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Difference between Organic Vegetables and Pesticide-Free Vegetables

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ABSTRACT

In Japan, there are different names such as organic vegetables and pesticide-free vegetables for the same kind of crops (plants), depending on the types and amounts of fertilizers and pesticides used in the production process. They create price differences; only some consumers find differences in their commodity values (superiority or inferiority), and this becomes a reason that influences the decision to buy them. However, we believe that there are few consumers who fully understand the difference in names; in addition, there is a lack of understanding of the advantages and disadvantages. Just because something is expensive does not mean that it is safe or secure; we explain this in this paper. We discuss whether vegetables produced using the conventional production methods are very low in value, and whether pesticides and chemical fertilizers are bad.

INTRODUCTION

In Japan, there are different names for organic and pesticide-free vegetables depending on the type and number of fertilizers and pesticides used in the production process, even for the same type of crops (plants)[1)]. There are two types of organic vegetables in Japan: vegetables grown without the use of chemically synthesized fertilizers and pesticides (hereafter abbreviated as organic vegetable **Y**), and vegetables grown using non-chemically synthesized fertilizers (pesticides are undefined; hereafter abbreviated as organic vegetable **O**). They create price differences, and only some consumers find differences in their product values (superiority or inferiority), which drives their buying decision[2)]. Consumers who are particular about such vegetables often purchase them directly from farmers via the internet, from high-end mass retailers, or direct sales outlets along the roads called roadside stations, rather than from supermarkets in their neighborhoods. We believe that there are few consumers who fully understand the difference in names; in addition, there is a lack of understanding on the advantages and disadvantages of such specialized produce. In several countries, there are cases where labels on packages distinguish whether crops have been produced using ecological and sustainable development goal (SDG)-conscious production methods; however, the types differ depending on the country[3)].

In this study, we first show how such differences in names influence how crops are grown. Japanese people see this content on posters in supermarkets every day; therefore, we assume they have a basic knowledge. Subsequently, the advantages and disadvantages are discussed. In terms of the production method, it is expensive to remove pests and weeds by hand without relying on substances such as pesticides because the distribution volume is smaller than that of harvested crops. However, just because it is expensive does not necessarily mean it is safe or secure; therefore, this paper will explain the details. Finally, we discuss whether vegetables produced using conventional methods have really low values, and whether pesticides and chemical fertilizers are not good.

Production and distribution method of crops

To grow crops, a suitable field and proper care is necessary. There are variations in crop yield, color, shape, size, and other qualities. If the ground is too hard, it is difficult for plants to take

roots; therefore, it is necessary to plow (soften the soil) beforehand. Nutrients are essential for promoting growth; therefore, if the soil lacks sufficient nutrients, they must be supplemented in the form of fertilizers. In many cases, nutrients are depleted from the soil during the repeated growth of crops (because they are absorbed by plants). The quality of crops deteriorates unless the land is allowed to rest (creating a fallow period) or supplemented with fertilizer. Crops serve as food not only for people but also for wild animals and insects. Therefore, it is necessary to devise methods to prevent them from being consumed before harvesting. Fences are often built around fields to prevent wild animals from entering. Insect pests can be reduced through serial collection of insects by hand, the use of insecticides (a type of pesticide), and the release of beneficial insects (if they are beneficial to people, they are called beneficial insects) and other organisms that feed on insects. In addition, weeds affect production. In case of outdoor fields, the wind brings the seeds of other plants, resulting in weed growth. This can lead to nutrient depletion and impede crop growth. Solutions include removing plants other than the target crop by hand, spraying herbicides (also a type of pesticide), or releasing animals that eat weeds, such as ducks. The most common among these is the use of herbicides.

Many pesticides with different mechanisms of action have been developed, and the amounts and types to be used are determined strictly for each crop. This is because residual pesticides on the crops can be toxic to humans. In addition to chemical fertilizers developed artificially (also called inorganic fertilizers because of the presence of many inorganic substances), old organic fertilizers (close to natural fertilizers) are used sometimes. Chemical fertilizers, such as ammonium sulfate, are mainly used to supply nutrients such as nitrogen and phosphorus. Organic fertilizers are produced from incinerating harvested plants, rotting garbage, or human or livestock feces; many other ingredients coexist in addition to the necessary nutrients. It is characterized by the fact that it uses something that was not originally made as a fertilizer.

