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NARATIF BAHARU UKM
UNIVERSITI WATAN KITA

LESTARI
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Buku Abstrak Lanjutan

KOLOKIUM SISWAZAH LESTARI 2024

Institut Alam Sekitar dan Pembangunan (LESTARI) UKM

Tema:
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30 Tahun LESTARI
Memupuk Agenda Kelestarian Universiti Watan

15-16 Oktober 2024
Bilik Kuliah Utama, LESTARI UKM
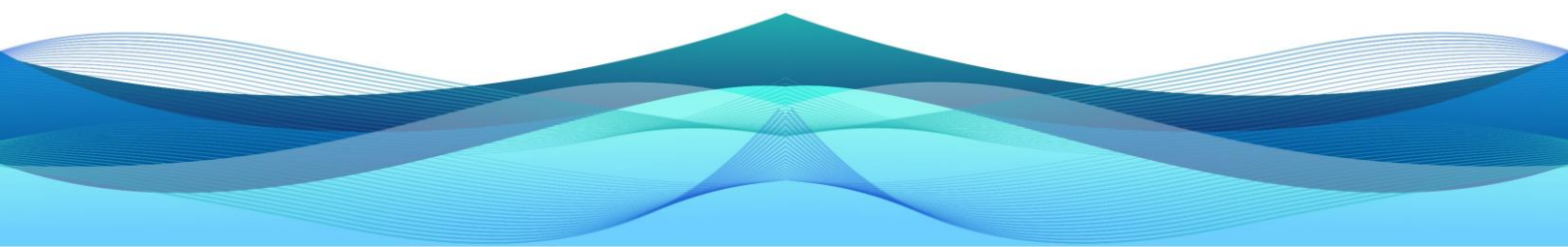
Penyunting:
Ku Adriani Ku Ayob & Mohd Fuad Tepit

INSTITUT ALAM SEKITAR DAN PEMBANGUNAN (LESTARI)

Institut Alam Sekitar dan Pembangunan (LESTARI)
Universiti Kebangsaan Malaysia

ISI KANDUNGAN

KOLOKIUM SISWAZAH LESTARI 2024
15-16 OKTOBER 2024
BILIK KULIAH UTAMA LESTARI

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ABSTRAK LANJUTAN PEMBENTANG
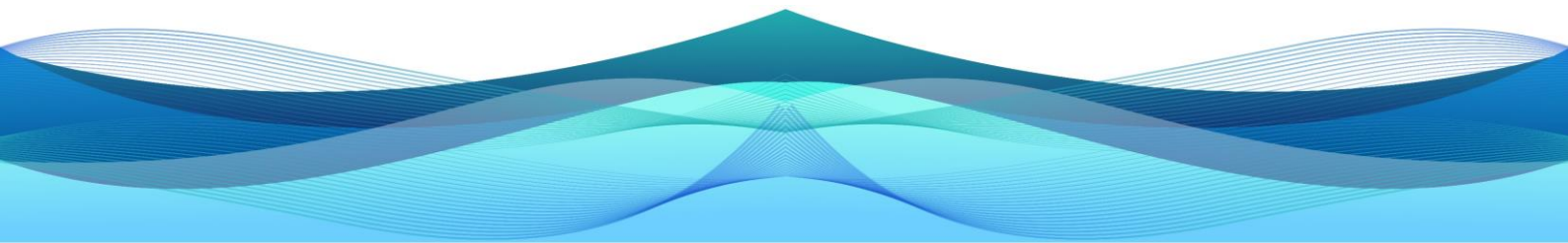
A STUDY OF CHINA'S RURAL AGRICULTURAL DEVELOPMENT WITHIN THE FRAMEWORK OF SUSTAINABLE DEVELOPMENT GOVERNANCE

LIU YU | P121694 | PhD

Main Supervisor: Prof. Dr. Muhammad Rizal Bin Razman
Co-Supervisor: Prof. Dr. Sharifah Zarina Binti Syed Zakaria
Co-Supervisor: Prof. Ts. Dr. Lee Khai Ern

1. INTRODUCTION

Sustainable rural agricultural development has become a critical focus globally due to increasing concerns over environmental pollution and resource scarcity (Adisa et al. 2024). Sustainable development was proposed in response to the environmental degradation caused by economic growth (Zhang et al. 2022). The 1987 report of the World Commission on Environment and Development defined "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Kono 2023). Sustainable development, as a paradigm for thinking about the future, requires a balance of environmental, social, and economic factors in the pursuit of development and improvement of the quality of life (Estoque & Wu 2024).

Strengthening the rural agriculture system has recently emerged as a vital prospect all over the world due to continuously rising issues of environmental degradation and availability of the resources (Zahoor & Mushtaq 2023). In China specifically, the rural agricultural sector is considered a significant endowment to China's development because it contributes to the attainment of stability and well-being of the country's populace. This paper examines the sustainable fashion of rural agricultural production in Shaanxi Province by applying effective governance of sustainable development and interweaving advanced technologies with traditional agriculture.

2. PROBLEM STATEMENT

The rapid industrialization and intensive agricultural practices in Shaanxi Province have resulted in significant environmental degradation and resource depletion. While traditional agricultural methods hold cultural significance, they frequently fail to meet the demands of modern sustainability challenges. Numerous domestic and international scholars have studied the industrial, agricultural, and ecological sustainability issues of China and they have achieved different study outcomes. Some of the crops that are grown in the region include wheat, maize, and apples. The major impacts of environmental degradation in Shaanxi province are soil erosion, water rationing, and pollution by fertilizers and pesticides affecting resource depletion and the ecosystem (Gai & Yang 2023). However, they lack of the concept of sustainable development that was evident in the other previous studies that focused on rural agriculture. Moreover, the majority of these studies have used qualitative methods of data analysis which have limited ability to provide the overall systematic picture of sustainable agricultural development (Koutridi & Christopoulou 2023).

This study identifies the factors affecting sustainable rural agricultural development and analyzes the impact of traditional and modern technological approaches (Dzanku & Osei 2023). Through modern technologies such as IoT devices, machine learning models, and the application of GIS in common farming practices, the research intends to increase agricultural output and environmental conservation as well as the socioeconomic development of the rural population.
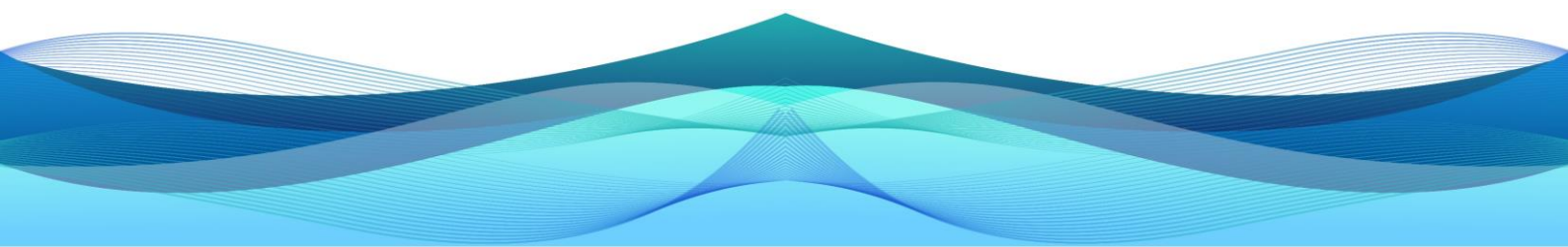
3. OBJECTIVE

This study seeks to establish a framework that could be used in promoting sustainable rural agricultural development in Shaanxi Province. This study has four main objectives, but I will be presenting only the first and second propositions of this LESTARI Colloquium. The 1st objective is to determine the indicators of sustainable agricultural development in Shaanxi Province. The 2nd objective is to assess the effect of the current practices in agriculture on environmental sustainability.

4. METHOD

This research adopted a mixed-methods approach, utilizing qualitative and quantitative data collection techniques resulting in a comprehensive analysis.

This study targeted local farmers, agricultural workers, and other stakeholders in Shaanxi Province. To increase variability, a stratified random sampling approach was used in this study. The total of the selected respondents was 300, out of which 200 were farmers and 100 were agricultural workers. Specific questionnaires were developed to obtain more specific data on the current practice in agriculture, the use of fertilizers, pesticides, and water management, the level of awareness, and the practice of sustainable agriculture. There were five focus groups, each including 8-10 participants from different regions of Shanxi Province. The FGDs were designed to establish the participants' understanding of the barriers to and opportunities for sustainable practices. In-depth interviews were carried out with 20 purposively selected informants comprising of agricultural experts, policymakers, and local government officials. This was to understand the policy effects, technologies, and challenges in sustainable development.

The literature was obtained from peer-reviewed journals, government documents, and international analyses of sustainable agriculture, environmental conservation, and rural development. Secondary data were collected from authentic statistical databases including the National Bureau of Statistics of China, FAO, and local agriculture departments. These sources provided crop yields, environmental indicators, and resource usage data.

Data collected from the questionnaires and surveys were analyzed using descriptive statistics. Inferential statistics techniques, such as regression analysis and ANOVA, were used to determine correlation and variance between variables. Factor analysis was employed to identify the factors that define sustainable agriculture. Supervised, unsupervised, and reinforcement learning algorithms were used in Python to analyze patterns and make predictions concerning agricultural production and sustainability. GIS and remote sensing were used to display and assess geographical information. This included soil moisture, weather, and crop health mapping in the various regions.

These data were collected in real-time through the IoT devices relating to the moisture content of the soil, weather, and crop. These devices provided accurate and timely information that was very essential for the analysis. This study sought to establish a strong framework for sustainable rural agricultural development in the Shaanxi Province by integrating these different data collection and analysis techniques.
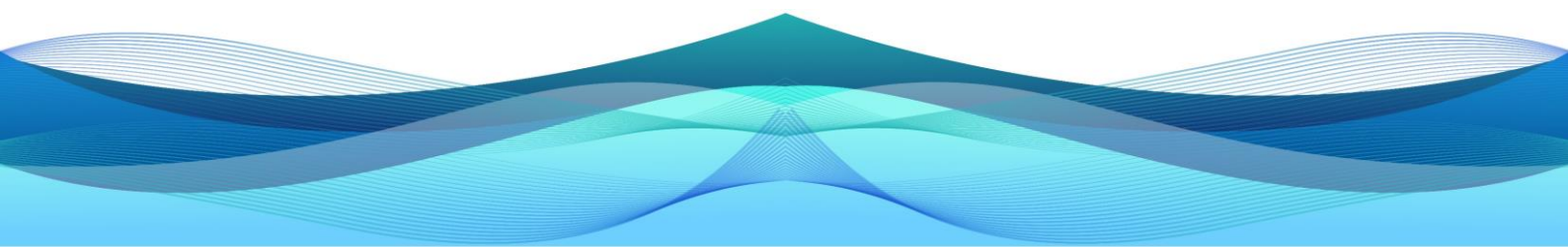
5. RESULTS AND DISCUSSION

The results of this research reveal the effectiveness of combining modern technologies with conventional farming techniques in Shaanxi Province. They are based on a combination of primary and secondary data collected from surveys, FGDs, interviews, literature reviews, and statistical databases. The results of the survey reveal that 70% of people knew about sustainable agriculture, while only 40% practiced sustainable agriculture. The main challenges highlighted include the absence of access to technology (45%) and inadequate policy support (30%). FGDs established that local farmers consider IoT and GIS to be helpful technologies for farming, but they are difficult to use because of costs and lack of technical knowledge. It also highlighted the cultural importance of traditional methods, suggesting a hybrid approach as the most feasible. The interviews with key informants, such as agricultural experts and policymakers, highlighted the importance of policy support and technology in delivering sustainability. Informants observed that good practice of incorporating technology into conventional methods enhanced productivity and utilization of resources.
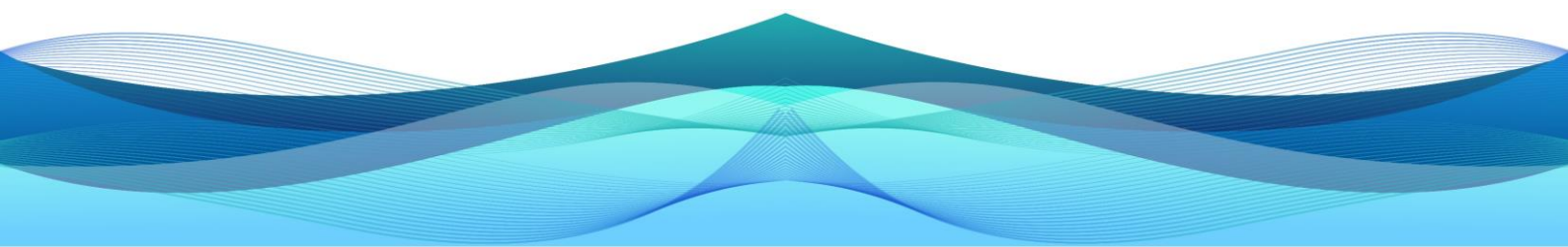
The literature review and statistical databases revealed information related to environmental issues within Shaanxi Province, including soil erosion and water scarcity. Data analysis from the National Bureau of Statistics of China and FAO was used to analyze crop yields and resource utilization. These methods were applied to measure the significance of various factors that affected sustainable development. The entropy weighting method gave the highest weight to policy support (0.35), technological adoption (0.30), and environment conservation (0.25). In addition, hierarchical analysis supported these conclusions with a consistency ratio of 0.05, ensuring their reliability. Supervised and unsupervised machine learning models were applied to predict the yields accurately at a rate of 85%. This led to improved resource management and a waste cut of 15%. GIS and remote sensing technologies showed a 25% variation in the soil moisture level in different areas, which meant that appropriate action could be taken. The irrigation efficiency was increased by 20% due to real-time data from IoT devices.

The integration of IoT devices, machine learning models, and GIS with conventional practices improved agricultural productivity. The incorporation of new technologies was also instrumental in the right use of resources, cutting on wastage, and promoting environmental consciousness. The major factors towards sustainable agricultural development were considered policy support, technology, and environment.

Through the integration of these multiple data collection and analysis techniques, the study offered a comprehensive framework for the development of sustainable rural agriculture in Shaanxi Province that could be useful for policymakers, farmers, and other stakeholders.

6. CONCLUSION

This study underscores the importance of sustainable development governance in improving rural agricultural development in Shaanxi Province. The presented framework is useful and provides concrete suggestions for policymakers, farmers, and other interested parties for improving agricultural production while preserving the environment. The strategies of integrating modern technology with traditional farming practices offer a sound method that can promote sustainable rural agriculture development and, subsequently, domestic economic stability and social well-being. Further research should be carried out to determine the long-term results of these interventions and to elaborate the proposed framework based on ongoing developments in the field.

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**SUSTAINABLE LIVELIHOOD MODEL FOR SMALL-SCALE RICE FARMERS
FACING FLOODS DUE TO CLIMATE CHANGE IN SOUTH SUMATERA-INDONESIA**

NURILLA ELYSA PUTRI | P108180 | PhD

Main Supervisor: Dr. Nor Diana Mohd Idris
Co-Supervisor: Prof. Ts. Dr. Lee Khai Ern

1. INTRODUCTION

Flooding disasters are happening more regularly worldwide (Echendu 2023). Particularly significant crop losses have been caused by floods, which has led to worries about rising import costs (Mwakyusa et al. 2023) if the issues remain unsolved. Floods had an impact on rural communities' physical and economic well-being, social position, and means of subsistence both directly and indirectly (Khayyam & Noureen 2020). Floods have a major negative socioeconomic impact, particularly on tiny coastal and lowland farming communities (Jega et al. 2018) including in Indonesia especially in South Sumatra. Smallholder farmers in South Sumatra Province frequently deal with flood conditions in their rice fields, consequently, the rice production is reduced and affected to the sustainable livelihoods of farmers. Serious flood damage brought on by global climate change presents a serious risk to the sustainable growth of rural economies and societies and creates challenges for farmers' livelihoods. Solving farmers' livelihood problems in flood-prone areas requires a proactive examination of short- and long-term actions (Ao et al. 2022).

This situation undoubtedly affects agricultural households' income, potentially raising the poverty rate in rural areas. The decline in income affects household spending and consumption, which will ultimately have an impact on the level of household welfare. This condition can threaten the sustainability of farming both due to technical cultivation and land carrying capacity (Yamin & Putri 2024). As households' capacity to meet essential needs declines, they become more vulnerable to the possibility of sustainable livelihood. The Sustainable Livelihood Approach is a concept for measuring human or community efforts in existing livelihood assets and activities needed as a means of life to cope with and improve pressure, maintain, or increase assets and capabilities but not destroy existing natural resources (Afifah et al. 2021). According to SDGs no 13 (climate action) and 15 (life on land), this study will focus on the smallholder farmers' action for dealing with floods in the rice fields as climate action (SDGs No 13, climate action) and recommend solving the smallholder farmers dealing with floods to continue with their sustainability livelihood in the rice fields (SDGs No 15, life on land). Identifying flood influencing factors encountered by small-scale farmers in South Sumatra and comprehensively examining of factors needed to overcome flooding and maintain the farmer's livelihood was the purpose of this analysis.

2. PROBLEM STATEMENT

Smallholder farmers will continue to face serious threats from climate change and the resulting rise in drought and flood frequency (Raghu et al. 2022). Rice production is reduced as a consequence of floods in the paddy fields. This situation undoubtedly affects agricultural households' loss of income, which has the potential to raise the poverty rate in rural areas. As households' capacity to meet essential needs declines, they become more vulnerable to the possibility of sustainable livelihood. It is uncommon to find out how smallholder farmers see flood impacts and flood disaster management (Jega et al. 2018). One crucial strategy for preventing and minimizing flood damage is flood control (Avand et al. 2021). When floods occur, small-scale rice farmers in South Sumatra province experience many problems, where losses arise due to failed planting and harvest failures, resulting in a decrease in rice

production, which is the source of income for farmer households. Rice Productivity fluctuate in many regencies in South Sumatra during 2019, 2020, and 2021. While total in South Sumatra rice production decreased from 2.603.396,24 tons in 2019 become 2.540.944, 30 tons in 2021 (BPS 2022). The problem of lack of irrigation facilities in rice fields, lack of farming technology used, and the absence of flood management in the form of flood control in rice fields make small-scale farmers vulnerable to losses due to flooding in rice fields and loss of sustainable livelihoods. The Comparison between flood frequency and rice productivity in 2019, shows there is significant low productivity in the farming area without irrigation services and in the swamp land typology. Then a decrease in farming areas without irrigation in the rainfed land typology as well, whenever it still high productivity in irrigation farming at the Tidal land typology (Walhi 2019; BPS 2022). The floods brought on by climate change affect rice farmers' ability to maintain a sustainable livelihood, it causes, low- productivity and loss of income for their livelihood. To help small-scale farmers who experience flooding in their rice fields to continue to be able to continue farming activities that support sustainable livelihoods, it is necessary to conduct a study to identify the factors of floods are facing by small-scale farmers related to climate change and to examine the factors are needed to overcome flood in the rice fields, to help the small-scale farmers prevent their sustainable livelihood.

