INTEGRATING TECHNOLOGY AND TRADITIONAL SYSTEMS IN REGIONAL REVITALISATION; INSIGHTS FROM JAPANESE PRACTICES

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1. INTRODUCTION

Japan faces a number of challenges in terms of regional revitalization, particularly in rural areas, where an aging population, depopulation, and socioeconomic issues pose significant hurdles. To address these challenges, the country has actively promoted the use of technology as a means of addressing socioeconomic issues and revitalizing these regions (Fukuda, 2020).

The Japanese government has launched various programs and policies to promote regional revitalization, which aim to address demographic challenges, promote economic activities, and improve infrastructure in rural areas. These include the "Regional Revitalization Vision", "The basic principles of the "*Digital Garden-City Nation*" Initiative, which promotes the use of technology in various sectors and various other strategies and approaches. (Japan Government Cabinet, 2023).

Japan aims to revitalize its regional areas by addressing socioeconomic issues, improving the quality of life, and promoting sustainable development in these regions. The government continues to encourage innovation and technological advancements. For example, the historic use of technology to improve farming methods dates back to the 1960s and the 1970s and includes agricultural mechanization and sophisticated irrigation systems. These early initiatives significantly increased productivity and crop yield (Shima, and Ali Hija, 2023). Agriculture and farming have multi-faceted importance in Japan, contributing significantly to various aspects of the country's economy, culture, and social wellbeing.

The agricultural sector in Japan is multi-faceted and serves as a cornerstone of the country's economy, culture, and food security. Economically, agriculture provides vital employment opportunities, particularly in rural areas, sustaining local livelihoods, and supporting community development. Despite its relatively small contribution to GDP compared with other sectors, agriculture plays a key role in regional economies.

In this way, the Japanese government aims to improve the Japanese economy by creating a flow of people from urban to rural areas, increasing income in rural areas, and carrying out regional revitalization through measures such as reforms to tourism and agricultural industries.

Aging of Japan's agricultural workforce is a serious problem. The problem began in the 1980s, and in 1995 there were 2.56 million people under the age of 60 working in agriculture, compared to 1.4 million in 2019. According to the Ministry of Agriculture, Forestry, and Fisheries, more than 50% of agricultural workers are over the age of 60. The 2022 report highlights a growing concern about the aging agricultural workforce and the escalating degradation of farmland (MAFF, 2022).

Another aging-dilemma related challenge that has its direct impact on Agriculture sector is abandonment of farmlands. According to the MAFF report "Current Status and Measures for Abandoned Agricultural Land (MAFF, 2022)", the area of abandoned agricultural land in Japan was 282,000 hectares in 2022, of which 90,000 hectares (32%) were potentially recoverable and 192,000 hectares (68%) were not. Since the establishment of the Agricultural Land Management Corporation in 2014, the proportion of agricultural land under management has increased to 58.9%, which is still small (an increase of 8.6 percentage points). This strategic move aimed to counteract the decline in agricultural land.

However, there is still a shortage of available farmland owing to an insufficient supply of farmland from farmers who have temporarily stopped farming for various reasons. Consequently, new prospective farmers find it difficult to secure leases from landowning farmers. This predicament highlights the inadequacy of a system designed to link land lessors with tenants.

This study examines the integration of Information and Communication Technology (ICT) solutions and its coexistence advanced technology with other systems and initiatives that operated in some regions of Japan to tackle some of the socio-economic challenges.

In the background and methodology section, Section 2, we provide a brief background about the research problem, and foundational guide for the research process. Essentially, we provide a contextual understanding of the research topic and our methodological approach to achieving the objective of analyzing and gaining insights into the practical implementation of conventional systems, initiatives and the use of ICT in some Japanese regions. The research conceptual framework presented in this section provides an understanding of the key concepts, variables or

phenomena under investigation. Section 3 highlights the socio-economic challenges in Japanese rural areas and government initiatives to support them. Section 4 presents two community-based systems in Japan, along with technology trends and initiatives. Section 5 examines a case study of regional challenges, government initiatives and technology-based approaches in the Okinawa region of southern Japan. Section 6. Discusses the initiatives, technology integration and case studies discussed in the previous sections. The conclusion is given in section 7.

2. BACKGROUND AND RESEARCH METHODOLOGY

The revitalization of Japan's regions involves overcoming various socioeconomic challenges. These include population decline and an aging population, resulting in labor shortages and reduced economic dynamism (Shima, and Hija, 2023). The Japanese government has implemented policies such as the Regional Revitalization Bureau to distribute resources and support regional growth. The consolidation of society-based systems and use of advanced technology are among the key measurements.

Japan has faced prolonged economic challenges marked by stagnation and deflation, hindering growth, investment, and progress across sectors. To address these issues, the country introduced the Revitalization Strategy in 2012, subsequently revised annually. This strategy emphasizes leveraging advanced technology to tackle economic hurdles, revitalize local areas, bolster industries, and reform agriculture (Dae-Yeob,2018). Concurrently, local governments in their regions are contending with rural depopulation and economic standstill as the population ages and younger demographics migrate to urban centers. In his 2014 book, Matsuda Y points out that by 2040, 896 of Japan's municipalities could cease to exist (Matsuda, H.,2014).

Agriculture plays a crucial role in Japan's regional revitalisation efforts. Rural areas in Japan are heavily dependent on agriculture as a primary economic activity, and the promotion and modernisation of agricultural practices are integral to the overall revitalisation of these regions. With their long history, community-based systems such as CSA and Teikei, which will be discussed in Section 4, play an important role in supporting agriculture in Japan by promoting cooperation, preserving traditional practices and ensuring sustainable agricultural development.

To counteract this trend, the government has initiated a regional revitalization policy, incentivizing businesses, farmers, and individuals to relocate to and invest in rural zones. The policy encompasses infrastructure enhancements and offers various financial and non-financial incentives to stimulate development (Cao, C., 2022).

In addition to its duty in addressing domestic development challenges, Japan has to remain competitive on the global stage, Japan must continue to promote innovation and technological progress. In 2016, the Japanese government launched its vision of a 'super-smart society' or 'Society 5.0'. This vision is based on the recognition of current global trends: the pace of technological, economic and social change has accelerated, and businesses and communities are struggling to keep up. In Vision 2016, Japan looks beyond Industry 4.0, which involves the use of digital and communication technologies from a global perspective, to address the country's social challenges through the idea of Society 5.0 (Fukuda, K., 2020).

