

## **An Integrated Data Quality Control Framework Toward Collective Cultural Scenario Exploration**

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The Kyoto Conference on Arts, Media & Culture 2025  
Official Conference Proceedings

### **Abstract**

Cultural Map Thailand is a national digital repository of cultural assets, yet early data inconsistencies limited its usefulness. This study introduces an integrated quality-control framework combining PHP filtering, Excel Power Query, GIS validation, AI-assisted screening, and social verification which refined 6,403 entries to 5,204 qualified datasets. A prototype system dynamics model was also developed to support collective scenario exploration, linking cultural capital, investment flows, social engagement, and policy timing. The results demonstrate that data-driven and participatory methods significantly improve cultural data reliability and reinforce evidence-based cultural governance.

*Keywords:* cultural mapping, data quality control, geographic information system, AI-assisted screening, scenario exploration, cultural capital

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## Introduction

Culture, in both its tangible and intangible forms, shapes community identity and social cohesion. As digital platforms increasingly become central to cultural documentation and public engagement, Cultural Map Thailand (<https://culturalmapthailand.info/>) has emerged as a national repository built from nearly a decade of culture-based research and development (CBRD). From 2016 to 2024, 117 projects across 67 universities contributed diverse cultural data spanning architecture, archaeological heritage, performing arts, folk literature, local wisdom, and ethnic languages intended to support cultural preservation and community development.

Rapid data expansion, however, also produced inconsistencies. Prior to 2021, cultural data were stored in incompatible formats across projects, resulting in variations in field definitions, spatial accuracy, and data completeness. These limitations restricted the ability to use the database for national planning and scenario analysis. As of September 2025, the database contained 6,403 entries across 11 categories and 53 provinces, attracting more than 600,000 visits from domestic and international users. This visibility underscored the need for a rigorous quality-control mechanism to address issues such as incorrect coordinates, mismatched provinces, duplicated entries, incomplete descriptions, and low-quality or inappropriate images. This study responds to these challenges by presenting:

1. An integrated data-quality control framework combining PHP filtering, Excel Power Query, GIS validation, AI-assisted screening, and social verification
2. Unified Modeling Language (UML) Sequence Diagram of the validation workflow
3. Quantitative outcomes of data quality control mechanism
4. A prototype system dynamics model that uses validated data for collective cultural scenario exploration.

By integrating computational tools with participatory verification, this research provides a balanced methodological model for strengthening cultural data reliability, supporting cultural governance, and advancing cultural-based development and soft-power strategies.

## Literature Review

The concept of cultural capital, originating from Pierre Bourdieu (1986), underlines how cultural knowledge, skills, artifacts, and practices shape social mobility, identity, and symbolic power. Bourdieu categorizes cultural capital into embodied, objectified, and institutionalized forms, illustrating how it circulates within and across generations. Extending this framework, Throsby (1999, 2010) positions cultural capital as both an economic and non-economic asset whose value supports cultural sustainability and community vitality. From a national-development perspective, cultural capital has become a key resource for promoting creative industries, cultural tourism, and soft-power strategies. Particularly in Thailand, cultural assets such as traditional craftsmanship, local wisdom, and regional festivals form a basis for livelihood development, community empowerment, and place-based identity formation.

## Cultural Mapping as a Research and Development Process

Cultural mapping has been recognized by UNESCO (2003) and cultural policy scholars as a participatory methodology for identifying cultural resources, strengthening community engagement, and fostering local development (Pillai, 2022). Poole (2003) describes cultural mapping as identifying and documenting a community's cultural resources. The Creative City

Network of Canada (2010) defines it as collecting, analyzing, and presenting data to highlight cultural strengths and stories. Taylor and Rollins (2021) emphasize participatory cultural mapping as a collaborative process that builds local ownership. Within Thailand, cultural mapping has been integral to CBRD, where research teams engage with communities to collect, verify, and analyze cultural data. This process not only preserves cultural diversity but also supports community planning, cultural entrepreneurship, and intergenerational learning.

### **Digital Cultural Mapping and GIS**

Geographic Information Systems (GIS) have transformed cultural mapping by enabling spatial visualization, proximity analysis, and multi-layered interpretation of cultural landscapes. Longley and Duxbury (2016) highlight GIS as an essential tool for managing geospatial phenomena, while cultural GIS studies demonstrate how spatial accuracy affects heritage interpretation, planning decisions, and visitor experiences. Digital cultural maps increasingly rely on high-resolution spatial data to ensure authenticity and usability. However, spatial mismatches incorrect coordinates, misclassified provinces, out-of-boundary points can distort cultural representation and mislead users. Therefore, data quality control becomes a foundational requirement.

### **Data Quality and AI-Assisted Screening in Cultural Databases**

Data quality challenges in cultural mapping include incompleteness, inconsistency, duplication, semantic variability, and outdated information. In recent years, AI-assisted screening approaches such as rule-based detection, anomaly detection, and machine learning models have strengthened data validation in large datasets (Krishnan & Wu, 2019; Rekatsinas et al., 2017). These methods improve efficiency and reduce human error in repetitive tasks. Yet, cultural data is context-sensitive. Automated tools require complementary human interpretation (Flick, 2004). Therefore, social validation where cultural asset owners verify data helps ensure accuracy, legitimacy, and ethical use.