3. OBJECTIVE

This research has three objectives, but only two goals will be present at this colloquium, which are to identify flood influencing factors encountered by small-scale farmers, as a result of climate change and to examine the factors required to prevent climate change-related floods in the rice fields in South Sumatra, Indonesia.

4. METHOD

This study uses primary data from the survey of small-scale rice farmers in flood-prone areas. The data was analyzed with the quantitative method. Purposive sampling was used with the specific criteria of farmers such as consisting of small-scale rice farmers (0.5-2 Ha), affected by flood in the rice field in 2023-in the seasons one and two season, minimum two-year experience in rice farming among 202 samples. The study area was divided into three districts in South Sumatra in different typological of farmland, there are tidal, swamp and rainfed. The study used a set of questionnaires as a tool or instrument for data collection with face-to-face interviews of smallholder farmers. The first objective is to identify flooding factors encountered by small-scale farmers in South Sumatra, Indonesia, because of climate change using secondary data and identified with descriptive analysis. The indicators to be identified in this objective are rainfall intensity, temperature, flood frequency, crop-affected area, and crop harvest loss. The second objective is to examine the factors required to prevent climate change-related floods in the rice fields in South Sumatra, Indonesia. The factors that are needed to prevent flooding will be subject to CFA analysis using MPLUS 8 Software. The questionnaires use a Likert scale with a 1 to 4 scale. The factors related to flood will be identified, and construction validated by using CFA (Alias et al. 2015) as it is useful for assessing the validity and reliability of such models (Baharum et al., 2023). Latent variable modelling has a broad range of analysis features. It has been found that a good fit would be indicated by a non-significant chi-square test statistic, values greater than or equal to 0.90 for the NNFI and CFI, and a value less than or equal to 0.10 for the RMSEA (Hau, Wen, & Cheng 2004), as confirmed by Sterner et al. (2024) that validity standard with NNFI=0.91, CFI=0.92, RMSRA=0.079 are the model fits well, and it is considered border lines depending on the context or specifics fields standart. Four latent variables were analyzed in this study, namely the frequency of flood disasters (X1), the responsibility of flood protection (X2), the local flood knowledge and education (X3) and trust in the government on risk management (X4).

5. RESULTS AND DISCUSSION

There has not been any systematic research on the trade-offs and synergies between people as SDG Targets and the effects of climate change, considering the widespread acceptance of these relationships (Fuso Nerini et al. 2019). Flooding caused by significant rainfall that occurs even when there is not a nearby body of water is known as pluvial flooding. All locations above riverbank or coastal flood zones are vulnerable to flood (Echendu 2022a). The result of the first objective is to identify flooding issues encountered by small-scale farmers in South Sumatra Indonesia. It has shown that the flod situation in the regions with the highest frequency of flooding are those with river basins or river beaches. Data shows that 53 per cent of locations in South Sumatra have a high potential for flooding, and 44 per cent of locations have a medium potential for flooding; only 3 per cent have a low potential for flooding. The data above illustrates this relationship, with the lowest temperatures occurring in January and October experiencing more flooding events than other months. Generally speaking, flooding incidents are lower at high temperatures and increase at low ones. Higher rainfall will raise the probability of flooding, as demonstrated by the high rainfall in October which results in more flood events. The production of rice in South Sumatra Province decreases when more floods occur in rice fields. The Province of South Sumatra experienced losses due to flooding which is comprised of 51 per cent physical loss and 49 per cent economic loss.

The research findings from the second objective are to examine the factors required to prevent climate change-related floods in the rice fields in South Sumatra, Indonesia. It is shown that at the first stage of the CFA, the model is still not fit, because it has not been able to meet the requirements of the model fit that have been determined. Thus, it is necessary to modify the model with the modification options provided by MI (Modification Indices). The result findings that the goodness of fit test results has been met where the CMIN/df value is $1.620 \leq 5$, RMSEA $0.055 < 0.080$, TLI $0.907 > 0.900$, and SRMR $0.059 < 0.080$. CFI $0.921 > 0.900$. This indicates that the constructs in the research have met the model's accuracy (goodness of fit). Construct validity of the scale was achieved by removing 23 items and retaining 25 valid items divided into four construct variables, flood disaster frequency (X1), responsibility of flood protection (X2), local flood knowledge and education (X3) and trust in the government on risk management (X4). The responsibility of flood protection (X2), the local flood knowledge, and education (X3) are factors that significantly influence each other on flood protection efforts, with a significance value of 0.648; variables X_1 and X_4 also have a significant correlation in protection efforts for floods in rice fields, where the frequency of flood disaster (X1) with trust in the government on risk management (X4) has a significance value of 0.295; then (X1) with the responsibility of flood protection (X2). Variable frequency of flood disaster (X1), where it is the variables that affect the frequency of flood disasters in South Sumatra, Indonesia. The highest loading factor value is found in the flood inundation indicator in the construct variable flood intensity, shift of rainy season in the construct variable rainfall intensity, and type of rain (storm, heavy rain, wind rain). The variable responsibility for flood protection (X2), indicate that the private actor variable has a higher factor loading value in terms of the impact of coordination, and the function of farmer groups that is, the necessity of joining a group when flooding occurs also has a higher factor loading value. This component certainly needs to be taken into consideration while dealing with flooding problems in rice fields because the extension worker's support is needed to solve the flooding problem and seems to have a considerable loading factor. The local flood knowledge and education variable (X3) is in line where the validity of the variable is found in the support indicator expected by farmers, to increase benefits for community defense, the variable establishment of a flooded community as a farmer's institution to overcome floods and a means of obtaining capital (X_3) is highly recommended and validated as an effort to handle floods in rice fields. Variable Trust in government on risk management (X4), the strong epidemic community measure has a rather high loading factor, indicating the variable's level of validity in society. The most evident indication is that farmer group actions are required to construct water channel infrastructure in rice fields. This is

consistent with this research (Tewari et al. 2015) that found that in the event of flooding in rice fields, spontaneous community activity proves to be more beneficial than government assistance, as it may resolve issues faced by farmers more quickly and effectively.

In order to assist climate action and reduce the threat of future floods in village communities, SDG 13 l ocalization is offered as an example of how the SDGs might be integrated into already   existing   local policies (Mortimer et al. 2023). The findings show that farmers need to be trained and given information on how to deal with floods additionally backs up earlier research that found farmers do not possess knowledge about flood control that they can receive from the government. In Indonesia, SDG 15, focusing on practical issues of forest and natural resources management, requires a more proactive, inclusive and results-based approach to be achieved (Echendu 2022b). It is related to findings that the strong epidemic community is needed as an effort to face flood in the rice fields.
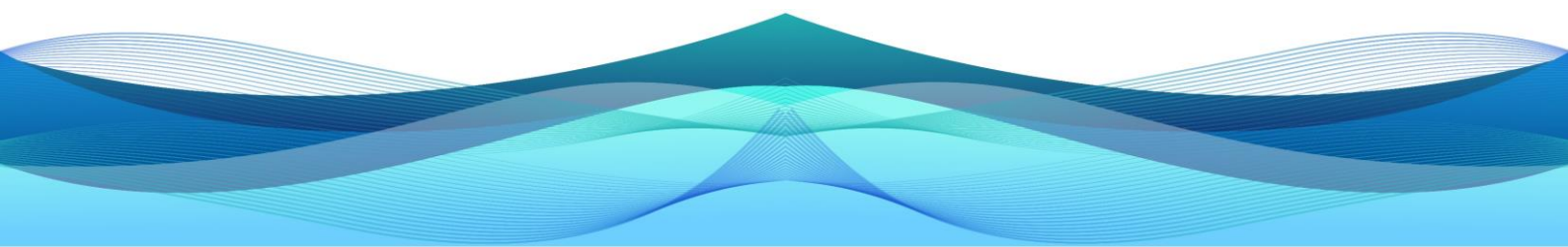
6. CONCLUSION

The conclusion from this research which are construct validity of the scale was achieved by removing 23 items and retaining 25 valid items. The highest loading factor value is found in the flood inundation indicator in the construct variable flood intensity, shift of rainy season in the construct variable rainfall intensity, and type of rain (storm, heavy rain, wind rain). This variable has an influence and can be recommended in the flood management of rice farming. The CFA analysis's findings for the variable "responsibility for flood protection" indicate that the private actor variable has a higher factor loading value in terms of the impact of coordination, and the function of farmer groups that is, the necessity of joining a group when flooding occurs also has a higher factor loading value. The establishment of a flooded community as a farmers' institution to combat floods and a way to obtain capital, government assistance (farmers always hope for government assistance, including seeds, fertilizer, and water channels in flooded rice fields), and providing information about managing rice fields to deal with floods are the only valid variables. Spontaneous community activity proves to be more beneficial than government assistance, as it may resolve issues faced by farmers more quickly and effectively. To support climate action and reduce the threat of flooding in rural communities, SDG 13 localization is proposed for integration into local policies. The findings show that farmers need to be trained and given information on how to deal with floods additionally backs up earlier research that found farmers do not possess knowledge about flood control that they can receive from the government. Achievement of all SDG 15 relates to practical issues in forest and natural resource management. It is related to findings that the strong epidemic community is needed as an effort to face flood in the rice fields.

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PENENTUAN AFLATOKSIN B$_1$ BERASASKAN BIOSENSOR ENZIM KEJURUTERAAN GENETIK UNTUK PENGURUSAN KAWALAN KUALITI PRODUK PERTANIAN

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1. PENGENALAN

Makanan tercemar AFB$_1$ boleh memasuki tubuh melalui rantai makanan, menyebabkan kerosakan pada hati, kesan pernafasan yang serius bahkan kematian (Mohamad et al. 2020). Had AFB$_1$ yang dibenarkan oleh Peraturan-peraturan Makanan Malaysia 1985 di bawah Akta Makanan 1985 ialah 5-35 µg kg^{-1} (Khalid et al. 2022; Chang et al. 2023). Walau bagaimanapun, sesetengah makanan tercemar AFB$_1$ didapati melebihi had yang ditetapkan dalam julat 0.4-222 µg kg^{-1} (Abdullah et al. 2022). Maka, pemantauan AFB$_1$ dalam pengurusan kawalan kualiti produk pertanian yang diproses amat disyorkan.

2. PERMASALAHAN KAJIAN DAN SOROTON KAJIAN

Kaedah konvensional penentuan AFB$_1$ yang biasa dilakukan di makmal berakreditasi dengan instrumen besar dan mahal, memerlukan teknik penyediaan sampel yang panjang dan kompleks, memakan masa, serta keperluan juruteknik yang mahir (Beitollahi et al. 2020) seperti HPLC dengan pengesan pendarfluor (FLD) atau spektrometri jisim (MS), kromatografi cecair (LC), kromatografi lapisan tipis (TLC), kromatografi imunoafiniti (IAC), dan ELISA. Memandangkan adanya batasan dengan teknik analisis instrumen ini, permintaan untuk peranti kecil dan pengesanan pantas AFB$_1$ semakin meningkat (Abnous et. al. 2017). Seterusnya, kaedah pemegunan tradisional seperti penjerapan, pemerangkapan dalam membran polimer atau melalui reagen penghubung silang menunjukkan transduksi isyarat yang buruk antara molekul pengecaman dengan transduser (David et al. 2018). Untuk meningkatkan prestasi pengesanan biosensor berasaskan enzim, seperti peningkatan terhadap kepekaan, kepilihan, julat dinamik dan kestabilan biosensor, peningkatan capaian substrat ke tapak aktif enzim melalui pemegunan enzim berorientasi dengan pendekatan biologi sintetik diusulkan untuk menguji konsep reka bentuk enzim kejuruteraan genetik untuk penentuan AFB$_1$ secara pantas dan spesifik.

3. OBJEKTIF KAJIAN

Melakukan sintesis enzim rekombinan diikuti penulenan aflatoksin oksidase bertanda R5 (AFO-R5) bagi kajian penciran tindak balas elekrokimia biosensor berasaskan enzim rekombinan AFO-R5 terpegun nanosfera silika berongga bagi penentuan AFB$_1$.

4. KAEDAH KAJIAN

Gen AFO-R5 dan AFO daripada *Armillariella tabescens.* Gen tersebut telah diklonkan ke dalam vektor pengklonan 2B-T yang membawa penanda-histidina 6× dan jujukan tapak protease pada terminus-N serta jujukan penghubung dan R5 pada terminus-C. Seterusnya, pengekspresan protein rekombinan AFO-R5 dan AFO dijalankan secara autoinduksi ke dalam plasmid *E. coli* pada suhu 20 °C selama 24 jam. Hasil daripada pengekspresan protein dianalisis melalui elektroforesis gel SDS-PAGE dan pemblotan *Western*. Penulenan protein dilakukan menggunakan dua kaedah kromatografi iaitu afiniti Ni-NTA melalui kolum HisTrap HP 5mL dan pertukaran anion (HiTrap Q FF 1 mL). Kajian tindak balas elektrokimia

plasmid rekombinan afiniti AFO-R5 terpegun pada elektrod nanosfera silika berongga dijalankan dengan kaedah voltametri siklik (CV) dengan kadar imbasan 100 mV s^{-1} untuk 4 kitaran dan voltametri denyutan pembezaan (DPV) pada julat 0.1 V-0.9 V. Rajah 4.1 menunjukkan carta alir kaedah sintesis gen rekombinan AFO-R5 dan AFO.
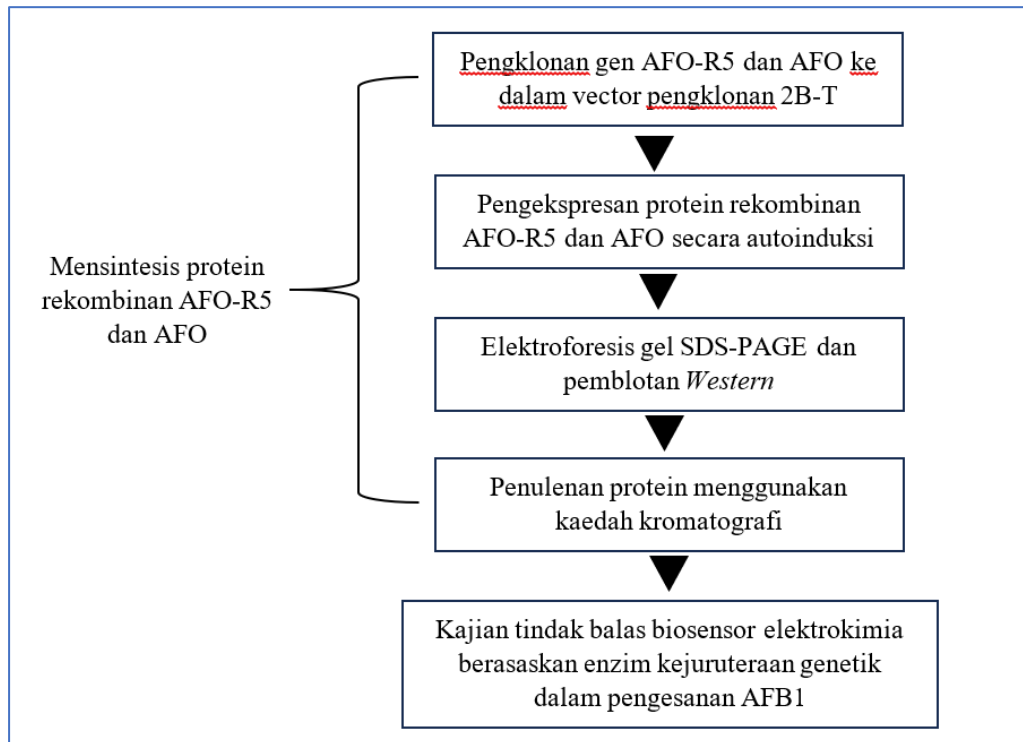
Rajah 4.1 Carta alir kaedah kajian sintesis protein rekombinan AFO-R5 dan AFO

5. KEPUTUSAN DAN PERBINCANGAN

Plasmid rekombinan AFO-R5 dan AFO berjaya diekspreskan secara autoinduksi ke dalam plasmid *E. coli* BL21 (DE3). Pengekspresan AFO dinyatakan lebih tinggi berbanding AFO-R5 berdasarkan saiz protein pada SDS-PAGE supernatant sel bebas. Berdasarkan jisim molekul, hasil penulenan pantas mengesahkan protein AFO dan AFO-R5 berjaya disintesis dengan jisim molekul AFO=77 kDa dan AFO-R5=79 kDa. Kajian Xu et al. (2017) berkenaan kajian struktur kristal aflatoksin oksida juga memperolehi jisim molekul AFO daripada *Armillariella tabescens* dalam 79 kDa. Pencirian tindak balas biosensor elektrokimia berasaskan enzim rekombinan AFO-R5 terhadap AFB$_1$ melalui CV menunjukkan rangsangan redoks yang dipertingkatkan dalam julat keupayaan 1.0 V-1.0 V terhadap elektrod rujukan Ag/AgCl menggunakan elektrolit penimbal 0.05 M Tris-HCl (pH 8.0) yang menggandungi 0.05 M ferisianida dan 0.1 M KCl (Nirbhaya et al. 2021) berbanding dengan rangsangan biosensor tanpa kehadiran AFB$_1$ disebabkan AFO-R5 terpegun memangkinkan tindak balas pengoksidaan AFB$_1$ pada ikatan karbon tak tepu struktur cincin bisfuran kepada sebatian penambah oksigen tidak stabil, iaitu exo-AFB$_1$-8,9-epoxide (AFBO) (Sinelnikov et al. 2023), dan hasil sampingan H$_2$O$_2$ (Guo et al. 2020). Kajian DPV juga mengesahkan puncak DPV elektrod enzim rekombinan yang telah dipertingkatkan secara ketara pada 0.57 V dalam kehadiran substrat AFB$_1$ pada kepekatan 112 nM atau 35 µg kg^{-1}.