To take advantage of these technological advances, smart agriculture has been promoted and supported by the Japanese government to increase production and enable efficient management at all stages of farming, including cultivation, marketing, and the supply chain, as well as to cope with the decline in labour and the dwindling number of experienced farmers (Shiokawa, 2020).
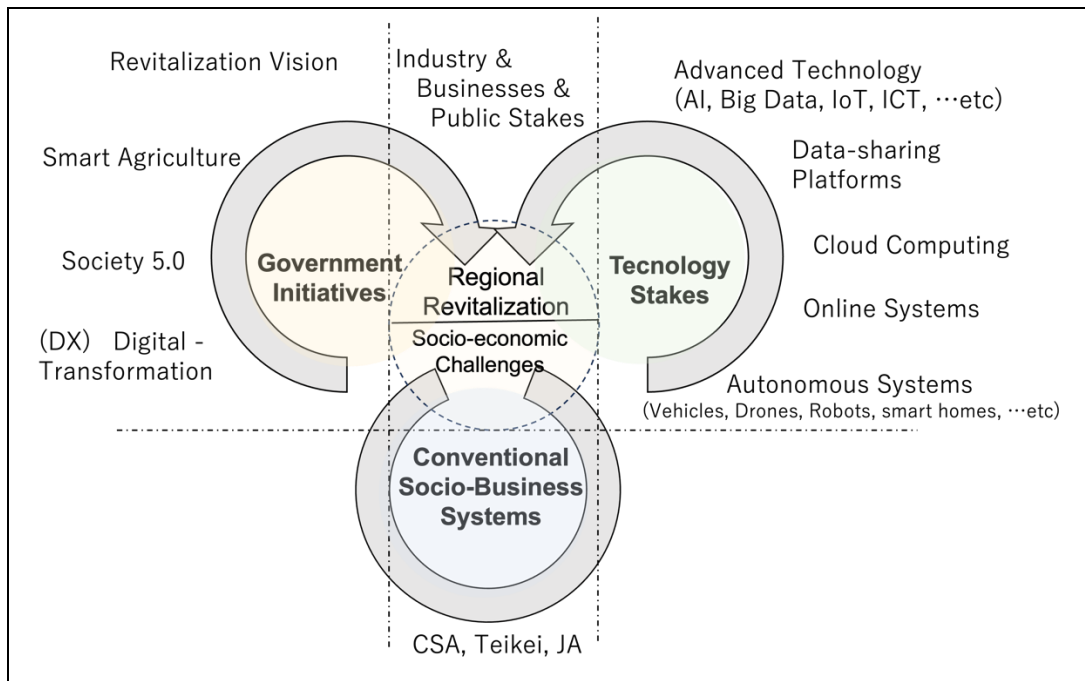
Fig.1: Conceptional framework for themes and scope of the research.

Our approach to exploring the theme of this research focuses on three elements; the existing conventional community-based systems, the government initiatives, and the technological stakes, which are believed to be a key factor in addressing regional socio-economic challenges and enabling targeted sustainable development and revitalisation of regions in Japan. Figure 1. Shows a conceptual framework with core elements and related concepts.

The paper aims to provide insights from the coexistence and interweaving of traditional social business systems with government initiatives and support systems, together with integrated ICT and advanced technologies.

3. AGRICULTURE CHALLENGES AND GOVERNMENT REVITALIZATION INITIATIVES

Despite being a vital sector, agriculture in Japan faces a number of challenges. A range of socio-economic challenges affect the sustainability and growth of the sector. The Government is supporting a multi-faceted approach and initiatives aimed at creating a more resilient, competitive and attractive agricultural sector, while revitalizing rural communities.

These revitalization initiatives address the socio-economic challenges in agriculture by encouraging innovation and the use of advanced technological solutions. The following subsections give a highlight on challenges faced by agriculture and some of the government approaches to tackle such challenges.

3.1 Agriculture and Socio-Economic Challenges

According to government reports, several factors have contributed to the decline of agriculture in Japan. Firstly, as the population migrates to urban areas and young people leave rural areas, the labour force responsible for tending farmland is shrinking. This has led to a decline in the management and cultivation of farmland and an increase in fallow land. Challenges also arise from the ageing of farmers, the limited influx of new farmers and the lack of successors (MAFF, 2022).

The aging demographic among small-scale farmers accelerates land fragmentation and alters land use patterns. The confluence of these factors synergistically promotes the proliferation of fallow farmlands. According to the MAFF report, more than 50% of agricultural laborers are now over the age of 60. This demographic shift, coupled with other challenges, raises concerns

about the proper inheritance of vital agricultural assets, such as farmland and advanced farming techniques, consequently further enfeebling the foundation of agricultural production (see Figure. 2).

Based on the diagram in Figure 2, it can be observed that in the 1995 survey, the number of farmers aged 60 or below was 2.56 million. The data are represented using square line graphs. The figure illustrates a decline in the number of farmers, dropping to 1.4 million in the initial year of the Japanese Reiwa Era, year 2019.
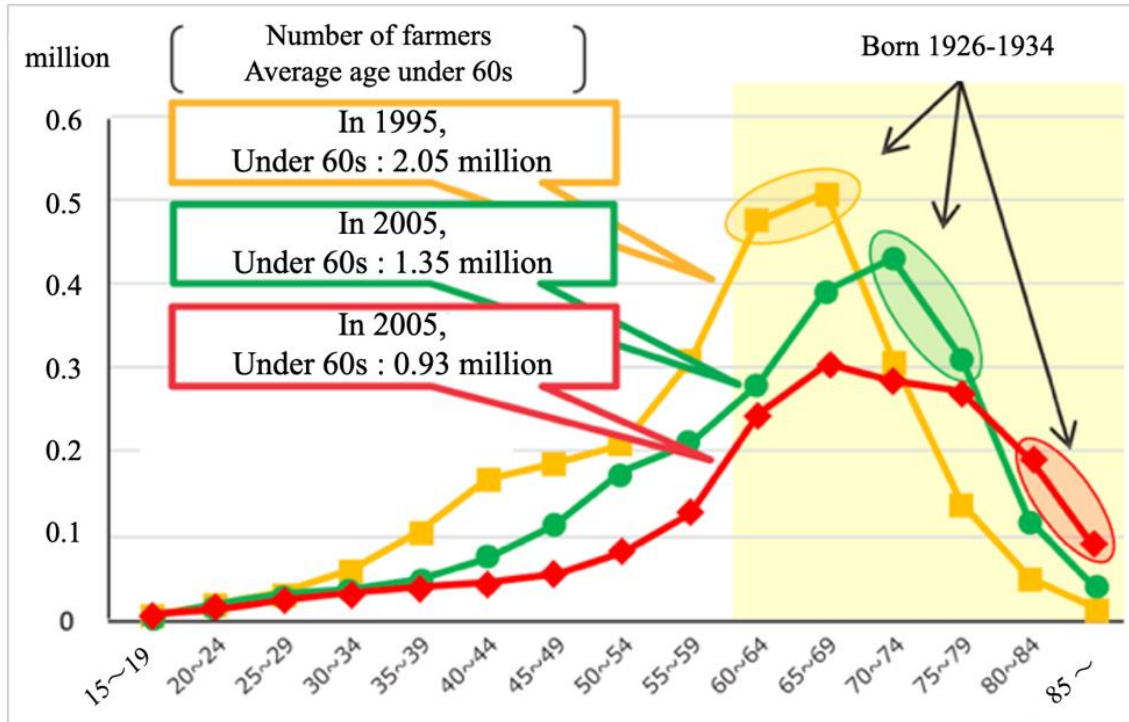

Fig.2: Changes in the age composition of key agricultural workers (Source: MAFF, 2022).

