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The Structure of Female Consumer Awareness in Purchasing Foods with Fukushima-Sourced Ingredients: The Situation over a Five-Year Period Following the 2011 Earthquake off the Pacific Coast of Tohoku

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Abstract On March 11, 2011, the Tohoku-Pacific Ocean Earthquake struck offshore Sanriku in Japan, and a nuclear accident occurred in Fukushima Prefecture. The purpose of this study is to identify the structure of purchase awareness regarding foods with Fukushima-sourced ingredients, focusing on three types: fresh agricultural products, sliced and packed vegetables, and box lunches. In March 2018, a web-based questionnaire survey was conducted in the urban areas of Tokyo and Osaka Prefecture. We applied the framework of dual-process theory and carried out a covariance structure analysis. This study showed the possibility that, as with fresh agricultural products from Fukushima, purchases of sliced and packed vegetables and box lunches from Fukushima were also being inhibited by consumers' awareness of "Anxiety about radiation and nuclear power plants."

Keywords Fukushima, Fresh agricultural products, Sliced and packed vegetables, Box lunches

1. Introduction

On March 11, 2011, an earthquake, with its epicenter located off the coast of Sanriku, brought about devastation to the Tohoku region in northeast Japan. It caused a nuclear accident at the Fukushima Daiichi Nuclear Power Plant, during which radioactive substances were released. The soil and agricultural produce in the area were suspected to have been contaminated in the aftermath of the accident, and the government issued evacuation orders to area residents as well as orders to restrict the shipment of local produce.

Agricultural products are currently subject to radioactivity inspections. Under the existing system, items containing radioactive substances below certain criteria are distributed and consumed in the same way as all other produce. However, the prices of agricultural and other products from Fukushima Prefecture, where the accident occurred, have still not returned to pre-disaster levels, though they are gradually rising towards the national average [1].

One cause for lower demand may be the consumers' reluctance to purchase them. Ohtomo and Hirose [2] describe consumers' guarded response to foodstuffs from disaster-affected areas as a secondary disaster brought about by social circumstances in the event's aftermath. They point out that these feelings of reluctance are preventing the economic recovery of not only the disaster-hit areas but of the surrounding regions. It is therefore important to identify the contextual background to such behaviors.

Several studies have been published on purchasing behaviors regarding foodstuffs from Fukushima Prefecture as well as the surrounding regions. One study on the reluctance to buy foodstuffs originating from Fukushima Prefecture after the 2011 earthquake found that consumers' purchase behaviors for agricultural products from Fukushima vary by type, including rational reasons, which take health risks into consideration, and emotional reasons, which result in reluctance to make purchases [3]. Another study, Kudo and Nakayachi [4], has used covariance structure analysis by following the dual-process theory model to investigate the factors that influence the intentions to purchase agricultural products from Fukushima Prefecture, which is common in applied psychology. They extracted two factors that influence purchase intentions: (a) "Anxiety about radiation and nuclear power plants" and

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"Support for disaster-stricken areas," for System 1, which comprises emotional aspects of decision making; and (b) two factors, "Knowledge-based judgment" and "Rational judgment" for System 2, which comprises objective, logical reasoning. They revealed that "Knowledge-based judgment" and "Rational judgment" which are included in System 2 reduce "Anxiety about radiation and nuclear power plants" and enhance "Support for disaster-stricken areas." They also showed that "Support for disaster-stricken areas" promoted purchase intentions.

A second study, Hori et al. [5], studied and compared the structure of consumers' purchase awareness regarding agricultural and, additionally, marine products from Fukushima Prefecture. They revealed that the dual-process theory's two systems had acted on marine products in the same way as on agricultural products. On the other hand, they noted that, unlike for agricultural products, rational judgment, a System 2 factor, was not confirmed to have affected the intention to purchase marine products. Their findings suggest that the amount of available information on radioactive contamination concerning marine products was insufficient in comparison with that for agricultural products.

These two studies analysed data as of 2013 and 2014, shortly after the earthquake had occurred off the Pacific coast of Tohoku in 2011 (Kudo and Nakayachi [4]; Hori et al., [5]), and no studies have been conducted since. They are extremely important in shedding light on consumers' feelings about agricultural products when faced with unprecedented situations. However, because consumer awareness is likely to have changed with elapsed time, we feel that ongoing investigations are also needed in terms of advancing risk studies and policy responses.