### **Scenario Exploration and Mediation Tools in Cultural Governance**

Scenario exploration has become a strategic tool in cultural policy, enabling stakeholders to examine future possibilities, evaluate policy impacts, and negotiate trade-offs. System Dynamics Modeling (Sterman, 2000) helps simulate feedback loops, delays, and dynamic interactions. When integrated with cultural databases, simulation becomes a mediation tool, allowing stakeholders to collectively explore cultural futures based on empirical data. This study integrates cleaned cultural data into a prototype system dynamics model to explore cultural capital dynamics, investment patterns, and engagement cycles.

## **Methodology**

### **Research Design**

The research design is structured around the integrated data quality control mechanism illustrated in the conceptual framework (Figure 1). This mechanism positions Cultural Map Thailand as a mediated platform that connects cultural capital owners, research teams, the Kanchanaburi Rajabhat University (KRU) development team with the search funding granted by PMU-A, and general users through a continuous cycle of data provision, verification, validation, and use. The design is fundamentally participatory, while also incorporating

computational and spatial analytical processes to ensure that cultural data reach a quality standard sufficient for subsequent simulation-based scenario exploration. At the core of the framework are two principal actors: Cultural capital owners and stakeholders, who provide cultural information and verify its authenticity; and Research teams from universities, who conduct fieldwork, analyze cultural narratives, and record data in the system. Both groups participate in a truly participatory process involving the iterative steps of collecting, analyzing, selecting, verifying, and using cultural information. This reciprocal exchange ensures that cultural data remain legitimate, contextually grounded, and socially validated.

To support this participatory process, the Cultural Map Thailand platform functions as the technical backbone where data are recorded, shared, reviewed, and randomly checked using established quality control procedures. These procedures involve four complementary types of validation: PHP-based filtering (F) ensuring basic completeness, formatting consistency, and initial screening for errors. Artificial Intelligence (AI) assisting in anomaly detection, duplication identification, and semantic checking. Geographic Information Systems (GIS) validating spatial accuracy, correcting geolocation errors, and ensuring alignment between coordinates and administrative boundaries. Social Validation (SV) enabling cultural asset owners, communities, and general users to review, comment, and correct information, thereby ensuring cultural legitimacy and public accountability.

The KRU development team plays a coordinating role, integrating automated checks, spatial cleaning, and user feedback. Notifications are issued when revisions or confirmation are required. This multi-actor, multi-method workflow ensures that data continuously improve in accuracy, credibility, and usability. Once cultural data pass these quality control stages and are designated as “qualified data”, they become suitable inputs for the next methodological component of this study: the development of a system dynamics simulation model. Only high-quality, validated datasets are used to construct cultural capital variables, initialize category-based stocks, and generate reliable policy scenarios. This ensures that scenario exploration aimed at understanding the balance between cultural preservation, investment, engagement, and socio-economic returns is grounded in robust empirical evidence.

