RESEARCH ARTICLE

SWOT ANALYSIS OF DIGITAL DEVELOPMENT OF RURAL INDUSTRIES IN MINORITY AREAS OF SOUTHWEST CHINA

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Manuscript Info	*Abstract*
	This study explores the digital transformation of rural industries in the southwestern ethnic minority regions of China, using a SWOT analysis to evaluate the region's digital development. The research identifies key strengths such as advancements in digital infrastructure and agriculture in regions like Sichuan and Yunnan, while also addressing the disparities in digital adoption in Guizhou, Guangxi, and Tibet. The study highlights opportunities presented by emerging technologies such as 5G, IoT, and AI, alongside the growing potential of e-commerce for expanding market access. However, the research also identifies significant threats, including external market competition, data security concerns, and the impact of climate change. Based on these findings, the study proposes strategies for strengthening infrastructure, enhancing digital literacy, ensuring data security, promoting agricultural innovation, and fostering sustainable digital development. This research offers both theoretical and practical insights into the digitalization of rural economies, with actionable strategies for policymakers, businesses, and local governments.

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Introduction:-

The southwestern ethnic minority regions of China, which include provinces such as Yunnan, Guizhou, Sichuan, Guangxi, and parts of Tibet, are among the most ecologically and culturally rich areas in the country. This region not only boasts diverse geographical features, such as mountains, gorges, and rivers, but also has a wealth of traditional agricultural and pastoral resources, including tea, medicinal herbs, chili peppers, fruits, and livestock. These natural resources lay a solid foundation for developing rural industries with regional advantages. At the same time, the unique ethnic cultures foster diverse and stable community structures, providing fertile ground for collective economies and cooperative models. These factors collectively endow the southwestern ethnic minority regions with a natural edge in developing distinctive rural industries.

With the rapid development of information technologies and the steady advancement of China's "Digital China" strategy, digital economy is profoundly reshaping the development landscape of urban and rural areas. Particularly with the "Internet Plus Agriculture" model, digital technologies are accelerating their penetration into rural areas, becoming a crucial force in transforming and upgrading traditional agriculture and promoting rural revitalization (Han, 2022). The Chinese government has introduced several policy documents, including the "Digital Rural

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Development Strategy Outline" and the "National Rural Revitalization Strategic Plan (2018–2022)", which provide policy guidance and financial support for the digital transformation of rural areas. In this context, the southwestern ethnic minority regions are presented with significant opportunities to apply digital technologies across various fields, including agriculture, tourism, e-commerce, and social governance.

The integration of digital technologies with the rural revitalization strategy not only expands the development space for rural industries but also injects new impetus into modernization efforts in border ethnic regions (Wu & Wang, 2025). Through precision agriculture enabled by the Internet of Things, optimizing rural market supply and demand using big data, breaking spatial barriers through e-commerce platforms to sell local specialty agricultural products, and showcasing ethnic cultures via digital tourism, these new development pathways are gradually demonstrating immense potential. In particular, digitalization has become a key engine for high-quality rural economic growth by enhancing the added value of agricultural products, stimulating rural entrepreneurship, and promoting population return.

However, this transformation process is far from straightforward. The southwestern ethnic minority regions face numerous challenges, including geographical remoteness, poor transportation infrastructure, and insufficient internet coverage, as well as limited digital literacy. Moreover, due to linguistic, educational, and cultural differences, some ethnic minorities have limited understanding and acceptance of digital technologies, which complicates the implementation and promotion of digital tools in the region. Furthermore, the entrenched traditional agricultural model and the difficulty of attracting external capital and talent somewhat undermine the sustainability and internal momentum of digital development.

Given the complexity and diversity of the digital transformation of rural industries in the southwestern ethnic minority regions, this paper employs a SWOT analysis framework to systematically examine the strengths, weaknesses, opportunities, and threats in this process. The analysis aims to clarify the current development landscape from multiple perspectives, identify key issues, and provide targeted policy recommendations and development pathways. Through this analytical framework, this study will not only offer scientific evidence to local governments and policymakers but also contribute theoretical support and practical guidance for exploring regionally adaptable digital development models in the future.