6. KESIMPULAN

Berdasarkan sintesis dan ekspresi enzim, didapati peptida R5 telah berjaya ditandakan kepada gen AFO melalui proses pengsubklonan dan pengekspresan. Selain itu, peptida R5 juga dapat diterapkan baik

sebagai bio-katalis pada gen AFO-R5 yang mendorong proses biosilisifikasi dan sebagai komponen pemegunan tag afiniti untuk meningkatkan afiniti enzim redoks pada permukaan elektrod bagi penentuan kuantitatif AFB$_1$ berdasarkan pemindahan elektron secara langsung antara pusat redoks enzim rekombinan terpegun dan elektrod. Dengan itu, enzim AFO-R5 yang dihasilkan secara kerujuteraan genetik berpotensi digunakan dalam pembangunan biosensor elektrokimia untuk mengesan AFB$_1$ dalam makanan. Kajian validasi biosensor enzim kejuruteraan genetik terhadap kaedah piawai HPLC dalam penentuan kuantitatif kepekatan AFB$_1$ dalam makanan yang diproses seperti jagung, beras, dan kekacang, yang amat penting dalam bidang pertanian dan industri makanan.

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PENCIRIAN GEOPRODUK BAGI LANGKAWI UNESCO GLOBAL GEOPARK (LUGGp)

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1. PENGENALAN

Pengiktirafan Langkawi sebagai UNESCO Global Geopark (LUGGp) pada 1 Jun 2007 telah mengangkat Langkawi sebagai Geopark pertama di Asia Tenggara dan ke-52 di dunia. Pengiktirafan ini disebabkan keunikan yang terdapat di pulau ini serta nilai warisan bertaraf antarabangsa selain faktor geologi. Pendekatan geopark pada prinsipnya memberi tumpuan kepada tiga komponen utama iaitu, 1) pemuliharaan sumber warisan tabii (geologi dan biologi) dan budaya; 2) pembangunan lestari wilayah; 3) pendidikan sepanjang hayat dan pembangunan komuniti yang memberi penekanan kepada keseimbangan pelancongan umum dan khusus serta penekanan komuniti sebagai penjaga warisan. Melalui integrasi ketiga-tiga komponen tersebut, geopark menjadi alat pembangunan yang mengiktiraf hubungan saling kebergantungan antara warisan tabii dan manusia. Hubungan ini terbentuk melalui keupayaan tapak warisan tabii dijadikan aset sepunya dalam pembangunan sosio-ekonomi setempat ke arah meningkatkan kesejahteraan komuniti (Ibrahim, Mazlin & Sarah Aziz 2010). Bagi meningkatkan kesejahteraan komuniti, pelbagai usaha turut dilaksanakan, termasuklah memperkenalkan geoproduk, iaitu penghasilan produk tempatan berasaskan sumber alam tabii dan budaya yang terdapat di Langkawi.

2. PERMASALAHAN KAJIAN DAN SOROTAN KAJIAN

Geoproduk sebenarnya mula diperkenalkan oleh geopark Naturtejo, (NUGGp) dan diiktiraf oleh Rangkaian Geopark Eropah pada tahun 2000 dan kemudiannya diiktiraf oleh Rangkaian Geopark Global pada tahun 2004 (Rodrigues & Neto de Carvalho 2009). Geoproduk dihasilkan oleh komuniti tempatan (rakan kongsi Geopark) dan mereka menggalakkan ekonomi tempatan, berkait rapat dengan wilayah Geopark (Popa et al. 2018; Andrasanu & Ciobaru 2018; Yuliawati et al. 2019a). Penerapan perasaan sepunya terhadap Langkawi geopark ini penting dalam mewujudkan Semangat 'Kawi yang mendasari pembentukan budaya dalam sanubari komuniti tempatan dan pihak berkepentingan yang lain (Ong et al. 2010). Geoproduk telah mula diperkenalkan di Langkawi UGGp oleh pihak LADA pada tahun 2018. Pembangunan geoproduk di Langkawi UGGp adalah dengan mengiktiraf produk yang dihasilkan menggunakan sekurang-kurangnya 50% bahan yang terdapat di Langkawi (LADA 2024). Namun, sebagai sebuah pulau tidak dapat dinafikan terdapat kesukaran bagi menghasilkan produk dengan menggunakan lebih 50% bahan mentah dari Langkawi disebabkan lokasi geografi yang terhad dan ini telah menghalang geoproduk terus berkembang. Justeru, kajian ini dilaksanakan bagi mengenalpasti pencirian geoproduk dan menyediakan garis panduan berkaitan dalam memastikan geoproduk Langkawi UGGp yang berkualiti terus berkembang serta memberi nilai kepada pengunjung.

3. OBJEKTIF KAJIAN

Kajian ini mempunyai tiga objektif utama yang memfokuskan kepada pengenalpastian dan pencirian geoproduk yang terdapat di Langkawi UGGp. Namun begitu, dalam pembentangan kolokium kali ini hanya objektif yang pertama dan kedua akan dibincangkan, iaitu objektif pertama; mengenal pasti geoproduk dan objektif kedua; membangunkan pencirian geoproduk yang terdapat di Langkawi UGGp.

4. KAEDAH KAJIAN

Bagi menjawab objektif pertama dan kedua, kajian ini telah menggunakan analisis kandungan dokumen dan pemerhatian di lapangan. Analisis kandungan dokumen telah dilakukan ke atas 14 buah dokumen dan 15 artikel berkaitan geoproduk (Burns 2000). Aspek yang ditumpukan adalah mengenai definisi dan pencirian geoproduk bagi mempelbagaikan geoproduk dalam merancakkan sektor ekonomi Langkawi. Manakala bagi pemerhatian di lapangan adalah menggunakan kaedah pemerhatian secara terus dengan melihat perkembangan geoproduk dan melakukan temu bual tidak berstruktur bersama pengusaha geoproduk. Kaedah persampelan bertujuan digunakan bagi mengumpulkan data yang melibatkan agensi pembangunan Langkawi UGGp, Lembaga Pembangunan Langkawi (LADA) menerusi Bahagian Pelancongan, Seksyen Geopark dan sepuluh orang pengusaha geoproduk (Wiersma 2000). Pengumpulan data ini melibatkan dua proses, iaitu sebelum dan semasa serta data sekunder dan data primer. Gerak kerja yang terlibat sebelum pengumpulan data melibatkan penelitian terhadap kajian lepas berdasarkan kata kunci yang dipilih iaitu geopark, geoproduk, produk tempatan dan komuniti. Data ini diperoleh melalui penelitian kajian lepas daripada sumber-sumber bertulis iaitu, Laporan Penilaian UNESCO Global Geopark, Pelan Pengurusan Langkawi Geopark (PPLG 2012-2030), Pelan Strategik LADA 2022-2026, Pelan Pengurusan Langkawi UNESCO Global Geopark 2024-2028, Laporan Tahunan LADA 2016-2022 dan artikel berkaitan. Data yang diperoleh daripada kaedah pemerhatian direkod melalui nota lapangan dan foto diekstrak sebagai catatan nota lapangan.

5. KEPUTUSAN DAN PERBINCANGAN

Menerusi proses triangulasi data, Langkawi UGGp mempunyai 14 geoproduk berbanding 20 geoproduk sebelum ini setelah melalui beberapa proses pelantikan semula sejak 2018 (LADA 2024). 14 produk dan pengusaha produk yang masih diiktiraf bermula tahun 2024 sehingga 2027 kerana menggunakan bahan 50% dari Langkawi manakala enam geoproduk yang tidak dilantik semula disebabkan penggunaan bahan dari luar Langkawi. ini telah menyebabkan bilangan geoproduk semakin menurun dan tidak dapat berkembang. Justeru, pencirian geoproduk perlu dilaksanakan mengikut kesesuaian lokasi atau kawasan UGGp dan tidak termaktub kepada mana-mana definisi. Langkawi UGGp seharusnya menetapkan pencirian geoproduk yang lebih sesuai tanpa menafikan keistimewaan sumber alam tabii yang terdapat di Langkawi, meskipun mempunyai kekangan lokasi yang terhad bagi mendapatkan sumber bahan mentah agar terus kekal relevan dan berkembang. Berdasarkan analisis data dan pemerhatian, pencirian geoproduk menggunakan 30% bahan mentah dari Langkawi dengan skala pengukuran yang fleksibel adalah lebih relevan sebagai sebuah pulau dengan melihat matlamat serta objektif utama geoproduk adalah bagi meningkatkan sosioekonomi masyarakat setempat dan berdasarkan pencirian baharu ini terdapat lebih dari 14 produk boleh diiktiraf sebagai geoproduk dan dengan cara ini ianya dapat mempelbagaikan pilihan geoproduk sekaligus membuka lebih banyak peluang pekerjaan dan sekaligus dapat menjana pendapatan komuniti Langkawi UGGp. Garis panduan juga akan disediakan bagi memberi panduan kepada LADA dan pengusaha geoproduk dalam memastikan produk yang ditawarkan berkualiti dan mampu bertahan dalam industri selain terus mengekalkan identiti Langkawi UGGp.

6. KESIMPULAN

Berdasarkan kajian yang dilaksanakan, pencirian geoproduk seharusnya mengikut kekuatan kawasan agar matlamat sebenar pembangunan geoproduk dapat dimanfaatkan secara maksimum. Penyediaan garis panduan yang lengkap dan koordinasi serta sistem penyampaian yang berkesan amat penting dalam memastikan objektif membangunkan geoproduk tercapai.

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**BIOMIMICRY OF ARCHITECTURE TO ENHANCE SUSTAINABILITY
OF LUSHAN UNESCO GLOBAL GEOPARK**

XIONG LYUXIN | P118292 | PhD

Main Supervisor: Assoc. Prof. Dr. Tanot Unjah
Co-Supervisor: Sr. Dr. Mazlan Mohd Tahir

1. INTRODUCTION

As German philosopher Walter Benjamin puts it, mechanical reproduction frees art from ritual and makes it an alternative practice. The inherent weakness of reproduction is the absence of the subject. Meanwhile, American literary theorist Fredric Jameson expresses the same option: at the heart of reproduction is the loss of the subject, the 'death of the subject'.

Architecture serves as a physical art as described in the ancient Roman architect Vitruvius's book *The Ten Books of Architecture*, the three principles of biomimicry are linked to architectural concerns of 'attractive', 'utility' and 'soundness' as a medium (Buren 2024).

In line with the theory of biomimicry proposed by Janine Benyus in 1997, involves identifying, analyzing and translating the language of nature. It is not simply a matter of replicating nature's design but of thoroughly understanding nature's strategies and thinking about natural factors to solve complex human problems. The biomimicry perspective suggests that nature has mastered and demonstrated the three principles of "effective", "appropriate", and "durable" in the course of evolution (Pathak 2019).

2. PROBLEM STATEMENT

Nowadays, when the sensory system is becoming more and more unconscious, "image perception" gradually replaces "real perception", and "image space" replaces "real space" as well. As a world cultural heritage, Lushan has always been the contradiction between the protection and utilization of historical buildings, the lifestyle and cultural heritage of residents, and the ability of tourists to better understand and experience local customs. Which also poses a great threat to the natural landscape and ecological environment.

3. OBJECTIVE

To identify architecture indicators related to biomimicry and environment that can enhance sustainable development.

4. METHOD

This research mainly adopts two research methods: content analysis and field observation. The Content analysis (Mishra & Alok 2022) began by identifying keywords including "Lushan UNESCO World Geopark", "biomimicry", "architecture", "sustainability". Secondly, Web of Science, local history and published books about Lushan is chosen as the main body of analysis. Focus again on the five aspects of planning and architecture: idea, layout, form, structure, and material. Finally, the focus is on the morphological characteristics of planning and architecture that is representative of the adaptation to the topography of the mountainous terrain, the strong structural characteristics that maintain stability and disaster prevention needs, and the performance appearance that matches the climatic conditions to create excellent natural adaptability.

The Field Observation (Femenias & Thuvander 2018) in this research is a comprehensive investigation of the buildings in the Lushan Geopark. It is necessary to understand the idea, form, function, structure and materials of planning and architecture. It focuses on the environmental adaptation process of biomimicry. The first is to adapt to the morphological characteristics of mountain topography, to maintain stability and disaster prevention requirements. The second is to create excellent natural adaptability performance combined with climate conditions.

5. RESULTS AND DISCUSSION

The existing architecture of Lushan, it was found that the elements related to biomimicry were included the White Deer Cave Academy in ancient Qing Dynasty and the Guling town planning and villa group under the influence of modern western ideas in modern times.

Biomimicry is the technique of taking inspiration from natural patterns, processes and cycles and applying them to solve problems. The process of biomimicry varies based on historical time, but the process is no more than four stages: the establishment of the medium, the formation of ideas, the creation of activities and the evaluation of adaptations.

### 5.1 Classical Chinese Architecture White Deer Cave Academy
White Deer Cave Academy, the practice of "Feng Shui" as a technology demonstrates the use of taking inspiration from nature and applying it to solve the problem of integrating people with buildings and the environment (Zhao et al. 2023). The White Deer Cave Academy emphasises integration with nature, observing natural factors, such as mountain topography, water flow, environmental climates, and plant communities, reflecting the environmental adaptability of traditional Chinese architecture and thinking about the human habitat. The Shuyuan uses the site environment to create microclimatic conditions to manage the humid and hot local climate, combining gardens with natural ventilation, and lighting to complement the dynamic environment.

5.2 Guling Town Planning Influenced by Early Modern Western Planning Conceptions
The combination of biomimicry and environmental ethics has given rise to the concept of 'biomimicry ethics', in which nature is not only a template for technological innovation but also a standard of measurement by which to assess the conformity of our practices with the principles of nature. This way of thinking emphasises that our ethical relationship to nature involves not only the protection of the various values of the natural world, but also the consideration of whether nature provides measurable ecological standards for our practices (He et al. 2015). From a biomimicry perspective, the layout of modern Guling Town reflects a quantitative expression of adaptation to the topography and climate of the environment, in terms of zoning, transport design, villa layout, and expression of livability.

5.3 Early Modern Architecture in Guling Township
The villa clusters of early modern architecture in Guling Town fully embody the aesthetic interests of Western architecture, demonstrating the Western way of seeking aesthetics and problem solving in nature and the human body. Modern European architecture was inspired by ancient Greek and Roman architecture and, after many revivals, established an order that valued symmetry, proportion, and balance. Russian architecture was used to express national will, political power, and social progress; American architecture went through a variety of styles, from neoclassical to modernist, high-tech, and deconstructivism; and the invention of steel and lifts facilitated the skyscraper as an urban symbol and landmark (Cai et al. 2021).
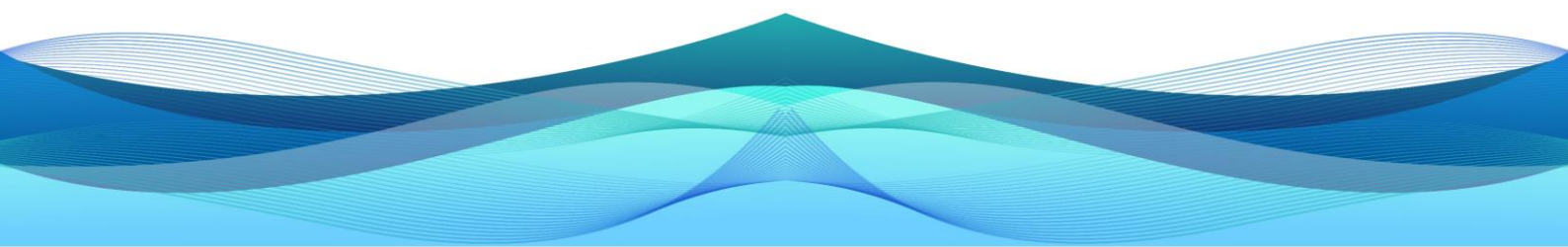
6. CONCLUSION

Architecture should return to the natural and functional needs of materiality, so that it can truly touch the deep consciousness and essential nature of human beings, as Russian director Tarkovsky and French philosopher Merleau-Ponty said, and make it a necessity for the practice of art. Architecture as a medium can help people to establish a connection with the real environment and build a harmonious coexistence between human and nature. As a medium and biomimicry, architecture, is regarded as a technological idea, is the simplest means to express nature.

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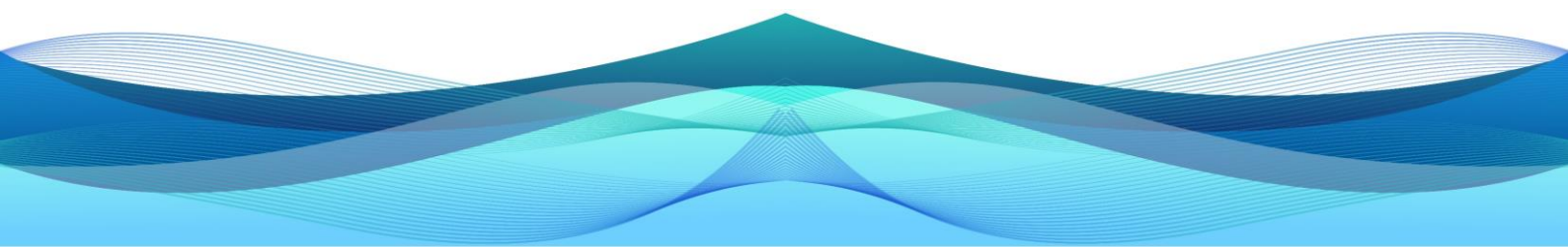
INTEGRATING DIGITAL ELEMENTS INTO THE EVALUATION FRAMEWORK OF PAPER-CUT CREATIVE DESIGN FOR SUSTAINABLE CULTURAL TOURISM IN TAIYUAN, CHINA

YANG JIE | P121729 | PhD

Main Supervisor: Ts. Dr. Lim Chen Kim
Co-Supervisor: Prof. Ts. Dr. Lee Khai Ern
Co-Supervisor: Prof. Dr. Zhang Li Min

1. INTRODUCTION

According to UNESCO's 2003 Convention for the Safeguarding of the Intangible Cultural Heritage (ICH), Chinese paper-cut was listed as one out of 43 Representative List of the ICH of Humanity in China in 2009. Chinese paper-cut is a folk art that uses scissors or carving knives to cut patterns on paper and is used to decorate life or cooperate with other folk activities (UNESCO 2009). In China, the Ministry of Culture and Tourism issued the Notice on Promoting the In-depth Integration of ICH and Tourism, which promotes the integrated development of ICH and tourism into tourism space, enriching tourism products, setting up experience centers, and protecting cultural ecology (Central People's Government of the People's Republic of China 2023). Digital creative design product is one of the pillars to promote the integrated development of ICH and sustainable cultural tourism, which is also one of the tools to realise the Chinese paper-cut. To achieve this goal, the digitalisation of ICH encompasses a broader range of cultural knowledge, digitalisation technologies, and processing, encoding and storage of digital resources (Stewart et al. 2021). The elements of paper-cut as cultural creative products pay attention to the interaction of aesthetic, culture, practices, social, origins and other factors to achieve innovative cultural combination (Liu & Men 2022). However, these elements lack digital interaction as an evaluation. Therefore, this evaluation-based research will integrate all aspects of digital elements into the creative design framework of Taiyuan paper-cut to enhance the sustainable cultural tourism development of Taiyuan city.