3.2 Agriculture and Government Revitalization Initiatives

According to Tabayashi et al., the agricultural workforce in Japan has been experiencing an aging trend since the late 1980s. Many individuals who had been actively involved in farming transitioned to land-owning non-farmers (Tabayashi, 2019). In 1999, the Japanese government introduced the Basic Law on Food, Agriculture and Rural Areas. Subsequently, the "Basic Plan for Food, Agriculture, and Rural Areas" was formulated in 2000 to uphold these fundamental principles (MAFF, 2000). This plan has undergone revisions every five years and three revisions to date. In 2014, the Farmland Intermediate Management Organizations (Farmland Bank), commonly known as the Farmland Bank, was established across all Japanese prefectures. These institutions lease and accumulate abandoned farmland, making it accessible to new individuals undergoing agricultural training (Tanimoto, 2014).
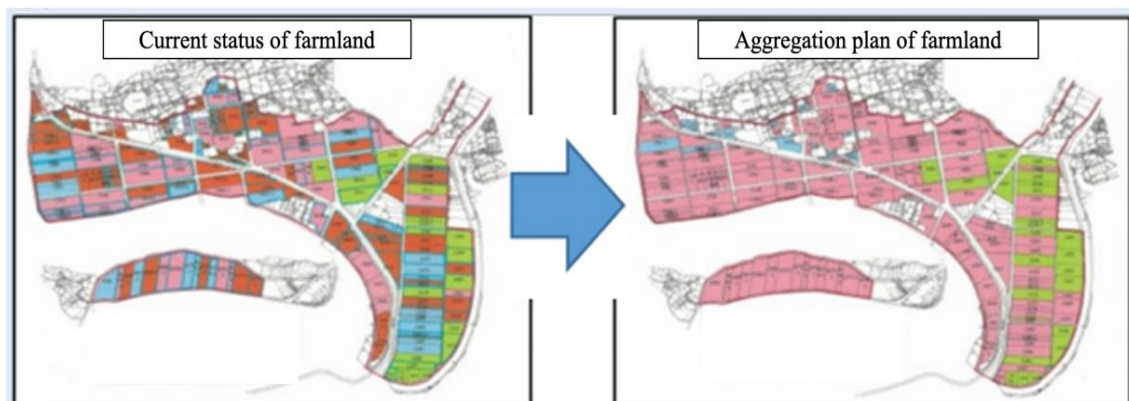
Fig.3: Before agricultural land accumulation (left), after accumulation (right) (Source:MAFF, 2022).

The role of agricultural land banks is to expand the scale of agricultural management, accumulate cultivated agricultural land, and promote the entry of new farmers into farming. The aim is to improve the efficiency and sophistication of the use of agricultural land and to contribute to the improvement of agricultural productivity (MAFF, 2023). For example, in the case of Hyogo Prefecture, the local coordinator of the Agricultural Land Bank works with relevant organizations to promote intensification, focusing on agricultural land cultivated by tenant farmers. The agricultural land bank lends land to the recipient in an intensification manner, and an agreement is formed between the two parties (MAFF, 2022).

As in Figure 3, farmland is accumulated through the farmland bank. Before agricultural land accumulation (left), the farmland was divided into small pieces and rented out to individuals. This would reduce the scale of agriculture, and new farmers would not be able to rent sufficient farmland. After agglomeration (right), the farmland bank and its coordinator facilitate the lending of small-scale farmland owners and new farmers, allowing land to be leased on a large scale. According to data from the Farmland Bank 2018 Business Report (refer to Table 1) (Farmland Bank, 2018), approximately 96% of the farmland leased area managed by the agency is currently under lease.

Table 1. Borrowing/Subleasing Status (Source: Farmland bank, 2018)

	Cumulative total (hectare)
Leased area (1)	499.7
- The Subleased Area (2)	479.9
- Area managed by Farmland bank	19.8
Subletting rate (2/1)	0.96

However, according to the "Survey on the Occurrence and Reclamation of Abandoned Farmland" conducted by the MAFF in July 2017, the area of abandoned cultivated land reached 423,000 hectares in 2015. This represents an increase of approximately twice that of the previous year's 21.7% (see Figure 4).
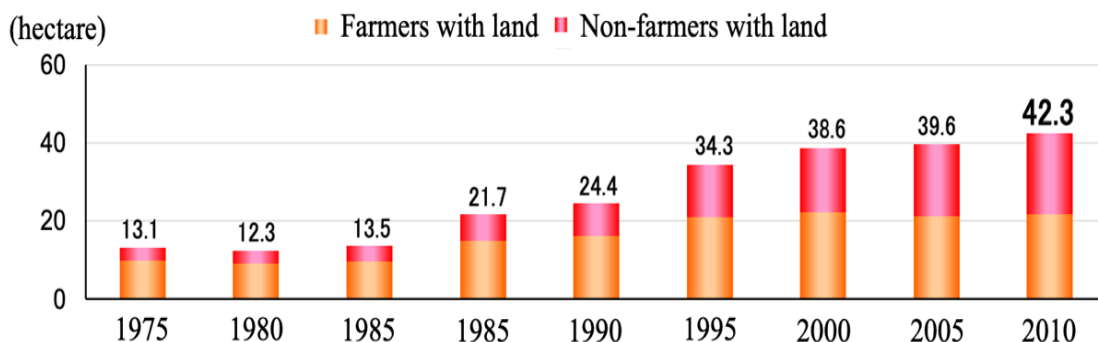

Fig.4: Changes in the area of abandoned farmland (Source: MAFF, 2021)

