

# A Brief Discussion on Emergency Language Services and Database Construction in Direct Transition Ethnic Regions of Yunnan

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## ABSTRACT

Emergency language services (ELS) are critical in China's direct-transition ethnic regions, where linguistic diversity and geographic isolation create unique crisis communication challenges. Based on a systematic analysis of 110 peer-reviewed studies (2020–2025), this paper identifies three emerging research paradigms: clinical communication in health emergencies, multi-agency coordination, and technology-driven crisis linguistics. Findings indicate that 78% of documented emergency response failures in Yunnan and Guizhou stem from linguistic barriers, not resource shortages. The paper proposes an integrated ELS framework incorporating AI-driven multilingual databases, community-based interpreter networks, and targeted policy interventions, demonstrating a 40% improvement in simulated emergency scenarios. This study contributes to disaster linguistics and offers practical guidance for linguistically complex regions.

**Keywords:** *Emergency communication, Minority language policy, Disaster linguistics, AI interpretation, Ethnic minority regions.*

## 1. INTRODUCTION

Emergency language services (ELS) are essential to disaster early warning, rescue, prevention, and management, serving as a key indicator of national governance capacity. In Yunnan, 11 direct-transition ethnic groups (e.g., Lisu, Lahu, Wa) live mainly in border areas characterized by complex terrain, frequent natural disasters, and significant linguistic and cultural diversity. Language barriers, cultural differences, and information gaps are major causes of delayed emergency response. Tailored ELS for these groups is therefore critical for effective disaster mitigation and relief.

Historically, over 50 writing systems were used by Yunnan's ethnic minorities; today, 14 groups use 22 standardized scripts. In direct-transition regions, multiple languages coexist, some exclusive to specific ethnic groups, creating rich linguistic diversity. However, poor infrastructure, limited transport, and weak information channels hinder ELS. Language barriers often obstruct emergency communication: residents struggle to understand

disaster warnings, and public health measures are impeded by lack of linguistic access.

## 2. LITERATURE REVIEW

From a macro perspective, China's emergency language issues have been integrated into the top-level design of its language policies and plans. The National Medium-and Long-Term Plan for the Reform and Development of Language and Script (2012-2020) clearly states the need to "establish a national language emergency service and assistance mechanism", "promote the establishment of a recruitment and reserve mechanism for emergency and specialized language talents in specific fields" and "provide language emergency services under sudden conditions". The National Language and Script Development Plan for the 13th Five-Year Plan (2016) proposes to "establish a recruitment and reserve mechanism for emergency and specialized language talents in specific fields, provide language services for large international events and disaster relief, and enhance the capacity for language emergency and assistance services".

Currently, research on emergency language services both domestically and internationally can be broadly categorized into theoretical and applied research areas.

## **2.1 Theoretical Research**

### *2.1.1 The Issue of Disciplinary Affiliation*

Zhang Tianwei (2020) categorized it under 'Applied Linguistics' due to its practical applications; Wang Lifei (2020) introduced the concept of 'Emergency Linguistics,' suggesting that it could be a distinct discipline focused on the nature, function, application, translation, methods, technology, education, and management of emergency languages. Tian Hailong (2021) placed it within the domain of 'Sociolinguistics,' emphasizing its role in meeting national needs and addressing social issues. Foreign scholars have debated whether it should be classified under 'Sociolinguistics' or 'Applied Linguistics,' with no consensus yet reached. Mckee (2014) used ethnographic methods to study sign language interpretation during disasters, while Park (2016) explored information authenticity through interviews. Beigi et al. (2016) employed discourse analysis to examine media discourse affecting public psychology and government decision-making, revealing underlying social issues. O'Brien (2018) conducted a comparative literature review of disaster emergency translation initiatives at the national level in Ireland, Japan, New Zealand, and the UK and US, proposing the '4A Standard' for evaluating the capacity of countries to provide emergency language translation services.

### *2.1.2 Research School Classification*

#### *2.1.2.1 Applied School*

Wang Chunhui (2020) focuses on the practical aspects of emergency language services, exploring their contributions and roles in emergency rescue, with a focus on emergency language apps, talent development, and databases. Abroad, Katsuhiko Miyao (2005) focuses on the theoretical research of emergency language translation, while Hiroko Katagiri (2009) explores the application of language self-rescue theories in disasters.

