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Farming Systems and Operations Contributing to a Sustainable Society and Their Multi-Dimensionality: An Essay at Planning Scenarios for Japan in 2040

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What types of farming systems and operations and their multi-dimensionality would contribute to construct a sustainable society in Japan by 2040? What policies would enable this transformation of the society? New agri-food policies promoted by the United Nations and European Union, and the rationality steering these policies, enrich the discussion and provide some spectra. This paper examines four scenarios of farm development and concludes that agroecological farming systems operated by small-scale family farms, a decentralized and localized agri-food system, and policies supporting this transformation would be the key to meet the new societal desires and construct a sustainable society.

Key words: sustainability, agroecology, family farming

1. Introduction

The crises experienced by current Japanese agriculture and rural society are threefold: a) environmental degradation and frequent climate catastrophes, b) societal stagnation characterized by a rapidly aging and declining population, and c) economic collapse of farms represented by a lack of successors and increasing abandoned farmland. Building sustainable agri-food systems is indispensable to overcome these crises and construct a sustainable society. What types of farming systems and operations and their multi-dimensionality would contribute to construct a sustainable society in Japan by 2040 [1)]? What policies would enable this transformation of the society? This paper examines four scenarios of farm development and proposes three enabling policies that meet the new societal desires and support this transformation. The discussion is based on literature surveys of new agri-food policies promoted by the UN and EU, and the rationality steering these policies as well as field surveys conducted by the author in 2019 in Japan.

2. Current Societal Desires for Agriculture and Transformation of the Market Economy

In the transition to a sustainable society, societal desires for the agri-food sector have been transformed. Among the goals listed in the UN Sustainable Development Goals (SDGs), providing food is the primary role of agriculture to achieve Goal 1 (No Poverty) and 2 (Zero Hunger). In addition, agriculture is expected to contribute to other dimensions related to SDGs. In this paper, I call these roles the multi-dimensionality of agriculture (Tama and Kimura, 2020). The following five dimensions of agriculture are central to achieving SDGs.

First, it contributes to Climate Action (Goal 13). In order to keep the internationally agreed promise of Zero Carbon by 2050, the global agri-food system needs to reduce its greenhouse gas emission, estimated to be 21-37% of total emission (IPCC, 2018). Agriculture must play its role not only to reduce emission but also to fix greenhouse gas to soils.

Second, it increases resource-energy efficiency (Goal 7, 9, 12). In measuring resource-energy efficiency, resource-energy consumed along whole agri-food value-chains from production of agricultural inputs and produce, processing, storage, transportation, and disposal of foods has to be considered.

Third, it stabilizes society (Goal 6, 10, 11, 16, 17) by creating employment in, maintaining population in, and reactivating rural areas. Appropriate distribution of population, budget, and financial services would realize an inclusive society and strengthen urban-rural integration.

Forth, it restores a healthy and balanced life (Goal 3) by

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1) In the 2020 Annual Meeting of the AESJ Symposium, the papers presented by panelists are expected to envisage scenarios for 2040 (Tama and Kimura, 2020).

providing safe and healthy foods. It also contributes to a decrease in chronic disease, immunodeficiency, and developmental disorders, as well as social security costs.

Fifth, it reminds us of our roots and tells us a way of living harmonized with nature (all Goals). As achievement of SDGs requires a holistic approach and paradigm shift, this way of living is essential to the achievement and repositions the economy to its proper place in society.

The market economy is also in transition towards a sustainable system. Consumers seek more ecological and ethical products and tend to consume less. Corporations and investors are increasingly eager for investing in Environmental, Social and Governance (ESG) businesses. Nations have started to build new orders in the market economy: The EU announced the European Green Deal in December 2019 and its project of Border Carbon Tax. In this context, the markets for organic, local, traditional, ecological, fair trade, and low carbon foot-print products, renewable forms of energy, and social businesses are rapidly growing.

3. New Agri-food Policies Rising in the International Arena

1) UN and international organizations

In the context of SDGs and the Paris Agreement, commitments and actions of UN member states are required for the achievements. Over the last decade, a series of UN Decades related to development of sustainable agriculture were launched: UN Decade on Biodiversity (2011-2020), of Soils (2015-2024), of Action on Nutrition (2016-2025), for Action on Water for Sustainable Development (2018-2028), of Family Farming (2019-2028), and on Ecosystem Restoration (2021-2030), as well as the Voluntary Guidelines to support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security, on the Responsible Governance of Tenure of Land, Fisheries and Forests, for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication, and the UN Declaration on the Rights of Peasants and Other People Working in Rural Areas. All these initiatives invite UN member states and stakeholders to revisit existing agricultural development models and employ novel approaches.