Literature Review:-
The digital transformation of rural industries has been a central focus of recent studies, particularly within the context of developing economies and remote regions. Digital technologies, including the Internet of Things (IoT), big data, and artificial intelligence (AI), offer significant opportunities for enhancing agricultural productivity, improving resource management, and reducing environmental impacts. These technologies enable farmers to optimize water usage, monitor crop health, and make more informed decisions regarding irrigation and fertilization. Such advancements are seen as pivotal in addressing inefficiencies and increasing yields in rural areas (Drobež et al., 2021). Moreover, precision farming technologies help reduce environmental degradation by ensuring that resources are used more sustainably, providing clear economic and ecological benefits (Shi& Yang, 2022).

Despite the promising potential, the adoption of digital technologies in rural regions faces several barriers. One of the primary challenges is the lack of adequate infrastructure, particularly in remote and mountainous areas. Reliable internet connectivity remains scarce in many parts of southwestern China, hindering the full implementation of digital solutions. Furthermore, the low level of digital literacy among rural populations presents another obstacle. Many farmers and rural workers lack the necessary skills to effectively use digital tools, which limits the scope and efficiency of technological integration in agricultural practices (Salemink et al., 2017). This issue is exacerbated by the cultural and linguistic diversity in ethnic minority regions, where traditional methods of farming are often deeply ingrained, and there may be resistance to adopting new technologies (Liu et al., 2022).

Another critical area of research focuses on the role of e-commerce in promoting rural economic development. E-commerce has been identified as a powerful tool for overcoming geographical isolation, enabling farmers to reach broader markets, including urban consumers and international buyers. Digital platforms provide rural producers with the opportunity to sell specialty products that may otherwise be limited to local markets, thus increasing their economic value (Bădîrcea et al., 2022). The growth of rural e-commerce has facilitated the commercial distribution of local agricultural products such as herbal medicines, ethnic foods, and traditional handicrafts, helping diversify income streams and reduce poverty in rural areas (Wang et al., 2023).

However, the uneven development of e-commerce in different rural regions raises concerns. While some southwestern areas have experienced significant success with digital sales, others continue to face challenges due to insufficient digital infrastructure and a lack of local e-commerce knowledge. The introduction of e-commerce requires more than just technological solutions; it also demands a thorough understanding of local cultural contexts and consumer preferences. In ethnic minority regions, the traditional market structures and consumption habits must be considered to ensure that digital trade is inclusive and effective (Zhao and Wang, 2018). Moreover, the involvement of local communities in digital platforms is crucial for ensuring that the benefits of e-commerce are equitably distributed and that rural populations are not left behind (Zhou and Wang, 2021).

The socio-economic impacts of digitalization, particularly on ethnic minority communities, have also garnered attention in recent literature. Some studies suggest that digital technologies can enhance access to services such as education and healthcare, thereby reducing social inequality. Online educational platforms, for example, offer rural children access to resources that would otherwise be unavailable, helping to close the educational gap between rural and urban areas (Chopra et al, 2024). Telemedicine and digital healthcare services also improve access to medical care in remote regions, offering consultations and services that reduce the need for long-distance travel (Ferrari et al., 2022). These developments are seen as essential for improving overall living standards and creating more equitable opportunities for rural communities.

Nevertheless, the socio-cultural impact of digitalization in ethnic minority areas has received less attention. While digitalization presents clear benefits, there is a risk that traditional cultural practices and social structures may be marginalized or overlooked. Ethnic communities in southwestern China have unique social organizations and cultural traditions that may conflict with the rapid pace of technological change. Without sensitive and culturally appropriate strategies, the introduction of digital technologies could inadvertently undermine local customs, traditions, and knowledge systems (Kwilinski et al., 2020). Therefore, future research must consider the importance of integrating cultural preservation with technological development, ensuring that digitalization respects and supports the values of these communities.

