รายงานการศึกษา ฝึกอบรม ดูงาน ประชุม/สัมมนา ปฏิบัติการวิจัยและการปฏิบัติงาน ในองค์การระหว่างประเทศ

ส่วนที่ 1 ข้อมูลทั่วไป

1.1 ชื่อ/นามสกุล(~~นาย~~/~~นาง~~/นางสาว) อารียาพัชร์ เพชรรัตน์

อายุ 47 การศึกษา ปริญญาเอก

ความเชี่ยวชาญเฉพาะด้าน เศรษฐศาสตร์ป่าไม้

1.2 ตำแหน่ง นักวิชาการป่าไม้ชำนาญการพิเศษ

หน้าที่ความรับผิดชอบ(โดยย่อ)ปฏิบัติงานหัวหน้าฝ่ายวิจัยพัฒนาป่าไม้และนวัตกรรม ศูนย์วิจัยและพัฒนาการป่าไม้ภาคใต้ (สงขลา)

1.3 ชื่อเรื่อง/หลักสูตร ปริญญาเอก ณ มหาวิทยาลัย Yeungnam University

สาขา Forest Resources

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( ) ปฏิบัติงานวิจัย ( ) ไปปฏิบัติงานในองค์การระหว่างประเทศ

ประเทศที่ไป สาธารณรัฐเกาหลี

แหล่งผู้ให้ทุน Asian Forest Cooperation Organization (AFoCO)

งบประมาณ

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คุณวุฒิ/วุฒิบัตรที่ได้รับ Ph.D. IN AGRONOMY

(Doctoral Degree Course, Department of Forest Resources)

ส่วนที่ 2 ข้อมูลที่ได้รับจากการศึกษา ฝึกอบรม ดูงาน ประชุม/สัมมนา ปฏิบัติงานวิจัย และไปปฏิบัติงาน ในองค์การระหว่างประเทศ (โปรดให้ข้อมูลในเชิงวิชาการที่สามารถนำไปใช้ประโยชน์ได้ หากมีรายงานแยกต่างหาก กรุณาแนบ File ซึ่งมีขนาดไม่เกิน 2 Mb ส่งไปด้วย)

2.1 วัตถุประสงค์

1) เพื่อศึกษาความชอบ (preferences) และความเต็มใจที่จะจ่าย (willingness to pay: WTP) ของประชาชนที่อาศัยอยู่ในกรุงเทพมหานครและปริมณฑล เพื่อฟื้นฟูบริการของระบบนิเวศพื้นที่คุ้งบางกระเจ้า

2) เพื่อศึกษาปัจจัยที่มีผลต่อความชอบ (preferences) และความเต็มใจที่จะจ่าย (willingness to pay: WTP) ของประชาชนที่อาศัยอยู่ในกรุงเทพมหานครและปริมณฑลในการฟื้นฟูบริการของระบบนิเวศพื้นที่คุ้งบางกระเจ้า

3) เพื่อกำหนดมาตรการในการฟื้นฟูบริการของของระบบนิเวศพื้นที่คุ้งบางกระเจ้า

4) เพื่อศึกษาความชอบ (preferences) ความเต็มใจที่จะจ่าย (WTP) และความเต็มใจที่จะเป็นอาสาสมัคร (Willingness to Volunteer: WTV) ของประชาชนในพื้นที่ถิ่นที่อยู่อาศัยของพลับพลึงธาร เพื่อฟื้นฟูบริการของระบบนิเวศจากถิ่นที่อยู่อาศัยของพลับพลึงธาร
5) เพื่อศึกษาปัจจัยที่มีผลต่อความชอบ (preferences) ความเต็มใจที่จะจ่าย (WTP) และความเต็มใจที่จะเป็นอาสาสมัคร (Willingness to Volunteer: WTV) ของประชาชนในพื้นที่ถิ่นที่อยู่อาศัยของพลับพลึงธาร เพื่อฟื้นฟูบริการของระบบนิเวศจากถิ่นที่อยู่อาศัยของพลับพลึงธาร
6) เพื่อกำหนดมาตรการในการฟื้นฟูบริการของของระบบนิเวศที่ได้รับจากถิ่นที่อยู่อาศัยของพลับพลึงธาร

2.2 เนื้อหา **วิทยานิพนธ์ เรื่อง การประเมินมูลค่าบริการของระบบนิเวศพื้นที่ชุ่มน้ำในประเทศไทย มีเนื้อหาสรุปโดยย่อ ดังนี้**

มูลค่าบริการของระบบนิเวศ (ecosystem services) มักถูกมองข้ามในกระบวนการกำหนดนโยบายที่เกี่ยวข้องกับพื้นที่ชุ่มน้ำ ดังนั้นการประเมินมูลค่าบริการจากระบบนิเวศจึงเป็นวิธีหนึ่งในการจัดการบริการของระบบจากนิเวศพื้นที่ชุ่มน้ำให้ดีขึ้น วิทยานิพนธ์นี้ใช้วิธีการทดลองทางเลือก (choice experiments) เพื่อประเมินมูลค่าบริการของระบบนิเวศจากพื้นที่ชุ่มน้ำ 2 แห่งในประเทศไทย ได้แก่ พื้นที่คุ้งบางกะเจ้า และถิ่นที่อยู่อาศัยของพลับพลึงธาร (*Crinum thaianum* J. Schulze) กรณีแรกเป็นการศึกษาความชอบ (preferences) และความเต็มใจที่จะจ่ายเงิน (Willingness to Pay: WTP) ของคนกรุงเทพและปริมณฑลเพื่อฟื้นฟูบริการของระบบนิเวศจากพื้นที่คุ้งบางกะเจ้า ในกรณีศึกษาที่สอง เป็นการศึกษาความชอบ (preferences) ความเต็มใจที่จะจ่าย (WTP) และความเต็มใจที่จะเป็นอาสาสมัคร (Willingness to Volunteer: WTV) เพื่อฟื้นฟูบริการของระบบนิเวศจากถิ่นที่อยู่อาศัยของพลับพลึงธารของประชาชนโดยการสัมภาษณ์แบบตัวต่อตัวกับประชาชนในอำเภอสุขสำราญ อำเภอกะเปอร์ จังหวัดระนอง และอำเภอคุระบุรี จังหวัดพังงาซึ่งเป็นถิ่นที่อยู่อาศัยของพลับพลึงธาร ผลการศึกษาพบว่า ชาวกรุงเทพฯ ให้ความสำคัญกับบริการของระบบนิเวศจากพื้นที่คุ้งบางกระเจ้าในด้านการเป็นแหล่งฟอกอากาศ รองลงมาคือการเป็นแหล่งอาหาร แหล่งพักผ่อนหย่อนใจ และถิ่นอาศัยของนกหลากหลายชนิด รัฐบาลและหน่วยงานที่เกี่ยวข้องควรผลักดันและอนุรักษ์ให้พื้นที่คุ้งบางกระเจ้าเป็นพื้นที่สีเขียวและคงรูปแบบเกษตรกรรมผสมผสานแบบดั้งเดิม ควรประยุกต์ใช้โครงการตอบแทนคุณระบบนิเวศ (Payment for Ecological Services: PES) และการท่องเที่ยวเชิงนิเวศเป็นเครื่องมือในการฟื้นฟูบริการของระบบนิเวศ ในกรณีของบริการของระบบนิเวศจากถิ่นที่อยู่อาศัยของพลับพลึงธารนั้นพบว่าสภาพต้นน้ำที่ดีขึ้นเป็นประโยชน์ที่สำคัญที่สุดสำหรับประชาชนในพื้นที่ รองลงมาคือความหลากหลายทางชีวภาพและคุณภาพน้ำในขณะที่ประชาชนมีความพึงพอใจต่อสถานะปัจจุบันของประโยชน์ทางด้านนันทนาการซึ่งเป็นเพียงการชมทัศนียภาพ ชี้ให้เห็นถึงความจำเป็นในการปรับปรุงสุขภาพป่าต้นน้ำและการควบคุมการกัดเซาะอย่างมีนัยสำคัญ การศึกษานี้เสนอแนะว่าการใช้ความเต็มใจที่จะเป็นอาสาสมัครสำหรับการประเมินมูลค่าบริหารของระบบนิเวศอาจเป็น

ทางเลือกที่ใช้งานได้จริง วิทยานิพนธ์ฉบับนี้มีส่วนทำให้เกิดความเข้าใจที่ดีขึ้นว่าบริการของระบบนิเวศมีผลกระทบต่อสังคมมนุษย์อย่างไร ช่วยให้ผู้กำหนดนโยบายและผู้มีส่วนเกี่ยวข้องเข้าใจถึงประโยชน์และผลที่ตามมาของการตัดสินใจและกิจกรรมของฝ่ายบริหาร และกำหนดแนวทางบริหารจัดการพื้นที่ได้อย่างเหมาะสม

2.3 ประโยชน์ที่ได้รับ

☐ ต่อตนเอง ได้พัฒนาความรู้ความสามารถและเพิ่มพูนประสบการณ์ด้านการวิจัยและมีผลงานวิจัยที่ยอมรับในระดับนานาประเทศ รวมทั้งได้เรียนรู้เรื่องภาษาและวัฒนธรรมของประเทศสาธารณรัฐเกาหลี

☐ ต่อหน่วยงาน พัฒนาศักยภาพของกรมป่าไม้ในเรื่องของงานวิจัยในกรอบความร่วมมือด้านการป่าไม้ในภูมิภาคเอเชีย โดยสนับสนุนภาระกิจด้านงานวิจัยของกรมป่าไม้

☐ อื่น ๆ (ระบุ) การประเมินมูลค่าทรัพยากรป่าไม้และบริการของระบบนิเวศ มีประโยชน์ในการประยุกต์ใช้กลไกการจ่ายแทนคุณระบบนิเวศ (Payments for Ecosystem Services: PES) เพื่อการอนุรักษ์ความหลากหลายทางชีวภาพด้านป่าไม้

ส่วนที่ 3 ปัญหา/อุปสรรค สถานการณ์การระบาดของไวรัสโควิด-19 เป็นอุปสรรคต่อการเก็บข้อมูลในประเทศไทย และการเดินทางกลับไปสอบวิทยานิพนธ์ที่ประเทศเกาหลี

ส่วนที่ 4 ข้อคิดเห็นและข้อเสนอแนะ

เห็นควรส่งเสริมและสนับสนุนให้บุคลากรกรมป่าไม้ ได้มีโอกาสศึกษาต่อต่างประเทศในระดับที่สูงขึ้น เพื่อพัฒนาศักยภาพ และสนับสนุนภารกิจด้านงานวิจัยของกรมป่าไม้

(ลงชื่อ) [signature]

(นางสาวอารียาพัชร์ เพชรรัตน์)

ส่วนที่ 5 ความคิดเห็นของผู้บังคับบัญชา (ระดับผู้อำนวยการกอง/คณบดี ขึ้นไป)

เห็นควรสนับสนุนให้บุคลากร สำนักวิจัยและพัฒนาการป่าไม้ ได้รับโอกาส ศึกษาต่อในระดับที่สูงขึ้นต่อไป

(ลงชื่อ) [signature]

(นางนิศากร จิ้ววิจิตร)

ผู้อำนวยการสำนักวิจัยและพัฒนาการป่าไม้

ตำแหน่ง

หมายเหตุ แบบฟอร์มนี้เป็น Electronic File หากเนื้อที่ไม่พอโปรดขยายหรือเพิ่มเติมให้ได้ข้อมูลที่สามารถนำไปใช้ประโยชน์ได้

Ph.D. thesis

Valuing wetland ecosystem services in Thailand.

Graduate School of Yeungnam University

Department of Forest Resources

Forest Resources Major

PETCHARAT AREEYAPAT

Advisors: Prof. Lee, Yohan

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Ph.D. thesis

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Graduate School of Yeungnam University

Department of Forest Recources, Forest Resources Major

PETCHARAT AREEYAPAT

Petcharat Areeyapat’s Ph.D. thesis is approved

Committee member Prof. Lee, Do-Hyung ___________

Committee member Prof. Chang, Jae Bong ___________

Committee member Prof. Lee, Ju-Hyoung ___________

Committee member Prof. Mo, Yongwon ___________

Committee member Prof. Lee, Yohan ___________

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Graduate School of Yeungnam University

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August 2021

Areeyapat Petcharat

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List of Abbreviations

BCA	Benefit-Cost Analysis
BKGA	Bang Kachao Green Area
CE	Choice Experiments
CL	Conditional Logit
CV	Contingent Valuation
MBIs	Market-based Instruments
MWTP	Marginal Willingness to Pay
MWTV	Marginal Willingness to Volunteer
PES	Payments for Ecosystem Services
TCM	Travel Cost Method
TEV	Total Economic Value
USD	United States Dollar
WO	Water Onion
WTA	Willingness to Accept
WTP	Willingness to Pay
WTV	Willingness to Volunteer

Chapter 1. Introduction

1.1 Problem statement

Since the majority of people now live in cities, urban wetlands are critical (United Nations, 2018; WWT Consulting, 2018). These natural ecosystems provide vital goods and services to humanity, as well as making cities livable. The purification of air and water, the regulation of the environment, the preservation of coastal beaches from wave erosion, the conservation of biodiversity, and the provision of artistic beauty and intellectual creativity that raise the human spirit are all services provided by urban wetlands. Urban wetlands are well-known for their importance in solving a number of urban issues such as health, flooding, air pollution, irrigation, climate change, and habitat depletion (Daily et al, 1997). Therefore, the long-term delivery of these ecosystem services provided by urban wetlands is critical for economic and social well-being.

However, urbanization and population growth also put a strain on the natural environment, especially wetlands within or near cities and the biological diversity that exists there. Many human activities are now affecting wetland ecosystems, resulting in the destruction and loss of functioning ecosystems and ecosystem services, such as direct habitat losses, water contamination, water scarcity, and climate change (Millennium Ecosystem Assessment, 2005; Global Biodiversity Outlook 3, 2010). Moreover, as the ecosystem services offered by wetlands, in general, are intangible and untraded in markets, human society has either taken these benefits for granted or not completely accepted their principles in decision-making (Costanza et al., 1997; Bingham et al., 1995). Since the economy fails to bear the full social costs of their degradation or benefits of their reconstruction, the information conveyed to decision-making processes remains inadequate. These factors may result in insufficient ecosystem resource allocation, overconsumption, and the reduction or lack of ecosystem-provided direct and indirect life-supporting resources, both of which have a negative impact on human well-being (Millennium Ecosystem Assessment, 2003).

The Bang Kachao Green Area (BKGA), the largest urban wetland in the Bangkok metropolitan area, has been severely damaged as a result of urbanization and expansion in Thailand. This urban wetland, which is covered in the rich biodiversity of trees, herbaceous plants, and food crops, provides a variety of provisioning services, especially food products, to Bangkok people and the city. This urban wetland can provide regulating services such as air purification and pollution reduction in the metropolitan area, as well as cultural services, especially the well-known Sri Nakhon Khuean Khan Park (Sommeechai et al., 2018; Ariando et al., 2017; Yotapakdee, 2019). Rapid urbanization and the steady rise in land prices, on the other hand, have been the primary causes of the country's forested land declines. Locals have abandoned their farms in order to live in the capital city. Overcrowding has turned traditional mixed orchards into overcrowded warehouses (Sukawattanavijit & Pricharchon, 2015). This is because the BKGA's services are grossly undervalued by society. Subsequently, the loss of open space has persisted, resulting in civil unrest, including congestion and health issues. Thus, both developers and the city face a challenge in preserving and improving this urban wetland.

Furthermore, the most commonly understood outcome of such habitat destruction is ended to the extinction of plant and animal species (Economics for the Environment Consultancy, 2005). Human activities have significantly altered ecological environments, culminating in the destruction of large ecosystems for plants and wildlife, resulting in drastic biodiversity declines. The Water Onion (*Crinum thaianum* J. Schulze) is an example of an endangered wetland species in Thailand (WO). It is an endangered native plant occurring only in a few flowing streams in the provinces of Phangnga and Ranong in southern Thailand (Schulze, 1972; Lansdown, 2012). This plant species plays a significant part in the ecology of a riverine wetland. The WO offers food and adequate living areas for native fish and biodiversity. It is a bio-indicator of the wetland habitats, growing in clear water. It aids in reducing the speed of water flow, thus stabilizing river soils and ensuring a steady supply of clean water (Lansdown, 2012). The WO enhances local livelihoods and economies by providing scenic beauty, especially during the blossom season of October and November, and by serving the recreational sector (Treerutkuarkul, 2020). Eighty percent of all previous WO communities have unfortunately vanished (Athihirunwong, 2018). Overexploitation for commercial uses as aquarium plants and makeup products was formerly thought to be the most serious challenge to WO. Currently, habitat loss and alteration due to water drainage, especially dredging of river channels to avoid flooding, pose the greatest threat to this species. These activities result in fast-moving water and intensified scour, causing whole WO communities to be uprooted. This has been associated with urban developments and upper catchment degradation, such as land conversion for rubber and oil palm plantations, which has resulted in nitrogen and sediment loading into waterways, resulting in poor water quality and degraded environments for WO (Lansdown, 2012). The WO is now classified as “endangered” by the IUCN Red List, and if current trends hold, it could soon be classified as “critically endangered” (IUCN, 2014).

Economists are frequently concerned with the reasons and responses of environmental destruction caused by market failure. They conclude that putting a tangible value on environmental resources may help achieve the twin goals of urban sustainability and wetland conservation through a market-based approach. The main problem in making decisions about human actions is to perform a benefit-cost analysis (BCA) that considers both the growth gains and the ecological costs of lost environmental resources (National Research Council, 2005). By displaying the full economic costs of trade-offs between any construction activity and environmental conservation, this strategy would assist decision-makers in making more informed choices regarding resource uses. For example, the government must be able to consider the monetary value of WO and its wetland ecology while deciding between preserving WO and leasing the loss of its wetlands for flood control, urbanization, or agriculture extension. In addition, the willingness-to-pay principles of ecosystem services favor the feasibility of a Payments for Ecosystem Services (PES) scheme to ensure ecosystem service delivery.

In response, economists have devised a variety of non-market-based methods for estimating or calculating the value that people put on ecosystem services and presenting those values in monetary terms. There are two types of non-market valuation techniques: revealed preference and stated preference. The revealed preference techniques estimate the value from people's observed actions, while the stated preference techniques depend on people's reactions to direct questioning or hypothetical scenarios. Therefore, stated preference methods can be used to value both use and non-use values, while revealed preference methods can only be used to value uses such as recreational facilities and scenic beauty. (Pearce et al., 2006; Hanley & Spash, 1993; Tunstall & Coker, 1996).

According to the framework of Total Economic Value (TEV), the economic value of an ecosystem can be derived from the uses of the services it provides, either consumptive or non-consumptive uses, or even its existence in the absence of use (Pascual et al. 2010). The task at hand is to determine the non-use values of the advantages offered by species or habitat diversity, as well as to solve the issue of decision-making in the absence of TEV and market prices (National Research Council, 2005). The addition of non-use values, such as bequest, altruist, existence, and option values, could boost the advantages of biodiversity protection and tip the balance in favor of saving natural habitats against other economic outcomes. Therefore, the application of stated preference-based approaches has become a major research topic (Tisdell, 2005). Contingency valuation (CV) and choice experiment (CE) are the most widely used stated preference methods for capturing non-use value (Adamowicz, et al., 1994). The CV method can be used to measure a complete change in an area, while the CE method can be used to value multidimensional environmental changes (Pearce et al., 2006). Furthermore, according to Christie et al., 2004, public preferences for various qualities of ecosystem services can be very useful in directing the construction of ecological restoration frameworks. Thus, the CE assumes responsibility for determining the most suitable methods for calculating different categories of ecosystem services. It allows the relative importance of various environmental attributes and attribute levels to be calculated (Olschewski et al., 2012).

In Thailand, there is a gap in the literature on the use of CE to analyze people's preferences and willingness to pay for the protection of urban wetlands. Athough Yotapakdee et al. (2019) used the market value of wood and carbon credits to estimate the monetary value of the BKGA's massive forests. Bejranonda and Attanandana (2011) also used the CV to estimate the value of using Bangkok's green spaces. Furthermore, there is a mismatch between their principles' potential and practical application in decision-making and policy-making (Talberth, 2015).

Even though several surveys to determine the value of species have been carried out. In general, charismatic species are more likely to be protected, and respondents place a higher value on them and are willing to pay a higher price to protect them (Richardson & Loomis, 2009; Ducarme, et al., 2013). According to research by Bonnet et al. (2002) and Clark and May, large species, particularly mammals and birds, have a high WTP (2002). Furthermore, the WTP for marine creatures is anticipated to be higher than that of terrestrial creatures (White et al., 2001). Although there is clear evidence that the public supports and is willing to pay to conserve charismatic animal species, the literature on the WTP for protecting endangered plant species is noticeably lacking (Pandit et al., 2015). Besides, the data on the financial benefits of wetland plant species is limited, especially in Thailand, despite the need for the government to prepare and communicate ecological strategies based on precise data.

Moreover, WTP responses are likely to be zero in developing countries where household incomes are very low and local people's budgets are too tight to give up part of their income for biodiversity conservation. Therefore, some studies suggest that in subsistence economies where cash is scarce, non-monetary measures can be used instead of cash as a measure of benefit (Ahlheim et al., 2010; Whittington, 2010). However, in the Thai context, we do not have enough information on the use of non-monetary payment measures, particularly labor contributions or willingness to volunteer (WTV), in the valuation of ecosystem services.

