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Developing a Framework for Edible Flower Conservation in the Mekong Region

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ABSTRACT

The rich cultural heritage and plant food diversity of the Mekong region face formidable challenges brought about by the negative effects of modernization and by environmental shifts. Among these plant foods, edible flowers are well rooted in rituals and traditions of the region's local communities. Unfortunately, industrial-scale food cultivation practices pose threats to the edible flowers and the traditions in which these are entwined, such as the local culinary, slow food, and cultural practices. Researchers from Thailand, China, Myanmar, Lao PDR, and Vietnam collaborated to explore ways in which they could gather information on and craft conservation strategies for edible flowers. The team was able to identify the importance of edible flowers and proposed multifaceted strategies and actions to protect edible flowers. Fostering research collaboration, the framework developed could generate vital insights into long-term industrial development, such as value-adding applications. Global partnerships and effective policy dissemination were also found to be essential to protect edible flower diversity. The framework's comprehensive approach, centered on community engagement, aims to balance cultural heritage preservation with environmental sustainability, ultimately safeguarding Mekong's unique botanical and cultural identity.

Keywords: ethnics, ethnobotany, food security, sustainable food system

JEL codes: Q24, F53, N55, O13

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INTRODUCTION

The Mekong region, situated in Southeast Asia, stands as a testament to the remarkable convergence of biodiversity and rich cultural heritage (de Bruyn et al. 2013; Myers et al. 2000). Encompassing parts of China, Myanmar, Lao PDR, Thailand, Vietnam, and Cambodia, the Mekong region has an astonishing array of ecosystems, ranging from pristine tropical rainforests to high-altitude mountain ranges. This diverse landscape has given rise to a wealth of biodiversity of flora and fauna, many of which are found nowhere else on earth (Lewis 2009). The indigenous communities residing in this area have cultivated a profound relationship with their natural resources; and they have been relying for generations on their deep knowledge of local plants as food, medicine, and cultural ritual materials. This connection between the people and their natural surroundings has fostered a profound cultural heritage that has been passed down through generations. One of the most captivating aspects of the local culture is the culinary traditions rooted in the changing seasons (Sommano et al. 2017). For instance, the people of the Mekong region have mastered the art of using local plants as key ingredients in their cuisine, adapting their recipes through the seasons. This dynamic relationship between people and plants has ensured food security and has contributed to the preservation of local plant diversity. Apart from their beauty and use in rituals, flowers are a source of various nutrients.

The consumption of flowers in the Mekong region is deeply rooted in cultural traditions. For instance, the Dai minority of Xishuangbanna in southern China has harnessed the vibrant yellow orange (sometimes brownish yellow) flowers of *Gmelina arborea*. These flowers serve as both coloring and flavoring agents, enriching local cuisine with their unique sensory attributes (Suksathan et al. 2021; Zhang et al. 2023). The ethnic communities across Southern China, Myanmar, Vietnam, Lao PDR, and Thailand alike have also been interested in the blossoms and buds of *Bauhinia variegata*. As a food source, these are also

valued for their therapeutic potential, contributing to the well-being of those who incorporate them into their diet (Sharma et al. 2021; Kumar et al. 2020).

Industrial-scale crop cultivation is one of the most difficult challenges of biodiversity in the Mekong region. Large-scale monoculture farming not only seizes vast tracts of land but also replaces diverse, indigenous flora with uniform, single-crop landscapes (Laurance, Sayer, and Cassman 2014). This transformation disrupts the intricate web of interdependence among species, jeopardizing countless plants and animals that rely on ecosystems for their survival. The relentless spread of global fast-food chains is another alarming phenomenon. As younger generations increasingly prefer convenience, traditional knowledge about local edible species is at risk of extinction as this brand of “modernization” sweeps across the region.

Urgent and concerted efforts are thus imperative to protect the irreplaceable biodiversity and preserve the invaluable legacy of local edible species for generations to come. The exchange of knowledge and cultural heritage regarding plants is a significant aspect of life in the Mekong region. Traditional practices and wisdom are shared within and among communities, ensuring the survival of time-tested techniques for plant utilization. This sharing of knowledge has helped sustain not only the people but also the biodiversity of the region. A collaborative consortium of researchers from Thailand, China, Myanmar, Lao PDR, and Vietnam has thus convened to address these pertinent issues.

