Asia-Pacific
Economic Cooperation

Stocktaking Report on Overview of Digital Rural Communities in Viet Nam and APEC Economies

APEC Policy Partnership on Food Security

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Table of contents

ACKNOWLEDGEMENTS 2
I. INTRODUCTION 3
2.1. Digitalization in agriculture and rural development 5
2.2. Emerging trends of digitalization 6
2.3. Definition and key characteristics of Digital Rural Communities (DRC) 9
III. RELEVANCE OF DIGITAL RURAL COMMUNITIES IN ADDRESSING KEY CHALLENGES OF APEC ECONOMIES 13
3.1. Overview of APEC economies 13
3.2. Challenges of APEC economies and necessity for developing digital rural communities 14
3.3. Potential impacts of digital rural communities to rural area development in APEC economies 23
IV. CURRENT STATUS OF DIGITAL RURAL COMMUNITIES IN VIET NAM AND OTHER APEC ECONOMIES 27
1. General situation in APEC economies 27
2. Current status of digital rural communities in Viet Nam 32
3. Current status of digital rural communities in some other APEC members 34
3.1. China 34
3.2. Indonesia 35
3.3. Japan 36
3.4. Republic of Korea 37
3.5. Thailand 38
V. Good practice models of DRC in Viet Nam and APEC economies 39
5.1. Viet Nam: Yen Hoa Commune 39
5.2. China: The Taobao Villages Ecosystem 40
5.3. Indonesia: Alamendah Village 42
5.4. Japan: Ina City, Nagano 43
5.5. Republic of Korea: Sangju Smart Farm Innovation Valley 45
5.6. Thailand: Village 9, Ban Yai district 46
VI. Key takeaways, challenges and successful factors for DRC development 49
6.1. Key findings on the status and importance of DRC 49
6.2. Common challenges in implementing DRC models in APEC economies 50
6.3. Critical success factors 51
6.4. Recommendations 52
REFERENCES 55

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I. INTRODUCTION

Agricultural and rural development has played a pivotal role in ensuring a steady supply of food for a growing population, alleviating extreme poverty, and boosting shared prosperity across the APEC region. Agriculture accounts for a significant share of Gross Domestic Product (GDP) in many member economies. However, this progress faces significant and escalating headwinds. Rural areas are grappling with a widening development gap compared to urban centers, demographic shifts leading to an aging and shrinking workforce, and increasing vulnerability to the impacts of climate change.

At the same time, it is important to recognize that these pressures are unfolding in a context where traditional policy instruments are reaching their limits. Incremental improvements in infrastructure, credit access or extension services, while still necessary, are often insufficient to address the structural nature of rural challenges such as demographic ageing, land fragmentation, and exposure to climate-related shocks. This creates a growing urgency for APEC economies to identify development approaches that are both more transformative and more adaptive, combining the strengths of conventional rural development with the opportunities created by new technologies and data-driven decision-making.

In this context, the development of Digital Rural Communities (DRC) has emerged as an essential and strategic solution. In the global marketplace of ideas, digital transformation is emphasized as a prerequisite for economies to accelerate the transition to smart, inclusive, and resilient rural models, in line with the Fourth Industrial Revolution and the Sustainable Development Goals. The DRC concept is therefore best understood not simply as a technological upgrade, but as a new development modality for rural areas. It brings together digital infrastructure, innovative business models, and community-driven governance arrangements in a coherent way. In practice, this means that digitalization becomes embedded in everyday rural activities – from how farmers plan production and access markets, to how local governments deliver services and engage with citizens. Rather than treating digital tools as external "addons" to existing systems, the DRC approach situates them within the broader social, economic, and environmental context of rural communities.

By focusing explicitly on capacity development, the project acknowledges that institutional capabilities and human capital are as important as physical infrastructure for successful digital transformation. Building a DRC requires local governments, cooperatives, SMEs, and community organizations to acquire new skills in digital planning, project design, partnership management and monitoring. It also requires them to learn from each other, both within and across economies, so that promising models can be adapted rather than replicated mechanically. The project thus positions APEC rural stakeholders not

merely as beneficiaries of digital transformation, but as active co-creators of new models and solutions.

The project **"Promoting APEC cooperation for scaling up best practices on digital rural community (DRC) models toward sustainable and inclusive rural transformation"** aims to improve the capacity in developing DRCs not just in Viet Nam but for other APEC economies by facilitating knowledge sharing and the exchange of best practices on rural digital transformation. The project particularly focuses on the application of digital technologies in the agri-food value chain, to safeguard the quality of life through sustainable growth, to strengthen the dynamism of SMEs and small-scale producers, and to develop their integration into the global market.

Within the framework of this project, this Stocktaking Report is conducted to provide an overview of DRCs in Viet Nam and APEC economies. The report shall present a conceptual framework illustrating the elements and interconnections of a DRC; provide a comprehensive overview of the current state of DRC development in Viet Nam and other selected APEC economies; analyze the relevance of DRCs in addressing key challenges, with consideration of gender sensitivity; and highlight key trends, challenges, and opportunities related to DRCs in APEC economies.

II. TREND OF DIGITALIZATION IN AGRICULTURE AND RURAL DEVELOPMENT IN APEC ECONOMIES

2.1. Digitalization in agriculture and rural development

In the context of the Fourth Industrial Revolution, the digitalization of agriculture and rural development has become both an inevitable trend and a critical imperative for addressing the complex challenges of food security, climate change, and sustainable development. To clarify this concept, numerous reputable international organizations and leading academics have proposed various perspectives, each highlighting a vital aspect of this transformative process.

From the broadest perspective, the Organisation for Economic Co-operation and Development (OECD) defines digitalization as the defining technological transformation of our era, referring to the adoption of information and communication technologies—including the Internet, mobile technologies and devices, as well as data analytics-to improve the generation, collection, exchange, and presentation of digital content. When applied to this field, the OECD's definition provides a wide framework for integrating technology into all facets of rural life.

More specifically, the World Bank contributes to this understanding by emphasizing that the process of digitalization in agriculture and rural development involves the use of digital technology and integrated systems to equip farmers and stakeholders with timely information, tools, and services across the entire value chain. Illustrative examples include AI-based advisory platforms, digital marketplaces for market linkage, traceability systems, and smart farm management tools.

The United Nations (UN) further clarifies the revolutionary impact of this process by contrasting it with traditional methods. According to the UN, the application of digitalization in agriculture allows for more frequent and accurate data collection. This data, often combined with external sources like weather information, is then analyzed so farmers can make more informed decisions. These decisions can be implemented with greater accuracy through robotics and advanced machinery, providing farmers with real-time feedback on the impact of their actions.

From an academic standpoint, Shamshiri (2024) focuses on the technical aspects, viewing the process of digitalization in agriculture as the practice of utilizing advanced technological solutions like sensors, robotics, and data analysis to improve the ecological and economic viability of agricultural

operations while elevating crop output and quality. Similarly, Samuel (2024) highlights the objectives of this process, describing how digitalization in agriculture leverages advanced technologies to improve the efficiency, productivity, and sustainability of farming practices through the integration of tools such as sensors, drones, GPS, and artificial intelligence for data-driven decision-making.

Synthesizing these perspectives, it becomes clear that while the definitions vary in their wording, they converge on several core principles. For the purposes of this report, digitalization in agriculture and rural development is defined as: “The integrated application of advanced digital technologies—such as the Internet of Things (IoT), Artificial Intelligence (AI), big data analytics, drones, and sensors-across the entire agricultural value chain and into all aspects of economic and social life in rural areas. The objective of this process is not only to enhance the productivity, efficiency, and sustainability of agricultural production but also to create new business models, improve market access, elevate the quality of public services, and improve livelihoods, thereby narrowing the development gap between urban and rural areas”.

2.2. Emerging trends of digitalization

The digitalization of agriculture and rural development across the APEC region is being propelled by a confluence of disruptive technologies and innovative business models. These trends are not only reshaping how food is produced but are also comprehensively transforming the socio-economic fabric of rural communities. Aligned with APEC’s overarching objectives, particularly its Food Security Roadmap Towards 2030, this digital transformation is recognized as a key enabler for increasing productivity, mitigating climate impacts, and fostering inclusive growth (APEC, 2021; foodticker, 2021; straitsresearch, 2024). The following are the principal emerging trends within the region.

(1) Data-driven precision agriculture

This foundational trend signifies a paradigm shift from experience-based decision-making to data-driven, real-time analytics. The Asia-Pacific smart agriculture market is projected to experience robust growth, from USD 4 billion in 2024 to over USD 12 billion by 2033 (straitsresearch, 2024). This trend is driven by a convergence of several technologies:

- Internet of Things (IoT) and sensors: On-field sensors are deployed to collect granular data on soil moisture, temperature, pH levels, and crop health (tracedataresearch, 2024)

- Drones and remote sensing: Unmanned Aerial Vehicles (UAVs or drones) are utilized for targeted pesticide spraying, crop health monitoring, and field mapping (Oliver, 2024). Satellite technology provides a macro-view of large farming areas, aiding in yield prediction and early problem detection (EOS, 2025).
- Artificial intelligence (AI) and big data analytics: AI algorithms analyze vast amounts of collected data to provide farmers with precise recommendations on when to irrigate, fertilize, and harvest, thereby optimizing resource use and increasing yields (APO, 2025).

(2) Automation and robotics to address labor shortages

Confronted with rapid demographic aging and a diminishing agricultural workforce, developed APEC economies like Japan; Republic of Korea are pioneering the adoption of automation (tracedataresearch, 2024). The average age of a Japanese farmer has reached 68, which has created an immense impetus for solutions that replace manual labor (Oliver, 2024; APO, 2025). Key trends include:

- Autonomous machinery: Self-driving tractors and harvesters equipped with GPS and AI can operate in large fields with high precision, reducing the need for human operators (tracedataresearch, 2024).
- Harvesting robots: Specialized robots are being developed to harvest high-value crops like strawberries, tomatoes, and cucumbers, performing delicate tasks previously requiring human intervention (Oliver, 2024).
- Smart management systems: Fully automated irrigation and climate control systems in greenhouses can be managed remotely via smartphone applications. (APO, 2025).

(3) Blockchain for supply chain transparency and traceability

Heightened consumer demand for transparency regarding food provenance and quality is a significant driver of innovation. Blockchain technology is emerging as a key solution to meet this demand (weforum, 2024). By creating a decentralized and immutable digital ledger, blockchain enables the secure and transparent tracking of a product from farm to fork (techcollectivesea, 2024; Rizwan et al., 2024). This trend is gaining significant traction in major agricultural exporting economies such as Australia; Thailand; and Viet Nam, where traceability is often a mandatory requirement for discerning import markets (apfood, 2018; techcollectivesea, 2024). It not only enhances food safety but also combats fraud, reduces waste, and builds brand trust.

(4) The rise of digital platforms and ecosystems

Digitalization is extending beyond the farm gate to encompass the entire agricultural ecosystem through integrated digital platforms. AgriTech startups are attracting substantial investment to build these platforms, which fall into several categories (FAO, 2024; globenewswire, 2025).

- E-commerce: Online platforms connect farmers directly to end-consumers or businesses, helping them achieve better prices and expand their market reach (FAO, 2024).
- Financial Technology (FinTech): Peer-to-peer (P2P) lending platforms, weather index-based crop insurance, and digital payment solutions are improving farmers' access to previously unattainable financial services.
- Farm Management Platforms: Integrated software helps farmers manage all aspects of their operations, from crop planning and financial management to supply chain tracking.

(5) Human-centric digitalization and smart village development

Recognizing that technology is merely an enabler, the most successful initiatives in APEC are increasingly human-centric. The Digital Villages Initiative (DVI) by the Food and Agriculture Organization (FAO) in Asia-Pacific clearly exemplifies this trend (FAO, 2024). The initiative promotes a holistic approach that focuses not only on technology provision but also on:

- Digital Skills Development: Implementing training programs to build capacity among farmers, especially women and youth, enabling them to use technology effectively (APEC, 2024).
- Digital Public Services: Providing essential services like e-health and e-learning to improve the quality of life and bridge the urban-rural divide (FAO, 2022).
- Inclusive Development: Ensuring that digital solutions are context-specific and co-designed with end-users, and that business models incorporate local participation to guarantee sustainability (APEC, 2022; FAO, 2022). Case studies of smart villages in Indonesia and Thailand show how empowering communities, including persons with disabilities, can generate immense social impact (FAO, 2024).

The trends of digitalization in agriculture and rural development within APEC are rapidly evolving, from optimizing on-farm production to re-architecting entire value chains and rural ecosystems. The success of this

transformation will depend on the ability of member economies to foster an enabling policy environment, promote investment, and, most importantly, ensure that technology serves the ultimate goal of improving people's lives and livelihoods.

2.3. Definition and key characteristics of Digital Rural Communities (DRC)

(1) Definition of a Digital Rural Community

The concept of a Digital Rural Community (DRC), often used interchangeably with "Smart Village", represents a strategic paradigm for rural development in the 21st century. At its core, a DRC is a rural community that harnesses innovative solutions – particularly digital technologies – to holistically improve its economic, social, and environmental well-being. In other words, it is not merely a place where digital tools are present, but a community where those tools are purposefully integrated into everyday life and local governance to generate tangible, long-term benefits.

This concept was first pioneered by the European Commission and the European Parliament, whose "EU Action for Smart Villages" initiative provides a foundational definition, stating that Smart Villages are "rural areas and communities which build on their existing strengths and assets as well as on developing new opportunities, where traditional and new networks and services are enhanced by means of digital, telecommunication technologies, innovations and the better use of knowledge." This definition underscores two essential dimensions: on the one hand, the recognition and mobilization of existing local strengths and assets; and on the other hand, the systematic use of digital and telecommunication technologies to open up new opportunities. A DRC therefore does not replace traditional rural systems, but rather enhances and connects them through modern tools and knowledge.

More specifically, the smart village model focuses on developing intelligent, context-specific solutions to address local challenges. It is a participatory development process that builds upon a community's existing assets and capacities to foster sustainable growth. This approach is inherently collaborative, benefiting from partnerships with other rural and urban communities and a wide range of stakeholders, and can be supported by a mix of public and private funding. In practice, this means that digital solutions in a DRC are not designed in isolation; they emerge from dialogue, co-creation, and coordination among local governments, cooperatives, private firms, civil society and citizens.