Agricultural Cooperatives have existed for long in Japan[4)]. They play a role in the stable supply of crop-based products, maintenance and management of price, and maintenance and guarantee of quality. Though it is a little different now, in the old days, it was common for these cooperatives to buy all crops grown by farmers at a fixed price and then ship them to the market to ensure that there was no variation in quality or price. There were certain standards for color, shape, size, and nutrients, and those that deviated from these were judged to be of low value or

not to be marketed. At the same time, the number of crops to be distributed was also adjusted. Farmers bring these products to direct sales stores, and there are ways to deliver the products via mail, making it easier for consumers to obtain products that do not meet JA standards.

What is pesticide-free vegetables and organic vegetables?

Crops are typically grown using fertilizers and pesticides. There is a belief among consumers that pesticides were bad for the human body and that fertilizers and chemical products (artificial ones) were not good. Therefore, a method that partially changed the production method became popular. These methods include pesticide-free and organic farming[5]. Vegetables produced in these ways are called pesticide-free organic vegetables. Table 1 shows the differences in the production methods of various types of vegetables. Table 2 outlines the advantages and disadvantages of pesticide-free organic vegetables. In Japan, producers (farmers) began selling these vegetables under various names. There is an appeal to produce vegetables using a special production method. This becomes an added value and vegetables are sold at higher prices. However, in 1992, the Ministry of Agriculture, Forestry, and Fisheries enacted the Labeling Guidelines for Organic and Specially Cultivated Crops because the definition was ambiguous or inconsistent, resulting in misunderstanding. Organic vegetables (**Y)** are defined as crops produced in fields treated with compost for two years or more before sowing or planting to avoid chemically synthesized fertilizers and pesticides[6]. These guidelines were not legally binding; therefore, products that did not meet this definition continued to be sold under various names, such as organic crops grown with reduced pesticides; this was confusing for consumers. Produce with the same name may not have the same standard. In April 2004, the Japanese Agricultural Standards (JAS) established standards for organic crops (equivalent to organic vegetables **Y**)[1]. Consequently, labeling the names of organic crops and foods made by processing organic crops is subject to the Act on JAS Law, and violations are subject to penalties[7]. In the second half of 2004, the Ministry of Agriculture, Forestry, and Fisheries established guidelines for specially cultivated crops, and it was no longer possible to add expressions such as no pesticides, reduced pesticides, no chemical fertilizers, or reduced chemical fertilizers to crops for sale[4].

Organic vegetable **Y** is sometimes interpreted as vegetables grown without using chemical fertilizers (inorganic fertilizers); however, in the past, even if some parts were replaced with

organic fertilizers, this name was used. Organic vegetable **O** was sometimes interpreted by consumers as vegetables grown using organic fertilizers or without adding fertilizers or pesticides; however, in reality, there are no regulations regarding pesticides. Currently, organic vegetable **O** is considered synonymous with organic vegetable **Y**, which are similar English expressions. In the case of pesticide-free vegetables, it is easy to assume that they are good for the body and safe because no pesticides are used. However, pesticides could have been used outside the cultivation period[8]. Alternatively, it could have been added to the soil instead of the crops. In addition, there are no strict standards or regulations that can prove the pesticide-free status[1]. This term can no longer be applied directly to vegetables; instead, the term, specially cultivated crops has emerged. Specially cultivated crops refer only to vegetables grown with a 50% or more reduction in the amount of pesticides and fertilizers used; therefore, the labeling will be the same irrespective of whether the reduction is 100% or 60%[6]. Consumers must procure product grown with the minimal use of pesticides and fertilizers; however, the production has not met this demand.

To compensate for this, private organizations have issued their own definitions. The definition of organic crops was independently determined by the Japan Organic Agriculture Association as follows: Organic crops do not use synthetic chemicals such as chemical fertilizers, pesticides, biopharmaceuticals, or radioactive materials throughout the process from production to consumption, and are produced by making the most of local resources and respecting the original productivity of nature. This definition is unique to the association, and when compared to that of JAS, it refers to specially cultivated crops that are closer to conventional pesticide-free vegetables. At present, this is the crop that uses the least chemicals in Japan.

