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An Investigation into the Roots of the Paradox of Vegetable Supply Diversity in Japan

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ABSTRACT

Japan is a long, narrow country with a climate ranging from subarctic to subtropical, which theoretically provides excellent natural conditions for vegetable diversity. However, at the retail level, a paradox of vegetable diversity has emerged, characterized by "limited variety, low per capita consumption, and prices prone to sharp spikes". This paper deconstructs vegetable diversity into two dimensions—biological variety and market product diversity—and integrates a comprehensive perspective that combines institutional analysis, distribution economics, and the cultural inertia of food consumption to systematically reveal the three underlying causes: the price stabilization system for "designated vegetables + specific vegetables" locks more than 70% of arable land into 49 "policy varieties" through subsidy thresholds and area-based entry requirements, resulting in "institutional homogenization" at the production level ; a vertical monopoly structure centered on the National Federation of Agricultural Cooperatives (JA Zen-Noh) suppresses variety diversification into a distribution structure characterized by uniform specifications through stringent grading standards and rigid settlement methods; The "white rice-centered" dietary pattern dating back to the Edo period, combined with a food culture and consumer inertia that prioritizes safety, reassurance, perfect appearance, and seasonal appropriateness, has collectively led the Japanese vegetable system into a low-level equilibrium trap spanning "production–distribution–consumption", resulting in a paradox of vegetable supply diversity.

Keywords: *Policy and institutional frameworks, Distribution structures, Consumer inertia.*

1. INTRODUCTION

In Tokyo's busiest supermarkets, the selection of vegetables available year-round is likely far less diverse than what one might find at a farmers' market in a third-tier Chinese city. This seemingly paradoxical phenomenon raises a profound question: Why has the vegetable supply system in a country blessed with superior natural resources and advanced agricultural technology fallen into a predicament of "diminishing variety"? This paper defines this phenomenon as the "diversity paradox" of Japan's vegetable supply—that is, despite possessing the potential for biological diversity, the market exhibits a contradictory state characterized by a lack of product diversity, a continuous decline in per capita consumption, and severe price volatility.

Arable land accounts for 11% of Japan's total land area, with 0.02 hectares of arable land per capita—significantly lower than China's 0.09 hectares. The country's 1.404 million core farming households (the majority of whom are elderly) have sustained the primary food self-sufficiency of its nearly 130 million people. In the 1970s, Japan achieved a vegetable self-sufficiency rate of nearly 90% through a "suburban agriculture and technology-intensive model." However, since the 1980s, its self-sufficiency rate has shown a continuous downward trend. By 2022, the vegetable self-sufficiency rate had dropped to 79.5%, while the fruit self-sufficiency rate stood at only 36.8%. In stark contrast, the product category structure at the retail level has shown remarkable stability: any general supermarket within Tokyo's 23 wards typically stocks approximately 35–45 varieties of vegetables year-round, with 14 "designated vegetables" accounting for over 60% of sales.(Ministry of Agriculture, Forestry and Fisheries, 2023[1]).During the same period, per capita vegetable supply in Japan also declined from

a peak of 143.9 kilograms in 1968 to 101.4 kilograms in 2022. How can this model of "small-scale, high-efficiency agriculture" coexist with a shrinking variety of vegetables? This article will conduct a systematic analysis from three dimensions—policy, distribution, and consumption—to delve into the underlying causes of this "diversity paradox" in the vegetable sector.

2. THE IMPACT OF POLICIES AND REGULATIONS ON VEGETABLE DIVERSITY

The Vegetable Production and Marketing Stabilization Act, enacted in 1966, established the "designated vegetable" system, with the core objective of "providing subsidies to producers when market prices fall significantly, while ensuring a stable supply to consumers". In 2015, the system added a "specific vegetables" category, resulting in a list comprising "14 designated vegetables + 35 specific vegetables" (by 2026, following the inclusion of broccoli, the list will cover a total of 50 varieties, including some fruits). The specific conditions for triggering subsidies are as follows [2-3] ("Figure 1"):

- ① Designated Vegetables—When market prices fall to between 60% and 90% of the average price over the past six years (the benchmark price), subsidies will be provided through joint funding by the national and county-level governments and producer organizations. Depending on the region of origin, the subsidy rate will range from 70% to 90%, with the standard rate set at 90% of the benchmark price;
- ② Specific Vegetables—When market prices fall to between 80% and 55% of the benchmark price, subsidies will be provided to bring prices up to 80% of the benchmark price.