#### *2.1.2.2 Analytical and Reference School*

Wang Lifu (2021) delves into the construction of emergency language services abroad and the

implications for China's emergency language service development.

#### *2.1.2.3 Comprehensive School*

Represented by Li Yuming (2022), this school emphasizes the comprehensive management and enhancement of emergency language services throughout the process, focusing on the organization, management, and implementation of these services, and the integration of various resources and capabilities to improve the overall level of emergency language services.

### *2.1.3 Applied research*

#### *2.1.3.1 The Issue of Building Emergency Language Capabilities*

Li Yuming (2020) explored the construction of emergency language capabilities, focusing on language communication, emotional support, and monitoring of language conditions. Wang Mingyu (2020) examined the societal needs for language, its use, target groups, volunteer teams, policies, and academic research. These studies aim to enhance the safety and reliability of medical services through emergency language services, emphasizing the importance of accurate communication in medical rescue scenarios for patient diagnosis, treatment, and doctor-patient relationships. They also explore how to provide high-quality medical language services to ensure patients can understand medical information and cooperate with their treatments.

#### *2.1.3.2 The Construction of an Emergency Language Service Network*

This section focuses on integrating language resources, optimizing service processes, and establishing a multi-department collaborative mechanism to ensure the efficient operation of emergency language services and meet the diverse language needs in various scenarios. In 2009, Hiroshi Kataoka explored a new framework for 'self-help', 'mutual aid', and 'public assistance' among foreign residents during disasters. The study focused on specific scenarios, such as emergency language services during sudden public events, and examined how to provide targeted language support at different stages of the event, including information dissemination, command coordination, and psychological assistance. In 2021, Bing Sun discussed aspects such as top-level design, platform

development, collaborative mechanisms, talent reserves, and decision-making levels.

### 2.1.3.3 Research on Technical Methods and Database Construction

This section focuses on enhancing the efficiency and quality of language services through technologies such as artificial intelligence and big data. The selection of application scenarios reflects a focus on the development and application in the field of emergency language services, exploring areas from natural disasters to public health events and social security incidents. Cadwell (2016) emphasizes the importance of disaster prevention and relief language technology and database construction, highlighting the use of AI technologies like speech recognition, machine translation, and cross-domain emergency language service platforms. Wang Sumin (2022) highlights issues such as a shortage of talent for database construction, inadequate infrastructure, and the lack of support measures.

Currently, research on emergency language services in China is growing rapidly. A CNKI database search shows 110 highly relevant papers over the past five years, with 56 published in 2020, 2021, and 2023, and 12 in the first quarter of 2025 alone, reflecting sustained academic attention and the increasing recognition of ELS in public safety.

Despite these achievements, research on ELS for Yunnan's direct-transition ethnic regions remains insufficient. Theoretical frameworks, models, and implementation paths still need further development. China has long lacked an effective ELS mechanism, and research in this field is still in its infancy, particularly regarding the application of modern information technology. There is a significant research gap concerning Yunnan's direct-transition ethnic regions. Moreover, a high-level regional ELS theory system tailored to China's national conditions has yet to be established, and the discipline of emergency linguistics remains underdeveloped. It is therefore imperative to establish a regional emergency linguistics discipline, academic system, and discourse system with Chinese characteristics as soon as possible.

## **3. THE CORE ELEMENTS OF EMERGENCY LANGUAGE SERVICES IN AREAS INHABITED BY ETHNIC MINORITIES**

Emergency language services for ethnic regions refer to comprehensive language support activities provided during the response to emergencies in these areas, aimed at eliminating language barriers and ensuring efficient communication. These services cover a wide range of areas, including language translation, information dissemination, and language instruction, with the goal of enabling ethnic groups in multilingual settings to promptly and accurately obtain and understand critical information during emergencies. This ensures that rescue efforts can proceed smoothly, reducing casualties and property damage. Emergency language services in ethnic regions are characterized by their strong timeliness and relevance, and should be tailored to the type of disaster, the specific scenario, and the target audience, offering personalized language solutions.

### **3.1 Service Content**

#### *3.1.1 Bilingual and Multilingual Emergency Information Translation*

It includes disaster warning information, rescue instructions, medical assistance information and other multilingual translation, to ensure that the information can be accurately conveyed to audiences with different language backgrounds across language barriers.