In summary, existing research has focused on how digital technologies can contribute to the modernization of rural industries, particularly in terms of increasing agricultural productivity, promoting rural economic development and improving social services. The trend of research shows that digitalization has obvious positive effects in promoting rural economic and social development. However, the existing literature also reveals a number of shortcomings, especially challenges in terms of infrastructure development, digital literacy improvement, and cultural adaptation. Nonetheless, the potential of digitalization in rural industries remains enormous and its development will profoundly affect the shape of the rural economy in the future.

SWOT Analysis:-
This section supports the SWOT analysis of the digital development of rural industries in Southwest China's ethnic minority regions through big data visualization. Data sources mainly include agricultural data from the National Bureau of Statistics (NBS), rural development reports released by local governments, and market data obtained through major e-commerce platforms and digital agriculture programs. These data provide quantitative support on agricultural productivity, market demand, infrastructure development, and digital acceptance of the rural population, helping to provide a more intuitive understanding of the current status and potential of digital development in the region.

Strengths
The development of digital infrastructure is a significant strength in the process of digitalizing rural industries in Southwest China's ethnic minority regions. According to the data visualizations, Sichuan and Yunnan have made notable progress in digital infrastructure construction over the past five years (2020-2024). Sichuan's digital infrastructure has seen an average annual growth rate of about 10%, reaching a growth rate of 23% by 2024. Similarly, Yunnan has shown a similar growth trajectory, with an annual growth rate of approximately 8%, reaching 20% by 2024. These growth figures indicate that Sichuan and Yunnan have invested significantly in digital infrastructure, with remarkable progress, thus laying a solid foundation for future digital transformation in rural industries.
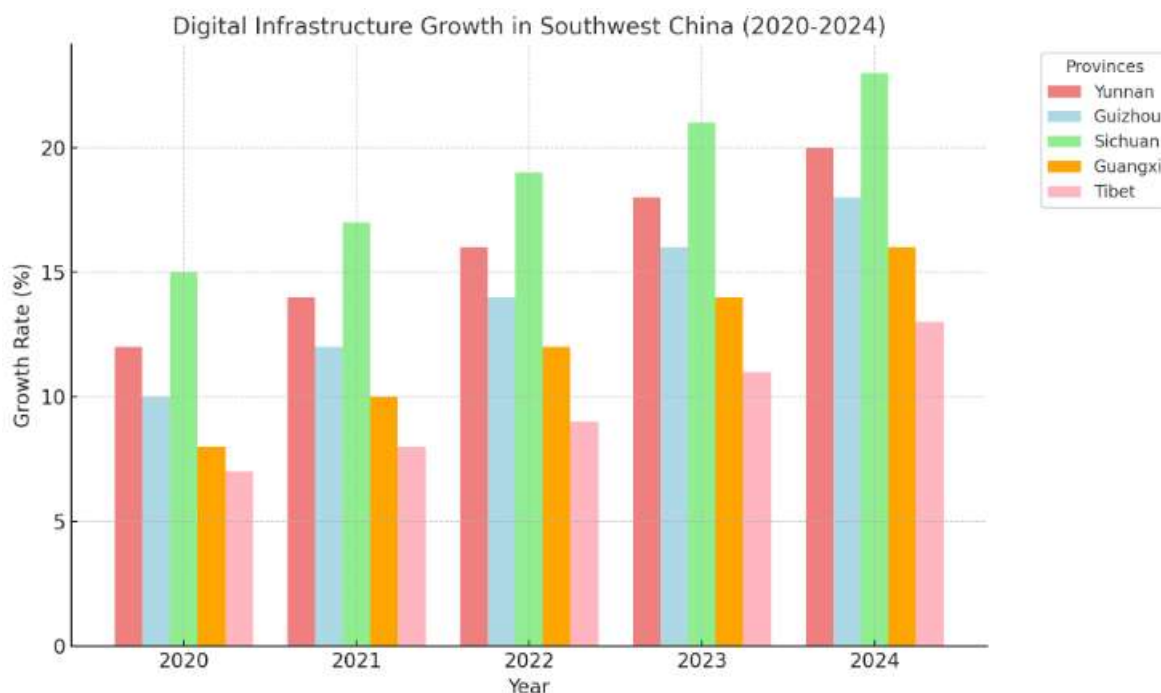
Figure 1:- Digital infrastructure development in five south-western provinces.