1.2 Research aims and objectives

In response to the above statement, this paper aims to assess the economic value of ecosystem services provided by wetlands in Thailand, specifically the Bang Kachao Green Area (BKGA) and the habitat of Water Onion (WO). This study examines how much people value various environmental resources based on their willingness to pay or volunteer labor to help improve them. The CE technique was used in two case studies, one in the Bangkok metropolitan region and the other in Phangnga and Ranong provinces in southern Thailand. It is intended to help decision-makers and land managers understand the principles and make future management and welfare decisions and exercises. The two case studies used in the study have the following main objectives:

Case study I: The BKGA case aims to:

1) Determine the preferences of inhabitants in the Bangkok metropolitan region and estimate their willingness to pay to improve the BKGA's ecosystem services.
2) Determine which variables impact WTP decisions, as well as the importance of each ecosystem service characteristic in influencing WTP decisions and the optimal levels within each attribute.
3) Include planning and management recommendations for the BKGA.

Case study II: the WO case aims to:

1) Examine residents' preferences and estimate WTP and WTV to improve ecosystem services provided by WO conservation.

2) Determine which variables influence residents' WTP and WTV decisions.

3) Make policy recommendations to urban planners and wetland managers for WO conservation.

1.3 Chapter description

There are five chapters in this dissertation. This chapter (Introduction) has introduced the analysis presented in this dissertation by defining the study's context, goals, and structure. The concepts of ecosystem services, market failure, and market-based strategies such as benefit-cost analysis and compensation for ecosystem services, as well as the role of economic values in decision-making, are introduced in Chapter 2, which serves as a foundation for discussing the case study results and recommending practical steps for urban planners and wetland managers. It is accompanied by a discussion of mechanisms for determining the value of ecosystem services, including the Total Economic Value (TEV) and other non-market-based metrics used by economists to assign monetary values to biodiversity and ecosystem services. This chapter also discusses recent state-of-the-art choice experiment studies in Southeast Asian countries and Thailand, as well as related ecosystem service valuation studies conducted in several developing countries. It then discusses the use of non-monetary payment vehicles for ecosystem valuation.

Chapter 3 delves into methods, specifically the CE approach, by highlighting the CE model's foundation and steps for implementing a CE analysis. Briefly, this chapter details an approach based on two non-market valuation studies conducted in Thailand. Therefore, this chapter contains accounts of the two CE studies: the BKGA and the WO habitat in Thailand. The first case study looks at Bangkok residents' preferences and WTP for improving ecosystem services in the BKGA. The first case study was published in the journal of Sustainability as Petcharat, et al., 2020. Residents' preferences for WTP and WTV for enhancing ecosystem services in the WO habitat in Phangnga and Ranong provinces in southern Thailand are the focus of the second case study. The second case study of WO is developed as a manuscript for submission to a peer-reviewed journal which was accepted at the 10th Asian Association of Environmental and Resource Economics (AAERE) Congress, Seoul National University, on August 20-21, 2021.

The results of the two case studies, as well as the discussion of the findings, are discussed in Chapter 4. Finally, Chapter 5 makes recommendations by presenting critical information about how to handle wetland ecosystem resources and funding strategies for wetland conservation in the study areas. It considers how the findings will help policymakers make decisions about wetland biodiversity conservation. The chapter also considers the research's limitations and future directions. Finally, a conclusion is reached.

Chapter 2. Literature Review

Wetlands provide important ecosystem services that benefit human populations. However, all of these services are likely to be undervalued because they are not exchanged in the markets. Threats to natural environments are likely to increase, so understanding and evaluating the values of environmental services, as well as integrating these values into decision-making, is critical (Daily et al. 1997). This chapter examines the concept of ecosystem services, categories of ecosystem services, especially those offered by wetlands, the importance of biodiversity in the delivery of ecosystem services, and the concept of market failure as well as the causes of environmental market failure and potential remedies. This chapter then looks at the underlying functions of ecosystem services values in making informed decisions. The sense of value and conceptual frameworks for evaluating ecosystem services, especially the Total Economic Value (TEV), are also discussed in this chapter. The methods for valuing these ecosystem resources that are currently available are also defined. A review of related ecosystem service valuation studies in developing countries, especially Southeast Asia and Thailand, follows. The use of non-monetary payment vehicles to value ecosystems is then discussed. Hence, the aim of this chapter is to provide an overview of the platforms used for conducting ecosystem services valuation studies as well as to address the findings.

2.1 Ecosystem services, biodiversity, and the market

2.1.1 What are ecosystem services?

Ecosystem services, in a broad sense, refer to a set of circumstances and cycles in which specific ecosystems and the animals they comprise aid in the maintenance and fulfillment of human life (Daily et al, 1997). Direct and indirect benefits from natural environments are included in ecosystem services (Mace et al., 2011; TEEB, 2010). Food, water, wood, fibers, pharmaceuticals, agricultural materials, and other direct products are all supported by ecosystem services. They can have a variety of indirect environmental benefits, including regulating, controlling, and renewing, as well as cultural benefits (Daily, 1997).

The Millennium Ecosystem Assessment (MEA), which brought together experts to assess the effects of biological system change on human well-being, conveyed the concept of ecosystem services to a wider audience. This conceptual framework was developed to highlight the real benefits to human health, security, social ties, and economic growth. These advantages are various and varied, and the categories are divided into four groups based on the services they provide: provisioning, regulatory, cultural, and supporting (Millennium Ecosystem Assessment, 2005).

Provisioning services include the material and energy supplied by habitats such as wood, fish, plants, pharmaceuticals, and industrial goods with a specific socioeconomic application. Benefits derived from ecosystem functions to regulate ecosystem processes such as climate management, air purification, water purification, water regulation, flood control, and crop pollination are examples of regulating services. Cultural services are the advantages that people derive from an ecosystem's physical environment, such as leisure, knowledge growth, relaxation, and spiritual reflection. The final group includes supportive curriculums, which are contributions from nature to other services. This category includes the development and renewal of soils, as well as nutrient cycling (Constanza et al. 2017). The categories of the Millennium Ecosystem Assessment will serve as our overarching structure in this study.

2.1.2 Wetland ecosystem services

Wetlands are usually transitional areas between and other bodies of water (Ramachandra et al., 2005). They are made up of plants and animals that can adapt to wet environments and, in many cases, need and withstand permanent or intermittent flooding (WWT Consulting, 2018). Wetlands may be natural, man-made, or a mixture of both. Wetlands include lakes, swamps, ponds, bogs, mudflats, mangroves, and coral reefs, to name a few. Wetlands include inland streams and waterfront or marine areas with water up to six meters deep at low tide (Ramsar, 2018).

Wetlands are one of the most active ecosystems on the planet. They are also essential for human survival and play an important role in providing a variety of financial, environmental, and economic benefits, which are referred to as wetland ecosystem services (WWT Consulting, 2018). Urban and peri-urban wetlands, which are situated inside a city or town's borders or adjacent to cities and towns, are particularly important in urban areas since they offer a broad range of tangible and intangible benefits to the city population (McCartney et al., 2010). Wetlands can store carbon, mitigate emissions, and protect against natural disasters, such as floods and erosion of riverbanks and coastlines, in addition to providing food and clean water. Urban wetlands and associated vegetation can have a cooling effect and help to moderate strong winds in the surrounding area. They also benefit the community by serving as urban green spaces that provide visual appeal, scene diversity, and recreational opportunities for city dwellers. Riverine wetlands are wetlands that are located within a channel (such as a stream, river, or creek) and the vegetation that grows along the streamside (Australian Government, 2012). They can be natural or man-made, and they can be found in wetlands such as lacustrine, palustrine, estuarine, and coastal (Stein, 2005). Riverine wetlands have a wide range of water levels. Water can be present in the wetlands all of the time or only on occasion, or they may be completely dry for long periods of time. The species that live in riverine wetlands can be highly adaptable due to the changeability of the environment.

In conclusion, wetlands provide habitat for biodiversity, agriculture and aquaculture, water supply, climate moderation, flood regulation, wastewater treatment, tourism, recreation and leisure, education, culture and heritage, science, and human health, to name a few benefits. Thus, the wetlands' ability to provide these ecosystem services in a sustainable manner is critical. It is essential to protect the health of wetlands in order to ensure that they continue to play an important role in our lives. Wetlands, on the other hand, are vulnerable to unsustainable usage, and the many services they provide have long been undervalued, leading to widespread loss and degradation.

2.1.3 Ecosystem services and biodiversity

An ecosystem is a network of nonliving and living communities of plants, animals, and microorganisms that communicate as a useful unit (Millenium Ecosystem Assessment, 2003). Biodiversity refers to the diversity of life forms found at all levels of an organization, from genetic to landscape (Daily et al, 1997). It is widely assumed that such a diverse ecosystem can demonstrate resilience, which is described as an ecosystem's capacity to maintain equilibrium in the face of adversity. In a more biodiverse planet, there are more species and interactions. Interactions are the functions that lead to the provision of ecosystem services. Since functional ecosystems and various species play different functions, environmental changes (disease, resource degradation, invasive species, and so on) have little impact on ecosystem services. More biodiversity in an ecosystem means it would be more likely to provide reliable services. Hence, the availability of ecosystem services is reliant on biodiversity. Ecosystems must be ecologically divested or in a functional state for society to benefit from the continued provision of ecosystem services (Cardinale et al., 2012; Balvanera et al., 2014; Harrison et al., 2014). Therefore, biodiversity plays an important role in the economy by promoting the distribution of a variety of ecological goods and services that are critical to human well-being and prosperity.

2.1.4 Threats to ecosystem services

A broad range of human activities is reducing and destroying ecosystem resources (Daily et al, 1997). The ongoing degradation of natural ecosystems, the modification of the gaseous composition of the environment, and the invasion of non-native animals are all examples of anthropogenic destruction of the natural ecosystem. Urbanization is the most lasting of human impacts, especially in metropolitan areas, and habitat loss is often linked to such destructions.

These challenges to ecosystem systems are fundamentally driven by two strong underlying factors. One is unsustainable population growth and per-capita consumption, as well as the effects that innovations and organizations have as they manufacture and distribute such consumables (Ehrlich et al. 1977). Market failure is the other. The many mismatches between individual economic rewards and social well-being have resulted in market failures. Individuals whose actions damage habitat, for example, do not account for the costs of such missed gains, whereas government also does not compensate landowners and other environmentalists. Thus, strategy practices that resolve these core thrusts and integrate the value of ecosystem services into decision-making processes are a fundamental prerequisite (Daily et al, 1997).

2.1.5 Ecosystem services and market failure

As mentioned in the previous section, the allocation of ecosystem services is muddled when the price mechanism fails to provide a productive or equitable allocation of scarce resources. This is known as a market failure, which is described as “the failure of the real market to demonstrate the efficiency of resource distribution that ideal markets should be seen to achieve” (Keat, 1997: 32). The price paid for a good or service that matches the marginal social cost of production is referred to as allocative proficiency. There would be a deadweight reduction of social security in situations where economies do not coordinate resource distribution effectively, such as where markets do not price environment goods and services properly or take external costs or advantages into account (Keat, 1997).

Ecosystem goods and services have many characteristics that make establishing and mainstreaming competitive markets for them very challenging. Excludability and rivalry are the most important traits. Excludability refers to the degree to which it is technically and commercially feasible to keep those who do not pay for a product from benefiting from it. Rivalry is described as the degree to which one person's enjoyment of a good reduces the potential of another to enjoy the same good (Tisdell, 2005). Private products, such as a chocolate bar, are both excludable and rival, allowing profitable economies to emerge. However, with environmental resources such as clean air, it is difficult to exclude others from using the good, and one person's consumption of the good has no bearing on the advantages that others get. Goods and services on which consumption is both non-excludable and non-rival are called public goods (Hanley et al, 1997). Therefore, non-exclusive public goods that are difficult to exclude anyone from purchasing and can be used by anyone with no competition in consumption contribute to the free-rider dilemma, resulting in the over-extraction of environmental goods and services (Hardarson & Hardarson, 2000).

A failure to price externalities from both output and demand is another major cause of market failure. External costs, also known as negative externalities, occur where manufacturing or use imposes costs on third parties outside of the industry for which no adequate compensation is provided. A recent example is where a private company delivers certain products or services but does not consider the cost of production to society, such as water and air pollution. Normally, a company's private costs include staff, raw materials, equipment, and energy; however, an additional expenditure, which constitutes a real cost to society, is hardly charged. As a result of this condition, overproduction and exploitation of natural resources may occur. Therefore, environmental loss or destruction, as well as excessive emissions, have often existed as a result of market failure (Cunninghamm, 2011).

Market failures are often caused by a lack of awareness for farmers and customers about the effects of their decisions, as well as insufficient or non-existent land rights to common-pool resources such as fish stocks. Markets for ecosystem commodities are insufficient since structures, such as well-defined land rights to natural resources, are difficult to create and enforce (Gustafsson, 1998). Besides, the costs and benefits of trading natural products across foreign borders, such as clean air and water, are difficult to manage. Consumer information on ecosystem commodities is typically lacking, costly to obtain, and difficult to comprehend. When there is no demand, the true value of an ecosystem asset is not known, resulting in overuse leads to what Hardin (1968) described as “The Tragedy of the Commons”.

2.1.6 Market-based solutions and the role of economic values

Since the causes of environmental market failure are complex, many approaches are needed. Market-based instruments (MBIs) are increasingly used in environmental policy to achieve the twin goals of resource use and sustainability while also responding to fundamental market failures. It is especially important to consider people's preferences and articulated their beliefs or the well-being that people attach to the ecosystem services offered by natural environments in monetary terms when making environmental decisions. The approximate values will aid in the implementation of the following MBIs and policy processes.

In strategic planning, the benefit-cost analysis (BCA) is an example of market-based arrangements. People's experiences, which are influenced by their beliefs or values, have an impact on how people behave in general (McAllister, 1980). When evaluating the suitability of a potential operation, leaders should consider all the benefits and drawbacks of that activity. It is appropriate to engage in the practice if the profits exceed the costs. If the costs outweigh the benefits, however, the practice is undesirable (Tietenberg & Lewis, 2009). Ecological tasks are evaluated in terms of the environmental services they can produce, and these are compared to the costs associated with them using the BCA method. Thus, we must assess the gains and disadvantages of the acts in financial terms so that they can be compared. For example, in determining the best balance between biodiversity protection and human activities that profit society but deplete biotic resources, society requires a valuation mechanism to assess the cost and gain of such endeavors. In this vein, the numerical value of ecosystem resources serves as a standard measure of reference for weighing the true cost and profit of various actions (Bennett, 2003).

Payments for ecosystem services (PES) is also a range of MBIs, including voluntary payment schemes, developed to compensate resource owners for the provision of ecosystem services (Sing et al., 2015). In this way, putting the tangible importance of environmental services creates a powerful impetus for local populations, corporations, and lawmakers to protect natural ecosystems. PES systems have recently gotten a lot of attention because they can provide new subsidies for species conservation and other environmental resources that are essential to human well-being (Rasul et al., 2011). Therefore, ecosystem valuation will provide data that will influence PES payment amounts (Wunder, 2007; Chase et al., 1998). Furthermore, the valuation of ecosystem services should be used to assess the feasibility of PES proposals for ensuring ecosystem service provision (Whittington and Pagiola, 2012).

Similarly, ecosystem valuation simply helps to bring sustainability concerns to light by emphasizing the importance of underappreciated natural resources. The ecosystem's economic value can be seen in the contributions that ecosystem functions bring to human prosperity (Freeman III, 2003). Land ownership, for example, can be expensive in urban areas. If there is little monetary benefit for natural properties, it is impossible to weigh their utility in land-use decisions, company purchases, and capital investment budgets (Wolf, 2010). Moreover, the monetary value is significant information for capitalism's ability to preserve animals and ecosystems (Pandit et al., 2015). The value of biodiversity can be used to justify limiting or prohibiting the trade in endangered species (Christie et al., 2004). Furthermore, economic valuation allows policymakers to assess the natural impact in monetary terms (Tisdell, 2005). It simply raises awareness of the costs of biodiversity destruction. For example, cap-and-trade strategies, which charge businesses for the pollution-causing substances they release into the environment, will ensure that total air or water exposure is reduced (Field and Field, 2009).

Additionally, public preferences for different ecosystem services provided by species and ecosystem diversity will greatly aid in the management of ecological restoration frameworks (Christie et al., 2004). Knowing the programs are valued by the general public allows for more tailored strategies to be developed, resulting in the greatest overall gain (Hanley et al., 1998).

To summarize, valuing ecosystem services serves a variety of purposes, including assessing the benefits and costs of policies, generating markets such as PES, raising awareness, and reflecting the costs of ecosystem loss. Therefore, ecosystem service is a useful concept for bringing knowledge about the benefits that humans receive from ecosystems and ecosystem processes into public policy spaces, especially by making explicit the benefits that humans receive from ecosystems and ecosystem processes.

However, to the degree that valuation is utilized to advise economic decision-making, it should identify with an exchange or a trade-off, and a defined shift starting with one circumstance then onto the next. For example, the relevant data is the relationship between changes in health and changes in the natural environment, rather than the absolute value of a given state of the planet.

2.2 The meaning of value and value types

2.2.1 The definition of value

The word “value” comes from utilitarian and deontological schools of thought, which demand a distinction between instrumental and intrinsic values, as well as anthropocentric and non-anthropocentric values (National Research Council, 2005). If an ecosystem is beneficial to humans or wildlife, it has instrumental importance. Even if it does not contribute to human well-being, it can be assumed to have intrinsic value. The anthropocentric viewpoint holds that the importance of existence is derived from its utility to humans. Non-anthropocentrism, on the other hand, asserts that nature has meaning in and of itself, even though it hasn't aided humans (Straton, 2006). Both instrumental and intrinsic values may have anthropocentric or non-anthropocentric meaning, and are thus classified as an anthropocentric instrumental value, anthropocentric intrinsic value, non-anthropocentric instrumental value, and non-anthropocentric intrinsic value (see Figure 2.1) (Turner et al., 2003).

Although utilitarian values are instrumental and anthropocentric in that they are viewed as a means to the end of improved human welfare as described by human preferences, utilitarian thought considers that utilitarian values are instrumental and anthropocentric in that they are perceived as a means toward the end of improved human welfare as defined by human preferences (National Research Council, 2005). Human preferences for ecosystem resources cannot be explicitly calculated, but they can be articulated in monetary terms (Kumar & Kumar, 2008).

The deontological method, on the other hand, assumes a continuum of rights to life. It means that intrinsically valuable items cannot be replaced, substituted, or offset for making more of something else. The intangible side of the social equation, such as history, ethics, and religion, is incorporated into inherent value, which appears to concentrate on the legal and political facets of a system rather than the economics (Millenium Ecosystem Assessment, 2003). As a result, based on the way in which it is used, the word value may have different meanings. I consider its instrumental and anthropocentric principles in this study. This anthropocentric concept of value, in particular, acknowledges that the economic value of ecosystems is extracted from the utility that humans gain directly or indirectly from ecosystem services.

	Anthropocentric	Non-Anthropocentric
Instrumental	Total Economic Value (TEV) consists of use and non-use values (including the bequest, altruist, and existence values for humans).	The value of entities independent of humans-e.g., the contributory value of ecosystem processes, structures, functions to ecosystem health, biodiversity.
Intrinsic	Value is attributed to entities that are valuable in and of themselves (cultural value). This is an anthropocentric value as a human has placed a value (monetary and non-monetary) on the entity).	Entities have inherent value. They possess value independent of any valuer.

Figure 2.1 Classification of environmental values
Source: Turner et al. (2003); National Research Council (2005)

2.2.2 Total Economic Value (TEV) framework and value types

The total economic value (TEV) paradigm will help categorize total economic value into a variety of categories when instrumentally valuing an environment. The overall value of an environment can be calculated using this framework as the number of its component values, which are split into three categories: use, non-use, and option values (see Figure 2.2) (Barbier, 1991).

The term “use value” refers to the benefit derived from actual ecosystem resources for which market prices are typically applicable. Direct and indirect use values are divided into two groups. Direct use values are the benefits obtained from the direct use of ecosystem resources. They can be extractive, involving the intake of things like food and raw materials, or non-consumptive, involving things like recreational facilities and scenic beauty. Plant species, for example, may have marketable direct use qualities such as food, fibers, and medicinal drugs. They also create non-market direct use values by allowing people to experience a wildlife viewing excursion and promoting wildlife tourism (Tisdell, 2005). Because of their position in promoting and preserving commercial development and land, natural habitats often have indirect use values. Regulatory services, such as air quality control, water quality regulation, and erosion prevention, are included in these indirect use values, which are not expressed in consumer transactions (Pascual et al., 2010).

The value derived from the existence of a good is referred to as a non-use value. Non-use values are impossible to quantify and estimate because they can be instrumental, such as natural beauty, or intangible, such as animal and plant organisms having a right to live (Millenium Ecosystem Assessment, 2003). They are, however, divided into three categories: bequest value, altruism value, and existence value. The importance of knowing that the fantastic is available for future generations and people is known as bequest value (Pearce et al., 2006). It usually occurs when someone knows that an asset or an animal species may be available to people in the future. Altruism value is the value that a resource should be available to others. Existence value is the value of a property that does not have a genuine or planned use. It also alludes to the pleasant sensation of discovering the resource's existence without directly benefiting from its use. Individuals respect the information that a particular or environment persists or is being preserved, so the existence value of an animal species or ecosystem exists without genuine or planned application. Thus, the bequest value represents our WTP for saving such properties for future generations, while the life value represents our WTP for recognizing that anything exists, even though we never want to use or visit it (Klemperer, 1996).

Because of its latent potential or uncertain future function, the natural environment is often considered to have an option value. The WTP for the decision to use a resource in the future is the option value. As a repository of genetic material for the biomedical industry, for example (Barbier & Aylward, 1996). A potential visit to a natural environment for recreation is another indicator of option value

(Pearce et al., 2006). A public park, for example, will have use benefit both now and in the future as a result of people visiting the park. Thus, option value refers to a potential visit, which becomes a kind of use value. In this way, the value of an alternative acts as a motivator to keep the alternative around for a longer period.

