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Original article

Soft Power Strategies for PM_{2.5} Risk Communication in Border Regions

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Abstract

Particulate matter 2.5 mm. (PM_{2.5}) pollution poses significant environmental and public health challenges in Thailand's border regions, where local and transboundary sources exacerbate air quality problems. This study investigated the integration of soft power principles into PM_{2.5} risk communication strategies through a mixed-methods approach conducted across six border provinces. The research involved 353 participants, including public health officers, village health volunteers, and community members, examining knowledge levels, communication practices, and cultural adaptation needs. Quantitative analysis revealed high levels of technical knowledge among health workers (93.8% correctly identifying PM_{2.5} characteristics), though confidence in communication skills varied significantly, particularly in managing public misconceptions (Mean=3.60, SD=0.736). Strong correlations emerged between community cooperation and managing public doubts ($r=0.785$, $p<0.01$), underscoring trust-building's importance. Qualitative findings elucidated that these doubts often stemmed from economic constraints, feelings of helplessness regarding transboundary pollution, and inconsistent regulatory enforcement. Qualitative findings also emphasized the crucial role of cultural sensitivity and economic considerations in message reception and behavioral change. The study identified significant gaps between technical understanding and effective community engagement. Digital media presented both an opportunity (high demand for training, Mean=3.97, SD=0.794) and challenges, with implementation barriers in resource-limited settings. Qualitative data highlighted the need for locally tailored digital content and culturally appropriate solutions to overcome these barriers. The research contributes to theoretical understanding by demonstrating specific applications of soft power in environmental health communication and identifying mechanisms through which cultural factors influence message effectiveness. These findings support the development of culturally adapted communication strategies that integrate traditional and

modern approaches while maintaining strong community involvement. Recommendations include strengthening cultural competency training for health workers, developing integrated communication strategies, and enhancing cross-border cooperation mechanisms. Future research directions should examine long-term impacts of culturally adapted communication strategies and investigate emerging technologies in supporting cultural adaptation of health messages.

Keywords: PM2.5; risk communication; community engagement; digital media; cultural adaptation; border regions

Introduction

PM2.5 pollution poses a significant environmental and public health challenge in Southeast Asia⁽¹⁾ with particularly severe implications for Thailand's border regions.⁽²⁾ These areas face a complex convergence of local and transboundary pollution sources, creating unique challenges for public health communication and intervention strategies.⁽³⁾ While the physical and health impacts of PM2.5 are well-documented, effective risk communication in these regions remains a persistent challenge⁽⁴⁾ complicated by cultural diversity, linguistic variations, and varying levels of health literacy among border communities.⁽⁵⁾

Thailand's border provinces, including Tak, Chiang Rai, Nan, Phitsanulok, Loei, and Nong Khai, experience heightened vulnerability to PM2.5 pollution due to multiple factors. Local sources such as agricultural burning, forest fires and industrial emissions combine with transboundary haze from neighboring countries to create severe air quality challenges, particularly during the dry season.⁽⁶⁾

Recent studies indicate that PM2.5 levels in these border regions frequently exceed World Health Organization guidelines, with measurements often reaching hazardous levels during peak pollution periods⁽⁷⁾. The health implications are substantial, with increased incidence of respiratory diseases,

cardiovascular problems and other related health issues affecting local populations. The economic burden of these health impacts, combined with reduced visibility affecting border trade and tourism, underscores the urgency of effective intervention strategies.

Traditional risk communication approaches have shown limited effectiveness in border regions, where cultural nuances, language barriers, and varied socio-economic conditions create unique challenges. Current communication strategies often fail to adequately address: (1) cultural diversity and traditional practices that influence environmental behaviors; (2) language barriers that impede the dissemination of critical health information; (3) limited access to digital resources and health information in remote border areas; and (4) varying levels of health literacy and risk perception among different community groups. Complex transboundary nature of PM2.5 pollution requires coordinated communication efforts.

These challenges are further complicated by the need to balance scientific accuracy with cultural sensitivity while maintaining message clarity and actionability. The limitation of conventional risk communication approaches in these contexts necessitates innovative strategies that can effectively bridge these gaps. Soft power, defined by Nye as influence through attraction rather than coercion⁽⁸⁾,

can enhance risk communication effectiveness by making health messages culturally attractive and credible. This study integrates soft power principles — cultural attraction, legitimacy building, and credibility enhancement — with traditional risk communication approaches to address PM2.5 challenges in culturally diverse border regions.