Guizhou also demonstrated steady growth in infrastructure development, with an annual growth rate of approximately 6%, achieving a growth rate of 18% by 2024. This suggests that Guizhou possesses good potential for further digital infrastructure development, particularly in promoting internet access and the application of digital technologies in rural areas, providing strong support for the digital transformation of agriculture.Overall, the steady progress in digital infrastructure construction in Southwest China provides a solid foundation for the digital transformation of rural industries in the region. This development fosters a conducive environment for digitalization in agricultural production, market sales, and rural social services. Notably, Sichuan and Yunnan's outstanding performance in infrastructure development serves as a model for other provinces, offering a replicable path for future development.This indicates that Southwest China's ethnic minority regions have already established a strong base in terms of digital infrastructure, which is crucial for the smart development of rural industries. As infrastructure continues to improve, the region's digital transformation is expected to achieve more significant outcomes, further promoting regional economic development.

Weaknesses
Southwest ethnic minority regions face significant regionalised development imbalances in the process of digital transformation. Despite the region's progress in building digital infrastructure, the actual utilisation of digital technologies varies greatly from province to province. This uneven digital utilisation is mainly reflected in areas such as agriculture, e-commerce and social services, resulting in different levels of development in digital transformation across provinces. The analysis of the heat map intuitively shows that Sichuan and Yunnan excel in digital adoption, while Guizhou, Guangxi and Tibet face greater challenges with lower penetration and utilisation of digital technologies. This uneven regionalised development is one of the main issues that need to be addressed in the process of digital transformation in the region.
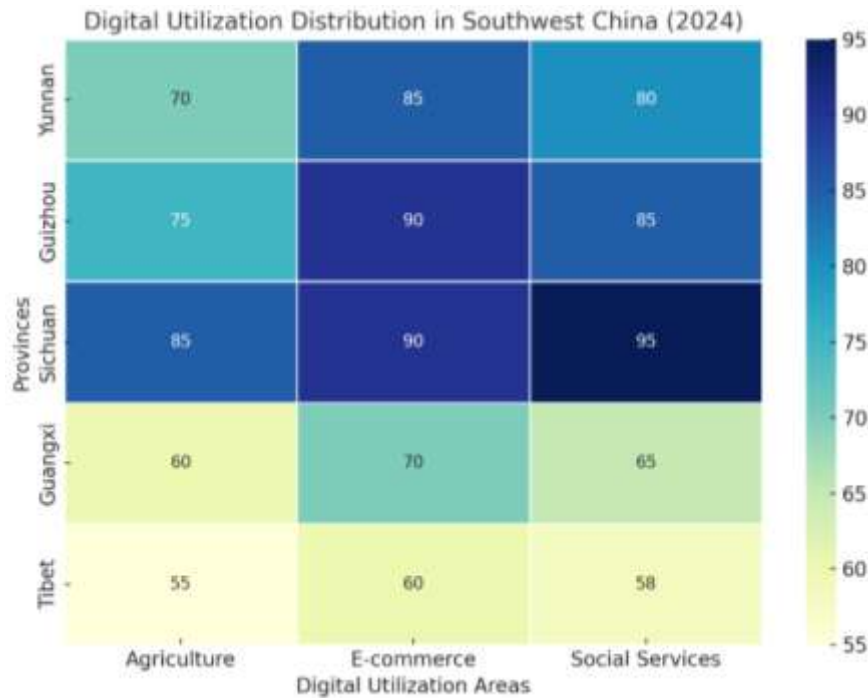
Figure 2:- Digital utilization distribution in southwest China.