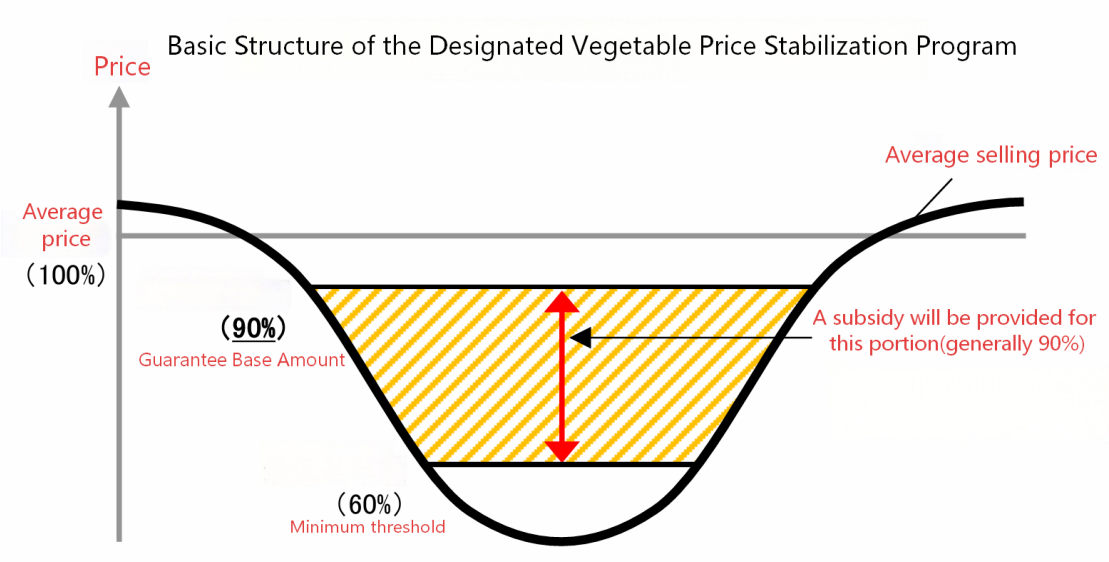

Figure 1 Basic structure of the designated vegetable price stabilization program.

The key point is that the subsidy base is calculated as "certified area × standard yield per unit area," and the area threshold requires that the average size of "government-certified production areas" be at least 10 hectares, with some vegetable-growing areas needing to exceed 20 hectares. This directly excludes small-scale farmers and specialty varieties from the policy benefits.("Table 1")

Table 1. Criteria for Designated Origin

	Specified Origin	Specific region	
Category	Specific vegetables	Certain vegetables	Specific vegetables
Cultivated area	Stems, leaves, and roots: 20 hectares or more Fruit and vegetables (summer and fall): 12 hectares or more Fruit and vegetables (winter and spring): 8 hectares or more	Approximately 5 hectares or more	Stems, Leaves, and Roots Approximately 10 hectares or more Fruits and Vegetables Approximately 5 hectares or more
Shipment ratio	more than two-thirds	Roughly two-thirds or more	Roughly more than half

a * Certain flexibility measures apply to factors such as cultivated area and shipment ratios, depending on specific circumstances.

In other words, to benefit from the policy incentives, farmers must grow crops listed in the "14+35" catalog and cultivate them on a large scale. Policy subsidies effectively internalize the externalities associated with "price risk", but their coverage is limited to the catalog varieties. This strongly incentivizes farmers to concentrate their farmland, cold storage, and organizational resources on policy-designated varieties, eventually leading to "path dependence." It can be said that the 1966 Vegetable Production and Shipping Stabilization Act, while stabilizing prices, directly shaped the variety structure on the production side, creating a dependency on "policy-designated varieties." Once the distribution sector is locked into specialized assets (such as pre-cooling facilities and fruit-sorting lines), it will in turn demand that production areas continue to expand the cultivation scale of policy-designated varieties to spread out fixed costs, thereby creating a positive feedback loop between "production and distribution." Meanwhile, consumers at the demand end, due to their unique dietary patterns and strong preference for domestically produced vegetables, exhibit low price elasticity of demand. This ultimately ensures that the cyclical model of a limited vegetable variety remains in a long-term state of equilibrium.

In 2022, designated vegetables accounted for 70.4% of the total vegetable cultivation area and 80.1% of shipments, while specific vegetables accounted for 37% and 23%, respectively. It is worth noting that the combined share of these two categories (excluding overlap) reached 107%. This figure clearly demonstrates that "policy vegetables" have "overbooked" the crop rotation system for arable land, squeezing out the survival space for non-policy varieties.