This study aimed to explore the situation and effectiveness of PM2.5 risk communication strategies, with specific objectives to evaluate current knowledge levels, communication skills, and training needs among public health workers and community leaders in border regions; assess existing risk communication strategies and identify cultural and linguistic barriers to their implementation of existing risk communication strategies; develop an integrated framework that incorporates soft power principles into PM2.5 risk communication; and propose evidence-based recommendations for implementing culturally sensitive communication strategies.

Methods

Research Design

This study employed a sequential explanatory mixed-methods design to investigate the integration of soft power principles in PM2.5 risk communication within Thailand's border regions. The research process began with a quantitative phase comprising structured surveys, followed by a qualitative phase of focus group discussions. This design allowed for both broad understanding of communication patterns and deep insights into cultural nuances affecting risk communication.

Study Setting and Participants

The research was conducted across six Thai

border provinces selected for their significant PM2.5 challenges and diverse cultural landscapes: Tak, Chiang Rai, Nan, Phitsanulok, Loei, and Nong Khai. These provinces were chosen based on historical air quality data indicating persistent PM2.5 problems and their representation of different border contexts and cultural groups.

The study involved 353 participants, comprising 224 public health officers, 67 village health volunteers, and 62 community members. The sample size was determined using power analysis for the quantitative component, with $\alpha = 0.05$ and power = 0.80. Participants were selected through a combination of purposive and stratified random sampling to ensure representation across professional roles, geographic locations, and demographic characteristics.

Data Collection

1. Quantitative Phase

The quantitative data collection employed a structured questionnaire developed through a rigorous process of expert consultation and pilot testing^(4,9). The questionnaire was initially drafted based on literature review and expert inputs⁽¹⁰⁾; and was then refined through cognitive interviews with ten potential respondents. After revision, it was pilot tested with 30 participants not included in the final sample. The final instrument contained four main sections: (1) demographic information and professional background; (2) knowledge assessment regarding PM2.5 and its health impacts^(6,10); (3) communication skills evaluation;^(9,11) and (4) training needs assessment.^(9,11) Survey distribution occurred between June and August 2024, with both online and paper-based options available to accommodate varying levels of digital access.^(5,9) The response rate reached 89%, with 353 completed

surveys distributed to 396 participants.

2. Qualitative Phase

The qualitative phase comprised four focus group discussions, each involving eight participants and lasting approximately 45 minutes. The groups were structured as follows: (1) agricultural workers who complied with legal regulations. (2) agricultural workers who had not adopted legal practices. and (3) two groups of individuals directly affected by PM2.5 pollution. Discussions were conducted in local languages with trained interpreters present when necessary. Sessions were audio-recorded with participant consent and professionally transcribed. The discussion guide, developed based on preliminary quantitative findings, explored themes of risk perception, communication preferences and cultural barriers to health message adoption.

Validity and Reliability Measures

1. Quantitative Validity

Internal validity was strengthened through pilot testing and expert review of instruments using item-object congruence index, with values ranging from 0.8 to 1.0 across all items (n=24). Content validity was established through systematic expert review by 5 specialists. Construct validity was assessed during the research design phase. The external validity of the study was supported by implementing a probability sampling approach across 6 provinces with 353 participants (95% confidence level, $\pm 5\%$ margin of error), ensuring findings can be generalized to the broader target population.

2. Qualitative Trustworthiness

Qualitative rigor was maintained through member checking, peer debriefing and thick description. An audit trail documented all analytical decisions.

Multiple coders, who were two researchers and two research assistants, and participant validation enhanced credibility. The presence of language support personnel ensured accurate capture of nuanced cultural meanings. Reliability analysis yielded a Cronbach's alpha of 0.921 for the overall instrument

Mixed-Methods Integration

Integration quality was ensured through careful timing of sequential phases, explicit connection between quantitative and qualitative components, and systematic comparison of findings from both methods. Regular team meetings—maintained consistency in interpretation and integration of findings.