The Japanese are dramatically outsourcing their food preparation, increasing their purchases of ready-make foods, as well as complete meals. Home meal substitutes are seeing rapid growth. (These are precooked, ready-made foods that do not keep for a long time, such as boxed lunches and side dishes which are cooked and processed outside the home, and brought back to home, office, schools, and outdoors to be eaten immediately, without cooking or heating [6]). The size of the market for these products, which was worth 8.2156 trillion yen in 2008, had reached 10.2518 trillion yen in 2018. Japan's National Dietary Guidelines [7] recommend "combining home-cooked meals with ready-made meals" to ensure a healthy diet. The Japanese are increasingly reliant on ready-made meals, and, because of this outsourcing, monitoring purchase intentions of pre-prepared food products and complete meals, can be said to be an important perspective in this study as well. Avoiding agricultural products from Fukushima is likely to affect not only fresh agricultural produce but also processed foods that incorporate such products as ingredients. Thus, there is a need to understand the structure of consumer awareness for processed foods as well. With discussions currently under way on the mandatory labeling of place of origin of processed foods, there is an increasingly urgent need to investigate people's awareness of purchasing processed foods that are labeled as originating in Fukushima Prefecture.

This study aims to identify the structure of consumers' awareness about purchasing foods that incorporate agricultural products from Fukushima Prefecture as ingredients (hereafter "foods with Fukushima-sourced ingredients"), especially three categories, fresh agricultural products, sliced and packed vegetables, and box lunches.

2. Materials and Methods

The methods of approaching these tasks are as follows. First, in Analysis 1, to confirm consumers' current awareness of agricultural products from Fukushima Prefecture, as well as type of purchase awareness, we compared data with the original studies in 2013. Consumers' awareness is likely to have changed with the elapsed time. Past studies have pointed out that the importance of consumer education has not been examined because various educational efforts have occurred since 2013. System 2 (logical aspects) is believed to influence purchase intentions to a greater extent, which in turn also influences System 1 (emotional aspects), which would likely result in influencing intentions.

Next, in Analysis 2, we confirmed the structure of purchase awareness towards not only fresh agricultural products from Fukushima, but also towards sliced and packed vegetables and box lunches, which are processed foods that use agricultural products from Fukushima. As described above, Hori et al. [5] explained that the results differed between agricultural products and marine products, since information on radioactive contamination of marine products was lacking. Because of this, the researchers note the possibility that consumers were less able to make rational judgments that would lead to purchases of marine products, minimizing their influence as a result, and stated the need to release more information. In other words, a situation in which information is being provided is necessary to activate System 2. Information on radioactivity inspections and other matters is being disclosed for fresh agricultural products, but processed foods such as sliced and packed vegetables and box lunches are not required to be labeled with their place of origin, showing that consumer-usable information may be lacking. In the light of these past studies and the current requirements for food labeling, consumers cannot obtain sufficient information when buying sliced and packed vegetables and box lunches, so System 2 is anticipated to be less influence on purchase intentions regarding these latter items than for fresh agricultural products.

2.1. Framework

As stated above, this study employs the framework of the dual-process theory used by Kudo and Nakayachi [4] and Hori et al. [5] to understand the structure of awareness in purchasing foods with Fukushima-sourced ingredients by

covariance structure analysis.

Dual-process theory presupposes that humans have two modes of information processing: System 1 enables emotional decision-making, and System 2 enables logical decision-making (Kahneman and Frederick [8], [9]; Kaneko [10]; Evans [11], [12]). Between these two forms of information processing, one involves intuitive, automatic, and emotional information processing while the other involves logical, rational, regulative, and neutral information processing (Evans [12]). These two forms of information processing are variously termed. Following Stanovich [13], in this study, we refer to them as System 1 and System 2. With respect to dual-process theory, Kaneko [10] pointed out that the substance of two information processing modes, as well as the conception of information processing, varies according to theorists. To examine dual-process theory, the elaboration likelihood model (ELM) and the heuristic- systematic model (HSM) have hitherto been proposed. According to the ELM, information processing that triggers attitude changes in response to someone's persuasion can follow either the central route or the peripheral route (Petty and Wegener [14]). According to the HSM, there are two modes of information processing, with one mode dealing with systematic information processing that enables careful thinking and the other mode dealing with heuristic information processing that enables understanding with ease. When the validity of heuristic information is denied by the function of systematic information processing, heuristic information is suppressed (Chaiken [15]; Chaiken et al. [16]; Chen and Chaiken [17]). These studies vary in the kind of information dealt with in each system and in interactions between the systems, according to the models they developed. However, they are in accordance that human decision making depends on two systems rather than a single system.