The implementation of smart village strategies may be based on existing initiatives and financed through various public and private sources. A DRC can thus evolve from pre-existing rural development programs, with digital technologies gradually layered onto them, rather than being created from scratch. This evolutionary nature is important, as it highlights that the DRC model is a process of continuous transformation rather than a fixed “end state”.

The realization of a successful DRC is therefore dependent on a set of core components that define the model itself, and a supportive enabling ecosystem that allows it to thrive. The core components provide the structural and functional backbone of the model, while the enabling ecosystem shapes the conditions under which these components can operate effectively and sustainably over time.

(2) Key characteristics of a Digital Rural Community

The realization of a successful DRC is dependent on a set of core components that define the model itself, and a supportive enabling ecosystem that allows it to thrive. These two dimensions are closely interlinked: strong core components cannot reach their full potential without an adequate ecosystem, and conversely, even a favourable ecosystem will not automatically deliver outcomes without clear core components.

Core components of the model:

- A rural community

The foundation of any DRC is a clearly identifiable rural community, consisting of one or several settlements without strict limitations on administrative boundaries. This community provides the social fabric – local norms, networks, and institutions – within which digital solutions are introduced. In practice, this means that the focus is not only on physical infrastructure but also on people and their relationships, including farmers, youth, women, local authorities, and community-based organizations.

- Digital technologies

Digital technologies are the key enablers that allow the community to enhance efficiency, resilience, and quality of life. These include ICT, IoT, and big data solutions, which can support activities ranging from precision agriculture and e-commerce to digital public services. High-speed broadband is a critical facilitator, as it determines the extent to which advanced applications can be deployed. However, the presence of infrastructure alone is not sufficient; it must be matched with affordable access and relevant applications for it to become meaningful in the daily lives of rural residents.

- A smart strategy

A DRC requires a locally tailored “smart strategy” that responds to the specific challenges and opportunities of the community, with clear objectives across various sectors such as healthcare, business, or tourism. This strategy acts as a roadmap, ensuring that digital investments are not ad hoc or fragmented but aligned with long-term development goals. It also clarifies roles and responsibilities among stakeholders, helping to coordinate efforts and avoid duplication.

- Characteristics of the enabling ecosystem

Beyond these components, the success of a DRC is critically dependent on a supportive enabling ecosystem with four key characteristics. These characteristics do not directly deliver services, but they shape the environment in which digital solutions can be introduced, scaled, and maintained.

- A supportive policy and institutional framework

This requires a coherent economy-wide digital transformation strategy that prioritizes rural areas, clear regulations, and strong local institutions like agricultural cooperatives. Such a framework provides direction, sets standards, and reduces uncertainty for investors and practitioners. When economy-wide policies explicitly endorse rural digitalization, they create the conditions for local initiatives to access funding, technical assistance and institutional backing.

- Developed human capital and digital literacy

This involves sustained investment in accessible training programs to build competencies beyond basic skills, including e-commerce and digital finance. Digital literacy is not limited to knowing how to use a smartphone; it also encompasses the capacity to critically evaluate online information, engage with digital platforms for production and marketing, and use digital tools in everyday problem-solving. Without such capabilities, communities will not be able to fully utilize the infrastructure invested.

- Financial accessibility and viable business models

The ecosystem must ensure that farmers and rural entrepreneurs have access to affordable finance to invest in digital solutions, while the solutions themselves operate on sustainable business models that can scale beyond initial subsidies. This means that grants and donor funding can play an important catalytic role, but long-term sustainability depends on the ability of digital services to deliver tangible value for users, who are willing and able to pay for them.

- Collaborative multi-stakeholder partnerships

The complexity of DRC requires a synergistic public-private-community partnership (PPCP), where government, the private sector, and the community work together as enablers, innovators, and anchors. Such partnerships pool complementary strengths: the public sector provides policy direction and public goods; the private sector brings innovation and market discipline; and communities ensure that interventions remain grounded in local realities. Where these partnerships are strong and trust-based, DRC initiatives are more likely to be inclusive, resilient, and scalable.

III. RELEVANCE OF DIGITAL RURAL COMMUNITIES IN ADDRESSING KEY CHALLENGES OF APEC ECONOMIES

3.1. Overview of APEC economies

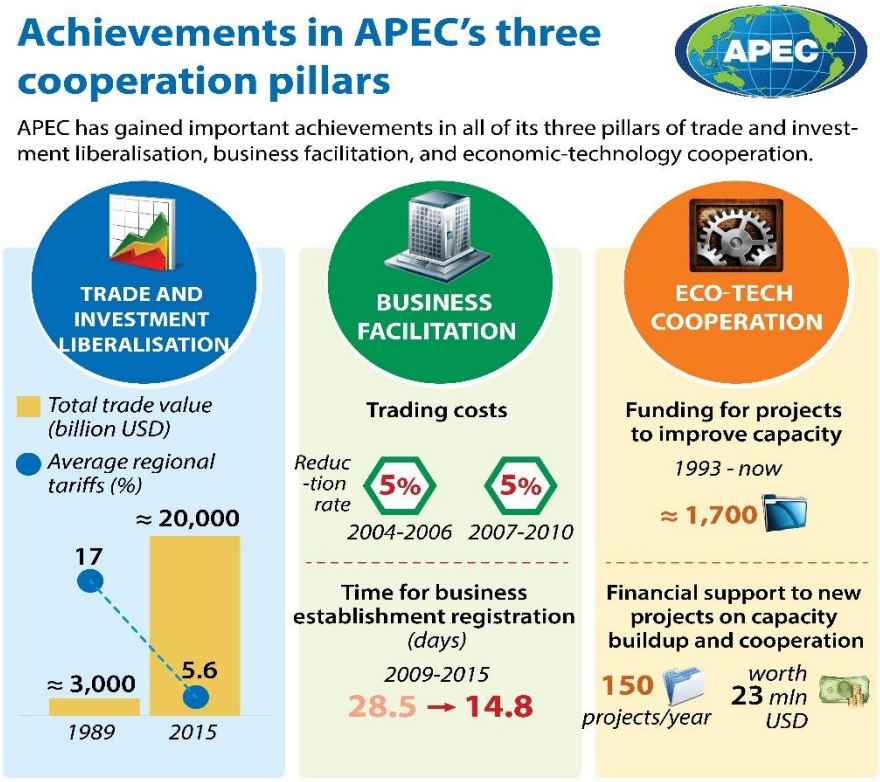
The Asia-Pacific region is one of the most diverse, dynamic, and strategically important regions in the world. The Asia-Pacific is home to more than 4.3 billion people, accounting for approximately 60% of the global population. It encompasses a vast area stretching from East Asia to Oceania and parts of North and South America, including members along the Pacific Ocean. The region is defined not only by its geographic boundaries but also by its economic, cultural, and political importance on the global stage.

The Asia-Pacific Economic Cooperation (APEC) plays a crucial role in fostering economic growth, trade, and cooperation among its 21 member economies within the broader Asia-Pacific region. APEC is a regional economic forum established in 1989 to leverage the growing interdependence of the Asia-Pacific. APEC's 21 members aim to create greater prosperity for the people of the region by promoting balanced, inclusive, sustainable, innovative and secure growth and by accelerating regional economic integration.

APEC has 21 members, commonly referred to as "economies", reflecting their diverse governance structures. These economies span both sides of the Pacific Ocean and include some of the world's largest economies (China; Japan; and United States). APEC's primary goal is to support sustainable economic growth and prosperity in the region, and its focus extends into social, environmental and governance issues affecting the development of its member economies. These economies account for about 60% of global GDP and 47% of world trade, making APEC a significant platform for economic engagement.

APEC's mission is rooted in three pillars:

- Trade and investment liberalization: Reducing trade barriers and promoting open and free trade across the region.
- Business facilitation: Improving the business environment by simplifying regulations and reducing the cost of doing business.
- Economic and technical cooperation: Fostering development and capacity building to bridge the economic disparity among member economies.



Source: VNA (2018)

3.2. Challenges of APEC economies and necessity for developing digital rural communities

(1) Challenges of APEC economies.

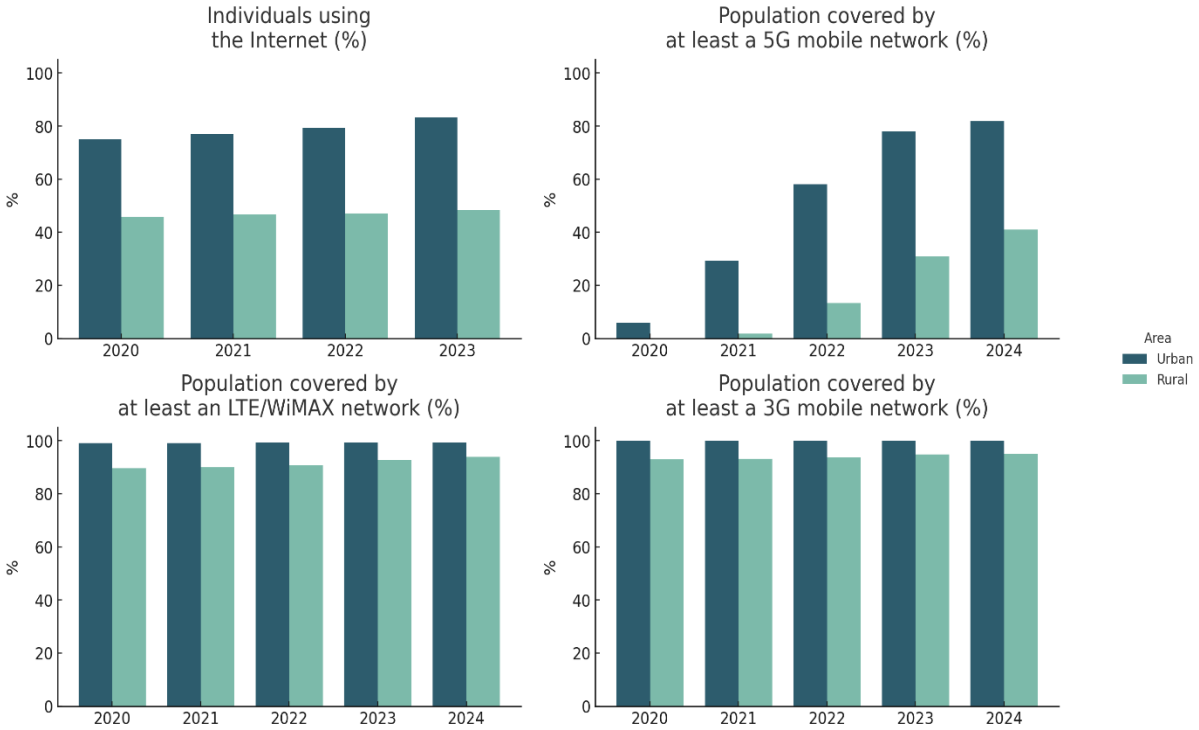
Although the Asia-Pacific is one of the world's most dynamic economic regions, the rural areas of many APEC member economies continue to face intertwined and complex challenges that impede sustainable and inclusive development. These challenges are not confined to economics but also encompass demographic, environmental, and social issues. In this context, the development of Digital Rural Communities (DRC) emerges as a strategic and urgent solution to address these root problems and realize APEC's vision of a prosperous future for all. These structural tensions are not temporary phenomena that will resolve themselves over time; rather, they are deeply rooted in the way production, investment and public services have historically been concentrated in urban and coastal growth poles. As a result, many rural areas in APEC economies face overlapping constraints in terms of physical connectivity, human capital, and access to information and markets. Even when aggregate indicators for an economy show impressive performance, these averages often conceal persistent pockets of rural deprivation and exclusion. Addressing the challenges outlined below therefore requires not only sector-

specific interventions, but also a strategic rethinking of how rural areas are integrated into economy-wide development trajectories.

a, The widening urban-rural development gap

The disparity in economic prosperity, opportunities, and social welfare between urban centers and rural areas remains one of the most significant impediments to equitable development in APEC (ADB, 2021). Rural inhabitants often face limited access to markets, quality education, healthcare, stable employment, and financial products (ADB, 2021; FAO, 2023). This gap not only perpetuates income inequality but also leads to a "brain drain" as skilled and younger individuals migrate to cities, leaving behind an aging workforce and eroding the economic potential and social vitality of rural communities (Rigg et al., 2018). Importantly, this gap is self-reinforcing. As younger and more educated residents migrate to urban centres in search of better employment and services, the remaining rural population tends to be older and less able to adapt to structural change. This, in turn, reduces the local tax base, weakens the demand for quality services, and makes it more difficult for authorities and private investors to justify major investments. Over time, the erosion of human and financial resources reduces the capacity of rural communities to innovate, diversify their economies or engage effectively with new technological opportunities.