The latest report from the Farmland Bank shows that the area of land use has steadily increased since 2014, when the organization was established. However, the farmland concentration rate remains 59.5% (see Figure 5) (MAFF, 2023).
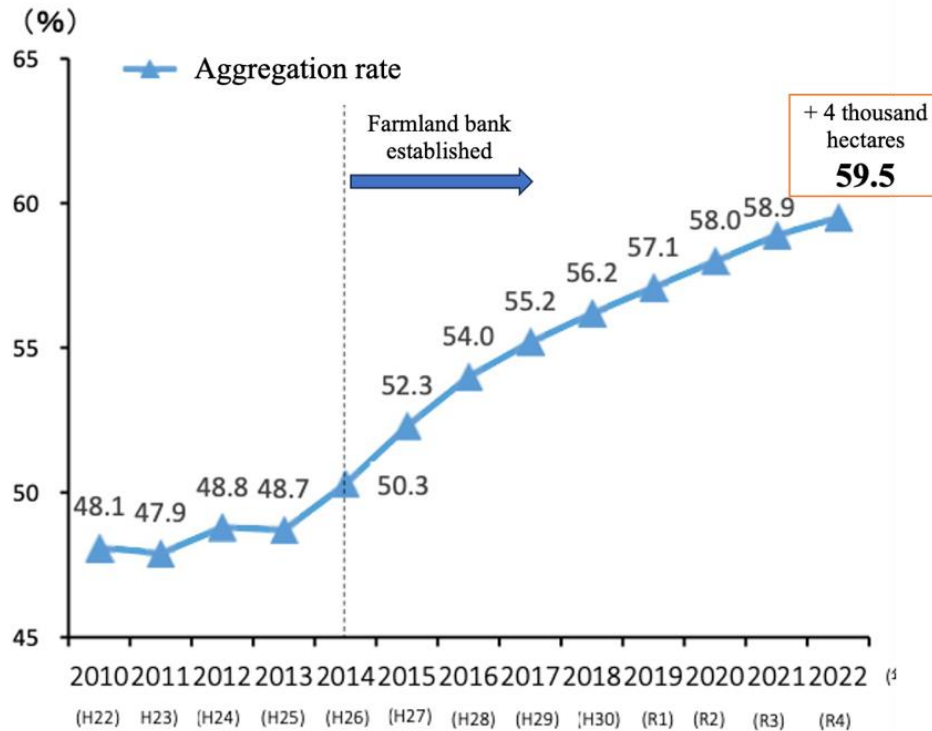
Fig.5: Share of area used by farmers in total cultivated land area (Source: MAFF, 2023).

There is still a gap in the agricultural information needs of landlenders and borrowers. To address this issue, the government created a website that aggregated information on farmland. In this website, the "eMAFF Farmland Navi" operated by the National Agricultural Committee Network Organization developed by local governments provide information for those who are preparing to start new agriculture (eMAFF Farmland Navi 2023). However, it is presumed that information on farmland management, such as water and soil information for farming and how to grow crops, is insufficient. Additionally, borrowers often do not have good information about agriculture or how to grow crops, nor do they have any experience in farming land. To compensate for their lack of knowledge, they may want to work with landowners to implement mowing and canal cleaning. To start farming, farmers lack sufficient knowledge and experience (e.g., crop and production planning) to operate a farm as well as information directly related to farmland (e.g., acreage and location surroundings), which discouraged farmers from starting farming (Takeyama, 2021).

4. COMMUNITY BASED SYSTEMS AND TECHNOLOGY

Society-based systems like Community Supported Agriculture (CSA) and Teikei in Japan are socio-economic systems due to their combined social and economic structures and goals (Hitchman, 2019), (kondo, 2021). Both systems intertwine social and economic aspects by establishing relationships between producers and consumers, prioritizing community welfare, supporting local agriculture, and promoting sustainable practices. They represent models that prioritize socio-economic cooperation, fostering mutual benefits for farmers and consumers while nurturing a sense of community and shared responsibility.

Like many other conventional industrial, business and social models and systems, CSA and Teikei have begun to integrate technology and digital transformation to improve their efficiency and reach. By incorporating digital technologies, CSA and Teikei models can use these advances to improve operational efficiency, strengthen farmer-consumer relationships, expand market reach, and further promote sustainable agriculture. In addition, well-planned use of technology makes sustainable agriculture more feasible, while maintaining its core principles of community support and maximizing local production.

The following subsections describe the CSA and Teiking models in more detail, as well as introducing some technology and data sharing frameworks and initiatives.

4.1. Community Supported Agriculture

In Japan, the aging of producers is progressing, and the participation of diverse human resources in agriculture is required. Under these circumstances, community-supported agriculture (CSA) is attracting attention as a new agricultural model that is realized through collaboration between producers and consumers and the participation of diverse human resources.

CSA is a system in which producers and consumers collaborate to support each other through prepaid agricultural contracts. Community-supported agriculture was established in Japan in the late 1960s. It includes two essential pillars: food sovereignty and solidarity economy. By definition, CSA implies the involvement of eaters (consumers) with producers, shared risks and benefits, and a localized agroecological model of production and consumption. A solidarity economy is present in all CSAs in terms of systemic economic changes. There are many ways to implement this change, but some systemic collective horizontal aspects are always present (Hitchman, 2019).

CSA is characterized by consumers participating in farm operations, such as farming and shipping, and is established through an equal relationship based on trust with producers and consumers sharing management risks. As basic principles, in 1978, the Japan Organic Agriculture Research Association compiled the few points for partnership, as a guideline for promoting organic agriculture through cooperation between producers and consumers (kondo, 2021). In terms of content, many of the characteristics and philosophies of CSA are common (Figure 6).
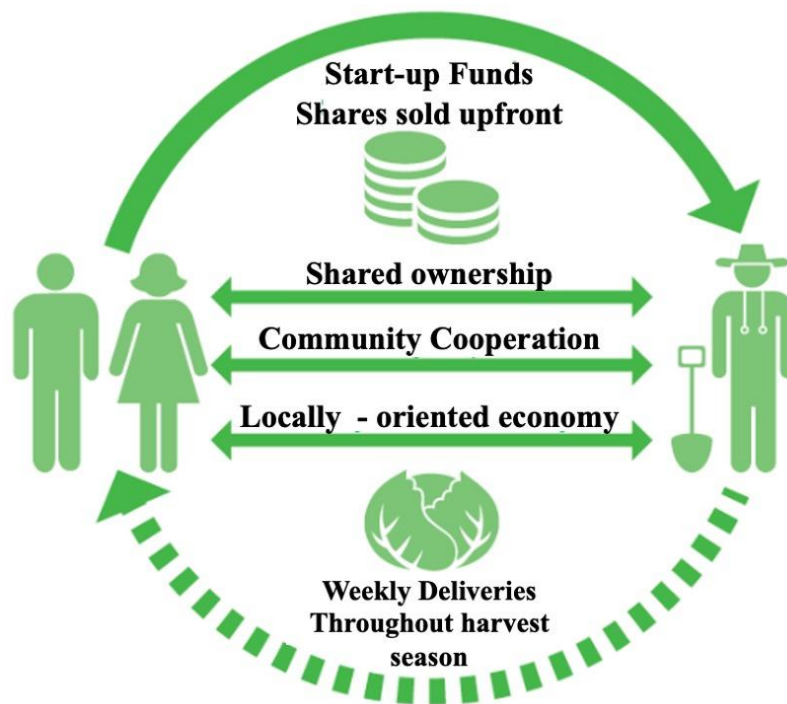

Fig.6: CSA philosophy and methods (Source: Kubota, 2021)