In light of the existence of two modes of human information processing thus observed, Kudo and Nakayachi [4] and Hori et al. [5] revealed that, in forming an intention to purchase foods with Fukushima-sourced ingredients, the logical System 2 influenced the emotional System 1. Following these study trends, we used Kudo and Nakayachi's [4] model, which successfully captured the structure of awareness in purchasing agricultural produce as a main tool and partially adopted Hori et al.' [5] model (see Figure 1). In both Kudo and Nakayachi' [4] and Hori et al.' [5] models, System 1 was assumed to be related to "support for disaster-stricken areas" and "anxiety about radiation and nuclear power plants," and System 2 was assumed to be "knowledge-based judgment (judgment used to suppress reluctance for making purchases by obtaining accurate knowledge on radioactivity and foods)" and "rational judgment (theoretical and hypothetical judgment)" in identifying the effects on "purchasing intention."

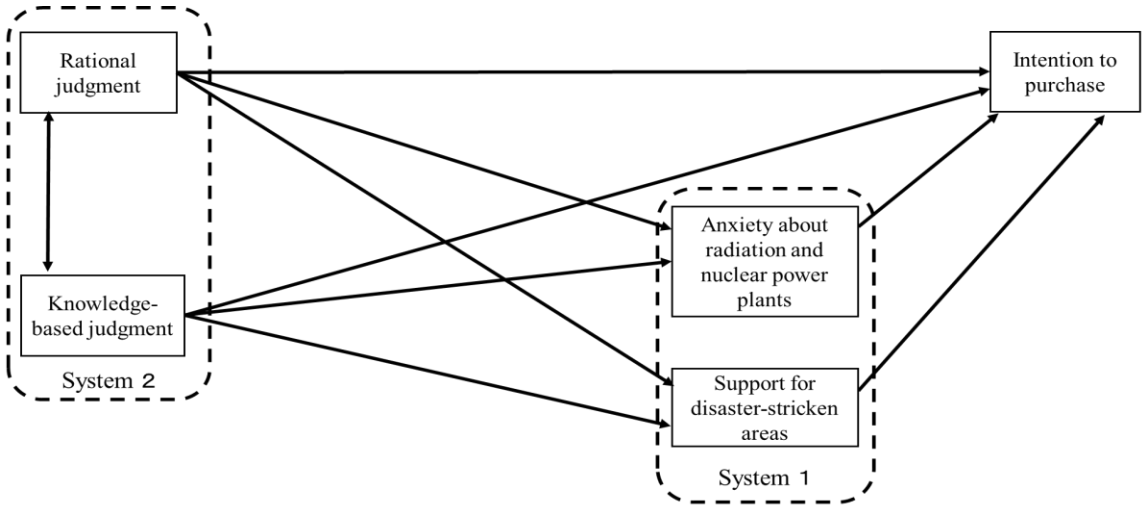

Figure 1. A model of purchasing consciousness for foods using materials from Fukushima Prefecture

First, in Kudo and Nakayachi's [4] model, which was used as a main tool of the present study, "knowledge-based judgment," "rational judgment," and "support for disaster-stricken areas" all promoted purchasing intention. In contrast, they suppressed "anxiety about radiation and nuclear power plants." Further, "knowledge-based judgment" and "rational judgment" suppressed "anxiety about radiation and nuclear power plants" and promoted "support for disaster-stricken areas." Since Kudo and Nakayachi [4] examined agricultural produce and the present study seeks to identify the structure of awareness in purchasing agricultural produce, the structure of purchasing awareness that the present study tries to reveal is expected to bear an overall similarity to that of Kudo and Nakayachi.