2. PROBLEM STATEMENT

This study has three problem statements, two problem statements that will be focused are: the first is the lack of experience in all aspects of digital creative design of ICH and the numerous opportunities and challenges encountered (Smithies et al. 2023). The second is the lack of an evaluation framework for ICH digital creative design to promote sustainable development of intangible cultural heritage tourism (Vert et al. 2021).

3. OBJECTIVE

This study has three main objectives, focusing on the evaluation of ICH digital creative design for the sustainable development of cultural tourism. Two objectives that will be focused are: to analyse the experience of stakeholders in various aspects of ICH digital creative design in cultural tourism, and to propose an evaluation framework for ICH digital creative design to promote the sustainable development of ICH tourism based on tourist data.

4. METHOD

This study uses a mixture of qualitative and quantitative research methods. The population of this study is in Taiyuan, Shanxi Province, China. The first objective, the qualitative research adopts the semi-structured interview method, and the stakeholders consisting the non-genetic inheritors and their

apprentices, enterprise personnel, designers and researchers related to Taiyuan paper-cut. A total of 14 respondents were studied in-depth and the purpose sampling method was used. The second objective, the quantitative research adopts KANO (Noriaki Kano) questionnaire and analytic hierarchy process, adapted from previous studies and scales (Wang et al. 2022), and uses random sampling to collect 451 questionnaires, which are confirmed by experts in related fields. The questionnaire is divided into three sections: section A is the cognition of intangible cultural and creative tourism products, section B is the evaluation of the importance of digitalisation of intangible cultural and creative tourism products, and section C is the demographic information of the respondents. Finally, NVIVO and SPSS were used for descriptive analysis of all the information, and the necessary type, expectation type and charm type of evaluation framework were obtained.

5. RESULTS AND DISCUSSION

In the semi-structured interview of the qualitative research, more than half of the respondents (57.1%) had worked in ICH or ICH tourism-related fields for more than 5 years and indirectly described their experience with ICH and its tourism. According to the results of the data analysis, when sustainable cultural tourism is questioned, the majority of stakeholders answered in the affirmative (91.7%) that they agree with and are willing to try the digital creative design of ICH in their respective fields. Among the three levels of instinct, behaviour, and reflection in digital creative design, the cultural inheritance and aesthetic value of the reflection level are considered the most important by respondents (50%), followed by the colour perception, graphic creation, modelling appearance of the instinct level, and the practical function and interactive experience of the behaviour level (41.7%). In quantitative research using a questionnaire survey in digital creative design, excluding undifferentiated and reversed types, the date shows that colour perception, cultural inheritance and modelling appearance are necessity types, practical function, graphic creation and aesthetic value are expectation types, spiritual belief, skill perception and interactive experience are charm types.

6. CONCLUSION

Based on the research data, it can be concluded that the weight relationship of stakeholders to the importance of nine indicators in the three levels of digital creative design. The research results show that the necessity types, expectation types and charm types of digital creative design play a decisive role in the evaluation framework of ICH tourism.

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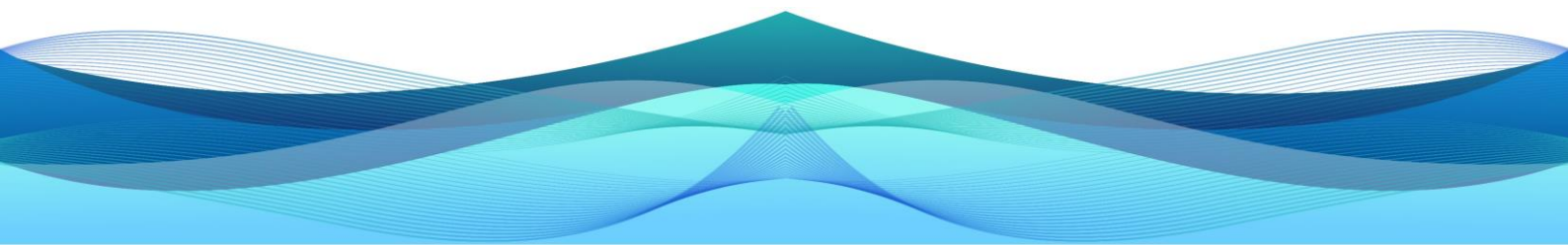
THE IMPACT OF URBANIZATION ON THE SUSTAINABILITY OF TEA CULTURE INDUSTRY IN SICHUAN PROVINCE

WANG JUE | P122116 |PhD

Main Supervisor: Prof. Dr. Ahmad Fariz Bin Mohamed
Co-Supervisor: Gs. Dr. Nuriah Abd Majid

1. INTRODUCTION

Tea in Sichuan is famous for its unique quality and traditional production process. However, with the acceleration of urbanization, this has not only affected tea cultivation and production but also posed new challenges to the local ecological environment and cultural heritage. While urbanization has directly affected the reduction of tea plantation areas, changes in tea cultivation and production methods and shifts in market demand, ecological damage, and lagging in tea culture research, it has also spawned the modern dissemination and branding of tea culture, injecting new vitality into the traditional culture. The Sustainable Development Goals (SDGs) proposed by the United Nations contain 17 goals covering environmental, economic, and social aspects, and the goals relevant to this study are decent work and economic growth (SDG8), industry, innovation, and infrastructure (SDG9), sustainable cities and communities (SDG11), responsible consumption and production (SDG12), and partnerships for goal achievement (SDG17). These goals call on us to achieve sustainable development in an environmentally friendly, economically sustainable and socially inclusive manner, and point the way for the future development of the tea culture industry.

2. PROBLEM STATEMENT

Urbanization in Sichuan Province has increasingly encroached on traditional tea areas, leading to the fragmentation of tea plantations due to land development and industrial growth (Cao & Shao 2023). Over the past 20 years, the spatial distribution of tea plantations has shifted significantly, though research on the long-term impacts of urbanization on these landscapes remains limited.

Most tea-growing regions in Sichuan are located in remote, ecologically stable areas, free from urban pollution (Wang & Li 2016). However, as urbanization advances, industrial activities and infrastructure development may encroach on these areas, risking air and water pollution (Chen & Wang 2021). Additionally, improper agricultural practices could lead to soil and water contamination (Liu et al. 2020). Infrastructure development, like road construction, might further disrupt ecosystems, affecting biodiversity and the health of tea plants (Xu et al. 2019; Gao & Zhou 2021).

Labor migration is another factor contributing to the fragmentation of tea plantations, limiting the industry's sustainability (Yang 2010). Consumer preferences have shifted from basic functionality to quality, packaging, and cultural value (Li et al. 2019). Despite this, many Sichuan tea companies are still underperforming in cultural branding, resulting in low added value for their products (Wang & Li 2016). This study, based on research by the Department of Agricultural Research of Sichuan Province (DARSP), and the National Academy of Agricultural Sciences of Sichuan Province (NAASSP), aims to address these challenges by advocating for scientific land use regulation to ensure the sustainable development of Sichuan's tea industry, balancing environmental, social, and economic factors within the framework of global sustainability.

3. OBJECTIVE

Environmental Benefits: The primary goal is to evaluate how urbanization affects the distribution and landscape patterns of tea plantations, identifying key factors that lead to fragmentation. This will help determine the critical environmental elements needed to sustain the tea culture industry.
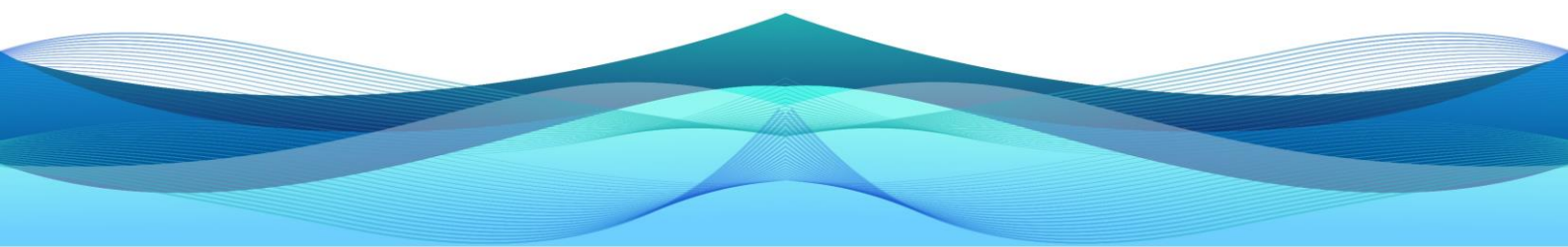
Social Benefits: The second objective is to examine urbanization's impact on the social aspects of the tea culture industry in Sichuan Province. This includes changes in farmers' incomes, living standards, cultural identities, and the preservation of traditional skills, aiming to pinpoint the essential social factors for the industry's sustainability.

Economic Benefits: The third aim is to analyze urbanization's influence on the economic aspects of the tea culture industry, such as shifts in urban market demand, industry growth, and employment opportunities. This will uncover the key economic factors vital for sustaining the tea culture industry.

4. METHOD

To answer the first research objective, the experiment firstly extracted the boundaries of tea plantations in 2000, 2005, 2010, 2015 and 2020 based on Random Forest Supervised Classification (RFC) using Landsat series of satellite remote sensing data images. Secondly, Patch Density, PD, Largest Patch Index, LPI and Landscape Shape Index, LSI were calculated based on land use data in Fragstats Landscape Ecology software and weighted as dependent variables of the study. In order to study the impact of urbanization on the change of tea garden landscape pattern, socio-economic data including population growth rate, GDP growth rate, and building density were collected as independent variables and finally analyzed based on the geodetector method.

In order to answer the second and third research objectives, this study used questionnaires and in-depth interviews as research tools to obtain data on the economic impact, social impact, and environmental impact of urbanization on the tea culture industry. The subjects of this study were tea farmers, tea industry workers, tea industry-related government department staff and tea consumers, as well as tea culture experts and scholars in Sichuan Province. A total of 250 respondents were studied in depth using non-random sampling, and 240 valid questionnaires were returned. The recovery rate reached 96%. Meanwhile, the questionnaire used in this study was self-developed and was validated by experts in the relevant fields after conducting a pre-survey before entering the formal stage. This questionnaire is divided into five parts: part A is the basic information of the respondents, while Part B reveals the extent of the respondent's understanding of the economic impact of urbanization on the tea culture industry. part C clarifies the extent to which the respondents attach importance to the social impact of urbanization on the tea culture industry, part D illustrates the extent to which the respondents experience the environmental impact of urbanization on the tea culture industry, and Part E is the extent to which urbanization affects the sustainable development of tea culture industry in an overall situation. By using the Statistical Package for Social Sciences (SPSS) software to conduct descriptive analysis, factor analysis and multivariate statistical analysis of all the information, structural equation modelling to deal with the complex influence relationship between the dependent and independent variables, and quantify the impact of each factor on the social sustainability of the tea culture industry moderates the study of the impact of urbanization on the social dimension of the tea culture industry and realizes the socio-cultural sustainable development of the tea culture industry.

5. RESULTS AND DISCUSSION

For research objective one: The results show that from 2000 to 2020, the tea plantation area in Sichuan Province shows an overall growth trend, but the tea plantation landscape fragmentation also rises significantly, while the increase of building density is the main driving factor leading to the tea plantation landscape fragmentation, and the interaction of urbanization-related factors increases significantly. In this paper, we pioneered the combination of remote sensing feature identification and geodetector in the study of the drivers of landscape pattern changes in tea plantations, which provides a practical method for the subsequent development of related applied research.

For research objectives II and III: The 240 respondents were demographically balanced in terms of gender distribution, with 51.2% male and 48.8% female. In terms of age, the largest number of respondents were in the 26-35 age group (33.3%), followed by the 18-25 age group (28.3%). Among the occupations, consumers accounted for the largest share (40.8%), while tea farmers accounted for 10.4%. In terms of regional distribution, Ya'an had the highest representation at 38.3%. Reliability and validity tests showed high internal consistency and suitability for factor analysis. Factor analysis revealed the structure and composition of the data related to the different dimensions of the study. In the gender t-test, there were significant differences in the socio-cultural and ecological dimensions, but not in the market economy and urbanization factor dimensions. Age ANOVA showed significant differences in the market economy and urbanization factor dimensions, but not in the socio-cultural and ecological environment dimensions. For occupation, there were significant differences in the socio-cultural dimension, while for the region, there were significant differences in the market economy dimension. Correlation analysis shows that socio-cultural and ecological environment are significantly negatively correlated with gender. There is a strong positive correlation between urbanization factors and market economy and socio-cultural.

6. CONCLUSION

Research Objective 1:
This study analyzed the impact of urbanization on the landscape patterns of tea plantations using Landsat satellite data, Random Forest Supervised Classification (RFC), Fragstats, and ArcGIS PRO. The findings reveal that although the total area of tea plantations has increased over the past 20 years, landscape fragmentation has also risen significantly. Building density, in particular, has been a major contributor to this fragmentation, highlighting the challenges of conserving tea plantation landscapes amidst rapid urbanization. Future planning should focus on integrated, eco-friendly strategies to ensure the sustainability of these landscapes, benefiting both the environment and economic development.

Data Accuracy: While Landsat 5 and Landsat 8 provide high spatial resolution, they may not be fine enough to accurately identify small tea gardens, potentially leading to misclassification. Differences in image acquisition times, lighting conditions, sensor status, and cloud cover across different years could also affect data consistency and accuracy.
Indicators: The study primarily used patch density (PD), the largest patch index (LPI), and the landscape shape index (LSI) to assess fragmentation, but these metrics may not fully capture the landscape's complexity and diversity.
Model Construction: The model may oversimplify certain relationships and lacks dynamic simulations or predictions of landscape changes in tea plantations, limiting its ability to fully understand the processes involved.
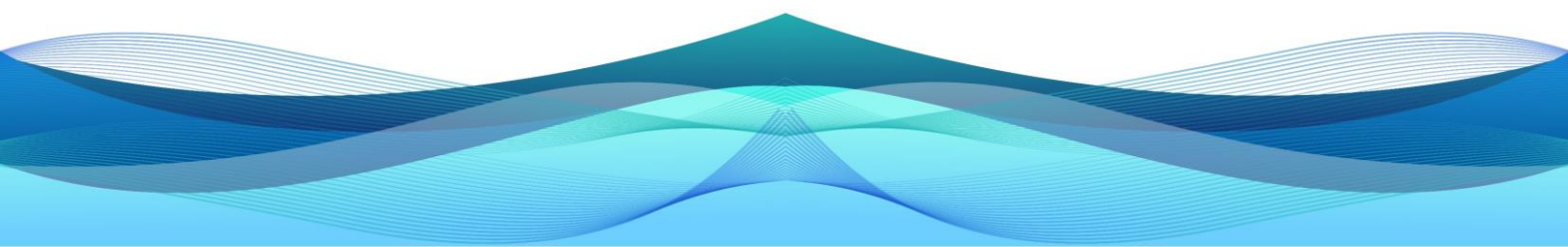
Research Objectives 2 and 3:

H1 Verification: The standardized total effect of Urbanization_Factors on Market_Economy is 0.559, with a direct effect of 0.412 and an indirect effect of 0.147, indicating a significant positive impact of urbanization on the tea industry's market economy.

H2 Verification: The coefficient between Urbanization_Factors and Social_Culture is 0.545, showing a strong positive effect of urbanization on the social culture of the tea industry.

H3 Verification: The coefficient between Urbanization_Factors and Ecological_Environment is 0.430, confirming a positive impact of urbanization on the tea industry's ecological environment.

H4 Verification: The indirect impact of Urbanization_Factors on Market_Economy through Social_Culture is 0.083, indicating that urbanization's enhancement of social culture can indirectly boost the market economy by attracting more consumers and investors.

H5 Verification: The indirect impact of Urbanization_Factors on Market_Economy through Ecological_Environment is 0.064, suggesting that a better ecological environment, driven by urbanization, can indirectly strengthen the market economy by improving tea quality and yield.

In summary, the positive coefficients in all hypotheses demonstrate that urbanization significantly benefits the market economy, social culture, and ecological environment of the tea industry. These factors interact directly and indirectly, supporting the sustainable development of Sichuan Province's tea culture.

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**INTEGRATION OF DIGITAL SUSTAINABILITY INTO THE BUZI CULTURAL HERITAGE
OF THE MING-QING DYNASTY (1368-1912) IN CHINA**

XU ZIHAN | P120831 | MASTER

Main Supervisor: Ts. Dr. Lim Chen Kim
Co-Supervisor: Dr. Minhaz Farid Ahmed
Co-Supervisor: Assoc. Prof. Dr. Lyu Jia

1. INTRODUCTION

Buzi is a square decoration located on the front chest and back of the Ming-Qing official uniforms, which is composed of different animal figurines, cloud patterns, water patterns, rocks, sun, and borders, according to different eras (Xiong et al. 2024). It was a political tool used by the emperor to manage officials. The Buzi itself is hierarchical, and the rank of the official is determined by the animal figurines on the Buzi (Mao et al. 2024). For example, the 1st - 9th rank of the Qing Dynasty civil officials respectively used cranes, golden pheasants, peacocks, cloud geese, white pheasants, herons, emus, quails, and magpies as the main patterns; The military generals of the Qing Dynasty were represented by fierce beasts, such as the unicorn for the 1st rank, the lion for the 2nd rank, the leopard for the 3rd rank, the tiger for the 4th rank, the bear for the 5th rank, the tiger cub for the 6th rank, the bull for the 7th and 8th rank, and the horse for the 9th rank (Zheng 2023). The Buzi not only reflects the performance of feudal etiquette in clothing but also shows the cultural heritage and aesthetic pursuit of ancient China. The study of Buzi is of far-reaching significance for inheriting and protecting the excellent traditional clothing culture of the Chinese nation and promoting cultural diversity and international exchanges. This study will integrate digital sustainability into the Buzi heritage of the Ming and Qing dynasties in China through data extraction, preservation, and interviews. For this colloquium, the interview is focused.