Urban-Rural Digital Divide in Asia-Pacific: Connectivity & Internet Use, 2020-2024

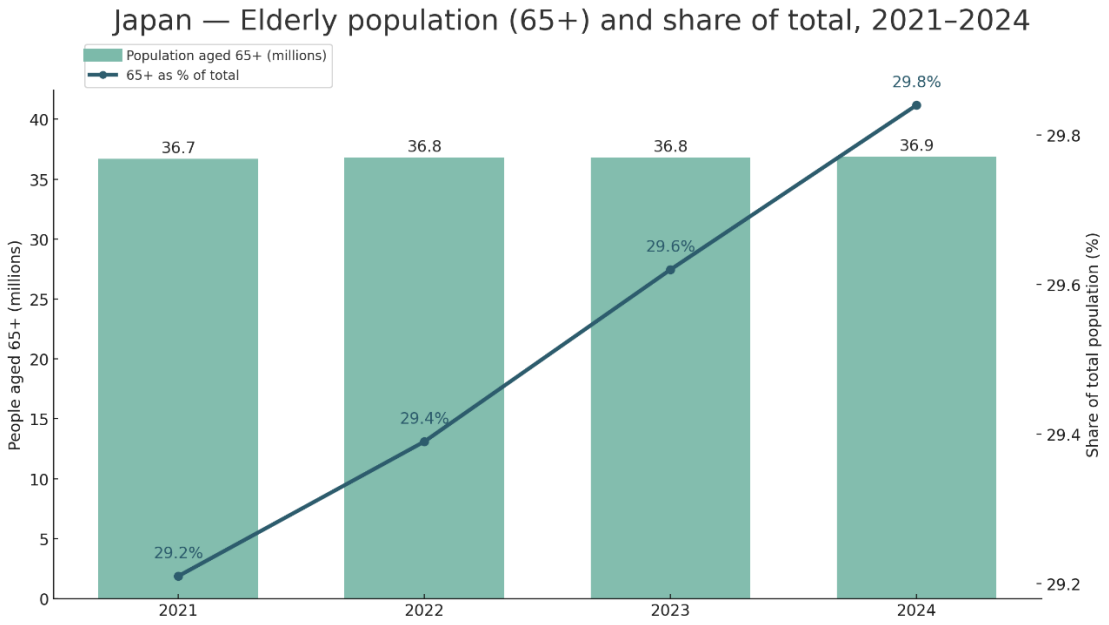


Source: ITU (2025), WITD (2025)

This development gap is starkly reflected in the digital landscape of the Asia-Pacific region. While foundational connectivity like LTE coverage has become relatively high in rural areas, reaching 94.0% in 2024, it still trails the near-universal coverage in urban centers (99.3%). The divide becomes dramatically wider with next-generation infrastructure; in 2024, 5G networks cover 81.9% of the urban population but only 41.0% of the rural population. Critically, this infrastructure gap translates into a more severe usage gap. As of 2024, while 83.3% of individuals in urban areas use the Internet, only 48.5% of their rural counterparts do. This persistent and significant disparity in usage, despite relatively high basic network availability, suggests that the barriers for rural populations extend beyond infrastructure to include affordability, digital literacy, and the availability of relevant digital content and services-all core challenges that DRC are designed to address. In this context, the emergence of DRC is particularly relevant because it directly targets these multiple dimensions of the urban-rural gap. By improving connectivity, lowering transaction costs and creating new channels for accessing services and markets, DRC initiatives offer a way to “re-link” rural areas to centres of economic dynamism without requiring large-scale physical relocation. However, the very existence of the current gap also means that the starting conditions for DRC development are highly uneven across and within APEC economies.

b, Demographic shifts: an aging population and agricultural labor shortages

Many APEC economies—especially China; Japan; and Republic of Korea-are experiencing rapid population aging (UN DESA, 2022). The Asia-Pacific region now hosts nearly half of the world’s older persons (ESCAP, 2022). This demographic tilt is particularly consequential for agriculture, a sector that remains labor-intensive across much of the region. These demographic dynamics have far-reaching implications for the viability of traditional agricultural and rural development models. Ageing farmers often face physical constraints that make it difficult to maintain labour-intensive production systems, while simultaneously lacking access to affordable mechanization or technical support. Younger generations, when they do remain in rural areas, frequently seek alternative livelihoods beyond agriculture, which can lead to the underutilization of valuable land and infrastructure. Together, these trends erode the resilience of food systems and increase the risk that rural communities will struggle to adapt to market and climate shocks.



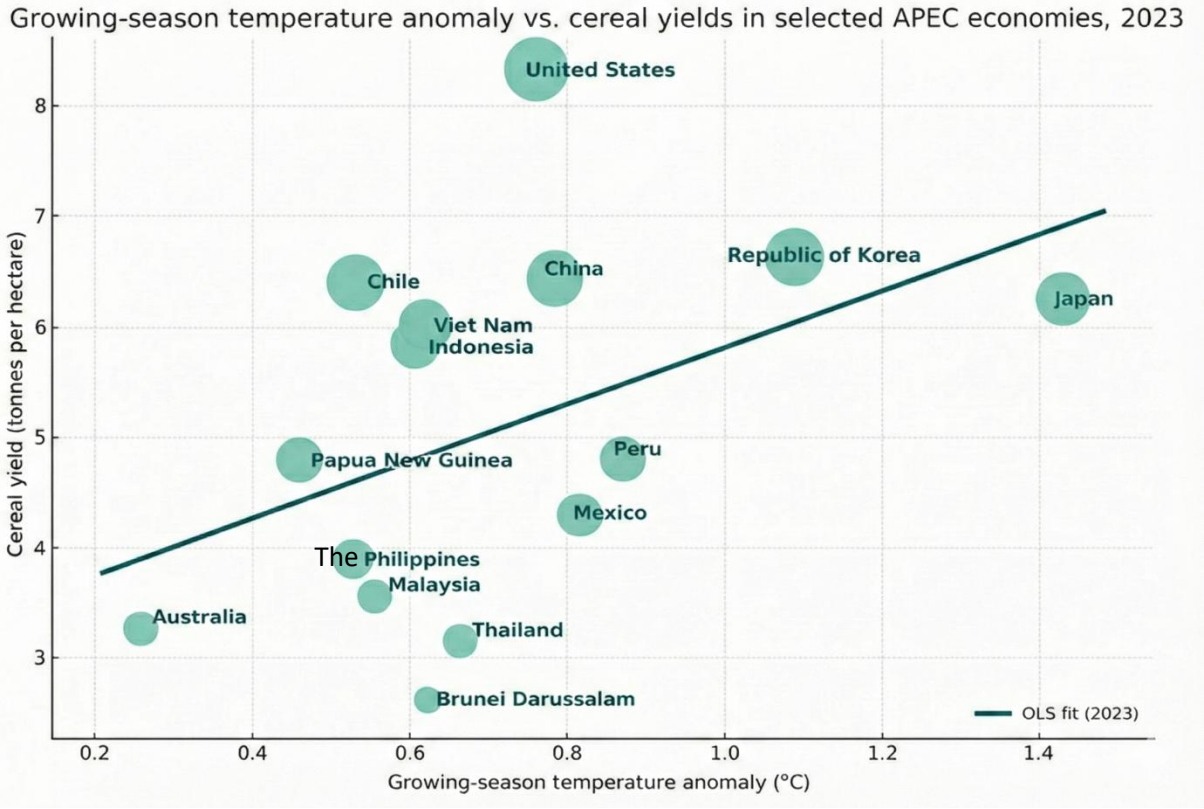
Source: WB (2025)

The chart illustrates Japan's trajectory, the 65+ population edged up from 36.7 to 36.9 million between 2021–2024, while the elderly share of the total population increased from 29.2% to 29.8%. Even these modest absolute gains translate into a steadily rising dependency ratio and a shrinking pool of working-age farm labor. As older farmers retire, replenishment lags-tightening seasonal labor supply, depressing adoption of physically demanding practices, and raising unit labor costs (OECD, 2021). Without productivity-enhancing technologies and targeted skills pipelines, this shortage risks undermining agricultural output, food security, and the continuity of traditional farming systems (FAO, 2017). The Japanese experience is therefore not an isolated case, but an early indicator of a broader pattern that many APEC economies are likely to face as they move through similar demographic transitions. What distinguishes DRC-oriented approaches is that they treat demographic change not only as a constraint, but also as a driver for transforming how agriculture and rural services are organized. By reducing the physical demands of farming, enabling new forms of remote work, and creating digitally enabled service jobs in rural areas, DRC can help re-align rural labour markets with the realities of an ageing population.

c, Climate change impacts and food security threats

The Asia-Pacific region is exceptionally vulnerable to the impacts of climate change, including an increasing frequency of extreme weather events such as typhoons, floods, and droughts (IPCC, 2022; UNESCAP, 2023). These disasters devastate crops, degrade land, disrupt supply chains, and directly threaten the livelihoods of millions of smallholder farmers (FAO, 2023b). With

global agricultural production needing to increase by an estimated 70 percent by 2050 to meet population demands, APEC economies play a central role in this challenge (FAO, 2009). Therefore, ensuring food security amidst a changing climate and diminishing natural resources is a top priority, demanding urgent and collective action as outlined in the APEC Food Security Roadmap Towards 2030 (APEC, 2021). Beyond the immediate economic losses from extreme weather events, climate change also undermines the long-term predictability on which rural livelihoods depend. Changing rainfall patterns, shifting pest and disease dynamics, and increasing temperature variability make traditional knowledge and historical experience less reliable as a guide for planting and investment decisions. This uncertainty disproportionately affects smallholders and rural communities that have limited access to irrigation, insurance or formal credit, leaving them more exposed to crop failures and income volatility. In many APEC economies, this translates into a heightened risk of localised food insecurity, nutritional deficits and distress migration from rural to urban areas.



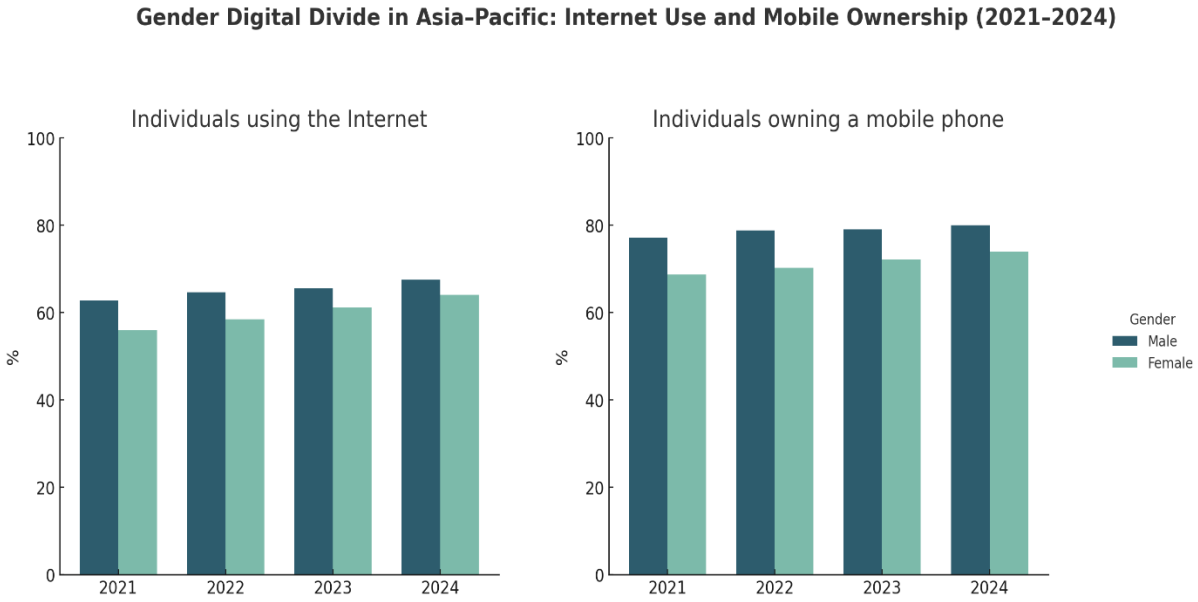
Source: OWID (2025), FAO STAT & ERA5 (2025)

Empirical evidence further highlights the challenge. The 2023 cross-section of selected APEC economies shows considerable heterogeneity in cereal yields relative to growing-season temperature anomalies. Economies such as Republic of Korea and United States achieved relatively high yields despite moderate or elevated anomalies, while others, including Australia and

several Southeast Asian economies, reported much lower yields under comparable conditions. The fitted regression line indicates a modest positive slope; however, this does not imply a simple causal relationship. Yield outcomes are mediated by a complex set of factors-ranging from irrigation infrastructure and seed varieties to exposure to extreme events. This dispersion underscores the need for region-wide investment in climate-resilient technologies, adaptive farming practices, and risk-management mechanisms to safeguard productivity and long-term food security. The growing recognition of these risks has led APEC economies to articulate ambitious commitments on climate adaptation and food security. However, implementation on the ground remains challenging when local decision-makers do not have timely access to data, tools or resources to support climate-smart practices. DRC models, by embedding digital monitoring systems, early-warning mechanisms and decision-support tools into everyday farming and local governance, provide a concrete vehicle through which these high-level commitments can be operationalized in rural communities.

d, The digital divide and gender inequality

Despite the proliferation of digital technologies, a significant "digital divide" persists, particularly in rural areas (ADB, 2021). A lack of digital infrastructure and essential digital skills prevents rural populations from fully harnessing the opportunities of the digital economy. This challenge is often more profound for women, who frequently have less access to technology and training than their male counterparts (FAO, 2023a). This gender gap in access to digital resources not only limits the economic potential of women but also constrains the overall development of the entire community. For many rural women, the digital divide is compounded by entrenched gender norms that limit their mobility, control over assets and access to formal education. Even when devices are present in the household, women and girls may have less decision-making power over their use, or may lack the confidence and support to explore more advanced applications. Similar patterns can be observed among other disadvantaged groups, including ethnic minorities and people with disabilities, who often face intersecting forms of exclusion. As a result, digitalization risks reinforcing, rather than alleviating, pre-existing inequalities if these social dimensions are not explicitly addressed.



Source: ITU (2025)

The gender digital divide is not merely a qualitative observation but a measurable reality across the Asia-Pacific. Data from 2024 shows that males consistently have higher rates of both Internet usage (67.5% for males vs. 64.1% for females) and mobile phone ownership (80.0% for males vs. 73.9% for females). While this gap persists, the data also reveals a positive trend of gradual convergence. For instance, the gender gap in Internet usage has narrowed from 6.8 percentage points in 2021 to 3.4 percentage points in 2024. Nevertheless, the remaining disparity underscores the need for targeted interventions that go beyond general access. Promoting digital literacy specifically for females, ensuring affordable access to devices, and supporting the creation of gender-sensitive digital content and services are essential strategies to close this gap, aligning directly with the inclusive principles of a successful DRC framework. From the perspective of DRC development, this implies that closing the digital divide cannot be treated solely as a question of infrastructure rollout or generic skills training. It requires deliberate strategies to identify and remove the specific barriers that different groups face in accessing, using and benefiting from digital tools. In practical terms, this may involve designing women-friendly training schedules, providing locally relevant content in minority languages, or working through trusted community organizations that can mediate access for vulnerable groups. Without such targeted efforts, substantial segments of rural populations may remain excluded from DRC initiatives, thereby weakening their overall effectiveness and legitimacy.