Among these initiatives, agroecology and small-scale family farming are considered keys to transform the global industrial agri-food system into a more sustainable and democratic food system. First, agroecology as an ecologically sound, socially proper, and economically just agri-food system is recommended by several reports published by the UN and international organizations (IAASTD, 2009; UNCTAD, 2014; Shutter, 2014; HLPE, 2019). Second, family farming, which comprises more than 90% of all farms in the world, provides more than 80% of food, and is mostly small (85% of family farms are less than 2 ha in size), is expected to play a significant role in food security and food sovereignty (HLPE, 2013; FAO, 2018). At the same time, around 80% of the undernourished population in the world lives in rural areas and runs farms; that means supporting them would be crucial to eradicating poverty and hunger (HLPE, 2013).

2) EU's Post-2020 CAP and European Green Deal

In November 2017, the European Commission released its basic policy for the Post-2020 Common Agricultural Policy (CAP), namely "The Future of Food and Farming" (European Commission, 2017). First, this policy includes strengthening supports for small-scale farms. It is a response to existing critiques on the current distribution of the CAP budget allocating 80% to the 20% large-scale farms, which appears unfair and insufficient to support small-scale farms for European citizens. In the Post-2020 CAP, the ceiling and progressive reduction of direct payments to large-scale farms and its redistribution to small-scale farms will be emphasized. The reason behind this reorganization of the CAP budget is the appreciation of the roles played by small-scale farms in employment creation in rural areas, maintenance and revitalization of rural communities, and other aspects of multi-dimensionality in urban and rural societies.

Second, the Post-2020 CAP will promote measures for mitigating climate change and environmental protection. In the direct payments, the basic payment and the green payment will be integrated, employing basic environmental measures as a condition of direct payment and additional environmental measures as a condition of eco schemes. Furthermore, the European Green Deal launched in December 2019 and From Farm to Fork Strategy announced in May 2020 under the new administration of the European

Commission will require more radical reform of the Post-2020 CAP to build sustainable agri-food system and a circular economy.

3) French law of future for agriculture

In the context of the debates in the international community and the Post-2020 CAP, the French government has reoriented its agri-food policies. After the post-WW II period in which it promoted structural reform and modernization of agriculture, France experienced a series of agricultural crises in the 1970s characterized by price volatility of agricultural inputs, climate disasters, diminished prices of agricultural products in value chains, environmental degradation, and depopulation in rural areas. Under the WTO regime and CAP reforms from the 1990s, the French government began controlling over-consolidation of farmland, greening agri-food policies, and supporting high quality agri-food products with official labeling systems such as organic and geographical indications.

In line with this reform of agri-food policies, the Law of the Future for Agriculture, Food and Forest, which promotes agroecology, was enacted under the Hollande administration in 2014. This new law is compatible with other policies that support pluriactivity in rural areas, and qualification of value-added agri-food products (organic, geographical indications, etc.), as well as no-tiller agriculture, conservation agriculture, 4/1000 initiatives, the brown revolution, and so on (Albright, 2015; UN Climate Change, 2015). The subsequent Macron administration basically followed the greening of agri-food policy and launched a new law that obliges public procurement such as for school meals to allocate more than 20% of its budget to purchase certified organic agri-food products and more than 50% to local and/or labeled high quality products. Program Ambition Bio was also introduced in June 2018 to increase farmland dedicated for organic farming from 9% in 2019 to 15% by 2022.

4. Planning Scenarios for Japanese Farming Systems and Operations in 2040

What types of farming systems and operations would contribute to constructing a sustainable society in Japan by 2040? In this section four agricultural models and scenarios categorized by two axes, labor and resource-energy, are examined. In Figure 1, the model at the upper right represents a modern farming operation that is labor-saving and relies on a high input of resource-energy. This model employs state-of-the-art technologies such as unmanned tractors running under satellite control, greenhouses controlled with sensors and Light Emitting Diodes (LEDs), robotics and cyborgs. Based on these technologies it increases labor productivity and environmental burdens. The model at the bottom right is labor-intensive organic business farming relying on off-farm resources. While it does not use any agro-chemicals, it needs to purchase labor and manure from markets, which means it is based on the industrial animal husbandry of the upper right model. The model at the upper left is labor-saving and relies on a low resource-energy input, namely extensive agriculture and/or pasturage. It requires relatively few laborers and less environmental burden, and can maintain a certain size of farmland. Finally, the model at the bottom left is labor intensive agroecology depending on on-farm resources. Other models between the four models are intermediate and/or transition models.