The Mekong region’s edible flowers, integral to local culture and cuisine, are at risk due to industrialization, environmental degradation exacerbated by air pollution from slash-and-burn practices for industrial crops, and fading traditional knowledge. This paper presents the development of a framework of an interdisciplinary network, seeking to showcase the significance of preserving edible flora species, juxtaposed against the pressing concerns surrounding their diminishing diversity and loss of traditional knowledge. We present viable solutions for the conservation of edible flowers in the context of the Mekong region. Furthermore,

we engage in a comprehensive exploration of the practical implications arising from our research findings, particularly in policymaking, community involvement, and broader conservation.

METHODOLOGY

This study employed a conceptual framework development methodology to address the complex interplay of cultural, environmental, and socioeconomic factors influencing the conservation of edible flowers in the Mekong region. The methodology comprises two primary phases: literature review and collaborative deliberation.

Literature Review

The data for this study was obtained from academic references, including academic theses, journal articles, conference proceedings, and unpublished reports. The online resources were selected to provide a comprehensive and up-to-date overview of the ethnobotany of flowers in the region since 2010. Search terms included edible flowers, Mekong region, biodiversity conservation, cultural heritage, and sustainable agriculture. In selecting the references to include in this study, we applied strict criteria to ensure that the data was of the highest quality and relevance. Only original research studies that provided information on the study sites, ethnicity, and the scientific names of the plants were included. This was important to provide a comprehensive and scientifically robust understanding of edible flower conservation in the Mekong region. The collected data were meticulously categorized and synthesized to identify key themes, gaps in knowledge, and emerging trends. Subsequently, the research team engaged in a series of collaborative deliberations to integrate the findings from the literature review with their respective professional experiences and regional insights.

Secondary Research and Methodical Approach

This approach utilizes the existing multidisciplinary approach to emphasize our strength as an international and multidisciplinary collaboration. This reflective analysis is categorized as a secondary research technique (Greene, Caracelli, and Graham 1989) and has been used in various existing disciplines such as urban planning, landscape architecture, and education (Suppakittpaisarn, Wanichyapaisit, and Dyball 2018; Greene, Caracelli, and Graham 1989; Gu and Deal 2018).

In the framework development, we also adopted a methodical approach guided by the framework proposed by Jabareen (2009) to integrate insights derived from the researchers' professional experiences with the knowledge acquired through their academic pursuits. Expert input and reflections were crucial for enriching our understanding of the research problem, drawing on the diverse expertise of the research team. Subsequently, a conceptual framework was constructed to outline key variables, relationships, and underlying theories guiding the study. This framework underwent iterative refinements based on feedback and emerging insights from the team. Finally, the framework's relevance, coherence, and utility in addressing research objectives were rigorously assessed.

RESULTS AND DISCUSSIONS

Literature Search

Our primary literature review encompassed a comprehensive analysis of 30 sources, including 24 research articles, three review papers, and three conference proceedings. While most of the studies focused on edible flowers consumed throughout Asia, the ethnobotanical exploration of these flowers was primarily confined to specific regions within the Mekong basin, notably northern Thailand and southern China.

The emphasis of the research articles centered on the phytochemical properties of edible flowers, focusing particularly on identifying bioactive compounds. This aligns with emerging research areas, such as edible flowers as potential sources of protein, natural pigments and colorants, and aromatic compounds. Moreover, their cultural significance as food, medicine, and materials in traditional practices, as well as their potential role in addressing the needs of an aging population, were recurrent themes. However, the literature showed a notable gap in the exploration of multifaceted roles of edible flowers within the socioeconomic and ecological frameworks of the Mekong region.

A key finding from this review is the escalating threat posed to local food systems by the encroachment of industrial agriculture. Simultaneously, a decline in traditional knowledge on the use of indigenous food plants is concerning. To ensure the long-term conservation of edible flowers, it is imperative to unlock their value-adding potential by rigorously investigating their nutritional and medicinal attributes. Disseminating this knowledge effectively to both local communities and regional stakeholders is crucial for fostering sustainable practices and preserving cultural heritage.