(2) Necessity of DRC for agricultural development in APEC economies

In the face of these multi-dimensional challenges, developing Digital Rural Communities (DRC) is no longer an option but an imperative. The digital transformation of agriculture and rural areas offers a strategic pathway to build resilience, drive sustainable growth, and ensure no one is left behind (APEC, 2020). In other words, DRC should be understood as a strategic response that weaves together multiple policy agendas which have often been pursued separately: rural development, digital transformation, agricultural modernization, climate resilience and social inclusion. Rather than creating a new policy silo, the DRC approach offers an integrative framework through which different sectors and stakeholders can align their efforts around a shared territorial vision for rural areas. This integrative function explains why, despite differing starting points and development priorities, a wide range of APEC economies are increasingly exploring DRC-type models as a central element of their future rural strategies.

a. Bridging the urban-rural gap

DRC facilitate the delivery of essential services such as healthcare, education, and public administration to rural populations through online platforms, breaking down geographical barriers. E-commerce platforms empower farmers to connect directly with markets, bypass intermediaries, and increase their incomes. This leads to tangible economic gains, a conclusion reinforced by the APEC survey where 70.00% of stakeholders reported that these technologies led to increased economic benefits, including higher corporate profits (58.06%) and lower quality management costs (77.50%) (APEC, 2025). This creates a more vibrant economic environment, helping to retain local labor and attract talent back to rural areas. By reducing the time, cost and uncertainty associated with accessing essential services, DRC directly address some of the most powerful “push factors” behind rural out-migration. When residents can consult doctors remotely, complete administrative procedures online, and access information about jobs or education without leaving their community, the perceived gap in opportunities between rural and urban locations narrows. At the same time, improved connectivity and service provision make rural areas more attractive for small businesses, social enterprises and public investments, creating new “pull factors” that can encourage return migration or circular mobility of skilled workers. Over time, this can help rebalance territorial development patterns in a more sustainable way.

b. Addressing labor challenges and modernizing agriculture

Smart farming, a cornerstone of DRC, applies technologies like IoT, drones, and robotics to automate production processes (OECD, 2019). This

directly enhances operational effectiveness, with the same APEC survey revealing that 84.44% of stakeholders believe digitalization raises management efficiency. This is achieved primarily by helping to achieve standardized management (80.00%) and improve overall management efficiency (78.06%) (APEC, 2025). This not only helps address labor shortages but also attracts a younger generation to agriculture through modern and less physically demanding business models (Shamshiri et al., 2018). Crucially, these technologies do not only substitute for labour; they also change the nature of agricultural work. Digital tools allow farmers to shift from reactive, manual decision-making to more proactive, data-driven management, in which monitoring and analysis play a greater role. This opens up new types of tasks that may be particularly attractive to younger, better-educated rural residents, such as operating drones, managing farm management software, or analysing sensor data to optimise inputs. As a result, DRC-enabled modernization can contribute to resolving labour shortages not only by improving efficiency, but also by redefining farming as a knowledge-intensive profession with more diverse and rewarding career paths.

c. Enhancing climate resilience and food security

Digital technologies enable farmers to access real-time data for precision agriculture, optimizing the use of water and fertilizer, reducing environmental impact, and increasing resilience to adverse weather conditions (FAO, 2023b). Furthermore, by enabling traceability and quality control, these technologies help deliver high-quality products and services, a key social benefit identified by 80.56% of APEC stakeholders (APEC, 2025). This directly enhances food safety, builds consumer trust, and contributes to the overall stability and sustainability of the food supply chain. In addition to supporting on-farm adaptation, DRC can strengthen resilience at the level of value chains and food systems. When production, storage, transport and market information are digitally connected, shocks in one segment can be detected earlier and managed more effectively. For example, real-time information on local crop conditions can inform targeted relief measures, dynamic reallocation of supplies, or temporary market interventions to prevent sharp price spikes. Over the longer term, data generated through DRC initiatives can be used to improve planning of public investments in irrigation, rural roads or storage infrastructure, thereby reinforcing the physical foundations of food security in a changing climate.

d. Promoting inclusive and equitable growth

The development of DRC necessitates investment in digital infrastructure and digital literacy programs for all citizens, including women and other vulnerable groups (ADB, 2021; FAO, 2023a). This is not just a theoretical benefit; the APEC (2025) survey found that 75.00% of respondents recognized

that digital and innovative technologies have the potential to eliminate women's vulnerability and inequality in the food industry. Key factors cited include narrowing the gender gap in physical strength and enhancing job stability and flexibility. Empowering all members of the community to participate in the digital economy not only promotes equality but also unlocks a vast economic resource for development. From an equity perspective, the strategic importance of DRC lies in their potential to democratise access to information, networks and markets that were previously concentrated in urban centres or among better-connected groups. When designed with inclusion in mind, digital platforms can lower traditional barriers related to distance, social status or informal gatekeepers, allowing smallholders, women entrepreneurs and youth-led start-ups to connect directly with buyers, service providers and sources of finance. This does not automatically resolve structural inequalities, but it does create new spaces for agency and upward mobility. Ensuring that these opportunities are widely accessible is therefore essential if DRC are to contribute meaningfully to the “leave no one behind” principle embedded in APEC and global development agendas.

3.3. Potential impacts of digital rural communities to rural area development in APEC economies

The successful development and scaling of Digital Rural Communities across APEC economies have the potential to catalyze a profound and structural transformation of rural areas, moving beyond incremental improvements to create a new paradigm for development. The impacts are not isolated but create a virtuous cycle, where advancements in one domain reinforce progress in others, leading to holistic and sustainable outcomes across the economic, social, environmental, and governance spheres. In this sense, DRCs can be seen as both a driver and a manifestation of a broader transition towards more inclusive and resilient rural development models.

(1) Economic transformation and the emergence of a new rural economy

The most significant potential impact of DRC lies in the structural transformation of the rural economy, from one based on primary commodity production to a diversified, dynamic, and integrated system. This transformation extends far beyond simply increasing the yields of existing farms. By providing tools for precision agriculture and data-driven management, DRC first enhance the productivity and profitability of the core agricultural sector. Farmers can optimize input use, reduce waste, and make better-informed decisions, resulting in more stable and predictable income streams.

However, the true transformative power of DRC lies in creating new value chains and new economic roles. The rise of e-commerce platforms, for instance, has the potential to create a "disintermediation" effect, allowing farmers and

rural artisans to bypass traditional intermediaries and connect directly with a massive consumer base, thereby capturing a greater share of the final product value. This, in turn, fosters the growth of a vibrant ecosystem of rural MSMEs in processing, logistics, packaging, branding, and digital services.

Furthermore, DRC can create entirely new types of employment. They generate demand for digitally-skilled workers such as e-commerce managers, digital marketers, drone operators, and data analysts within the rural community itself. These roles complement, rather than replace, traditional agricultural jobs, creating a more diversified rural labour market. This provides attractive, knowledge-based career pathways for educated youth, helping to reverse the "brain drain" and inject new skills and innovation back into their hometowns. Over time, the cumulative effect is the emergence of a new rural economy that is more resilient to shocks, more integrated into regional and global markets, and better positioned to benefit from the broader digital economy.

(2) Social inclusion and enhanced quality of life

DRC have the potential to fundamentally bridge the urban-rural divide not just in income, but also in quality of life and access to essential services. By leveraging digital platforms, DRC can deliver high-quality e-health and e-education services to remote areas, ensuring that geographical location is no longer a primary determinant of human development outcomes. Telemedicine enables rural residents to consult with doctors in urban hospitals without travelling long distances, while online learning platforms open access to diverse educational content for children and adults alike.

The ability to access specialized medical consultations or advanced educational resources remotely can significantly improve human capital and well-being in rural areas. When combined with digital public services – for example, online administrative procedures or social protection programs – rural residents can save time and transaction costs, and enjoy a more predictable and transparent relationship with public authorities.

Critically, DRC can be a powerful engine for gender equality and social inclusion. The digital economy creates flexible, home-based entrepreneurial opportunities that are highly compatible with the traditional caregiving responsibilities that disproportionately fall on women in many rural societies. Women can participate in online sales, digital bookkeeping, or remote service provision from their homes, while still performing unpaid domestic work. Moreover, by framing agriculture as a high-tech, knowledge-based profession, DRC can break down traditional barriers related to physical strength, creating a more level playing field for women and youth to become farm owners and managers. As these inclusive opportunities expand, the social fabric of the

community can become more cohesive, with a greater sense of shared opportunity and mutual support.

(3) Environmental sustainability and enhanced climate resilience

The widespread adoption of DRC models offers a pathway to a new paradigm for environmental stewardship in agriculture. The data-driven practices at the heart of smart farming enable a significant reduction in the environmental footprint of agriculture. Precision agriculture, powered by real-time data from IoT sensors and drones, allows for the optimized and targeted use of water, fertilizers, and pesticides. This not only reduces costs but also minimizes chemical runoff, improves soil health, and conserves scarce water resources, thereby supporting long-term ecological sustainability.

Furthermore, DRC enhance climate resilience. Integrated data platforms that provide farmers with hyper-local weather forecasts and early-warning systems for pests and diseases allow them to make proactive, adaptive decisions to protect their crops and livestock. For instance, timely alerts can help farmers adjust planting dates, modify irrigation schedules, or implement preventive measures before a shock materializes. At a macro level, the data collected from thousands of digitally connected farms can be aggregated and used for more effective regional planning, water resource management, and the development of more accurate climate adaptation strategies.

In this way, DRC contribute directly to regional food security goals by stabilizing production in the face of increasing climate variability and extremes. The combination of improved resource efficiency and better risk management can reduce losses, enhance productivity, and support more sustainable land use practices, aligning agricultural development with the broader objectives of climate mitigation and adaptation.

(4) Strengthened governance and community empowerment

Finally, DRC have the potential to transform the relationship between citizens and the state at the local level, fostering a more transparent, responsive, and participatory model of governance. By providing a clear and accessible digital channel for communication, feedback, and the delivery of public services, these systems can empower citizens to take a more active role in their own development. Digital platforms enable local governments to disseminate information quickly, collect feedback, and manage public resources more transparently.

This digital engagement fosters a stronger sense of community ownership and social cohesion. When residents feel that the DRC is not something being imposed upon them, but something they are actively shaping, it ensures long-term engagement and sustainability. Online forums, social

media groups, and digital consultation processes can provide spaces for collective decision-making, knowledge sharing, and the organization of community-led initiatives. These processes strengthen the social fabric that is the ultimate foundation of any resilient rural community.

In addition, the increased availability of data and digital tools can help local leaders to plan more effectively and allocate resources more efficiently. By tracking service delivery, monitoring project implementation, and analyzing local development indicators, they can make more evidence-based decisions. Over time, this can enhance trust in institutions, reduce information asymmetries, and support a virtuous cycle of accountability and participation.

IV. CURRENT STATUS OF DIGITAL RURAL COMMUNITIES IN VIET NAM AND OTHER APEC ECONOMIES

1. General situation in APEC economies

a) APEC's high-level strategic framework

The development of digital rural communities (DRC) is a core component of APEC's broader strategic agenda for regional economic integration. This commitment is articulated through a multi-layered policy architecture. The overarching Putrajaya Vision 2040, and its implementation guide, the Aotearoa Plan of Action, identify "Innovation & Digitalization" as a key economic driver for the region and explicitly emphasize the goal of building inclusive digital economies.

This vision is operationalized through the APEC Internet and Digital Economy Roadmap (AIDER), which provides a practical action plan with eleven key focus areas that are foundational for DRC development. AIDER specifically prioritizes the establishment of digital infrastructure, ensuring universal broadband access, and promoting inclusive digital participation.

Complementing these frameworks, the APEC Framework for Securing the Digital Economy (2019) establishes guiding principles to foster a secure and trusted digital environment. It sets forth principles of awareness, responsibility, cooperation, and privacy, ensuring that digital systems are built on a foundation of trust through robust data protection and user empowerment. While this comprehensive framework provides strong high-level strategic direction, the pace and nature of its translation into economy-wide strategies and on-the-ground implementation vary significantly across member economies.

Taken together, these high-level frameworks signal a clear political consensus within APEC that digital transformation is a cross-cutting priority which must encompass rural areas, not only cities and industrial hubs. They also indicate that DRC-related initiatives are not isolated experiments, but form part of a broader regional effort to build resilient, innovative and inclusive digital economies. However, the translation of these broad commitments into concrete, coordinated action at the local level remains uneven. The degree to which rural communities are explicitly targeted, resourced and supported within economy-wide digital agendas varies significantly across member economies, shaping the speed and depth of DRC development.

b) A typology of DRC development across APEC economies

The current state of DRC development can be understood through a typology of three distinct stages. First, Advanced economies, such as Japan; Republic of Korea; and United States, have already integrated DRC initiatives into comprehensive economy-wide strategies. These economies benefit from

high internet penetration, mature digital ecosystems, and strong private sector involvement, allowing them to move beyond pilot projects toward broad, systemic adoption of digital solutions.

