoring using Airbeam held in Udon Thani (Thailand) in March 2018 brought together UCRSEA country partners, students and researchers to discuss the use of the Airbeam device to engage with local stakeholders in air quality monitoring. The discussions involved reviewing common research questions and methodologies for data collection, collective efforts to synchronise dates for data collection across the region, and sharing plans for citizen science activities.
- The 4th Partners Annual Workshop in Yangon in May 2018 focused on providing support to the country partners for the development of effective and high-quality research outputs designed to reach diverse stakeholder audiences. The workshop activities were designed for the partners and students to enhance the impact of research data through strengthened

theoretical framing, more varied and innovative knowledge mobilisation strategies, and more frequent and active engagement with key stakeholders.

- The third regional workshop on Curriculum Development was held in Chiang Mai in May. This final workshop focused on the structure and teaching materials of a climate change course introduced by academics from Canada. Through dialogues, networks of universities and academics collaborated on integrating this new course into existing teaching and research agendas in multiple institutions across the region.
- Research teams with junior researchers and students carried out small collaborative and participatory research projects in different locations and documented key findings (Hayward 2017, Rhodes 2018, Wontragoon 2018).
- Two journal articles and a book chapter were published (Kimleng 2017, Beringer and Kaewsuk 2018, Friend and Thinphanga 2018a).

In the final year of UCRSEA (Aug18-Jul19), key milestones achieved include;

- The final Partners Annual Workshop held in Bangkok in May 2019 included a one-day Policy Forum 'Linking Research and Practice to Policy', where 'Boundary Partners' and other (external) actors in the related fields of urban climate resilience and disasters, including representatives of UN agencies, international and national NGOs, Thai government officials, and university academics and researchers, were invited to participate in discussions focusing on climate change and urbanisation in Southeast Asia based on UCRSEA research findings.
- In this period, two journal articles (Friend and Thinphanga 2018b, Beringer et al 2018) and a book titled Urban Climate Resilience in Southeast Asia (Editors Daniere and Garschagen 2019) were published.
- UCRSEA short films focusing on key research findings in each of the Mekong countries were made and distributed (https://www.youtube.com/playlist?list=PLbRtQ6HOlaJlX4nCw0_n-7s6Kz1SauVjR).

UCRSEA grants	**Student / nationality**	**Institution**	**Research topic**
PhD full scholarship (2014-2019)	Try Thuon PhD candidate Cambodia	Social Sciences Faculty of Social Sciences, Chiang Mai University, Thailand	Remaking of urban space, livelihood changes and resilience among people in Cambodia: Case study from Battambang
PhD full scholarship (2015-2019)	Ly Quoc Dang PhD candidate Vietnam	Women's and Gender's Studies, Faculty of Social Sciences, Chiang Mai University, Thailand	Gender Dimensions and Urban Flooding in Can Tho City of Vietnam
Field	Kim Thi Ho	University of Social	Assessing livelihood

UCRSEA grants	Student / nationality	Institution	Research topic
research grant Awarded in 2015	PhD student Vietnam	Sciences and Humanities Vietnam National University – Ho Chi Minh City	resilience and vulnerability to climate change of Khmer households in Soc Trang, Mekong delta region
Field research grant Awarded 2016	Ei Shwe Sin Phyo Master student Myanmar	Department of Archaeology, University of Yangon, Myanmar	Urban Flooding in Bago City in Lower Myanmar (Phyo 2017)
Field research grant Awarded in 2016	Sa Kimleng Master student Cambodia	Royal University of Phnom Penh Cambodia	Urban Climate Vulnerability in Cambodia: A Case Study in Koh Kong Province (Kimleng 2017)
Field research grant Awarded in 2016	Nguyen Song Master student Vietnam	The department of Anthropology, Vietnam National University, Hanoi College of Social Sciences and Humanities	Impacts of climate change on the livelihood of coastal urban-dwellers in Vietnam Case study of Haiphong city (Song 2017)
Field research grant Awarded in 2016	Chanthol Hay Master student Cambodia	Faculty of Sociology and Community Development, University of Battambang, Cambodia	Slum areas in Battambang and Climate Resilience (Samnang and Chanthol 2018)
Field research grant Awarded in 2016	Piti Srivongchai Ph.D. Candidate Thailand	Development Science, Faculty of Humanities and Social Sciences, Khon Kaen University, Thailand	Guidelines to Reduce Individual Greenhouse Gas (GHG) Emissions for Low Carbon City in Khon Kaen, Thailand
Field research grant Awarded in 2017	Dara Lim Master student Cambodia	Royal University of Phnom Penh Cambodia	Impacts of Seasonal Flooding on the Lives of Battambang Urban Poor, Cambodia (Lim 2018)
Field research grant Awarded in 2017	Tay Zar Myo Win Master student Myanmar	International Development Studies, Faculty of Political Science, Chulalongkorn University, Thailand	Decentralization towards democratic accountability in providing public services: A Case

UCRSEA grants	Student / nationality	Institution	Research topic
			Study of Dawei Township, Myanmar
Field research grant Awarded in 2017	Pham Thi Thu Huong Master student Vietnam	Department of Interdisciplinary Science Vietnam National University, Hanoi	Vulnerability Assessment on Climate Change of Sa Pa Town in Lao Cai and its Vicinity

Table 1 Students from Southeast Asia who were awarded a full PhD scholarship or Field Research Grant under UCRSEA

IV. Synthesis of Research Results and Development Outcomes

To address complex challenges of the interaction of urbanisation and climate change, there were two complementary streams of activities implemented under the UCRSEA project. The first work stream; *Capacity Development and Networking*, consisted of two main aims; i) to strengthen research capacity, knowledge and technical skills of academics, researchers, students and practitioners in urban climate resilience; and ii) to engage and build a collaborative regional network of actors to generate new knowledge and address urban and climate challenges. The second work stream; *Urban Climate Vulnerability and Resilience Research*, guided by the three research questions, was to generate new knowledge and document evidence of the implications of urbanisation, interactions between urbanisation and climate change and linkages of urbanisation, urban governance and climate vulnerability of local communities, through case studies from selected secondary cities across the Mekong countries.

Through these work streams, the UCRSEA project provided multiple forms of support including funding for research projects, resources for knowledge mobilisation, and opportunities for training and partnership development. UCRSEA's Theory of Change framework was collaboratively developed to map out logical steps and guide the project partners to achieve expected outputs and desirable outcomes. As a tool, the UCRSEA theory of change framework was also used to link the two work streams, consolidate the outputs and engage the project partners in a dialogue-base process for monitoring and evaluation of progress.

Capacity Development and Networking

The project successfully created and expanded regional network of academics, researchers, students and practitioners to participate and engage in urban climate resilience research and dialogues. Initially, there were 10 formal partner organisations (2 partner organisations in each of Cambodia and Vietnam, and 3 in each of Myanmar and Thailand). These formal collaborators participated in research activities, trainings and regional workshops. Throughout the project, new partners and partner organisations joined the UCRSEA network at different capacities and were engaged in various activities from implementing research projects to participating in regional workshops and meetings (Annex A).

Over five years of the project, a number of regional workshops, trainings and meetings, including Theory of Change, Curriculum Development, Research Exchange, Writeshops, Citizen Science for Air Quality Monitoring using the Airbeam device, and City Exchange, were organised to maximise opportunities for capacity building, research collaboration, networking and sharing of experiences and lessons learned. In addition, Partners Annual Workshops also brought together all partners and graduate students from Southeast Asia and Canada (University of Toronto, University of Ottawa and York University) as well as the four members of the International Advisory Board to discuss research findings and impacts, and collaborate on work plans.