4.2. TEIKEI PARTNERSHIP SYSTEM

The Teikei system originated in Japan. "Teikei means "partnership" or "cooperation" in English. It is a collaborative system or movement that aims to foster a direct relationship between farmers and consumers. The teikei system emerged in Japan in the 1960s in response to concerns about industrialised agriculture and a desire for more sustainable and community-based farming practices (kondo, 2021). The Japan Organic Agriculture Association (JOAA), founded in 1971, describes teikei as 'an idea to create an alternative distribution system that does not depend on the conventional market'. Although the forms of teikei vary, it is essentially a direct distribution system (Fomsgaard, S. I., 2017). The teikei system has been influential not only in Japan, but also in various parts of the world. The impact of teikei comes from the promotion of local, sustainable food production and direct relationships between farmers and consumers (Yasuda,

1986). As shown in Figure 7, Yasuda S. in (Yasuda S., 1986) illustrated the relationship oriented between farmers and consumers at different stages and operations of agricultural production and distribution, and the resulting life-oriented society.
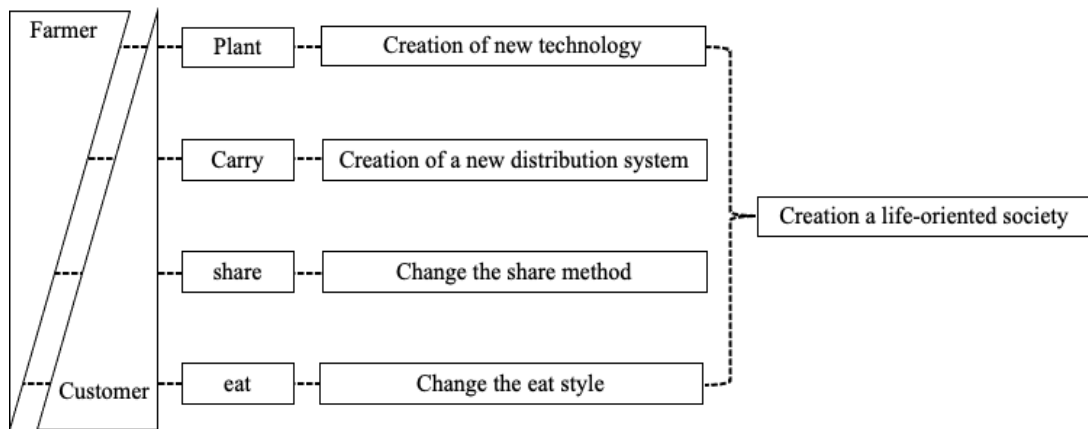

Fig.7: Teikei philosophy and methods via Organic Agriculture (Reproduced from Yasuda, 1986, Orginal in Japanese).

4.3.   Advanced Technology and Innovative Initiatives

Modern technologies and the spread of the digital society have led to modern adaptations of the system. It has evolved with modern technology, allowing for online platforms, subscription models and greater accessibility to urban consumers. Considering Japanese developments, various technological advances have been integrated. Online platforms consolidate digital communication, and mobile phone applications also provide active follow-up, tracking and updates, increasing resilience.

There are several initiatives and systems that are driving innovation and the integration of ICT and advanced technologies into problem solving schemes, and hence contributing to the revitalisation and development of various sectors in Japan. These include the Society 5.0 vision, smart city initiatives, industrial networking, smart agriculture, research and data sharing platforms and systems, to name a few. Advanced technologies have gradually been integrated into Japan's agricultural systems, influencing both CSA and Teikei (Matsuura, 2016). In the following subsections, we highlight some of these technology stakes.

4.4.   Society 5.0

"Society 5.0" was first introduced as a concept by the Japanese government around 2016. This vision was articulated by the Japanese government, specifically the Ministry of Economy, Trade, and Industry (METI), as part of Japan's national strategy to guide the country's societal evolution and technological advancement. (Cabinet Office, Government of Japan, 2023).

This vision reflects Japan's efforts to align technological progress with societal needs to create a more inclusive, resilient and sustainable society. Society 5.0 represents Japan's efforts to harness technological advances for social improvement, economic growth and sustainable development. A key feature of Society 5.0 is the interconnection of various business services through data exchange for expansion and innovation. The integration of ICT and emerging technologies such as IoT, artificial intelligence, cloud computing and drones is a key enabler for initiatives and applications to serve higher goals and expectations. These include addressing socio-economic challenges, achieving sustainable revitalization of regions and maintaining the country's global competitiveness.

4.5.   Smart City

The smart-city initiatives emphasized three pillars of Japan's characteristics being the foundation for a data-driven urban development: Transit-Oriented Development (TOD), Robust City Planning, and Eco-City realization. (Japan Cabinet, 2015).

Eco-city initiatives in Japan emphasize considerations such as low carbon, resource recycling and minimizing environmental impact, stemming from a historical focus on energy efficiency following the oil crisis of the 1970s. Japan is striving to become an eco-city that balances environmental friendliness in both infrastructure and lifestyle, with efforts including the creation of a low-carbon society and resource recycling.

Transit-Oriented Development (TOD) in Japan aims to reduce traffic congestion and improve urban functionality by prioritizing public transport in urban planning. This involves locating office, commercial and hotel complexes within walking distance of railway stations, and strategically placing residential areas along railway lines in suburban regions. This approach concentrates advanced urban functions in city centers while mitigating traffic problems.

Japan's urban development paradigm extends to disaster prevention, drawing on its experience with earthquakes and typhoons. Proactive measures include improving the resilience of social infrastructure, using technology and warning systems to predict and prevent disasters, and developing technologies to reduce the damage caused by disasters. The aim is to share Japan's expertise in disaster prevention globally, contributing to safer urban life around the world.
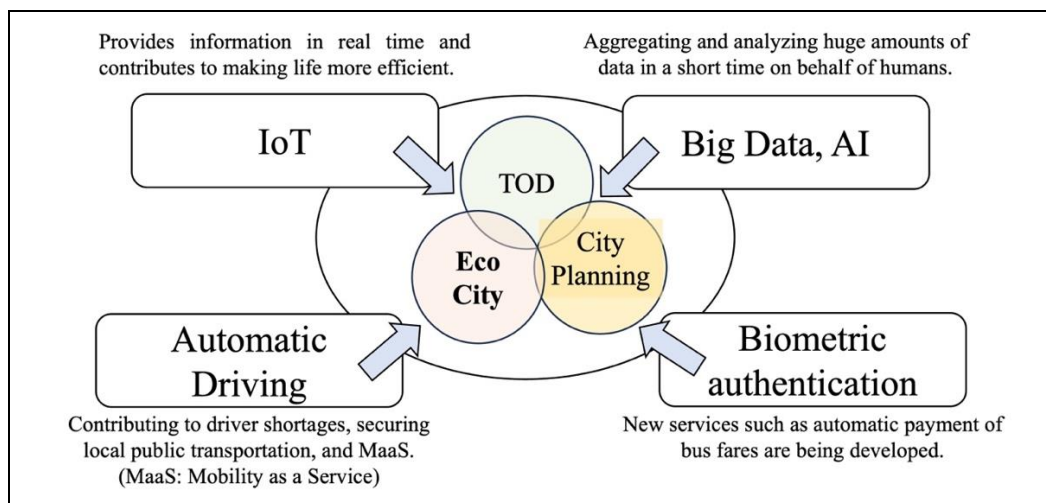

Fig.8: Building a human-centered society (Society 5.0), and enabling advance technologies drivers (Reproduced from Japan's Kantei Publication, 2023)

The Japanese initiatives recognize that the digital transformation of society and the robust use of advanced technologies complement the strengths of conventional urban infrastructure development and advance the construction of a human-centered society ("Society 5.0") that balances the resolution of socio-economic issues and economic development (Japan's Kantei Publication, 2015), (Brendan F.D., 2021). To enable and sustain the pillars and goals of smart cities, Japanese government initiatives recognize the following technologies and tools as particularly essential (Japan's Kantei Publication, 2023): Internet of Things (IoT) applications, big data, artificial intelligence (AI), and smooth access control through biometric authentication, Figure 8.