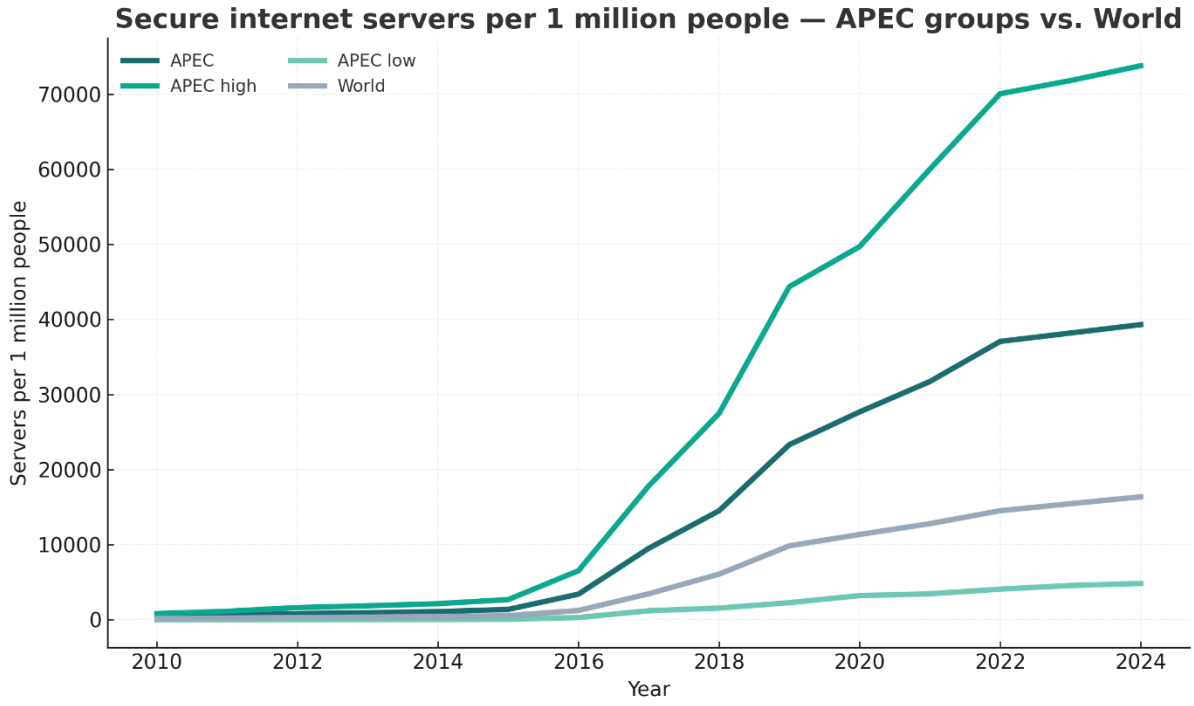
Second, a significant number of emerging economies, including Indonesia; Thailand; and Viet Nam, have made important strides but remain at an intermediate stage. These economies have launched economy-wide strategies or well-supported pilot programs, yet progress is often uneven and implementation can be fragmented, frequently limited to specific demonstration projects rather than achieving economy-wide coverage.

Third, several APEC economies are still at an early, pilot-based stage, where DRC exist mainly as small-scale, donor-led initiatives. Economies like Papua New Guinea; the Philippines face substantial structural barriers, particularly in securing basic connectivity. Consequently, DRC projects in these contexts tend to be heavily reliant on external support and are yet to be integrated into broader economy-wide development frameworks.

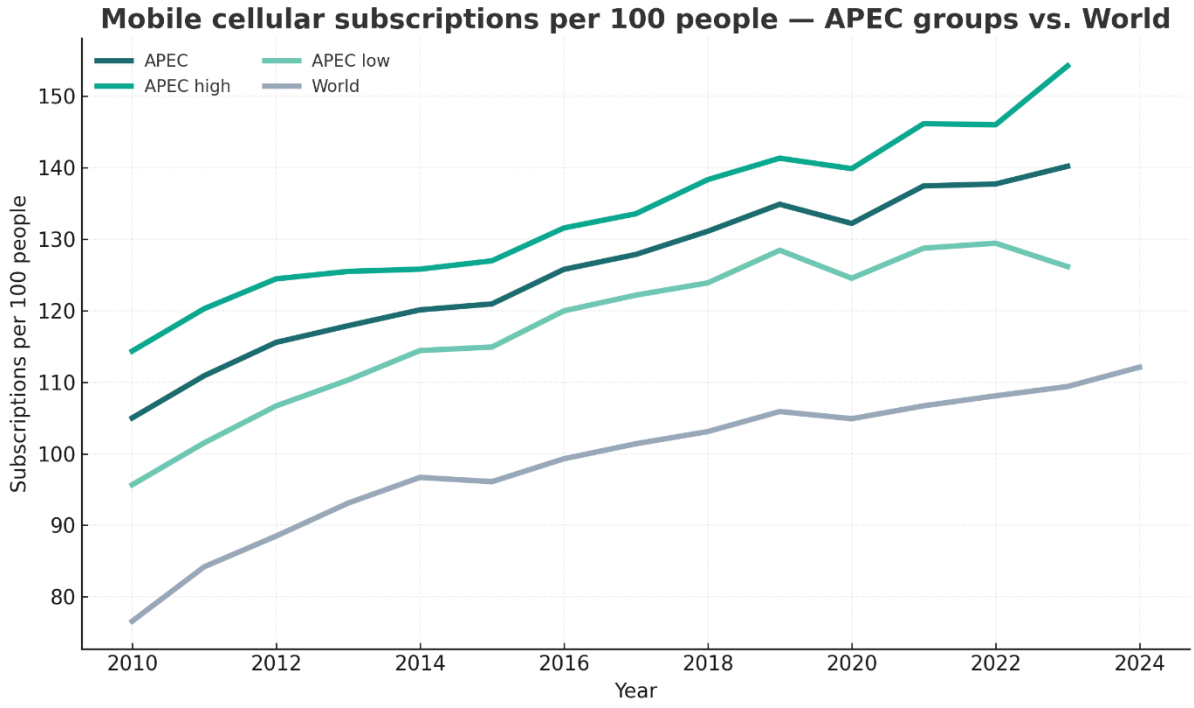
This typology highlights that APEC economies are not starting from the same baseline, and therefore require differentiated approaches to DRC promotion. Economies with advanced, system-wide DRC integration can increasingly focus on fine-tuning regulatory frameworks, strengthening data governance, and fostering innovation in high-value services. Emerging economies, by contrast, often face the dual challenge of scaling promising pilots while simultaneously addressing foundational gaps in infrastructure, skills and institutional coordination. Economies at an early, pilot-based stage may need to prioritize building basic connectivity and institutional capacity before more complex DRC models can be realistically implemented. Recognizing these differences is critical to avoid one-size-fits-all prescriptions and to design support measures that are commensurate with each economy's specific stage of development.

c) Quantifying the digital divide: readiness and infrastructure gaps

This developmental disparity is quantifiable through key indicators of digital readiness. While mobile access is mature across APEC, providing a solid foundation for basic services, a severe gap exists in higher-level infrastructure. From 2010 to 2023, mobile subscriptions rose to 154 per 100 people in high-income APEC economies and 126 in low-income ones, both well above the global average of 109.



Source: WB (2025)



Source: WB (2025)

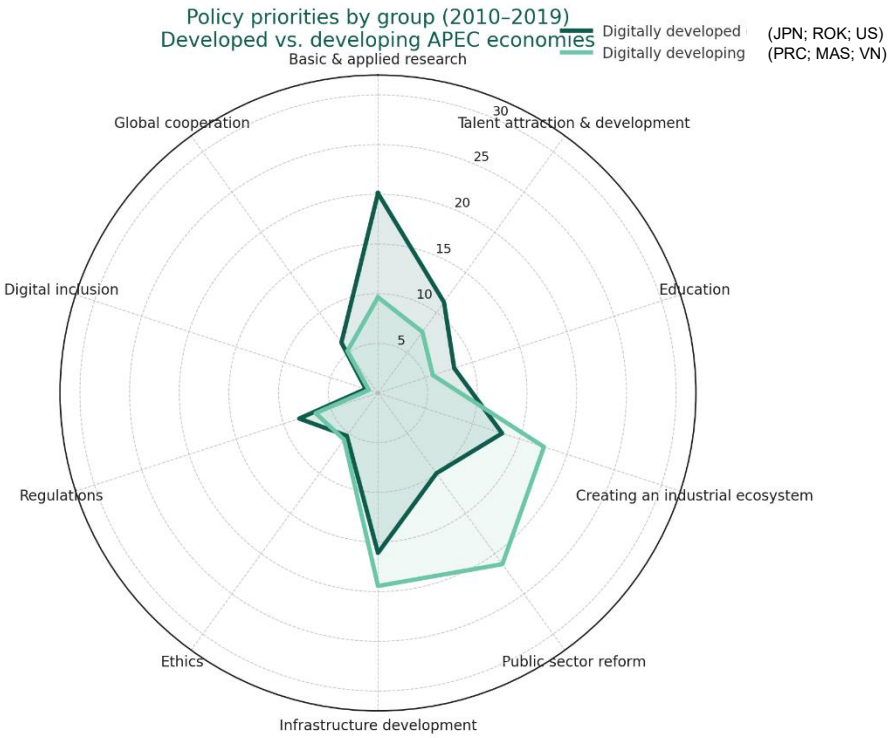
However, the security infrastructure is surging but remains highly uneven. The number of secure internet servers per million people-a critical indicator of a mature and trusted digital ecosystem-jumped from 423 to 39,309 in APEC overall since 2010 (93-fold increase). Yet, this average

masks a deep divide: APEC's high-income group reached 73,777 servers, while the low-income group, despite accelerating fastest, reached only 4,842. This signifies that the high-income group has an infrastructure capacity for a secure digital economy that is roughly 15 times greater, revealing a clear gap in both technical capacity and the foundation for digital trust.

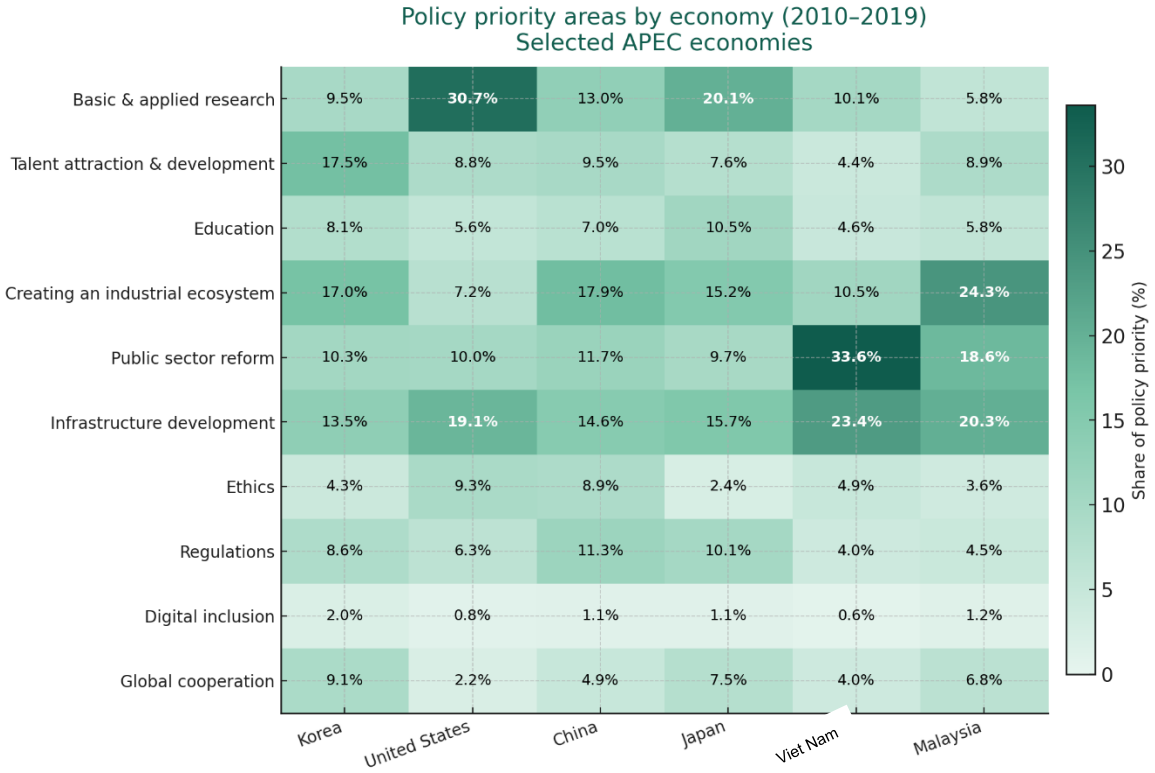
Beyond the statistics, these disparities have direct implications for how rural communities experience and benefit from digitalization. In economies where high-speed connectivity, secure data infrastructure and affordable devices are widely available, rural residents can more easily access sophisticated services such as e-commerce, digital finance, and precision agriculture tools. Where such infrastructure is lacking or prohibitively expensive, rural digitalization tends to remain confined to basic communication and information services, limiting its transformative potential. The quality and reliability of infrastructure also influence trust: frequent service disruptions or security incidents can discourage adoption, particularly among risk-averse smallholders who cannot afford losses or service failures.

d) The influence of divergent domestic policy priorities

The three-tiered landscape and the underlying digital divide are not accidental; they are a direct reflection of divergent domestic policy priorities. An analysis of digital transformation policies from 2010 to 2019 reveals a clear strategic distinction between economy groups.



Source: Jang (2021)



Source: Jang (2021)

As shown in the comparative data, digitally developed economies prioritize R&D and talent, reflecting an innovation-driven path. For example, the United States places a heavy emphasis on basic and applied research (30.7%), while Japan; Republic of Korea maintain more balanced but research-oriented portfolios. In contrast, digitally developing economies concentrate on building foundational platforms. Their policies stress public-sector reform, infrastructure development, and ecosystem building. This is evident in Malaysia; Viet Nam, which emphasize public-sector reform (33.6% and 18.6%, respectively) and infrastructure (23.4% and 20.3%). This strategic divergence is the primary determinant of an economy's current stage of DRC development and shapes its unique pathway for future rural digital transformation.

These divergent priorities do not inherently imply that some approaches are “better” than others; rather, they reflect different historical trajectories, institutional capacities and development objectives. For example, economies that prioritize research and development may generate cutting-edge technologies but still need deliberate mechanisms to ensure that these innovations reach and benefit rural communities. Economies that focus on public-sector reform and infrastructure may succeed in building a strong enabling environment, yet still require targeted programmes to foster local innovation and entrepreneurship. For DRC development, the key challenge is therefore to strike an appropriate balance between long-term investments in

systemic capabilities and targeted interventions that quickly demonstrate tangible benefits for rural populations.

2. Current status of digital rural communities in Viet Nam

a) Policy and strategic initiatives

The Government of Viet Nam has proactively established a comprehensive, multi-layered, and top-down policy architecture to steer its economy-wide digital transformation, with the digitalization of agriculture and rural development identified as a priority sector.