These regional workshops, trainings and meetings required efforts in coordination of participants from different countries and structured facilitation of dialogues to ensure learning and networking objectives were achieved. In addition, local stakeholders (external, non-project partners) from the government, academia and communities or research informants were invited to these regional workshops and meetings to participate in discussions. In some events, English-local language interpreters were necessary. The regional engagement and learning activities were found to be valuable to the project partners and students as well as to local stakeholders. Cross-learning and peer-to-peer learning generated new knowledge, influenced new practices and contributed to better decision-making processes and policy change. Examples include; the Governor of Battambang was interested to learn from UCRSEA research to update the provincial climate change and urban development plans; Pra Lap Municipality in Khon Kaen province was seeking for UCRSEA research inputs to influence urban development and flood management plans of Khon Kaen city; Lao Cai city governments responsible for climate policy implementation were interested in updating vulnerability assessments in response to rapid urban growth since the highway linking to Hanoi finished; the research teams from the Centre for Environment and Community Research (CECR) learned new skills in undertaking climate and urban research; on the City Exchange trip, UCRSEA partners learned directly from local fishing communities in Dawei about the impacts of the special economic zone development on water availability; the research teams from CRES at Vietnam National University learned from fellow UCRSEA partners how to engage with local families in Phu Hao village, Khanh Phu commune, Ninh Binh city.

Contributions of UCRSEA funded students

The opportunities for graduate and research students as well as junior researchers from the Mekong countries to meet, network and exchange and share knowledge with and to have access to fellow students, researchers, and senior academics, not only within their countries, but also across the region and Canada, were unique and valuable. The regional workshops and meetings invited the students who were awarded research grants by UCRSEA (as listed in Table 1) and other students from the partner universities to participate in discussions and provided opportunities for them to practise presenting their research by PowerPoint or posters in English. Although the students directly funded by UCRSEA Field Research Grants were encouraged to publish their research, more academic and technical support would be necessary to improve their research techniques and writing in English. Nevertheless, UCRSEA funding provided opportunities for the students to get

exposure to new area of study, carry out research in climate change, vulnerability and urbanisation, and learn new research skills. While the research quality of the graduate students might not meet the international research and publication standards, their research findings contributed to new knowledge of the UCRSEA network. Examples include;

The work of Kim Thi Ho explored the vulnerability of ethnic minority groups of Khmer women in O Man district in Can Tho, and Khmer immigrants in Ban Tan district, a peri-urban area of Ho Chi Minh City. The effects of rapid urbanisation of Can Tho and Ho Chi Minh City have influenced the transformation of livelihoods and enforced the adaptability of the community groups. However, they were able to adapt to the more urbanised lifestyle because of their social capital within households, and by retaining their cultural identity and religious beliefs.

Ei Shwe Sin Phyo, a student in Archaeology, analysed the urban flood in Bago by examining hydrological data, town planning and drainage system structure and maps to identify root causes of frequent floods, and discussed the vulnerability of local residents impacted by frequent floods, by drawing on the complex systems thinking. The research revealed urban floods in Bago were caused by poor and out-dated drainage system and infrastructure. It was also found that local institutions had weak and ineffective capacity and were unable to deal with rapidly changing land use and urban landscapes. Furthermore, domestic and construction wastes were dumped in the drainage system blocking water flow. With limited support from local governments during floods, local communities relied on each other for food, water supply and boats.

Two research studies were conducted in Battambang focusing on the vulnerability of the urban poor communities, using the linkages of social-ecological-technological systems. The work of Rem Samnang and Hay Chanthol explored the socio-economic conditions of the slum communities. Dara Lim looked at the impacts of floods on the low-income communities. Both studies showed the daily income of the urban poor was above the poverty line of 1 USD per day, earned by working as construction works or shop and restaurant assistants. However, access to clean water was a challenge without and during floods. Those without access to piped water would harvest rainwater for drinking and cooking and some would buy water from private vendor companies. Increasing flood frequency as a result of urban land use change and climate impacts and without improving access to clean water will exacerbate the vulnerability of the urban poor.

Research conducted by Try Thuon in Battambang explores in-depth institutional and governance practices in urban planning and management and the impacts of urban and economic development on equity, justice and the urban poor. Battambang is a second largest city after Phnom Penh, rich with natural resources and cultural heritages of pre-colonial and French colonial buildings and temples. For this reason the city has been strategically designated for urban and economic development. The revised urban vision promotes equitable land sharing for informal settlements and low-cost housing scheme, as well as agro-ecotourism using urban heritage area as cultural village. However, without the participation and consultation of local residents in land use planning, coupling with dominance

of selective groups with political connection, the implementation of the urban vision has led to social and political conflicts and resistance of certain groups to proposed urban infrastructure development. The promotion of urban cultural heritage tourism is more lucrative and has led to increased income of few residents who own land and heritage houses. Land has also been sold and shared with non-residents. Uncontrolled and unregulated land development, such as land filling has led to increasing flooding. With contested access over strategic resources such as land, the revised urban vision with the intention to improve the livelihoods of the urban poor and informal settlements has instead contributed to increasing vulnerability of local residents. Key findings of this research will inform on-going development initiatives and programmes currently taking place in Battambang, which will have important implications on the urban poor communities. For instance, the green belt development project, supported by the Climate Investment Fund, the green city programme, led by the Global Green Growth Institute, and the urban development programme of the French Development Agency, will need strategic inputs to ensure inclusive, equitable development that will increase climate adaptive capacity and resilience of local residents, particularly the urban poor (Thuon 2019, personal communication 3 October).

Contributions of UCRSEA partners

Guided by the UCRSEA conceptual framework and three research questions, the partners carried out situation analyses, vulnerability assessments and citizen science activities in selected secondary cities (Annex B). The Theory of Change approach was used to support the partners in linking the design of their research projects and research findings to policy impacts and knowledge mobilisation (UCRSEA Theory of Change Framework 2017). In the training, each of the partners was requested to identify key boundary partners and highlight important messages to inform policy. As a result, emerging findings became more clearly directed toward policy briefs, targeting the correct audience. Each partner worked on specific paths of influences that contributed to an overarching Theory of Change (Figure 1).

- *The Centre for Environment and Community Research (CECR)*

CECR focused on guiding women access diverse, sustainable livelihoods within their community and obtain the knowledge, capacity, and resources they need to withstand and recover from climate related shocks. CECR collected data on the impacts of tourism development on the livelihoods and wellbeing of families in the UNESCO World Heritage Site at Trang An. Throughout the vulnerability assessment CECR engaged with the Women's Union of Truong Yen and Dong Thanh to better understand connections between tourism entrepreneurs and local women (Ly et al 2017). CECR developed evidence-based recommendations to support sustainable tourism development that will improve the livelihoods of women and protect the environment across Vietnam. Using example of Trang An, the recommendations targeted the Vietnam Union of Science and Technology Associations of Ninh Binh, Trang An Landscape Complex Management board, Center For Environmental Monitoring Portal and Department of environment of Ninh Binh (Ly et al 2019). Through this work, CECR engaged with the Vietnam Tourism Association (VITA). The engagement has consequently led to further

collaboration and partnership. CECR and VITA continue to work on a new project on 'Transforming Climate change affected areas into sustainable tourist destination: Building up a new Green Tourism Business Models for MSMEs and local communities' and Ninh Binh has been selected as one of the project sites (Ly 2019, personal communication, 2 October).

Furthermore, key research findings were shared in the dialogue focusing on Gender and National Determined Contributions (NDC) in August 2019 to highlight the issues of gender and women and to influence inclusiveness regarding gender dimensions. Through the work of UCRSEA, CECR has become one of the main partners in a new UN Women training programme on Women and Climate Change. In addition, CECR is now a leading NGO to advocate for gender mainstreaming in climate change policies in Vietnam and in the region. CECR will speak on a panel at the Asia-Pacific Ministerial Conference to influence and advocate for gender equality for women and girls in environmental conservation, climate action and resilience building (Ly 2019, personal communication, 2 October).