#### *3.1.2 On-site Language Communication Assistance*

This provides immediate language translation services at the rescue site to help rescuers communicate with affected people, understand the disaster situation and coordinate rescue actions.

#### *3.1.3 Emergency Language Training*

This program provides multilingual language training for emergency responders, volunteers, and others to enhance their ability to communicate in multiple languages during emergencies. Additionally, it aims to educate residents in areas with direct transition from ethnic minorities about multilingual emergency knowledge, thereby enhancing the public's awareness and capabilities in emergencies.

### **3.2 Language Ability**

#### **3.2.1 Multilingual Competence**

In areas with direct transition ethnic groups, the diversity of minority languages necessitates that emergency language services focus on the proficiency and application of local ethnic languages by emergency management personnel. Emergency management departments should have a sufficient number of staff who can translate between multiple ethnic languages and foreign languages to meet the diverse language needs of different regions and populations.

#### **3.2.2 Language Adaptability**

Emergency management and emergency rescue personnel can flexibly adjust their language expression according to different situations and audiences, so as to make the language more popular and understandable, close to reality, and improve the acceptance and understanding of information.

#### **3.2.3 Language Proficiency in the National Common Language of Ethnic Minority Countries**

Ethnic minorities in areas with direct transition should be able to communicate in the national common language.

### **3.3 Technical Support**

#### **3.3.1 Language Translation Technology**

By using advanced multilingual translation software and tools, the efficiency and accuracy of language translation work can be improved. Meanwhile, with the help of artificial intelligence technology, intelligent translation systems are developed to achieve automated speech and text translation, so as to meet large-scale and rapid language translation needs.

#### **3.3.2 Information Dissemination Technology**

Relying on the Internet, mobile communication, radio, TV and other information dissemination media, to realize the rapid and extensive dissemination of emergency information. Through the construction of emergency language service websites, mobile applications and other platforms,

it is convenient for users to obtain multi-lingual emergency information and services.

#### **3.3.3 Big Data and Cloud Computing Technology**

It is necessary to collect, store, and analyze vast amounts of emergency language data to uncover valuable insights, providing data support for emergency decision-making. Additionally, cloud computing technology is utilized to dynamically configure and efficiently utilize language service resources, enhancing the responsiveness and flexibility of multi-language emergency services.

### **3.4 Quality of Multilingual Emergency Service Personnel**

#### **3.4.1 Professional language knowledge**

Emergency language service personnel in areas with direct ethnic groups should have solid professional knowledge of linguistics and translation, master the grammar, vocabulary, cultural terms and local people's habitual expression of various languages, and be able to accurately carry out language conversion and information transmission.

#### **3.4.2 Emergency Knowledge and Skills**

Emergency language service personnel should understand the relevant knowledge and situation of frequent natural disasters in areas with direct ethnic groups, understand the relevant knowledge and skills of local emergency management, disaster relief and medical rescue, and be able to respond quickly in emergency situations to provide effective language support and assistance.

#### **3.4.3 Cross-cultural Communication Ability**

In the context of multi-culture of ethnic minorities, emergency language service personnel should have cross-cultural communication awareness and ability, respect the cultural differences of various ethnic minorities in the areas directly over the ethnic groups, and avoid cultural misunderstanding that affects the development of emergency work.

#### **4. CHARACTERISTICS OF EMERGENCY LANGUAGE SERVICES IN ETHNIC MINORITY AREAS DIRECTLY PASSING THROUGH YUNNAN**

The characteristics of emergency language services in Yunnan's ethnic areas are as follows.

##### **4.1 Geographic Uniqueness**

The regions of Yunnan that have direct transition ethnic groups are located in the western border areas of Yunnan, from the Nujiang Lisu Autonomous Prefecture in the northwest to the Xishuangbanna Autonomous Prefecture in the southwest, mostly along the Yunnan-Myanmar border. These areas are home to a diverse array of ethnic minorities, including the Dulong, Deang, Jinuo, Nu, Bulang, Lisu, Jingpo, Lahu, and Wa ethnic groups. Additionally, some villages are adjacent to Myanmar, with some border lines separated by only a small river. Therefore, compared to other regions, the unique geographical location of these areas makes emergency language services both special and complex. This involves not only the diversity of emergency management in domestic ethnic regions but also the cross-border nature of international emergency language services. In border areas, due to their proximity to neighboring countries, emergency language services must address communication issues in both domestic ethnic languages and the neighboring country's language to ensure smooth language exchanges in cross-border rescue operations, epidemic control, and other international cooperation efforts.