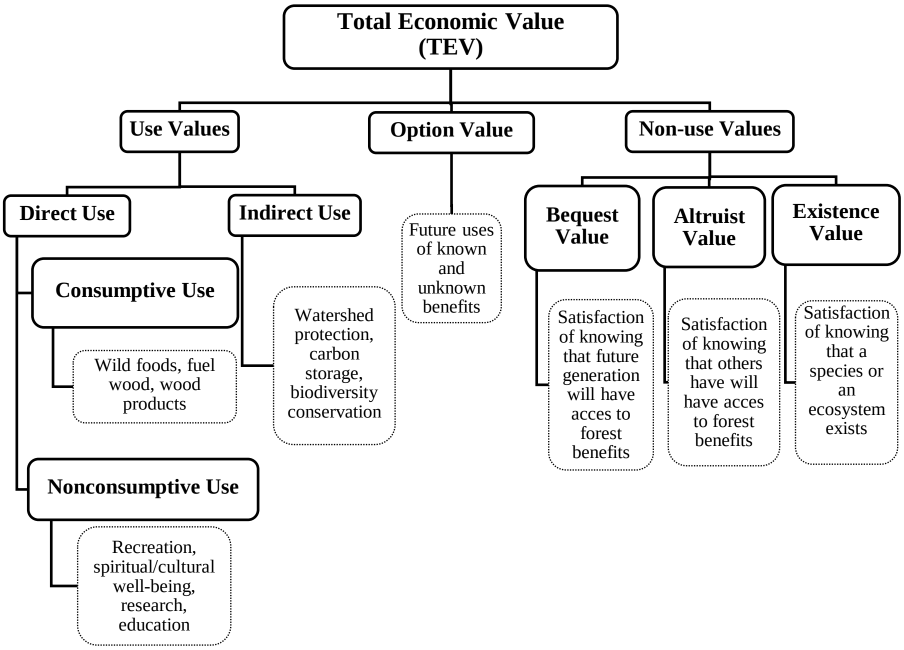


Figure 2.2 Value types within the TEV approach

Source: Adapted from Pascual et al. (2010)

2.3 Ecosystem service valuation methods

According to the TEV approach, natural goods and services have not just market-priced commodities but also non-market advantages. Since most ecosystem services are not traded, they must be evaluated in a certain manner in order to be compared to various monetary qualities (Mullan, 2014). Consequently, economists have developed a number of valuation methods for determining the dollar value of ecosystem resources. Direct market price, revealed preference, and stated preference methods are the three basic techniques for valuing ecosystem services.

2.3.1 Direct market price approaches

Market-based methodologies assess the value of ecosystem resources that are not traded in a market by using the market costs of the merchandise. Data on the effects of changes in ecosystem resources on the production or use of merchandise is combined with market prices for such items in direct market valuing strategies. The production function approach, which uses a theoretical model or regression analysis to measure the real effects of changes in ecosystem services on financial movement and the comparing value of the resulting changes in monetary profits, is the most widely used of these methods. For example, Pattanayak and Kramer (2001) investigate the impact of changes in irrigation water availability on crop production income in Indonesia, while Pattanayak and Wendland (2007) investigate the impact of changes in water quality on human welfare. These results may be measured in terms of medical costs or missed workdays, or in non-monetary terms such as illness risk or the number of people affected.

This method has the benefit of being easy to identify increases in prosperity and simple to incorporate once the production function has been identified. Despite this, quantitative evidence on the relationship between environmental factors and human activities or outcomes is often lacking. Furthermore, as far as rates are concerned, the market cost of the replacement has a lower request record of the value of the assistance. Society is currently confronted with compromises that necessitate determining the minimum value of biological system administrations, i.e., the value gained by an additional unit of administration, in order to determine the cost of sacrificing versus the benefit of maintaining a given quantity or nature of administration. Market evaluative techniques make it difficult to obtain this information (Daily, 1997). Furthermore, multiple collaborators suddenly value ecosystem resources, and market prices alone do not capture these values (Small et al., 2017).

2.3.2 Revealed preference approaches

People's values for non-market products are gathered using revealed preference methods based on their impressions of their real decisions in other established business sectors, and they represent utility maximization within their budget constraints. It is critical to creating a connection between changes in ecosystem resources and changes in people's behavior that can be observed (Freeman III, 2003). In this case, economic agents use their options to expose people's desires (Tisdell, 2005). The travel cost method (TCM) and the hedonic price method (HPM) are the two main methods used in the revealed choice approaches.

The TCM is focused on the idea that the recreation utility of a particular site can be derived from a demand feature that compares consumer behavior to visit costs (Defrancesco & Rosato, 2006). In this way, the TCM determines the worth of a good based on the amount of money or time that people spend using it. It is commonly used to determine the value of recreational attractions such as recreational areas and national parks where visitors can enjoy a beautiful setting. For instance, Kaosa-ard et al. (1995) applied the TCM to calculate the direct use importance of the Khao Yai National Park, which includes ecotourism, habitat prospecting, and logical travel industry.

The HPM assigns a rating to a resource's attributes based on financial purchases such as house prices and wages. It is predicated on the premise that the observed asset valuation represents the environmental good or service's net profit. As a result, the HPM examines the connection between land and property valuation and environmental consequences. For example, the prices of identical houses can differ based on their surroundings, such as air quality. Pearson et al. (2002) give an explanation of using the hedonic price approach to value Noosa National Park, a Queensland urban national park. A view of the national park was discovered to have a positive impact on land values.

Both of these revealed preference approaches are important since they derive values from actual actions. These methods have the distinct drawback that they can only be used to measure use values, or the values of products and services that are consumed in combination with market goods; they are not appropriate for monetizing non-use values such as the bequest, altruist, and existence values (Adamowicz et al., 1998). Since revealed preference techniques such as the TCM and the HPM cannot estimate non-use values, stated preference techniques are becoming more common (Smith, 1993; Adamowicz, 2004).

2.3.3 Stated preference approaches

Unlike revealed preference approaches, which look at real consumer behaviors, stated preference strategies use survey methods to approximate values (Tisdell, 2005). They focus on comments made in response to hypothetical case questions or stated principles by individuals (Freeman III, 2003; Tisdell, 2005). Thus, the specified choice methods will value both use and non-use values (Hanley & Spash, 1993; Tunstall & Coker, 1996). The CV approach and various attribute-based methods (ABMs) are two stated preference strategies that use surveys to outline a hypothetical market (Mitchell & Carson, 1989).

People are asked to attach a numerical value to a potential product or service using the CV form. In CV tests, one of two valuation formats can be used to convert individual expectations into Hicksian stable welfare figures. The first format asks how much people would be willing to pay for environmental improvements (WTP). The other method involves asking people how much they would be willing to accept (WTA) in exchange for this improvement (Garrod & Willis, 1999). A questionnaire is the most common method for eliciting WTP or WTA values, and it includes either bidding games with payment cards or open-ended questions, or dichotomous choice questions (Adamowicz et al., 1998). Furthermore, utility bills, tax payments, monetary donations, and labor volunteering are all options for paying for the service. There are no established guidelines for the design of CV surveys. Thus, the selection of a response format and payment vehicle is an important area that requires further investigation (Boyle, 2003).

The CV technique is flexible and widely used to capture non-market values, particularly non-use values (Choe et al., 1996; Walsh et al., 1984). However, the validity and reliability of the CV technique are influenced by a variety of errors or biases (Venkatachalam, 2004). To begin with, because the CV is theoretical, individuals are not required to reconcile expressed valuations with their financial needs. Furthermore, if respondents want to increase the likelihood of a strategy being carried out, they may engage in strategic behavior by overstating their values. People may, on the other hand, underestimate their values if they accept that they must pay more tax if the policy is met.

The next limitation is that people may be unfamiliar with environmental assets, which can lead to a lack of sensitivity to scope. Individuals express WTP values that are unresponsive to changes in the quantity of environmental goods as a result of this (Mendelsohn & Olmstear, 2009). Another source of scope effect bias is when the WTP for one good is insignificantly different from the WTP for a more inclusive good (Harrison, 1992). CV studies that value two commodities rather than one are unreliable (Dimond & Hausman, 1994). Giving respondents a clear explanation of the change in the service being valued is a common way to address this (Nunes & van den Bergh, 2001). However, providing more information than is necessary can lead to respondents appearing to be overeducated, resulting in overstated stated values (Rolfe & Bennett, 2001).

Finally, the choice of response mode has been a hot topic in discussion. Some CV formats are useless in this regard. For example, using bidding processes in which respondents respond to a series of discrete decision questions can result in anchoring effects such as starting point bias and yea-saying, resulting in inaccurate welfare estimates (Bateman et al., 2002). Furthermore, some people may be unfamiliar with an open-ended query in which the respondent is asked to provide a single value that represents their maximum willingness to pay for the good in question. As a result, it is currently recommended that single bounded dichotomous questions with a specific monetary value for either accepted or rejected responses be used. Follow-up values based on the first answer using a double-bounded dichotomous option response format that simulates consumption choices in a real marketplace can also be suggested (Bateman et al., 2002; Boyle, 2003).

Although CV provides a potential for valuing certain goods that cannot be valued with the observed methods or revealed preference methods (Adamowicz et al., 1998), the value of each attribute in multi-attribute environmental goods cannot be recognized using the CV technique (Seenprachawong, 2016). In this way, various attribute-based methods (ABM)s have been created and suggested for non-market valuation (Holmes & Adamowicz, 2003).

Lancaster's characteristics theory of value and conventional conjoint analysis have resulted in the ABMs, which are a set of methods (Homes & Adamowicz, 2003). Individuals derive utility from a good based on its features or attributes, according to the AMBs. An environmental good may be decomposed into several attributes (Campbell et al., 2008). These characteristics vary on a variety of levels, and people must demonstrate their interests through a variety of tasks (Farber & Griner, 2000). When a monetary attribute is attached, value estimates in the form of marginal willingness to pay can be made (Grafton et al., 2008). Choice experiments (CE), contingent rating, contingent ranking, and paired comparisons are all examples of AMBs. The CE assumes that people will make discrete decisions between competing options, whereas contingent rating refers to the rating of options using a pre-determined scale. Respondents are asked to rank their preferences from most to least preferred in the contingent ranking. The paired comparison technique involves a sequential cycle in which respondents are asked to choose their most preferred other option first, then rate the excess other option. The econometric analysis can then be used to infer part-worths, which show the relative importance of each attribute in determining utilization choices (Bateman et al., 2002).

ABMs have a number of benefits over the CV method, including the ability to elicit a greater amount of knowledge about human preference systems. ABMs also produce welfare estimates for individual attributes as well as measures for a group of attributes (Hanley et al., 2001). The unpredictability of the test configuration measure and the fact that not all reaction arrangements can yield welfare-compatible estimates are the fundamental limitations of ABMs.

2.4 Non-market valuation studies in developing countries

Non-market valuation has principally been applied in developed countries to measure the value of environmental goods and services, though in recent years the method has also been applied in less-developed countries (Whittington, 2010). However, geographically, non-market valuation has rarely been applied in developing countries (Pandit et al., 2015). According to Pandit et al. (2015), all non-market evaluations of endangered species (92 percent) are based on developed countries. Only six of them used data from developing and developing economies (Brazil, China, India, Kenya, South Africa, and Sri Lanka). Furthermore, many developed countries' valuation implementations also need method improvements (Bennett & Birol, 2010; Whittington & Pagiola, 2012).

Whittington (2010) found that household willingness to pay was poor for a wide range of services provided to respondents in stated choice experiments when looking at WTP values in developing countries. Despite the fact that absolute WTP figures from developed countries were higher, Richardson and Loomis (2009) found that people in developing countries were willing to pay more for across-country symbolic types as a proportion of their financial benefit than people in developed countries. They cite the work of Bandara and Tisdell (2004), who found that the WTP values of Sri Lankan respondents for maintaining Asian elephants were 17.10 USD-20.65 USD per household per year, which was equal to one percent of a total annual income of 1,911 USD. In a coffee-growing area in India's the Western Ghats, Ninan and Sathyapalan (2005) estimated WTP values for Asian elephant conservation in terms of time (lost income) and discovered that the economic value of elephant ranged from 71 USD to 165 USD per household per year, accounting for about ten percent of individuals' financial benefit. Jin et al. (2008), on the other hand, studied the black-faced bat-eared fox in Macau, China, and discovered that the mean WTP was much smaller - just around 0.2 percent of annual financial benefit. However, this was much higher than WTP amounts in US studies of the bald eagle, which only ranged from 0.05 to 0.07 percent of individuals' financial benefit. Ro et al. (2020) used a mixed-method that involved geospatial technology, household surveys, market value, and avoided cost measurements to value the ecosystem services offered by Boeng Cheung Aek, a vast urban wetland in the south Phnom Penh, Cambodia. They estimated that the wetlands have thirty million dollars in monetary gain per year, with a range of fifteen to fifty million dollars.

Non-market valuation studies in Thailand started in 1987 to evaluate Lumpinee Park's recreational value using TCM (Phoompanich, 2007). Several studies have used revealed preference and stated preference methods to value different habitats such as national parks, forests, wetlands, and cultural heritage sites since then. For example, in Khao Yai National Park, Kaosa-ard et al. (1995) used one of the revealed preference approaches, the TCM, to elicit visitors' WTP and a specified preference CV approach to analyze visitors and non-visitors WTP for plant and wildlife protection. They focused on the National Park's direct use and non-use values and discovered that the overall economic benefit of the National Park is over 3 billion Baht (120 million USD) per year. Furthermore, Seenprachawong (2001) determined the economic value of coral reefs in Thailand's Andaman Sea, covering both use and non-use values. He calculated the recreation value using the TCM and the biodiversity value using the CV. The recreational benefit and biodiversity benefit were valued at 6,491 USD per ha per year and 15,718 USD per ha per year, respectively. In 2009, Bejranonda and Attanandana (2011) performed a CV survey with 676 people in Bangkok, using a closed-ended, double-bounded payment approach, and discovered that Bangkok's WTP for green space creation and management is 750 Baht (23.5 USD). As a result, the annual use value of green space in Bangkok was estimated to be about 1.69 billion Baht (52.8 million USD).

We conclude that TCM-based studies are unable to estimate non-use values. CV analyses may be used to assess a particular aspect of ecosystem change. Almost all research did not provide a measure of indirect use values, such as improved water and air quality. Estimating values of multi ecosystem functions and services using CE methods is relevant from an environmental management perspective, especially in developing countries. The following are CE studies from Asian countries, especially Thailand.

2.4.1 Applications of CE in Southeast Asia

This brief review also reveals that CE approaches have been used to value natural habitats in developing countries in many studies. Although there have been an increasing number of recent CE applications in Southeast Asian countries, only a few of these CE studies have focused on urban forests and wetlands (see, for example, Othman et al., 2004; Bann, 1999; Do & Bennett, 2009; Siew et al., 2015; Suziana, 2017; Hassan et al., 2019). The primary study in Southeast Asia to use the CE technique to estimate the importance of the Matang mangrove in Malaysia was by Othman et al. (2004). The findings highlighted CE's adaptability in assessing not only marginal values of environmental attributes but also the welfare implications of a number of other management options. CE was used by Do and Bennett (2009) to assess the ecological importance of wetlands in Cambodia. WTP figures improved with wages and schooling in the report. They discovered that farmers were hesitant to help with wetland restoration because the benefits were insufficient to compensate for the lack of access to the area. This emphasizes the importance of remembering local people's connections to the different environmental resources provided by wetlands.

Hassan et al. (2019) studied the priorities of urban and rural Malaysians for wetland protection. The findings by using CE and a latent class model revealed three distinct preference classes. The first part consists of people who live in remote areas who are unwilling to pay for wetlands protection. The second community consists of rural residents who have a strong desire to preserve the environment. The final category is metropolitan, with both negative and positive attitudes toward different facets of conservation.

2.4.2 Applications of CE in Thailand

The use of CE to assess the economic value of ecosystem services is less common in Thailand, though it is increasing in agroecosystem services (see, for example, Narjes & Lippert, 2016; Jourdain & Vivithkeyoonvong, 2017). In the province of Chiang Mai, Narjes and Lippert (2016) used a discrete choice experiment (DEC) to examine longan farmers' preferences concerning hypothetical changes in the native population of pollinating bees. They calculated a positive WTP of about 22 USD per household for preserving local bees and a negative WTP of about 50 USD per household for preventing a 50 percent decline in the bee population. They also discovered that, in addition to individual variables like gender, people's attitudes toward native bees played a role in pollination preferences. They concluded that, despite underestimating the true benefits of crop pollination, longan farmers were willing to pay far above the implementation costs for a comprehensive bee defense project. Besides, Jourdain and Vivithkeyoonvong (2017) investigated how Thai citizens valued ecosystem services gained from irrigated rice cultivation using a CE survey. The findings reveal a high willingness to pay for services such as drought relief, water quality and climate, and rural lifestyle and rice farming culture preservation.

Just a few studies in Thailand have used CE to value non-market products and services from wetlands, such as Seenprachawong (2016), Praisankul and Nabangchang-Srisawalak (2016), and Petcharat and Lee (2020). The study of

Seenprachawong (2016), who expanded his previous CV survey valuing the benefits of improved wetland ecosystem services in Phang Nga Bay, is the first CE study explicitly focused on Thai wetland ecosystems. He estimated that developing the Bay would result in a net benefit of 2,458 USD per hectare per year. The non-use value of biodiversity has the highest value, followed by local subsistence and ecological functions, which are valued equally, and endangered species have the lowest value. In Trang province, southern Thailand, Praisankul and Nabangchang-Srisawalak (2016) used a CE survey to estimate the economic value of the seagrass ecosystem. They discovered that the use value from fisheries and ecotourism was 1.5 million dollars and 5 million dollars, respectively. While the indirect value of carbon sequestration and storage was estimated to be 65 million dollars, the non-use value of this seagrass ecosystem was estimated to be 275 million dollars. In addition, Petcharat and Lee (2020) used the CE process to evoke nonusers' WTP for dugong conservation in Thailand. People in Bangkok were willing to pay 4,382 Baht (122 USD) per person per year for the most common dugong conservation program (a tagging buoy system, habitat restoration, and slowing dugong population decline). They discovered that the public appreciated the implementation of a buoy system the most while raising local fishermen's knowledge of dugong conservation was not a significant attribute.

Furthermore, while Yotapakdee et al. (2019) used market-based methods to elicit the use-value of the BKGA, and Saengavut, et al. (2018) applied CV to estimate the benefit of Yangna (*Dipterocarpus alatus*), a tropical tree species, there have been no prior studies of choice experiments relating to the valuation of urban green areas and endangered wetland plant species.

2.5 The use of non-monetary payment vehicles to value ecosystems

The WTP is likely to be zero in countries where household incomes are too poor and local people's budgets are too tight to give up any portion of their earnings for environmental protection. According to recent research, this may be due to the payment method chosen, rather than a preference for the service (Kassahun et al., 2020). As a result, recent stated preference studies in developing countries have used non-monetary payment modes as a utility measure or valuation of various environmental goods and services (Abramson et al., 2011; Amare et al., 2016; Gibson et al., 2016; Tadesse et al., 2017; Navrud & Vondolia, 2019; Kassahun et al., 2020).

According to Ahlheim et al. (2010), non-monetary payment vehicles will reduce the proportion of zero bids. Allowing respondents to express their willingness to provide volunteer labor raises the estimated value of forest ecosystem services, according to Vondolia and Navrud (2019). Furthermore, respondents are more likely to favor labor donations over monetary donations (Whittington et al., 1990; Alam, 2006; Hung et al., 2007; Vondolia et al., 2014).

Other in-kind commodities, such as rice and beehives, have been used in some studies to resolve the cash constraint problem (Asquith et al., 2008; Brouwer et al., 2009; Rai & Scarborough, 2012, 2015). Brouwer et al. (2009), for example, investigated the role of in-kind payment modes in moving from zero cash bids to positive non-monetary bids using a dichotomous option CV of flood control policy in Bangladesh. They discovered that 75 percent of respondents were willing to donate labor, 20 percent were willing to donate harvests such as rice, and the remaining 5 percent were willing to donate land for the construction of a bank to mitigate flood damage. Thus, the availability of volunteer workers has been seen as a practical scenario for low-income welfare measures (Echessah et al., 1997; Vasquez, 2014; Gibson et al., 2016; O'Garra, 2009).

The CV study conducted by Echessah et al. (1997) in Busia District, Kenya was the first to use labor time in welfare estimates. This study found that people were able to contribute enough time and money to control the tsetse flies that spread trypanosomiasis. Vasquez (2014) used sequential CV questions to investigate household priorities for labor time and money for developing water services in Guatemala. It was found that individuals with access to municipal services were able to pay a substantial increase in their water bills (more than 200 percent) in return for a reliable supply of safe drinking water, and they were willing to contribute roughly 19 hours per month to improve these services. In addition, Brouwer et al. (2009) investigated the role of in-kind payment modes in switching from zero monetary bids to positive non-monetary bids in a dichotomous preference contingent analysis of flood control policy in Bangladesh. They discovered that 75 percent of those who responded were willing to donate labor, 20 percent were willing to donate their harvests, such as rice, and the remaining 5 percent were willing to donate land for flood-damage relief bank development.

Several CV studies have shown that the expected willingness to contribute labor is more likely to exceed the WTP. For example, according to O'Garra (2009), willingness to contribute time is three times greater than the willingness to contribute money. According to Lankia et al. (2014), the respondent's WTP was higher in terms of labor than monetary. Furthermore, income has been shown to have a negative impact on willingness to contribute labor.