Table 2. Simulation of production trends for designated vegetables and traditional local varieties in Japan over the past 30 years [4] (1995–2022)

Year	Indicators	Selected vegetables (14 varieties)	Traditional local varieties (estimated)	Total Vegetables
1995	Cultivated area（hectares）	410,000	55,000	650,000
	Production capacity （tons）	13,500,000	1,400,000	18，000,000
	Percentage of total area	63.1%	8.5%	100%
2005	Cultivated area（hectares）	395,000	48,000	600,000
	Production capacity （tons）	13,800,000	1,200,000	17,500,000
	Percentage of total area	65.8%	8.0%	100%
2015	Cultivated area（hectares）	380,000	38,000	550,000
	Production capacity （tons）	14,000,000	950,000	16,500,000
	Percentage of total area	69.1%	6.9%	100%
2022	Cultivated area（hectares）	370,000	30,000	520,000
	Production capacity （tons）	14,200,000	750,000	15,800,000
	Percentage of total area	71.2%	5.8%	100%

a Note: The data in this "Table 2" are estimates based on publicly available sources, such as the Ministry of Agriculture, Forestry and Fisheries' *Crop Statistics*, and trends in academic research. They are intended to illustrate structural changes; please refer to official statistics for precise figures. Due to the lack of official statistics, the figures for "traditional local varieties" are estimates and primarily include regional brand varieties such as Kyoto vegetables and Kaga vegetables.

As clearly shown in the "Table 2" above, over the past nearly 30 years, although Japan's total vegetable cultivation area has sharply declined from 650,000 hectares to 520,000 hectares (a

decrease of approximately 20%), the cultivation area for the 14 designated vegetable varieties has only slightly decreased from 410,000 hectares to 370,000 hectares. More notably, their share of the total area has steadily risen from 63.1% to 71.2%. Against the backdrop of overall agricultural contraction, the price stabilization system has served as an "anchor," firmly locking scarce land resources into policy-designated crops. Faced with market risks and dwindling resources, farmers have rationally chosen the "safe bet" of subsidized crops, leading to a further concentration of production toward policy-designated varieties and solidifying a trend of "institutional monoculture."

In stark contrast to the steady growth of designated vegetable varieties, the market share of traditional local varieties has shrunk dramatically. Their cultivation area has fallen from 55,000 hectares to 30,000 hectares—a decline of 45%—far exceeding the overall decline in total vegetable cultivation area. Their share of the total area has also shrunk from 8.5% to less than 6%.

This set of data vividly illustrates the harsh reality of the "crowding-out effect." When arable land becomes scarce, local varieties—which lack subsidies and struggle to enter mainstream distribution channels—are the first to be abandoned by farmers. This is not merely an economic choice but an inevitable outcome driven by institutional factors. The evolution of Kyoto's traditional vegetable varieties, known as "Kyōyasai," serves as a microcosm of this macro trend. Originally comprising more than 60 varieties, "Kyoyasai" had dwindled to fewer than 20 by 2023—a decline of over 66%. While five varieties—including Kujo Leek and Horikawa Burdock—have been designated as "Specific Vegetables," the majority of the remaining varieties, such as Shogoin Radish and Kamo Eggplant, are cultivated on small-scale farms. Since their cultivation areas are less than 3 hectares, they cannot meet the 10-hectare threshold for "Certified Production Areas" and thus are ineligible for "Specific Vegetable" subsidies. This places them at a significant competitive disadvantage in the market. Unless they can command a premium through branding measures such as Geographical Indications (GI), their decline is unlikely to be reversed. Faced with market risks, farmers are forced to switch to the designated varieties "cabbage and daikon radish," which offer more guaranteed returns. This is one of the most direct manifestations of how policy systems are leading to a dwindling number of vegetable varieties in Japan.

If we plot the trend lines for the share of designated vegetables and that of traditional local varieties side by side, a classic "scissors gap" pattern becomes immediately apparent: one line (the share of designated vegetables) rises steadily, while the other (the share of traditional local varieties) continues to decline. The area created by this "scissors gap" represents the space for diversity that has been "squeezed out" by the system. This implies that, in order to meet the planting quotas for policy-designated varieties, farmland is being utilized intensively and monotonously, severely squeezing out the space for crop rotation, fallow periods, or the cultivation of minor varieties. While this "over-allocation" ensures the supply of designated vegetables in the short term, in the long run, it comes at the expense of soil health, ecosystem diversity, and the resilience of the agricultural system.