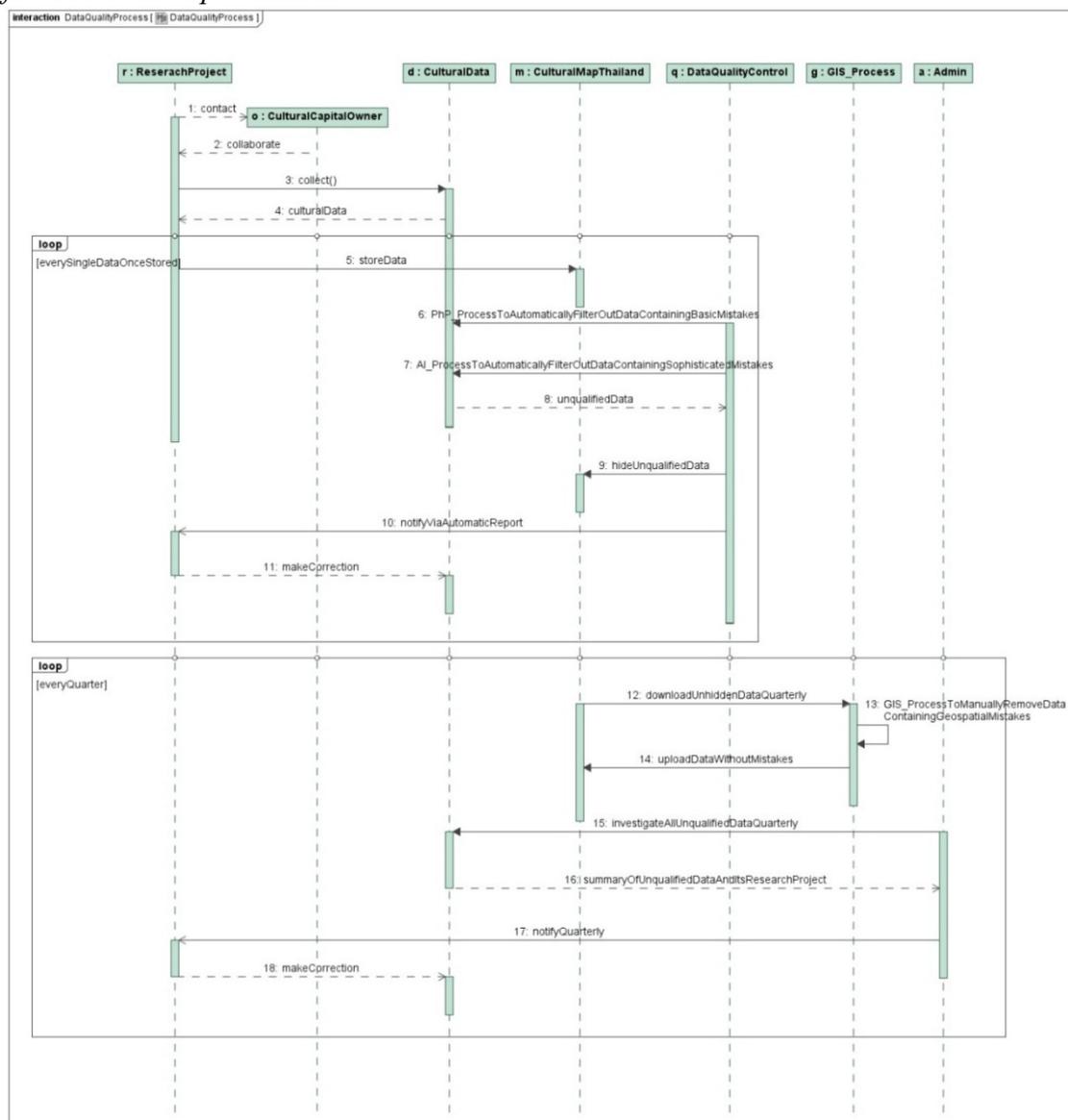


## Integrated Data-Quality Control System and Workflow

The data-quality control system in this study is a multi-layered mechanism designed to ensure that cultural data recorded in Cultural Map Thailand are accurate, legitimate, and culturally authentic before being used for analysis or simulation. As illustrated in the UML Sequence Diagram (Figure 2), the workflow spans the full process from data collection to quarterly spatial validation and community correction.

**Figure 2**

*UML Sequence Diagram Illustrating the Workflow of Integrated Data Quality Control System for Cultural Map Thailand*



The system is built on collaboration between cultural capital owners, research teams, and the KRU development team, with Cultural Map Thailand serving as the platform where data are stored, filtered, validated, and monitored. Two iterative cycles operate simultaneously: continuous validation, triggered whenever new data are uploaded, and quarterly validation, which provides deeper spatial and administrative review.

In the continuous cycle, research teams collect and store information verified with cultural capital owners (Steps 1–5). Automated checks then begin with PHP filtering (Step 6) to detect missing cultural codes, malformed coordinates, and incomplete mandatory fields. AI-assisted screening (Step 7) follows, identifying semantic inconsistencies, duplicate patterns, and weak descriptions. Entries that fail these checks are temporarily hidden (Step 9), and an automatic notification (Step 10) prompts research teams to correct and resubmit data (Step 11).

The quarterly cycle reinforces spatial accuracy. The system downloads unverified entries (Step 12) and conducts GIS-based validation (Step 13) to detect mismatched provinces, out-of-boundary points, maritime coordinates, and projection errors. Corrected data are re-uploaded (Step 14), unresolved cases are investigated further (Step 15), and summaries are returned to responsible teams (Step 16) before another notification is issued (Step 17) for the research team to amend (Step 18).

Together, these automated, spatial, algorithmic, and participatory processes ensure that cultural data are both technically sound and socially credible. Ethical safeguards are embedded throughout: inaccurate data are hidden from public view, verification is required before release, and cultural capital owners participate in ongoing validation. Only entries that satisfy all structural, semantic, spatial, and cultural requirements are classified as qualified data. These high-quality datasets form the empirical foundation for the simulation model described in the next section, ensuring that cultural scenario exploration is grounded in reliable and ethically validated information.

## Results

### Identification of Nine Error Types

The intensive use of Cultural Map Thailand at Culture Connex in Yaowarat, Bangkok, offered a real-world setting to observe how cultural data perform in a public environment. When cultural entries were displayed to visitors, several inaccuracies became immediately visible. Combined with the systematic QC process, these observations led to the identification of nine major error types, each requiring specific corrective mechanisms (Table 1).

**Table 1**

*Major Error Types Found in Cultural Map Thailand and Proposed Data Quality Methods*

<b>Error Type</b>	<b>Proposed Data Quality Method</b>
Mislocation or Wrong Location (Latitude Longitude)	GIS, PHP-Filtering, Social Validation, Participatory Action
Null Data (Empty or Name Only)	PHP-Filtering, Social Validation, Participatory Action
Incomplete Data or Very Short Description	PHP-Filtering, Social Validation, Participatory Action
No Image Attached	PHP-Filtering, Social Validation, Participatory Action
Low Image Quality	Artificial Intelligence, Social Validation, Participatory Action
Irrelevant Images to the Cultural Content	Artificial Intelligence, Social Validation, Participatory Action
Personal Data Protection Act (PDPA) and/or Copyright Issue	Artificial Intelligence, Social Validation, Participatory Action

Too Generic Data (e.g., common food recipe, trees)	Artificial Intelligence, Social Validation, Participatory Action
Repeated Data (previously recorded in earlier projects)	GIS, PHP-Filtering