Many organically grown vegetables do not meet the JA standards[4]. For example, cucumbers that are bent, yellow in color, too large, or too small are considered nonstandard. In addition, the amount harvested varies depending on the year and season. When grown naturally, it does not straighten and may turn yellow depending on how it is exposed to sunlight. In recent years, there is a trend where consumers prefer to buy things that are out-of-shape or covered with mud and, in some cases, produce that have caterpillars moving on the surface because consumers feel that these are indications of crops grown naturally. An increasing number of people want to buy freshly-harvested seasonal vegetables even for small quantities. In the right season, the seasonal

vegetables are harvested in larger quantities than that at other times; fresh vegetables are easier to obtain; they taste better and have more nutrients).

What difference does it make in quality and price?

In 2003, the Food Standard Agency of the United Kingdom stated that there was no evidence (scientific basis) that organic food was better. In 2006, there was evidence that milk from cows fed organic crops had higher ω-3 fatty acid content[9]. A study from the University of Newcastle, England reported that there was a general tendency for organic crops to contain more antioxidants and fewer lipids.

Wheat, tomatoes, potatoes, cabbage, and onions contained 20−40% more nutrients. In addition, the antioxidant content of milk from cows fed organic crops was 50−80% higher. However, the specific name of the substance was not disclosed in news reports at the time. There is a high possibility that these studies are limited and their credibility is low. In Japan, there are almost no such survey reports, and consumers are convinced that it is a good product, based on the assumptions of the producers and the advertisements from the farmers. We believe this is akin to a placebo effect.

The prices of vegetables vary greatly in Japan, owing to the different names mentioned above[2]. There are cases where the use of chemicals is reduced and a lot of work is required; however, quality control is difficult (such as in the case of worm-eaten produce and variations in size), and the lower the market volume, the more expensive it becomes. Among those listed in Table 1, specially cultivated crops are the most expensive, followed by organic vegetables; the cheapest are the conventional vegetables. Table 3 shows the price differences between organic and non-organic vegetables. Generally, vegetables that use more pesticides and chemical fertilizers are easier to grow and can be harvested in large quantities; therefore, they are sold in large quantities at low prices[2]. This can be attributed to the use of pesticides (insecticides and herbicides) and chemical fertilizers. Farmers can maintain a certain level of quality because they use pesticides and expect a large yield per unit area of field. This means that the production efficiency is high[1]. It does not require much labor, making it easy for new farmers to begin. Organic farming methods may increase the concentration of nutrients by using a lot of labor without using chemical substances; however, it is possible to obtain the same amount of nutrients through an

increased consumption of vegetables. Therefore, it may not always be necessary to choose anything other than vegetables. The price difference between organic and conventionally-grown vegetables was approximately two times; however, the difference in nutrient content was not significant (Table 3). Chemicals such as pesticides exacerbate diseases such as allergies[10]. Therefore, use of pesticide-free vegetables could be beneficial for such patients.

Examples of classification in foreign countries

As an example, from other countries, we would like to introduce organic farming in the Philippines. In developing countries, also called as emerging countries, especially in Asia and Latin America, there is a movement to promote environmental conservation in agriculture[3]. The governments in each of these countries are responsible for promoting and disseminating knowledge on environmental conserving agriculture. In line with government policies, NGOs and social businesses are involved in various activities at the grass-root level.

The Japanese Ministry of Agriculture, Forestry, and Fisheries defines environmental conservation agriculture as follows: sustainable agriculture that takes advantage of the material circulation function of agriculture and pays attention to harmony with productivity while considering the reduction of the environmental burden caused by the use of chemical fertilizers and pesticides through soil preparation[6]. Based on this definition, organic farming, which is considered the most environmental friendly farming method in Japan, can be considered a form of environmental conservation agriculture. In Japan, there are various other names, such as reduced pesticide farming methods, but there are few such types overseas, including in the Philippines.