Second, Hori et al. [5] observed a correlation between "knowledge-based judgment" and "rational judgment." This is not found in the model of Kudo and Nakayachi [4], who conducted their survey in June 2013. In comparison, Hori et al. [5] conducted a survey in December 2015 when people were considered to be more informed about foods with Fukushima-sourced ingredients. Information on foods with Fukushima-sourced ingredients became more disseminated

with the passage of time, and consumers are considered to be making judgments based on such knowledge. Therefore, in the present study, we adopted the model that showed a correlation between "knowledge-based judgment" and "rational judgment."

2.2. Survey Participants

A web-based questionnaire survey was conducted in March 2018, seven years after the earthquake had occurred, in the urban areas of Tokyo and Osaka Prefecture. We obtained data from 305 women aged 20s to 70s who had purchased foodstuffs within the past month, and excluded incomplete questionnaires, for a total of 258 women for analysis (Table 1). To understand consumer awareness in food purchasing, we examined only women, as they represented a high proportion of those who played the role of the household chef in Japan.

Table 1. Demographic characteristics of the sample (n = 258)

Gender	
Male	0 %
Female	100 %
Age	
20-29	14.3 %
30-39	18.2 %
40-49	20.9 %
50-59	14.3 %
60-69	17.8 %
70-79	14.3 %
Per capita annual income（yen）	
less than 2 million	8.5 %
2 million to less than 4 million	26.0 %
4 million to less than 6 million	19.0 %
6 million to less than 8 million	16.3 %
more than 8 million	16.2 %
No Answer	14.0 %
Area of residence	
Tokyo	49.6 %
Osaka	50.4 %

2.3. Questionnaire

We aimed to clarify the relationship between the subjects' awareness of foods with Fukushima-sourced ingredients and their intentions to purchase them using a questionnaire.

Initial questions addressed the participant's purchase intentions and the following questions addressed System 1 and System 2 factors. Purchase intentions were determined by multiple choice responses of "I would want to actually buy it," "I would buy it if I saw it in a store," "I might try buying it as a test," "I would rather not buy it myself," and "I would hesitate to buy it."

The four factors that we examined were consumer awareness, anxiety about radiation and nuclear power plants, knowledge-based judgement, and rational judgement. Regarding awareness, as the factor for "Support for disaster-stricken areas," we selected four items, namely, "I want to support the farmers in that region," "I don't think we should be prejudiced about the place of origin," "I don't intend to eat agricultural products from that region just to support them," "I strongly want to buy them to support the farmers in that region."

For the factors for "Anxiety about radiation and nuclear power plants," we selected four items, namely, "I'm afraid of contamination by radioactive substances," "I worry that eating these products will expose me to radiation," "I have no particular anxiety about radiation," and "I worry about the impact of the nuclear accident."

For the "Knowledge-based judgment" factors, we selected four, namely, "The products cannot be guaranteed as safe, since some radioactive substances have extremely long half-lives," "They are safe, since the relevant government agencies publish safety information," "The influence of radiation is slight since time has passed," and "They are safe since they have undergone thorough radioactivity inspections"; and as the factors for "Rational judgment," we had four items, namely, "I would buy them if they are cheaper than agricultural products from other prefectures," "I would check their place of origin and prioritize safety over price," "I would avoid them, since the grounds for claiming that no radioactive substances have been detected are unclear," "We cannot necessarily say that radioactive substances are attached to agricultural products."

Similar to prior studies, the subjects were asked to answer survey items on a 7-point scale from "Strongly disagree" to "Strongly agree." For the above items, we showed the subjects three types of products: fresh agricultural products from Fukushima, sliced and packed vegetables (salad to be eaten raw) from Fukushima, and box lunches from Fukushima (pre-cooked foods sold at convenience stores and supermarkets that can be eaten immediately after purchase). We then asked them questions about each one and compared their type purchase awareness. The sliced and packed vegetables and box lunches from Fukushima were labeled as products that used materials from Fukushima, but we did not specify where they were manufactured or sold.