- a. **Mislocation or Wrong Coordinates:** Many cultural points were placed in the wrong district, province, or even offshore due to incorrect coordinate input or decimal errors. These require GIS cleaning, PHP filtering, and social verification.
- b. **Null Data (Empty Fields):** Some entries contained only names without descriptions or context, making them unusable for interpretation. PHP filtering and community review were essential for identifying and correcting them.
- c. **Incomplete or Very Short Descriptions:** Minimal or generic narratives weakened cultural storytelling and required manual enrichment and community-based interpretation.
- d. **No Image Attached:** Entries without images created confusion in public displays. Social validation is needed to obtain appropriate visual documentation.
- e. **Low-Quality Images:** Blurred or poorly framed photos reduced cultural clarity. AI-assisted image-quality checks helped identify cases requiring replacement.
- f. **Irrelevant Images:** Some images did not match the cultural content (e.g., incorrect buildings or unrelated objects). AI similarity analysis and community review were necessary to detect these mismatches.
- g. **PDPA or Copyright Concerns:** A small number of images included identifiable individuals or copyrighted materials, requiring removal or replacement to meet ethical and legal standards.
- h. **Overly Generic Data:** Examples included common food dishes or everyday objects that lacked cultural specificity. Participatory validation helped differentiate meaningful cultural assets from generic items.
- i. **Duplicate Entries:** Repeated cultural points, often from overlapping projects, were easily noticeable on public screens. GIS and PHP-based duplicate detection were used to consolidate them.

On the whole, the combination of front-shop observations and systematic QC revealed that cultural data errors are both technical (e.g., wrong coordinates, null fields, duplicates) and interpretive (e.g., weak narratives, irrelevant or low-quality images, generic content). These findings underscore the need for a hybrid QC system combining digital tools (GIS, AI, PHP) with human-centered processes (social validation and participatory correction), forming the foundation for the data-quality improvements applied in this study.

### Quantitative Outcomes of Data Quality Control

The quantitative analysis highlights the effectiveness of the integrated quality-control system in improving cultural data accuracy and completeness over time. As shown in Table 2, the dataset extracted on September 10, 2025 contained 6,403 cultural entries prior to any types of screening. These entries spanned all 11 cultural categories. Following sequential application of the data-quality control mechanisms, the number of qualified entries declined progressively at each stage:

- a. PHP filtering reduced the dataset from 6,403 to 5,244 entries, eliminating records with invalid cultural codes, missing values, and basic formatting issues.
- b. Excel Power Query reduced the dataset further to 5,229 entries, removing duplicates, correcting structural inconsistencies, and standardizing field formats.

- c. GIS spatial validation resulted in 5,204 qualified entries, identifying and eliminating entries with mislocated coordinates, mismatched provinces, and out-of-boundary points.

**Table 2**

*Data Sets From Cultural Map Thailand on September 10, 2025 Before and After Quality Control (QC)*

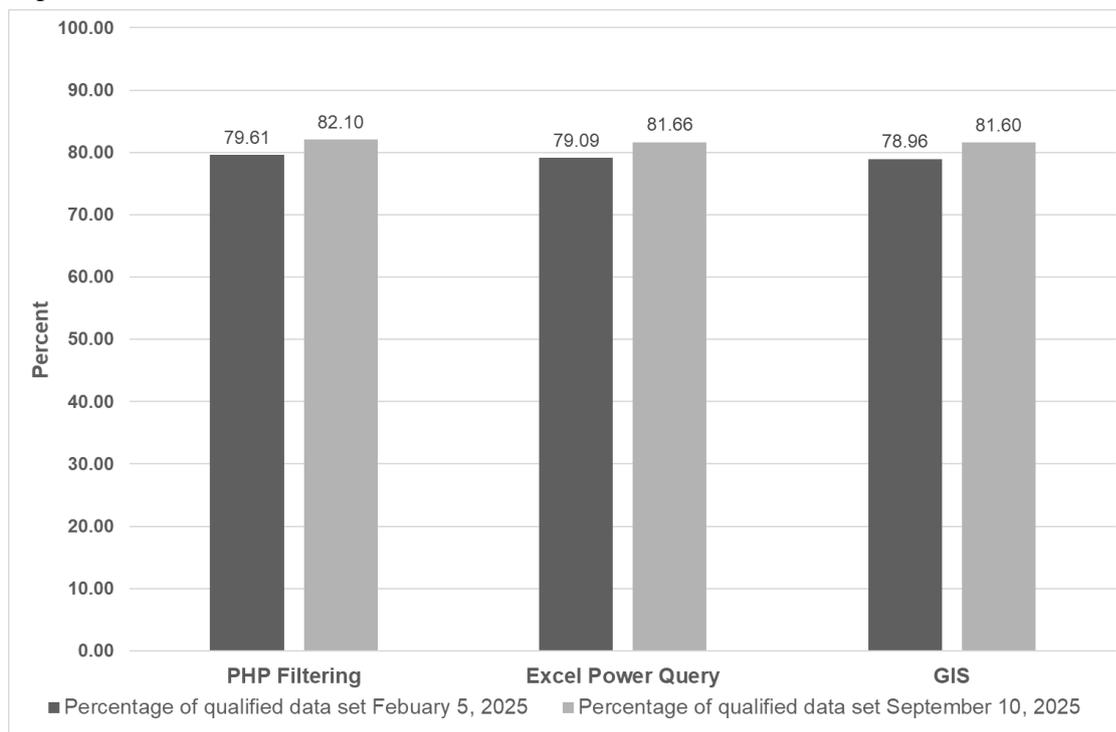
<b>Cultural Category</b>	<b>Data set before QC</b>	<b>After PHP Filtering</b>	<b>After Excel Power Query</b>	<b>After GIS</b>
Cultural Space	559	474	-	3
Architecture	1,398	1,102	-	-
Archaeological Site	511	404	-	-
Archaeological Artifact	324	278	-	-
Performing Art	544	417	-	-
Traditional Craftsmanship	974	847	-	-
Folk Literature	182	142	-	-
Knowledge and Practices concerning Nature and the Universe	1,076	888	-	1
Social Practices, Ritual and Festive Events	703	598	-	-
Folk Sport Game and Martial Arts	99	70	-	-
Thai Local and Ethnic Languages	32	24	-	-
No auto-code generation	-	-	15	-
Mismatching Province	-	-	-	21
<b>Total</b>	<b>6,403</b>	<b>5,244</b>	<b>5,229</b>	<b>5,204</b>
<b>Percentage</b>	<b>100.00</b>	<b>81.89</b>	<b>81.66</b>	<b>81.27</b>