Figure 2 reveals a clear disparity in the utilization of digital technologies across the five southwestern provinces of China (Yunnan, Guizhou, Sichuan, Guangxi, and Tibet) in the areas of agriculture, e-commerce, and social services for the year 2024. Sichuan and Yunnan stand out with relatively high utilization scores, indicating that these provinces have made substantial progress in integrating digital tools into their agricultural, commercial, and public service sectors. These provinces have successfully leveraged digital platforms to boost agricultural productivity, expand market access for local products, and enhance public service delivery, particularly in rural and underserved areas.In contrast, Guizhou and Guangxi exhibit moderate levels of digital utilization. While these provinces have begun to embrace digital technologies, their scores indicate that the adoption of digital tools in agriculture and e-commerce remains in the developing stages. These regions may encounter challenges related to infrastructure, digital literacy, and local awareness, which impede the widespread integration of digital technologies into their agricultural practices and online commerce activities. Progress in social services has also been relatively slow compared to Sichuan and Yunnan, with digital initiatives like e-government and online education platforms still in the early phases of implementation.

Tibet, however, significantly lags behind in all three areas, registering the lowest utilization scores. The region's underutilization of digital technologies in agriculture, e-commerce, and social services points to substantial barriers to digital transformation, such as geographic isolation, limited infrastructure, and low internet penetration. Although there have been some improvements in digital infrastructure, Tibet's remote location and limited access to digital technologies restrict local communities from benefiting from the same digital opportunities available in other provinces. This digital gap further exacerbates the region's existing socio-economic challenges.

Overall, the heatmap highlights the uneven distribution of digital utilization across Southwest China, with Sichuan and Yunnan leading the charge in digitalizing agriculture, commerce, and social services. The moderate levels of digital adoption in Guizhou and Guangxi contrast sharply with Tibet's challenges, demonstrating the considerable regional differences in the ability to capitalize on digital transformation. Addressing these disparities will require targeted interventions, including enhancing digital infrastructure, expanding access to technology, and improving digital literacy throughout the region to ensure a more equitable and inclusive digital transformation.

Opportunities

The southwestern ethnic minority regions of China are poised to capitalize on a wealth of opportunities for digital development, especially in the fields of digital agriculture, rural revitalization, and e-commerce. Firstly, national policies supporting digital agriculture and rural revitalization have been continuously strengthened. The government

has provided substantial financial incentives and policy measures to encourage local governments and businesses to engage in the digital transformation of rural industries. These policies have created a conducive external environment for advancing digital initiatives in agriculture and rural economies, enabling the allocation of more resources to digital projects that can enhance productivity and sustainability.

Figure 3 clearly underscores the increasing adoption of cross-border e-commerce in southwestern China, reflecting a growing opportunity to export local agricultural products. With an expected annual growth rate of 25% by 2024, this trend highlights the bright future for the region's agricultural digital economy, offering an invaluable opportunity for economic diversification and rural development. The growth in cross-border e-commerce represents a significant opportunity for southwestern ethnic minority regions to tap into international markets, creating new economic growth points and improving the livelihoods of rural populations. Combined with technological advancements and continued government support, these digital opportunities are set to propel the region's rural economy forward, fostering greater prosperity and enhancing integration into the global market.
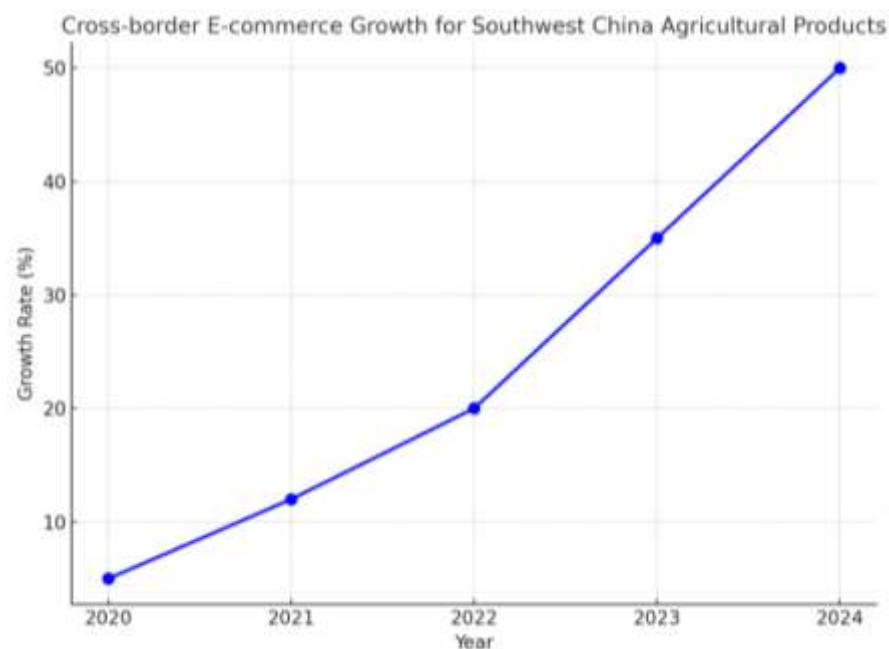
Figure 3:- Cross-border e-commerce in southwestern China's agricultural products.