3. THE IMPACT OF DISTRIBUTION CHANNELS ON VEGETABLE DIVERSITY

For many years, Japan has relied on a system in which farmers sell their produce to wholesale markets, which are then sold by supermarkets to consumers. This system ensures a steady supply of large quantities of agricultural products to dining tables and serves as the foundation of Japanese food culture.[5]

According to statistics, JA Zen-Noh controls approximately 57% of agricultural product procurement and operates more than 5,300 collection centers and 3,100 fruit sorting lines. It has achieved the first level of standardization in the "farm-to-retail" process. Within mainstream national wholesale systems, a vegetable variety must undergo grading at sorting facilities based on strict standards such as size, shape, color, and sugar content during the market entry process. The distribution process from farmer to consumer includes 16.9% collection fees, 5.0% wholesale fees, 10.3% intermediary fees, and 20.4% retail fees, with total distribution costs reaching 52.6%. This means that for every 100 yen paid by a consumer, only about 47.4 yen reaches the farmer. If a farmer grows a small quantity of non-standard local varieties, those varieties cannot enter the JA's standardized sorting lines because the fixed costs of changing molds and sorting are too high. Unit distribution costs can reach as high as 70%, meaning that for every 100 yen paid by the consumer, the farmer receives only about 30 yen.

Consequently, traditional local vegetable varieties are excluded from the main distribution channels from the outset. Only "policy varieties"—such as cabbage and daikon radish—that can be produced in massive volumes and are highly standardized can operate efficiently within this system, spreading costs across every stage. This, in turn, incentivizes farmers to grow only these "safe" varieties.

Although direct-sales markets for vegetables are one channel for vegetable distribution in Japan, they are all located along roads within 30 kilometers of production areas and contribute little to the variety of vegetables on urban residents' dining tables.

Japanese agriculture places great emphasis on product quality management, striving to produce high-quality, safe, and organic agricultural products while continuously enhancing product value-added [6]. To improve efficiency and standardization, as early as 1989, Mitsui Metal introduced a near-infrared (NIR) sugar content sorter; in 2019, Shizuoka JA Mikkan introduced an AI image recognition and NIR integrated system, achieving 99% accuracy and reducing labor by 40%. However, standardization comes at the cost of substantial equipment investments for each fruit sorting facility—amounting to approximately 3 billion yen—making it economically viable only for designated varieties that are "large-scale and eligible for subsidies." Consequently, while investments in high-efficiency and standardized equipment have to some extent alleviated the challenges posed by Japan's aging agricultural population, they have further solidified the crop variety structure, resulting in a classic case of technological lock-in.

4. THE IMPACT OF CONSUMER INERTIA ON VEGETABLE DIVERSITY

Japanese dietary habits do not place a high demand on vegetables. In the late Edo period, the "one soup, one dish" model centered on "rice and pickles," with vegetables serving merely as "side dishes." The Meiji army used "six-cup white rice" to attract recruits, reinforcing the path dependence of "rice culture." A 2023 survey revealed that 85% of the population "eats rice every day," with side dishes still dominated by "rice companions" (such as natto and raw eggs). Vegetable intake stands at only 256 g per day, far below the Ministry of Health, Labour and Welfare's target of 350 g. Furthermore, the fast pace of modern life has led to a trend of "not eating vegetables." A survey by Kagome on the reasons for "not eating vegetables" revealed that the two most common reasons were lack of time to cook (28.5%) and high vegetable prices (13.9%). In 2024, cabbage prices skyrocketed by 250%, with a single head selling for over 1,000 yen. While demand for "pre-washed vegetables" and "frozen vegetables" has risen, pre-washed vegetables are largely concentrated in salad kits featuring "specific vegetables," further exacerbating the homogenization of production.

Secondly, Japanese consumers generally believe that only vegetables grown in Japan, during the right season, by farmers familiar with the local climate can truly capture the essence of "shun" (the peak of the season). "Local production for local consumption" is not merely a consumer philosophy; it is also an expression of regional pride and identity. Savoring local specialties is a way to support and preserve local culture. The freshness and emotional connection that "local production for local consumption" provides are unmatched by vegetables from other regions or those imported from overseas.