The final total of 5,204 qualified datasets represents 81.27% of the original dataset. This proportion reflects the combined filtering power of automated processes, spatial analysis, and subsequent human verification. Certain categories experienced more substantial reductions than others. For example, the Architecture category decreased from 1,398 to 1,102 entries after PHP filtering, indicating a high frequency of basic errors within that group. Similarly, the Knowledge and Practices category showed inconsistencies in coordinate and location fields, requiring manual correction during GIS validation.

To evaluate the improvement over time, the results from February 5, 2025 were compared with those from September 10, 2025, as illustrated in Figure 3. This comparison demonstrates measurable progress across all three quality-control methods: PHP filtering accuracy increased from 79.61% to 82.10%, Excel Power Query accuracy increased from 79.09% to 81.66%, and GIS spatial validation accuracy increased from 78.96% to 81.60%. These improvements correspond with the introduction of the automated notification system, which alerts research teams when unqualified data are detected. As notifications prompted more timely corrections and greater researcher engagement, the proportion of qualified data increased across all methods. This indicates not only better structural and spatial data consistency but also growing familiarity with QC procedures among contributing institutions.

**Figure 3**

*Improvement Of Data Quality Over Time on February 5, 2025 Comparing With Those on September 10, 2025*



Overall, the quantitative results demonstrate that the layered QC mechanism combining PHP, Excel PQ, GIS, and participatory review substantially enhances the reliability of the Cultural Map Thailand database. The improvement across two data extraction periods further confirms that continuous feedback loops and automated alerts play an important role in maintaining long-term data quality.

### **Demonstration Scenario: “Rice & Culture”**

To illustrate the analytical potential of high-quality cultural data, a demonstration scenario was conducted focusing on the relationship between rice as Thailand’s major agricultural product and its corresponding cultural expressions, with the objective of identifying opportunities for enhancing rice-based cultural value and increasing farmer income. Using GIS-based visualization and keyword-density analysis, three layers of spatial information were generated to explore where and how “rice culture” appears within the Cultural Map Thailand dataset.

### **Rice Word Density Across Provinces**

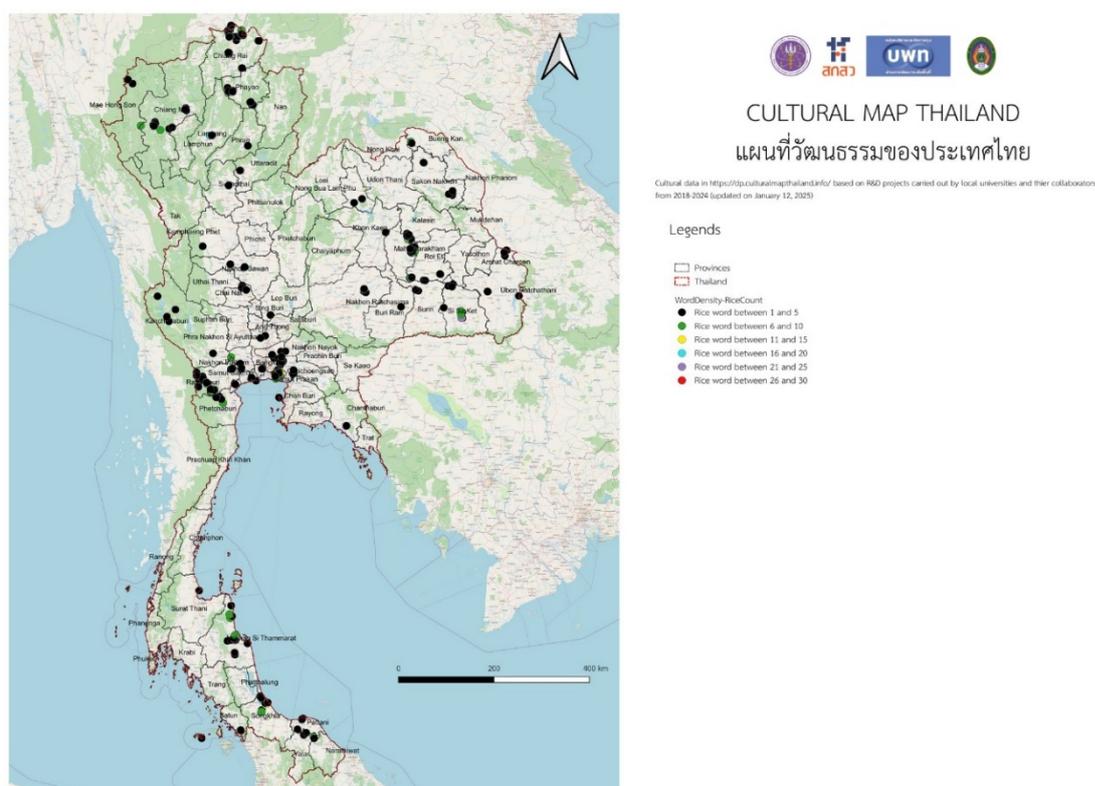
The first map (Figure 4) revealed a heterogeneous distribution of rice-related cultural expressions across Thailand. Provinces in the Central region such as Ayutthaya, Suphanburi, and Nakhon Pathom demonstrated the highest density of rice-related terms. The Northeastern region also showed substantial rice cultural presence, particularly in provinces such as Ubon Ratchathani, Sisaket, Roi Et, and Surin. In contrast, southern provinces exhibited fewer rice-associated cultural entries, except in areas with prominent heritage communities (e.g., Phatthalung and Nakhon Si Thammarat).