Additionally, the rapid advancement of emerging technologies such as 5G, the Internet of Things (IoT), and artificial intelligence (AI) presents unprecedented opportunities for rural industries to integrate digital tools. The application of these technologies is set to not only increase agricultural productivity but also enable smart processing, precision marketing, and optimization of supply chains for agricultural products. This technological leap offers local farmers new ways to increase their income and improve operational efficiency. Moreover, digitalization enhances local governments' ability to improve rural governance and boost the efficiency of public services, such as healthcare, education, and administrative functions.E-commerce has also unlocked vast market opportunities for the region. The unique agricultural products of southwestern ethnic minority areas possess strong market competitiveness, and digital platforms enable these products to overcome geographical barriers and extend their reach across regions. The "Belt and Road" initiative further accelerates the potential for cross-border e-commerce, creating pathways for local agricultural products to enter international markets, thus opening up new economic growth avenues. The trend chart below illustrates the growth rate of cross-border e-commerce for agricultural products in the region, revealing a steady and robust increase over the years.

Threats
Despite the numerous opportunities for digital development, the southwestern ethnic minority regions of China face several threats in the process of digitalizing rural industries. First, external market competition is becoming increasingly fierce. As digitalization becomes more widespread, rural industries in other regions are also rapidly transforming, meaning that agricultural products from the southwestern regions may face competitive pressure from

other domestic and international markets. In particular, with the growth of e-commerce, more agricultural products are entering both national and global markets, creating a more complex and competitive market environment. How to stand out in such fierce market competition and find a unique competitive advantage becomes a significant challenge for the region's digital transformation. While digital technologies offer more sales channels, without enhancing product quality and brand competitiveness, it may be difficult to meet the challenges from other regions and international markets.

Secondly, another critical threat in the digitalization process is technology security issues. As digital technologies are increasingly applied in agriculture, data security and privacy concerns have emerged as new threats, especially in rural areas where awareness of information security is relatively weak, and the security of digital platforms has not been adequately addressed. With more sensitive data being stored and transmitted online, there is a risk of farmers' personal information and agricultural data being leaked. Data breaches not only violate privacy but could also harm the credibility and long-term development of digital platforms. If security issues are not properly addressed, it may reduce farmers' trust in digital tools and even impact the sustainability of the platform.

Additionally, the uncertainty in agricultural production caused by global climate change is another significant threat to the digital transformation in the southwestern ethnic minority regions. As climate change intensifies, extreme weather events such as droughts, floods, and typhoons have become more frequent, directly affecting agricultural yields and quality. For example, unstable rainfall and abnormal temperature increases may lead to crop failures or lower quality, reducing predictability in agricultural production. While digital technologies can help improve agricultural management efficiency and accuracy, the risks and uncertainties brought about by climate change pose a challenge to their effectiveness. The digital technologies must be integrated with strategies for adapting to climate change in order to increase the resilience of agricultural systems; otherwise, their impact may be constrained by the challenges posed by climate change.