At the same time, to facilitate transportation, vegetables from other regions or imported vegetables are often harvested before they are fully ripe; even if they look similar, they are considered to have lost their "soul" and "vitality." As a result, consumers are particularly eager to choose vegetables labeled as "seasonal vegetables" when shopping. "Seasonal vegetables" represent the brief period during the year when these ingredients reach their absolute peak in flavor, nutrition, and texture. This is a cultural practice that pursues the ultimate gustatory experience, as well as an aesthetic concept imbued with Zen philosophy and a view of nature. Japanese culinary culture holds that savoring ingredients at their "shun" (peak season) is the most direct dialogue with the rhythms of nature and a way to honor the bounty of heaven and earth. Consequently, this obsession with "shun" (peak season) has further reinforced the demand for mainstream, classic varieties. Because the "shun" (peak season) of "designated vegetables" such as cabbage, daikon radish, and turnips is deeply ingrained in the public consciousness, it has created stable consumer expectations. Meanwhile, some niche regional varieties, whose "shun" (peak season) is unknown to the general public, struggle to enter mainstream consumer culture and are thus marginalized in the market.

Furthermore, the collective psychological fixation on “safety and peace of mind” has indirectly impacted the development of vegetable diversity in Japan. “Safety” refers to objective technical standards (such as pesticide residue levels not exceeding limits), while “peace of mind” is a subjective emotional state (“I feel reassured”). “Produced in Japan” is almost synonymous with “peace of mind”; consumers trust (or choose to trust) Japan’s agricultural production standards, regulatory systems, and farmers’ professional ethics. In contrast, no matter how strictly imported vegetables are tested, they are always shrouded in a psychological shadow of ‘unknown’ and “uncontrollable.” This extreme pursuit of “peace of mind” perfectly explains why JA’s standardized, high-cost distribution system has been able to endure for so long. Consumers are willing to pay a premium for this sense of “traceability and assurance.” And through rigorous fruit selection and grading, the JA system provides precisely these standardized “reassuring products.” This creates a closed loop: consumers seek reassurance → this drives the JA standardization system → the system excludes niche and non-standard varieties → consumers have a narrower range of choices, but feel a stronger sense of “reassurance” regarding their existing options.

Ultimately, Japanese aesthetics pursue the ultimate in simplicity, harmony, and perfection. This aesthetic extends to food ingredients. A “good” vegetable must not only taste delicious but also look appealing—with a uniform shape, consistent size, vibrant color, and no blemishes. Behind this lies recognition of the producers’ “craftsmanship,” where farmers are viewed as artisans striving for perfection. JA’s vegetable sorting facilities are the institutional embodiment of this cultural demand. Through optical sensors and manual sorting, vegetables are strictly categorized into SS, S, M, and L grades, with all “non-conforming” products weeded out. Consumers have grown accustomed to seeing vegetables on store shelves that look as if they were “copied and pasted,” and they view this as a symbol of high quality. Domestic vegetables, especially those processed through the JA system, best satisfy this visual “obsession with perfection.” For niche or traditional varieties, however, their natural characteristics often include “irregular shapes” and “varying sizes.” Under JA’s stringent standards, most of these are classified as “substandard” or “out of specification,” barred from major distribution channels and sold at extremely low prices. Consequently, to gain market acceptance, producers are forced to choose “policy-designated varieties” that are easier to standardize, sacrificing the natural diversity of the crop.

Japanese consumers are not inherently averse to a diverse range of vegetables; rather, their cultural values systematically favor a specific type of vegetable—one that is safe, reassuring, visually perfect, in season, and has a story behind it (related to the producer or region). This cultural preference has solidified the categories of vegetables available, ultimately sacrificing vegetable diversity.

5. CONCLUSION

The paradox of vegetable diversity in Japan does not stem from a lack of natural resources, but rather from a triple lock-in involving “price stabilization policies—the JA distribution system—and sociocultural factors.” The price stabilization system ensures a steady supply of mainstream varieties, satisfying consumers’ basic needs for “peace of mind” and a “sense of seasonality.” Through standardization, the JA distribution system perfectly meets consumers’ exacting demands for “perfect appearance” and “peace of mind.” Consumers are immersed in a carefully crafted “high-quality, high-reassurance” consumption experience, yet they fail to realize that this experience itself comes at the expense of a broader world of vegetables that might offer greater flavor and cultural depth. Consumer inertia has fostered a system highly optimized to satisfy specific cultural preferences, ultimately sacrificing vegetable variety. The “triple lock” analytical framework developed in this paper not only offers a new perspective for understanding the Japanese context but also provides a crucial cautionary tale for other nations seeking to balance “efficiency, openness, and diversity” in their pursuit of agricultural modernization. Achieving truly diverse supply requires a systemic transformation encompassing production subsidies, distribution infrastructure, consumer culture, and global competitive strategies, with the ultimate goal of building a sustainable social system that meets basic needs while possessing sufficient resilience.

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