## Presence or Absence of Rice-Related Cultural Coding

The second map provided a binary overview, distinguishing between entries that contained at least one rice-related term and those that did not. Out of 4,556 entries analyzed, 3,947 entries (86%) contained no rice-related keywords, while 609 entries (14%) explicitly referenced rice. Although rice is a dominant agricultural product nationwide, its cultural representation in the dataset is uneven. This underscores that rice culture is not merely tied to agricultural production volume but is deeply linked to specific socio-cultural contexts—rituals, local identity, and historical narratives. This insight is valuable for policy-makers seeking to localize rice-based cultural innovation rather than applying uniform strategies.

**Figure 4**

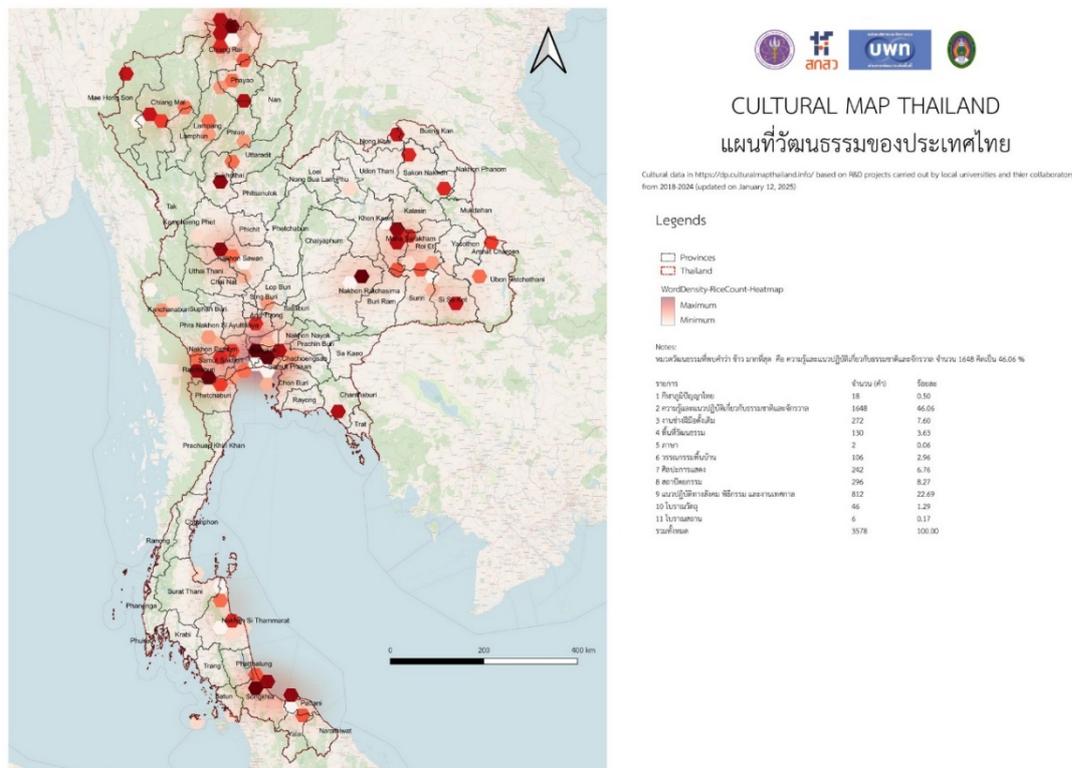
*Map of Rice-Related Terms Density in Cultural Map Thailand*