Data Analysis

1. Quantitative Analysis

Statistical analysis was conducted using SPSS version 28.0. Descriptive statistics summarized demographic characteristics and response distributions. Inferential analyses were performed to examine relationships between key variables. Pearson correlation coefficients were calculated to identify associations among knowledge levels, communication skills and training needs. Specifically, correlations were analyzed among communication skills — such as explaining scientific information, using media effectively, addressing public concerns, raising awareness, and managing misconceptions — and among training needs, including updating knowledge on PM2.5 impacts, using digital/social media, simplifying scientific communication, building community cooperation, and managing doubts.

2. Qualitative Analysis

Qualitative data underwent thematic analysis following Braun and Clarke's⁽¹²⁾ six-phase approach. Two researchers independently coded the transcripts.

The analysis process involved:

- 1) Familiarization with the data through repeated transcript reading and initial note-taking.
- 2) Systematic coding of the entire dataset, identifying relevant patterns and potential themes.
- 3) Theme development through iterative refinement and discussion among researchers.
- 4) Theme review and validation against the original data.
- 5) Theme definition and naming through consensus.
- 6) Report production with compelling extract examples.

Ethical Considerations

The study received approval from the Institutional Review Board of Chulalongkorn University (COA No. 463/67, 006/68, 116/68, and 297/68). All participants provided written informed consent, with forms available in multiple languages. Data confidentiality was maintained through coded identifiers and secure storage. Participants could withdraw at any time without consequence.

Results

Participant Demographics

The study included 353 participants across 6 border provinces in Thailand. Female participants

constituted 70.3% (n=248) of the sample, while male participants represented 29.7% (n=105). Educational backgrounds varied, with 64.3% (n=227) holding bachelor's degrees, 24.4% (n=86) having education below bachelor's level, and 11.3% (n=40) possessing advanced degrees. Public health officers formed the largest professional group at 63.5% (n=224), followed by village health volunteers at 19.0% (n=67), professional nurses at 10.8% (n=38), and other healthcare workers at 6.7% (n=24).

Knowledge Assessment Results

Table 1 presents participants' knowledge of PM2.5. The findings indicate high levels of technical knowledge among participants, with 93.8% correctly defining PM2.5 as particles smaller than 2.5 microns, 94.3% identifying main sources in border areas, 98.3% recognizing health effects, and 99.4% knowing the most effective self-protection measures.

Table 2 shows participants' self-reported communication abilities. Mean scores ranged from 3.60 to 3.79 across five skill areas. "Using media effectively" achieved the highest mean score (3.79, SD=0.795), while "Addressing public concerns" and "Managing public misconceptions" both scored lowest (Mean=3.60, SD=0.736).

Table 3 presents correlations between various communication abilities. All skill areas showed strong

Table 1 Knowledge of PM2.5 among participants

Question	Correct Response	Count	Percentage
What is PM2.5?	Particles smaller than 2.5 microns	331	93.8%
Main sources in border areas?	Open burning and forest fires	333	94.3%
Most important health effects?	Respiratory and cardiovascular	347	98.3%
Most effective self-protection measure?	N95/KN95 masks	351	99.4%

Table 2: Participants' self-reported communication abilities

Skill Area	Mean	Standard deviation
Explaining scientific information	3.71	0.748
Using media effectively	3.79	0.795
Addressing public concerns	3.60	0.736
Raising awareness and encouraging prevention	3.75	0.715
Managing public misconceptions	3.60	0.736

Table 3 Abilities correlation table

Variables	Explaining info	Using media	Answering concerns	Raising awareness	Managing misconceptions
Explaining info	1	0.604*	0.710*	0.559*	0.612*
Using media	0.604*	1	0.578*	0.582*	0.559*
Answering concerns	0.710*	0.578*	1	0.602*	0.673*
Raising awareness	0.559*	0.582*	0.602*	1	0.656*
Managing misconceptions	0.612*	0.559*	0.673*	0.656*	1

* Significant at $p < 0.01$ level

positive correlations significant at $p < 0.01$ level. The strongest correlation was between “explaining scientific information” and “answering concerns” ($r = 0.710$), followed by “answering concerns” and “managing misconceptions” ($r = 0.673$).

Training Needs Analysis

Table 4 outlines identified training needs for effective communication. Participants expressed high demand across all areas, with means ranging from 3.80 to 3.98. “Updating knowledge on PM2.5

impacts” received the highest score (Mean=3.98, SD=0.757), followed by “using digital/social media for communication” (Mean=3.97, SD=0.794).