The highest-level strategic direction is provided by the Politburo's Resolution 52-NQ/TW (2019) on proactively participating in the Fourth Industrial Revolution. To operationalize this vision, the government issued the "National Digital Transformation Program to 2025, with a vision to 2030" (Decision No. 749/QD-TTg). This cornerstone program sets a clear economy-wide roadmap and explicitly designates agriculture as one of eight priority sectors for transformation. This overarching strategy is complemented by other economy-wide initiatives aimed at fostering a digital economy, such as the approval of a shared economy project (Decision No. 999/QD-TTg) and the establishment of the Viet Nam National Innovation Center (Decision No. 261/QD-TTg).

For rural areas specifically, the most significant initiative is the integration of digital transformation into the National Target Program on New Rural Development. This is concretized through the "Digital Transformation Programme in new rural development 2021-2025" (approved by Decision No. 924/QD-TTg), which mandates the Ministry of Agriculture and Rural Development (MARD) to lead and coordinate the development of pilot models for smart villages and communes economy-wide.

To further guide implementation at the grassroots level, MARD has issued a series of specific, operational-level documents. These include Decision No. 969/QD-BNN-VPDP (2023) which established the framework and criteria for pilot smart communes, and Decision No. 1824/QD-BNN-VPDP (2023) which further detailed the set of criteria. Most recently, MARD issued Official Dispatch No. 3445/BNN-VPDP (2023), providing temporary official guidelines for localities on how to select, design, and implement pilot models for "new-style rural smart communes" and "e-commerce communes," thus translating overall digital transformation strategy into concrete local action. To create a supportive enabling environment, this entire framework is reinforced by a wide range of multi-sectoral policies focused on removing key barriers through preferential credit, land, infrastructure, and tax incentives.

Taken together, these strategies and instruments illustrate that Viet Nam is not pursuing rural digitalization through a single flagship programme but through a layered governance approach. High-level political resolutions provide direction and legitimacy, economy-wide digital transformation programmes set out cross-cutting priorities and targets, and sectoral policies translate these into concrete mandates for agriculture and rural development. At the local level, detailed guidelines on criteria, selection and design of pilot communes help to reduce ambiguity and provide a practical basis for line agencies and local governments to act. This vertical coherence between central guidance and local implementation is a critical precondition for scaling up DRC initiatives in a systematic rather than ad hoc manner.

b) Current status and key achievements

Viet Nam is categorized as an emerging economy in DRC development, characterized by a distinct government-driven model where the state acts as the primary architect and catalyst. The practical application of digital solutions on the ground demonstrates a clear focus on optimizing production processes and enhancing farm-level management. According to data from the FAO, the most frequent solutions currently being adopted are comprehensive farm management services and AI/Big data-based solutions, indicating a clear trend in Viet Nam towards more intensive, data-driven agriculture. This configuration has important implications for how DRC models emerge and evolve in practice. Because central authorities play a leading role in defining objectives, allocating resources and selecting pilot sites, there is a relatively high degree of alignment between local initiatives and economy-wide development priorities. At the same time, the reliance on government-led programmes means that the pace and depth of adoption often depend on the capacity and commitment of provincial and district-level administrations. In this context, the design of DRC initiatives in Viet Nam tends to emphasize replicable models, standardised criteria and clear reporting lines, which can facilitate scaling but also requires continuous attention to local specificity and feedback from end-users.

A notable characteristic of the Viet Nam’s context is the strong strategic emphasis on the fisheries sector, with digital solutions being applied to both catch fishery management and digital aquaculture to improve sustainability and productivity. Concurrently, the widespread presence of value chain traceability solutions reflects Viet Nam's strategic efforts to meet stringent international food safety standards and promote its agricultural exports. A key achievement to date has been the successful implementation of centrally coordinated pilot projects, such as the comprehensive models in Yen Hoa and Bach Dang communes. These pilots, which cover multiple facets of digital government,

digital economy, and digital society, serve as crucial testbeds. They are providing valuable, context-specific lessons on implementation challenges and success factors, which are essential for informing the future scaling up of the DRC model economy-wide.

3. Current status of digital rural communities in some other APEC members

The development of Digital Rural Communities (DRC) is accelerating across APEC economies, driven by a shared recognition of digitalization's critical role in fostering sustainability, resource efficiency, and inclusive growth. However, each member economy is at a different stage of developing and implementing DRC initiatives, a journey heavily influenced by its unique ICT infrastructure, policy frameworks, and socio-economic context. This chapter will provide a comprehensive overview of the current state of DRC development in Viet Nam as the host economy, followed by a comparative snapshot of other key agriculture-based APEC economies, including China; Indonesia; Japan; Republic of Korea; and Thailand..

3.1. China

China represents a model of an advanced economy where rural digitalization is identified as a key economy-wide strategic priority, characterized by a distinct top-down orientation and a highly coordinated implementation mechanism. Its approach is deeply integrated with China’s broader economic goals, particularly in modernizing key agricultural sectors to ensure food security and global competitiveness.

Policy and strategic initiatives: China has identified rural digitalization as a key strategic priority at the economy level and a core instrument in its successful fight against poverty. Its approach is characterized by a distinct top-down orientation, guided by the highest levels of policy-making. Overarching strategic frameworks include the Digital Rural Development Strategy Outline (2019) and the 14th Five-Year Plan for Digital Economy Development. A key feature of China's implementation is its highly coordinated inter-ministerial mechanism, guided by the Digital Village Development Action Plan (2022-2025), which ensures synchronized policy execution across different ministries, thereby avoiding the fragmented efforts seen in other economies.

Current status and key characteristics: As an advanced economy, China's digital solutions in rural areas reveal a uniquely strong and specialized focus on the fisheries and aquaculture sector. This strategic concentration directly reflects China's status as the world's largest aquaculture producer and its domestic food security goals. The three most prominent solution categories-digital aquaculture, catch fishery management, and the foundational technology

of IoT/sensor-controlled water management-demonstrate a clear economy-wide strategy to modernize this key sector through high technology, aiming for more precise, sustainable, and efficient management at a massive scale.

What is particularly notable in the Chinese experience is the deliberate effort to integrate digitalization into the broader restructuring of rural industries, rather than treating it as a parallel or standalone agenda. Digital technologies are deployed to upgrade traditional sectors, attract investment into new rural industries, and strengthen the links between agriculture, manufacturing and services. At the same time, the scale and speed of implementation have generated valuable lessons on issues such as data governance, platform regulation and the risk of exclusion for smaller producers. For other APEC economies, China's trajectory underscores both the transformative potential of ambitious, state-led digital strategies and the importance of carefully managing their distributional consequences.

3.2. Indonesia

As a vast archipelago and an emerging economy, Indonesia presents a unique case where DRC development is driven by a dynamic interplay between bottom-up legal empowerment and a vibrant, startup-led ecosystem. Its approach is less about a single, top-down central government plan and more about fostering an environment where local and private-sector innovations can emerge.

Policy and strategic initiatives: Indonesia's policy framework is unique in its multi-layered structure, which combines a foundational bottom-up enabling law with top-down operational programs. The Village Law (Law No. 6 of 2014) is pivotal, as it formally grants villages the autonomy, resources, and development responsibilities to proactively pursue their own innovative initiatives, including digitalization. This decentralized foundation is complemented by central government programs like the Smart Village Program, led by the Ministry of Villages, which utilizes a unique implementation mechanism of deploying "Digital Ambassadors" to act as on-the-ground agents providing direct digital skills training.

Current status and key characteristics: As an emerging economy, Indonesia's digitalization landscape is characterized by a vibrant, startup-led ecosystem. While practices show a dual focus on both value chain optimization and direct farmer support, a notable characteristic is the strong and growing role of AgriTech startups (such as eFishery and Habibie Garden) in identifying specific farmer pain points, developing targeted market-driven solutions, and then partnering with government programs to scale their impact. This dynamic interplay between bottom-up legal empowerment and private-sector innovation defines Indonesia's unique path.

The Indonesian case demonstrates the opportunities and constraints of pursuing DRC development in a context marked by geographic dispersion and institutional diversity. Local governments, cooperatives and start-ups often act as first movers, tailoring digital solutions to the needs of specific communities or value chains. This has generated a rich landscape of experimentation, from fisheries platforms to village-level e-commerce hubs. At the same time, the patchwork nature of these initiatives highlights the importance of building stronger linkages between local innovation and economy-wide policy frameworks, so that successful models can be scaled and sustained without losing their responsiveness to local conditions.

3.3. Japan

Japan, another advanced economy, is confronting the dual existential challenges of a rapidly aging population and a severe agricultural labor shortage. Consequently, its approach to rural digitalization is characterized by highly specialized, problem-oriented technological interventions designed to mitigate these demographic pressures and ensure social sustainability.

Policy and strategic initiatives: Facing the dual existential challenges of a rapidly aging population and a severe agricultural labor shortage, the Government of Japan has identified digitalization as a vital strategy for rural revitalization. The most encompassing vision is the "Digital Garden City Nation Vision," a domestic-level initiative aimed at blurring the lines between urban and rural areas through significant investment in digital infrastructure and the deployment of essential digital services to make rural life more viable. This is supported by the Strategic Innovation Promotion Program (SIP), a cross-ministerial funding mechanism that drives R&D and the practical application of advanced technologies like AI, IoT, and robotics.

Current status and key characteristics: As an advanced economy, Japan's DRC development is characterized by a "problem-first, technology-second" approach. Its initiatives are often highly specialized, thematic projects that use advanced technology to solve specific social and production challenges stemming from its demographic crisis. Rather than pursuing a single comprehensive model, Japan's approach is exemplified by the use of AI-powered robots in Hanyu City to directly address the labor shortage in greenhouses, and the deployment of drone delivery services in Ina City to solve the "shopping refugee" crisis facing its isolated elderly population.

In Japan, the DRC agenda is closely intertwined with efforts to maintain social cohesion and quality of life in ageing, depopulating rural communities. Digital tools are increasingly used to ensure that essential services—such as healthcare, mobility and retail—remain accessible even as traditional service providers withdraw. This gives DRC a distinctly human-centric and welfare-

oriented character, in which the success of innovations is measured not only by productivity gains but also by their contribution to dignity, safety and social connectedness for elderly residents. Japan's experience therefore broadens the understanding of DRC beyond production and markets, highlighting its role as a pillar of rural social policy.

3.4. Republic of Korea

As an advanced economy facing significant demographic pressures on its agricultural sector, Republic of Korea has positioned agricultural digitalization as a core component of its economy-wide innovation strategy. Its approach is defined by a focus on building comprehensive innovation ecosystems rather than promoting singular technologies.

Policy and strategic initiatives: The government has positioned agricultural digitalization as a core component of its economy-wide innovation strategy, driven notably by the Republic of Korea's New Deal and its Digital New Deal framework. The focus in Republic of Korea is less on singular technology adoption and more on building comprehensive innovation ecosystems designed to address the dual economy-wide challenges of stagnating productivity and an aging agricultural workforce. A central pillar of this strategy is the "Smart Farm Innovation Valley" program, a large-scale, state-led initiative to create regional hubs that integrate R&D, business incubation, and intensive training for a new generation of farmers.

Current status and key characteristics: As an advanced economy, Republic of Korea's digitalization practices demonstrate a sophisticated focus on optimizing the entire agrifood system, rather than concentrating solely on primary production. The three most frequent digital solutions-value chains management, farm management services, and supply chain management-reflect a highly integrated and systematic approach aimed at enhancing efficiency and transparency "from farm inputs to the final consumer". This system-wide approach is complemented by the promotion of high-tech solutions such as urban agriculture and indoor farming to address the Korea's land and climate constraints.

Republic of Korea's approach illustrates how DRC development can be embedded within a wider economy-wide innovation system. Rather than focusing solely on individual villages or communes, policy measures are designed to create interconnected hubs of smart agriculture, training and entrepreneurship that radiate outwards to surrounding rural areas. This networked model allows for rapid diffusion of knowledge and technology, while providing young farmers and agri-entrepreneurs with access to research institutions, incubators and export-oriented value chains. It also demonstrates

that, in contexts of severe labour shortages and land constraints, digitalization is not merely a matter of efficiency but a strategic tool for reconfiguring how agriculture is practiced and who participates in it.

3.5. Thailand

As an emerging economy aiming to escape the middle-income trap, Thailand has identified digitalization as a central pillar of its whole-of-economy development strategy. Its approach is characterized by a focus on transitioning towards a value-based and innovation-driven economy, with a particular emphasis on building the capacity of its large agricultural workforce.

Policy and strategic initiatives: Digitalization is a central pillar of the "Thailand 4.0" initiative, a whole-of-economy framework aimed at transitioning the economy beyond the middle-income trap towards a value-based and innovation-driven economy. This strategic vision is operationalized through the Digital Economy and Society Master Plan. Implementation is institutionally led by the Ministry of Digital Economy and Society (MDES) and its key promotional arm, the Digital Economy Promotion Agency (DEPA), which is tasked with promoting investment, supporting enterprises, and building digital capacity.

Current status and key characteristics: As an emerging economy, Thailand's digitalization practices reflect a clear strategic priority on farmer capacity building and market linkage. According to FAO data, the overwhelmingly dominant digital solution being deployed is farm advisory services, indicating a significant economy-wide effort in transferring modern knowledge and cultivation techniques to its large base of smallholder farmers. This is complemented by a strong focus on digital marketing and trading, reflecting a dual strategy of empowering farmers with new knowledge while simultaneously enabling their access to markets and modern production technologies.

Thailand’s experience underlines the centrality of human capital development in DRC strategies for emerging economies. While digital infrastructure has expanded relatively quickly, the effective use of digital tools in agriculture still depends on sustained investment in training, extension and advisory services that reach smallholders in their own communities. By positioning DRC initiatives as platforms for continuous learning—rather than one-off technology roll-outs—Thailand is gradually building a cadre of digitally literate farmers, cooperative leaders and rural youth. This people-centred orientation suggests a pathway whereby incremental improvements in skills and organisational capacity can, over time, unlock more advanced and integrated forms of rural digitalization.