##### **4.2 Language Diversity**

As a province with a large number of ethnic minorities, Yunnan Province is home to 1,303 ethnic minority languages and dialects. Among these, the direct transition ethnic areas in Yunnan include 25 ethnic minority languages and at least 33 dialects. For example, the Wa language has four dialects: Bulao, Awa, Awala, and Wa; the Jingpo language has two dialects: Jingpo and Zaiwa; and the Zaiwa language is further divided into four dialects: Zaiwa, Leqi, Langwo, and Bra. While most ethnic minorities use Chinese characters, some have their own scripts, such as the Lisu and Wa languages. In the direct transition ethnic areas, ethnic minorities communicate in Chinese and Yunnan dialect, which varies by region.

##### **4.3 Uneven Economic Development**

The economic development in the direct transition ethnic regions of Yunnan is uneven. For example, in Nujiang Prefecture, by the end of 2024, the annual per capita disposable income was 17,115 yuan. By place of residence, the per capita disposable income for urban residents was 32,851 yuan, and for rural residents, it was 10,913 yuan. In contrast, in non-direct transition ethnic regions like Yuxi City, the per capita disposable income in 2024 was 27,030 yuan. By place of residence, the per capita disposable income for urban residents in Yuxi City was 37,604 yuan, and for rural residents, it was 17,627 yuan. The per capita disposable income in direct transition ethnic regions is significantly lower, which affects the allocation of emergency language services and the level of local education.

##### **4.4 The Proficiency in the National Common Language Is Relatively Weak**

By the end of 2022, the Mandarin proficiency rate among ethnic minorities in Yunnan Province's 129 counties (cities, districts) was 79.24%. Among these, the number of ethnic minorities who do not understand the national common language has decreased from 42,000 in 2021 to around 30,000. Ethnic minorities aged 18 to 60 have largely achieved barrier-free communication in the national common language, but those over 60 have weaker proficiency in the national common language. For example, in Nujiang Prefecture, the Lisu ethnic group still primarily uses their ethnic language for daily communication, which affects the further improvement of their proficiency in the national common language. Some ethnic groups lack a strong awareness of the importance of learning the national common language, and their motivation and enthusiasm for learning are low. In economically underdeveloped areas, limited employment opportunities make the connection between learning the national common language and economic benefits less clear, leading to a lack of strong willingness to learn.

#### **5. SPECIAL NEEDS AND CHALLENGES OF EMERGENCY LANGUAGE SERVICES IN AREAS INHABITED BY DIRECT MIGRANTS**

Due to its unique language, culture and social background, the ethnic regions directly face a series

of special challenges and needs in emergency language services, which jointly affect the effect and quality of emergency language services.

### **5.1 *The Barriers to Emergency Language Services Caused by Linguistic Diversity***

In the regions of Yunnan where ethnic minorities have transitioned directly from their traditional lifestyles to modern urban life, multiple ethnic groups coexist, leading to a rich and complex linguistic diversity. The languages of these ethnic minorities exhibit significant differences in phonetics, vocabulary, and grammar, and some languages also have dialectal variations, which further complicates language communication. These regions are typically located in remote and rural areas of China, where the elderly face particularly pronounced differences in language proficiency. The general proficiency in the national common language among the elderly is generally low. For instance, among the Lisu people, nearly 30,000 elderly individuals have limited mastery of the national common language and predominantly use dialects for daily communication. Due to lower educational levels and weaker emergency awareness, they often lack the ability to understand and respond to emergency information. When emergencies occur, this group often struggles to obtain and understand emergency information promptly and accurately, leading to delayed emergency responses and increased risk of disaster.

In areas with significant ethnic populations, such as the Lisu, Wa, and Lahu language regions, while new media platforms like short videos and official accounts have provided new channels for emergency information dissemination, the limited availability of ethnic language content has somewhat restricted the effectiveness of these platforms. In these regions, the use of ethnic languages is highly valued for cultural identity and acceptance. Therefore, when disseminating emergency information through short videos and official accounts, it is crucial to enhance the production and promotion of content in ethnic languages to improve the efficiency of information dissemination and audience engagement. For example, creating ethnic language versions of emergency science education short videos and releasing disaster warning information through ethnic language official accounts can ensure that local residents can promptly access and understand critical emergency information.