Collaborative Endeavor Facilitated through Interdisciplinary Networking and Framework Development

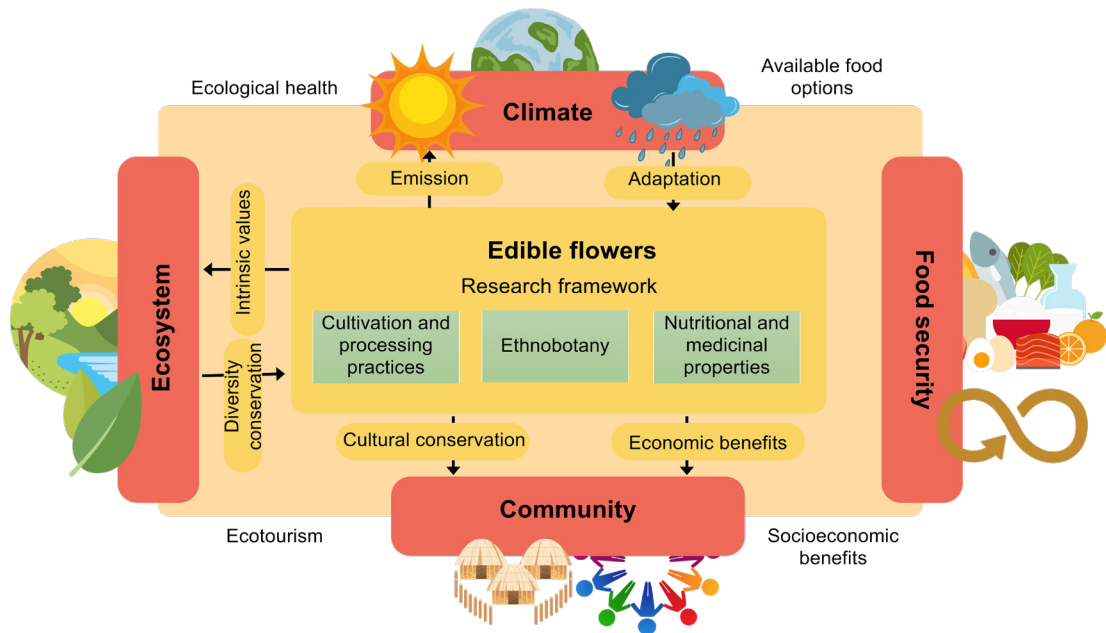
Throughout this process, we documented the activities using electronic communication and meeting notes. These records were then synthesized into a conceptual framework, laying the foundation for the exploration of how the collaborative effort would investigate edible flowers in the region. The collaboration was fostered through a meticulous networking effort, assembling leading research teams with diverse expertise encompassing plant taxonomy, ethnobotany, environmental psychology, phytochemistry, and forest ecology, representing Thailand, China, Myanmar, Vietnam, and Lao PDR. This cooperative endeavor was made possible through the generous support extended by the Mekong-Lancang Special Fund of the Chinese

Embassy in Thailand. The collaboration unfolded through a series of meetings, commencing with an inaugural kick-off meeting. During this pivotal gathering, the project leadership team from Thailand delineated the overarching concept, emphasizing the paramount importance of local edible plant species within the Mekong region. This session also provided a comprehensive framework for the subsequent research survey. An onsite meeting was then convened to enable face-to-face interactions among researchers. It served as a platform in disseminating initial research findings and insights. It was during this gathering that a formal agreement was reached, outlining the ongoing actions and commitments dedicated to the preservation of indigenous plant species of local significance.

Research Collaboration and Framework Development

Researchers from seven institutions in four countries across the Mekong region collaborated under a working agreement, allowing the exchange of edible flower data collections, as well as knowledge and staff exchanges under the local and global regulations on plant and species conservations. A memorandum of agreement among the institutions of researchers is underway and will make the partnership more sustainable in the future. Under the working agreement, the research group proposed a conceptual framework for edible flower conservation, which highlights the directions toward food security and sustainability in the region.