V. Good practice models of DRC in Viet Nam and APEC economies

5.1. Viet Nam: Yen Hoa Commune

Model summary:

Yen Hoa Commune is a government-led, comprehensive pilot project at the economy level covering all 7,500 residents in a remote, mountainous area. Launched in 2020, the initiative is structured around three official pillars: Digital Government, Digital Economy, and Digital Society. The case demonstrates how a top-down strategic push, combined with strong community readiness evidenced by a 90% smartphone ownership rate, can successfully accelerate the adoption of a wide range of digital solutions. Its success has been so significant that it was featured by the Food and Agriculture Organization (FAO) as an exemplary model in its Digital Villages Initiative.

By explicitly structuring interventions around these three pillars, the model provides a tangible illustration of what a DRC can look like in practice when economy-wide policy direction is closely aligned with local implementation capacity. Rather than focusing on one sector or a single flagship application, the Yen Hoa initiative deliberately integrates improvements in administrative governance, public service delivery, and economic opportunity within a single coherent framework. This holistic design helps avoid the common pitfall of fragmented, project-based interventions and instead encourages local stakeholders to view digitalization as a long-term transformation process that touches all aspects of community life.

Initiator:

This is a government-led model, initiated as one of the Viet Nam's first pilot sites for digital transformation. The project is strategically guided and coordinated by Viet Nam's Ministry of Information and Communications, in partnership with local authorities.

Key innovations applied:

The model implemented a holistic and multi-pillar suite of innovations. For Digital Government, it deployed a full suite of digital administration tools, including the iOffice document management system and universal adoption of digital signatures, alongside an AI-powered radio system for more effective citizen communication. In the Digital Society pillar, it launched a sophisticated two-pronged Telehealth system that skillfully blended informal, community-focused platforms (like the Medici app and Zalo groups) with a formal platform connecting the local health station to economy-wide level hospitals for remote consultations. For the Digital Economy, it built a full support ecosystem around

the central-level hospitals PostMart.vn e-commerce platform, providing local cooperatives with end-to-end support from product branding to logistics.

Results and impact:

The impacts have been transformative across all pillars. A local cooperative saw its sales volume grow by 4.5 times in just ten months after joining the e-commerce platform. This directly translated into a near threefold increase in the monthly income for cooperative members, rising from approximately VND 1.5 million to over VND 4 million per person. In the social sphere, the Telehealth initiative conducted nearly 2,500 remote consultations in its first year, saving the community an estimated VND 200 million in healthcare and travel costs.

Equally important are the less tangible, but strategically crucial, changes in local attitudes and expectations. The successful deployment of digital government services and telehealth has increased citizens' confidence in digital tools and in local institutions' ability to manage them. For farmers and cooperative members, the visible income gains from e-commerce have demonstrated that digitalization can directly improve household welfare rather than being an abstract policy priority. This combination of improved material outcomes and strengthened trust has created a virtuous cycle in which community members are more willing to participate in new pilots, provide feedback, and invest their own time and resources in further digital initiatives.

Lesson learned:

The primary lesson from Yen Hoa is that building digital trust by first addressing a critical and tangible social need, such as healthcare, can be a powerful strategy. This initial trust acts as a vital form of social capital that can then be leveraged to effectively accelerate the community-wide adoption of more complex economic tools, such as e-commerce.

5.2. China: The Taobao Villages Ecosystem

Model summary:

The "Taobao Village" model is a comprehensive, economy-wide e-commerce ecosystem designed to transform the entire rural economy. It represents a large-scale solution for rural empowerment, aiming to alleviate widespread rural poverty, create new economic opportunities, and bridge the significant urban-rural development gap by connecting rural producers to a massive economy-wide consumer base.

The Taobao Villages ecosystem thus represents more than a successful commercial platform; it constitutes a new socio-economic infrastructure for rural

areas. By embedding digital marketplaces into the everyday economic life of villages, the model has reconfigured traditional relationships between producers, intermediaries, and consumers. Local entrepreneurs are able to build brands, experiment with product differentiation, and access real-time market information, while at the same time drawing on shared logistics, training, and payment systems provided through the wider ecosystem. This dense web of services and interactions illustrates how rural digitalization can move beyond isolated online shops to form a comprehensive, territorially anchored digital economy.

Initiator:

This model is a prime example of a strategic Public-Private Partnership, driven by the collaboration between the Chinese Government and the private technology giant, Alibaba Group.

Key innovations applied:

The core innovation is a full ecosystem approach. Alibaba provided the core e-commerce platform (the Taobao marketplace) and co-invested billions of dollars with the government to build a complete support system. This included establishing economy-wide logistics networks with over 100,000 delivery routes, providing extensive financial services including over CNY 58 billion (approximately USD 8.4 billion) in credit, and creating a robust human capital pipeline through e-commerce training centers established in thousands of villages.

Results and impact:

The model achieved unprecedented scale and profound economic impact. By 2017, the network had grown to over 4,000 officially recognized "Taobao Villages." The ecosystem generated annual e-commerce revenue of approximately CNY 700 billion (approximately USD 100 billion) and created an estimated 6.8 million jobs. This initiative significantly boosted rural incomes, with average rural per capita income increasing by 8.6% in 2017 alone, and successfully attracted a new generation of young entrepreneurs back to rural areas.

Lesson learned:

The key lesson from the Taobao model is the power of a full ecosystem approach driven by a strong public-private partnership. When the private sector provides the core technological platform and the government provides the enabling infrastructure and policy framework, it is possible to transform rural economies at a massive scale.

The Taobao experience also underscores that scaling up DRC-like models requires sustained investment in “soft” infrastructure such as human capital, institutional arrangements and trust-based relationships, in addition to digital platforms and physical logistics. E-commerce training centers, mentorship networks, and local leadership have all been crucial for translating the potential of the platform into widespread, equitable participation. Without this continuous investment, the ecosystem could have easily remained limited to a small number of early adopters. The lesson for other APEC economies is that large-scale digital platforms can be powerful catalysts for rural transformation, but only when they are accompanied by long-term commitments to capacity building and inclusive governance.

5.3. Indonesia: Alamendah Village

Model summary:

Alamendah Village in West Java presents a highly successful model of digital innovation in agriculture, covering a large community of 22,000 residents specializing in horticulture. It is a leading example of a "bottom-up" or "community-led" approach, where a trusted, pre-existing local institution takes the lead in integrating technology into both production and marketing, demonstrating remarkable scalability and resilience.

Alamendah illustrates the potential of community-based and private sector-led innovation in contexts where public resources and institutional capacities are relatively constrained. Rather than waiting for large-scale government programmes, local actors leveraged available digital tools and partnerships to progressively build a more connected and diversified rural economy. The model demonstrates how even modest, incremental investments in connectivity, digital skills and online marketing can generate cumulative effects over time, especially when anchored in strong community organizations and shared economic interests.

Initiator:

This is a Community-led model, driven not by a top-down government program but by a local, school-run cooperative, the Al-Ittifaq Cooperative.

Key innovations applied:

The cooperative integrated multiple innovations to build a comprehensive digital ecosystem. In Smart Agriculture, it deployed the "Alif Karya" service, equipping greenhouses with IoT technology and mobile applications for remote monitoring and control of irrigation, temperature, and fertilization. In Integrated E-commerce, the cooperative manages the entire value chain from production

to distribution, supplying 3.2 tons of 63 different types of vegetables daily to both traditional markets (60%) and modern outlets like supermarkets and hotels. Critically, to ensure sustainability, it established its own In-house Capacity Building center, the Alif Learning Center (ALEC), to provide hands-on training on the technology for community members.

Results and impact:

The model's success is so profound that it has proven its scalability, having been successfully replicated in more than 60 other Islamic boarding schools throughout Indonesia. It also demonstrated remarkable economic resilience by establishing a thriving online horticulture market during the COVID-19 pandemic. This success became a catalyst for its subsequent growth, attracting support from Indonesian government funds and technical expertise from the Netherlands to build its advanced greenhouses.

Beyond direct income gains, the digital initiatives in Alamendah have also contributed to reshaping local perceptions of what is possible in rural areas. The visible success of early adopters has encouraged other households to experiment with new crops, processing techniques and marketing strategies, thereby increasing the overall dynamism of the village economy. At the same time, the experience has revealed the limits of purely local initiatives in the absence of broader improvements in infrastructure and regulatory support, highlighting the importance of linking bottom-up innovation with supportive economy-wide policies.

Lesson learned:

A trusted, pre-existing community institution, such as a cooperative or a school, can act as a powerful and sustainable engine for driving comprehensive digital transformation from the bottom up. This approach ensures a high degree of local ownership, relevance, and long-term success, and can be more cost-effective and scalable than purely top-down initiatives.

5.4. Japan: Ina City, Nagano

Model summary:

This model addresses an urgent social challenge in a super-aging society: "shopping refugees" (kaimono jakusha)-elderly residents in remote areas unable to travel for food and necessities. It is a prime example of a "problem-first, technology-second" approach, where a specific technology is deployed not as a demonstration, but as a direct tool for social sustainability.

The model is particularly noteworthy because it explicitly frames digital innovation as a tool to address a critical social vulnerability – the isolation of

elderly residents in depopulating rural areas – rather than as an end in itself. By centering the design around the needs and constraints of older users, Ina City demonstrates how advanced technologies can be deployed in a human-centric manner. The focus on reliable access to essential goods, rather than on promoting consumption more broadly, also reflects a careful alignment between technological possibilities and the municipality's social policy objectives.

Initiator:

This is a Public-Private Partnership, initiated by the Ina City government in collaboration with private technology and logistics companies to solve a pressing local demographic issue.

Key innovations applied:

The core innovation is the launch of one of Japan's first regular drone delivery services. The service is not a technology trial but a meticulously designed logistics solution tailored to a specific social need. A key aspect of the innovation is its accessible design; residents can place orders via simple, low-tech channels like telephone or through staff at community centers, ensuring the service is usable by its target elderly population.

Results and impact:

The initiative ensures stable access to essential goods like food and medicine, significantly improving the quality of life for the elderly. More importantly, it enables them to "age in place," maintaining their independence and dignity without having to relocate to centralized care facilities. It provides a powerful blueprint for using technology to deliver essential social services in remote areas, a challenge many APEC economies will increasingly face.

Lesson learned:

The most impactful digital solutions are those designed as a direct response to a specific, pre-existing, and urgent community problem. This problem-centric approach ensures immediate relevance and a clear value proposition for end-users, which is critical for successful and sustainable adoption.

The Ina case highlights that DRC initiatives dealing with vulnerable populations must pay close attention to usability, trust and perceived reliability. Even technologically sophisticated solutions will fail if target users perceive them as complex, intimidating or fragile. The success of the drone-based delivery system rests not only on its technical performance, but also on careful communication, community engagement, and the establishment of clear contingency plans for service continuity. For APEC economies with rapidly

ageing rural populations, Ina City provides a concrete example of how digital technologies can be harnessed to uphold social cohesion and dignity in remote communities.

5.5. Republic of Korea: Sangju Smart Farm Innovation Valley

Model summary:

The Sangju cluster is a large-scale innovation hub that serves as a prime example of Korea's "Smart Farm Innovation Valley" project. The model is not just a technology park, but a comprehensive ecosystem designed to address the economy-wide challenge of an aging farm population by mentoring, training, and equipping a new generation of young, tech-savvy farmers for data-driven agriculture.

By combining advanced production facilities with comprehensive training and business support, the Sangju model effectively functions as an integrated innovation hub rather than a conventional agricultural park. It brings together technology providers, researchers, financial institutions and young farmers in a shared physical and institutional space, thereby reducing coordination costs and information asymmetries. Participants are not only exposed to the latest smart farming technologies, but also supported in acquiring the entrepreneurial skills needed to operate commercially viable agribusinesses. This integrated design helps ensure that the substantial investments in infrastructure translate into sustainable, market-oriented outcomes.

Initiator:

This is a government-led initiative, driven by the Ministry of Agriculture, Food and Rural Affairs (MAFRA) as a core component of the Republic of Korea’s New Deal, a economy-wide innovation strategy.

Key innovations applied:

The core innovation is the creation of an integrated ecosystem for human capital development. This is built around a Startup Incubation Centre (SIC) that provides a structured, 20-month hands-on training program. The physical ecosystem supports this with state-of-the-art facilities, including "rental smart farms" where trainees can apply their skills, and R&D test centers for private companies to develop new technologies. Critically, this training is integrated with an economy-wide Smart Farm Big Data Platform and provides direct business support for exporting high-value products like strawberries.

Results and impact:

The program has successfully trained hundreds of young farmers, directly addressing the economy-wide agricultural succession crisis by creating an

attractive and viable career pathway into high-tech agriculture. Enrollment grew from an initial 104 trainees in 2019 to 208 across all valley locations by 2022. By focusing on high-value crops and integrating the entire value chain, the model fosters a new generation of entrepreneurs equipped to lead the future of Republic of Korea's agriculture, enhancing both economy-wide food security and export competitiveness.

Lesson learned:

The most critical lesson from Sangju is that addressing long-term agricultural labor shortages requires a strategic, holistic investment in building the next generation of human capital. Creating dedicated innovation hubs that integrate practical training, R&D, and tangible business support is a more sustainable long-term strategy than simply deploying labor-saving technology.

The Sangju experience suggests that for economies facing severe labour shortages and ageing farmer populations, DRC development strategies may need to prioritize the creation of new farmer cohorts with significantly different skill profiles. Investments in smart infrastructure are most effective when they are matched with systematic efforts to attract, train, and retain a generation of digitally literate rural entrepreneurs. This requires not only technical curricula, but also attractive career pathways, adequate access to finance, and supportive institutional arrangements. In this sense, Sangju demonstrates that rural digitalization can be a vehicle for regenerating the social base of agriculture, not just making existing practices more efficient.

5.6. Thailand: Village 9, Ban Yai district

Model summary:

This case study from Village 9 in Ban Yai district, Nonthaburi province, Thailand offers a practical example of how a targeted digital technology can be deployed to address a specific, widespread agricultural challenge. The village, known for its cultivation of rice, vegetables, and fruit, faced significant profitability issues due to labor shortages and high labor costs. The community's response showcases a successful model of collective action and technological adoption.