However, in stated preference surveys, using labor and other non-monetary payment forms as cost contributors poses theoretical challenges (Rai & Scarborough, 2015). Ahlheim et al. (2010), for example, argue that a CV survey based on labor participation conducted in Vietnam does not provide a credible and substantive decision rule for the allocation of funds for public projects because the economic value of the number of labor days reported by individuals is profound to the value of labor, which is condition dependent.

In addition to the CV process, the CE will investigate preferences using non-monetary payment modes. For example, Ando et al. (2020) used a CE to assess the benefits of enhancing stormwater management in terms of reported WTP money and willingness to sacrifice time in two major U.S. cities. This study found that people were able to volunteer their time for programs worth 1/3 of the average wage rate, and people benefited from volunteering.

Vondolia and Navrud (2019) used a CE to evoke preferences among smallholder farmers in developing countries for flood risk mitigation and flood insurance attributes. They discovered that respondents' attitudes toward money, labor time, and harvest payment modes were all similar. Non-monetary payment vehicles' relative scale parameters, on the other hand, were found to be lower than monetary payment vehicles' relative scale. Rai and Scarborough (2012) assessed the implied prices for each payment mode by adjusting for a means of payment using dual cost attributes, that is, monetary and labor attributes combined in CE. The dual cost attributes, on the other hand, can make interpreting the results more difficult. Then, they used a two-stage CE to enable respondents in the Chitwan National Park buffer zone in Nepal to express their willingness to contribute in the form of labor if they did not want to pay in cash. Male migrants with higher education and households with higher non-farm income were more likely to perform the money option mission, according to the binary logistic model's findings. Respondents from the buffer zone or with a larger family, on the other hand, were more likely to prefer employment as a source of income (Rai & Scarborough, 2015).

2.6 Summary

While ecosystem services, such as provisioning, regulating, cultural, and supporting, are extremely useful and beneficial to humans, estimating demand for these services is difficult. This is because a wide range of these services have use or non-use qualities but are not exchanged in the markets. Market failure has arisen as a result of unclearly specified and unenforceable property rights for ecosystem goods and services, and the price mechanism is unable to provide the true value of ecosystem goods and services.

Environmental economics focuses on environmental valuation to reduce environmental issues through informed decisions about policies or programs that impact the environment's efficiency. The TEV paradigm, on the other hand, divides ecosystem resources into use, non-use, and option values, and goes beyond marketed costs. As a result, economists are attempting to value the entire spectrum of products and services associated with biodiversity and ecosystems. The revealed preference methods, which involve observable behavior, and the stated preference methods, which involve hypothetical behavior, are two commonly used methodologies for valuing non-market goods and services. Using data from the real market, revealed preference methods provide an accurate estimation of ecosystem service values. These methods, on the other hand, cannot be used to calculate non-use values. Therefore, specified preference methods, such as the CV and CE methods, are used to assess both use and non-use values. Both of the stated preference methods are focused on surveys. The CV approach is used to elicit a single attribute of an environmental asset, while the CE method allows for the calculation of preferences across several environmental asset attributes.

The CE is a technique for eliciting nonuse or passive use values that is consistent with random utility theory. Individuals are asked to indicate their preference for hypothetical alternative scenarios, products, or services based on attribute levels created by an experimental design using the CE process. In terms of different attribute levels, each alternative "good" is represented by multiple attributes. In contrast to a CV, which cannot be used to differentiate the significance of individual attributes in multiple attribute environmental products, this enables estimation of the relative importance of multiple environmental attributes and their levels. Several variables influence the approximate WTP for species and ecosystem services offered by species, according to the findings of previous stated preference studies. The type of species assessed, the change in the size of the species population, whether the species is assessed by tourists or households, the survey mode, and the response rate are all factors to consider.

CV and CE research on endangered species has been undertaken and established continuously in developing countries. While there is clear evidence that the public supports and is willing to pay for the protection of charismatic species, the literature, especially for endangered plant species, has substantial gaps. There have been few studies on the economic value and preferences for plant protection.

Furthermore, WTP responses are likely to be zero in countries where household incomes are extremely low, and local people's budgets are too tight to give up any portion of their earnings for environmental protection. As a result, modern stated preference studies advocate for the use of labor volunteering or willingness to volunteer (WTV) as a utility metric. By integrating the interests of a plurality of households and allowing for a self-selection model of contribution, determining the WTV will enhance our perception and estimate of social utility.

Chapter 3. Methodology

The economic values of ecosystem services provided by two wetland ecosystems, the Bang Kachao Green Area (BKGA) and the Water Onion (WO), were measured using choice experiments (CE). The data used in these two case studies came from the CE surveys conducted in Bangkok and the southern Thai provinces of Phangnga and Ranong, respectively. This chapter covers the CE theoretical foundations for this study. It also introduces wetlands as one of the two case studies. The methods and steps used to value these two wetlands are primarily presented in this chapter. It also goes through the findings from the two case studies and how they are supposed to react to the problem formulation and study questions.

3.1 Choice experiments

3.1.1 Introduction to choice experiments

The CE approach emerged from the conjoint analysis, an attribute-based method (ABM) widely used in marketing, transportation, and psychology research (Green & Wind, 1975; Adamowicz et al., 1998; Louviene et al., 2000), but only recently applied to environmental economics research (Adamowicz et al., 1994; Holmes et al., 1998). People’s preferences for a good's characteristics are elicited in the initial conjoint study, which involves creating imaginary or hypothetical market conditions. However, some functional issues may arise when using conjoint analyses' ranking or rating techniques. Respondents, for example, can find it difficult to rate a large number of options. Consumers are not usually confronted with ranking or rating options. Furthermore, rather than behavioral theory, traditional conjoint analyses are focused on mathematical and methodological concerns (Bennett & Blamey, 2001; Louviere, 2001).

The CE, which is a branch of ABMs, differs from traditional conjoint analysis in that participants are asked to select an option from a list of options rather than ranking or scoring them (Adamowicz et al., 1998). The basic premise of the CE method is that respondents are decision-makers who are supposed to increase their utility by making a particular option in a given situation (Choi & Fielding, 2013). The CE approach tries to replicate an actual demand for a non-market good described by a series of characteristics. In practice, a person first determines the possible choices, then considers the characteristics of each choice, then uses the utility maximization decision rule to choose an alternative from a collection of options. As a result, an individual chooses the option with the greatest utility. A selection of attributes and attribute levels distinguish the choices. Since cost is a numerical feature of the good in and choice, a marginal rate of substitution between these attributes and money is calculated (Adamowicz et al., 1998). This approach will help the researcher determine the welfare transition from the status quo since the status quo is normally included in the option package (Boxall et al., 1996). It also reflects the price consumers can pay for one of any of the product's attributes. It is possible to predict the importance people put on improving the qualities of environmental products, or the amount of money they are willing to pay to prevent an adverse feature of the good that they do not value in this manner (Adamowicz et al., 1998).

3.1.2 The basis of the CE model estimation

Lancaster's characteristic theory of value (Lancaster, 1966) and random utility theory are combined to form the CE (Manski, 1977; Thurstone, 1927). The total utility obtained from a product or service is the number of individual utilities provided by the characteristics of that good, according to Lancaster's demand theory (Lancaster, 1966). It means that people derive utility or happiness from a good dependent on its properties or characteristics, rather than from the good itself (Campbell et al., 2008). For example, some people will like a fishing trip even better if it is on a comparatively pristine river with few people, while others may choose to fish on a lake with many people (Wallmo, 2003).

The random utility model assumes that an individual chooses the choice with the highest utility and that each individual's utility for option *j* (U_j) is made up of two components: a measurable proportion (V_j) and a random proportion (ε_j), or the proportion of utility unknown to the observer. The utility that an individual derives from a particular choice *j* can be calculated as:

$$U_j = V_j + \varepsilon_j \tag{1}$$

The utility maximization rule says that from a set of possible options, a person will choose the choice that maximizes his utility. In other words, if $U_j > U_m$ for all $m \neq j$, a person would choose choice *j*. Assume that an individual chooses choice *j*, which has the highest utility. After each alternative has been tested, the probability of choosing choice *j* is proportional to the probability that the utility of choice *j* is greater than the utility of choice *m*. Since utilities have an error aspect, the probability that anyone will choose option *j* can only be expressed as follows:

$$Prob\{j\ is\ selected\} = Prob\left\{V_j + \varepsilon_j > V_m + \varepsilon_m; \forall_m \in C\ \right\} \tag{2}$$

where C denotes the list of all available choices The conditional logit (CL) model, according to McFadden (1974), gives the likelihood of a person choosing choice *j* if the error fraction in equation (2) is independent and identically distributed (IID) with an extreme value distribution of form I. The CL model, which says that the inclusion or elimination of other choices does not affect the relative probabilities of two choices being chosen, is as follows:

$$Prob\{j\ is\ selected\} = \frac{e^{\lambda V_j}}{\sum_{m \in C} e^{\lambda m}} \tag{3}$$

A scale parameter λ, which is inversely proportional to the variance of the error term, and a position parameter δ define this distribution. The regular Gumbel distribution of λ = 1 and δ = 0 is usually used in practice (Ben-Akiva & Lerman, 1985). If the measurable proportion (V_j) of utility is linear in the parameters, the individual's indirect utility function for choice *j* is typical of the form

$$V_j \;= \alpha_j + \sum_{k=1}^{n} \beta_k X_k + \sum_{s=1}^{m} \gamma_s \alpha_j \, Z_s \tag{4}$$

where α_j is the coefficient reflecting an "opt-out" (alternative "status quo"), X_k is the alternative's ecosystem features including a cost attribute expressed in either cash or time, Z_s is a vector of person characteristics affecting their choice between choices (e.g., age, income, occupation, experiences), and α_j, β_k, and γ_s are parameters (Liu et al., 2019; Haab & McCornnell, 2003). The model incorporates the considered ecosystem attributes through effect codes. According to Hanemann (1984), the calculation of increases in wellbeing associated with a decrease in the degree of an attribute is as follows:

$$CV = \frac{1}{\mu}\,[\ln \sum_{j \in C} e^{V_{j1}} - \ln \sum_{j \in C} e^{V_{j0}}] \tag{5}$$

where *CV* is the compensating difference and is the marginal utility of income; V_{j0} and V_{j1} are the utility before and after the adjustment under consideration. Equation (5) is simplified when the choice set only includes a single before and after alternative.

$$CV = \frac{1}{\mu}\,[V_{j1} - V_{j0}] \tag{6}$$

Equation (6) shows that the marginal rate of substitution between ecosystem service attributes and cost attributes is simply the ratio of their coefficients for a linear utility function (Hensher & Johnson, 1981). Therefore, the ratio of the coefficients can be used to describe a marginal WTP (MWTP) value of a shift within a single attribute k:

$$MWTP_k = -\beta_k/\mu \tag{7}$$

where β_k is the coefficient of the service attribute k and μ is the coefficient of the money cost attribute. The marginal rate of substitution between the money cost adjustment and the attribute in question is effectively provided by this partial value formula (Bennett & Blamey, 2001). Further, a marginal WTV (MWTV) value of a transition within a single attribute k can be expressed as a ratio of coefficients, as seen in equation (8).

$$MWTV_k = -\beta_k/\mu \tag{8}$$

where μ is the coefficient of the labor time attribute and β_k is the coefficient of the attribute k. The marginal rate of substitution between time cost adjustment and the attribute in question is essentially calculated using this part-worth calculation (Bennett & Blamey, 2001).

3.1.3 Steps in a CE study

The process of implementing any CE study involves several stages. These include 1) choice experiment design, 2) questionnaire design 3) survey administration, and 4) model and welfare estimation.

The first phase, designing the choice experiment, entails determining the problem to choose the attributes and attribute levels, as well as designing the choice sets. The most important step in the design process is to define the appropriate attributes and their levels of the good to be measured (Adamowicz et al., 1998). These characteristics must be selected depending on the study goals, prior principles, and focus group results. It is also crucial to include all of the characteristics that are affected by the regulation. Consultation with consultants who are responsible for the policy's design will also aid in the identification of the characteristics. One of the attributes used to calculate WTP is the expense parameter. Following that, each trait can be described using pilot surveys, literature reviews, focus groups, and expert discussions. These procedures allow for the collection of appropriate, practicable, and accurate attribute values (Pearce et al. 2006). According to Alberini and Longo (2006), qualitative qualities are classified into two or three groups. The current position, or status quo, as well as any shifts in either or both ways, are included. Once the characteristics (attributes) and levels have been allocated, a statistical design theory must be used to integrate them into various situations. Individuals are faced with alternate variations of a good represented by a collection of attributes, with variances in attributes and levels, as well as the cost of each choice, in a survey. To merge the levels of attributes into different choices presented to respondents, a full factorial experimental design is initially used. When there are a vast number of attributes and levels, though, the designs also result in an excessive number of variations. As a result, the fractional factorial design can be used to keep the number of possibilities to a minimum. Another method for dealing with this issue is to use a block template. The scenarios are divided into sets or blocks in this case, so that separate respondents are assigned to a subset of scenarios.

The creation of the questionnaire is the second phase. Respondents are usually randomly assigned to one of the blocks for the CE query segment and given a minimum of one or more choice sets. In each choice set, respondents are asked to choose their most preferred alternative from multiple options, including the status quo option, which is usually included in each choice set. This allows researchers to calculate the difference in wellbeing from the current situation (Pearce et al. 2006).

Respondents must also be made aware of their financial constraints by "cheap chat". Questions on other forms of data, such as socioeconomic, attitudinal, or behavioral data, are typically included as well. Follow-up questions are used to help participants better consider the motivations and decision-making processes of respondents (Bennett & Adamowicz, 2001).

The next move is to put the survey into action after the questionnaire has been completed. A pre-test and pilot test of the questionnaire or interview script is also recommended for this stage's production (Adamowicz et al., 1998). The CE survey can then be used to gather data. Data can also be gathered by face-to-face interviews. Johnson and Orme (2003) susgest the minimum sample size requirements for the CE depend on the number of choice sets (t), the number of analysis cells (a), thus the minimum sample size (N) is calculated using the following equation.

$$N > 500c/(t * a) \tag{9}$$

when considering main effects, c is equal to the largest number of levels of any attributes.

Finally, econometric analysis is used in the estimation and welfare calculations to specify formulas for determining the marginal value of these attributes as well as the WTP for all alternatives of concern (Alberini & Longo, 2006). The mathematical analysis is typically based on the CL model, which is discussed in greater depth in the following section.

3.1.4 Advantages and problems of the CE method

The ability to evoke use and non-use values is one of the advantages of the defined choice method. In these situations, stated preference strategies can be used to collect overall non-market values (Bateman et al., 2002). The CV and CE were used to value items that are not yet traded and have a non-use value, CE may outperform the CV methodology in many ways for things that people do not use regularly, such as biodiversity (Adamowicz et al., 1998).

First, rather than eliciting respondents' preferences for the definite good, the CE approach aims to evoke respondents' preferences for the characteristics of the good. Researchers will detect the origins of trade-offs that people would make if they know what choices they make from a range of options. They will swap one of these functions for another to calculate the marginal rate of substitution between them. This allows for the estimation of the relative value of various ecosystem service attributes and levels. This is the primary advantage of the CE method over the CV method, which cannot discern the value of each attribute of environmental properties (Seenprachawong, 2016). Knowing which values of the elements are valued by which sectors of the community makes it more possible to develop policies or projects that are more personalized and produce the highest net gains (Hanley et al., 1998).

Second, the CE approach will avoid the assumptions that the CV method concedes (Pearce et al., 2006). The CE is thought to avoid the hypothetical distortion that happens in CV surveys when respondents overestimate their ability to pay for a good when they do not pay for it (Alberini & Longo, 2006). As a result, the CE is more useful than CV surveys because people have more opportunities to express their preferences for goods at various price points.

Furthermore, compared to other ABMs such as contingent ranking, contingent scoring, and paired contrast, the CE approach has significant advantages. The CE's first benefit is that it can mimic real-world consumer conditions in which people must choose whether or not to buy one of several products with identical attributes but varying levels of these attributes. Respondents find it easier to choose an option from a preference range than to compare or rate a variety of alternatives (Hanley et al., 2001). Alternative methods such as contingent rating, contingent ranking, and pairwise comparisons produce a conclusion that is inconsistent with market theory (Hanley et al., 2001) and places a significant cognitive burden on people (Holmes & Addamowicz, 2003), while the CE approach provides measures of welfare consistency. These issues can be avoided since CE asks respondents to make a single distinct choice from multiple choices.

The main disadvantage of CE is that it involves making difficult choices between packages of various attributes and tiers. The cognitive load associated with several different qualities and tiers, or when people are asked to choose between products with which they are unfamiliar, are disadvantages of the CE approach (Alberini & Longo, 2006). Another problem arises when doing a CE analysis to calculate a product's total economic value since the value of the entire is assumed to be equal to the sum of the parts. There may be additional characteristics of the good that are not included in the analysis, because the total value of the good may not be proportional with this method. There is also proof that the value of entire packages of a good is less than the sum of the value of the individual elements (Pearce et al., 2006).

In addition, when applying the approach in developed nations, several problems can be addressed with extra care. The payment vehicle, for example, is the method by which the hypothetical payment is captured. This payment system can be found in developed nations where utility bills are used, but utility bills may not be available or received on a daily basis in developing countries. It is possible that the taxes will not be paid, and that the respondents will not pay the taxes. It is conceivable that the tax collecting system is not trustworthy or capable of supplying services or goods. Focus groups will once again assist in the selection of a practical and secure payment vehicle. Therefore, CE necessitates a significant amount of work in terms of design, both in terms of scenario creation and mathematical design methods.

3.2 Case study I: Valuing ecosystem services of the BKGA

3.2.1 Description of the BKGA

The Bang Kachao Green Area (BKGA) is situated in the southern part of Bangkok, in the district of Phra Pradaeng, Samut Prakan province, and occupies an area of roughly 21 square kilometers within the Chao Praya River basin.

Figure 3.1 depicts the site, with the Chao Praya River (which spans 17 kilometers) encircling the oval-shaped green space of Bang Kachao (Sukawattanavijit & Pricharchon, 2015).

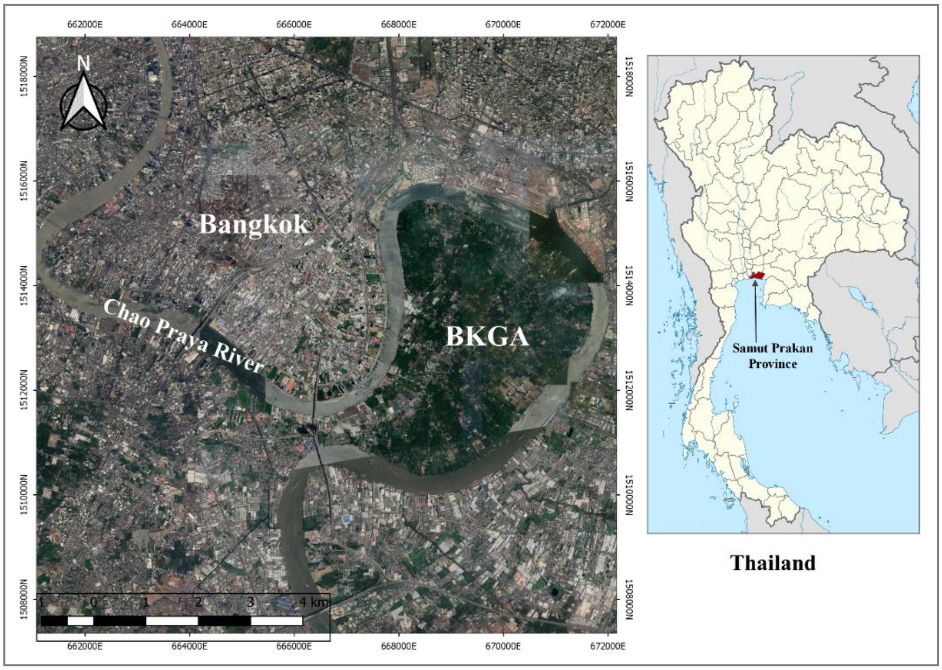


Figure 3.1 Location of the Bang Kachao Green Area (BKGA)

The BKGA's ecosystem is divided into four categories. The first is a recovery forest, which consists of five habitats: wet evergreen forest, dry evergreen forest, floodplain, swamp, and an abandoned orchard. The second form is agroforestry, which is done in-home gardens by traditional farmers who grow a variety of fruit and native tree species. Mangroves found along riverbanks are the third kind. The Sri Nakhon Khuean Khan is one of the last forms (Sommeechai et al., 2018). As a result, Bang Kachao is ecologically relevant and provides valuable environmental services to support urban society (Yotapakdee et al., 2019).

Several efforts have been made to conserve green space and retain its advantages, such as supplying the primary source of oxygen in the province of Samut Prakan, which helps to minimize agricultural air pollution. To preserve the reputation of Bang Kacaho, Princess Maha Chakri Sirindhorn's government launched research and environmental management initiatives. Consequently, the Sri Nakhon Khuean Khan Park was created by the government to conserve and preserve designated green areas for ecological and recreational purposes. In the meantime, the Royal Forest Department (RFD) has completed conservation and tree-planting projects in 10 percent of the district (Ariando et al., 2017). Figure 3.2 depicts a photograph of the park, as well as the BKGA's natural scenery and abundance of greenery.

Figure 3.2 The greenery of the BKGA and Sri Nakhon Khuen Khan Park
Source: The Royal Forest Department

However, as a result of urbanization, the quality of this urban green space has deteriorated, as has the provision of its ecosystem services. Owing to improvements in land use, the size of Bang Kachao has shrunk. Between 1996 and 2006, approximately 1.5 square kilometers of dispersed orchards were turned into residential areas, accounting for 7.11 percent of the total territory. Due to urbanization, the quality of this urban green space and the provision of its ecosystem services have been compromised. The area of Bang Kachao has decreased due to land-use changes. Between 1996 and 2006, about 1.5 square kilometers or 7.11 percent of the total area of scattered orchards was converted to residential areas. The loss of green space causes social tension as a result of pollution, including stress and health issues (Sukawattanavijit & Pricharchon, 2015).