Inspired by Figure 1, Table 1 illustrates the four scenarios of agricultural development. First, in scenario I: Intelligent Lord, only a limited number of elite farms operate agriculture employing new technologies such as IoT (Internet of Things) and AI (Artificial Intelligence) and exporting their products to international markets accessible due to recent Free Trade Agreements. Though it enjoys high labor productivity, the depopulation of rural areas and decline of rural communities will be accelerated, which negatively impacts farming operations. In addition, it would face difficulty in accessing international markets that block non-environmentally friendly products with Border Carbon Tax. Climate catastrophes will occur more frequently, and risks of disasters and pests will be increased. It cannot be considered as a desirable scenario.

In scenario II: Reformist Statesman, farms start organic farming to overcome the limits of scenario I. However, it still relies on a package of modern technologies and just replaces agro-chemicals with biological pesticides and organic manure supplied by off-farm industries. In other words, this

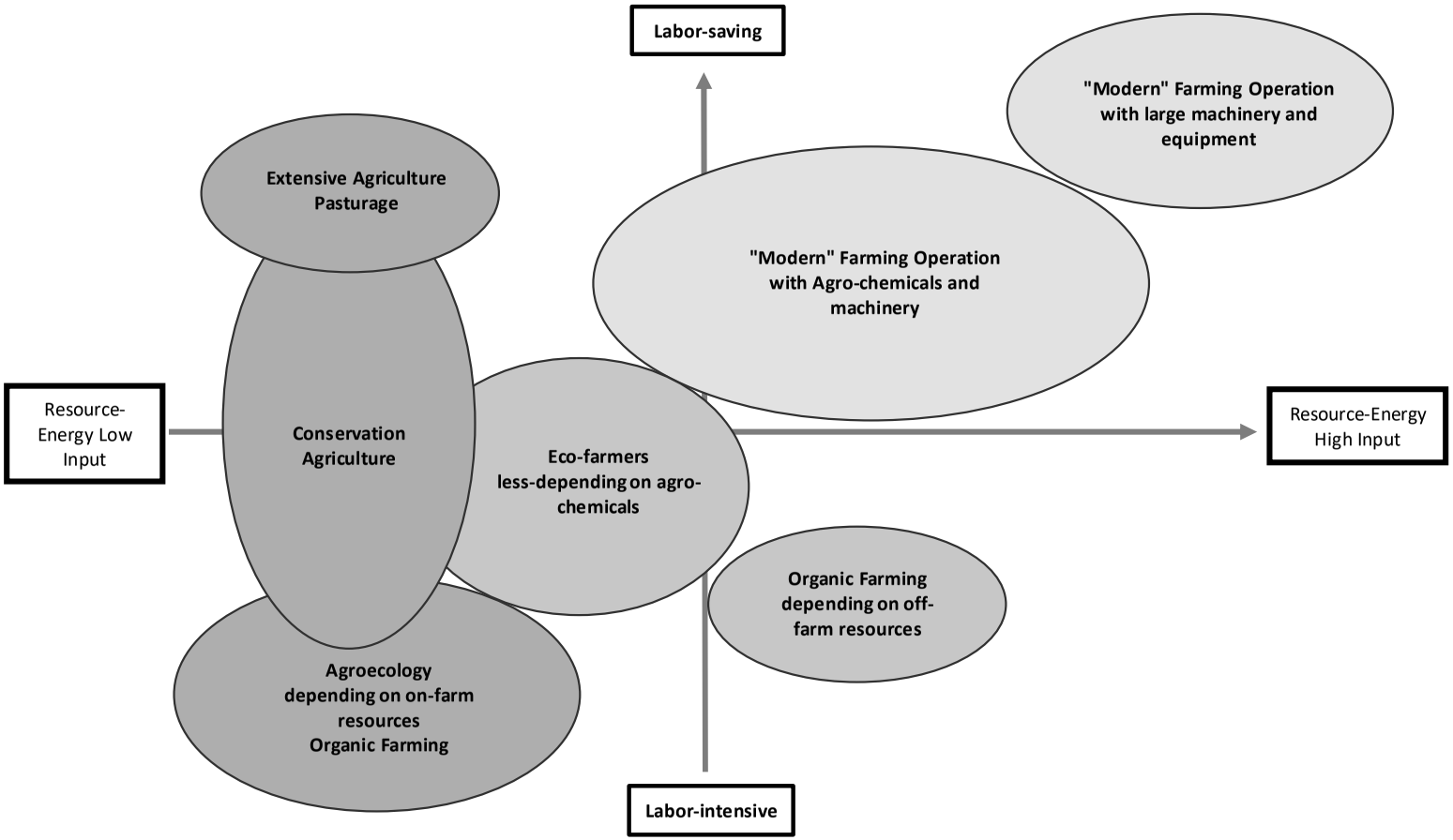

Figure 1. Agricultural models categorized by labor and resource-energy

Source: Elaborated by the author.

scenario is not self-contained and does not realize balanced ecological cycles in farms even though it contributes to create employment in the labor market.