Organic farming is widely deployed in environmental conserving agriculture in the Philippines. In rural areas, environmental ministries, NGOs, universities, and local governments, centered on the Ministry of Agriculture, are developing a wide variety of organic farming promotion projects using various approaches. Organic farming in the Philippines is strictly defined by Philippine law; therefore, it has a meaning different from that for the organic farming led by private companies in Japan. Therefore, caution is required when using the term organic farming in the Philippines. The definition of organic farming in the Philippines is as follows: Organic agriculture includes all agricultural systems for food and fiber production that are ecologically

friendly, socially acceptable, and economically and technically feasible. Organic farming dramatically reduces external inputs by avoiding the use of chemical fertilizers and pesticides. This implies the use of science and technology in accordance with the principles of this law, such as selective breeding in the absence of chemicals, pesticides, and natural selection. This also means, but is not limited to, complying with cultural practices and increasing productivity without causing soil destruction or health hazards to farmers and consumers. In other words, it is performed without the use of chemicals and more strictly than the specially cultivated Japanese crops.

Why are governments in developing countries and NGOs putting effort into the spread of environmental conserving agriculture? There are five possible objectives for promoting environmental conserving agriculture in developing countries: **A**) environmental conservation, **B**) livelihood improvement for producers (small farmers), **C**) social justice (social equity), **D**) improving public health, and **E**) adaptation to climate change. Among them, the most important is **B**) (including **C**), in the perspective of the government[3)]. Originally, it should have been **A**) or **E**); however, priority was given to maintaining individual interests and living standards. Even small-scale farmers can earn a living and continue farming if they grow and sell special crops.

CONCLUSION

In Japan, adding value to ordinary crops, in the form of organic vegetables and pesticide-free vegetables, creates an image of high value and contributes to price increase[2)]. Organic vegetables are currently produced using limited amounts and types of pesticides and fertilizers. There was a misconception that pesticides were never used on pesticide-free vegetables. Therefore, the name could not be used; the crops were reclassified as specially cultivated crops. However, this name is not completely synonymous because it only refers to reduced pesticides and fertilizers. There are similar special names overseas, but not as many as in Japan. Such names were not conferred by the private sector to make profits, but the governments of each country enacted laws to differentiate the crops and protect the farmers.

It is difficult to produce crops with a uniform color, shape, size, and nutrients. The more labor a farmer puts in, the higher the price. Unfortunately, not everyone considers these special vegetables to be of high quality, and as a result, the market is not very large. We do not

necessarily believe that organic vegetables are of high quality. This is because organic fertilizers are not always harmless[11]. They may contain parasites and harmful chemicals[12]. Generally, chemical fertilizers and pesticides cannot be considered nontoxic; however, the amounts to be used are strictly determined, and if properly used, they rarely exhibit harmful effects. Therefore, it may be preferable to consume general vegetables to ensure safety. The conclusion is that there is no need to buy expensive vegetables such as organic vegetables. Alternatively, if very particular, the consumers could obtain specialty crops from trusted vendors.

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Table 1 Differences in vegetable types and production methods

Name	Definition		Price
	Past (until March 2000)	Now (from April 2000)	
General vegetables	Vegetables grown without restrictions on pesticides and fertilizers.	Vegetables grown without restrictions on pesticides and fertilizers. Or vegetables that cannot appeal that the type and amount of fertilizer is limited (such as the manufacturing method cannot be disclosed properly).	Cheap
Organic vegetables **Y**	Vegetables grown using a method called organic farming, which does not use chemical fertilizers or pesticides. However, even when the cultivation used less pesticides and fertilizers, this name was used.	Vegetables grown using only designated pesticides and organic fertilizers derived from plants and animals such as fishmeal and oil cake. Vegetables that meet the requirements of the "organic JAS standard" established by the Ministry of Agriculture, Forestry and Fisheries.	Middle
Organic vegetables **O**	General vegetables grown with organic fertilizers (other than chemically synthesized fertilizers) such as kitchen waste sediments and livestock excrement. Pesticides are ambiguous (use, reduce, no chemicals, etc.).	Same meaning as organic vegetables **Y**. Vegetables that use organic fertilizers and only use specified pesticides.	
(Pesticide-free vegetables)	Vegetables grown without the use of pesticides during the cultivation period. The type and amount of fertilizer to be used has not been determined.	× Currently, this notation cannot be described at the time of sale (instead, the name "specially-cultivated crops" was created). The term is still used in oral reports.	-
(Reduced pesticide vegetables)	Vegetables grown with reduced pesticides during the cultivation period. How much is reduced depends on the farmer's discretion. The type and amount of fertilizer to be used has not been determined.	× Currently, this notation cannot be described at the time of sale. (Instead, the name "specially-cultivated crops"" was created).	-