These threats suggest that the southwestern ethnic minority regions must address factors such as external market competition, technology security, and climate change as they pursue digital transformation in rural industries. By enhancing technological innovation, raising awareness of information security, and developing digital strategies to cope with climate change, the region can better navigate these threats and ensure the smooth progression of digital transformation.

Digital Development Strategies:-
Based on the SWOT analysis, the southwestern ethnic minority regions of China face significant strengths, weaknesses, opportunities, and threats in their digitalization process. The region possesses notable advantages, particularly in digital infrastructure and agricultural production, with Sichuan and Yunnan being frontrunners in implementing digital tools. However, disparities in regional development are evident, with Guizhou, Guangxi, and Tibet showing slower adoption of digital technologies. Additionally, external threats, such as intense market competition, data security risks, and the unpredictable impacts of climate change, pose challenges to the region's digital transformation. In light of these findings, it is essential to implement a comprehensive digital development strategy to overcome these challenges and leverage opportunities for sustainable growth and digital inclusion across the region.

Strengthening digital infrastructure is a fundamental step in advancing digitalization in the southwestern ethnic minority regions. While significant progress has been made in improving connectivity, especially in urban areas, gaps remain, particularly in rural and remote regions such as Tibet and some parts of Guangxi. Expanding high-speed internet access, improving mobile network coverage, and ensuring stable connectivity across all sectors are critical. Government and private sector investments in 5G networks and broadband infrastructure should be prioritized to ensure that digital technologies can be widely adopted in agriculture, e-commerce, and public services. Building a robust infrastructure backbone will enable more regions, including remote and underserved communities, to fully participate in the digital economy.

The second crucial element of a successful digital strategy is enhancing digital literacy and capacity building among local residents. Many rural inhabitants, particularly in Tibet and Guangxi, face barriers to adopting digital technologies due to a lack of knowledge and experience. To address this, local governments, in collaboration with universities and technology companies, should launch targeted educational programs that teach basic digital skills, e-commerce, and digital agriculture. These programs should be tailored to meet the specific needs of rural

communities, enabling farmers and local entrepreneurs to utilize digital tools effectively. Additionally, integrating digital literacy into school curricula can help cultivate a digitally savvy workforce in the future, ensuring that younger generations are well-prepared to thrive in a digital economy.

Data security and privacy concerns must be addressed to foster trust and facilitate widespread adoption of digital technologies. In rural areas, where information security awareness is generally lower, there is an increased risk of data breaches, which could harm individuals and digital platforms alike. Establishing robust data protection mechanisms, including encryption, secure payment systems, and clear data usage policies, is essential for safeguarding personal and agricultural data. The government should implement laws and regulations to ensure data protection while also educating the public on the importance of information security. Proactively addressing these security challenges will help build confidence in digital platforms, ensuring that farmers and businesses feel safe when using digital tools for agricultural management, e-commerce, and other purposes.

Emerging technologies such as 5G, IoT, and artificial intelligence offer significant opportunities to transform agriculture in the southwestern ethnic minority regions. The application of these technologies can improve agricultural productivity, facilitate smart processing, and enhance supply chain optimization. Real-time monitoring of crops, intelligent irrigation systems, and AI-driven analytics can help farmers optimize their resources, increase yields, and reduce waste. To fully capitalize on these technologies, the region should foster collaborations between technology companies, research institutions, and local agricultural stakeholders. By piloting and scaling digital agriculture projects, the southwestern regions can become leaders in sustainable and technologically advanced farming practices.

In parallel, the development of e-commerce represents a vital opportunity for the region to tap into broader markets and promote local agricultural products. The unique products of southwestern ethnic minority areas, such as specialty teas, herbs, and ethnic foods, have strong market potential but often face barriers due to geographic isolation. To overcome these challenges, regional governments should encourage collaboration with major e-commerce platforms, enabling local farmers and businesses to access national and international markets. Additionally, providing training and support in e-commerce operations, online marketing, and digital payment systems will empower local entrepreneurs to establish and grow their online businesses. This will enable them to capitalize on the growing digital marketplace and open up new revenue streams.