The conceptual framework, designed to understand the role of edible flowers within socioeconomic, ecological, and climate systems, is a comprehensive model that integrates multiple dimensions of research and action. The framework aims to foster collaborative efforts across various disciplines, including cultivation and processing, phytochemical analyses, and ethnobotany, with the overarching goals of conservation and enhancing food security. Figure 1 illustrates the conceptual framework developed.

Figure 1. Conceptual framework for edible flower conservation in the Mekong region

Roles of edible flowers in socioeconomics

Edible flowers play a significant role in the socioeconomic system of local communities, often deeply intertwined with cultural heritage especially in Asia (Kaisoon et al. 2011). The preservation of these edible flowers not only safeguards biodiversity but also serves to sustain the richness of local cultures and traditions. The economic opportunities derived from cultivating and utilizing edible flowers extend to various dimensions of the community. The production of floral-based products creates opportunities for entrepreneurship and small-scale businesses. Local farmers and producers involved in cultivating and processing these flowers become integral contributors to the regional economy. Furthermore, the marketing of these unique floral products can attract tourists, contributing to the growth of the local tourism industry. The cultural significance of edible flowers, combined with their economic potential, thus forms a holistic approach to community development. In Yunnan province in China, edible rose cultivars and

Rhododendron flowers illustrate how these floral resources contribute to the local socioeconomic system (Shi et al. 2021; Cui et al. 2022; Ge and Ma 2013) (Figure 2). The cultural significance of these flowers is reflected in various traditional practices and festivities. In Yunnan, the edible rose cultivars are not only valued for their aesthetic appeal but are also incorporated into culinary practices. The petals are used to make rose tea, a popular beverage

Figure 2. Edible Rhododendron flowers (*Rhododendron yunnanense*) of Yunnan province, China



Note: Photo courtesy of Kunming Institute of Botany, Chinese Academy of Sciences, Yunnan, China

known for its delicate flavor and potential health benefits. Additionally, products such as rose flower cakes (*xianhuabing* in Chinese, served during the Qing Dynasty) contribute largely to the economic development of the region (Cui et al. 2022).

Roles of edible flowers for the ecosystem

In this topic, the collaborators discussed several key ideas. First and foremost, some collaborators asserted that plant species have the right to exist and have the value of their own regardless of their usefulness to people, a concept known as “intrinsic value” (Forman 1995; Gobster et al. 2007). Nonetheless, many suggested that utilization could be a motivation for people, especially for locals, to conserve the species (Wisetkomolmat, Suppakittpaisarn, and Sommano 2019; Gore et al. 2008). Taking water hyacinth (*Pontederia crassipes*) as a notable example, we recognize this free-floating vascular plant for inducing significant ecological and socioeconomic transformations in Southeast Asia. Well-documented effects include decreased phytoplankton productivity and dissolved oxygen concentrations beneath the mats. Moreover, its capability to absorb heavy metals, organic contaminants, and nutrients positions it as a potential biological alternative for secondary and tertiary treatment in wastewater management (Villamagna and Murphy 2010; Chunkao, Nimpee, and Duangmal 2012). Within the construction framework, we observed that the flower of water hyacinth is consumed by Laotians (Figure 3). On the other hand, the Javanese have reported consuming young leaves, including petioles and inflorescence, recognizing these as valuable protein sources (Aasim et al. 2018). Nevertheless, due to its effective absorption of heavy metals, the consumption of water hyacinth requires careful consideration. It is important to note that water hyacinth has been reported to contain hydrogen

Figure 3. Water hyacinth (*Pontederia crassipes*) flowers in Luang Prabang, Lao PDR



Note: Photo courtesy of Northern Agriculture and Forestry College, Lao PDR

cyanide, alkaloids, and triterpenoids, which could lead to itching (Ghosh 2010).

Lastly, the local edible flowers can represent geographically specific food or those that can be eaten only at certain places (Buiatti 2011; Butarbutar et al. 2015; Teeranuson 2016). This could be used to promote tourism and the local economy, especially when combined with cultural and local cooking processes as a part of the slow-food movement,¹ which encourages the intentions and values of local and traditional food consumption (Buiatti 2011; Butarbutar et al. 2015; Sommano et al. 2017; Saroinsong 2020).