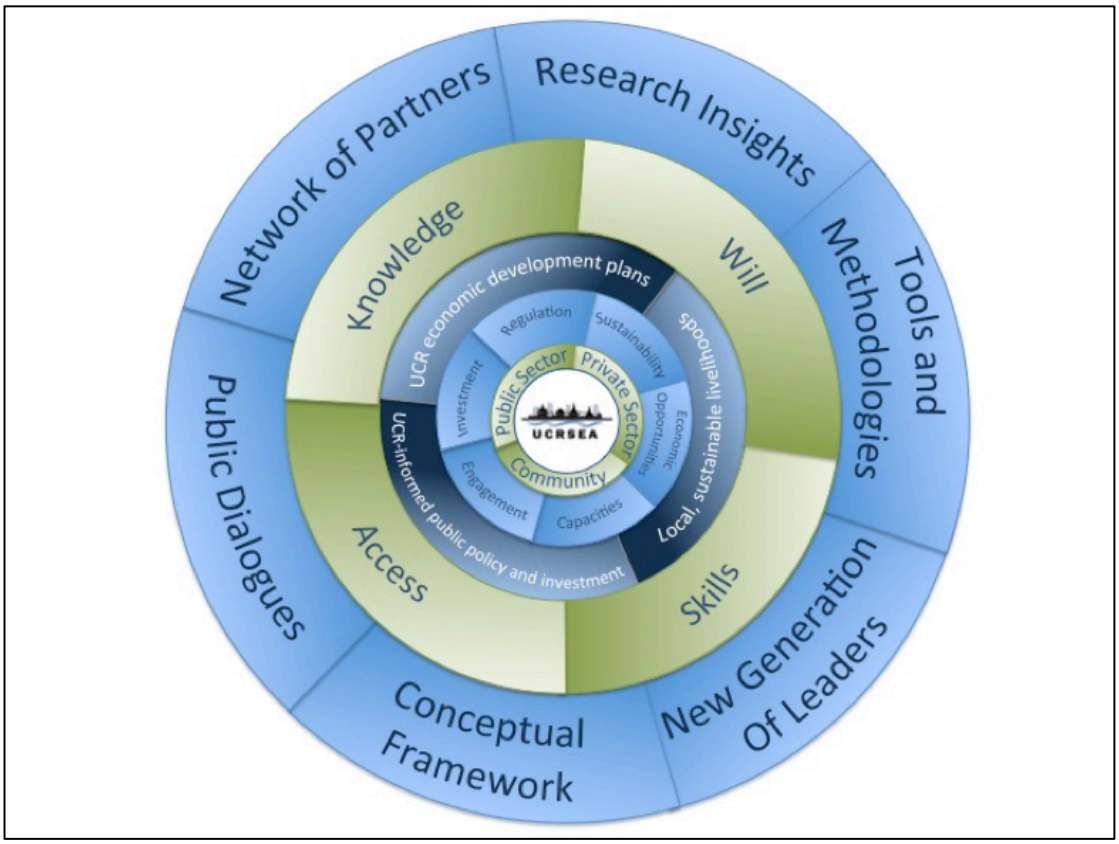

Figure 1 UCRSEA Theory of Change Framework

- *The Centre for Natural Resources and Environmental Studies (CRES)*

The work of CRES aimed at influencing the development of local industrial zones so that they become more inclusive, environmentally respectful, and sustainable. CRES collected environmental and social data on the negative impacts of Khanh Phu industrial development to assess the climate vulnerability of local community

members in Phu Hao village. The villagers experience health issues from contaminated water supply due to wastewater discharge of the industrial zone. The commune also experiences more frequent floods due to changes in land use and climate impacts. CRES developed evidence-based materials to support the efforts of local civil society organisations and targeted the policymakers at the Khanh Phu Commune People's Committee, the Ninh Binh Industrial Zone Management Board, the Ninh Binh Provincial Department of Natural Resources and Environment, the Ninh Binh Provincial People's Committee, and the Ministry of Natural Resources and Environment to protect the interests of local residents (Le and Ha 2019).

- *The Faculty of Environment and Resources Studies at Mahasarakham University (MSU)*

The research team from MSU focused on the implications of the development of special economic zone in Mukdahan. The aim was to find effective approaches to minimise the negative impacts of industrial development on nearby residents and the environment and maximise the benefits to local communities. They argued that in order to maintain the balance between industrial development and the livelihoods of local communities, a proportion of community forests must be protected and managed by the communities (Bridhikitti 2017). The team suggested different approaches and used this evidence to proposal to the Board of Mukdahan Special Economic Zone Development Committees (Bridhikitti and Khadkar 2019). The results of UCRSEA research influenced new planning and decision to incorporate the concept of eco-industrial design for the Mukdahan SEZ in response to the natural resource-based needs of Mukdahan indigenous groups and to achieve sustainable development goals (Inmuong 2019, personal communication, 30 September).

The research team also followed up on the dialogue and engagement with the Khon Kaen Provincial Governor to discuss possible solutions to mitigate floods and flood risks in Pra Lap community. Water diversion and sewerage outflow of Khon Kaen City Municipality exacerbate the impacts of floods. Dr Inmuong stated that in August 2019, using the UCRSEA research findings, the Department of Public Works and Town & Country Planning, Ministry of Interior, agreed to include the flood issues of Pra Lap in the development the Master Plan of Design and Investment of Flood Management and Mitigation of Khon Kaen City (personal communication 30 September 2019).

- *The Royal University of Phnom Penh (RUPP)*

The research teams from RUPP aimed to provide technical support to policymakers in the development of sustainable urban futures for rapidly urbanising cities across Cambodia, using Battambang and Koh Kong as example. Working closely with local stakeholders, RUPP focused on understanding the impacts of climate change and urbanisation on the social wellbeing of vulnerable communities in order to advance more effective and sustainable urban systems and build more inclusive cities. The teams engaged directly with provincial and municipality officials, Department of Land Management, Urban Planning and Construction, and Department of Public Works and Transportation, in dialogues to assess vulnerability and influence change (Asif et al 2016, Thuon et al 2016).

- *The National University of Lao (NUOL)*

The research team from NUOL participated in the Theory of Change training and learned new for their future research to develop an academic methodology for equitable and inclusive urban design planning, and creating a multi-stakeholder platform that allows community members, policymakers, academics and private sector stakeholders to collaboratively develop urban design plans.

- *PhD candidate funded by UCRSEA*

Ly Quoc Dang (Table 1) participated in the UCRSEA Theory of Change training workshop in late 2016 and was able to use the framework to incorporate the Sustainable Livelihood approach to assess vulnerability and gender inequality in his PhD research. The theory of change framework brings about a discussion focusing on how women and men in different classes, ethnicity groups, religions, and livelihood backgrounds are impacted by urban flooding disaster in Can Tho. The differential impacts reflect the differences in social, economic and political dimensions, which are in turn dynamic. Flooding is also a catalyst leading to social, political and economic changes, driving inequality. His research is informing appropriate economic and infrastructure development planning and adaptive strategies that are inclusive to improve the livelihoods of vulnerable groups, particularly women (Dang 2019, personal communication, 30 September).

Urban Climate Vulnerability and Resilience Research Findings

The significance of cities is increasingly recognised in global agendas. The Sustainable Development Goals (SDGs) explicitly acknowledge the important role that cities play in the pursuit of sustainable development through Goal 11, which aims to 'Make cities and human settlement inclusive, safe, resilient and sustainable'. SDG 13 focuses specifically on taking urgent action to tackle climate change issues. The 2015 Paris Agreement also highlights the key role of local governments in the global response to climate change. However, many cities, particularly in the Global South, face enormous constraints and lack the necessary capabilities to effectively deal with the issue of climate change (Tanner et al 2009).