Table 5 shows correlations between various training needs. All training areas were strongly and positively correlated at $p < 0.01$ level. The strongest correlation was between “building community cooperation” and “managing doubts” ($r = 0.785$), followed by “simplifying science” and “managing doubts” ($r = 0.738$).

Table 4 Training needs for effective communication

Training Area	Mean	Standard deviation
Updating knowledge on PM2.5 impacts	3.98	0.757
Using digital/social media for communication	3.97	0.794
Simplifying scientific communication	3.80	0.843
Building community cooperation	3.85	0.841

Table 5 Training needs correlation table

Variables	Updating knowledge	Using digital media	Simplifying science	Building cooperation	Managing doubts
Updating knowledge	1	0.694*	0.661*	0.606*	0.629*
Using digital media	0.694*	1	0.718*	0.568*	0.612*
Simplifying science	0.661*	0.718*	1	0.699*	0.738*
Building cooperation	0.606*	0.568*	0.699*	1	0.785*
Managing doubts	0.629*	0.612*	0.738*	0.785*	1

* Significant at p<0.01 level

Table 6 presents key insights from four focus group discussions. Agricultural workers (compliant) acknowledged legal compliance benefits but cited cost challenges. Non-compliant agricultural workers expressed resistance due to economic constraints and enforcement concerns. People directly affected by PM2.5 emphasized health impacts and requested locally tailored

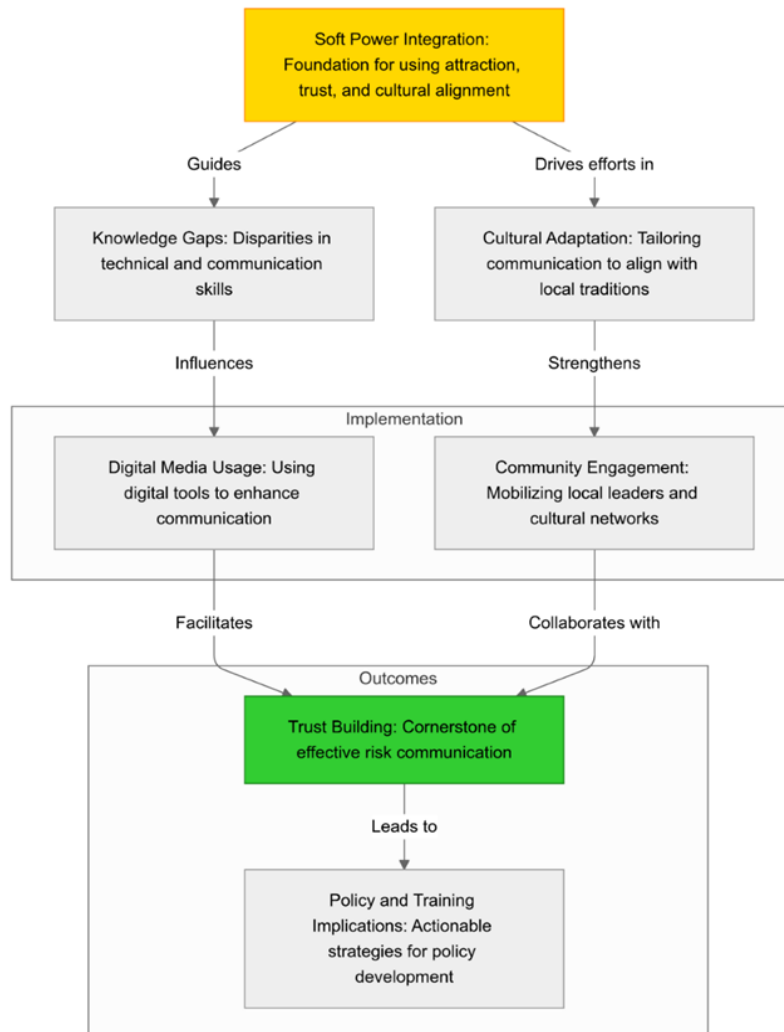
communication solutions including visual materials and community leader involvement.