This case study from Village 9 in Ban Yai district demonstrates how collective action can significantly reduce individual risks and transaction costs associated with adopting new technologies. By organizing farmers into a cohesive group and pooling resources, the community was able to negotiate better terms with technology providers, coordinate training activities, and share experiences on how to integrate digital tools into their farming practices. The

model shows that even relatively simple technologies can have substantial impact when embedded in a strong cooperative structure.

Initiator:

This is a Community-led model, initiated by a local farmer group, the Ban Mai Rice Center Community Enterprise. The initiative is supported by a Public-Private Partnership, receiving partial funding from the Thai government's Digital Economy Promotion Agency (DEPA) and crucial training support from a private company.

Key innovations applied:

The key innovation was the collective acquisition and use of agricultural drones by the community enterprise to directly address the labor shortage. This solution was built upon the village's robust digital foundation, which includes reliable 2G-5G connectivity and the "Net Pracharat" free government-led internet service. Critically, the community established a community-rental business model, where members of the farmer group can rent the drones for a service fee that is significantly lower than the market price. This approach effectively overcomes the high cost barrier of new technology that individual farmers would typically face.

Results and impact:

The collaborative model yielded multiple tangible benefits for the farming community. It directly led to significant cost savings by reducing expenses on manual labor. The use of drones also resulted in increased precision in sowing and fertilizer application, and, importantly, enhanced safety by preventing farmers' direct exposure to harmful chemicals during pesticide spraying. The initiative has been successful, with its primary challenge now being a shortage of trained drone operators ("drone drivers"), which has limited its wider use and highlights the ongoing need for capacity building.

Lesson learned:

Community organizations, when empowered with targeted government funding and strategic partnerships, can successfully deploy technology to solve their own core problems. A collective, rental-based approach is a highly effective and replicable model for overcoming the high initial cost barrier of new agricultural technology, making innovation accessible to individual smallholder farmers.

The experience of Village 9 underscores that community organizations are not merely passive recipients of technology, but can act as crucial intermediaries that translate generic digital solutions into locally appropriate

practices. Their ability to aggregate demand, provide mutual support and enforce collective agreements makes them particularly well suited to managing the risks associated with innovation in smallholder-dominated agricultural systems. For policy-makers and private actors seeking to promote DRC development, working through and strengthening such community organizations can therefore be an effective strategy to achieve both scale and inclusiveness.

VI. Key takeaways, challenges and successful factors for DRC development

6.1. Key findings on the status and importance of DRC

A primary finding from the comparative analysis is that there is no single, monolithic model for initiating rural digitalization. Instead, a diversity of leadership archetypes can successfully drive transformation, underscoring that the optimal approach is highly context-dependent. The case studies reveal at least three distinct models: government-driven models, prominent in the top-down economy-wide programs (Republic of Korea and Viet Nam) ; startup- and private sector-led models, best exemplified by the agile, market-oriented innovations seen in Indonesia; and community- and cooperative-centered models, visible in (Indonesia; Thailand) where grassroots organizations take the lead. This diversity demonstrates the importance of aligning the implementation strategy with the existing institutional landscape and socio-economic context of a given economy, rather than attempting to replicate a single “best practice” blueprint.

A second universal finding is the critical role of a local support ecosystem. The most impactful and sustainable DRC initiatives are invariably those supported by a robust local ecosystem that extends beyond mere technological provision. This includes physical points of technical support, such as the local contact centers established by eFishery in Indonesia; embedded training programs, like Al-Ittifaq Cooperative's in-house learning center; and strategic partnerships with local academic institutions. These elements collectively ensure that farmers and rural residents are not left alone to navigate complex technologies. The case studies consistently prove that technology cannot succeed in a vacuum; without a human-centric support infrastructure, even the most advanced technology will fail to achieve widespread and effective adoption.

Finally, the analysis affirms that the development of DRC is no longer an option but a strategic imperative for APEC economies. In the face of profound and interconnected challenges – including the widening urban-rural development gap, structural demographic shifts towards aging populations, and the escalating impacts of climate change – DRC offer a tangible and strategic pathway to build resilience, drive sustainable growth, and ensure that the benefits of digitalization are shared equitably, leaving no one behind. This imperative is not only economic but also social and environmental, making DRC a central pillar in achieving broader development agendas, including those related to food security, gender equality, and climate resilience.

6.2. Common challenges in implementing DRC models in APEC economies

Despite strong political will in many APEC economies, the implementation of DRC models is consistently constrained by a series of deep-seated, interconnected challenges. These can be conceptualized as four interrelated "divides" that function as systemic barriers to progress. Each divide reinforces the others, meaning that partial solutions are often insufficient to unlock the full potential of DRC.

The first is the foundational divide of infrastructure and affordability. A significant gap in high-quality, affordable digital infrastructure between urban and rural areas remains the primary structural constraint. Even where basic connectivity is available, the high cost of data plans and digitally-enabled devices remain a prohibitive barrier for many low-income rural households, effectively excluding them from the benefits of the digital economy. As a result, rural residents may be formally “covered” by networks but practically disconnected in their daily lives. Addressing this divide requires not only investment in physical infrastructure but also policies and business models that lower costs and expand access.

The second, and arguably most persistent, is the human capital divide of digital skills and literacy. A recurring finding across nearly all case studies (Thailand to Viet Nam), is that a lack of digital literacy – especially among the middle-aged and older farmers who form the backbone of agriculture – severely limits the adoption of even the most user-friendly technologies. This skills gap prevents communities from fully harnessing the potential of digital tools, thereby limiting the scalability and impact of otherwise promising innovations. In practice, without confidence and basic competence in using digital devices and platforms, many rural residents may prefer to continue with familiar analogue practices, even if digital solutions could offer clear benefits.

The third is the economic viability divide of investment and sustainable business models. Many promising DRC initiatives face the "pilot trap," where they achieve success on a small scale with the support of public subsidies but struggle to develop a financially self-sustaining business model required for scaling up. The high upfront cost of many technologies, coupled with the difficulty in demonstrating a clear and immediate return on investment for smallholder farmers, makes it challenging to attract the private investment necessary for long-term growth. This divide highlights that technology design must go hand-in-hand with careful consideration of affordability, risk-sharing mechanisms, and revenue models that work for both providers and users.

The final barrier is the institutional divide of policy coordination and gender-blind design. At the institutional level, a lack of synergy and coordination between different government ministries, such as those for agriculture, ICT, and commerce, can lead to fragmented policies, duplicated efforts, and inefficient resource allocation. Critically, many policies and digital solutions are designed with a "gender-blind" approach, failing to account for the unique barriers women face – from lower access to finance to greater time poverty – and thus miss crucial opportunities to maximize the potential of DRC for inclusive growth. Overcoming this divide requires deliberate cross-ministerial collaboration, gender-sensitive policy design, and mechanisms to ensure that marginalized groups are explicitly included in planning and implementation.

Taken together, these four divides form a mutually reinforcing system of constraints rather than a set of isolated bottlenecks. For example, efforts to expand infrastructure will have limited impact if users lack the skills and confidence to engage with digital tools, while even the most innovative business models will struggle to reach scale in the absence of supportive policies and effective public–private coordination. Similarly, gender-blind or socially neutral designs risk entrenching the very inequalities that DRC are intended to mitigate, thereby weakening their legitimacy and long-term sustainability. Recognising the systemic nature of these challenges is essential: it implies that piecemeal interventions are unlikely to be sufficient, and that integrated strategies are needed to address multiple divides in a coordinated manner.

6.3. Critical success factors

From the analysis of the most successful and resilient good practice models, a set of critical success factors can be distilled. These represent the "how" and "why" behind effective rural digital transformation and serve as a guide for future initiatives, indicating the conditions under which DRC are most likely to thrive.

A foundational factor is the presence of a visionary policy and strong institutional support. A coherent and committed policy vision from central or provincial governments serves as a powerful catalyst, mobilizing resources and signaling long-term commitment to all stakeholders. This vision must be operationalized through strong institutional support, often via a dedicated agency like Thailand's DEPA or a multi-stakeholder governance model as seen in Korea's Smart Farm Innovation Valley, to translate broad policy into tangible, on-the-ground programs. Where such institutional arrangements are clear and well-resourced, DRC initiatives are less vulnerable to short-term political cycles and more able to plan for sustained implementation.

The most resilient and impactful DRC models are not driven by a single actor but by a synergistic public-private-community partnership (PPCP). The complexity of DRC development transcends the capacity of any single entity. A successful partnership model allows for a strategic distribution of risk and a leveraging of core competencies: the government acts as the enabler by providing public goods and a conducive policy environment; the private sector acts as the innovator, providing cutting-edge technology and agile business models; and the community acts as the anchor, ensuring local relevance and driving user adoption. The case studies show that when any one of these pillars is weak or absent, the sustainability of DRC initiatives is significantly reduced.

Furthermore, successful initiatives often adopt a "problem-first, technology-second" approach. The most impactful digital solutions, such as the drone delivery service in Ina, Japan; or the IoT system for disabled farmers in Thailand, were designed as a direct response to a specific, pre-existing, and urgent problem within a community. This user-centric design philosophy ensures immediate relevance and a clear value proposition, which are critical for achieving adoption among often risk-averse rural populations. By starting from concrete problems rather than available technologies, initiatives are better able to prioritize and sequence interventions in ways that match local capacities and needs.

Finally, the ability to leverage social capital and foster community ownership is paramount. The Dong Thap Farmers' Clubhouse model in Viet Nam is a powerful testament to the fact that strong social capital and pre-existing, trusted community institutions can be the most effective foundation for digital transformation. Fostering a sense of community ownership, where residents feel that the DRC is built by them and not imposed upon them, ensures long-term engagement, continuous adaptation, and ultimate sustainability. In practice, this involves transparent communication, participatory decision-making, and mechanisms for communities to provide feedback and influence the direction of digital initiatives.

6.4. Recommendations

Translating these findings and success factors into actionable strategies requires tailored lessons and recommendations for each of the key stakeholder groups involved in building digital rural communities. While the overall direction is shared, the specific roles and entry points of policymakers, practitioners, and the private sector differ and must be clearly articulated.

For policymakers and government agencies, the primary imperative is to shift their role from a direct "implementer" to an "ecosystem enabler." Instead of managing every project, the core function of government should be to create

an enabling environment. This involves focusing on developing favorable policies for data sharing and cybersecurity, creating flexible funding mechanisms that encourage private sector innovation, and reducing regulatory barriers. Public funds should be invested strategically in "digital public goods" – the foundational elements that the private market cannot provide, such as robust last-mile infrastructure, large-scale digital literacy programs, and open government datasets that can fuel innovation. Furthermore, governments should move beyond individual pilot projects to develop a unified economy-wide DRC framework that harmonizes technical standards, key performance indicators, and data governance protocols to ensure long-term policy coherence and interoperability. In parallel, policymakers need to embed rigorous learning and adaptation mechanisms into DRC strategies from the outset. This includes defining a concise set of outcome-oriented indicators for economic, social, environmental and gender-related impacts; establishing feedback channels that allow local governments and community organisations to report implementation bottlenecks; and creating spaces for regular review where lessons from pilots and early adopters can be used to adjust regulations, funding modalities and technical guidelines. By institutionalising such iterative learning, governments can avoid the “pilot trap” and gradually move from fragmented, project-based initiatives towards a more coherent and scalable DRC policy framework.

For practitioners, such as cooperative leaders and farmer groups, the key is to become local digital pioneers. This involves proactively organizing small-scale, practical training sessions focused on specific applications that deliver immediate and tangible value to the community, thereby building trust through demonstrated success. The most effective strategy is to start small, prove value, and then scale. By piloting new technologies with a small group of willing early adopters, their success stories become the most powerful tool for persuading the rest of the community to join, creating organic and demand-driven growth. It is also crucial to foster peer-to-peer learning by creating and moderating local communication platforms, such as Zalo or WhatsApp groups, where members can share experiences and solve problems collectively, building community resilience and a sense of mutual support. Over time, practitioners can also play a crucial bridging role between local knowledge and external expertise. By systematically documenting their experiences – for example, through simple case notes, photos, or short videos – and sharing them with extension services, research institutions and development partners, they help ensure that future digital tools and programmes are better tailored to real-world constraints and opportunities in rural areas. In many cases, cooperatives and farmer groups are uniquely placed to identify where small design tweaks, additional training modules or changes in timing could significantly improve

adoption among their members. When this practical insight is fed back into programme and product design, it can substantially increase the effectiveness of DRC initiatives at relatively low cost.

For the private sector, including tech companies and investors, the first principle is to design for rural realities. Products must be designed for the context in which they will be used, meaning they must be user-friendly for those with limited digital literacy, affordable, and capable of functioning reliably in areas with low or intermittent connectivity. Second, they must build a business model that includes service and support. The success of companies like eFishery lies not just in their product, but in their local support network; the cost of training and technical assistance must be integrated into the business model from the outset. Finally, they must seek strategic partnerships. A standalone approach is far less likely to succeed than one built on a foundation of strong, collaborative partnerships with government agencies and trusted local cooperatives to gain access to a network of end-users. Through such partnerships, private actors can scale their solutions more rapidly while contributing meaningfully to inclusive rural development. In addition, private actors can enhance both commercial viability and development impact by explicitly incorporating inclusion objectives into their business strategies. This may involve, for example, designing pricing schemes that allow smallholders to start with low-cost entry packages and scale up as benefits materialise, or working with women's groups and youth organisations as distribution and support partners. By doing so, companies expand their potential customer base while contributing to broader policy goals on gender equality and rural employment. In the long term, firms that build strong reputations as trusted partners in rural communities are likely to enjoy higher user retention, more reliable data flows and greater resilience in the face of market or policy shocks.

Ultimately, the effectiveness of these recommendations will depend on the extent to which different stakeholder groups are able to align their efforts around a shared territorial vision for rural development. DRC provide a practical framework for such alignment, but they do not automatically guarantee it. Deliberate mechanisms for dialogue, joint planning and accountability are needed to translate broad commitments into coordinated action on the ground. When policymakers act as ecosystem enablers, practitioners as local champions, and private actors as context-sensitive innovators, the cumulative effect can be far greater than the sum of individual projects. In this sense, advancing DRC is not only about deploying more digital tools, but about forging new forms of collaboration that reflect the complexity and potential of rural communities in APEC economies.

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