2. PROBLEM STATEMENT

Buzi's research presents an active academic trend. It mainly focuses on history and culture (Xiong et al. 2024; Mao et al. 2024; Zheng 2023; Yu 2024), cultural heritage preservation (Huang 2019), design innovation and application (Hua 2024; Li et al. 2023; Ma 2023), digitalization and sustainability (Ranjgar et al. 2024; Li et al. 2023; Cui et al. 2023), and the research spans across multiple disciplines. These studies have contributed to theoretical, methodological, and practical applications, but they also face many challenges. For example, the Buzi motifs comparative analysis of the Ming-Qing dynasties with modern needs to be complemented (Zhang et al. 2024; Zhu 2024). There is still much room to explore the sustainability of cultural heritage preservation, especially in terms of increasing public interest (Jing et al. 2024; Wang et al. 2024). The diversity and complexity of data lead to limited preservation (Borlund et al. 2024; Xu et al. 2024; Wang et al. 2024). Therefore, the question "What is the Buzi patterns evolution of the Ming-Qing dynasties as compared to modern trend? How to reach out to the public to increase participation? How to collect and store data?". For this colloquium, the issue of public participation is focused.

3. OBJECTIVE

Based on the above problem statement and research questions, the following are three corresponding research objectives: use digital technology to analyze and compare the differences between Ming-Qing dynasties and modern Buzi patterns; Through semi-structured interviews to evaluate and enhance public participation and interest in Buzi's cultural heritage; to utilize digital technologies to create an accessible Buzi database. This phase focuses on the 2nd objective.
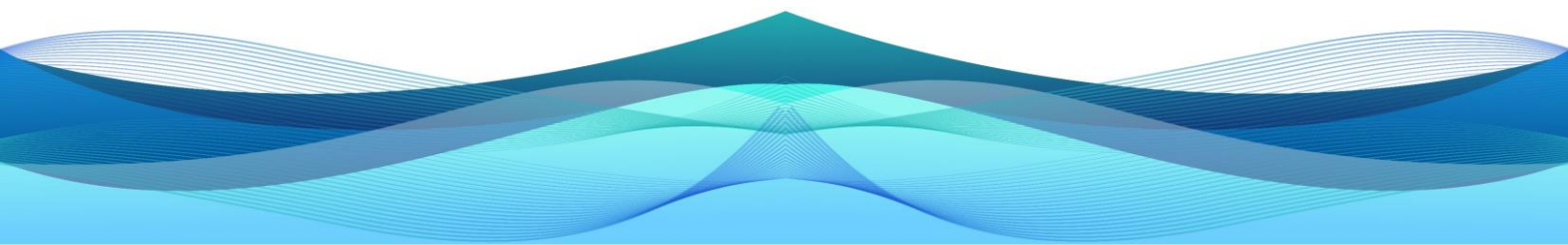
4. METHOD

This study is a qualitative research. Based on the literature research method and comparative analysis method, Zotero was used to collect the literature, and CNKI Visual Analysis and Adobe Photoshop were used to analyze the literature. Based on the interview method and content analysis method, Sojump was used to collect interviews and MAXQDA was used to analyze interviews. This stage focuses on the sample collection process for semi-structured interviews. This stage focuses on the sample collection process and interviews results of semi-structured interviews.
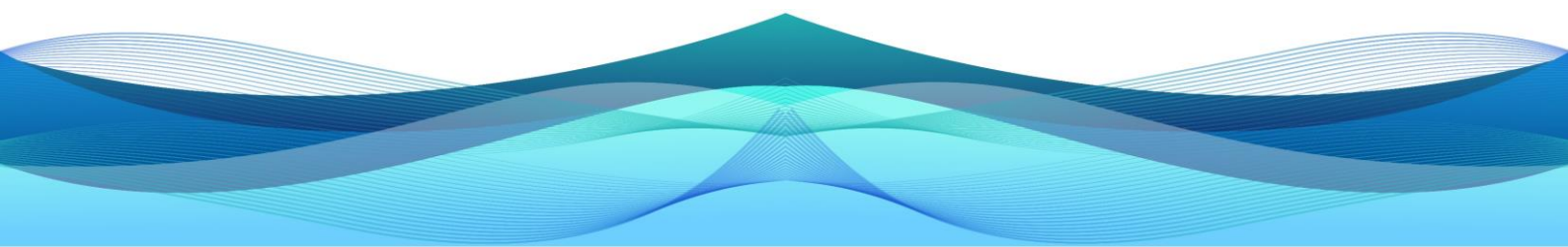
To understand the public's attitudes and perceptions towards "Buzi-cultural heritage-digital sustainability", considering the representativeness, professionalism, and diversity of the interviewees, the comprehensiveness and reliability of the research results, and the geographical, time, and economic costs, this study used occupational stratification sampling to select the respondents, including two history professors, three Buzi enthusiasts, three "Hanfu" enthusiasts, three fashion design students, three museum staff, four social media active users, and two ordinary community residents. When recruiting, information is disseminated through multiple channels, and targeted interviewees are directly invited. After initial consent is obtained, send a detailed letter and informed consent form (approved by the UKM Ethics Committee JEP-2024-003) specifying the details of the study and data protection measures, to be signed to confirm participation. The interviews are scheduled to take place from April to September 2023, with each session lasting about 30 minutes at flexible locations. At the end of the day, the recordings are quickly transcribed within 24 hours, and the data is encoded to ensure that the results of the study are comprehensive and reliable.

5. RESULTS AND DISCUSSION

The results of the interviews show that most of the respondents (85%) (especially history professors, Buzi fans, Hanfu enthusiasts, and museum staff) have some knowledge about Buzi, mainly due to their professional background or interest. As for active social media users and general community residents, although some of them may not be fully know of Buzi (15%), many of them indicated that they have heard about it through different channels. This reflects a certain degree of social knowledge of the Buzi as a cultural heritage. Respondents generally agreed on the importance of the Buzi as a symbol of status and rank for officials (100%) and pointed out the artistic value of its motifs, its exquisite craftsmanship, and the symbolism behind it. When it comes to the sustainability of the digitization of cultural heritage, the majority of respondents expressed their support (80%). They believe that digitization is an effective means of preserving cultural heritage, expanding dissemination, and improving accessibility. At the same time, they are aware of the important role of digitization in preserving cultural heritage information for a long time and making it accessible and learnable to a wider audience. The non-supporters (20%), on the other hand, were concerned that digitization might weaken the authenticity and uniqueness of the original artifacts, or worried about data security and privacy issues. Regarding the combination of traditional elements with modern products, younger groups (e.g. students, and social media users) were generally supportive (60%), believing that it could increase the appeal and cultural connotation of the products. Neutral respondents, on the other hand, emphasized that it depends on the design and presentation of the specific product (40%).

6. CONCLUSION

Through semi-structured interviews, this phase of the study gained an in-depth understanding of the public's perception and attitude towards "Buzi-cultural heritage-digital sustainability", further verified the importance and challenges of the protection of Buzi heritage and digital sustainability in previous

studies and supplemented the specific practices of public participation improvement in previous studies. It also provides a richer empirical basis and direction for future research.

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DISSEMINATION MANAGEMENT SYSTEM FOR SHU BROCADE WEAVING TECHNIQUES FOR DIGITAL COMMUNITY AND SUSTAINABILITY IN CHENGDU, CHINA

YAN ZI | P120119 | PhD

Main Supervisor: Ts. Dr. Lim Chen Kim
Co-Supervisor: Assoc. Prof. Dr. Sharina Halim
Co-Supervisor: Prof. Dr. Hu Dongmei

1. INTRODUCTION

The Shu brocade weaving techniques are regarded as the first batch of representative items of China's traditional techniques of Intangible Cultural Heritage (ICH) for its high historical, artistic, and economic value (Ministry of Culture and Tourism of the People's Republic of China 2006). Since preservation, dissemination, and enhancement are the measures for safeguarding the ICH (UNESCO 2003), Chinese national and local governments have also raised the importance of promoting the digital dissemination of ICH (China's State Council 2017 & 2021; Sichuan Provincial People's Government 2021; The Ministry of Culture and Tourism of China 2023). However, the failure to include stakeholders to be familiar with traditional skills in the dissemination process, and the lack of authentic complete recording and dissemination of cultural connotations and precious skills, resulted in unsatisfactory dissemination of ICH. Therefore, this research constructs a new dissemination management of the Shu brocade weaving techniques that combines the evaluation indicator system to assess the current digital dissemination effect of the Shu brocade weaving techniques; and proposes the dissemination strategy for a "digital community" which includes technologies, stakeholders, and social media. By integrating digital means and stakeholders, this research aims to achieve Sustainable Development Goals (SDG) 11.4 and to ensure the long-term preservation of cultural heritage and integrity, thus fostering its digital sustainability.
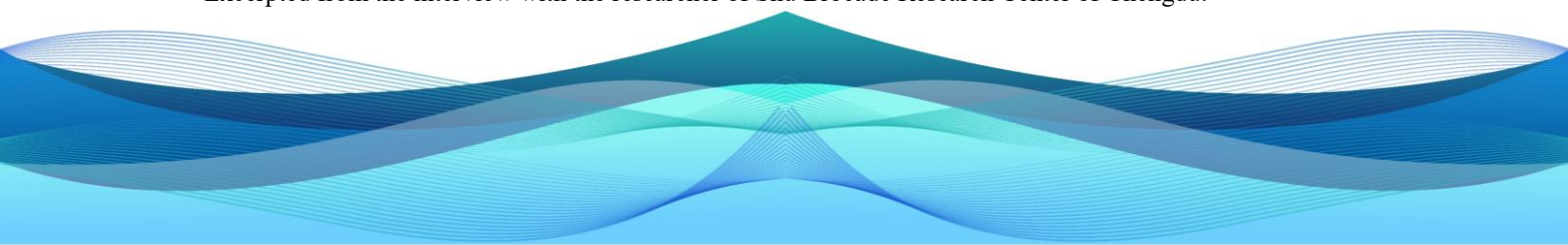
2. PROBLEM STATEMENT

A previous study identified that ICH lacks the assessment of its digital dissemination effect (Xue et al. 2019), thus threatening the scientific evaluation and long-term development of the Shu brocade weaving techniques. Meanwhile, the dissemination of the Shu brocade weaving techniques lacks stakeholder engagement[1] and needs the combination of technology and cultural connotation[2], to expand public understanding and recognition of ICH culture (Chen et al. 2022; Li & Kim 2023), and to achieve a digitally sustainable community (Sparviero & Ragnedda 2021). Therefore, this study constructs a dissemination management system to contribute to the digital sustainability of the Shu brocade weaving techniques in Chengdu.

3. OBJECTIVE

This study focuses on the effect assessment and new strategy of the digital dissemination of Chengdu's Shu brocade weaving techniques of ICH, to promote the development of China's cultural diversity, and achieve the goal of digital sustainability of ICH. Two objectives are highlighted as follows: (1) to construct an evaluation indicator system of the digital dissemination effect of the Shu brocade weaving techniques, and (2) to propose a dissemination strategy for the "digital community", both of which together constitute the dissemination management system proposed in this study.

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[1] Excerpted from the interview with the manager of Chengdu Intangible Cultural Heritage Protection Center.
[2] Excerpted from the interview with the researcher of Shu Brocade Research Center of Chengdu.

4. METHOD

To achieve research objective 1, this research was vetted by two social scientists and was verified by the UKM Ethics Committee (Approval Code: JEP-2024-002) and adopted a qualitative research method by conducting semi-structured interviews with stakeholders, covering managers, researchers, and industry participants of the Shu brocade weaving techniques, and used the purposive sampling method of non-probability sampling to select the most representative 10 people among the three types as the respondents. Original data were analyzed using NVivo (Allsop et al. 2022) to determine the initial evaluation indicators. The Delphi method was further used to collect the opinions of 30 related experts and combined with the Analytic Hierarchy Process (AHP) method (Zhou et al. 2022) to determine the weights of each indicator to form the final evaluation indicator system. Based on the primary data collection through systematic literature review and the constructed evaluation indicator system as the secondary data, a dissemination strategy for the "digital community" is proposed, to fulfill the research objective 2.

5. RESULTS AND DISCUSSION

Analyzing the results of semi-structured interviews with 10 stakeholders through the NVivo software, this study preliminarily determines the evaluation indicators of the digital dissemination effect of the Shu brocade weaving techniques; and combines with the AHP method to assess the weights of a total of 33 indicators in 5 dimensions to construct the evaluation indicator system of the digital dissemination effect of the Shu brocade weaving techniques to achieve research objective 1, and obtains the results that complete recording and expression of skills (83.3%), financial support (82%), reduce the impact of the disappearance of inheritors (82%), good communication between stakeholders (81.3%), smooth transmission channels (81.3%), as well as the authenticity (81%) are the most important indicators, to fill in the gaps of previous research on Chengdu's ICH and on evaluating the effectiveness of digital dissemination of traditional techniques of ICH. Therefore, the proposed "digital community" emphasizes the in-depth participation of stakeholders and technology to ensure the authenticity and complete cultural connotation in the process of dissemination, and healthy communication and interaction of stakeholders through digital platforms, to fulfill research objective 2 and to achieve sustainable development of precious local cultural resources.

6. CONCLUSION

Based on interviews, expert questioning, and AHP methodology, this study constructed an evaluation indicator system of the digital dissemination effectiveness of the Shu brocade weaving techniques and a "digital community" dissemination strategy to achieve research objectives 1 and 2. The importance of digital sustainability as a guiding principle for future dissemination efforts is emphasized in this process, to ensure the enduring protection and accessibility of ICH for present and future generations. The dissemination management system will be provided to the management department of Chengdu's ICH as an important reference for its 2025-2030 ICH development plan.

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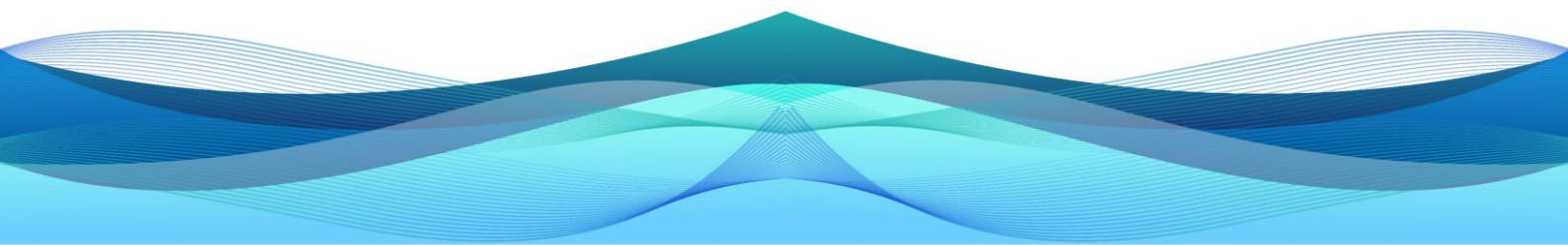
MEMETAKAN TABURAN SPATIAL KEDALAMAN OPTIK AEROSOL (AOD) DI MALAYSIA MENGGUNAKAN PELBAGAI PENDERIA: KAJIAN KES JEREBU SEPTEMBER DAN OKTOBER 2023

SITI AMINAH ANSHAH | P119394 | SARJANA

Penyelia Utama: Ts. Dr. Murnira Othman
Penyelia Bersama: Dr. Ooi Chel Gee
Penyelia Bersama: Prof. Ts. Dr. Kasturi Devi Kanniah

1. PENGENALAN

Pencemaran aerosol di atmosfera ialah kehadiran zarahan dalam bentuk pepejal atau cecair mikroskopik yang terampai di udara boleh memberi kesan buruk kepada alam sekitar dan kesihatan manusia. Zarahan ini terdiri daripada zarahan kasar yang bersaiz 10 µm dan zarahan halus bersaiz kurang dari 2.5 µm (Naing & Lee 2020). Sumber pencemaran aerosol termasuklah aktiviti perindustrian, asap dari kenderaan dan kebakaran hutan dan pertanian (Khokhar et al. 2019). Kesan buruk yang boleh dikaitkan kepada manusia adalah risiko kelahiran pra-matang, peningkatan gejala asma dan penurunan fungsi paru-paru (Othman et al. 2022). Di samping itu, pencemaran aerosol turut menyebabkan lapisan ozon menjadi nipis, mengganggu kitaran awan dan keseimbangan sinaran atmosfera.

Kedalaman optik aerosol (AOD) adalah parameter mengukur aerosol menggunakan intrumen seperti fotometer matahari, radiometer dan LIDAR (Li et al. 2025) yang dipasang di bumi. Walau bagaimanapun perkembangan teknologi angkasa memberi peluang AOD boleh diukur menggunakan penderiaan jauh. Teknologi penderian jauh ini boleh dibahagikan kepada dua kategori iaitu satelit polar kutub dan satelit geostasioner. Satelit polar kutub telah lama digunakan untuk memantau kualiti udara di Malaysia manakala satelit geostasioner adalah teknologi yang baru diperkenalkan lebih kurang empat tahun kebelakangan ini. Satelit yang membuat cerapan di negara Malaysia adalah dari Himawari-8/9 dan Geostationary Environment Monitoring Spectrometer (GEMS). Satelit ini adalah dari negara Jepun dan Korea.

2. PERMASALAHAN KAJIAN DAN SOROTAN KAJIAN

Sebahagian negara di Asia Tenggara merupakan negara yang pesat membangun dan aktif dalam ekonomi berasaskan pertanian. Sisa pertanian dan pembakaran biojisim telah menghasilkan bahan pencemar yang tinggi dalam bentuk zarahan halus dan kasar (Othman et al. 2022). Bilangan stesen pemantauan kualiti di Malaysia adalah terhad dan tidak dapat memberi maklumat sebenar pencemaran yang telah berlaku. Maka teknologi satelit digunakan untuk memberi maklumat pencemaran meliputi kawasan yang lebih besar dengan kos yang berpatutan (Bilal et al. 2018; Hsu et al. 2013).