The conceptual framework of UCRSEA guided research activities to advance understanding of and document the range of vulnerabilities faced by urban residents in small- and medium-sized cities and explore ways in which these cities can fully engage in resilience building activities. Case studies from different locations collectively show how urbanisation increases the exposure and susceptibility of urban residents to disasters and climate-related shocks, and that impacts are felt unevenly among urban populations (Kimleng 2017, Beringer and Kaewsuk 2018, Le and Ha 2019). The urbanisation pattern in this region reflects the long-term considerations of climate change adaptation being of much lower priority than short-term economic growth (Bridhikitti 2017, Ly et al 2019, Martin et al 2019). Much of the research also discussed limited capacity and accountability of city governments to deal with emerging environmental and socio-economic challenges associated with urban infrastructure and industrial development (Thuon et al 2016, Friend and Thinphanga 2018b). Furthermore, the work of UCRSEA suggested effective governance and institutional capacity must be

highlighted when addressing urban climate vulnerabilities (Hayward 2017, Rhodes 2018, Friend and Thinphanga 2018a).

Similar urbanisation patterns can be observed across the region. Rural towns and cities are being positioned as new industrial or special economic zone for economic development, such as Mukdahan and Dawei. Mukdahan, Northeast Thailand, is located in the middle of the East–West Economic Corridor (EWEC), connected to Sawannakhet, Lao PDR by a Thai-Laos Friendship Bridge. Due to its location Mukdahan is targeted for trade and tourism and Mukdahan Special Economic Zone (MSEZ), covering over 500 sq km, has been established by the national government (Bridhikitti and Khadka 2019). Changing land use and ecological landscapes is a main concern for local communities. With limited water availability, increasing demand will lead to conflicts, as it is likely that water will be allocated and distributed to the industry as priority (Friend and Thinphanga 2018b).

The Dawei Special Economic Zone (DSEZ) with a deep-sea port, in Myanmar, is set to be one of the largest in Asia, covering an area of approximately 200 sq km (Mercy Corps 2017). With the opening of the ASEAN Economic Community (AEC), the project will now be linked directly by road to Quy Nhon where plans for a similar, but smaller scale, petrochemical industrial plant have been approved. A highway, railway, and oil and gas pipelines are also being constructed linking Dawei to Thailand's Map Tha Phut and to Quy Nhon in Vietnam (Friend and Thinphanga 2016a). The completed SEZ will include a deep-sea port, oil refinery, coal-fired and liquefied petroleum gas power plants, steel mill, petrochemical complex, and other medium and light industries.

The establishment of special economic zone represents a dramatic transformation of the ecological, social, and economic landscape in both towns and will have broader implications as observed in established industrial zones like the Eastern Seaboard in Thailand (Rhodes 2018). Dawei and Mukdahan are not only experiencing population growth, but also direct and indirect impacts from the development of the adjacent SEZ, many poorer rural and urban households are experiencing the dispossession of their land, which is leading to the loss of livelihoods, forced migration, and increased commodity prices (Martin et al 2019). There remains a significant gap in considering the institutional and regulatory mechanisms that will be required for managing the transformation that the industrial estate will bring to the wider area, including managing the demand for water and how this will be met, preventing impacts on air, groundwater and soil quality, ensuring transparency and proactive communication with the public, maximizing economic benefits to the community, and managing resettlement and compensation for loss of land and resources integral to local livelihoods (Friend and Thinphanga 2016a, Rhodes 2018). Importantly, given the anticipated long lifespan of the project, it will also be important to consider climate change vulnerabilities, and how these can be mitigated (Martin et al 2019).

Urbanisation in many areas across Vietnam is driven by economic development through the tourism industry. The establishment of Trang An as a UNESCO heritage complex in Ninh Binh has transformed the livelihood of Truong Yen

commune from a rural agriculture to more urbanised economies (Ly et al 2019). The tourist operation of Trang An is solely done by one company, the Xuan Truong Company. On one hand, the economic development model of the tourism sector is important for poverty reduction in rural areas. Per capita income of Truong Yen has increased by eightfold in a decade. Tourism contributes more than 80% of Truong Yen commune's GDP despite employing just 20% of labour. In contrast, while employing about 60% of labour, agriculture accounts for only 20% of total GDP (Ly et al 2017).

On the other hand, dramatic changes in livelihoods and land use contribute to increasing vulnerabilities. The loss of agricultural areas along with large influx of tourists means that food becomes less affordable to local residents. Food and necessity price in Truong Yen is further pushed up by the influx of tourists. The company employs only women as rowers, taking tourists on boat tours. Other family members migrate to the city for employment, leaving behind elderly and children. During peak tourist season, each rower may get up to two rounds of boat tour, earning approximately USD6.60 per tour. Outside of peak season, it is common that rowers may wait for several days without getting a tour. During this period of no boat riding income, they resort to informal jobs such as day labour construction. Thus in Truong Yen, the new urbanised livelihood is characterised by the instability and insecurity of income and migration of men and young people out of the commune (Ly et al 2017).

Urbanisation is also associated with shifting values and lifestyles. There is increasing desire to be more urban for more 'modern' lifestyle, especially among the younger generation who have better access to communication tools (internet, social media), and greater exposure to media and advertising. This is prefaced by changing attitudes by youth towards 'conventional' livelihoods such as farming and fishing which is seen as labour intensive, unpredictable income and too precarious (Asif et al 2016). In the coastal fishing communities of Koh Kong, Cambodia as an example, many sons and daughters have remarked that they have no desire to do fishing after watching their parents struggle to make enough money for the family. Instead, they aspire to leave the fishing village with the daughters wanting to work in the factories of the Koh Kong Special Economic Zone and the sons seeking either further education or labour or service jobs in the city, like Phnom Penh and sometimes Thailand. Meanwhile, their parents stay in the village, either continuing to fish, making whatever they can, or selling goods from their house, or abandon fishing altogether, relying on remittances from their sons/daughters. The effects of out-migration of people of Koh Kong phenomena lead to shifting dimensions of vulnerability (Asif 2019).

The thinking and argument of UCRSEA supported the need of climate vulnerability assessments need to move away from a 'predict and act' approach towards assessing climate thresholds (Friend and Thinphanga 2018a). This means that instead of taking (downscaled) climate projections as the starting point for vulnerability assessments, it is important to assess how patterns of urbanisation and other factors such as dependence on complex urban systems, infrastructure and technology are creating vulnerabilities that will be exacerbated by future climate change (Chelleri 2011, Friend et al 2015, Friend and Moench 2015). This

thinking of climate vulnerability determines the points at which a crisis will occur, and the social processes in which this crisis is identified (Friend and Thinphanga 2018a). Furthermore, shocks and crises are not only determined by the location of a particular event, but by the ways in which systems are networked, and how the impacts of shocks and crises cascade through inter-linked, inter-locked systems across different locations, impacting different people in different ways (Friend et al 2015, Friend and Thinphanga 2018a). The ways, in which actors (individuals, households, communities, organisations) access and control urban systems, are key determinants in wellbeing and welfare, and conversely in poverty and vulnerability. The approach to investigate the interface between critical urban systems, such as water and waste, and actors as a key principle to situate and unfold dimensions of vulnerability was carried out by the research teams in Battambang, Phra Lap in Khon Kaen, and Ninh Binh.