4.6. NARO Organization and WAGRI Agriculture Data platform

The National Agriculture and Food Research Organization (NARO), which aims to deepen and penetrate Society 5.0, contributes to the achievement of the SDGs (Kawamura T., 2022). The National Agriculture and Food Research Organization (NARO) originated at the Ministry of Agriculture and Commerce's Agricultural Experiment Station, which was established in 1983. It was established in 2001 as an independent administrative institution. In 2016, it

became the current "National Research and Development Corporation for Agriculture, Food and Bio-Industry Technology". The National Agriculture and Food Research Organization conducts joint research and technology transfer activities in collaboration with the government, prefectures, universities, and companies to implement research and development into society. The research segments of the National Agriculture and Food Research Organization are divided into five major categories: segment 1 is Agri-Food Business, Segment 2 is Smart Production Systems, Segment 3 is Agri-Bio Systems, Segment 4 is Robust Agricultural Systems, and finally, there is basic technology research.

In addition, the agricultural data-sharing platform (WAGRI) introduced in the previous chapter is a sharing system developed by NARO. The WAGRI started operating in April 2019 and is promoting environmental improvement for the on-site implementation of smart agricultural technologies. According to Matsumoto, smart agriculture is expected to be a means of solving the serious challenges of aging and shortage of agricultural workers, and it has also been shown that the construction of an agricultural data-sharing platform that supports smart agriculture is important (Matsumoto, 2020). In the Strategic Innovation Creation Program (SIP) of the government, various data are aggregated and integrated, such as public data from administrative and research institutions, and private agricultural ICT services. By expanding agricultural ICT services, it promotes the improvement of services provided by private companies and the creation of new services. WAGRI is being studied and developed to construct a "smart food chain" that expands the scope of data linkage, sharing, and provision from production to processing, distribution, and consumption by promoting the participation of a wide range of entities.

When new agricultural workers consider renting farmland, it is important to collect comprehensive information that is useful for agriculture, as well as address, area, and land use of farmland. It is also important to confirm various information such as the characteristics of farmland, such as sunlight and drainage. In this study, it is necessary to identify and refer to information that captures the characteristics of farmland to consider an information-sharing system that can make agricultural plans from planting to crop harvesting. While the technology to support farmers is growing systematically, the system of communities that supports new agricultural workers is also important in parallel with functional support.

Endo et al. summarized in detail the community system that supports new agricultural workers. In the context of the serious aging and shortage of successors to agriculture, some examples of movements to promote new farming are being activated, such as new farming support, municipalities, agricultural corporations, agricultural cooperatives (JA), and regional communities and producer networks. In the regional community, (comnity-supported agriculture CSA () is attracting attention as a domestic initiative to support new farmers. CSA is a system in which local consumers and farmers mutually support each other, and consumers can pre-purchase vegetable sets for units such as one year or six months and actively participate in farm management. In addition, producers exchange information in the market for producer networks and collaborate with each other to supply seedlings and seeds to each other (Endo, 2020). The community system strongly reflects the concept of SDGs, and a system is systematically constructed in which production and consumption occur in the region.

4.7. Smart agriculture initiatives

To maintain competitiveness, Japan continues to encourage innovation and technological advancement. The country has a long history of using technology to improve agricultural practices and embraced agricultural mechanization and advanced irrigation systems as early as the 1960s and the 1970s, which significantly increased productivity and crop yields (Toshiyuki, K., 1987).

Japan's Ministry of Agriculture, Forestry and Fisheries (MAFF) has defined smart agriculture as a mode of agricultural production that uses robotic technology and ICT to achieve significant labor savings and high-quality production (Kitano, 2021). MAFF characterized smart agriculture as a production method that uses robotics and Information and Communication Technology (ICT) to achieve several key objectives, such as significant labor efficiency and ensure higher quality production (Shima, and Ali Hija, 2023).

In recent announcements and meetings, the Japanese Cabinet has reaffirmed its commitment to maintaining agricultural production levels even in the face of rapid population decline and has considered new legislation and initiatives that will lead to the development of new technologies such as smart technology and the promotion of smart agriculture (MAFF_2023). Meanwhile, it is recognized that a system should be put in place to encourage changes in production, distribution and innovative methods to adapt to new technologies.

5. A CASE STUDY OF REVITALIZATION IN THE OKINAWA REGION

In this section, we focus on one region and look at the challenges, actions and approaches taken by regional governments and various partners and stakeholders. We pick up representative topics; a regional smart food chain initiative, challenges in the agricultural sector in Okinawa Prefecture, and a smart city initiative of Nogo City, in the north of Okinawa.
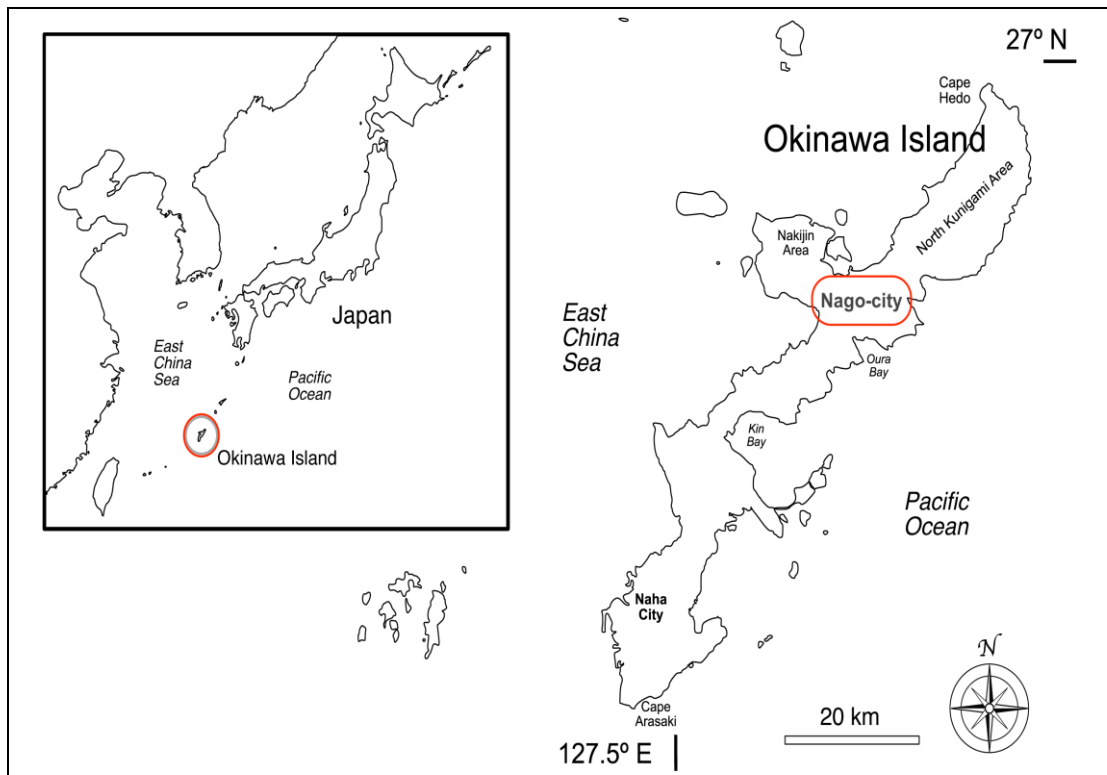