## Heatmap of Rice-Related Cultural Expressions

The heatmap (Figure 5) further refined this analysis by identifying high-intensity cultural clusters related to rice. Strong hotspots emerged in: Central Thailand, particularly in provinces with historical rice-based economies and long-standing cultural practices (e.g., Suphanburi, Ayutthaya, Ang Thong). Northeastern Thailand, where rice is intertwined with ceremonies such as boon khaw sak, community-based rice storage traditions, spiritual practices, and agrarian rituals. Southern Thailand, where rice-related hotspots were concentrated in Phatthalung, Trang, and Nakhon Si Thammarat, areas known for distinctive rice landraces and cultural rice cuisines. The heatmap's provincial breakdown revealed that rice-related cultural practices accounted for 46.66% of the total keyword frequency, dominated by categories such as: Rice-based local knowledge and foodways, rituals involving rice seeds or spirits, traditional rice farming tools and craftwork, folklore and narratives referencing rice cultivation.

**Figure 5**  
Heatmap Showing High-Intensity Cultural Clusters Related to Rice Density in Cultural Map Thailand



### Implications for Cultural-Based Economic Development

This scenario highlights how culturally grounded insights can directly support rice value enhancement strategies: High-density cultural clusters in the Central and Northeastern regions provide strong foundations for rice-based creative products, cultural tourism routes, heritage branding, and soft-power storytelling. Rice-related rituals and narratives documented in Northeastern provinces can serve as inspiration for community-led cultural products, educational media, ceremonial or festival-based tourism, and intangible heritage conservation. Rice landraces and culinary traditions in the South indicate opportunities for geographically specific branding (GI products), culinary tourism, and packaging rice-based knowledge for high-value markets.

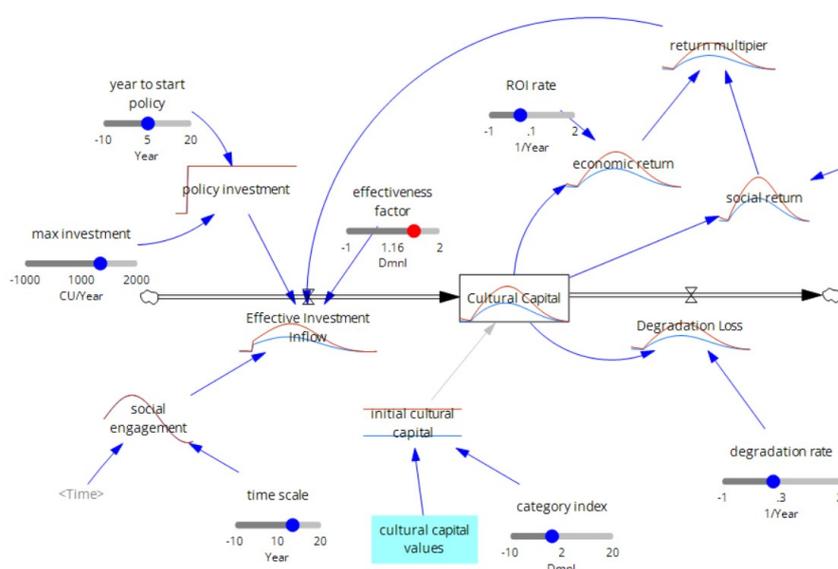
The uneven distribution of rice culture emphasizes that rice-based product development should not rely solely on agricultural output but must be aligned with locally grounded cultural meanings, enabling more authentic and sustainable value creation. This demonstration scenario shows how high-quality cultural data, when combined with GIS visualization and keyword-density analysis, can guide collective scenario exploration among researchers, communities, and policy actors. By revealing where rice culture is deeply embedded and how it varies across regions, the Cultural Map Thailand system supports informed decision-making aimed at improving farmer livelihoods, enhancing soft power, and strengthening cultural-based economic strategies.

## Scenario Exploration Using System Dynamics

To demonstrate how high-quality cultural data can support collective cultural management discovery, a prototype System Dynamics (SD) simulation model was developed using Vensim DSS (Figure 6). The Cultural Capital Model (Version 1) is designed as a mediation tool, enabling researchers, policymakers, cultural practitioners, and community members to explore how different interventions influence long-term cultural capital dynamics. System Dynamics is particularly suitable for cultural studies because cultural systems are inherently complex composed of feedback loops, time delays, fluctuating engagement patterns, and policy-driven changes. By translating these dynamics into a transparent model structure, stakeholders can collectively examine potential futures and negotiate shared understandings.

**Figure 6**

*Cultural Capital Model (Version 1): Dynamic Stock-and-Flow Model With Feedback Loops*



The model is organized around the central stock of Cultural Capital, which accumulates or declines based on two opposing flows: Effective Investment Inflow and Degradation Loss. Cultural Capital is initialized using category-specific values derived from the qualified Cultural Map Thailand dataset, ensuring that scenario exploration is grounded in empirically validated information. Three auxiliary components shape this stock: the return multiplier, policy investment, and social engagement.

Following the ODD (Overview–Design Concepts–Details) protocol (Polhill et al., 2008), the model simulates the accumulation and depletion of cultural capital by integrating economic returns, social returns, investment policies, and engagement patterns. Economic and social returns are calculated using constant ROI and SROI rates, reflecting how cultural assets generate both monetary value and social benefits. These returns contribute to the return multiplier, which enhances future investment inflows and represents the reinforcing dynamics present in real cultural ecosystems.