The BKGA was chosen for the analysis because it is the city of Bangkok's primary source of clean air and offers unique food items and leisure amenities to the public. It is reflective of other metropolitan areas in Thailand as well as other countries where contaminated urban conditions are also a major problem. Another explanation for choosing this green space is that it has been the subject of many conservation efforts, including high community participation in urban forest conservation. Via Corporate Social Responsibility (CSR), private sectors such as financial institutions, hospitality, and manufacturing industries have also contributed to funding to secure the BKGA (Ariando et al., 2017). Therefore, it is critical to comprehend the need for a PES scheme to be implemented in this green space to enhance the integrity of the environmental services offered while still supporting people's livelihoods.

3.2.2 Choice experiment design

The BKGA CE survey aims to (i) evaluate the economic value of BKGA ecosystem services, (ii) explore the factors affecting respondents' WTP in Bangkok for enhancing BKGA ecosystem services, and (iii) make concrete recommendations for urban wetland planners and policymakers. We used a CE approach to estimate the WTP for quality improvements of different ecosystem service attributes in the green area, to estimate the welfare gain from improving BKGA ecosystem services. We presumed that the existing condition of ecosystem services in Bang Kachao is unchanged (no change) and provided respondents with two separate BKGA wetland restoration programs (Plan A and Plan B). The new restoration projects, we clarified, would increase the efficiency of ecosystem services provided by the BKGA. Each plan has four service attributes, as well as a price attribute, that can be applied to status quo, good, or excellent levels. Initially, the BKGA's ecosystem service characteristics were derived from previous studies and consultations with forestry experts from the Royal Forest Department and Kasetsart University professors with expertise in ecological conservation and management. The payment choice and four ecosystem service attributes were planned. The first attribute was a food product, which was given by agricultural land and mixed orchards within the BKGA as a proxy for consumptive use. The payment choice and four ecosystem service attributes were planned. Food product was the first feature, which served as a proxy for the consumptive use of agricultural land and mixed orchards in the BKGA. The second trait was air quality, which served as a proxy for green space's indirect use or controlling operation. Leisure amenity, the third quality, is a proxy for recreational use, namely the scenic view of the region and its appeal to tourists and travelers. Bird species abundance, as a proxy for non-use or existence value, is the fourth attribute. Since this green space attracts a variety of bird species, including native species and migrants, particularly during migration season, the bird species abundance attribute was chosen. The BKGA's Bioblitz survey, which was undertaken to establish a biodiversity database, found 82 bird species (Fredrickson, 2014). Besides, ecological restoration projects, including the planting of native fruits and endemic plants, have the potential to reintroduce many bird species (Ariando et al., 2017). All four qualities were graded on three levels (status quo, good, and excellent), corresponding to a 0, 25, and 50 percent growth, respectively. These attribute levels are equivalent to those of Seenprachawong (2016). We have created a payment option (i.e., a numerical attribute) that reflects a one-year monetary contribution to the BKGA project, which is administered by a third-party organization. The available payment options are 100 Baht (2.9 USD), 200 Baht (5.8 USD), 500 Baht (14.4 USD), and 1000 Baht (28.9 USD). These payment amounts are similar to the offered bids in the CV survey conducted by Bejranonda and Attanandana (2011). Table 3.1 shows the selected characteristics and their levels.

Table 3.1 The attributes and attribute levels used in the BKGA case study

Attribute	Level
Food product	Status quo: no change Good: the number of food items from agricultural areas and mixed fruit orchards within the BKGA has increased by 25%. Excellent: the number of food items from agricultural areas and mixed fruit orchards has increased by 50%.
Air quality	Status quo: no change Good: the air quality has improved by 25% Excellent: the air quality has improved by 50%
Leisure amenity	Status quo: no change Good: the scenic view has improved by 25% Excellent: the scenic view has improved by 50%
Bird species abundance	Status quo: no change Good: the number of bird species has increased by 25%. Excellent: the number of bird species has increased by 50%.
One-time payment	0, 100, 200, 500, 1000 Baht

Then we generated multiple sets of options by combining the selected attributes and levels. The complete factorial experimental architecture yields LAC potential configurations, where C denotes the number of alternatives and A denotes the attributes. However, there are so many options that choosing between them will be too boring and mentally taxing for respondents. To achieve 40 alternatives, the fractional factorial or orthogonal design in SPSS (version 17.0) is used (Plan A). Then, using a cyclic pattern, we came up with one alternate solution (Plan B). As a result, each option set had three scenarios: The status quo or baseline alternative is often the first option; Plan A is made up of one of the 40 alternatives, and Plan B is made up of increasing one degree in each attribute in Plan A. As seen in Appendix A, the 40 choice sets were then, grouped into ten blocks of four choice sets each, which were distributed in ten different iterations of the questionnaire.

3.2.3 Questionnaire design

The questionnaire was then divided into ten individual versions (as seen in Appendix B). There are three parts to each version. Sections A and B of each questionnaire version provide the same detail, but Section C differs. Respondents' socioeconomic characteristics, such as age, gender, marital status, schooling, profession, wages, and the number of family members, are collected in Section A. Section B aims to gather information about the respondent's environmental issues, experiences, and aspirations of the BKGA. Section C, the CE, is the final section, and it consists of four choice sets, each with three options. Figure 3.3 depicts an example of a choice set. Respondents were asked to pick the alternative they felt would be the best plan for the BKGA and the one they preferred, taking into account both attributes and a potential cost.

Which of the two restoration plans (Plan A and Plan B) do you prefer? Benefits will be increased if you chose either A or B, and you will be expected to pay. The "status quo" alternative, on the other hand, would not entail payment, but the state of ecosystem resources for food, air quality, leisure amenity, and bird species abundance attributes would not be changed.

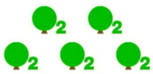
Benefits	**Status quo**	**Plan A**	**Plan B**
Food product	No change 	Good  25% increase	Excellent  50% increase
Air quality	No change 	Good  25% improvement	Excellent  50% improvement
Leisure amenity	No change	Excellent	No change
Bird species abundance	No change 	No change 	Good  25% increase
Payment	0 Baht	100 Baht	200 Baht
Please choose the one you prefer.	( )	( )	( )

Figure 3.3 Example of a choice set used for the BKGA case study

3.2.4 Survey administration

The survey will then be launched, and data will be collected through a face-to-face interview. We performed a small pilot survey of 45 people to get a sense of the experimental style that would be used in the main survey. Between July and September 2016, we used a random sampling technique to interview any fifth person who visited one of Bangkok's five well-known public parks: Chatuchak Park, Lumpini Park, Sri Nagarindra Park, Suan Luang Rama 9 Park, and Sri Nakhon Khuean Khan Park. Respondents were allocated to one of ten blocks (questionnaire versions) at random. Section C, the CE queries, is the most critical element. Respondents were given a history information card and a selection of four choice sets in this segment. In a given choice set, each respondent was given three options from which to choose: two strategy options and one status quo option in a given preference package. Since each participant completed four individual option assignments, a total of 200 interviews yielded 800 insights (200 × 4).

3.2.5 Model and welfare estimation

A CL model was created using data from 200 face-to-face interviews in the Bangkok metropolitan area and LIMDEP 9.0 software. The discrete CE approach was used to identify the variables that influence WTP in each alternative with various attribute levels. To code the data from CE, effect codes were developed based on Louviere (1988). All service attributes are coded using effect codes (1, -1, and 0). One level is included as the status quo and two results code variables are generated for the other two levels. For example, we applied the status quo level and two variables (good and excellent level of food product) to the data set while coding the food product parameter. Therefore, the status quo has been assigned the code "-1". When the good level was included in the alternative, it was coded as "1" and the excellent level was coded as "0". On the other hand, where the excellent level was the included level of the option, the excellent was coded as "1" and the good was coded as “0” (Seenprachawong, 2016). Then, the three other attributes (air quality, leisure amenity, and bird species abundance) were coded in the same way.

Ecosystem service attributes were grouped into three hypothetical alternatives by the CL model, from which respondents could choose their preferred alternative. These numbers were used to determine the importance of the attributes. The CL model also included monetary and personal characteristics, allowing us to estimate the WTP for enhancing ecosystem service efficiency by optimizing the probability function. The WTP for wetland restoration was then calculated. We also looked at socioeconomic factors that affected people's choices.

3.3 Case study II: Valuing ecosystem services of the Water Onion

3.3.1 Description of the Water Onion and its wetland ecosystem

Water Onion, Water lily, Thai Water Onion, Onion Vine, and Yellowish leaves lily are all common names for *Crinum thaianum*, an aquatic plant in the Amaryllidaceae family (Lekhak & Yadav, 2012). This species reproduces primarily by vegetative means, with a mother bulb producing several smaller bulbs, which are visible as clusters of bulbs emerging in the stream (see Figure 3.4).

Figure 3.4 *Crinum thaianum*: A habit showing long flat leaves; B inflorescences; C fruiting inflorescence

The WO is an endemic endangered wetland plant found only on Thailand's upper southwest coast, in the provinces of Ranong and Phangnga, stretching 110 square kilometers from Ranong's Kapoe and Suksamran districts to Phangnga's Khura Buri and Ta Kua Pa districts (Schulze, 1972). This wetland plant survives in a unique environment, particularly in canals with clear water and sunlight passing through to the canal bed (Kongsuwon, 2018). According to a survey in 2008, there are ten canals where WO can be found. These canals ran from Kapoe district, Ranong province, south to Ta Kua Pa district, Phangnga province, covering a total area of approximately 17,168 square meters. However, between 2010 and 2011, the distribution of WO has decreased to 5,456 square meters. In 2013, the Thailand Institute of Scientific and Technological Research (TISTR) performed a survey and discovered that the WO is no longer present in certain locations. The study also discovered that the number of WO exit sites has been steadily decreasing. Since 2008, the area of WO distribution in some canals has declined by more than 50 percent. For example, the WO area in the Naka canal of Ranong province's Suksamran district decreased from 8,832 square meters in 2008 to only 208 square meters in 2013. Similarly, the Bang Pong canal in the Khura Buri district of Phangnga province had 3,760 square meters in 2010, but just 278.4 square meters in 2013. This may imply the WO are critically endangered. Finally, the TISTR completed a survey of the area where the WO was found in 2016, discovering a total of 18 canals with a population of 12,824 square meters, as well as a small increase in the presence of WO (Kongsuwon, 2018).

Since this plant species has a limited range of habitats, the extinction of a single organism could result in the extinction of the entire species if proper management practices are not implemented (Kimmins, 1997). As a result, the WO-rich areas of Phangnga province's Khura Buri district and Ranong province's Suksamran and Kapoe districts were chosen as study areas.

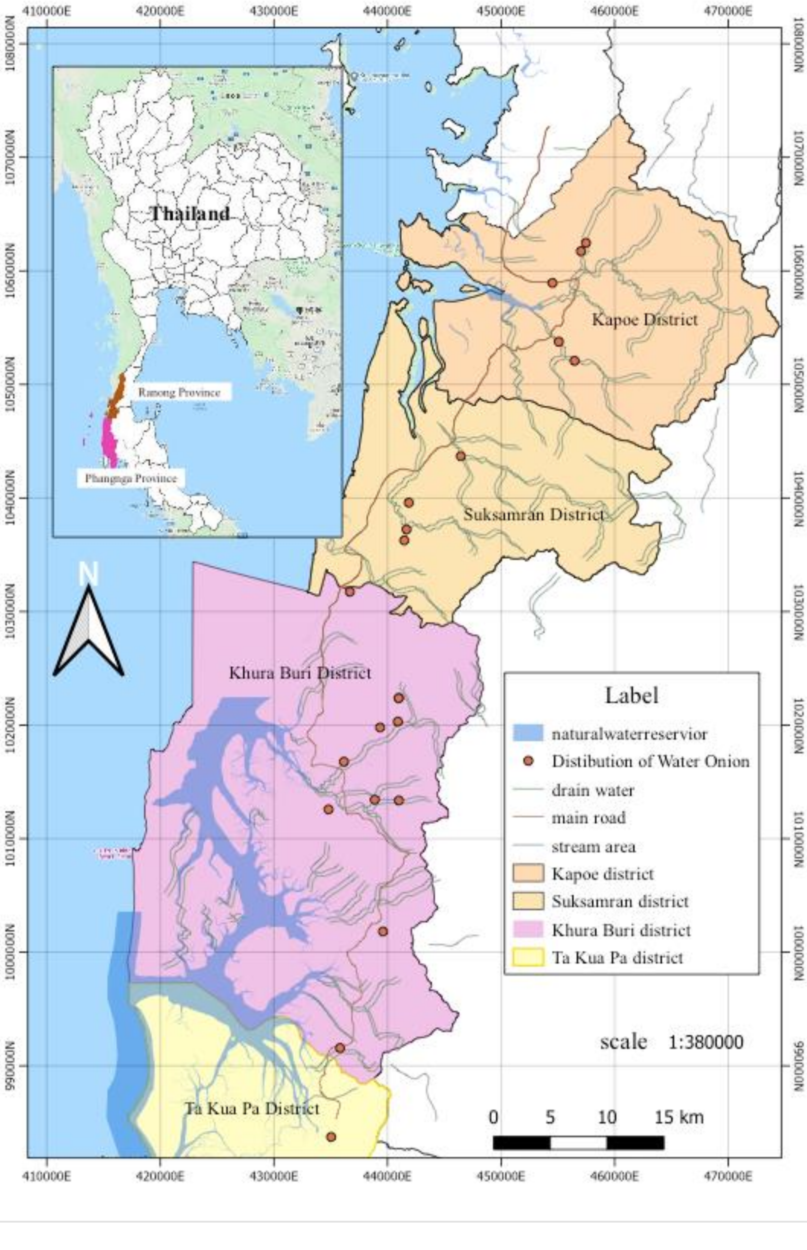


Figure 3.5 Study area and the distribution of WO in 2018

Note: The WO distribution is shown in red.

Source: Adapted from Kongsuwon (2018)

3.3.2 Choice experiment design

We used CE surveys and interviewed people in the research area to evoke their interests, WTP, and WTV for enhancing ecosystem services gained from the conservation of WO and its wetland ecosystem in this case study. The current status of ecosystem services generated by the WO is believed to be low (status quo). Two new conservation proposals were given to respondents. These plans will ensure that the ecosystem services that are considered are improved. A monetary donation or labor contribution was used as a WTP or WTV measure attribute, respectively. However, to calculate a given marginal WTV, we only used samples from Ranong province in which respondents performed CE tasks in both monetary and labor terms.

The selection of attributes and their levels is the first step in designing a preference experiment. Based on fieldwork, literature analysis, and interviews with local citizens and ecologists who are specialists in wetland and WO management, the characteristics correlated with the outcomes resulting from WO conservation programs were established. Biodiversity, water quality, upstream condition, and recreational opportunity were chosen as the four ecosystem service attributes as a consequence. As indicated in Table 3.2, these four characteristics are divided into three levels (low, medium, and high).

Biodiversity was described as the abundance and variety of WOs, fish, insects, animals, and other aquatic species. It denotes a non-use value. The low level indicates that the wetland contains a small number of water onions, fish, insects, animals, and other aquatic species. At the medium level, the abundance and variety of water onions, fish, insects, animals, and other aquatic species have increased by 25%. The high level refers to a scenario in which the abundance and variety of aquatic species such as water onions, fish, insects, animals, and other aquatic species have grown by 50%.

The second attribute, indirect value, was chosen as a proxy for water quality. When performance is low, odors and algae become visible. The medium level suggests somewhat muddy water with visible algae but no smell. The high water quality is crystal clear and odorless.

The third feature considered was the upstream condition, which reflects the density of upstream and riverside plants, as well as the degree of bank erosion. Low: there is a lack of upstream and bank vegetation, and erosion is common at this level. There is a moderate level of upstream and bank vegetation, as well as a moderate risk of erosion, at the medium level.

The recreational opportunity reflects a non-consumptive use-value. Only visual amenity is available at the low level. Secondary contact recreation such as fishing, rafting, and boating is possible at the medium level. At the highest level, all types of recreation are available, as well as the development of tourism infrastructure.

According to Rai and Scarborough (2015), using two cost-attributes, monetary and labor, as attributes in the CE will enhance the sophistication of the results review. In this study, we used the cost attribute in monetary or labor donations to help WO conservation projects that strengthen wetland ecosystem services. The monetary contribution is a one-year grant to the WO conservation project. Respondents were asked open-ended questions during the pilot test period to express their desires for monetary donation and labor commitment. Thus, the survey's monetary and labor payment amounts were chosen from the top-four ranking frequencies of respondents in the pilot test. There were 50 Baht (1.5 USD) to 100 Baht (3 USD), 200 Baht (6 USD), and 400 Baht (12 USD). The labor allocation is the number of days that respondents will spend taking steps to strengthen ecosystem services. We demonstrate that events must be available for people of all abilities, and the province would keep track of the work. Labor days are divided into four categories: 2, 4, 6, and 12 each year. Table 3.2 lists this attribute and their levels.

Table 3.2 The attributes and attribute levels used in the WO case study

Attributes	Attributes levels
Biodiversity	Low: the wetland has a low abundance and variety of water onions, fish, insects, animals, and other aquatic species. Medium: the abundance and variety of water onions, fish, insects, animals, and other aquatic species have increased by 25%. High: the abundance and variety of water onions, fish, insects, animals, and other aquatic species have increased by 50%.
Water quality	Low: low water quality; smell and algae noticeable Medium: slightly murky water; some algae noticeable; no smell High: water quality is very good (clear and clean); no smell
Upstream condition	Low: upstream and bank vegetation are scarce, and erosion happens frequently. Medium: there is a moderate amount of upstream and bank vegetation, and a moderate chance of erosion. High: there is a lot of upstream and bank vegetation, and no danger of significant erosion.
Recreational opportunity	Low: visual amenity only Medium: Secondary contact recreation possible (fishing/rafting/boating) High: All type of recreation possible, tourism infrastructures
Contribution	Annual contribution There are 5 levels: In cash: An annual donation of 0, 50, 100, 200, 400 Baht or In volunteer labor: 0, 2, 4, 6, 12 days

The next step is to create CE tasks from the selected attributes. We first create the CE task in monetary terms by using a typical preference modeling experimental design with non-status-quo choices in choice questions being assigned attributes and levels according to a full factorial experimental design (Holmes & Adamowicz, 2003). However, the number of potential configurations or possibilities based on the chosen characteristics is enormous, and it is difficult to include all of them in the survey. To create a more tractable CE survey, we used the fractional factorial and orthogonal styles in SPSS. As a result, forty possibilities representing the first alternatives in of choice set (Plan A) were created to cover the spectrum of uncertainty between all possible combinations (Seenprachawong, 2016).

Then, as an extension of the orthogonal strategy, the cyclical design was used to derive the second alternative (Plan B) from a particular Plan A. As a result, each choice set includes two different plans (Plan A and Plan B). Each choice set also included the status quo, which resulted in a low condition in all ecosystem services due to the lack of restoration projects. The forty choice sets were then divided into ten blocks, each with four choice sets. In monetary terms, the CE task is divided into ten versions (1A-10A), as seen in Appendix C.

We planned the CE task in labor contribution after we developed the CE task in monetary terms. This mission has a labor contribution as an expense attribute instead of a cash donation. The labor contribution is the number of days a respondent will spend on things like harvesting seeds, transplanting, replanting, upstream forest preservation, erosion prevention, and promoting youth education about wetlands and WO protection, enhancement, and restoration. The sum of money in Baht (50, 100, 200, and 400) was replaced with the number of labor days (2, 4, 6, and 12), respectively. Then, as seen in Appendix C, we reordered the forty choice sets into ten blocks (1B-10B). Figures 3.6 and 3.7 show an example of a choice set for the CE task in monetary terms and the CE task in labor contribution, respectively.