Satelit polar kutub yang biasa digunakan untuk pencemaran udara adalah dari penderia MODIS yang telah mencerap lebih dua puluh tahun. Walaupun begitu, masih terdapat kelemahan satelit jenis ini kerana resolusi temporalnya adalah rendah. Resolusi temporal yang rendah boleh menyebabkan berlaku kehilangan data reruang. Maka dengan sebab itu, teknologi satelit dari geostasioner diperkenalkan dalam pemantauan kualiti udara kerana kadar resolusi temporal jauh lebih tinggi berbanding satelit polar kutub (Handschuh et al. 2022).

3. OBJEKTIF KAJIAN

Objektif kajian ini adalah memetakan taburan spatial AOD dari satelit polar kutub dan geostasioner bagi kejadian pencemaran jerebu yang berlaku di sebahagian Asia Tenggara disebabkan oleh pembakaran hutan di Indonesia yang berlaku pada September dan Oktober 2023.

4. KAEDAH KAJIAN

Kajian ini melibatkan beberapa peringkat seperti muat turun data satelit daripada (1) Jaxa: *https://global.jaxa.jp/*, (2) GEMS: *https://nesc.nier.go.kr/en/html/satellite/viewer/index.do#* dan (3) MODIS MAIAC *LP DAAC - Resources (usgs.gov)*, pra-pemprosesan data, menganalisis data dan menghasilkan peta taburan spatial AOD. Beberapa perisian dan aplikasi digunakan seperti *python Jupyter notebook*, *GEMSAT*, *Panoply*, *Google Earth Engine* dan ArcGIS. Data yang dimuat turun adalah bermula dari 20 September 2023 sehingga 20 Oktober 2023.

5. KEPUTUSAN KAJIAN DAN PERBINCANGAN
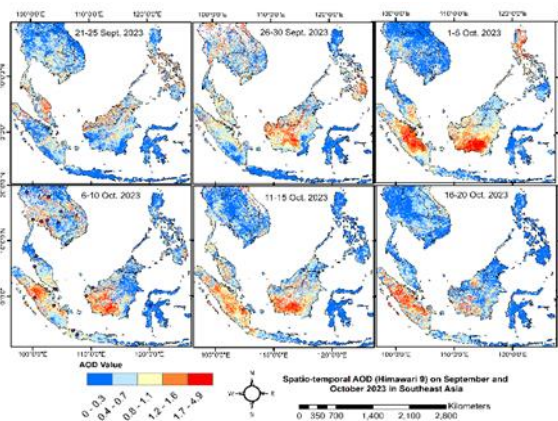
Rajah 1. Taburan spatial AOD dari data Himawari 8/9 (kiri)
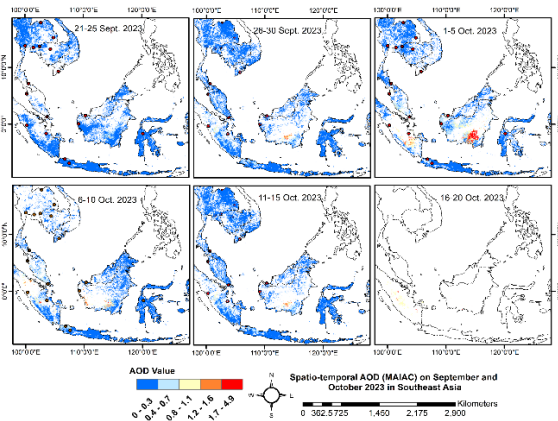
Rajah 2. Taburan spatial AOD dari data MODIS (MAIAC) (kanan)

Rajah 1 menunjukkan taburan spatial AOD dari data penderia Himawari 8/9. Data secara harian diproses dan dilakukan *mosaic* bagi setiap lima hari 21-25 Sept., 26-30 Sept, 1-5 Oktober, 6-10 Oktober, 11-15 Oktober dan 16-20 Oktober 2023. Proses yang sama dijalankan untuk data dari Rajah 2 (MODIS-MAIAC). Julat AOD adalah dari 0-4.9, menunjukkan semakin tinggi nilai AOD semakin tercemar kawasan tersebut. Oleh kerana kebakaran hutan di Barat Sumatera, Selatan Sumatera dan di Selatan Kalimantan, Indonesia dikesan terjadi pada minggu ketiga di bulan September 2023. Maka peta taburan AOD ini boleh memaparkan perubahan peningkatan nilai AOD di kawasan kebakaran sehingga membawa jerebu ke Singapura, Semenanjung Malaysia, Sabah dan Sarawak disebabkan faktor angin monsun barat daya. Laporan daripada agensi kualiti udara di Malaysia meletakkan status daripada tidak sihat kepada sangat tidak sihat. Peta dari Rajah 1 menunjukkan data Himawari yang padat dan hanya sedikit kehilangan data. Oleh kerana, Himawari-8/9 berkeupayaan mencerap kawasan liputan setiap jam dan telah dipuratakan secara harian berbanding data dari MODIS-MAIAC kitaran adalah 16 hari tetapi telah menggunakan formula khusus bagi mendapatkan purata data secara harian.
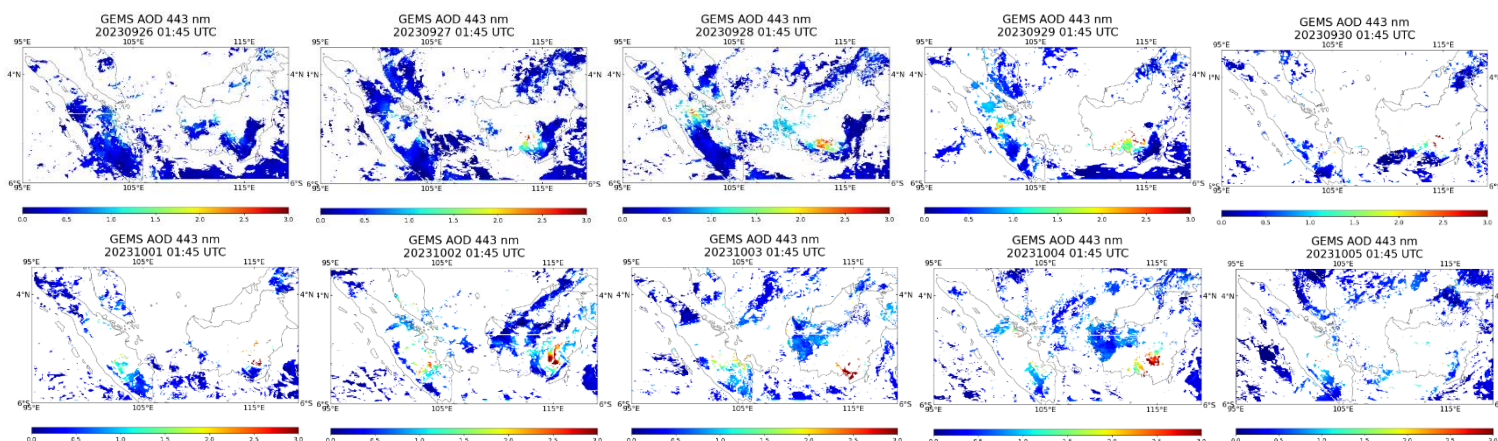
Rajah 3. Taburan spatial AOD dari data GEMS

Rajah 3 adalah data GEMS dari satelit negara Korea yang baru diorbitkan pada 2020 dan data cerapan bagi negara Malaysia hanya boleh dimuat turun bermula Ogos 2023. Peta taburan AOD ini di tunjukkan secara setiap hari pada waktu 0145 UTC bersamaan jam 9.45 pagi waktu Malaysia. GEMS berkemampuan untuk mencerap setiap jam pada siang hari berjaya menunjukkan perubahan nilai AOD semasa berlakunya kejadian jerebu 2023.

6. KESIMPULAN

Menggabungkan data daripada satelit geostasioner dan polar kutub berpotensi meningkatkan keputusan memetakan pencemaran AOD dengan lebih baik, terutamanya di kawasan yang diliputi awan menyebabkan halangan untuk mendapatkan cerapan data.

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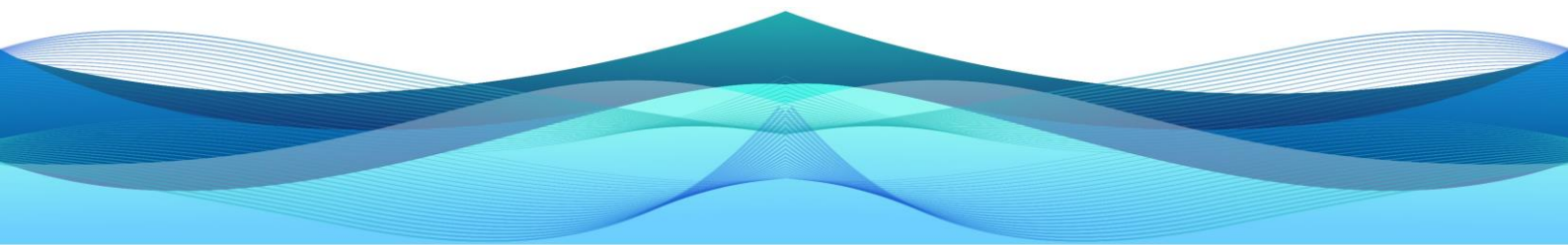
IDENTIFYING FLOOD MANAGEMENT CHALLENGES IN MALAYSIA: A CASE OF SHAH ALAM CITY

HAZIQ SARHAN BIN ROSMADI | P126807 | SARJANA

Main Supervisor: Dr. Minhaz Farid Ahmed
Co-Supervisor: Prof. Emeritus Dato' ChM. Dr. Mazlin Bin Mokhtar

1. INTRODUCTION

Floods in Malaysia are natural geohazards caused by heavy rainfall, with two types: flash floods and monsoon floods. Monsoon floods occur during the northeast monsoon season while flash floods usually can occur anytime in areas with rapid development, causing rapid water level rise, intense winds, and debris. The December 2021 floods were one of the worst flash floods, affecting 33 districts in 8 states with 62,999 persons displaced in 430 evacuation centres (AHA Centre 2021). Shah Alam, a city near the Klang River, is one of the areas that is susceptible to flooding due to its confluence of smaller rivers. The city's urban transformation from oil palm plantations has worsened the issue. Although Malaysia has become more skilful in managing flood disasters after long history of flood disaster, the climate changes nowadays along with weakness in implementing flood risk management plans resulted in much losses and damages throughout the country (Haziq Sarhan et al. 2023). Therefore, this study focuses on identifying challenges exist in current flood management specifically around Shah Alam, Selangor area for improving the existing flood management plan.

2. PROBLEM STATEMENT

Shah Alam was one of the most affected areas during the 2021 floods with total number of fatalities in Shah Alam alone up to 14 people (BERNAMA 2021). The area around Shah Alam had history of major floods such as the Taman Seri Muda area, which was hit by a major flood in December 1995 (Zain 2022). Weaknesses in terms of disaster management are the main focus where there are still deficiencies in terms of communication and cooperation involving government agencies, non-governmental organizations (NGOs) and residents (Mabahwi 2020). Some of the examples were difficulties in coordination during disaster and information sharing. The government has made efforts, revamping drainage systems and implementing better flash flood management but the problem persists because a holistic approach is needed (Praveena Nair 2024). Therefore, this study article aims to provide an overview of the challenges exist in current flood management plan especially in local level management in Shah Alam, Malaysia. The findings in this study from multi-stakeholder following the quadruple helix stakeholders' model will be used as references for the local government to improving the flood management plan thus minimising the flood effect in the Shah Alam area.

3. OBJECTIVE

This study was conducted to identify challenges exist in current flood management specifically around Shah Alam, Selangor area for improving the existing flood management plan.

4. METHOD

Primary data was collected through informal interviews with twenty informants following the quadruple helix stakeholders' model, focusing on four main sectors: government, academia, business, and community/NGO. Five informants in government and academia were chosen using purposive sampling based on their influence and knowledge about floods and the management in the Shah Alam area, while

businesses and communities were chosen based on their preparedness for flash floods. This method was chosen to identify and to list out all the challenges faced by each member of the local stakeholder group that hindering them to tackle the flash flood problem properly together. Secondary data was also collected through a comprehensive review of books, journals, research papers, and government reports to back up the findings from informal interview. The study received ethical approval from the UKM Research Ethics Secretariat reference number (UKM PPI/111/8/JEP-2023-011), ensuring participant confidentiality and safety. A qualitative theme analysis was used to examine the interview information, based on four themes adapted from the UNDRR: understanding disaster risk, enhancing disaster risk governance, investing in disaster risk reduction and preparedness, early warning, and rebuilding better after a disaster (UNDRR 2015). The Taguette tool was used for data analysis to create a codebook of the themes, their descriptions, and supporting phrases (Rampin & Rampin 2021). Taguette 1.4.1 is the version of this tool that is available under a BSD-3-Clause license. Finally, for validation, all twenty research participants were contacted to verify details and solicit their input on the findings to improve the report, fill in gaps, and address any concerns or objections raised by the participants.

5. RESULTS AND DISCUSSION

The study discovered that the local government lacks proactive leadership responsibilities for coordination and collaboration among agencies and other related parties, as well as inadequate data support and communication infrastructure. This leads to issues in implementing flood management programs. Cooperation is sometimes hampered by policy and bureaucratic conflicts, particularly in large-scale initiatives involving several organisations. Problems with several agencies and officers of different grades and positions have emerged, which makes it difficult to promote efficient cooperation. Report on from 2021 supports this assertion by stating that this problem results from "ranking" in the uniform units and some of the agencies have greater levels and influences compare to others (Mabahwi 2020). Additionally, there is a lack of real-time information shared, which presents challenges for rescue teams during emergency. Some of the data and valuable information needed were not centralized causing precious seconds during emergencies that could be better used to save a lot more victims during flooding events. This problem also affecting the public as some of them admitting that "there was no proper information" during emergency time thus hindering evacuation process.

6. CONCLUSION

In conclusion, major constraints from aspects such as jurisdictions and policies greatly inhibit planning by the implementing party. For future recommendation, as a first step, close cooperation with various parties, including residents, is very important to reduce the gaps thus covering for each party's weakness. Next, the presence of NADMA at the local level is crucial for overseeing management and creating more influential leadership and proactive leadership by the local authorities led by the district office. Lastly, a centralized data centre should be established and managed by the local authority with full cooperation from government agencies to ensure real-time information is accessible during emergencies.

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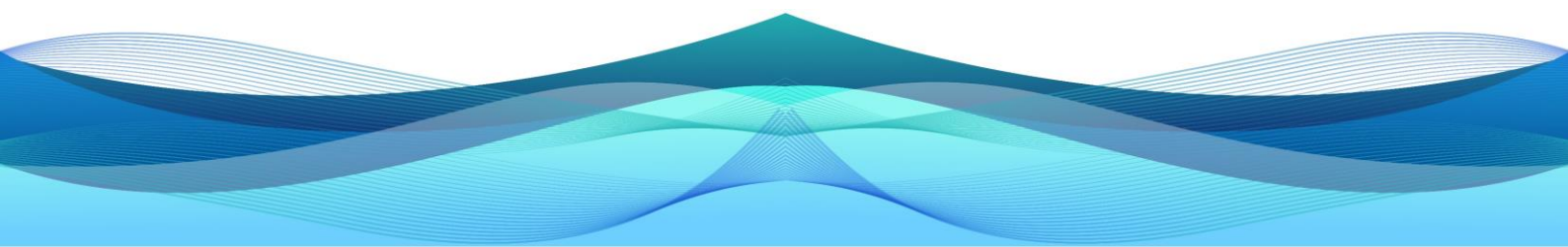
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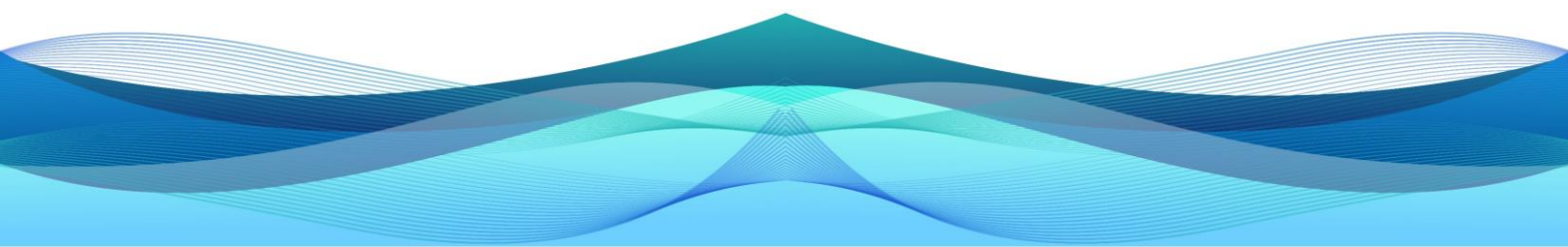
FLOOD RISK MAPPING AND COMMUNICATION GUIDELINE FOR MULTI STAKEHOLDER TO REDUCE DISASTER RISK AT SHAH ALAM, MALAYSIA

ADAM NARASHMAN BIN LEEONIS | P126808 | SARJANA

Main Supervisor: Dr. Minhaz Farid Ahmed
Co-Supervisor: Prof. Emeritus Dato' ChM. Dr. Mazlin bin Mokhtar

1. INTRODUCTION

In Malaysia, one of the known disasters is flooding caused by continuous rain and monsoon winds. It is, however, prevalent mostly in the lowland zones. Flash floods, often caused by human activities such as industrialization, transportation, irregular drainage system management, and logging in river catchment areas (Ghazali 2000), can equally occur from long, continued heavy rains (Jamaluddin et al. 2010). Severe floods from intense precipitation are becoming more frequent globally, exacerbated by climate change, which increases the risk of economic and non-economic losses (Minhaz & Mazlin 2022). In tackling flood issues, the use of GIS applications is needed and utilized to generate flood risk maps. The use of GIS can also be used for understanding, managing, and mitigating the impacts of floods, leading to more effective and informed flood management strategies (Johari et al. 2022). However, in managing flash flood disasters in Shah Alam, Malaysia, various challenges and issues arise when employing GIS. Therefore, appropriate actions should be carried out, such as improving communication between multi-stakeholders, in order to be able to manage flood disasters.