(No chemical fertilizer vegetables)	Vegetables grown without the use of chemical fertilizers (mostly inorganic) during the cultivation period. The types and amounts of pesticides have not been determined.	× Currently, this notation cannot be described at the time of sale. (Instead, the name “specially-cultivated crops”" was created).	-
(Vegetables with reduced chemical fertilizers)	Vegetables grown without chemical fertilizers during the growing season. How much is reduced depends on the individual farmer's discretion. The types and amounts of pesticides have not been determined.	× Currently, this notation cannot be described at the time of sale. (Instead, the name “specially-cultivated crops”" was created).	-
Specially-cultivated crops	× An expression that did not exist in the past (a name that appeared in place of “pesticide-free vegetables”)	Agricultural crops grown with less than 50% use of pesticides targeted for reduction and less than 50% of the nitrogen content of chemical fertilizers compared to local practice levels.	High

Classified according to the type and amount of pesticides and chemical fertilizers used.

In 2004, expressions such as no pesticides, ‘reduced pesticides,’ no chemical fertilizers, and reduced chemical fertilizers were banned.

Based on references 5), 7).

Table 2 Advantages and disadvantages of vegetable types

Vegetable type	Advantages	Disadvantages
General vegetables	Most widely marketed. It is possible to select and purchase from the production area. According to the standard by JA, the shape is often constant. Cheapest price.	△Pesticides and chemical fertilizers are used in normal amounts (this is a disadvantage for those who are concerned and those with related diseases).
Organic vegetables	Health-conscious (slightly reduced risk of pesticides). △The taste is rich and delicious. The farmer may appear on the label. Environmentally friendly (fields are less likely to be contaminated with agricultural chemicals). △High nutritional value.	Shape tends to be irregular. Tend to be expensive. Not yet familiar (compared to normal vegetables, sales places are limited).
Specially-cultivated crops	Health-conscious. The risk of pesticides and chemical fertilizers is low but varies by product. Farmers are often listed on the label.	Even the shape, size, and color may not be considered. Price is high. Not circulated in large numbers. There is no obligation to display how much pesticides have been reduced.
(Pesticide-free vegetables)	Can reduce the risk of pesticides. △People can feel the taste of vegetables firmly. The farmer may appear on the label. △If people do not have to worry about yield or quality, it can be regarded as a simple method (because people can leave it as it is for the most part). △High nutritional value (increased worm-eaten vegetables).	Irregular shape Expensive Better known than organic vegetables. Due to the name change (→ specially-cultivated crops), the characteristics have become difficult to understand.

Many of the descriptions are in comparison with general vegetables.

△ indicates content that cannot necessarily be said to be an advantage or disadvantage.

Based on the contents of references 5) and 6).

Table 3 Price difference between organic vegetables and ordinary vegetables

Purchase unit	Vegetable type	Price (Japanese yen)					Price ratio (E/D)
		General vegetables				Organic vegetables average (E)	
		Supermarket A	Supermarket B	Supermarket C	Supermarket D		
Per bag	Cucumber	57	38	59	51	100	2.0
	Eggplant	59	66	68	64	180	2.8
	Tomato	97	45	100	81	150	1.9
	Spinach	147	178	198	174	300	1.7
	Cabbage	127	198	148	158	300	1.9
Per month consumption	Cucumber	1083	722	1121	975	1900	1.9
	Eggplant	649	726	748	708	1100	1.6
	Tomato	1843	855	1900	1533	2850	1.9
	Spinach	441	534	594	523	900	1.7
	Cabbage	762	1188	888	946	1800	1.9

We compared the average price of organic vegetables with that of ordinary vegetables sold in supermarkets.

The amount of vegetables in a bag can be approximately considered to be of constant weight.

Monthly vegetable consumption was calculated using national averages. However, the amount varies slightly depending on the region and season.

The price ratio indicates the price of organic vegetables over that of regular vegetables, which is an approximate two-fold difference.

Based on the contents of reference 13).