Figure 1 shows conceptual framework integrating soft power strategies for enhanced PM2.5 risk communication in Thailand's border regions. The model illustrates how soft power principles (attraction, trust, and cultural alignment) guide communication

Table 6 Key insights from focus group discussions

Group	Key themes	Specific insights
Agricultural workers (Compliant)	Highlighted benefits of adhering to regulations, including reduced health impacts and fewer conflicts with authorities.	<ul style="list-style-type: none"> Participants acknowledged using legal methods to clear crops but cited challenges in adopting them due to cost. Ex. "We try to comply, but access to resources like machines for non-burning methods is still limited."
Agricultural workers (non-compliant)	Resistance due to economic constraints and skepticism about alternatives' effectiveness.	<ul style="list-style-type: none"> Some participants expressed frustration over enforcement measures, citing uneven application. Ex. "Burning is cheaper and faster, and the alternatives don't make sense when no one helps us afford them."
People directly affected	<p>Focused on the health impacts of PM2.5 on themselves and their families, emphasizing respiratory diseases and reduced quality of life.</p> <p>Urged for better communication from authorities and proposed locally tailored solutions to promote awareness and prevention.</p>	<ul style="list-style-type: none"> Participants expressed helplessness in controlling pollution sources from neighboring areas. Ex. "My son has asthma, and every burning season, his condition worsens." Suggested increasing the use of visual materials, such as videos or images, to improve understanding of the risks and mitigation methods. Ex. "We need our local leaders to share practical advice in meetings or through campaigns."

Figure 1 Integrating soft power strategies for enhanced PM2.5 risk communication



interventions, influence digital media use and community engagement, and facilitate trust building – leading to actionable policy and training strategies for sustainable health communication.

Discussion

This study reveals significant patterns in the integration of soft power principles with PM2.5 risk communication in Thailand's border regions. High PM2.5 knowledge among health workers (93.8–99.4% correct), combined with lower communication confidence, particularly in managing misconceptions

(Mean=3.60), suggests a critical gap between technical understanding and effective community engagement. This finding aligns with previous research by Covello⁽⁹⁾, who identified similar disparities in environmental risk communication.

The strong correlation between community cooperation and managing public doubts ($r=0.785$, $p<0.01$) demonstrates the interconnected nature of trust-building and effective risk communication.⁽¹³⁾ This relationship supports Nye's⁽⁸⁾ theoretical framework of soft power, particularly regarding the importance of attraction rather than coercion in

achieving behavioral change. These public doubts, as revealed by qualitative findings in Table 6, often stem from the apparent tension between economic constraints and environmental compliance across groups, indicating a need for culturally integrated messaging that addresses economic realities alongside health concerns. The finding extends current understanding by demonstrating specific applications in environmental health communication within culturally diverse border regions.

Cultural Adaptation and Communication Effectiveness

The study findings emphasize the crucial role of cultural adaptation in risk communication effectiveness. Strong correlations across communication skills (Table 3) highlight their interconnectedness. Cultural adaptation, in the context of soft power, serves as a key mechanism for influencing behavior through attraction and persuasion rather than coercion. By tailoring communication to align with local traditions, values, and languages, it enhances the receptiveness and relevance of risk messages within diverse communities. The qualitative data revealing community preferences for locally contextualized communication approaches supports Brooks et al.'s⁽¹⁴⁾ assertion about the importance of cultural sensitivity in health messaging. However, our findings extend this understanding by identifying specific mechanisms through which cultural adaptation influences message reception and behavioral change in border communities.

The economic constraints identified by agricultural workers regarding adoption of alternative farming methods highlight the complex interplay between cultural practices and environmental health behaviors. This finding enriches previous research by Janta et

al.⁽²⁾ by demonstrating how economic factors influence the effectiveness of environmental health communication in border regions.

Digital Media Integration

The high demand for digital media training (Mean=3.97, SD=0.794) among health workers reflects the growing importance of technology in public health communication. This reflects health workers' desire to enhance both technical knowledge and communication tools. However, the qualitative findings reveal nuanced challenges in implementing digital strategies within border communities. Insights from focus group discussions (Table 6) highlighted the need for locally tailored digital content, such as visual materials like videos and images, to enhance understanding among community members, underscoring the importance of cultural sensitivity in digital content creation. Furthermore, economic constraints identified by agricultural workers indirectly point to barriers in digital access and adoption within resource-limited settings, necessitating culturally appropriate and accessible digital solutions. This tension between digital potential and practical implementation challenges extends O'Hair's⁽¹¹⁾ work on digital health communication by identifying specific barriers in culturally diverse, resource-limited settings.