Fig.9: Nago-city, in north of Okinawa, which is the most southern prefecture of Japan (Source: reproduced from free maps).

6.1 Smart Food Chain (Advanced Technology-Base for Region Economy and Society)

Regarding initiatives related to regional community creation, the Japan Agricultural Research Institute (NARO) is promoting the Kyushu Okinawa Economic Zone Smart Food Chain Project (Kyushu Okinawa SFC) in collaboration with private companies, public research institutes, and universities to expand exports of high-value agricultural and processed food products to Asia. The project was divided into three segments:

− Agri-Food Business: This segment aims to strengthen business competitiveness through the creation of new foods and smartening of the food chain.
− Agri-biosystem: This segment aims to strengthen the agricultural and food industries and create new bio-industries by integrating biotechnology and AI.
− Robust Agricultural System: This segment aims to achieve both robustness of agriculture and environmental conservation.

NARO's efforts to achieve smartening through AI and data integration have been confirmed to be effective in regional community creation. For example, drones, which are widely used as a

means, are also used in agriculture for image sensing to collect information on crops and soil and for the application of seeds, pesticides, and fertilizers. In rural areas, drones are expected to be used for a variety of purposes at the regional level, not just for agricultural services such as monitoring and scarring away wildlife, crime prevention and monitoring, and confirming the damage situation in the event of a disaster (Nagasaki, 2021).

6.2 On the Agriculture of Okinawa

The agricultural output of Okinawa Prefecture increased from 45 billion yen in 1973 after the second world war, and most high of 1,160 billion yen in 1985. However, it has remained at around 116 billion yen in recent years, reaching approximately 92 billion yen in 2021. The main agricultural products are crops suitable for the warm climate of the subtropical region, such as sugarcane, mango, and pineapple.

By 2020, the number of agricultural workers had decreased to 13,288. However, the average age of agricultural workers in Okinawa Prefecture is 65.9 years old in 2023, which is slightly younger than the national average of 67.9 years old. The proportion of agricultural workers over the age of 70 years is 45.8% in Okinawa Prefecture, which is also slightly lower than the national average of 56.7% (Okinawa Cabinet Office, 2023). This is because the "Agricultural Next-Generation Human Resources Investment Fund System" was introduced in 2017, and the number of new farmers in Okinawa Prefecture increased from 292 in 2020 to 313 in 2021 (Fig 10).
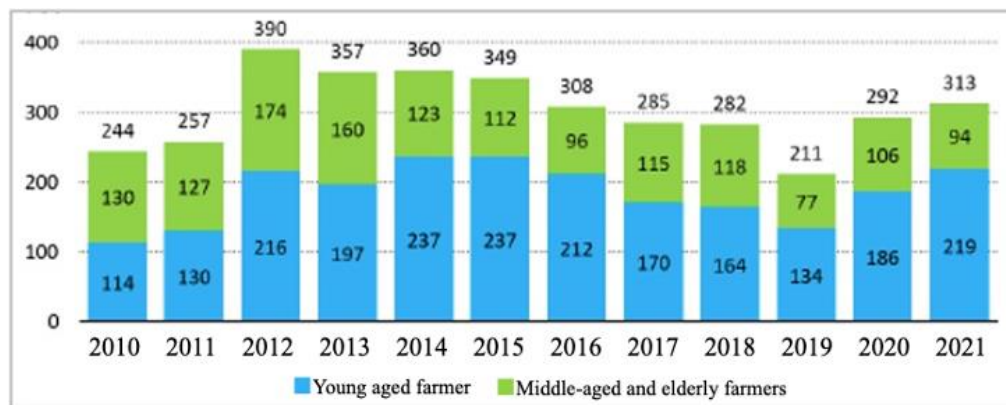

Fig.10: Changes in the number of new farmers in Okinawa (Reproduced from Okinawa PIPC,2023, Original in Japanese).

To prevent the decline of the primary industry, Okinawa Prefecture has strengthened agricultural support measures by establishing laws and systems, preparing subsidies to secure new agricultural workers, and preventing the increase in fallow land. In recent years, Okinawa Prefecture has promoted industrial reform through the use of digital technology. A notable example is the establishment of the Smart City concept in Nago City, located north of Okinawa Prefecture.

6.3 Smart City Project of Nago-City, Okinawa Prefecture

Nago City is the largest city in northern Okinawa. It has revised its master plan with the most recent update as version 5, where it has promoted smart city as the core of its 10-year plan. The master plan defined the target image of the smart city and then showed the direction of efforts to achieve it (Nago-City, 2023). Therefore, the 5th Nago City Master Plan defines the theme of urban development as "Connecting, Creating, A flexible future" and promotes "various" measures. This master plan shows the direction for realising the target image using the most digital technology.

While building on the current comprehensive plan, the Nago Metropolitan Government is redefining its vision by making the most of opportunities such as the use of digital and advanced technologies, and setting a direction for the realisation of its master plan vision.

The city government is establishing an approach that can serve as a reference for other regions as a regional core city (a core local government that drives the region). The approach includes all the resources of the region, including the private sector, researchers, civil communities, to gear up the action plan and contribute to the development of its smart city version.

The Master Plan and Smart City initiatives will address socio-economic challenges. The aim is to continue the urban development practices of the past, bringing together different actors, networking and creating a flexible future of a city that is resilient to different changing times.

As in many other regions, there are some common challenging threats from the external environment. These are defined as

- Declining birthrate/ageing population
- Declining population
- Ageing infrastructure

In particular, the following issues are expected to lead to more serious problems in the future.