3. Results

3.1. Analysis 1: Consumers' Awareness of Agricultural Products from Fukushima Prefecture and the Structure of Their Purchase Awareness

First, to confirm internal consistency in the question items, we calculated Cronbach's coefficient of reliability (α) as an index of reliability. The results showed that the α-coefficients were within range for various factors regarding agricultural products from Fukushima were 0.82

for "Support for disaster-stricken areas," 0.91 for "Anxiety about radiation and nuclear power plants," 0.92 for "Knowledge-based judgment," 0.80 for "Rational judgment," and 0.94 for "Intention to purchase." A coefficient of about 0.7 or 0.8 would generally be judged as valid [18], so these results appear to confirm the reliability of each of these factors (Table 2).

Second, we compared the average scores of consumers' awareness of agricultural products obtained by Kudo and Nakayachi [4] (the 2013 data), and the average scores for 2018 gained in this study. Under normal circumstances, statistical tests should have been performed on the data for 2013 and 2018; however, no such tests were conducted, since we could not obtain the data for 2013 that Kudo and Nakayachi [4] used.

While "Anxiety about radiation and nuclear power plants" included in System 1 scored 4.46 points in 2013, it was 3.62 points in 2018. This suggests that the respondents' anxiety about radiation was steadily decreasing. The scores for "Support for disaster-stricken areas" were 4.92 points in 2013 and 4.69 points in 2018. Although "Knowledge-based judgment," included in System 2, scored 3.46 points in 2013, it was 4.18 points in 2018; and while "Rational judgment" scored 3.84 points in 2013, it was 4.46 points in 2018. With System 2, a tendency was seen for the scores to increase from 2013 to 2018: the scores for "Intention to purchase" were 4.93 points in 2013, and 4.44 points in 2018.

Third, to make a comparison with Kudo and Nakayachi's [4] purchase-determining model, we calculated the structure of purchase awareness regarding foods with Fukushima-sourced ingredients using a similar method.

Regarding the models' goodness of fit with the agricultural products data, GFI was 0.990, AGFI was 0.843, CFI was 0.984, and RMSEA was 0.093, so it was judged that the models showed a favorable fit with the data (Figure 2).

The results show that the dual-process theory's two systems had acted on consumers' purchase intentions. Specifically, we obtained results that showed that the factors "Rational judgment," "Knowledge-based judgment," and "Support for disaster-stricken areas" showed positive values regarding "Intention to purchase," indicating that these factors promoted purchases, whereas "Anxiety about radiation and nuclear power plants" showed negative values regarding "Intention to purchase," reducing purchases.

A tendency different from that seen in the 2013 data featured in past research was evident, in that a correlation was seen between "Rational judgment" and "Knowledge-based judgment," with the standardized partial regression coefficient (β) showing a value exceeding 0.8, which was higher than between other factors. Moreover, whereas in the 2013 data, "Rational judgment" showed the largest value of 0.53 regarding "Support for disaster-stricken areas," in the 2018 data, "Knowledge-based judgment" showed the largest value of 0.86 regarding "Support for disaster-stricken areas."