The strong correlation between digital media usage and simplifying scientific information ($r=0.718$, $p<0.01$) suggests potential synergies in developing integrated communication strategies. This finding offers new insights into how digital tools might be leveraged to enhance traditional communication approaches while maintaining cultural sensitivity."

Community Engagement and Trust Building

The emphasis on community leader involvement in message dissemination emerged as a crucial factor in communication effectiveness. Moreover, the strong correlation between community cooperation and managing doubts ($r=0.785$, $p<0.01$) underscores this connection. This finding reinforces Watanabe et al.⁽¹⁵⁾ research on community engagement while providing specific evidence of its application incommunicable disease control communication. The study extends current understanding by demonstrating how traditional authority structures can be integrated with modern communication approaches like soft power integration.

The qualitative findings revealed cultural sensitivity considerations, including preferences for local leadership involvement and visual communication formats. The tension between economic constraints and environmental compliance indicates a need for culturally integrated messaging addressing both health concerns and economic realities.

The qualitative data revealing the importance of balancing cultural traditions with environmental protection presents new insights into the complexity of implementing sustainable practices in border communities. This finding contributes to the theoretical understanding of how soft power principles can be applied in addressing environmental health challenges.

Conclusion

The integration of soft power principles in PM2.5 risk communication presents both opportunities and challenges. While the study demonstrates the potential effectiveness of culturally sensitive approaches, it also highlights the complexity of implementing such strategies in diverse border communities. The findings

suggest that successful risk communication requires careful balance between traditional practices and modern approaches, supported by strong community engagement and cultural understanding.

Practical Implications

1. Policy Development

The findings suggest several important policy implications for enhancing PM2.5 risk communication in border regions. First, policies should prioritize cultural adaptation in communication strategies, incorporating local languages and cultural references. Second, resource allocation should consider both traditional and digital communication channels, acknowledging the complementary roles they play in effective risk communication.

2. Training Program Design

The identified gaps in communication skills and digital media usage indicate specific areas for training program development. Programs should focus on building capacity in managing public misconceptions and addressing public concerns while incorporating cultural sensitivity training.

3. Community Engagement Strategies

The findings support the development of community engagement strategies that leverage existing social structures and cultural practices. These strategies should acknowledge economic constraints while promoting sustainable environmental practices through culturally appropriate channels.

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กลยุทธ์ซอฟต์แวร์ในการสื่อสารความเสี่ยงฝุ่น PM2.5 ในพื้นที่ชายแดน