Battambang, one of the oldest towns in Cambodia established before the French colonisation period, is rapidly urbanising. Situated on the Southern Economic Corridor, an important node of ASEAN, a traditionally agricultural town, Battambang has recently transformed into agro-industrial centre. With increasing population and expansion of urbanised areas, local authorities are unable to provide adequate services, such as solid waste management, and water infrastructure, such as drainage and sanitation (Thuon et al 2016). Solid waste collection and dispersal is instead contracted to a private company. Up to 80% of households in urban areas receive this service through the company, including factory and hospital wastes. With weak legal framework and governance, the company does not follow environmental regulations and is not accountable for management and overflow of the only dumpsite, which is located near residential areas. In this case, with urban sprawl and lack of urban planning, residential areas edge closer to the dumpsite. Contaminated water from the dumpsite is leaked into nearby paddy fields and houses, and is exacerbated by floods. Battambang is experiencing more frequent floods, as paddy fields have been converted into built environments with inadequate drainage (Thuon and Cai 2019). The current drainage system was built during the French period. Only a small proportion of households are connected to the central sewage system. Untreated wastewater is discharged into farmland, rivers and canals.

Communities of Pra Lap sub-district are faced with increasingly complex water resource issues, ranging from changing flood patterns, intensity and duration to water supply shortages in the same year (Kaewsuk and Beringer 2017). This peri-urban area is downstream from fast growing city of Khon Kaen and shares the same water supply source in the Chi river basin. As the urban population of Khon Kaen continues to expand, water is limited and cannot meet increasing demand. Water is largely allocated for urban consumption and industries. In addition, unregulated and uncontrolled urban sprawls lead to transformation of natural waterways and ecological landscapes, causing frequent floods (Friend and Thinphanga 2018b). To protect urban economic centres, floodwater is pumped and diverted to Pra Lap. Pra Lap villagers, particularly women, children and elderly, suffer from a suite of health impacts and are vulnerable to water resource issues, including water supply shortages, contaminated and degraded water

quality due to untreated wastewater and urban run-off from Khon Kaen, and increasingly unpredictable floods (Beringer and Kaewsuk 2018).

In Ninh Binh, the establishment of Khanh Phu industrial zone increases vulnerabilities of nearby local communities of Phu Hao village through rising air pollution and water contamination (Le and Ha 2019). Contaminated water is leaked into groundwater causing losses of livestock, reduction of crop yield and human health impacts, and is exacerbated by floods. Weak local institutions in managing complex interlinked urban systems that are operating across administrative boundaries and inadequate water infrastructures for supply, sanitation and drainage mean floods and pollution pose serious challenges (Le and Ha 2018).

In conclusion, building resilience is a necessary feature of future urbanisation, particularly in fast growing small- and medium-sized secondary cities (Birkmann et al 2016, Solecki et al 2017). Vulnerabilities are shaped by urbanisation and economic development as observed across the Mekong region. Patterns of urbanisation in the Mekong cities reveal important issues of urban governance and approach to vulnerability assessments. Drawing on complex social-ecological-technological systems thinking and approaches provides a lens through which we can understand cities beyond their spatial or territorial boundaries. The complex systems lens also provides a new mechanism to assess vulnerability to climate change. Increasingly, the impacts of climate shocks and crises are felt through the failure of urban systems, and the ways in which these cascade across different locations and people. Furthermore, observed unequal power relationships and access to power, resources and urban systems of diverse urban community groups contributes to increasing vulnerabilities. Local communities of this region have limited space for participation and influence in decision-making processes that shape urbanisation. Ineffective institutional capacity and weak urban governance from incomplete decentralisation processes means that local governments are unable to develop citywide long-term actions and prepare for disaster and climate impacts that transcend across political and administrative boundaries.

V. Methodology

A range of research methods and analytical techniques were used in the UCRSEA project. The partners were encouraged to conduct Shared Learning Dialogue (SLD) as an approach to engage with multi-stakeholders for vulnerability assessments and with decision-makers to contribute to influencing policy change (Reed et al 2013). The Framework for Climate Vulnerability Assessment in Urbanising Asia was developed as a guidebook for partners and students to carry out situation analyses and vulnerability assessments in different selected cities (Friend and Thinphanga 2016b). The framework highlights the governance dimensions of urban climate vulnerability and resilience, combining complex Social-Ecological Systems (SES) approaches with actor-oriented approaches. This combination of frameworks is grounded in theory of resilience and assets, capabilities and freedoms (Bahadur et al 2010, Bahadur and Tanner 2014). The partners carried out situation analyses of cities to explore urban systems and infrastructure, and

the linkages to institutions that operate these critical systems to identify points of fragility and failures (Bridhikitti 2016, Asif et al 2016, Kaomuangnoi Urbanek 2016, Thuon et al 2016).

Prior to working with the UCRSEA Partnership, many partner organisations drew primarily on quantitative data collection methods for research. Since being involved in this project, greater use of urban climate resilience theories informing UCRSEA's conceptual framework has altered the way in which the partner organisations gather data and construct research. To elucidate upon this evolution, this section provides a brief overview of the methods used by each of the URCSEA partners.

- *The Centre for Environment and Community Research (CECR)*

CECR incorporated in-depth interviews and participatory focus group discussions in their Research Brief and Vulnerability Report (Ly et al 2019). Their methods drew on strength, weakness, opportunities, threats (SWOT) analysis, hazard mapping, disaster history, seasonal calendars, Venn diagrams, and social network analysis. Researchers performed a variety of these participatory methods on a wide selection of stakeholders including residents, governmental staff (local and provincial), management boards, and community level authorities. In addition, they also made a conscientious effort to address gender differences through engagement with a women-only focus group (Ly et al 2017).

- *The Centre for Natural Resources and Environmental Studies (CRES)*

CRES specifically conceptualised their work around the Theory of Change within their context to frame their research. They applied an assortment of methods to their work: desk study, stakeholder meetings, household interviews, key informant interviews, focus group discussions, and field observations (Le and Ha 2018). The CRES is an education and training centre in Vietnam; thus, their expansion into qualitative methods, such as those just listed, carries significant influence beyond their own organisation as these methodologies can be shared with other research initiatives throughout Vietnam.

- *The Faculty of Environment and Resources Studies, Mahasarakham University (MSU)*

Focusing their research on stakeholders' adaptive capacity to urban dynamics and climate change, MSU's research in Mukdahan was informed by the use of livelihood assessments, household surveys, interviews, and mailed surveys (Bridhikitti 2017). The other research team employed the climate resilience framework and sustainable livelihoods approaches in Khon Kaen, focusing on the impact of flooding and how households could cope with and adapt to such situations to strengthen resilience. By reviewing relevant documents and literature, hosting preliminary meetings with municipalities and university departments, and conducting household surveys and in-depth interviews, researchers mapped out major flood vulnerability areas and determined community adaptive strategies (Kaewsuk and Beringer 2017). In addition, they produced policy briefs and a publication from this work to further disseminate this information.

- *The Royal University of Phnom Penh (RUPP)*

RUPP's research strategy concentrated on a qualitative approach using focus groups and interviews. This research noted the importance of linking key findings to the social, political, capacity, and institutional dimensions of local governments in Battambang and Koh Kong. The research teams at RUPP also focused on a survey method and applied the United Nations International Strategy for Disaster Reduction (UNISDR) Local Government Self-Assessment Tool (LG-SAT), framed under the Hyogo Framework of Action (Yin 2017, Thuon and Naret 2018). The LG-SAT is a powerful tool, which helps cities reflect on and assess their own capacity for disaster risk reduction (DRR) as a means to facilitate space for dialogue around key capacities and vulnerabilities (Henceroth et al 2015).

- *The Department of Geography, Yangon University*

Relying on a mixed methods approach of surveys and interviews to address questions about economic opportunities, this research partner working in Bago made further connections to sustainable environmental practices and climate change resilience with the data obtained.