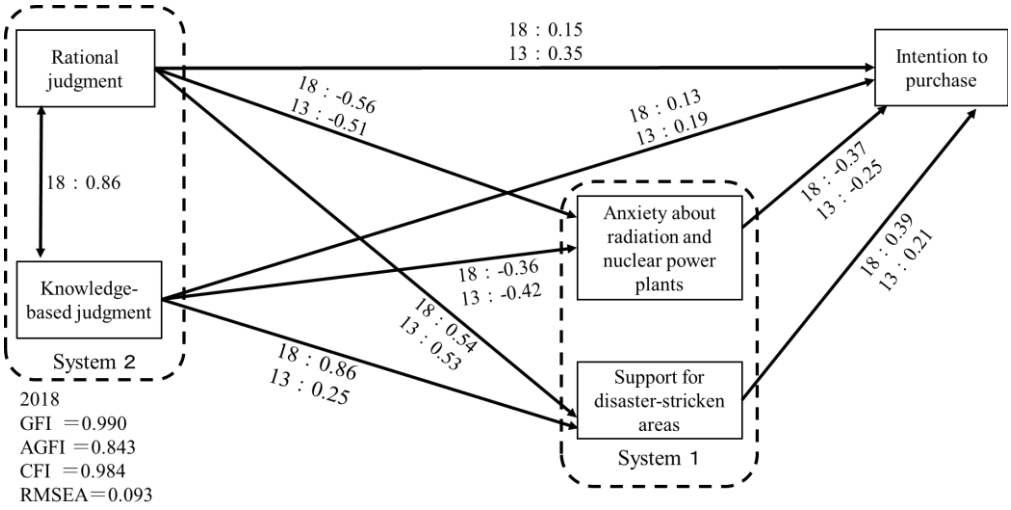

Figure 2. Structure of purchase awareness towards fresh agricultural products from Fukushima Prefecture Note: 18 shows the data of this study, 13 shows the data of Kudo and Nakayachi [4]

3.2. Analysis 2: Structure of Purchase Awareness Towards Sliced and Packed Vegetables and Box Lunches from Fukushima Prefecture

As with agricultural products, we calculated Cronbach's coefficient of reliability (α) as an index of reliability to confirm the internal consistency in the question items for sliced and packed vegetables and box lunches. The results showed that α-coefficients were within range of the factors of "Support for disaster-stricken areas," "Anxiety about radiation and nuclear power plants," "Knowledge-based judgment," "Rational judgment," and "Intention to purchase" were 0.82, 0.90, 0.88, 0.77, and 0.93, respectively, regarding sliced and packed vegetables, and 0.82, 0.87, 0.83, 0.75, and 0.92, respectively, regarding box lunches. These results are regarded to indicate the reliability of the various factors (Table 2).

Next, we confirmed the average scores for sliced and

packed vegetables and box lunches, and found that, with "Support for disaster-stricken areas," which is a factor included in System 1, the score was 4.70 points for sliced and packed vegetables and 4.74 points for box lunches; and, with "Anxiety about radiation and nuclear power plants," the score was 3.63 points for sliced and packed vegetables, and 3.71 points for box lunches. With "Knowledge-based judgment," which is a factor included in System 2, the score was 4.22 points for sliced and packed vegetables, and 4.18 points for box lunches; and, with "Anxiety about radiation and nuclear power plants," the score was 4.44 points for sliced and packed vegetables and 4.45 points for box lunches. Regarding purchase intentions, moreover, the score was 4.30 points for sliced and packed vegetables and 4.40 points for box lunches. A three-party comparison was made among fresh agricultural products and sliced and packed vegetables/box lunches, but no significant differences were seen: sliced and packed vegetables and box lunches showed more or less the same tendency as fresh agricultural products.

We then calculated the structure of purchase awareness regarding sliced and packed vegetables and box lunches from Fukushima. Regarding the models' goodness of fit with the data for sliced and packed vegetables, GFI was 1,000, AGFI was 0.996, CFI was 1.000, and RMSEA was 0.093, and, for box lunches, GFI was 1,000, AGFI was 0.999, CFI was 1.000, and RMSEA was 0.093. Both models were therefore judged to show a favorable fit with the data (Figure 3, Figure 4).

This study targeting fresh agricultural products from Fukushima as well as sliced and packed vegetables and box lunches also provided evidence to support the dual-process theory's two systems had acted on consumers' purchase intentions. This is consistent with both earlier studies examining agricultural products and marine products (Kudo and Nakayachi [4]; Hori et al. [5]).

Moreover, as in the case of fresh agricultural products, even with sliced and packed vegetables and box lunches, "Rational judgment," "Knowledge-based judgment," and "Support for disaster-stricken areas" showed positive values regarding "Intention to Purchase," so we can see that these factors promote purchasing. On the other hand, "Anxiety about radiation and nuclear power plants" showed negative values regarding "Intention to purchase," which is a result indicating that it suppresses purchases. A correlation was also seen between "Rational judgment" and "Knowledge-based judgment" for all three food items, with the standardized partial regression coefficient (β) exceeding 0.8, a higher value compared with other factors.