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บทคัดย่อ: มลพิษ PM2.5 สร้างความท้าทายอย่างยิ่งทั้งด้านสิ่งแวดล้อมและด้านสาธารณสุขในพื้นที่ชายแดนของประเทศไทย ซึ่งมีทั้งแหล่งกำเนิดฝุ่นในท้องถิ่นและฝุ่นข้ามพรมแดน โดยทำให้ปัญหาคุณภาพอากาศทวีความรุนแรงขึ้น การศึกษาได้พยายามค้นหาแนวทางในการบูรณาการแนวคิด soft power กับกลยุทธ์การสื่อสารความเสี่ยงต่อฝุ่น PM2.5 โดยใช้ระเบียบวิธีวิจัยแบบผสมวิธี ซึ่งดำเนินการใน 6 จังหวัดชายแดน งานวิจัยนี้มีผู้เข้าร่วม 353 คน ประกอบด้วยเจ้าหน้าที่สาธารณสุข อาสาสมัครสาธารณสุขประจำหมู่บ้าน และสมาชิกในชุมชน โดยงานวิจัยได้วัดระดับความรู้ วิธีการสื่อสาร และความต้องการในการปรับตัวทางวัฒนธรรม การวิเคราะห์เชิงปริมาณพบว่าบุคลากรด้านสุขภาพมีความรู้ทางเทคนิคในระดับสูง โดยร้อยละ 93.8 สามารถระบุลักษณะสำคัญของ PM2.5 ได้อย่างถูกต้อง อย่างไรก็ตาม ความมั่นใจในทักษะการสื่อสารมีแปรปรวนอย่างยิ่ง โดยเฉพาะในการจัดการกับความเข้าใจผิดของประชาชน (Mean=3.60, SD=0.736) นอกจากนี้ยังพบความสัมพันธ์ในระดับสูงระหว่างความร่วมมือของชุมชนและการจัดการกับข้อสงสัยของประชาชน ($r=0.785$, $p<0.01$) ซึ่งเน้นย้ำถึงความสำคัญของการสร้างความไว้วางใจเพื่อให้เกิดการสื่อสารความเสี่ยงที่มีประสิทธิภาพ ข้อค้นพบเชิงคุณภาพจากการสนทนากลุ่มยังเน้นย้ำถึงบทบาทที่สำคัญของความละเอียดอ่อนทางวัฒนธรรมและการคำนึงถึงปัจจัยด้านเศรษฐกิจ รวมถึงความรู้สึกไร้อำนาจในการควบคุมปัญหาฝุ่นจากต่างประเทศ และการบังคับใช้กฎหมายที่ไม่สม่ำเสมอ ที่มีต่อพฤติกรรมรับรู้และการเปลี่ยนแปลงพฤติกรรม การศึกษานี้ได้ระบุช่องว่างที่สำคัญระหว่างความเข้าใจทางเทคนิคและการมีส่วนร่วมกับชุมชนอย่างมีประสิทธิภาพ โดยเฉพาะอย่างยิ่งในการสร้างสมดุลระหว่างวิถีปฏิบัติแบบดั้งเดิมกับความต้องการด้านการปกป้องสิ่งแวดล้อม นอกจากนี้ยังพบว่าสื่อดิจิทัลเป็นทั้งโอกาสและความท้าทาย โดยความต้องการฝึกอบรมในระดับสูง (Mean=3.97, SD=0.794) ซึ่งก็พบว่ายังมีอุปสรรคในการนำความรู้ไปสู่ปฏิบัติในสภาพแวดล้อมที่มีทรัพยากรจำกัดเช่นกัน ข้อมูลเชิงคุณภาพชี้ให้เห็นถึงความจำเป็นในการพัฒนาสื่อดิจิทัลที่เหมาะสมกับบริบทท้องถิ่นและแนวทางแก้ไขที่สอดคล้องกับวัฒนธรรมเพื่อเอาชนะอุปสรรคเหล่านี้ งานวิจัยมีส่วนช่วยทำให้เกิดความเข้าใจเชิงทฤษฎีโดยแสดงให้เห็นถึงการประยุกต์ใช้ soft power ในการสื่อสารสุขภาพที่เกิดจากสิ่งแวดล้อมและระบุกลไกที่ปัจจัยทางวัฒนธรรมมีอิทธิพลต่อประสิทธิผลของข้อความ ข้อค้นพบเหล่านี้สนับสนุนแนวทางการพัฒนากลยุทธ์การสื่อสารแบบปรับให้เข้ากับวัฒนธรรม ซึ่งบูรณาการแนวทางดั้งเดิมกับแนวทางสมัยใหม่ ในขณะที่ยังคงรักษากฎการมีส่วนร่วมในระดับสูงจากชุมชน ข้อเสนอแนะได้แก่ การส่งเสริมให้เกิดการฝึกอบรมเพื่อพัฒนาสมรรถนะด้านวัฒนธรรมสำหรับบุคลากรด้านสุขภาพ การพัฒนากลยุทธ์การสื่อสารแบบบูรณาการ และการเพิ่มกลไกความร่วมมือข้ามพรมแดน ทิศทางการวิจัยในอนาคต ได้แก่ การตรวจสอบผลกระทบระยะยาวของกลยุทธ์การสื่อสารแบบปรับให้เข้ากับวัฒนธรรมนี้ และค้นหาเทคโนโลยีต่างๆ ที่เกิดขึ้นใหม่ที่จะนำมาใช้สนับสนุนการปรับปรุงให้ข้อความด้านสุขภาพเข้ากับวัฒนธรรมยิ่งขึ้น

คำสำคัญ: PM2.5; การสื่อสารความเสี่ยง; การมีส่วนร่วมของชุมชน; สื่อดิจิทัล; การปรับตัวทางวัฒนธรรม; พื้นที่ชายแดน