In scenario III: Liberal Pioneer, farms start no-tiller agriculture and/or pasturage. Though its contribution to creating employment will be limited because of its labor-saving nature, it can maintain a broad stretch of farmland. If it does not apply any agro-chemicals, this farming system can be equated with natural farming.

Lastly, in scenario IV: Peasant Living with Nature, farms/peasants respect traditional knowledge and cultures, pay attention to their communities, secure generational succession of family and farms, and operate pluriactively. They are the new peasantry that Ploeg (2008) called for. They are keen to maintain agricultural biodiversity and microorganisms in soils through self-seeding and create agricultural tools according to necessities. In other words, they are genuine innovators and not outdated.

Table 1. Four Scenarios of Farming Operation Development in 2040

	Resource-energy low input	Resource-energy high input
Labor-saving	**Scenario III: Liberal Pioneer** Features: free from stereotype, attached to broad stretch of land	**Scenario I: Intelligent Lord** Features: elite lord, novelty-loving, eager for trade
Labor-intensive	**Scenario IV: Peasant Living with Nature** Feattures: attached to tradition, community, and family, eager for enriching soil, closet innovator	**Scenario II: Reformist Statesman** Features: reform-minded, dependent on lord's permission

Source: Elaborated by the author.

As shown in section 3, the UN and international organizations, the EU, and France promote agri-food systems and operations in scenarios III and IV. Scenario II could be accepted as a transition model in the short term. It would be difficult to consider Scenario I as a sustainable model if it cannot drastically update its technologies to increase resource-energy efficiency. In addition, its labor-saving operation would negatively impact employment and population maintenance in rural areas. However, those elite farm operators would be eager to learn the new rules and reorient their activities.

As these models presented in the four scenarios are prototypes, there would be several combinations of models according to the given conditions in communities. However, the vector of transition would be towards scenario III and IV if we seek to mitigate climate change and increase resource-energy efficiency in agri-food systems. In those scenarios, farms rely on fewer off-farm resources, and therefore can maintain higher profitability. A less stressful environment for animals and a lower use of antibiotics, healthier agri-food products and humans, more resilient territories, agricultural biodiversity, healing landscapes, heartwarming festivities, and a suppression of social security costs can also be realized. The virtuous cycle in the whole society will be widely spread from such sustainable agri-food systems.

In the case of Japan, which faces a rapidly aging and declining population, the obstacle would be availability of labor that can be provided in the agricultural sector. To be sure, an aging and declining population is not a given condition but variables of the policies that improve supporting systems of parenting and work-life balance. Furthermore, the population over-concentrated in megalopolises can move to rural areas to escape from stressful urban life and vulnerability to risks such as Covid-19 in urban spaces. If an appropriate level of income is secured by direct payments, a certain number of laborers, especially those working as temporary employees, who comprise more than 40% of the Japanese labor market (more than 70% among the young generation), would be willing to work in the agricultural sector. For the purpose of attracting urban laborers to the agricultural sector and generational successions of farms, improvement of economic conditions (e.g. income) and social conditions (e.g. social recognition, empowerment of women and the young generation, relations within family members, and living conditions in rural areas) would be substantial.

5. Conclusions: The Future Has Already Begun

What policies would enable the transformation of agri-food system towards a sustainable system? This paper concludes that the following three interrelated policies are central to a progressive transition towards scenarios III and IV.

First, it is necessary to drastically reform existing agri-food policies to promote agroecology and mitigate climate change. This reform would also contribute to creating employment and restoring conditions that revitalize livelihood and production in rural areas. Reorganizing the agri-food curriculum in high schools, vocational schools, and collages/universities would be also indispensable.

Second, it is essential to strengthen measures supporting small-scale family farms that are considered guardians of the agri-food system. Those who are not captured in statistics such as subsistence farmers, hobby farmers, edible school yards and community gardens, must be measured, paid more political attention, and allocated public support.

Third, it is crucial to create new measures to build more decentralized, localized, democratic and smaller agri-food systems. The schemes that promote Community Supported Agriculture (CSA), public procurement of organic and localized agri-food products, farmers' markets for agro-ecological products in every primary school district, local foods manufactured by local small-and-medium-sized processors, grounded agritourism, and agri-food and nutrition education would be the components of these policies.

The year 2040 is the upcoming future. Novel initiatives to construct a sustainable society have already begun in several regions and countries. Administrations as well as academia are expected to transform themselves to respond to current societal desires.

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