<table>
<tr><td colspan="4">Any of the following alternatives demonstrates increased benefits as a result of the WO conservation plan: Plan A and Plan B are also viable options. Which of the two options do you prefer? If you choose either option, you will incur a fee. The "Neither A nor B" alternative, on the other hand, would not entail payment, but the state of ecosystem resources would not be changed.</td></tr>
<tr><th>Benefits</th><th>Plan A</th><th>Plan B</th><td rowspan="6">Neither
A nor B:

I prefer the NO conservation plan.</td></tr>
<tr><td>Biodiversity (abundance and variety of water onions, fish, insect, animals, and other aquatic species)</td><td>
Medium
(25% increase)</td><td>
High
(50% increase)</td></tr>
<tr><td>Water quality</td><td>Medium
Slightly murky water
some algae noticeable
no smell</td><td>High
Clearwater
No smell</td></tr>
<tr><td>Upstream condition</td><td>
Medium abundant
Moderate chance of erosion</td><td>Good

High abundant
No danger of significant erosion</td></tr>
<tr><td>Recreational opportunity</td><td>
Low
Visual amenity only</td><td>
Medium
Secondatry contact recreation
(fishing/rafting/boating) possible</td></tr>
<tr><td>Monetary donation</td><td>100 Baht</td><td>200 Baht</td></tr>
<tr><td>I would prefer:</td><td>☐</td><td>☐</td><td>☐</td></tr>
</table>

Figure 3.6 Example of a choice set for the CE task in monetary terms

<table>
<tr><td colspan="4">Any of the following alternatives demonstrates increased benefits as a result of the WO conservation plan: Plan A and Plan B are also viable options. Which of the two options do you prefer? If you choose either plan, you would be expected to volunteer labor for a different amount of days. The “Neither A nor B” alternative, on the other hand, would not require any labor, but the state of ecosystem resources would not be enhanced.</td></tr>
<tr><th>Benefits</th><th>Plan A</th><th>Plan B</th><td rowspan="6">Neither
A nor B:

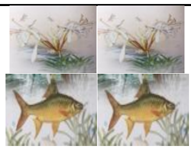
I prefer the NO conservation plan.</td></tr>
<tr><td>Biodiversity (abundance and variety of water onions, fish, insect, animals, and other aquatic species)</td><td>
Low</td><td>
Medium (25% increase)</td></tr>
<tr><td>Water quality</td><td>Low
Low water quality
algae and smell noticeable</td><td>Medium
Slightly murky water some algae noticeable no smell</td></tr>
<tr><td>Upstream condition</td><td>
Medium abundant
Moderate risk of erosion</td><td>
High abundant
No danger of significant erosion</td></tr>
<tr><td>Recreational opportunity</td><td>
Low
Visual amenity only</td><td>
Medium
Secondatry contact recreation (fishing/rafting/boating) possible</td></tr>
<tr><td>Volunteer Labor</td><td>6 days/year</td><td>12 Days/year</td></tr>
<tr><td>I would prefer:</td><td>☐</td><td>☐</td><td>☐</td></tr>
</table>

Figure 3.7 Example of a choice set for the CE task in labor contribution

3.3.3 Questionnaire design

The key questionnaire used in this analysis is divided into three parts (as shown in Appendix D). The first section of the questionnaire covers socioeconomic characteristics such as gender, marital status, age, education, profession, income, and household size. The second section contains questions about respondents' perceptions of the advantages of WO and risks to the WO and its wetland habitat, conservation interactions of WO, and perceptions of conservation initiatives for this species. The final section is about the choice experiment task in monetary terms. In addition, to evoke the WTP of respondents in Ranong province, we added the following CE challenge in labor contributions and its relevant queries.

3.3.4 Survey administration

A 30-person pilot test was conducted before prescribing the final sample to ensure that the characteristics selected and the choice experiment tasks are acceptable. Five qualified postgraduate students with a forestry major then conducted the surveys, which were focused on face-to-face interviews with sample residents of Phangnga and Ranong provinces, in June and December 2019.

The first survey using the CE task in monetary terms (questionnaire versions 1A-10A) was conducted in June 2019 in Khura Buri district, Phangnga province. Rural residents were randomly chosen from the three communities in the district. Thirty to thirty-five people were chosen at random from each community. As a result, 101 people were assigned to one of ten different monetary-based questionnaire versions at random. Participants were questioned about their socioeconomic status, their beliefs of the benefits of WO, the threats of WO, and future management methods, as well as their previous experiences with WO conservation. Then, in the CE section, the interviewer presented respondents with background information about WO and its wetland ecosystem using cards and pictures (as shown in Appendix D). Typically, this stage consists of the CE task in monetary terms. All respondents were first asked to complete four choice sets, each of which allowed them to choose between two possible WO conservation outcome scenarios and the status quo.

The second survey was performed in Ranong province's Suksamran and Kapoe districts in December 2019. Residents from the total three villages in the two districts were selected at random. Each village had 50-60 people selected at random. In the CE section, 166 respondents were first assigned to one of ten versions (1A-10A) of the CE task in monetary terms, which consisted of four choice sets. After that, they were asked to replicate the process for the CE task in labor contribution (1B-10B), which also had four different sets of questions. For instance, a respondent who was initially asked to complete the 1A version was also asked to complete the 1B version. Thus, respondents were given eight different choice sets to choose from. Therefore, the CE task in monetary terms, as well as the CE task in labor contribution, are all included in this survey.

Finally, all 267 respondents were asked to complete the CE task in monetary terms, with 166 in Ranong province being asked to complete the CE task in labor contribution as well. Therefore, we gathered data from two treatments: monetary (267 respondents) and labor (166 respondents).

3.3.5 Model and welfare estimation

In the CE tasks listed above, each respondent was asked to select one of two restoration outcomes or the status quo choice to determine whether or not to support the WO conservation project. Every respondent was given four separate choice sets to answer in each CE task. Therefore, each respondent gave one answer for each choice set, which was registered alongside the alternative levels for the two hypothetical restoration plans and the status quo option. There are $4\times 3 = 12$ data points for each respondent.

All ecosystem attributes are coded using effect codes (“1”, “-1”, and “0”) when coding the attribute levels. When the base preference is presented, the status quo option's coding attribute levels are normally treated the same way as the other preference alternatives (Holmes & Adamowicz, 2003). One level is included as the status quo for the four considered ecosystem service attributes of three levels, and two results code variables are generated for the other two levels. For example, while coding the biodiversity parameter, we used a low level as the baseline and two variables (medium and high levels of biodiversity improvement). Thus, the current situation has been given the code "-1". The medium level was marked as "1" when it was included in the alternative, whereas the high level was marked as "0". On the other hand, the high level was marked as "1" and the medium level was coded as "0", where the high level was the option's included level (Seenprachawong, 2016).

The data were evaluated using the random utility theory and the CL model. The utility function for alternative j is often in equation (4) where X_k denotes the alternative's characteristics or attributes, such as biodiversity, water quality, upstream condition, recreational opportunity, including a cost attribute expressed in either cash or time. α_j, β_k, and γ_s are parameters (Liu et al., 2019; Haab & McCornnell, (2003). By simply calculating the ratio of their coefficients, we can calculate the marginal rate of substitution between ecosystem service attributes and cost attribute or labor time attribute using a linear utility function (Hensher & Johnson, 1981). Therefore, a MWTP value and a MWTV value of a transition within a single attribute k can be expressed as a ratio of coefficients, as seen in equations (7) and (8), respectively. We used LIMDEP 9.0 tools to approximate CL models for MWTP and MWTV values in this case study. The influence of socioeconomic characteristics on preferences was also investigated.

Chapter 4. Results and Discussion

4.1 Choice experiment estimated value of ecosystem services of the BKGA

4.1.1 Respondents' socioeconomic characteristics

The collected data contains 200 completed interviews. The majority of responders were female (121, or 60.5 percent), with 109, or 54.5 percent, being married. The respondents ranged in age from 19 to 70, with one-third of them being between the ages of 26 and 35. The average age was 38, with an average of 15.4 years of schooling (bachelor's degree) spent. The average monthly family income was 51,000 Baht (1,473 USD), whereas respondents' average monthly income was 20,800 Baht (600 USD). Respondents had an average of three to four family members. The majority of the respondents (44 percent) resided in Bangkok; the remainder (32 percent, 13 percent, and 5 percent, respectively) lived in the adjacent provinces of Samut Prakan, Nonthaburi, Pathum Thani, and Samut Sakhon. These respondents' information was analyzed to examine if those characteristics were connected to choice and WTP for improving ecosystem services.

4.1.2 Environmental concern, experiences, and expectations for the BKGA

Section B of the research includes questions about general environmental issues, as well as respondents' experiences and perceptions. These questions are meant to elicit reasons why people support the BKGA's restoration. First, when respondents were asked to choose the most serious environmental concern from a list of options, 72 people (36 percent) said deforestation was the most serious issue in the country. Twenty-seven people (13.5 percent) expressed anxiety about air quality. Drought, water pollution, global warming, and biodiversity loss were all mentioned by a similar number of people: 25, 23, 21, and 18 (12.5 percent, 11.5 percent, 10.5 percent, and 9 percent, respectively). Floods, mangrove degradation, and solid waste were deemed serious difficulties by just 8 individuals, 4 individuals, and 2 individuals (4 percent, 2 percent, and 1 percent, respectively).

After that, respondents were asked how frequently they had visited the BKGA in the previous five years. Sixty-six percent of respondents said they had visited the BKGA at least once before taking the survey. The majority of respondents were familiar with the region, and at least one-third of them valued it enough to return numerous times. Visitors claimed they used the region for outdoor activities such as cycling, horseback riding, bird viewing, and purchasing fresh produce. Even though only half of the respondents had visited Bang Kachao, the majority (88.5 percent) claimed the BKGA had benefited them, particularly in terms of air purification (67 percent). Overall, 180 persons (90 percent) expressed an interest in visiting the BKGA during the next five years.

4.1.3 CL model results

For the analysis, after receiving the 200 valid questionnaires, we used LIMDEP 9.0 software to estimate the CL models: without socioeconomic variables (Model 1) and with socioeconomic variables (Model 2), as shown in Table 4.1. The magnitude and sign of the coefficients of both models are as expected, especially the prediction that the coefficient for cost is negative and significant, implying that respondents prefer lower cost. Bangkok people, overall, prefer higher levels of all values, including food, air quality, leisure amenity, and the abundance of bird species. At the excellent level, the food product, leisure amenity, and bird species abundance coefficient estimates are all significantly favorable. This indicates that respondents place a higher value on the excellent improvement in these attributes than on lower levels. Thus, the great majority of respondents would rather have excellent than good. The estimated coefficient for an excellent level of bird species abundance is only significant at the 10 percent significance level and remains the lowest value. Furthermore, the only socioeconomic factor that influences the WTP for restoring the BKGA is the respondents' age; the coefficient sign is negative.

Table 4.1 The coefficient estimates for the CL specifications with two models: no socioeconomic variables (Model 1) and with socioeconomic variables (Model 2) from the BKGA case study

Variable	Model 1			Model 2		
	Coefficient	**T Statistic**	***P* Value**	**Coefficient**	**T Statistic**	***P* Value**
Opt out (status quo)	−0.4166 **	−2.2760	0.0229	−0.4301	−0.5690	0.5691
Cost	−0.0015 ***	−9.3690	0.0000	−0.0015 ***	−9.000	0.0000
Excellent food product	0.3139 ***	4.5270	0.0000	0.3198 ***	4.5930	0.0000
Good food product	−0.4971	−0.7280	0.4663	−0.0547	−0.8030	0.4222
Excellent air quality	0.4024 ***	6.0090	0.0000	0.3931 ***	5.8840	0.0000
Good air quality	0.1269 *	1.8610	0.0627	0.1413 **	2.0550	0.0399
Excellent leisure amenity	0.1959 **	2.9130	0.0036	0.1955 **	2.9050	0.0037
Good leisure amenity	−0.0057	−0.0840	0.9334	−0.0036	−0.0520	0.9584
Excellent bird species abundance	0.1245 *	1.8230	0.0683	0.1276 *	1.8670	0.0618
Good bird species abundance	−0.0758	−1.0970	0.2727	−0.0718	−1.0380	0.2993
Male				−0.0922	−0.4670	0.6408
Age				−0.0171 *	−1.7400	0.0819
Income				−0.4188	−0.5080	0.6116
Education				0.0495	1.2930	0.1961
Log-likelihood	−733.42			−729.27		
No. of respondents	200			200		
No. of observation	800			800		

***1% significance level, **5% significance level, *10% significance level

4.1.4 Estimation of willingness to pay

The results of the coefficient values given in Table 4.1 are not easy to comprehend, despite their significance and relative magnitude. The marginal rates of substitution between attributes must be calculated using the cost coefficient as the numeraire (Hanemann, 1984). Therefore, the rates were represented as the average marginal WTP for each attribute shift. The outcomes are shown in Table 4.1.

Table 4.2 Marginal WTP for a change in each attribute and the average WTP of improved ecosystem services in the BKGA

Attribute	Status Quo	Good	Excellent	WTP (%) (Baht/Person/Year)
Food product (Consumptive Use Value)	−207	-	207	414 (29%)
Air quality (indirect use value)	−347	92	255	602 (42%)
Leisure amenity (non-consumptive use value)	−127	-	127	254 (18%)
Bird species abundance (non-use value)	−83	-	83	166 (11%)
Total				1,436 (100%)

1 Baht = 0.03 USD (2016/09/01)

Equation (6) was then used to assess the welfare consequences of a move from the status quo to a good or excellent level as a compensating variation (CV) (Hanemann, 1984). The negative number of the other levels of the specified attributes makes up the base levels (status quo) of utility coefficients according to effect coding. Hence, they are not confused with the alternative-specific constant or with each other, unlike dummy coding. The CV for improving a food product from the status quo to excellent, for example, is 207-(-207) or 414 Baht per person per year. The CV for increasing air quality from the status quo to excellent is 255-(-347) or 602 Baht per person per year, whereas the CV for improving air quality from the status quo to good is 92-(-347) or 439 Baht per person per year. The CV for improving leisure amenities is 127-(-127) or 254 Baht per person per year. In addition, the CV for increasing bird species abundance is 83-(-83) or 166 Baht per person per year.

Therefore, the BKGA's average WTP for restoring the most desired ecosystem service is 1,436 Baht (42 USD) per person each year. The highest average WTP value is for excellent air quality, followed by good air quality, excellent food product, excellent leisure amenity, and excellent bird species abundance (17.3 USD, 12.7 USD, 12 USD, 7.3 USD, and 4.7 USD), respectively. The average WTP figures are summarized in Table 4.2.

4.1.5 Discussion of the findings

The results of the BKGA case study can be used to draw a variety of assumptions. According to this valuation task, which aims to explore the preferences and WTP of Bangkok residents for the enhancement of ecosystem services through BKGA restoration, residents value clean air first, followed by food, leisure amenity, and bird diversity. Preferences for the air quality parameter are consistent with existing literature claiming that urban forests improve air quality significantly (Jayasooriya & Ng, 2017; Zupancic et al., 2015). For instance, a study in Beijing, China, used expert Delphi and CE methods to rank the value of six ecosystem service attributes and discovered that air quality control was the most valuable ecosystem service to people. According to the study, the average WTP for extending forests to increase air quality was about 12.2 USD for low to medium levels and 17.3 USD for methane levels. Likewise, a survey in Hong Kong found that the majority of residents regard urban trees as beneficial to air quality (Ng et al., 2015).

Non-use values such as the abundance of bird species are less well known, and there has been some controversy in the field over their abundance. As a result, the public can underestimate the proliferation of bird species (Seenprachawong, 2016). While the use value of green spaces yields higher welfare figures than non-use values, non-use values are also important in enhancing ecosystem service value. For biodiversity protection in urban wetlands, it is also important to promote awareness of supporting services and demonstrate their benefits to urban society and individuals (Livesley et al., 2016; Giergiczny & Kronenberg, 2014).

We discovered that the overall WTP for ecosystem service conservation in the BKGA was 1,436 Baht (42 USD) per person per year, in addition to residents' preferences. when compared to the average WTP for using green space in Bangkok given by Bejranonda and Attanandana (2011), our estimated WTP is two times higher than the previously estimated value based on the CV survey conducted in 2009, the public's WTP for using green space is 750 Baht (23.5 USD). Furthermore, the overall value to the entire population of the Bangkok Metropolitan Region (10.77 million people) was 446.7 million USD, which was significantly higher than the numerical value of big trees in Bang Kachao measured using market-based processes, which was 281,364 USD per year (Yotapakdee et al., 2019). Our CE analysis took into account non-use values and measured the TEV of the urban wetland, unlike previous studies (Yotapakdee et al., 2019) that only considered a portion of ecosystem services in their functional usefulness. Since they are calculated using various metrics that include different assumptions, it is not necessary to compare the market-based, CV, and CE values directly (Qiu et al., 2006). The CE technique, on the other hand, captures other types of wetland values, such as indirect and non-use values. Thus, this CE study shows that Bangkok residents value the BKGA more than the city's entire green space for recreational purposes.

We investigated the influence of socioeconomic variables on people's WTP and choices in this study by incorporating human factors into our CL model (Balogh et al., 2016; Hoffman & Duncan, 1988). We discovered that respondents' age influenced WTP for the wetland improvement in a major socioeconomic way. Young people were more likely to pay for higher-quality ecosystem services in the urban wetland than older people were. This observation is in line with previous studies (Caula et al., 2009; Lopez-Mosquera et al., 2011). Since Sri Nakhon Khuankhan Park, a public park in Bang Kachao, provides numerous recreational opportunities for youth groups such as jogging, biking, and environmental education initiatives (Kongsasana & Roopklom, 2013), and it is also a common check-in location for young Facebook users, young people may enjoy this green space more than older groups. However, there was no proof that income had a statistically relevant impact on Bangkok residents' preferences for ecosystem service attributes in the BKGA, confirming the findings of Koo et al. (2013) that urban wetlands are a necessary asset for urban residents in big cities.

4.2 Choice experiment estimated value of ecosystem services of the WO

4.2.1 Respondents' socioeconomic characteristics

Table 4.3 shows the primary socioeconomic status of the respondents. A total of 267 people responded to the money treatment, and 166 people responded to the voluntary labor treatment. The participants in the money treatment were largely male (57 percent) and ranged in age from middle-aged to elderly, with an average age of 46. A 35-49-year-old group accounted for 44 percent, while the 50-64-year-old group accounted for 33 percent. Most respondents were married (72 percent). Below high school was the most common educational standard (39 percent), followed by high school (36 percent) and undergraduate (22 percent). Farmers (36 percent) were the most common occupation among respondents, followed by civil servants (33 percent), self-employed (15 percent), employees (12 percent), and others (5 percent). The average monthly income of the respondents was 13,232 Baht (382 USD), with an average family size of 3.8 individuals. Most responders were from Ranong province, with 43 percent from Kapoe district and 19 percent from Suksamran, and the remaining 30 percent from Phangnga province's Khura Buri district.

The socioeconomic characteristics of the labor treatment sample are similar to those of the money treatment. The majority of those who responded were men (61 percent). Participants ranged in age from 18 to 64, with an average of 46. Eighty-one percent of respondents were married. The most common educational standard was high school (42 percent), followed by below high school (40 percent) and undergraduate (15 percent), respectively. Farmers were likewise the most common occupation in the volunteer labor therapy, followed by civil servants. With a medium-sized family of 3.8 individuals, the respondents' average monthly income was 12,632 Baht (379 USD). All of the respondents were from Ranong province, with 70 percent being from Kapoe and 30 percent coming from Suksamran.

Table 4.3 Socioeconomic characteristics of respondents in the WO case study

	Money Treatment	Labor Treatment
Gender		
Male	57%	61%
Female	43%	39%
Marital status		
Single	27%	19%
Married	72%	81%
Age		
18-34	16%	13%
35-49	44%	48%
50-64	33%	34%
>64	7%	5%
Mean age in years	46.2	46.1
Education		
<High school	39%	40%
High school	36%	42%
Bachelor's degree	22%	15%
>Bachelor's degree	3%	3%
Mean in years	11.2	10.9
Occupation		
Civil servant	33%	34%
Self-employed	15%	5%
Farmer	36%	47%
Employee	12%	10%
Other (student, housewife, retired)	5%	4%
Monthly Income (Baht)		
<10,000	38%	39%
10,000-19,999	44%	43%
20,000-29,999	13%	11%
>30,000	6%	6%
Mean in Baht per month	13,232	12,632
Household size		
<3	18%	17%
3-5	69%	69%
>5	13%	13%
Mean	3.8	3.8
District		
Khura Buri, Phangnga	101(38%)	-
Suksamran, Ranong	50(19%)	50(30%)
Kapoe, Ranong	116(43%)	116(70%)
Sample size, N	267	166

4.2.2 Respondents' attitudinal characteristics

Table 4.4 summarizes respondents' perceptions of WO benefits and risks, as well as their experiences with WO conservation. For the money treatment, most of the respondents (87 percent) had known about the benefits of WOs. They believe that this plant species provides recreation values, water purification, and income for the local community. Furthermore, the majority of respondents believe that the greatest threat to the WO's wetland habitat is river dredging and expansion for flood risk management, followed by commercial exploitation as aquarium plants. Environmental organizations made up 49 percent of the overall. The majority of respondents (67 percent) said they had taken part in WO conservation programs, with around 52 percent saying they had done so by WO breeding and planting. Almost all respondents (89 percent) said they would be willing to volunteer to assist in WO conservation efforts. About 80 percent of respondents agree that WO conservation can be accomplished by voluntary engagement. The labor treatment yielded similar findings in terms of respondents' perceptions toward WO.

Table 4.4 Respondents' perceptions, experiences, and participation regarding WO conservation

	Money Treatment	Labor Treatment
Perceived benefits of WO	87%	92%
Perceived threats		
River dredging	57%	63%
Over-exploitation	17%	21%
Land conversion in upper catchment river	17%	7%
Flooding	7%	7%
Water contramination and pollution	2%	2%
Member of an environmental conservation group	49%	53%
Participated in WO conservation	67%	78%
Voluntary in WO conservation is needed	89%	90%
Sample size, N	267	166

4.2.3 CL model results

After data collection, the commonly chosen neither alternative responses were classified and omitted from the full sample. Thus, by excluding these answers, 242 usable samples (968 observations) for WTP estimation and 148 usable samples (592 observations) for WTV estimation can be obtained. Data from the CE task in monetary terms (money treatment) and the CE task in labor contribution (labor treatment) are included in the findings. The CL models were calculated using LIMDEP 9.0 software as respondents chose one of the particular choices (Plan A or Plan B) or neither alternative.

Table 4.5 shows the coefficient estimates for the CL specifications from the WO case study using the money treatment with two models: no socioeconomic variables (Model 1a) and socioeconomic variables (Model 1b). The marginal utility of the four attributes, biodiversity, water quality, upstream condition, and recreational opportunity, is shown in this table at different levels. The regression coefficients can be interpreted as marginal utility values, which represent how individuals' utility increases or decreases when the attribute level changes (Mercer & Snook, 2004). The estimated coefficients obtained from the money treatment in both models (1a, 1b) show a negative and significant coefficient exists for the money cost attribute. The magnitudes of the service attribute coefficients are all significant and on the predicted sign, with the exception of the recreational opportunity coefficient. The upstream condition and water quality coefficients are significant and positive at the high level. For both medium and high biodiversity, the coefficients are positive and significant. Hence, residents value a high degree of improvement in the upstream condition and water quality, as well as a medium and high degree of increase in biodiversity, whereas residents prefer the current status of recreation attribute. The coefficient of respondents' age was found to be positive and significant among the socioeconomic factors. Thus, the elderly were more willing to pay money to improve ecosystem services offered by WO conservation.