2. PROBLEM STATEMENT

Heavy rain over a long period of time is one of the causes of flash floods that occurred in Shah Alam, Malaysia, in 2021. This disaster has caused many negative effects on the social, economic, and environmental. To control flooding, the government as well as researchers have resorted to the use of Geographic Information System (GIS) applications for purposes of mapping floods. However, public access to GIS-based flood information is relatively limited, and public education and engagement through GIS tools are still developing, while other countries like Australia and the United States have developed public-facing GIS platforms that allow citizens to access flood risk maps, for example. FEMA's Flood Map Service Center provides easy access to flood maps for any location in the United States (FEMA 2020). Despite efforts by government and local councils to address annual flooding, poor awareness of GIS utilization among stakeholders and the public remains a significant problem. This study aims to give multi-stakeholders a communication guideline for a better use of Geographic Information System (GIS) based on flood risk mapping to reduce flood risks. Conducting community awareness campaigns and organizing community workshops and training sessions can ensure that the use of GIS will be more effective.

3. OBJECTIVE

This study aims to develop a communication guideline for multi stakeholders to better use flood risk mapping at Shah Alam, Malaysia.

4. METHOD

This study used a qualitative method to identify challenges by using GIS applications, and appropriate actions should be taken by all sectors to improve flood management in Shah Alam, Malaysia. The study used a qualitative approach, conducting informal interviews using the quadruple helix model method.

Primary data collection involved selecting 20 respondents from four key sectors: government, academic, business, and community/NGO to get information about the use of GIS in flood management in Shah Alam Malaysia. Qualitative thematic analysis using Taguette was employed for data analysis. For the validation of the data analysis, all 20 participants have already been contacted by researchers, who will follow up once more to verify their information and get input on the findings. After the informal interview was conducted, some information and responses were analyzed and arranged according to the theme that was modified from the Sendai Framework, UNDRRR, in 2015 regarding the use of GIS in flash flood management at Shah Alam, Malaysia.

5. RESULTS AND DISCUSSION

Based on output, this study shows some keywords: information about GIS, benefits using GIS, limited access, high cost, lack of equipment, and improvement for better use of GIS related to the use of GIS in flood management. However, there are some factors that need to be resolved, such as Malaysia's gaps and deficiencies in flood risk management (Haziq et. al. 2023) The data from the informal interviews were analyzed using Taguette, and it showed that there are many challenges as well as advantages to using GIS in flash flood disaster management in Shah Alam, Malaysia. One expert, an officer from the Malaysia Civil Defence Force (APM), said lack of awareness and equipment for using GIS for community is one of the challenges facing Malaysia now. For example, flood disaster management is not only dependent on management, but from a technical point of view also needs to be taken seriously because the authorities should also better understand the use of GIS for their own benefit when managing flood disasters in Shah Alam, Malaysia. Therefore, the application of this GIS should be done by all sectors, especially once in academia, by holding a workshop or GIS training among employees in each agency so that they know more about the use or importance of this GIS more carefully, and residents in Shah Alam can also better understand and realize the current situation before the occurrence of flash floods.
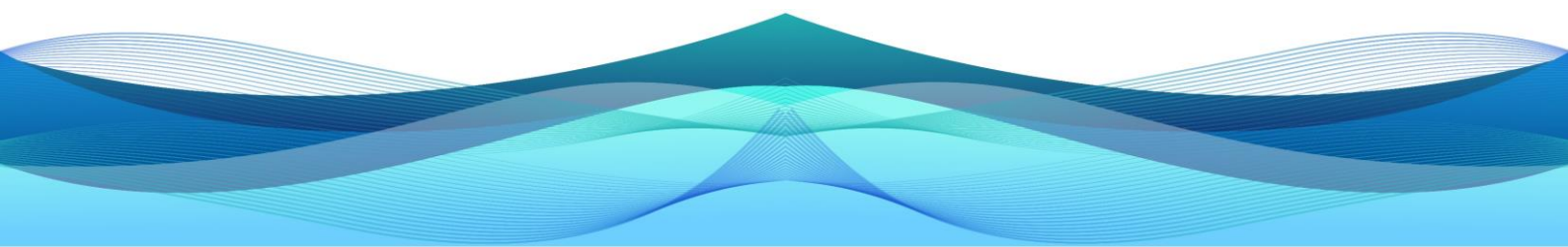
6. CONCLUSION

In conclusion, there are various challenges that have occurred throughout the use of GIS in managing flash flood disasters in Shah Alam, Malaysia, by government agencies. There are annual floods and incorporating various types of safety, but often the problem is poorly solved because of the low popularity of such information and ineffective control. By using the communication guide, it can have an effective effect in increasing the awareness of the community to use flood mapping better, and authorities such as local governments, NGOs, and district offices can identify the appropriate steps to fully use this GIS application in management. Therefore, communication guidelines are created to ensure that all stakeholders involved in the use of GIS in Shah Alam can collaborate effectively, respond quickly during emergencies, and contribute to the sustainable management of flood risks. The understanding and application of GIS can be greatly enhanced by holding workshops or GIS training, encouraging collaboration between community citizens and government agencies, and conducting awareness campaigns. This will lead to improved flood management and disaster response, especially at Shah Alam, Malaysia.

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IMPACT OF ENVIRONMENTAL MANAGEMENT SYSTEMS (EMS) ON OIL AND GAS INDUSTRY IN THE KINGDOM OF SAUDI ARABIA (KSA)

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Main Supervisor: Assoc. Prof. Dr. Sharina Abdul Halim
Co-Supervisor: Dr. Lubna Alam
Co-Supervisor: Dr. Abdulaziz Elsinawi

1. INTRODUCTION

The oil and gas industry in the Kingdom of Saudi Arabia (KSA) is a cornerstone of the nation's economy, yet it is also a significant source of environmental concerns (Waxin et al. 2018). The rapid industrial growth and intensive resource extraction have led to various environmental challenges, including air and water pollution, waste management issues, and ecosystem degradation (Said et al. 2018). These environmental impacts have necessitated the adoption of robust management practices to mitigate adverse effects and promote sustainable development. One of the most effective tools for managing environmental impact is the Environmental Management System (EMS). An EMS provides a structured framework for companies to systematically assess and improve their environmental performance (Ikram et al. 2019). It encompasses setting objectives, decision-making, data collection, monitoring progress, and continuous improvement in resource use, waste reduction, and emissions control. By implementing EMS, companies can establish formalized processes to minimize environmental incidents and comply with local environmental regulations and standards. This study evaluates the impact of EMS implementation in the KSA oil and gas industry.

2. PROBLEM STATEMENT

The oil and gas industry in the KSA faces significant environmental challenges due to its extensive operations and rapid industrial growth (Ali et al. 2022). Environmental degradation, including air and water pollution, waste management issues, and ecosystem damage, has become a critical concern (Waheed 2022). Despite the potential benefits of EMS in mitigating these impacts, the adoption and implementation of EMS within the KSA oil and gas sector remain inconsistent and fragmented. The primary problem is the lack of comprehensive understanding and evaluation of EMS effectiveness in this industry. There is a gap in comparing the environmental performance of EMS-adopting companies versus non-EMS companies, leading to uncertainties about the tangible benefits of EMS protocols. This study seeks to address these issues by investigating the impact of EMS on environmental performance in the KSA oil and gas industry. It aims to provide a comparative analysis and predict the potential environmental benefits of EMS adoption.

3. OBJECTIVE

The main aim of this study is to examine the impact of EMS implementation in the oil and gas industry in the KSA. Two specific objectives guide the study in achieving this aim. First, it compares the environmental effects of oil and gas operations between companies that have adopted EMS protocols and those that have not. Second, the study predicts the potential environmental benefits of EMS adoption through a comprehensive analysis of EMS protocols and their implications for the KSA oil and gas industry.
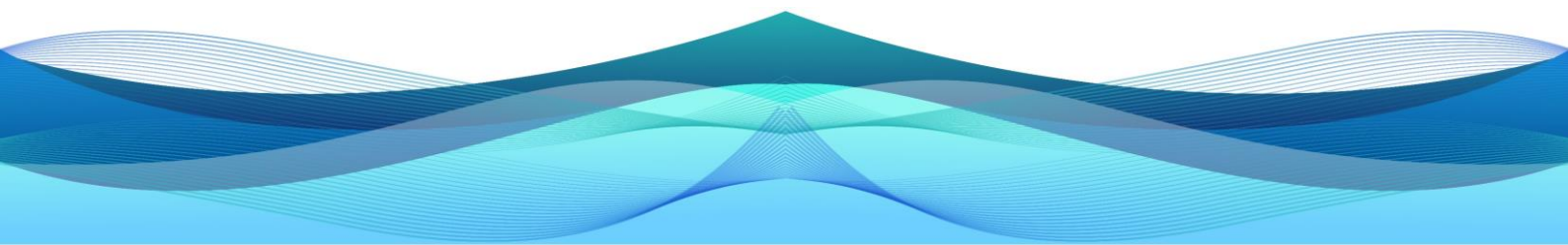
4. METHOD

This research employed a mixed-methods approach comprising surveys, interviews, and advanced statistical analyses to achieve the objectives of this study. For the first objective, this study used a two-step methodology involving surveys and interviews. This research conducted a structured survey of 10 EMS and 12 non-EMS companies to collect quantitative data on environmental impacts, including volumes of atmospheric emissions, wastewater, and solid waste, and incidents of spillage and leakage. Following the survey, this study performed semi-structured interviews to gain qualitative insights into the companies' environmental histories and the effectiveness of their EMS practices. For the second objective, which is to predict the impact of EMS on the environment, this study used surveys and interviews to gather data on the willingness to adopt EMS and the challenges faced. The survey included questions on institutional pressures, environmental commitment, and perceived challenges related to EMS adoption. This research employed Multiple Linear Regression (MLR) to predict environmental outcomes based on these factors.

5. RESULTS AND DISCUSSION

Table 1. Environmental Effects Comparison between EMS and Non-EMS Companies.

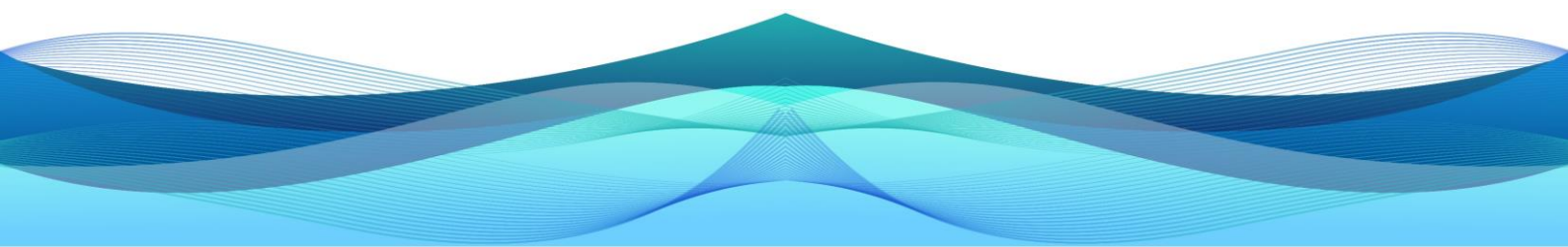| Parameter	EMS Companies	Non-EMS Companies	Significance (p-value)
Atmospheric Emission	2,000 tons/year	3,500 tons/year	< 0.01
Wastewater	1,200 cubic meters/year	2,100 cubic meters/year	< 0.01
Solid Waste	800 tons/year	1,400 tons/year	< 0.01
Spillage and Leakage Accidents	5 incidents/year	12 incidents/year	< 0.01

The table highlights a significant environmental advantage for EMS-adopting companies in the KSA oil and gas industry. These companies have substantially lower atmospheric emissions, wastewater generation, solid waste production, and spillage incidents compared to their non-EMS counterparts, with all differences showing high statistical significance (p < 0.01). This underscores the effectiveness of EMS in reducing environmental impact across multiple vital parameters. The study predicts that widespread EMS adoption in the KSA oil and gas industry could reduce hazardous waste by 25% and critical pollutant emissions by over 30%. Additionally, industry-wide EMS implementation could lower environmental incidents by 40%, enhancing sustainability and regulatory compliance. These findings highlight the significant potential of EMS in improving environmental performance.

6. CONCLUSION

Implementing EMS in the oil and gas industry significantly reduces environmental impacts. Companies with EMS protocols show marked improvements across crucial parameters, including atmospheric emissions, wastewater, solid waste, and spillage and leakage incident rates. Statistical analysis confirms the significance of these improvements, indicating that EMS adoption leads to better environmental performance and operational control. This study underscores the importance of EMS in fostering sustainable industrial practices. Wider adoption of EMS protocols could result in substantial environmental benefits, promoting a healthier and safer environment.

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THE APPROACHES ON TEACHING AND LEARNING OF CHINESE HIGHER EDUCATION FOR SUSTAINABLE DEVELOPMENT IN THE TIBET UNIVERSITY, CHINA

CHEN ZHIMIN | P120537 |PhD

Main Supervisor: Prof. Dr. Muhammad Rizal Bin Razman
Co-Supervisor: Prof. Dr. Sharifah Zarina Binti Syed Zakaria
Co-Supervisor: Prof. Ts. Dr. Lee Khai Ern

1. INTRODUCTION

Education for Sustainable Development (ESD) is a key instrument in transforming societies towards sustainable development (Hajdukiewicz & Pera 2020). Higher education plays an important role in the implementation of sustainable development, not only because it can be used to address environment problems like climate change, biodiversity loss, depletion of natural resources, and inequality (Raworth 2017); but also because It can prepare future professionals in the field of sustainable development as leaders, managers and employees (Wendlandt Amézaga et al. 2022). Yet while the role of higher education in achieving sustainable development and realizing the SDGs is recognized as positive, so far so little hard evidence has been found that the issue now becomes critical (Ssossé, Wagner & Hopper 2021). Moreover, it is explicitly recognized as one of the seven key strategies for UNESCO's wider reform (UNESCO 2015): there is a need to "identify appropriate, relevant and measurable indicators for each initiative and project at the local, national, regional and international levels". Therefore, this study will assess the ESD process in Tibet University from a holistic and reductive perspective, including the assessment of materials, teachers and students in teaching and learning, which will be useful in promoting actions or action plans for higher education institutions in Tibet and other parts of China to achieve sustainable development, and the results of the study can be a baseline for future research to conduct a comprehensive assessment.

2. PROBLEM STATEMENT

Although researchers have often studied sustainable development and emphasized the role of education in achieving the SDGs, we believe that few studies have focused on the integration of the SDGs into educational content, especially in pedagogically based frameworks. We believe that there is a research gap on the translation of the SDGs into formal and non-formal educational practices. The United Nations 2030 Agenda for Sustainable Development recognizes the importance of appropriate educational responses to achieve sustainable development (Hajdukiewicz & Pera 2020). In this context, therefore, there is certainly reason to reflect on the 2030 SDGs and their SDG implementation. At the same time, students and teachers, as the main participants in teaching and learning, are also essential to assess in our evaluation of the ESD process, although current research tends to focus on one of these groups. Therefore, assessing the process of sustainable development in higher education from a holistic perspective is the innovation of this study.

3. OBJECTIVE

This study has four main objectives, but in the presentation of this LESTARI Colloquium, I will be focusing mainly on the first and second objectives. These two objectives are: (1) Identify the elements of ESD on teaching and learning in Tibet University. (2) Analyse reductionist and holistic approaches on teaching and learning about the elements of ESD in Tibet University.
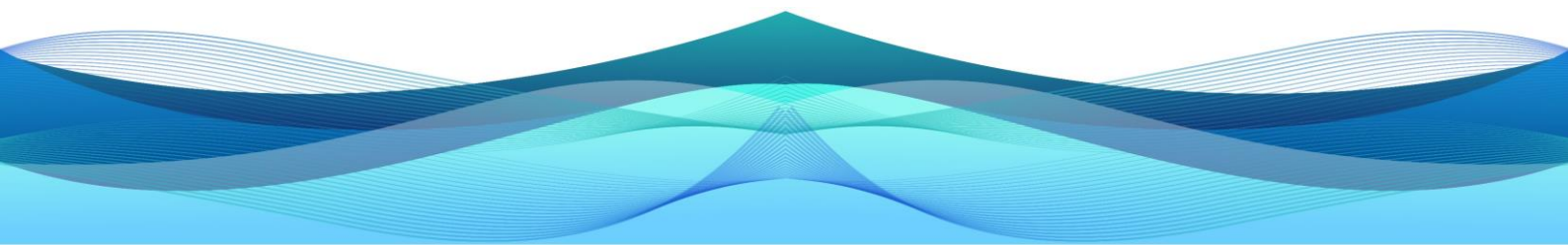
4. METHOD

In order to achieve the objectives 1 and objective 2, content analysis and questionnaire method were employed in this study respectively. The undergraduate talent development programs were used as the research material for Objective 1 in order to obtain the content of knowledge related to ESD in the teaching and learning materials of Tibet University. MAXQDA was used as a content analysis and text mining tool to identify keywords assigned to specific SDGs in the selected talent development programs. Finally, the collected data were analysed with descriptive statistics and chi-square tests were conducted for the 17 SDGs across the faculties.

The research subjects for Objective 2 were students and teachers from Tibet University. For students, the questionnaire proposed and developed by Michalos et al. to measure their SD knowledge, attitudes and behaviours was mainly used in this study and a total of 251 valid questionnaires were collected (Michalos et al. 2015). The instrument used for this study was composed of four sections: (1) sociodemographic data, wherein the participants were asked their age, gender, ethnic group, faculty and living area; (2) an SD knowledge index, including 20 items measuring the consistency between the participants' knowledge and selected issues considered necessary or essential for SD; (3) an index of attitudes favourable to SD, comprising 15 items measuring the level of attitudinal support for SD; and finally, (4) an index of behaviours favourable to SD, with 16 items measuring the level of behavioural support for SD. In order to facilitate the comparison of the level of SD among students at the University of Tibet and to compare it with students in other countries, we classified the participants' level of SD knowledge, attitudes and behaviours according to a scale based on an exponential general average developed by (Wendlandt Amézaga et al. (2022). In this sense, it is possible to define ranges based on indices to mark the different average levels of progress of the participants. The levels are high ($x = 4.5-5$), medium-high ($x = 4-4.5$), medium ($x = 3.5-4$), medium-low ($x = 3 - 3.5$), and low ($x \leq 3$). Finally, an analysis of differences in sustainability knowledge, attitudes, and behaviours on socio demographic variables was conducted by SPSS 27 and Amos 28 was used to validate the impact of SD knowledge, attitudes on behaviors.