Roles of edible flowers in climate action

Like all plants, edible flowers engage in photosynthesis, a process that sequesters carbon dioxide from the atmosphere, assisting in climate change mitigation and thereby reducing greenhouse gas levels. The cultivation of edible

¹ Slow food movement originated from Italy and is a socioeconomic movement that encourages the understanding of the processes of food creation from gathering or planting, harvesting, preparing, to serving. This movement is the counterculture of the capitalistic fast-food movement, which provides fast access to food but at the expense of stories, flavors, and sustainability. However, its practicality to modern applications are up to debate (Simonetti 2012).

flowers often involves sustainable practices such as agroecology, intercropping, and maintaining natural habitats (Jadhav et al. 2023). These practices contribute to biodiversity restoration, enhancing ecosystem resilience against climate impacts. Nonetheless, the exploration of how the cultivation of edible flowers affects local climate systems requires a more thorough investigation that encompasses the habitat characteristics and climate adaptation behaviors of cultivated edible flowers (Pieterse, Millan, and Schönfeldt 2023). Some edible flowers are resilient to specific climate conditions. Cultivating and promoting these varieties can contribute to climate-resilient agriculture, as they are better adapted to changing environmental conditions. Growers often select flower varieties well-suited to local climates, minimizing the necessity for excessive inputs and enhancing habitat resilience. Furthermore, as edible flowers often evolve within local cultures, the knowledge about their cultivation and utilization is deep-seated with indigenous communities. This indigenous knowledge usually includes sustainable practices that are adapted to local climates. Several edible floral vegetables, including the Vietnamese fish mint (*Houttuynia cordata*), have a longstanding history of use in traditional medicines across China, India, Vietnam, and Thailand (Hung et al. 2023) (Figure 4). Research indicates that this plant exhibits resilience as a tropical species, growing in environments with varying light intensities (Li et al. 2015; Li et al. 2021).

Figure 4. Vietnamese fish mint (*Houttuynia cordata*), a common aromatic vegetable traditionally known for its medicinal value



Note: Photo courtesy of Queen Sirikit Botanic Garden, Thailand

Moreover, the indigenous cultivation of edible flowers holds the potential to stimulate the consumption of locally grown flora, thereby diminishing carbon footprint linked with transportation. This contributes significantly to climate action by mitigating emissions generated from extensive transportation of food over long distances. Crucially, as integral components of the local habitat, including these edible flowers in the daily diets of local communities offers prospects for alleviating food insecurity. This integration also stands as a catalyst for socioeconomic transformation, especially in economically disadvantaged and rural regions (Pieterse, Millan, and Schönfeldt 2023).

Research approach

Within the collaborative framework, we call for research action that spans across the domains of the food supply chain. This encompasses ethnobotanical data collection by compiling traditional knowledge related to local edible flowers, along with documenting cultivation and processing practices. Additionally, the collaborators deliberated on the health benefits of edible flowers. Not only do edible flowers provide basic nutritional requirement but also exhibit medicinal properties, capable of preventing or curing illnesses (Jadid et al. 2020; Sommano et al. 2020; Kumari, Ujala, and Bhargava 2021). Edible flowers belonging to the legume (Fabaceae) family like Bauhinia (*Bauhinia variegata*) and butterfly pea (*Clitoria ternatea*) are noteworthy examples (Figure 5). These locally consumed edible flowers contribute not only to nutritional enrichment but also harbor bioactive potentials to combat human diseases (Kumari, Ujala, and Bhargava 2021). Consequently, the conservation of these botanical resources emerges as a crucial initiative with the potential to contribute significantly to public health and well-being. We have divided the subthemes of research on edible flowers as follows:

- edible flowers as sources of protein;
- edible flowers as sources of pigments and colorants;

Figure 5. *Bauhinia variegata* (left), and butterfly peas (*Clitoria ternatea*)(right), members of local edible flowers from the Fabaceae family



Note: Photo courtesy of Queen Sirikit Botanical Garden, Chiang Mai, Thailand

- edible flowers as cultural food, medicine, and practice;
- edible flowers as aromatic crops; and
- edible flowers for an aging society.