Table 4.5 The CL coefficient estimates for the WO case's money treatment using two models: no socioeconomic factors (Model 1a) and with socioeconomic variables (Model 1b)

Variable	Model 1a			Model 1b		
	Coefficient	T Statistic	*P* Value	Coefficient	T Statistic	*P* Value
Status quo	-2.9251***	-5.503	0.0000	1.8440	0.951	0.3417
Money Cost	-0.0011***	-2.956	0.0031	-0.0011***	-2.945	0.0032
Biodiversity: high	0.4530***	6.863	0.0000	0.4518***	6.845	0.0000
Biodiversity: medium	0.1436**	2.232	0.0256	0.1440**	2.238	0.0252
Water quality: high	0.2485***	3.850	0.0001	0.2486***	3.852	0.0001
Water quality: medium	0.0810	1.247	0.2126	0.0818	1.258	0.2085
Upstream condition: high	0.7872***	11.617	0.0000	0.7879***	11.620	0.0000
Upstream condition: medium	0.0804	1.2978	0.1942	0.0794	1.283	0.1996
Recreation: high	0.0896	1.3760	0.1689	0.0891	1.368	0.1712
Recreation: medium	0.0355	0.5680	0.5703	0.0870	0.573	0.5667
Age				0.0786*	1.828	0.0675
Income				0.0001	1.336	0.1816
Log-likelihood		−522.01			−519.04	
No. of respondents		242			242	
No. of observation		968			968	

***1% significance level, **5% significance level, *10% significance level

Table 4.6 shows the coefficient estimates for the CL specifications from the money treatment of the WO case using two models: no socioeconomic variables (Model 1a) and with socioeconomic variables (Model 1b). This table demonstrates that the labor cost attribute has a negative and significant coefficient. The results are consistent with the previous models in that the coefficient for payment is significant and negative, while all other characteristics are positive and significant excluding recreational opportunity. These results show that a medium to a high degree of change in upstream conditions, as well as a high degree of improvement in biodiversity and water quality, were expected to be vital to respondents. It also implies that respondents are satisfied with the present state of the leisure attribute, which is purely visual amenity. Furthermore, those with lower incomes were more likely to provide labor to improve these ecosystem services among the socioeconomic factors.

Table 4.6 The CL coefficient estimates for the WO case's labor treatment using two models: no socioeconomic factors (Model 2a) and with socioeconomic variables (Model 2b)

Variable	Model 2a			Model 2b		
	Coefficient	T Statistic	*P* Value	Coefficient	T Statistic	*P* Value
Status quo	-2.4563***	-4.504	0.0000	-3.4247	-1.506	0.1320
Labor Cost	-0.0421***	-2.666	0.0077	-0.0420***	-2.661	0.0078
Biodiversity: high	0.4320***	4.890	0.0000	0.4341***	4.904	0.0000
Biodiversity: medium	0.0204	0.249	0.8036	0.0204	0.248	0.8039
Water quality: high	0.4158***	4.647	0.0000	0.4191***	4.671	0.0000
Water quality: medium	0.1616	0.197	0.8441	0.0154	0.187	0.8518
Upstream condition: high	0.6345***	7.822	0.0000	0.6346***	7.816	0.0000
Upstream condition: medium	0.4118***	4.944	0.0000	0.4134***	4.957	0.0000
Recreation: high	0.0844	1.376	0.1689	0.0835	1.001	0.3167
Recreation: medium	-0.0960	-1.179	0.2383	-0.0972	-1.193	0.2330
Age				-0.0031	-0.060	0.9525
Income				-0.4551*	-1.924	0.0544
Log-likelihood		−320.25			−318.11	
No. of respondents		148			148	
No. of observation		592			592	

***1% significance level, **5% significance level, *10% significance level

4.2.4 Estimation of willingness to pay and willingness to volunteer

Table 4.7 shows calculations of the MWTP and MWTV for changes in the three attributes, including erosion prevention, biodiversity, and water quality. Then, we used equation (5) to estimate the compensation variation (CV) as the welfare estimations of moving from the status quo to the non-status quo (medium and high) levels (Hanemann, 1984). Initiate, we used the coefficients on the significant three services and the money payment attribute from Model 1a to calculate the CV for upgrading each service from the status quo to higher levels. Thus, the CV for improving upstream conditions from low to high is 744-(-744), 1,488 Baht (45 USD) per person per year. The CV for increasing biodiversity from low to high is 428-(-564), 992 Baht (30 USD) per person per year, and the CV for enhancing water quality is 235-(-235), 470 Baht (14 USD) per person per year. Consequently, increasing average welfare by 2,950 Baht (89 USD) per year by enhancing upstream conditions, biodiversity, and water quality from low to high.

Similarly, we estimated the CV for enhancing all major ecosystem resources using the approximate coefficients from the labor treatment (Model 2a). From the status quo (low) to the high level, upstream conditions take 15.1-(-24.9), 40 days per person per year, biodiversity takes 10.2-(-10.2), 20.4 days per person per year, and water quality takes 9.9-(-9.9), 19.8 days per person per year. Hence, respondents have a WTV of 80.2 days per year for a high improvement in upstream conditions, biodiversity, and water quality to a high level.

Table 4.7 Marginal WTP and WTV for each attribute improvement, and the average WTP and WTV of improved WO ecosystem services

Attribute	**Improved level**			WTP (Baht/ Person/ Year)	**Improved level**			WTV (Days/ Person/ Year)
	Low	Medium	High		Low	Medium	High	
Biodiversity	-564	136	428	992	-10.2	-	10.2	20.4
Water quality	-235	-	235	470	-9.9	-	9.9	19.8
Upstream condition	-744	-	744	1,488	-24.9	9.8	15.1	40
Recreation	-	-	-	-				
Total				2,950				80.2

1 Baht = 0.03 USD (2019/09/01)

4.2.5 Discussion of the findings

A number of discussion points can be derived from the results of the WO case study. Initially, residents in WO-rich areas of Phangnga and Ranong provinces value upstream conditions first, followed by biodiversity and water quality, and are unlikely to support increased recreational opportunities. It can be inferred that among the ecosystem services examined in this study, the most need of residents is an improvement in upstream conditions. Residents would like to see a significant increase in upstream quality. Since the residents reported that they were concerned about eroded reversals, and dredging of the river was identified as the greatest threat to WO. Moreover, although there is a small difference in Model 2 using the labor cost attribute, biodiversity, which is a non-use value, is more important than water quality as an indirect benefit. Residents, on the other hand, were not in favor of expanding recreational opportunities. This means that the current state of recreational opportunities, which is purely visual, is satisfactory to locals.

Furthermore, the CE situations can be used to determine the WTP and WTV values in a specific way. For example, as shown in Table 4.7, improving upstream condition, biodiversity, and water quality, to high-level yields average welfare of 89 USD per year. According to the results of a CE report conducted by Ando et al. (2020), people value improving aquatic health from fair to outstanding, and water quality from boatable to swimmable in lakes and rivers as much as 294 USD per household per year in Chicago, and 277 USD per household in Portland. Thus, our average value is significantly smaller than that of Ando et al (2020). This backs up the statement that respondents in developed countries are likely to pay more money than respondents in developing countries (Whittington, 2010). However, it is consistent with the results of Seenprachawong, (2016) who conducted an earlier CE analysis in the adjacent region of Phangnga Bay and found a WTP of 71 USD per year for the improvement of the Phangnga Bay ecosystem.

In comparison, the approximate WTP value for conserving WO is two times higher than Bangkok residents' WTP for restoring the BKGA (42 USD per person per year). One reason for this is that people are likely to support the conservation of endangered species (Pandit et al., 2015). Since, residents in Phangnga and Ranong are becoming involved in WO conservation efforts, making them more aware of the value of protecting this endemic species and its wetland habitat (Athihirunwong et al., 2018). According to this study, people's attitudes, desires, and expectations regarding ecosystems influence their perceptions of ecosystem service values (Chaikaew et al., 2017).

We also discovered that the most common attribute combination resulting from the labor treatment, which was similar to the money treatment, had an average WTV of 80.2 days per year. Therefore, respondents would be willing to volunteer up to two days per week to help with WO conservation. Because no preference research has been conducted in Thailand, we cannot compare WTV estimates with those from the previous study in the country. These results contradict those of Shandas et al. (2010), who found that respondents in Portland would be willing to volunteer a few hours a month to help mitigate stormwater pollution and increase watershed health. It is also higher than the findings of Ando et al. (2020), who found that respondents will be willing to volunteer 50 hours a year to increase water quality from boatable to swimmable and conserve aquatic habitat from fair to excellent. Furthermore, our estimated WTV is ten times higher than those calculated by Rai and Scarborough (2015), which found that the estimated labor contribution for forest ecosystem services in Nepal was 9.38 days/year. Besides, the WTV of residents for the firebreak establishment and maintenance program in Vietnam was 5 days per year according to the CV data of Hung et al. (2007). In comparison to these previous surveys, our findings show higher WTV values. This might be because residents have a strong desire to participate and are familiar with WO conservation and volunteerism. According to Athihirunwong et al. (2018), 57 percent of survey respondents had previous experience with WO conservation, and they observed that youth conservation motivations in Kopoe district, Ranong province, promote actual conservation participation. Furthermore, we observed that 78 percent of labor treatment responders had participated in WO conservation. Therefore, our WTV estimate may be somewhat large.

The results from the money treatment are similar to those of the labor treatment, with a few exceptions. In the money treatment, people benefit from increased biodiversity at a medium or high level, while in the labor treatment, people benefit from improved upstream conditions at a medium or high level. However, the overall data show that preferences for improved ecosystem services from the money and labor treatments were not evaluated differently. The advantage of using the latter model is demonstrated by an increase in the log-likelihood function. This study suggests that using volunteer labor as a payment method for obtaining accurate welfare estimates might be a viable option.

We explored the impact of socioeconomic variables on their WTP, WTV and decisions in this analysis. According to our findings, the age of respondents had a positive effect on the WTP for increasing ecosystem services supplied by WO conservation. This may be due to a long preriod relation with WO that elderly people received (Casiwan-Launio et al., 2011). While income is a key factor affecting WTV decisions. The negative effect of income on WTV found in this study may be because people with high income have higher opportunity cost of time. This finding supports the conclusion of Lankia et al. (2014) that income has a negative impact on willingness to contribute labor.

Finally, Ando et al. (2020), who used a CE to evaluate the outcomes of stormwater management improvement in terms of reported WTP money and willingness to sacrifice time in two large U.S. cities, found that people were willing to contribute their time for services worth 1/3 of the average wage rate and that people benefited from volunteering. Moreover, the opportunity cost of labor provided by Rai and Scarborough (2012) is estimated to be 2.33 USD per day. Hence, we modified this result by converting the approximate WTV of 80.2 days into a dollar value. In 2019, the average wage rate in Ranong province was 10 USD per day, thus, the average value of volunteer labor worths 3 USD per day. Consequently, the annual cost for 80.2 days was calculated to be 240.6 USD per person. Our results show that WO is highly regarded in the community. Therefore, our findings support that statement that allowing respondents to express their willingness to contribute labor increase the estimated value of forest ecosystem services in developing countries (Rai & Scarborough, 2015).

Chapter 5. Policy Implications and Conclusions

5.1 Policy implications

One of the purposes of this dissertation was to provide useful information and practical recommendations to conservationists, local communities, landowners, and decision-makers so that they may design optimal biodiversity conservation strategies in wetlands, particularly in the BKGA and WO ecosystems. Based on the results, the study provides the following policy recommendations:

5.1.1 Policy recommendations based on the BKGA valuation study

Several policy implementations and recommendations have been made based on the findings of the BKGA valuation. First, it is critical to understand people's desires for long-term services so that policymakers may weigh the pros and disadvantages of various policy options or examine alternative approaches before enacting public policy. We strongly encourage the government and related agencies to develop ecological restoration measures to improve the wetland's air purification capacity, since this is the most desired ecosystem function. Flood-tolerant species like mangroves and marsh plants, for example, can be planted along riverbanks, particularly in draining mangroves (Leksungnoen et al., 2017).

Second, the benefits of air purification must be balanced against food availability and recreational opportunities. Using traditional agricultural practices such as orchards and agroforestry, the BKGA will increase its capability to supply agricultural commodities. Traditional farmers can profit from ecotourism projects that increase local revenue. The BKGA will benefit from the introduction of PES because it provides an incentive to improve ecosystem services. Bangkok residents can help communities maintain their traditional mixed orchards and green spaces by offering incentives in the form of ecotourism, and environmental education (Wunder, 2007).

Third, because non-use values like bird species abundance are less well-known, use values provide larger welfare estimates than non-use values. However, non-use value is equally important in increasing economic value. Thus, raising biodiversity awareness and demonstrating the benefits of biodiversity to urban society is equally crucial (Livesley et al., 2016; Giergiczny & Kronenberg, 2014).

Finally, the younger generation may be more willing to participate in conservation programs or PES initiatives, as seen by the growing tendency of WTP among younger responders. Additionally, local governments and communities should provide recreational possibilities, such as healing activities at Sri Nakhon Khuen Khan Park, to relieve stress and health issues, allowing the government to fulfill the rising demand for urban wetlands among middle-aged residents and retirees (Lee et al., 2016).

5.1.2 Policy recommendations based on the WO valuation study

We offer policymakers information on the economic value of WO and its wetland habitat so they may decide if it is worth investing in its conservation. Except for the recreational service, we proposed that restoring all of the WO wetland's ecosystem services might increase inhabitants' utility. Because enhancing the condition of upstream forests is the most important ecosystem function, followed by increasing biodiversity and improving water quality, we firstly recommend the government to increase its efforts to promote upstream forest management and erosion control. The appropriate authorities could take steps to strengthen incentives for private landowners, particularly rubber and oil palm producers, to safeguard WO, such as promoting agroforestry. For example, the government could establish a market where the purchase price of particular agroforest products is guaranteed. PES might be used to allow communities and inhabitants to pay for advantages in exchange for non-use values from WO. Second, channel dredging should be avoided to reduce sediment erosion, preserve wetlands and ecological health, and improve water quality. Monocultures, such as those involving chemicals, should be avoided. Local engagement and volunteerism, in particular, can assist in WO conservation.

Finally, because residents are opposed to increasing recreational opportunities, tourism should have a fixed zone to conserve genetic resources. Rather than relying on tourism infrastructure, communities should concentrate on ecotourism and environmental education, which would increase public knowledge and participation in conservation WO.

5.2 Limitations and suggestions for further research

In terms of proportions of socioeconomic characteristics and social statuses such as age, schooling, occupation, and income, our BKGA data do not perfectly reflect the population of Bangkok statistically. Compared to census data from Bangkok, Thailand (where the proportion of civil servants is less than 25 percent), our sample data contain a high proportion of civil servants, leading to an overestimation of mean WTP (Dumenu, 2013; Vesely, 2007). We also questioned people who visited five different public parks in the Bangkok metropolitan area as part of the data collection procedure. This might lead to an overestimation of WTP, since these respondents may place a higher value on urban forest services than those who do not use them on a daily basis. Besides, although we used a random sampling methodology to avoid statistical bias, we used a small number of samples in this study, which may contribute to coverage errors in the statistical analysis. A sufficient number of samples is needed to address these statistical issues. Future research could compare the difference in mean WTP between large and small samples to address this coverage error.

In terms of scenario rejection, we discovered that persons living in WO environments in southern Thailand react positively to the CE survey employing volunteer labor contribution. The WTV of other stakeholders should be investigated. Furthermore, in Thailand and other developing countries, there is very little experience in conducting CE utilizing non-monetary payment surveys. There is a need to reflect on the applicability as well as the deeper meanings of the estimated value.

Furthermore, the CL model used in the two case studies has its own limitation. Discrete choice models are common because they have an easily interpretable closed choice probability and a globally concave likelihood function (Train, 2009). The CL model used in this study assumes that respondents are homogeneous and that each error term is independent and identically distributed, meaning that the probabilities of the election outcomes are unaffected by the availability of other outcomes (McFadden & Train, 2000; Train, 2009). However, the CL model can only account for respondent heterogeneity in a very simplistic way. Sources of observed heterogeneity (i.e., socioeconomic and attitudinal variables) were incorporated into the CL model via interaction with the constant words or main design attributes. Consequently, although this model gives respondents sufficient time to understand the option sets, it is limited in its ability to answer the effects of repeated voting decisions by the same respondents. Future studies may extend the model by allowing for random parameters, particularly to account for the heterogeneity of unobserved preferences, due to advances in statistical programs.

5.3 Conclusions

This dissertation aims to value the improvement in wetland ecosystem services of the BKGA, an urban wetland in Bangkok, and the WO habitat in Thailand. The BKGA case study aims to investigate the preferences and willingness of residents in Bangkok to pay for enhancing ecosystem services provided by the BKGA. Bangkok citizens who visited the five public parks in the Bangkok metropolitan area were chosen as respondents for the BKGA valuation. All 200 face-to-face interviews were performed between July and September 2016. The researcher used the LIMDEP 9.0 software to generate CL models. According to the findings, Bangkok residents were willing to pay 42 USD per person per year for improved ecosystem services in the BKGA. The most important ecosystem service in this urban wetland was improved air quality, which was followed by food production, leisure amenity, and bird species abundance. By including individual characteristics into our CL models, we investigated the impact of socioeconomic factors on their WTP and decisions. We discovered that respondents' age is a crucial socioeconomic factor influencing their WTP decisions. Young people were more likely to choose improved ecosystem services than the elderly.

In the case of valuing ecosystem services offered by the WO, face-to-face CE surveys were conducted in 2019 using either monetary or labor as the cost attribute. The findings reveal that in exchange for high improvements in upstream condition, biodiversity, and water quality, respondents would be willing to pay 89 USD and volunteer 80.2 days per person per year. Improving upstream conditions was the most important ecosystem function provided by WO conservation, followed by increasing biodiversity and improving water quality. Offering recreational opportunities, on the other hand, was considered unnecessary. The age of respondents had a positive impact on the WTP for improving ecosystem services offered by WO conservation. WTV decisions were negatively influenced by income. Volunteering labor to improve the quality of ecosystem service provision was more common among low-income people than among higher-income people.

The findings of these two case studies have substantial policy implications and recommendations, including the government's propaganda efforts in the BKGA through PES initiatives to promote air purification, agroforestry, ecotourism, and biodiversity conservation. In terms of WO conservation, the government, local communities, and related organizations should prioritize upstream forest quality.

In conclusion, this dissertation makes two contributions to the valuation literature. First, it raises awareness of the importance of the numerous ecosystem services supplied by Thailand's fundamental life support systems, wetlands, and can help stimulate significant conservation efforts in these regions. It can be inferred that improvements in all ecosystem services offered by the BKGA will increase the utility of Bangkok people and gain their support. We also argued that, except for recreational activities, improving all ecosystem services offered by the wetlands of WO might improve inhabitants' benefits. Second, the CE valuation methods are integrated with the non-payment vehicle. In this study, the CE was utilized for the first time to analyze people's preferences and WTV in Thailand's rural wetlands. We may conclude that allowing respondents to indicate their WTV increases the estimated value of forest ecosystem services. In terms of scenario rejection, this study shows that the CE survey with a voluntary labor contribution as a payment vehicle tends to work well with local people in this wetland region in southern Thailand. It is especially crucial because Thailand is a developing country with a large enough volunteer workforce to support conservation efforts.

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Appendices

Appendix A. The choice sets resulting from the orthogonal and cyclical designs used in the BKGA case study

Choice sets	Plan A					Plan B					Blocks
	F	A	L	B	Baht	F	A	L	B	Baht	
1	2	2	2	1	100	3	3	3	2	200	1
2	2	2	3	1	100	3	3	1	2	200	1
3	2	2	1	2	500	3	3	2	3	1000	1
4	2	2	1	3	500	3	3	2	1	1000	1
5	2	3	2	3	1000	3	1	3	1	100	2
6	2	3	2	3	200	3	1	3	1	500	2
7	2	3	3	2	1000	3	1	1	3	100	2
8	2	3	3	1	200	3	1	1	2	500	2
9	2	1	2	2	500	3	2	3	3	1000	3
10	2	1	3	2	1000	3	2	1	3	100	3
11	2	1	1	3	200	3	2	2	1	500	3
12	2	1	1	1	100	3	2	2	2	200	3
13	3	2	2	2	200	1	3	3	3	500	4
14	3	2	2	1	1000	1	3	3	2	100	4
15	3	2	3	3	1000	1	3	1	1	100	4
16	3	2	3	3	500	1	3	1	1	1000	4
17	3	2	1	1	1000	1	3	2	2	100	5
18	3	3	2	2	100	1	1	3	3	200	5
19	3	3	2	1	200	1	1	3	2	500	5
20	3	3	3	2	200	1	1	1	3	500	5
21	3	3	3	1	100	1	1	1	2	200	6
22	3	3	1	2	500	1	1	2	3	1000	6
23	3	1	2	3	100	1	2	3	1	200	6
24	3	1	3	3	100	1	2	1	1	500	6
25	3	1	1	2	200	1	2	2	3	200	7
26	3	1	1	1	1000	1	2	2	2	100	7
27	1	2	2	2	1000	2	3	3	3	100	7
28	1	2	2	2	100	2	3	3	3	200	7
29	1	2	3	2	100	2	3	1	3	200	8
30	1	2	3	1	200	2	3	1	2	500	8
31	1	2	1	3	200	2	3	2	1	500	8
32	1	3	2	3	1000	2	1	3	1	100	8
33	1	3	3	1	500	2	1	1	2	1000	9
34	1	3	1	2	100	2	1	2	3	200	9
35	1	3	1	3	100	2	1	2	1	200	9
36	1	3	1	1	1000	2	1	2	2	100	9
37	1	1	2	1	200	2	2	3	2	1000	10
38	1	1	2	1	200	2	2	3	2	500	10
39	1	1	3	2	1000	2	2	1	3	100	10
40	1	1	3	3	500	2	2	1	1	1000	10

Note: F: food product; A: air quality; L: leisure amenity; B: bird species abundance; 1: no change; 2: good; 3: excellent
Source: Adapted from Seenprachawong (2016)

Appendix B. The translation of questionnaire used in Case Study I: the BKGA

Note: Each questionnaire version's Sections A and B contain the same material, but Section C varies, as shown in Appendix A.