- Lack of businesses and human resources (implying a decline in the local economy)
- Urban sprawl (implying a decline in the vitality of the city)
- Progress of transient tourism (implying sluggish growth of tourism industry)

Figure 11 provides an overview of the key objectives, the main enabling instruments and the supporting bodies and resources as presented by the initiative's working group.
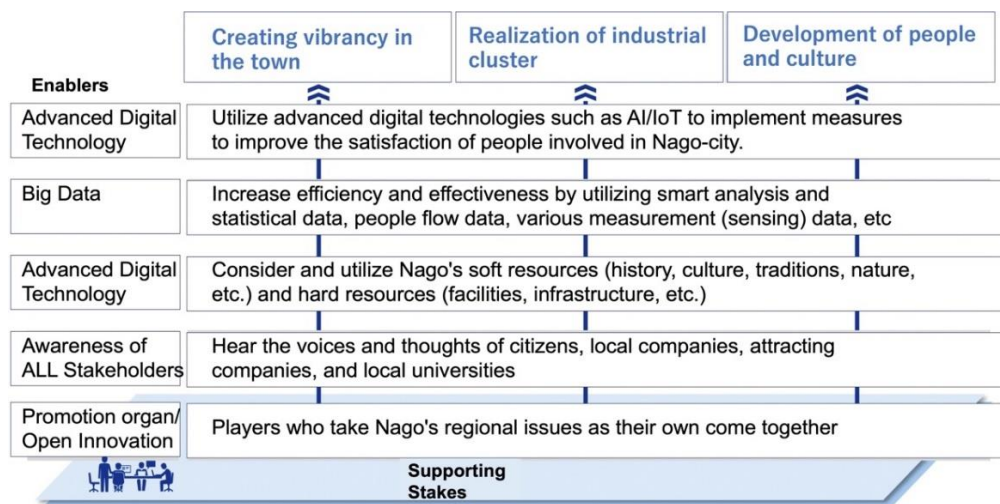

Fig.11: Vision objectives, with key supporting actors, tools for the Nago City Master Plan (Reproduced from the Master Plan Report published by the City, Nago, 2023).

The central themes of the Nago City Master Plan are "Regional Economic Revitalisation" and "Improving Quality of Life". Furthermore, seven industry themes have been identified, including "agriculture, tourism, education, digital content, transportation, public services and healthcare". Agriculture is positioned as one of the key themes for regional economic revitalisation and is an important benchmark for the use of digital technology as a primary industry (e.g. smart agriculture).

For each of these themes, a working group of researchers, civil servants/officials, businesses and community members has been set up to develop action plans, and started working in 2023. The planning phase will take further two years. The implementation phase will take five years, until 2029.

A community-based regional public university, Meio University, is also involved in the Smart City Plan (Maekawa, 2022). In the project Center of Community Plus (COC+), the university has a track record of using digital technology to address the challenges of a strawberry farm business in the village of Ginoza and solving the challenges of the farm business (Meio University, 2018).

Behind these plans, it is also seen as a challenge that the achievements of each have not yet been systematically linked, as the reform of the industrial structure through the use of digital technology is being promoted throughout Okinawa Prefecture.

6. DISCUSSION

In this study, we identified the general approach taken by national Japanese government, and local governments to tackle different challenges, and various initiatives. Japan's approach to domestic challenges combines technological innovation, traditional social systems, and global engagement. By harnessing technology while preserving its societal fabric, Japan is addressing socio-economic issues, supporting its global commitments, and maintaining its position as a technological and societal leader on the global stage.

Japan has been actively addressing domestic challenges, including socio-economic issues, while fulfilling its global commitments to the SDGs, including through various strategic initiatives and support schemes, and by leveraging technology and its society-based systems.

Technology integration: Japan has embraced technological innovation in various sectors. From robotics and AI in manufacturing to IoT in agriculture, these advances are expected to increase productivity, efficiency and competitiveness, and address economic and social challenges.

Society-based systems: With its regions facing the persistent threats of an ageing population, depopulation, local economic challenges and the need for revitalization, Japan is supporting community-based approaches such as agricultural cooperative associations (JAs) and CSA, as well as Teikei mutual aid systems, supporting rural development and preserving cultural heritage while addressing societal challenges.

Smart city initiatives: Efforts to create smart cities use technology for efficient energized economy, a robust public transportation, inter-connected society, and resilient schemes that enables responding well to future changes and challenges.

Research and Innovation: By emphasizing innovation and research, robust education and human resources development systems, Japan is strategically addressing socio-economic challenges and fostering a resilient, technologically advanced society that adapts to changing demographics, responds well to economic problems, addresses environmental concerns and maintains its position as a global competitor and leader in innovation.

Better future for an ageing society: Faced with an ageing population, Japan has turned to robotics and AI to support healthcare, care and assistance for the elderly, reducing the burden on the healthcare system and aiming to create a prosperous life for people.

7. CONCLUSION

With the vision of Society 5.0, Japan aims to create a human-centred society that integrates technological advances to create a more inclusive and sustainable society of well-being. In this study we find that the Japanese government initiatives, local governments, businesses and communities are using Society 5.0 as a blueprint to harness the potential of technological advances to build a more inclusive, sustainable and resilient society that balances economic growth with societal well-being.

The study highlighted the integration of Information and Communication Technology (ICT) solutions and advanced technology practices and their coexistence with conventional systems and initiatives that have been operating in different regions of Japan to address some of the socio-economic challenges. The methodological approach of the study includes three facets, namely government initiatives, technology involvement and local society actors.

The study revealed that the advances of technology, data-based approaches and practices at nation initiatives, as well as at regional governments 'visions and action plans.

The study examined government visions and initiatives of Japanese government that emphasized the use of advanced technology as a key factor and tool to enable solutions and realize the target vision.

The main challenges that face regional revitalization had been highlighted. The ageing population and economic stagnation are common challenges in different regions of Japan. The adaptation of technology and the integration of technological advances across sectors with an impact on productivity have been explored in the Visions, Initiatives, and Action Plans. With an ageing farming community, and with aim of full revitalization of the region.

Smart agriculture is one of the developments highlighted, as is the use of artificial intelligence and big data analytics, and autonomous systems in the image of the 'smart city' plan of a case study local government of Nago-city, in the southern prefecture of Okinawa. The study notes that Society 5.0 is seen as a blueprint for harnessing the potential of technological advances to address social and economic issues and build a more inclusive, sustainable and resilient society that balances economic growth with societal well-being.

The involvement of community institutions, research and business, together with public officials, was remarkable and indicated a human-centred approach driving technology adaptation.

Future work will be directed to trace the challenges and impacts of the use of technology-based and digital solutions on the realization of the Smart City model in Nago-city, as well as evaluation of various projects through their implementation phase of the Master Plan and Smart City vision.

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