For teachers, this study aimed at exploring the perspectives of teachers in Tibet University on sustainable development via the scale developed by Ferguson et al. (2021). A total of 51 valid questionnaires were collected the questionnaire consisted of 19 closed-ended questions. It was divided into two sections. The first section collected demographic information (age, length of service, and gender). The second section consisted of 17 Likert scale items determining teacher perceptions of sustainable development. Responses on the Likert scale ranged from 1 = Disagree to 3 = Strongly Agree and covered areas such as the environmental (natural resources such as water, forestry, and degradation of plant life), social (human rights such as gender equality), and economic (poverty reduction, employment) aspects of sustainability. Factor analysis was used for the teachers' questionnaire to explore the factor structure of secondary school teachers' view of sustainable development. All data processing and analyses were conducted with SPSS27.

5. RESULTS AND DISCUSSION

Through the study of Objective 1 the results indicate that SDGs are present in most of the talent development programs in Tibet University. SDG9, SDG3, SDG8, SDG1 and SDG17 were given high emphasis while SDG2, SDG5 and SDG6 were present to a lesser extent in the programs. The faculty of science is the most represented faculty with the presence of SDGs, as opposed to the faculty of Tourism and Foreign Languages.SDG1- No poverty is represented in every major. The chi-square test showed a statistical difference in the degree of presence of SDGs in each faculty. A specific interpretation of the content of the development programs revealed that SDGs are present in different majors depending on

the theme, and that these development programs represent different aspects of sustainable development economic, social and environmental.

In response to Objective 2, the results of the study on students showed that the knowledge (x=3.28) attitude (x=29) and behaviour (x=3.30) of undergraduate students of Tibet University on sustainable development are at a medium-low level. A comparative mean analysis of the three variables revealed significant differences in the sustainable development behaviors of the students in Tibet University in terms of nation, age, and residential area. Structural equation modeling was used to confirm that knowledge and attitudes related to SD have a positive positive effect on behaviors.
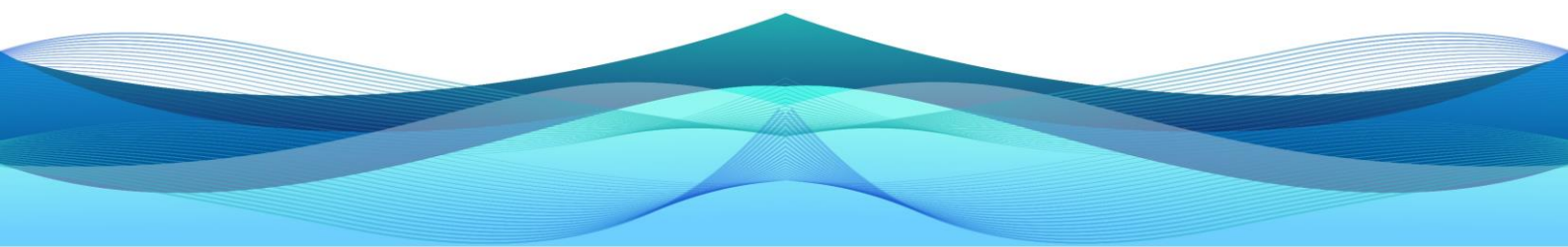
For the teachers' study, the views of 51 teachers of various faculties of the University of Tibet were collected, of which 32 were male and 19 were female. The data revealed that the majority of teachers' views exhibited a citizen participation perspective. In addition, the study found that to a lesser extent, teachers associated holistic thinking perspective with sustainable development.

6. CONCLUSION

With a mission to create and disseminate knowledge, universities play a vital role in addressing the greatest challenges facing the planet (Sáez de Cámara, Fernández & Castillo-Eguskitza 2021). This study assesses the implementation of ESD in Tibet University, including the evaluation of teaching and learning materials, teachers and students. The study found that the talent development programs of Tibet University include elements of the SDGs, the students' level of SD knowledge, attitudes and behaviors are at a low to moderate level, and the teachers mostly present a civic engagement perspective on SD. The results of this research might be used as a baseline for future studies to perform full assessments of sustainability in institutes of higher education. These results also might motivate scholars to generate new theories and hypotheses from the data that emerged (Garcia 2010).

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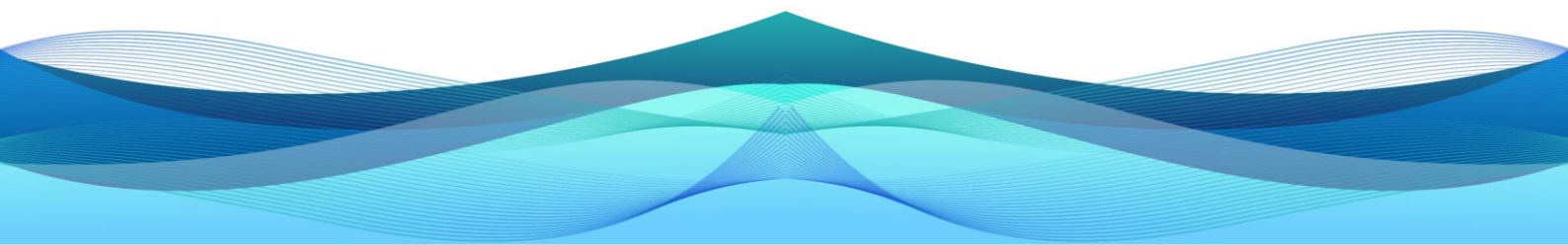
INTEGRATING INTANGIBLE CULTURAL HERITAGE IN UNIVERSITY TEACHING MODEL WITH STEAM CHARACTERISTICS—A CASE STUDY OF WOODBLOCK NEW YEAR PICTURES, CHINA

SUN YANHU | P123627 | PhD

Main Supervisor: Dr. Nuriah Abd Majid
Co-Supervisor: Assoc. Prof. Dr. Sharina Abdul Halim

1. INTRODUCTION

The *Convention for the Safeguarding of the Intangible Cultural Heritage* (2003), adopted by UNESCO in October 2003, states that "intangible cultural heritage is an element that brings people closer together, enabling communication and understanding between them." On September 25, 2015, the United Nations Sustainable Development Summit was held at the UN headquarters in New York, where 193 member states of the United Nations officially adopted 17 Sustainable Development Goals (SDGs). **Goal 4: Quality Education 4.7**: By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development. This includes education for sustainable development, sustainable lifestyles, fostering global citizenship, affirming cultural diversity, and recognizing the contribution of culture to sustainable development. **Goal 11: Sustainable Cities and Communities 11.4**: Strengthen efforts to protect and safeguard the world's cultural and natural heritage. Specifically, indicator 11.4.1 focuses on the total per capita expenditure (public and private) on the preservation, protection, and conservation of all cultural and natural heritage, broken down by type of heritage (cultural, natural, mixed, or designated by UNESCO World Heritage Centre) and level of government (national, regional, and local/municipal).

The United Nations *2030 Agenda for Sustainable Development*, under Goal 4.7, acknowledges the contribution of culture to education for sustainable development. Under this macro-level guidance, although China has made adjustments to its higher education system, the strength of intangible cultural heritage education in secondary and higher education, as well as in higher education alone, remains relatively weak in the Chinese educational system. Intangible cultural heritage education has its unique educational principles, forming an independent system (Yu 2017). Scholars in the academic community unanimously agree on the interdisciplinary and cross-professional characteristics of intangible cultural heritage itself (Gao Xiaokang, 2021; Liu Wenliang & Zhang Wuyan, 2022; Dong Yunchuan & Lin Miaoyu, 2020; Jia Zhijie & Song Jingjing, 2021; Wu Yujun, 2019; Lei Xianfeng, 2021; Shao Huifang, 2021). Therefore, if intangible cultural heritage education is to be integrated into the current university curriculum system, it must be an integrated approach.

STEAM is an acronym for "Science" "Technology" "Engineering" "Arts" and "Mathematics" (Fu Yu, 2018). The United States is the birthplace of STEM education and the most developed country in STEM education worldwide (Zhang Yahui et al. 2017). In 2006, G. Yakman from Virginia Tech in the United States proposed STEAM education on the basis of STEM education, integrating Arts into STEM education to enhance students' artistic cultivation and humanistic literacy. STEAM teaching emerged alongside the humanistic turn, focusing on integrating arts and technology with STEM teaching at its core. It emphasizes improving students' critical thinking and problem-solving abilities, aiming to cultivate students' all-round development and creative innovation spirit.

Thus, whether intangible cultural heritage education can be combined with the integrated STEAM curriculum framework to form a sustainable intangible cultural heritage higher education curriculum framework, and reasonably adjusted according to the intangible cultural heritage transmission and protection projects, is a key research question. This study aims to use university courses as a platform

and STEAM's integrated education as a tool, centered on intangible cultural heritage transmission and protection projects. It seeks to explore the best path to cultivate more talents for the transmission and protection of intangible cultural heritage.

2. PROBLEM STATEMENT

The Evaluation Report on the Implementation of the Intangible Cultural Heritage Law of the People's Republic of China in Various Regions (2017) by the Ministry of Culture also frankly acknowledges that the biggest problem currently is the "shortage of talent resources." Some traditional crafts are facing the dilemma of having no successors (Lan Xiaoling, 2021). Currently, the majority of the representative inheritors of China's intangible cultural heritage projects are older, with an average age of over 50, and the oldest have entered their centenarian years. Intangible cultural heritage transmission faces an awkward situation where young people are either unable or unwilling to undertake the role of inheritance. With no successors, the current intangible cultural heritage education faces "four deficiencies": lack of institutional setup, lack of specialized faculty, lack of specialized teaching materials, and lack of funding. The existing university curriculum system is heavily divided by disciplines, leading to students being trained with narrow focus, singular skills, and a detachment from real-life cases and practices. The long-standing emphasis on specialization over culture, skills over theory, and classroom learning over practical experience among university teachers and students has resulted in weak humanistic qualities and theoretical foundations. This makes them unfit for scientific research and theoretical exploration, with their knowledge structure being quite thin and the teaching level relatively low (Liang Jialin & Xue Yan, 2019b). Clearly, the current teaching models and curricula lack the necessary understanding and scientific arrangement of intangible cultural heritage, making it insufficient to complete the holistic education of talents related to intangible cultural heritage. How to build a curriculum that aligns with the discipline characteristics of intangible cultural heritage inheritance and protection projects within the current university system is the primary goal of this research.

3. OBJECTIVE

This study has three main objectives. So far, two research objectives have been completed:
To examine the incorporation of the STEAM characteristics into university education programs on ICH teaching in China.
To verify the feasibility of integrating ICH teaching and the STEAM curriculum through interviews with professional ICH teachers and STEAM teachers.

4. METHOD

Methods for the First and Second Research Objectives:
For the first research objective, this study employed the Delphi expert interview method. The participating experts included intangible cultural heritage (ICH) inheritors, ICH research experts, ICH university teachers, and integrated education experts. The questionnaire focused on several aspects, including the value, course design, implementation, and challenges of integrating ICH into STEAM courses in higher education. The questionnaire was distributed using the Wenjuanxing platform. The main process involved obtaining expert consent, pre-testing the questionnaire through interviews, revising the questionnaire, distributing the final questionnaire, collecting responses, analyzing the data, and providing feedback on the results. The data collection process took three and a half months and consisted of three rounds of interviews, ultimately achieving expert consensus on the integration of ICH into STEAM courses in universities.
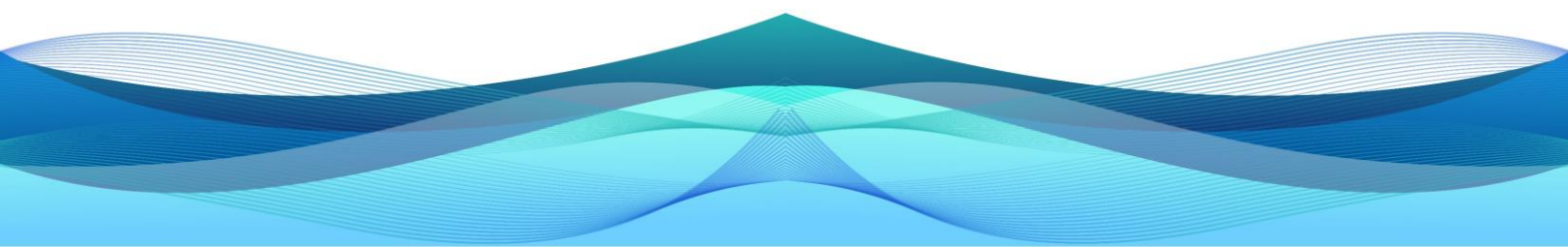
For the second research objective, the study applied Constructivist Grounded Theory. The interview method used was semi-structured, in-depth interviews. The interviewees were ICH inheritors and university ICH teaching practitioners. The research process included pre-testing the interview questionnaire, revising the questionnaire, and conducting formal interviews. The interviews took place in Shanghai, Suzhou, and Hohhot. The data collection was done using a voice recorder. The interview content focused on collecting data on knowledge, views, attitudes, and practices related to university ICH teaching and the application of the ICH STEAM teaching framework. The data collection took one and a half months. The data was analyzed using NVivo14 software, following the Constructivist Grounded Theory methodology.

5. RESULTS AND DISCUSSION

The study titled "Integrating Intangible Cultural Heritage with STEAM-Characteristic Higher Education Models: A Case Study of Chinese Woodblock New Year Pictures" employs the Delphi method for the first research objective. After contacting over 50 experts, 18 participants agreed to take part in the study. The questionnaire used was adapted from previous research and validated by experts in the relevant field. The study conducted three rounds of interviews, and the data was analyzed using social science statistical software (SPSS). The first research objective aimed to investigate the characteristics of an integrated ICH STEAM curriculum from the perspective of experts, including aspects such as definition, course objectives, course design, implementation, and the challenges faced in implementing the course framework.

For the second research objective, the Constructivist Grounded Theory method was applied to examine the perspectives of active university teachers on the integrated ICH STEAM curriculum. Eight university ICH teachers were interviewed. The questionnaire used was also adapted from previous research and validated by field experts. The study explored concepts such as the understanding of integrated ICH STEAM practices, teaching practices, teacher integration training, and factors influencing implementation. NVivo14 software was used for descriptive analysis of all the information.

Since there was an overlap between the two groups of experts, out of the 21 participants, 18 held titles of associate professor or above, 8 were both ICH inheritors and university teachers, and 11 were involved in interdisciplinary and STEAM-related education, including one design director from NetEase, one Asia-Pacific inheritor, one national inheritor, and two ICH scholars. Data analysis showed that 95% of the interviewed teachers believed that the integration of ICH into university education through STEAM interdisciplinary teaching was beneficial, with less than 1.4% advocating for traditional apprenticeship methods. However, 90% of respondents agreed with the course objectives of the integrated ICH STEAM teaching framework. The survey results on the design of the integrated ICH STEAM course revealed that 95.2% of respondents considered the segmentation of course objectives by difficulty a significant challenge, mainly due to the highly specialized nature of current university education. For the implementation of the integrated ICH STEAM course, 90% of frontline teachers have already begun initial attempts at integrating ICH teaching into related courses. However, there are challenges to promoting the integrated ICH STEAM course at the university level. While 19% of teachers felt that societal understanding of STEAM education was not yet widespread and that there was insufficient focus on ICH education, 71% believed that integrating course practices and teacher training posed significant challenges. Additionally, 10% of respondents noted that Chinese universities currently place more emphasis on the development of science disciplines, with less policy support for the humanities. As China emphasizes new forms of productivity, policies are increasingly focused on the sciences, leading to a yearly decline in the development and funding of humanities and social sciences disciplines.
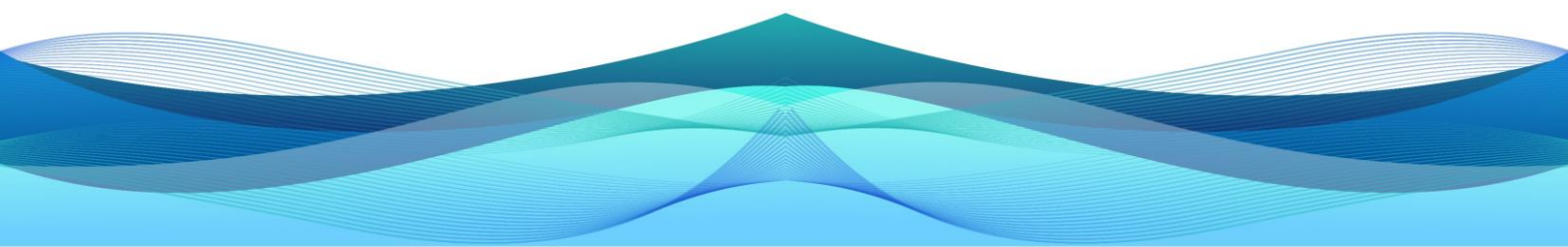
6. CONCLUSION

The study results indicate that using the STEAM curriculum framework to train intangible cultural heritage (ICH) inheritors and researchers in universities is feasible. The integration of ICH into STEAM courses in higher education can align ICH transmission with global economic development trends. However, the implementation of these courses requires: 1. Policy support and enforcement. 2. The construction of a comprehensive teaching framework that considers the regional characteristics of ICH. 3. Active participation of the teaching staff in the construction process. These factors are essential for the successful integration of ICH into university curricula.

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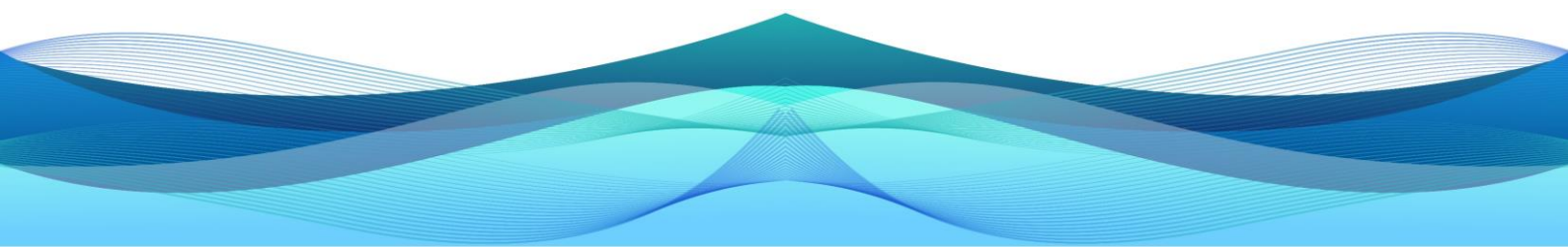
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