Table 2. Mean for each factor and Cronbach's coefficient of reliability (α)

		Kudo and Nakayachi [4]		This study					
		fresh agricultural products (2013 data)		fresh agricultural products (2018 data)		sliced and packed vegetables (2018 data)		box lunches (2018 data)	
		M	α	M	α	M	α	M	α
System 1	Support for disaster-stricken areas	4.92	0.85	4.69	0.82	4.70	0.82	4.74	0.82
	Anxiety about radiation and nuclear power plants	4.46	0.86	3.62	0.91	3.63	0.90	3.71	0.87
System 2	Knowledge-based judgment	3.46	0.88	4.18	0.92	4.22	0.88	4.18	0.83
	Rational judgment	3.99	0.77	4.46	0.80	4.44	0.77	4.45	0.75
	Intention to purchase	4.93	0.96	4.44	0.94	4.30	0.93	4.40	0.92

Note:Answers were made using the seven-item method. The higher the average score, the stronger the awareness of each factor.

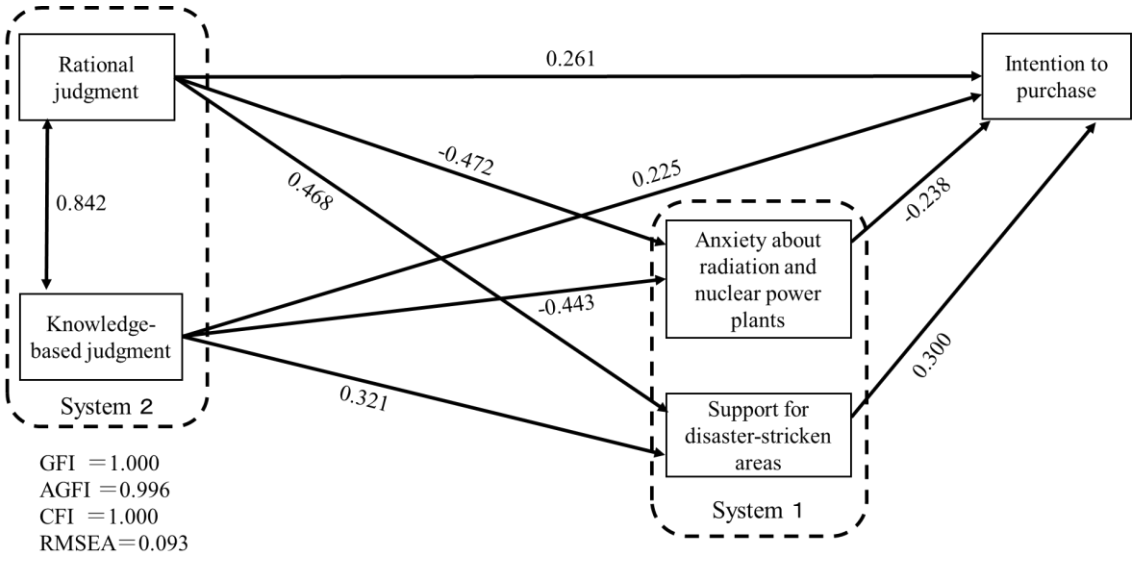

Figure 3. Structure of purchase awareness towards sliced and packed vegetables from Fukushima Prefecture