A distinctive feature of the model is its use of a sine-based social engagement function. Cultural engagement fluctuates over time due to seasonal festivals, annual cultural events, tourism cycles, and periodic social interest in cultural heritage. The sine function captures these

oscillations, allowing stakeholders to observe how cultural capital fluctuates when engagement rises or falls. This is especially relevant in contexts where cultural vitality is closely tied to temporal rhythms such as Thai festivals, agricultural cycles, and ritual seasons.

Another key structural component is the “year to start policy” parameter. This variable determines when policy investment begins and plays a significant role in shaping simulation outcomes. In many cultural systems, timing determines whether interventions are preventative, restorative, or reactionary. Early investment such as funding cultural education, supporting artisans, or protecting heritage sites can generate compounding long-term benefits. Conversely, delayed interventions may fail to reverse cultural decline, particularly when degradation rates exceed investment inflows. Allowing stakeholders to adjust this parameter helps them explore the consequences of acting early versus late, fostering more strategic policy discussions.

When users interact with the model, they can adjust parameters such as maximum investment, ROI/SROI rates, degradation rates, effectiveness factors, time scale, and policy timing to simulate different scenarios. Each scenario reveals how cultural capital might grow, stabilize, or deteriorate under particular conditions. Because the model uses cleaned and validated data from Cultural Map Thailand, the results reflect plausible trajectories rather than abstract estimations.

In general, this prototype SD model demonstrates how complex cultural dynamics can be transformed into an accessible exploration tool. By visualizing the interplay between investment, social engagement, and cultural capital, the model supports collective scenario exploration, stimulates policy dialogue, and enables stakeholders to jointly identify effective strategies for cultural preservation, development, and cultural-based economic enhancement. It provides a foundation for future refinement, including category-specific sub-models, integration with spatial data, and participatory modeling workshops.

## Discussion

This study demonstrates the value of an integrated, interdisciplinary approach to cultural data management. By combining digital tools i.e. PHP filtering, Excel Power Query, GIS validation, and AI-assisted screening with participatory verification from cultural asset owners, Cultural Map Thailand effectively improves both the technical accuracy and cultural legitimacy of its data. This hybrid approach empowers researchers, communities, and cultural practitioners to play active roles in shaping a national cultural data ecosystem.

The availability of a cleaned and validated dataset strengthens evidence-based cultural policy, supporting initiatives in heritage conservation, creative economy planning, and community-driven cultural entrepreneurship. The ability to locate cultural clusters, such as rice-related cultural patterns, also enhances Thailand’s soft-power strategies, enabling more targeted cultural development and promotion. Methodologically, the project offers a replicable framework for national cultural databases. Its interoperable workflow integrating automated filtering, spatial validation, AI-assisted review, and social validation advances participatory data governance by recognizing that cultural meaning cannot be verified by technology alone. Human insight remains essential for ensuring contextual accuracy. Some limitations remain. AI tools are still in prototype stage and require refinement; certain cultural categories have sparse data; GIS validation relies on quarterly manual checks; and the simulation model has yet to be calibrated with longitudinal data. Addressing these issues will be important for future system development.

In essence, the integration of computational precision, community engagement, and interdisciplinary thinking shows how cultural data ecosystems can evolve into powerful tools for strategic cultural management. Continued refinement and deeper collaboration with communities will be key to sustaining and expanding the long-term value of Cultural Map Thailand.

### **Conclusion**

This study shows how Cultural Map Thailand can develop into a robust national cultural data ecosystem when supported by a systematic and participatory data-quality framework. By integrating PHP filtering, Excel Power Query, GIS validation, AI-assisted screening, and social verification, the project improved the accuracy and legitimacy of cultural data, refining 6,403 entries down to 5,204 high-quality datasets. Beyond data cleaning, the study demonstrates how validated cultural information can guide strategic cultural management. The rice-related cultural scenario illustrates how spatial and keyword analyses can inform policy design, support community-driven cultural products, and strengthen soft-power and cultural-based economic initiatives.

The prototype System Dynamics model expands this potential by enabling collective scenario exploration. By visualizing the relationships between investment, social engagement, policy timing, and cultural capital, the model supports shared understanding among policymakers, researchers, and communities and lays a foundation for more advanced cultural Agent-Based Modeling. Although limitations remain such as early-stage AI tools, sparse data in some categories, the need for ongoing spatial validation, and uncalibrated simulation parameters the study provides a replicable methodological framework for national cultural information systems. The combination of technical precision, participatory verification, and interdisciplinary insight demonstrates how cultural mapping can move toward meaningful cultural governance. Ultimately, the project shows that when cultural data are trusted, validated, and collectively interpreted, they become a strategic resource for sustainable cultural development, innovation, and community empowerment. Cultural Map Thailand thus stands not only as a database but as a platform for cultural learning, policy experimentation, and shared exploration of Thailand's cultural future.

### **Acknowledgements**

This study was supported by the Program Management Unit for Area-Based Development (PMU-A) and facilitated by Kanchanaburi Rajabhat University. We also thank the local communities, cultural asset owners, and partner universities whose participation and verification efforts ensured the accuracy and legitimacy of the cultural data used in this research.

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