We also highlighted a common procedure for data collection. Both biological and cultural uses of the specimen must be collected and recorded (Ordóñez-Barona 2017; Jadid et al. 2020; Zhang et al. 2023). Secondly, to make sure people use them, data dissemination such as herbariums, museums, botanical gardens, and classes about edible flowers must be produced in several levels (Saroinsong 2020; Sommano et al. 2017). Thirdly, some edible flowers may have lost their uses due to shifts in cultures and geographical contexts. The ways people use, contain, and prepare flowers must be reintroduced (Wisetkomolmat, Suppakittpaisarn, and Sommano 2019). Movements such as local foods, wild foods, and slow foods may be paramount in pushing forward this sustainable conservation (Lotti 2010; Buiatti 2011; Delang 2006).

The collaboration needs to create a global collective dataset, which can be used across the region to make the conservation more effective (Sommano et al. 2020). Furthermore, the species must be compared between locations to make sure that the information is accurate. Finally, climate change conditions may make some plants shift their habitat and community to nearby locations, or it might make a species extinct. Thus, regional and global watches for changes in the ecosystems are needed for a long-term sustainable

plant conservation (Grimm et al. 2008; Shrestha, Chaweewan, and Arunyawat 2017).

Need for Global Collaborations

During the collaboration, researchers from the region had the opportunity to visit each other and learn the geographical and cultural contexts of each country. This underscored the importance of the regional- and global-scale database and knowledge sharing system. The outputs of the collaboration included the sustainable partnership within the region. The collaboration and knowledge sharing enabled many researchers to learn data collection and analysis including phytochemical measurements, ethnobotanical data collection, and archival and historical research from within the collaboration. Furthermore, it provided evidence of values in species and diversity conservation, which could be used to advocate for ecological conservation policy as well as to instill positive connections with natural resources among the people in the region. This could lead to a collaboration beyond research into a regional-scale public policy regarding food plant conservation and the slow food movement.

Research Dissemination and Informing Policy

Outcomes from the collaborative framework provide benefits for diverse stakeholders, including academia, nutritionists, consumers, marketers, and

businesses engaged in the flower value chain and the food supply chain. Strategic dissemination of research results and networking is planned through organized events to engage these stakeholders. Concurrently, concerted efforts from policymakers are essential to establish and enforce robust food quality standards. Moving beyond fundamental research, the significance of such standards and regulations is heightened, particularly considering that certain edible flowers may pose safety concerns or require specialized preparation. In terms of product availability, enhancing productivity can expand the local produce market. Nevertheless, challenges such as labor-intensive production, widespread pesticide use, and the need for larger-scale production necessitate comprehensive national-level regulations. Moreover, government support is crucial for fostering innovative approaches, including the development and adoption of processing technologies and modern agricultural practices.

CONCLUSION

The collaborative research efforts in the Mekong region have provided critical insights into the conservation and utilization of edible flowers. This interdisciplinary network that connects researchers from Thailand, China, Myanmar, Lao PDR, and Vietnam has significantly contributed to understanding the relationship among biodiversity, cultural heritage, and local food systems. By focusing on the conservation of edible flora, particularly flowers, the research has emphasized their roles in socioeconomic systems, ecosystem sustainability, climate action, and public health.

This collaborative approach has allowed for a deeper understanding of the intrinsic value of plant species, their importance in local cultures, and their potential in promoting food security and economic development.

As the project moves forward, the need for global collaboration becomes evident. The exchange of knowledge and practices among different countries within the MLC region enhances the effectiveness of conservation efforts.

The engagement of local communities and the integration of traditional knowledge with modern scientific research are pivotal in preserving these invaluable natural resources.

Local edible flowers, often overlooked, possess immense potential for biodiversity conservation in the Mekong region. The research initiative not only contributes to the conservation of biodiversity and the preservation of cultural heritage in the Mekong region but also offers a model for similar collaborative efforts worldwide, such as the slow food movement. By emphasizing the value-added potential of local edible flowers, the framework promotes cultivation and processing, thereby boosting the income of local communities. Furthermore, community engagement and capacity building can foster a sense of ownership and stewardship over the region's overexploited natural resources. The sustainable use and conservation of edible flowers, as part of this project, highlights a pathway toward a more resilient and diverse food system. The success of this initiative encourages further interdisciplinary and international collaboration in addressing the pressing environmental and socioeconomic issues of our time.

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