An engagement tool – the Airbeam device

The use of the Airbeam device as a practical engagement tool was proved to be effective. As part of the efforts to address the third UCRSEA research question (How can we strengthen the agency of individuals, groups and institutions to improve economic, physical and social well-being in urban areas, particularly in response to climate change?), the partners designed project activities using the Airbeam device to engage with target groups and key local actors.

In the recent years, air pollution has become a serious threat in many cities across the world. Poor air quality is rapidly worsening in Southeast Asian cities and is exacerbated by fast paced urbanisation, poor urban governance and ineffective institutional capacity. Many cities where UCRSEA operated have been ranked by the Greenpeace Southeast Asia to be in the top 5 with the highest annual average concentrations of PM2.5. Environmental quality monitoring in this region is generally inadequate, unreliable, inaccurate and often non-existent. Raising awareness, increasing understanding of health risks associated with air pollution, advocacy for clean-air actions, and improving access to information among local communities will contribute to strengthening resilience.

The partners were advised not to use the Airbeam device for scientific measurement of PM2.5 levels due to the accuracy of the measurement to meet scientific standards. However, using the Airbeam device to engage with government officials, local communities, students, and youth groups to visualise real-time PM2.5 levels and highlight the urgency to tackle air pollution problems was effective and practical (Win and Oo 2018, Bridhikitti and Prabamroong 2018, Wongtragoon 2018). Some of the partners were able to provide evidence of poor air quality to the public and using press release to inform public policy planning and advocate for the government to take immediate action (Khan 2018). The use of a practical tool to open up space for learning, dialogues, access to information and multi-stakeholder engagement is critical for many countries in Southeast Asia with weak environmental safeguards and governance. Building capacity of university

academics, junior researchers and students is an important approach to support the planning and decision-making processes of the governments and to inform public policy. The Airbeam device was used to train academics and researchers in 12 universities and research institutes in Yangon, Bago and Dawei with participation of relevant government officials. This resulted in state and non-state collaboration and policy dialogues (Win 2019, personal communication, 1 October).

VI. Project Outputs

UCRSEA strengthened the knowledge and technical skill capacities of academics, researchers, students and NGOs in urban climate resilience through learning and developing research questions, implementing research activities, and writing up and presenting research findings. The partners and graduate students were financially supported by UCRSEA to present their research in relevant international conferences in different countries (Annex C). Throughout the project, they were strongly encouraged and supported to write up and publish their research findings. As a result, a range of research outputs, including grey literature, journal articles, and book chapters, has been produced over the years. Some are listed below.

Peer reviewed articles

- Friend, R. and Thinphanga, P. (2018) Urban Water Crises under Future Uncertainties: The Case of Institutional and Infrastructure Complexity in Khon Kaen, Thailand. Sustainability 10, 3921; doi:10.3390/su10113921
- Berginer, A.L. and Kaewsuk, J. (2018) Emerging Livelihood Vulnerabilities in an Urbanizing and Climate Uncertain Environment for the Case of a Secondary City in Thailand. Sustainability 10, 1452; doi:10.3390/su10051452
- Beringer, A.L., Inmuong, Y., Kaomuangnoi, K. (2018) Understanding urban vulnerabilities to climate change impacts in Khon Kaen and Mukdahan in Thailand. Social Science Asia 4 (4): p1-13 in conjunction with Community University Engagement Journal. DOI: 10.14456/ssa.2018.28
- Kimleng, S. (2017) Urban Climate Vulnerability in Cambodia: A Case Study in Koh Kong Province. Economies, 5, 41, doi:10.3390/economies5040041
- Asif, F., Marschke, M., Ngin, C. (2017) Assessing the potential of a low-carbon future for Cambodia. Journal of Renewable and Sustainable Energy 9, 021404. http://dx.doi.org/10.1063/1.4978495
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Book chapters

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A textbook

A Thai textbook titled '*Khon Kaen City: Urban Growth, Challenges and Opportunities*' (ISBN 978-974-8479-80-4 First edition published in May 2019, 156 pages), authored by the research team of the Research Group on Wellbeing and Sustainable Development (WeSD), Khon Kaen University, led by Dr Promphakping, aims at undergraduate university students as background reading and a prerequisite to understanding urbanisation for framing research around urban and climate issues. The textbook highlights the urbanisation process of Khon Kaen city as a regional growth pole, shaped by national policy and economic development and industrialisation. Various urban theories and city concepts are discussed. The book points out the importance of urban governance and the need to understand urban climate vulnerability. (https://www.thaicity-climate.org/document/kk-urbanisation-2/)

Grey literature

Some of the partners have published research/policy briefs, highlighting key research findings and messages targeting their 'boundary partners'.

- Ly, N.N., Hoa, T.L., Anh, N.P. (2019) Research brief: Public private partnership in sustainable tourism development in Trang An Landscape Complex Ninh Binh in the context of climate change. The Center for Environment and Community Research (CECR), Vietnam
- Yin, S., Ngin, C., Heng, N. (2018) Policy brief: How can a Secondary Coastal City in Cambodia be Better Prepared for Climate Change and Natural Disaster Risks? Royal University of Phnom Penh, Cambodia

Creative outputs
In addition to the publications of journal articles and book chapters, creative outputs based on UCRSEA research were produced.

- UCRSEA short films

Short films were commissioned highlighting key messages emerging from the vulnerability assessments conducted by the partners and research students in Cambodia, Myanmar, Thailand and Vietnam. Research was guided by the UCRSEA conceptual framework and funded by IDRC. The film production was carried out by Living Films & Eureka Films, funded by SSHRC.

Based on the UCRSEA Theory of Change framework, the short films focused on changes in Knowledge, Access, Skills, and Will as an approach to building urban climate resilience. The films highlighted UCRSEA messages on generating new knowledge, increasing access to resources, enhancing learning of new skills, and improving political willingness as key factors contributing to changes in decision-making processes and planning and strengthen climate resilience.

  - https://youtu.be/iKMz5jP6nx8
  - https://youtu.be/ebGfNVUTYuw
  - https://youtu.be/y0L__nWbLck
  - https://youtu.be/nArId7MD6ws
  - https://youtu.be/CKkci_u7ojQ
  - https://youtu.be/uA8KkZpxW-8
  - https://youtu.be/w6wmG635EAY

- Bangkok Post – following the final Partners Annual Workshop, this news article highlights on the key messages emerging from UCRSEA research across the Mekong region
  - https://www.bangkokpost.com/news/special-reports/1684044/preventing-climate-change-in-the-face-of-urbanisation

VII. Problems and Challenges

UCRSEA was supported under the programme of the International Partnerships for Sustainable Societies Grant (IPaSS). There were two sources of funding. Funding from Social Sciences and Humanities Research Council (SSHRC) was responsible by the Asian Institute, Munk School of Global Affairs, University of Toronto, and funding from the International Development Research Centre (IDRC) was under the responsibility of Thailand Environment Institute (TEI). Under the IPaSS programme, there were specific requirements and outcomes to be achieved by UCRSEA. However, there were some differences in the requirements and objectives between the two funders, posing challenges in project management and administration for the two co-directors. UCRSEA was implemented in multiple countries with multiple partner organisations. It was evitable for the project to experience some administrative and partnership problems and challenges arising during the implementation. In addition, there were differences in expectations and capacity of the project partners. However, problems and challenges were handled

and resolved professionally, through open discussion and face-to-face meetings between the project co-directors and implementing partners or between the two co-directors or between the co-directors and the Project Management Committee, depending on the nature of problems and challenges.