The "Belt and Road" initiative further accelerates the potential for cross-border e-commerce, offering a pathway for southwestern agricultural products to enter international markets. With increased connectivity and the growth of cross-border digital trade, local products can reach consumers worldwide, enhancing their market presence and creating new economic growth opportunities. By leveraging this initiative, the region can diversify its economic activities, attracting global consumers and improving its economic prospects. Cross-border e-commerce not only provides a platform for farmers to sell products but also strengthens the region's integration into the global economy, facilitating trade, and stimulating regional economic growth.

Ensuring that the digital transformation is sustainable and inclusive is a crucial aspect of the development strategy. The southwestern ethnic minority regions are home to a rich cultural diversity, and digitalization must be implemented in a way that respects and supports these communities. To avoid exacerbating existing inequalities, digital development should prioritize inclusivity, ensuring that all ethnic groups, including those in remote areas, have equal access to digital resources and opportunities. This can be achieved by designing localized digital solutions that are culturally sensitive and by making digital tools accessible to underserved populations. Furthermore, the digital transformation should align with environmental sustainability goals, using technology to promote green practices in agriculture and reduce environmental impact.

In conclusion, the southwestern ethnic minority regions of China have significant opportunities to capitalize on digital transformation, but achieving success will require a multi-faceted approach. By addressing infrastructure gaps, enhancing digital literacy, ensuring data security, promoting agricultural innovation, fostering e-commerce, and ensuring sustainability, the region can realize the full potential of digitalization. These strategies will not only support economic growth but also improve the livelihoods of rural populations and strengthen the region's integration into the global digital economy. Through careful planning and coordinated efforts, southwestern China's rural industries can emerge as competitive, resilient, and prosperous in the digital age.

Conclusion:-

This study provides an in-depth analysis of the digital transformation of rural industries in the southwestern ethnic minority regions of China, employing a SWOT analysis to identify the key strengths, weaknesses, opportunities, and threats in the region's digital development. The research highlights the significant advantages of digital infrastructure and agricultural production in regions like Sichuan and Yunnan, while also addressing the disparities in digital adoption across Guizhou, Guangxi, and Tibet. The study also emphasizes the substantial opportunities presented by emerging technologies such as 5G, IoT, and AI, and the growing potential of e-commerce for expanding market access for local agricultural products. Additionally, it underscores the critical threats that could hinder this digital transformation, including market competition, data security concerns, and the unpredictable impacts of climate change. The theoretical significance of this study lies in its comprehensive framework for analyzing digitalization in rural economies, while its practical significance provides actionable strategies for policymakers, businesses, and local governments to foster inclusive and sustainable digital development.

Despite the valuable insights offered, the study has certain limitations. The analysis is based on secondary data and broad trends, which may not fully capture the specific regional variations within each province, particularly in more isolated areas such as Tibet. Additionally, the study does not account for the rapidly changing dynamics of digital technology, which may evolve at a pace that outstrips the ability to gather and analyze data effectively. Moreover, while the research explores digital adoption at a regional level, it does not delve deeply into the micro-level impacts on individual farmers or businesses, which could provide a more granular understanding of how digital tools are applied in daily practice.

Looking forward, this research opens avenues for future studies that can further explore the localized impact of digital transformation on rural livelihoods, particularly in under-researched areas such as Tibet and rural Guangxi. Future research could also focus on evaluating the effectiveness of specific digital tools and policies, conducting field studies to assess the real-world outcomes of digitalization on agricultural productivity and market integration. Moreover, with the rapid pace of technological advancements, future studies can investigate the emerging role of technologies like blockchain in ensuring supply chain transparency and boosting consumer trust in digital platforms. By building on the insights provided, future research can contribute to the continuous refinement of digital development strategies, supporting the long-term prosperity of southwestern China's rural economy in the digital era.

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