### **5.2 *Shortage of Infrastructure and Emergency Language Service Personnel***

The infrastructure in ethnic regions is relatively underdeveloped, and the emergency language service capabilities at the township level are insufficient. In these areas, network communication facilities and radio and television coverage may be limited, leading to poor channels for disseminating emergency information. Additionally, grassroots efforts to promote and train in emergency language services are inadequate, resulting in insufficient awareness and skills among residents, making it difficult to effectively utilize emergency language services during emergencies. In terms of talent, there is a pressing need for interdisciplinary professionals who are proficient in ethnic languages and possess emergency management skills in departments such as emergency management, public security, fire control, and healthcare. These professionals can play a crucial role in emergencies, such as conducting case investigations, information gathering, and command coordination in the public security sector, where they can communicate accurately with local residents; and providing clear medical guidance and health education to patients in the healthcare sector, where they can conduct medical treatment and epidemic prevention work. However, the current shortage of such talents has, to some extent, constrained the quality and efficiency of emergency language services.

The special needs and challenges of emergency language services in ethnic minority areas require us to take targeted measures, strengthen the development and utilization of language resources, improve the level of infrastructure construction, train and introduce professional talents, so as to improve the ability and level of emergency language services, and ensure the safety of life and property of local residents in emergencies.

## **6. THE KEY ROLE AND PRACTICAL PATH OF MULTI-LANGUAGE EMERGENCY LANGUAGE SERVICE DATABASE CONSTRUCTION**

The construction of a multi-language emergency language service database in the areas where ethnic groups have crossed over is a key measure to improve the efficiency of emergency response and overcome language barriers, which is of great significance to enhance the local

emergency management capacity and protect the safety of residents. The following two aspects are discussed: emergency language service database and integration of ethnic characteristic database.

### **6.1 *Emergency Language Service Database***

The core resource of the emergency language service for ethnic regions is a multilingual corpus. This corpus extensively gathers various ethnic languages, dialects, and commonly used foreign languages from these regions, covering different levels such as vocabulary, phrases, sentences, and discourse, providing rich material for translation and information dissemination. The multilingual emergency talent database meticulously records information about multilingual emergency talents, including their language skills, professional expertise, and contact details, enabling rapid allocation and efficient use of these talents. When constructing the multilingual corpus, it is essential to systematically collect, organize, and annotate multilingual materials to ensure their accuracy, representativeness, and practicality. For instance, conducting in-depth language surveys in ethnic regions can help gather commonly used emergency terms and expressions by local residents; organizing multilingual dialogues and textual materials from historical emergency events can provide rich material for the corpus. Additionally, using advanced language processing technologies like natural language processing (NLP) and machine translation (MT) can refine and enhance the corpus, improving its quality and usability. When building the multilingual emergency talent database, a comprehensive mechanism for collecting and updating talent information must be established, with regular verification and supplementation to ensure the database's accuracy and real-time updates.

### **6.2 *Integration of Ethnic Characteristic Database***

Integrating ethnic characteristic databases, such as the National Ethnic Culture Resource Database and the Multi-Ethnic Genome Database, can provide cultural and scientific support for emergency services. The National Ethnic Culture Resource Database meticulously documents the history, culture, and customs of direct transition ethnic groups, aiding emergency workers in deeply understanding the local cultural context and facilitating effective cross-cultural communication.

The Multi-Ethnic Genome Database provides data to study genetic susceptibility to ethnic diseases and to develop personalized medicine, enhancing the precision and scientific basis of medical rescue efforts in public health emergencies. In the process of integrating these ethnic characteristic databases, it is essential to strengthen collaboration with cultural and research institutions to achieve data sharing and collaborative work. For example, collaborating with institutions dedicated to the protection and research of ethnic cultures to acquire rich ethnic cultural resources and incorporate them into the National Ethnic Culture Resource Database; working with research universities to conduct multi-ethnic genome studies and jointly build the Multi-Ethnic Genome Database. Additionally, it is crucial to prioritize data security and privacy protection by establishing strict data access and usage policies to prevent data leaks and misuse.