- *Theoretical and research challenges*

The most important challenge that was recognised early on in the project was the understanding of the conceptual framework and research questions among all of the project partners from Canada and Southeast Asia. While different interpretations and exploration of different approaches to address the research questions were welcomed and encouraged in order to generate diversity and learning through varying case studies, at times different understanding and perspectives created some confusion and conflicting opinions. For instance, some of the SE Asian partners were more interested in understanding the urbanisation process driven by regionalisation and economic development and how this pattern of urbanisation contributed to climate vulnerability of local communities. Some of the academic partners from Canada were more interested in climate impacts on disasters, such as floods, and how these climate impacts drive the vulnerability, but took the issues of current urban economic development pathway very lightly. The theoretical frameworks and various definitions of climate vulnerability discuss both perspectives of urban and climate impacts as drivers of vulnerability. This shows the differences in how to approach and understand climate vulnerability. However, confusion occurred in Year 3 when academics from Canada strongly pushed to remove one of the selected Thai cities, Mukdahan, because the city did not rigorously display climate risks and impacts and to replace it with a new city in the south of Thailand that had recently experienced flood crises.

In Project Year 1, all of the partners from Canada and Southeast Asia came together to develop and agree on city selection criteria. The partners from each of the Mekong countries were then responsible for reviewing proposed short-listed cities and deciding their respective final 2 cities per country. It was also agreed that the partners would work in one or both of the cities in their respective countries. Some confusion arose when Canadian students were funded (by SSHRC) to conduct research in locations that were not in the group of the selected cities. Furthermore, the Student Selection Committee would award SE Asian students' research proposals that were not in any of the selected cities.

Reconciliation of the research question and approaches around the implications of urbanisation, climate impacts and vulnerability would have benefited the actual research conducted under the project. UCRSEA had the opportunity to take the lead in refining methodologies for vulnerability assessments in the context of rapid urbanisation and climate change and generating evidence-based knowledge to better understand how both socio-economic development and climate change contribute to urban vulnerability.

- *Partnership support challenges*

With multiple partner organisations across the Mekong countries, it was anticipated that there would be a range of interests, agendas, capacities, and research and writing skills. Understandably, some partners would require more

resources and support than others, such as the academic partners in Myanmar where universities had been shut down by the military regime for decades. One of the objectives of UCRSEA was to strengthen research capacity and skills of academics, researchers and practitioners. Therefore, some of UCRSEA activities were designed to meet this objective. These activities included small-group discussions in each of the countries, trainings and regional workshops. However, most of the Southeast Asian partners expected academic support from Canada in particularly academic writing for publication (in English). To meet this request, postdoctoral fellows and PhD students from Canada were asked to provide research and publication support to the partners. The challenge faced by the project was the balance of providing support to the partners and students' own academic advancement. With limited time spent in Asia, postdoctoral fellows and PhD students from Canada naturally opted for their own academic advancement.

- *Southeast Asian student support challenges*

The weak capacity of graduate students from the Mekong nations was not anticipated. UCRSEA was designed to provide financial support to graduate students from the Mekong countries to conduct research in urban climate resilience. Calls for proposals were announced at least twice a year. Graduate students were encouraged to submit research proposals in English addressing elements of the UCRSEA research questions. A few problems and challenges emerged. The number of applications per call was much lower than anticipated. Number of applications per country submitted was imbalanced. Applications from Laos, Thailand and Myanmar were lowest. Research proposals were poor in quality and did not meet the requirements. English skills were also generally weak.

Originally some of the IDRC budget was allocated to support a total of 16 students for the Field Research Grants and a total of 4 PhD students with full scholarships. Due to the challenges listed above, UCRSEA supported a total of 2 PhD candidates and 9 students were awarded field research grants. The remaining budget was reallocated to support research teams that included junior researchers and graduate students to conduct small or one-year research projects. The aim was to strengthen research capacity and skills of university-level academics and researchers.

Furthermore, through discussions with the SE Asian academic partners, it was discovered that part of the problem was from the rigidity of the university system across the region. The subjects of climate vulnerability, urbanisation, and resilience were not widely taught and under researched at the university level. These subjects would cut across multiple disciplines and faculties and the existing university system operates in silo. In addition, graduate students would need support from different supervisors across different faculties to conduct research. To help address this university issue, UCRSEA established a regional university network for Curriculum Development bringing together senior academics from various universities in the Mekong countries to collaborate, plan and develop a new curriculum. The aim was to bridge physical and social sciences, creating a new degree course that would address challenges of climate change, urbanisation and sustainability. The regional university network, co-hosted by Dean of Faculty of Environment and Resources Studies, Mahasarakham University (MSU), also

engaged with the academic partners from Canada for the development of a new urban-climate course, and for sharing of reading materials and resources for teaching. Through this collaborative engagement, a course on 'Urban Climate Change in Southeast Asia' was developed with 15-week course schedule and reading lists. The Mekong university partners were keen to operationalise the new curriculum and collaborate across universities in the region to share resources. There were limited interests and efforts from the academics in Canada to pursue further collaboration in linking at the institutional level with universities in the Mekong countries. With the existing regional platform and networks of universities, the academic partners in the Mekong will seek future opportunities to continue the collaboration to develop and promote new teaching and research agenda and institutionalise urban climate resilience approaches.

The academic partners in Canada organised and hosted several Students Virtual Seminars to provide opportunities for students from Southeast Asia and Canada to network, share and exchange research plans and findings, and discuss theoretical literature. This activity was highly beneficial to the students. However, additional support, including access to publications, to meet research capacity building and training needs of students from Southeast Asia would be valuable. In adequate infrastructure and Internet connectivity in some locations like Myanmar means that students have little or no access to e-library and virtual seminars.

- *Ethics*

All of the partner universities in the Mekong countries did not have ethics reviewing process in place. To meet the requirement of IDRC for ethic approval of research, a University of Toronto ethics application was adapted for SE Asian partners and students. Prior to transferring budget for research, the partners and students were requested to fill in and submit the ethics application for approval. Data and information of the ethics applications were stored at TEI.

- *SSHRC requirement challenges*

The different requirements, regulations and rules of SSHRC and IDRC created some confusion among the Southeast Asian partners. SSHRC funding was designated to support graduate and research students and postdoctoral fellowships from Canada for a range of activities under UCRSEA, including internships and conducting field research in any of the four countries and attending international conferences. The objective and role of Canadian students were initially unclear and the SE Asian partners misunderstood in thinking that the student programme was a different project to UCRSEA. The internship programme, which appeared to value Canadian research students, but disadvantage the regional partners who were not compensated for the additional time they spent training students and setting up student projects, exacerbated funding issues. Furthermore, early on in the project, a few challenges emerged during student internships, particularly from those Canadian students traveling overseas for the first time. However, with the recognition of this problem, students and interns from Canada were required to attend session at the Partners Annual Workshop and network with fellow interns and research students. Students and supervisors were invited to meet at these workshops to build working relationship. Students were introduced to UCRSEA administration team to ensure access to as many contacts as possible during their

time in the field. There were also some suggestions that a stronger focus on culturally appropriate behaviour and the role of interns in certain settings was needed.

VIII. Administrative Reflections and Recommendations

Overall, the scope and five-year duration of the project were good for a research-action programme. UCRSEA was set out to serve as a regional capacity platform to advance research and knowledge in urban climate resilience in locations where solutions to address the emerging issues of urbanisation and climate change are urgently needed. Despite some challenges in the project management under different funders, the collaborative intentions of joint funding and partnerships between Canada and developing countries were highly commended. Grant administration and management of IDRC were of high standard, providing strong support to the partners. However, the project implementation in Southeast Asia was constrained by currency exchange fluctuations. Towards the final year of the project, key activities, including knowledge mobilisation and dissemination, were cut back due to substantial budget losses from the devaluation of the Canadian dollar.