Questionnaire: Valuing Ecosystem Services in the Bang Kachao Green Area (BKGA)	
Version:1	No.:
Location:	Interviewer's name:
Date:	Time interview starts: Time interview ends:

INSTRUCTION TO INTERVIEWERS ARE IN CAPITALS
INTRODUCE YOURSELF AS FOLLOWS:

Greetings in the morning/afternoon. My name is..................... I'm conducting research in the Bang Kachao Green Area (BKGA). We're determining how much Bangkok residents value the BKGA's ecosystem services.

The interview will last between 30 and 40 minutes. Your data will be kept secure and all of the details you give in the survey will be kept strictly confidential. Your answers to the survey questions will be anonymous since they will be grouped with all other respondents' responses. Your input and involvement are greatly valued.

Will you agree to participate in the survey right now?
IF THE Response IS YES, PROCEED WITH THE STUDY.

SECTION A: RESPONDENT'S PROFILE

First and foremost, we'd like to gather some details about you.

1. Gender ☐Male ☐Female
2. Marital status
   ☐Single ☐Married ☐Widowed / divorced / separated
3. What is your age? WRITE EXACT AGE […………] years old
4. What is your occupation?
   ☐Civil servant ☐Self-employed
   ☐Employee ☐Student
   ☐Retired ☐Other […………………]
5. What is your highest level of educational achievement?
   ☐Primary school ☐Secondary school
   ☐College ☐University
   ☐Graduate school ☐Other […………………]
6. Size of household […………] people
7. How much is your approximate monthly income?
   ……………………...Baht/month

8. How much is your approximate monthly income?
……………………..Baht/month
9. Where do you usually live?
☐Bangkok City ☐Nonthaburi
☐Pathum Thani ☐Samut Prakan
☐Samut Sakhon ☐Other […………………]

SECTION B: ENVIRONMENTAL CONCERNS, EXPERIENCES, AND EXPECTATION

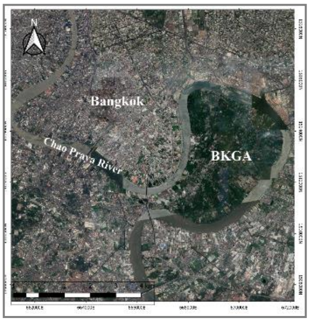
10. In your opinion, what is the most serious environmental issue in Thailand?
☐Water pollution ☐Air pollution
☐Global warming ☐Mangrove degradation
☐Deforestation ☐Flood
☐Drought ☐Losses of biodiversity
☐Other […………………]
11. Have you been to the BKGA in the last 5 years?
☐No ☐Yes, how many times? (………………………….……)
12. Have you benefited from the BKGA?
☐No ☐Yes, please explain (………………………….……)
13. Would you like to visit the BKGA?
☐No ☐Yes

SECTION C: CHOICE EXPERIMENT

SHOW CARD A: READ THE BKGA'S BACKGROUND INFORMATION

CARD A

Bang Kachao is situated in the southern part of Bangkok, in the Phra Pradaeng district of Samut Prakan province, and covers an area of 21.10 square kilometers within the Chao Praya river basin. It is the Bangkok metropolitan area's largest urban wetland.



The natural beauty of the BKGA and Sri Nakhon Khuen Khan Park

The BKGA is ecologically significant and provides significant ecosystem services to residents of Bangkok and the surrounding metropolitan areas. This wetland provides a variety of benefits, including food items. It has the ability to provide regulating services such as air purification and emissions reduction.

The natural beauty of this wetland provides cultural services such as recreational amenities, especially the well-known Sri Nakhon Khuean Khan Park. It also serves as a haven for a variety of bird species.

However, due to urbanization and growth, this wetland has been severely degraded. It has an effect on the provision of environmental services, resulting in social disturbance as a result of pollution, including stress and health issues.

Several attempts have been made to conserve this wetland and preserve its benefits. It is a good idea to establish a program to restore the BKGA in order to improve the four services offered by this urban wetland, which include food, air quality, leisure amenity, and bird species diversity.

14. Choice questions

!!! EXTREMELY IMPORTANT!!! INSTRUCT THE RESPONDENT TO COMPLETE A SERIES OF THE FOUR CHOICE TASKS RELATED TO THE BANG KACHAO RESTORATION PROGRAMS AS FOLLOWS:

In this segment, I will take you through a series of scenarios that explain various BKGA statements under “current policy/status quo” and “new policies/new restoration programs” that can help improve food products, air quality, leisure amenity, and bird species abundance.

After that, we will ask you to pick which one you want. In terms of the basic characteristics of ecosystem services offered by hypothetical restoration projects, the scenarios can differ.

Food product refers to the extraction of BKGA-related foods for human consumption and uses from agricultural areas and mixed fruit orchards within the BKGA (No Change = current status of food provision, Good= 25% increase in food provision, Excellent= 50% increase in food provision).

Air quality refers to the capacity of healthy wetlands to serve as filtering systems, eliminating contaminants from the air, is referred to as air quality (No Change = existing air quality in Bangkok Metropolitan). Good improvement equals a 25% improvement in air quality, and Excellent improvement equals a 50% improvement in air quality).

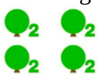
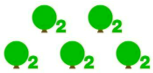
Leisure amenity refers to a proxy for recreational use; the scenic view of the area and its attractiveness to tourists and visitors (No Change = the current status of the recreational view in the BKGA, Good= 25% increase in the scenic view, Excellent= 50% increase in the recreational view)

Bird species abundance refers to the number of bird species contained in the BKGA as a proxy for non-use value or existence value is referred to as bird species abundance. (The current state of bird species abundance in the BKGA is No Change.) Good= Improving some important BKGA conditions to increase bird species by 25%, Excellent= Improving some essential wetland conditions to increase bird species by 50%)

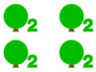
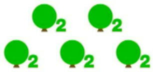
Payment refers to a monetary contribution for the purpose of enhancing wetland ecosystem services: a once-a-year payment (0, 100 Baht, 200 Baht, 500 Baht, 1,000 Baht)

CHOICE TASK #1

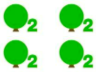
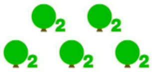
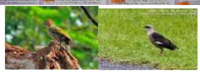
Which of the two restoration plans (Plan A and Plan B) do you prefer? Benefits will be increased if you chose either A or B, and you will be expected to pay. The "status quo" alternative, on the other hand, would not entail payment, but the state of ecosystem resources for food, air quality, leisure amenity, and bird species abundance attributes would not be changed.

Benefits	Status quo	Plan A	Plan B
Food product	No change 	Good  25% increase	Excellent  50% increase
Air quality	No change 	Good  25% improvement	Excellent  50% improvement
Leisure amenity	No change	Good	Excellent
Bird species abundance	No change 	No change 	Good   25% increase
Payment	0 Baht	100 Baht	200 Baht
Please choose the one you prefer.	( )	( )	( )

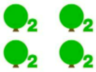
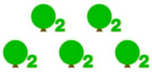
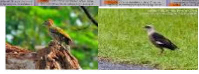
CHOICE TASK #2

Which of the two restoration plans (Plan A and Plan B) do you prefer? Benefits will be increased if you chose either A or B, and you will be expected to pay. The “status quo” alternative, on the other hand, would not entail payment, but the state of ecosystem resources for food, air quality, leisure amenity, and bird species abundance attributes would not be changed.			
Benefits	**Status quo**	**Plan A**	**Plan B**
Food product	No change 	Good  25% increase	Excellent  50% increase
Air quality	No change 	Good  25% improvement	Excellent  50% improvement
Leisure amenity	No change	Exellent	No change
Bird species abundance	No change 	No change 	Good   25% increase
Payment	0 Baht	100 Baht	200 Baht
Please choose the one you prefer.	( )	( )	( )

CHOICE TASK #3

Which of the two restoration plans (Plan A and Plan B) do you prefer? Benefits will be increased if you chose either A or B, and you will be expected to pay. The "status quo" alternative, on the other hand, would not entail payment, but the state of ecosystem resources for food, air quality, leisure amenity, and bird species abundance attributes would not be changed.			
Benefits	**Status quo**	**Plan A**	**Plan B**
Food product	No change 	Good  25% increase	Excellent  50% increase
Air quality	No change 	Good  25% improvement	Excellent  50% improvement
Leisure amenity	No change	No change	Good
Bird species abundance	No change 	Good   25% increase	Excellent   50% increase
Payment	0 Baht	500 Baht	1,000 Baht
Please choose the one you prefer.	( )	( )	( )

CHOICE TASK #4

Which of the two restoration plans (Plan A and Plan B) do you prefer? Benefits will be increased if you chose either A or B, and you will be expected to pay. The "status quo" alternative, on the other hand, would not entail payment, but the state of ecosystem resources for food, air quality, leisure amenity, and bird species abundance attributes would not be changed.			
Benefits	**Status quo**	**Plan A**	**Plan B**
Food product	No change 	Good  25% increase	Excellent  50% increase
Air quality	No change 	Good  25% improvement	Excellent  50% improvement
Leisure amenity	No change	No change	Good
Bird species abundance	No change 	Excellent   50% increase	No change 
Payment	0 Baht	500 Baht	1,000 Baht
Please choose the one you prefer.	( )	( )	( )

IN THE TABLE BELOW, RECORD THE RESPONDENT'S ANSWERS TO EACH CHOICE QUESTION.

Choice task (question)	Status quo	Plan A	Plan B
1.			
2.			
3.			
4.			

15. Are there any other points you'd like to bring up?

………………………………………………………………………………
………………………………………………………………………………
………………………………………………………………………………
……………………………………………

Thank you very much

Appendix C. The choice sets resulting from the orthogonal and cyclical designs used in the WO case study

Choice sets	Plan A					Plan B					Money (A) Versions	Labor (B) Versions
	B	W	U	R	Baht/Day	B	W	U	R	Baht/Day		
1	2	2	2	1	50/2	3	3	3	2	100/4	1	10
2	2	2	3	1	50/2	3	3	1	2	100/4	1	10
3	2	2	1	2	200/6	3	3	2	3	400/12	1	10
4	2	2	1	3	200/6	3	3	2	1	400/12	1	10
5	2	3	2	3	400/12	3	1	3	1	50/2	2	9
6	2	3	2	3	100/4	3	1	3	1	200/6	2	9
7	2	3	3	2	400/12	3	1	1	3	50/2	2	9
8	2	3	3	1	100/4	3	1	1	2	200/6	2	9
9	2	1	2	2	200/6	3	2	3	3	400/12	3	8
10	2	1	3	2	400/12	3	2	1	3	50/2	3	8
11	2	1	1	3	100/4	3	2	2	1	200/6	3	8
12	2	1	1	1	50/4	3	2	2	2	100/4	3	8
13	3	2	2	2	100/4	1	3	3	3	200/6	4	7
14	3	2	2	1	400/12	1	3	3	2	50/2	4	7
15	3	2	3	3	400/12	1	3	1	1	50/2	4	7
16	3	2	3	3	200/6	1	3	1	1	400/12	4	7
17	3	2	1	1	400/12	1	3	2	2	50/2	5	6
18	3	3	2	2	50/2	1	1	3	3	100/4	5	6
19	3	3	2	1	200	1	1	3	2	400/12	5	6
20	3	3	3	2	100/4	1	1	1	3	200/6	5	6
21	3	3	3	1	50/2	1	1	1	2	100/4	6	5
22	3	3	1	2	200/6	1	1	2	3	400/12	6	5
23	3	1	2	3	50/2	1	2	3	1	100/4	6	5
24	3	1	3	3	50/2	1	2	1	1	200/6	6	5
25	3	1	1	2	100/4	1	2	2	3	200	7	4
26	3	1	1	1	400/12	1	2	2	2	50/2	7	4
27	1	2	2	2	400/12	2	3	3	3	50/2	7	4
28	1	2	2	2	50/2	2	3	3	3	100/4	7	4
29	1	2	3	2	50/2	2	3	1	3	100/4	8	3
30	1	2	3	1	100/4	2	3	1	2	200/6	8	3
31	1	2	1	3	100/4	2	3	2	1	200/6	8	3
32	1	3	2	3	400/12	2	1	3	1	50/2	8	3
33	1	3	3	1	200/6	2	1	1	2	400/12	9	2
34	1	3	1	2	50/2	2	1	2	3	100/4	9	2
35	1	3	1	3	50/2	2	1	2	1	100/4	9	2
36	1	3	1	1	400/12	2	1	2	2	50/2	9	2
37	1	1	2	1	200	2	2	3	2	400/12	10	1
38	1	1	2	1	100/4	2	2	3	2	200/6	10	1
39	1	1	3	2	400/12	2	2	1	3	50/2	10	1
40	1	1	3	3	200/6	2	2	1	1	400/12	10	1

Note: B: biodiversity; W: water quality; U: upstream condition; R: recreational opportunity; 1: low; 2: medium; 3: high

Source: Adapted from Seenprachawong (2016)

Appendix D. The translation of questionnaire used in Case Study II: the WO

Note: 1) The information in Sections A and B is the same in all questionnaire versions, but there is a variation in Section C, as shown in Appendix C; 2) Question no. 1-16 for respondents who live in Phangnga province, while question no.1-19 for respondents who live in Ranong province.

Questionnaire:
Valuing Ecosystem Services from the Water Onion

No………………………Date………………………
District…………………….Province………………
Interviewer's Name…………………………………

Greetings in the morning/afternoon. I'm conducting a survey to learn more about public opinion on Water Onion, specifically residents' priorities for enhancing ecosystem services. We're determining how much residents in Phangnga and Ranong provinces esteem the WO's ecosystem services.

The interview will last between 30 and 40 minutes. Your data will be kept secure and all of the details you give in the survey will be kept strictly confidential. Your answers to the survey questions will be anonymous since they will be grouped with all other respondents' responses. Your input and interest are greatly valued.

Will you be willing to take part in the survey right now?
IF THE Response IS YES, CONTINUE WITH THE STUDY.

SECTION I: PERSONAL INFORMATION

This information is for statistical purposes only and is completely anonymous.

1. Gender
   - ○ Male
   - ○ Female

2. What is your age? […………..] years old

3. Marital status
   - ○ Single
   - ○ Married
   - ○ Widowed / divorced / separated

4. What is your highest level of educational achievement?
   - ○ Primary school
   - ○ Secondary school
   - ○ College
   - ○ University
   - ○ Postgraduate degree
   - ○ Other……………………………

5. What is your occupation?
   - ○ Civil servant
   - ○ Self-employed
   - ○ Employee
   - ○ Student
   - ○ Retirement
   - ○ Other […………………………]

6. Size of household [………..] people

7. About how much is your monthly income?
   ....Baht/Month

8. Do you currently belong to any environmental groups?
   - ○ No
   - ○ Yes, WRITE THE NAME OF THE GROUPS………………………

SECTION B: LET US KNOW WHAT YOU THINK

9. Do you know anything about the “Water Onion”?
    - ○ No
    - ○ Yes

10. Have you, your family or your community got benefits from the Water Onion?
    - ○ No
    - ○ Yes please explain […………………………………]

11. In your opinion, what is **“THE MOST IMPORTANT THREAT**” to the Water Onion?
    - ○ Exploitation for commercial purposes
    - ○ River dredging and expanding for flood mitigation
    - ○ Fast-moving water during the rainy season
    - ○ Water pollution
    - ○ Deforestation
    - ○ Other……………………………

12. Have you ever participated in any activities associated with the conservation of the Water Onion?
    - ○ No
    - ○ Yes, please explain [……………………………………]

13. Would you be willing to participate in WO conservation?
    - ○ No
    - ○ Yes, please explain the reason why would you participate. [……………………………………

SECTION C: CHOICE EXPERIMENT

Please read the following information!!! (Ask the respondent to read the following information).

The Water Onion

In the southern Thai provinces of Phangnga and Ranong, **the Water Onion** has a very limited range. This species of plant thrives in clean, flowing water. The Water Onion not only beautifies the climate, but it also aids in the slowing of fast-moving water and provides shelter for freshwater creatures.

However, habitat loss and modification, as well as species exploitation, have resulted in a rapid population collapse in some regions, with local extinction in some streams within its range. As a result, the species is listed as Endangered, and if current conditions persist, it may become Critically Endangered quickly.

To avoid the extinction of this species and to increase the quality of ecosystem services provided by this species and its environment, it would be a smart idea to establish Water Onion conservation activities that will help to improve the quality of ecosystem services provided by this species and its habitat. Biodiversity, water safety, erosion control, and tourism opportunities are also examples of environmental services.

Nonetheless, the amount of money needed varies by schedule.

14. We will now present you with four different collections of Water Onion conservation plans that could be applied in Phangnga and Ranong provinces to improve ecosystem services. Then, for each preference package, choose the most desired alternative (record the respondent's responses in the table below).

Choice set (question)	Status quo (no restoration plan)	Plan A	Plan B
14.1			
14.2			
14.3			
14.4			

15. Please clarify why you've chosen this choice. You have always chosen the status quo alternative in the above preference sets. Could you tell me why this happened? (Please choose the option that best suits you)?

- ○ The program should be funded by the state.
- ○ I am on a limited budget and cannot afford it
- ○ I don't believe that the initiatives would work
- ○ I am not interested in environmental issues
- ○ Other……………………………

16. Please explain why you rarely or never chose the "present situation/ no new steps" option in any of the options sets above. (Please choose the option that best suits you.)

- ○ For myself and my family as we got benefits from the wetland
- ○ Feeling good to preserve wetlands for future generations
- ○ It is our responsibility to protect wetlands
- ○ Other……………………………

The following question no.17-19 for respondents who live in Ranong province only.

17. Willingness to volunteer choice questions (record the respondent's answers to each choice question in the table below)

Choice set (question)	Status quo	Plan A	Plan B
17.1			
17.2			
17.3			
17.4			

18. Please clarify why you've chosen this choice. You have always chosen the status quo alternative in the above preference sets. Could you tell me why this happened? (Please choose the option that best suits you)?

- ○ The government should be responsible for the program
- ○ I have no time
- ○ I don't believe that the initiatives would work
- ○ I am not interested in environmental issues
- ○ Other……………………………

19. Please explain why you rarely or never choose the "current situation/ no new steps"option in any of the choice sets above. (Please choose the option that best suits you.)

- ○ For myself and my family as we got benefits from the wetland
- ○ Feeling good to preserve wetlands for future generations
- ○ It is our responsibility to protect wetlands
- ○ Other……………………………

Thank You

태국 습지 생태계 서비스 가치 평가

펫자랏 아리야팟

영남 대학교 대학원

산림자원학과 산림자원 전공

지도 교수: 이요한

요약

습지 생태계서비스는 당연시 여겨지고 정책입안 과정에 고려되지 못하는 경우가 빈번하다. 이 같은 습지 생태계서비스의 보다 나은 관리를 위해서는 생태계서비스의 가치평가가 요구된다. 본 논문은 태국 습지 생태계서비스의 가치평가를 목적으로 선택실험법을 이용한 두 가지 지역의 사례연구로 구성된다. 연구대상은 방콕시(Bangkok) 방카차오(Bang Kachao Green Area) 지역의 도시습지와 팡나주(Phangnga), 라농주(Ranong) 남부지역의 문주란(*Crinum thaianum*) 서식 습지이다. 첫번째 사례연구에서는 방콕 지역주민을 대상으로 방카차오 지역의 생태계서비스 개선을 위한 선호도와 지불의사액을 도출하였다. 두번째 사례연구에서는 대상지역 주민의 문주란 서식 습지의 생태계서비스 개선을 위한 선호도, 지불의사액, 노동참여의사를 산출하였다. 연구결과 방콕 시의 응답자는 대기질 개선, 식량생산, 휴양제공, 조류 다양성 증진 순으로 선호도를 나타내었다. 방콕시는 방카차오 지역의 혼농임업 및 생태관광 활성화를 추진하는 것이 필요하며생태계서비스 지불제(PES)를 통해 지역의 생태계서비스 개선에 기여 가능하다. 문주란 서식지 사례연구를 통해 상류지역 환경 개선, 종다양성 증진, 수질 개선 순으로 주민의 편익에 중요한 영향을 미치는 것을 확인했으며, 여가제공은 주민의 편익에 유의하지 않은 영향을 미치는 것을 발견하였다. 이 연구결과는 산림의 상류환경 개선과 토양침식 방지 활동의 중요성을 제시한다. 비금전적 지불과 금전적 지불은 동일한 결과를 나타내었다. 이에 따라 지역에서 선택실험법 설문조사 시 노동참여의사를 대체 지불수단으로 주민의 복지수준 산출에 활용 가능하다. 본 논문은 생태계서비스가 인류사회에 미치는 영향력을 설명하며 정책입안자와 토지관리자의 생태계서비스 관련 활동 및 의사결정 지원에 기여가능하다.

키워드: 비시장가치 평가, 생태계서비스, 선택실험법, 선호도, 지불의사(WTP), 노동참여의사(WTV), 방카차오 녹지 (BKGA), 문주란 (*Crinum thaianum*)