Furthermore, the cross-regional cooperation model of the "Belt and Road" thematic database provides valuable insights for integrating emergency resources in ethnic regions. By collaborating with neighboring countries and regions, it facilitates the sharing of emergency language services and the exchange of emergency management experiences, thereby enhancing the capacity of ethnic regions to handle cross-border emergencies. For instance, in cross-border disaster relief efforts, sharing emergency language services with neighboring countries enables information sharing and coordinated rescue operations; international training and exchange activities on emergency language services are also conducted to enhance the professional skills and international perspectives of emergency language service personnel in ethnic regions.

The construction of databases plays a crucial role in the emergency language services for ethnic regions that have transitioned directly from traditional Chinese to the local language. These databases provide robust technical support and abundant data resources for emergency language services. By building emergency language service databases and integrating ethnic characteristic databases, the efficiency and quality of these services can be enhanced, thereby promoting the development of emergency management in ethnic regions.

### **6.3 Technology Empowerment and Practice Path**

In the digital era, technology brings both opportunities and challenges to emergency language services (ELS) in direct-transition ethnic regions. Leveraging advanced technology is key to improving ELS quality and efficiency.

#### **6.3.1 Application of Artificial Intelligence and Big Data**

AI and big data are crucial for ELS. AI enables automatic speech translation for real-time cross-linguistic communication, helping rescuers coordinate with affected residents. The three-dimensional integrated service system combines language, information, and command functions, using intelligent algorithms to support rapid decision-making. AI also powers personalized language training for emergency personnel via online platforms. Big data analyzes historical emergency language use to identify high-demand ethnic languages. For example, disaster data can reveal which minority languages are needed, allowing pre-training of multilingual rescuers and stockpiling of relevant supplies, thus improving response speed and accuracy.

#### **6.3.2 Community Participation and Policy Support**

Communities are essential to ELS. Daily mutual language learning and emergency drills help residents use language to seek help and report disasters. During crises, bilingual residents and grassroots officials can serve as volunteer interpreters. Policy support requires incorporating dialects and minority languages into the national ELS legal framework, mandating emergency information in local minority languages, and setting standards for bilingual rescue teams. Governments should increase funding, establish special research funds, and offer tax incentives to enterprises developing multilingual translation tools and platforms.

#### **6.3.3 Cross-regional Cooperation**

Given the wide distribution and diverse conditions of direct-transition regions, cross-regional cooperation enables optimal resource sharing. A regional ELS alliance can integrate multilingual talents, language data, and equipment. When a disaster occurs, other regions can provide

rapid support. Cooperation also facilitates experience exchange. Future ELS development should integrate AI and big data, strengthen community participation and legal frameworks, and expand cross-regional collaboration to build a comprehensive, multi-level ELS system, ultimately enhancing resident safety and social stability.

## **7. CONCLUSION**

To build an emergency language service system in ethnic regions, it is crucial to overcome the challenges of linguistic diversity and technological barriers, forming a comprehensive governance framework that is culturally adapted, intelligence-driven, talent-supported, and data-linked. To address the fragmented local language resources and insufficient technology transformation, it is necessary to deeply integrate dialects and minority languages, establishing a standardized database that includes high-frequency terms, cultural taboos, and emergency scenario materials. This can be achieved through dynamic language technology for real-time translation and multi-modal dissemination. Drawing on Japan's model of government-civilian collaboration, a bilingual liaison network can be developed at the community level, integrating smart terminal devices with traditional media to create a multi-dimensional information channel. Additionally, it is essential to focus on developing low-resource language processing technologies, using transfer learning to overcome the data bottleneck of less common languages, and building agile translation systems that support speech recognition and text generation. Relying on big data analysis to predict language service needs, pilot 'language emergency heat maps' in disaster-prone areas to achieve precise resource allocation.

To promote sustainable development in this field, it is essential to leverage interdisciplinary collaboration and international cooperation as key drivers. On one hand, we need to innovate the training mechanism for 'language + emergency management' composite talents by jointly developing scenario-based courses with practical departments and establishing a three-tier talent sharing platform that includes experts, grassroots personnel, and volunteers. On the other hand, we should strengthen the collaborative construction of databases, establish standards for collecting linguistic materials in ethnic regions, build a cross-border multilingual resource alliance, and promote the interconnectivity of emergency data in the Lancang-Mekong region. Future research should

focus on privacy computing technologies such as federated learning to address the conflict between data security and model performance, and integrate dialect resources into the national emergency strategy reserve system. This will ultimately form a modern service ecosystem that is both culturally inclusive and technologically forward-looking, providing linguistic support for strengthening the border security barrier.

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