The area for improvement would be aligning the collaborative role of research and graduate students and postdoctoral fellows from Canada to the needs of Southeast Asian partners, particularly junior researchers, and graduate students in terms of academic collaboration, research assistance, and capacity building. Streamlining and sharpening research conducted by Canadian researchers to address the UCRSEA conceptual questions would advance and enforce knowledge and increase science-policy relevance in Southeast Asia. For a collaborative partnership programme, identification of strategic approaches to enforce, support and increase collaborative efforts among the partners was important. Greater collaborative efforts between academics from Canada and Southeast Asia in conducting research, refining and institutionalising urban climate resilience approaches and publications would have delivered greater academic and policy impacts of UCRSEA.

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X. Annexes

Annex A – A list of Southeast Asian partner organisations making up the UCRSEA network

Status	Partner organisations
Original formal partners	Centre for Environment and Community Research (CECR), Vietnam
	Centre for Peace and Conflict Studies, Chulalongkorn University, Thailand
	Graduate Program in Development Studies, Royal University of Phnom Penh (RUPP), Cambodia
	Mercy Corps Myanmar
	Ministry of the Environment, General Department of Administration for Nature Conservation and Protection, Cambodia
	Renewable Energy Association Myanmar (REAM)
	Regional Centre for Social Science and Sustainable Development (RCSD), Faculty of Social Sciences, Chiang Mai University, Thailand

Status	Partner organisations
	Research Group on Wellbeing and Sustainable Development (WeSD), Khon Kaen University, Thailand
Additional formal partners	Centre for Natural Resources and Environmental Studies (CRES), Vietnam National University, Vietnam
	Faculty of Environment and Resources Studies, Mahasarakham University (MSU), Thailand
	Department of Urban Environment, National University of Laos, Lao People's Democratic Republic
	Geography Department, University of Yangon, Myanmar
	Rajamangala University of Technology Lanna (RUTL), Thailand
Partners participated in research activities or regional workshops, meetings or trainings	Faculty of Environmental Science, Vietnam National University of Hanoi
	Environmental Faculty, Ha Noi University of Natural Resources and Environment
	Faculty of Environment, Bachkhoa Univerity, Ho Chi Minh City, Vietnam
	Faculty of Environment, Ho Chi Minh University of Natural Resources and Environment
	Department of Natural Resource Management- Development, Faculty of Development Studies, Royal University of Phnom Penh
	Faculty of Environmental Science, National University of Lao
	Faculty of Architecture, King Mongkut's Institute of Technology, Ladkrabang (KMITL), Thailand
	Asian Disaster Preparedness Center (ADPC)
	Department of Geography, University of Mandalay, Myanmar
	Maubin University, Ministry of Education, Union of Myanmar
	Udon Thani Rajabhat University (UTRU), Thailand
	Department of Sociology and Anthropology, Faculty of Humanities and Social Sciences, Khon Kaen University, Thailand
	University of Battambang, Cambodia
Partners left the network	Swanyee Development Foundation, Myanmar ISET-International Vietnam

Annex B – A list of SE Asian partner organisations and their research topics

Partners	Vulnerability Assessments	Citizen Science and Air Quality Monitoring using Airbeam
CECR Vietnam	Vulnerability Assessment: a case study of Truong Yen commune in Trang An scenic landscape complex, Ninh Binh, Vietnam	Engaging with school students in Hanoi to raise awareness
CRES Vietnam	Assess the vulnerability of local community caused by the impact of urban development in the climate change context. The field survey was focused on Phu Hao	Engaging with school and local communities in Ninh Binh to raise awareness 1) Quan Thien secondary school in Kim Son District

Partners	Vulnerability Assessments	Citizen Science and Air Quality Monitoring using Airbeam
	village, Khanh Phu commune, Ninh Binh city	2) Khanh Phu commune in Yen Khanh District
Yangon University Myanmar	Economic Potential of Bago City: Opportunities and Challenges compared with Urban Climate Change Practices	-
Mercy Corps Myanmar	Stakeholder Mapping Report of the Dawei Special Economic Zone, Myanmar	-
RUPP Cambodia	Assessing City Resilience Using the UNISDR Local Government Self-Assessment Tool in Koh Kong, Cambodia	Air quality monitoring training for government officials in Phnom Penh
RUPP Cambodia	Fact Finding study to Battambang's Border Districts with Thailand on Productive System, Trades that Link to Key Engine for Urban Growth of Battambang province, Cambodia	Air quality monitoring and awareness raising with local communities in Battambang
MSU Thailand	Adaptive capacity of Mukdahan Special Economic Zone to the problems relating to the extreme weather events and urban growth	Students training and community engagement Air quality monitoring and PM2.5 mapping in Maha Sarakham
MSU Thailand	Livelihoods Vulnerability Assessment of Flood-Prone Pralab Community in Khon Kaen, Thailand	-
RCSD Thailand	Understanding institutional challenges for urban planning in Vientiane, Lao PDR	-
REAM Myanmar	-	University students training and air quality monitoring in ten locations in Yangon, Bago, Muabin and Dawei
RUTL/ UTRU Thailand	-	Participatory air quality monitoring in municipal area of Udon Thani

Annex C – A list of international conferences where UCRSEA partners and students attended and presented their research (funded by IDRC)

Project Year	Events	Dates / locations
Project Year 2	The regional symposium "Shared Solutions: Safeguarding Sustainable Development in the Mekong"	August 2015, Bangkok

Project Year	Events	Dates / locations
	The Sixth Asia Pacific Urban Forum (APUF6): Sustainable Urban Development in Asia-Pacific: Towards a New Urban Agenda	Jakarta, October 2015
	The Conference on Crossing Borders: Governing Environmental Disasters in a Global Urban Age in Asia and the Pacific	NUS, Singapore, November 2015
	The Workshop on Tools and Indicators for Assessing Urban Resilience	December 2015 at The University of Tokyo, Japan
	The Resilience Roundtable, hosted by USAID	Bangkok, in January and May 2016
Project Year 3	The 13th Asia Pacific Sociological Association Conference (APSA), UCRSEA panel (6 presenters) - Title: Regionalisation, urbanisation and climate change	24-25 Sept 2016 Phnom Penh
	The 10th International Convention of Asia Scholars (ICAS10), UCRSEA panel (5 presenters, 1 discussant) - Title: Trends and trajectories of the Mekong Region – understanding the implications of regionalisation, urbanisation and climate change	20-23 Jul 2017 Chiang Mai
Project Year 4	IEEC 2017, Individual paper - Title: Life is now a disaster with the rains": the impact of climate change and urbanization in Khon Kaen city	15 – 17 Nov 2017 South Korea
	Forum on Urban Resilience to Climate Change and Disaster Risk Management Strategies, Individual paper - Title: Vulnerability Assessment in Dawei, the impacts of Special Economic Zone	4-8 Dec 2017 Philippines
	2017 ANPOR Technical Advances and Public Opinion Research, Individual paper - Title: Slum areas in Battambang and Climate Resilience	1-4 Nov 2017 Shanghai
	14th Asian Urbanisation Conference "Sustainable Development Goals in Asia, Individual paper - Title: Urban Floods in Can Tho City: Vulnerability and Resilience among Women	11-13 Jan 2018 Bangkok
	Dimension of Political Ecology, Individual paper - Title: Vulnerable Lives of Women and Empowerment Process in Urban Flooding in Can Tho City, Vietnam	22-24 Feb 2018 Kentucky, USA
	International Conference on Business & Human Rights, Individual paper - Title: Lessons learned for Dawei: Learning from Map Tha Phut	12-13 July 2018 Bangkok
Project Year 5	Policy Forum – Linking Research and Practice to Policy, UCRSEA panel (4 presenters, 2 discussants) - Title: What is needed to inform and influence policy change in urban development and	22 May 2019 Bangkok

Project Year	Events	Dates / locations
	climate responses?	