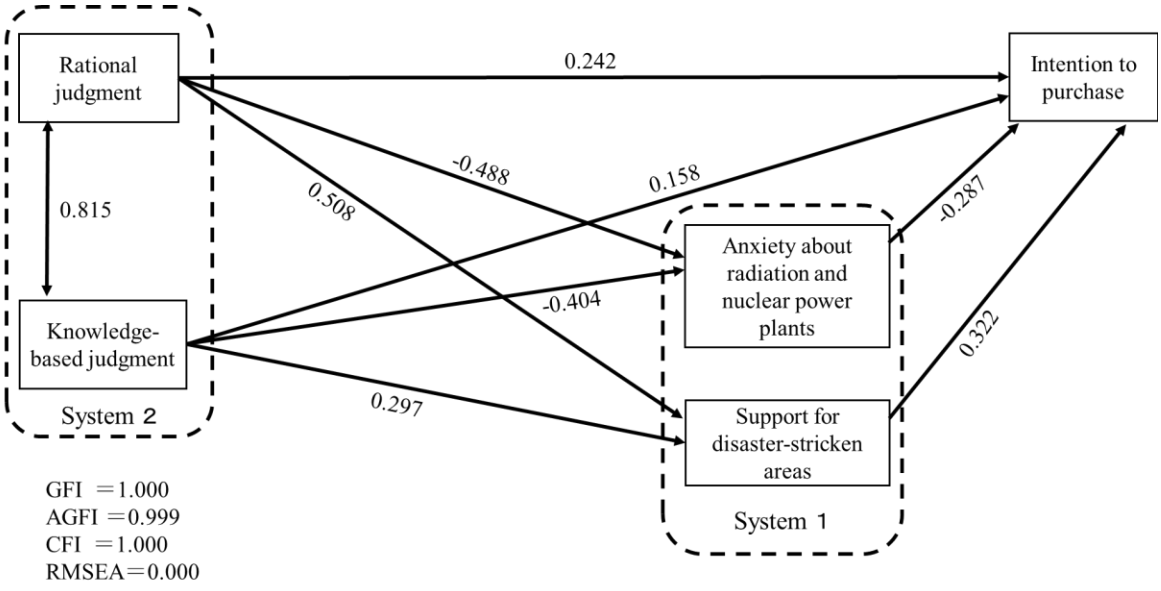

Figure 4. Structure of purchase awareness towards box lunches from Fukushima Prefecture

Next, to investigate the tendencies for each food item, we checked the standardized partial regression coefficient (β). All three types of food items, including fresh agricultural products, showed a correlation between "Rational judgment" and "Knowledge-based judgment," showing the largest value within each of the models. As for the relationship between other factors, with fresh agricultural products, "Knowledge-based judgment" showed the highest value regarding "Support for disaster-stricken areas" of 0.855. With sliced and packed vegetables, "Rational judgment" had the greatest influence on "Anxiety about radiation and nuclear power plants" at –0.472, followed by "Rational judgment" regarding "Support for disaster-stricken areas" at 0.468. With box lunches, "Rational judgment" had the greatest influence on "Support for disaster-stricken areas," at 0.508, followed by "Rational judgment" regarding "Anxiety about radiation and nuclear power plants" at –0.488.

4. Discussion

The purpose of this study was to identify the structure of purchase awareness regarding foods with Fukushima-sourced ingredients, focusing on three types: fresh agricultural products, sliced and packed vegetables, and box lunches. In this more recent study, it became clear that, similar to Kudo and Nakayachi [4]'s study on fresh agricultural products in 2013 and Hori et al.'s [5] study on marine products in 2013, the dual-process theory's two systems could act on consumers' purchase intentions. To summarize this study, the following two items can be noted.

First, Analysis 1 showed that the decrease of purchasing agricultural products from Fukushima weakened in 2018 compared to 2013, for the likely reason that consumer education strategies during the 5-year period were effective.

We compared the average scores for consumer awareness of fresh agricultural products from Fukushima (2013 data) and the average scores for 2018 obtained through this study. The results showed that, while the score for "Anxiety about radiation and nuclear power plants," a factor included in System 1, was 4.46 points in 2013, it fell to 3.62 points in 2018, suggesting a gradual decrease in public anxiety about radioactivity. As of 2018, however, although anxiety about radiation and nuclear power plants is gradually decreasing, we can point out the possibility that this anxiety is still suppressing purchase intentions, and that consumers are still holding back from buying fresh agricultural products from Fukushima.

Moreover, a difference was seen in that, although in 2013, "Rational judgment" showed the largest value regarding "Support for disaster-stricken areas," in 2018, "Knowledge-based judgment" showed the largest value regarding "Support for disaster-stricken areas." According to Kudo and Nakayachi [4], "Knowledge-based judgment" is a type of judgment in which obtaining accurate knowledge of food and radiation (e.g., from the Food Safety Commission and the Consumer Affairs Agency) enables decision-making based on such knowledge, eliminates any rational grounds to avoid specific products, and suppresses reluctant buying; on the other hand, "Rational judgment" is summarized as a type of judgment that can be rephrased as logical and hypothetical judgments, as described by Evans[11]. In the light of the above, it is possible that, during the five-year period from 2013 to 2018, as a result of providing consumers with education on food and radiation, their accurate knowledge of radiation has been promoting and reinforcing feelings of "Support for disaster-stricken areas."

Next, Analysis 2 showed the possibility that, as with fresh agricultural products from Fukushima, purchases of sliced and packed vegetables and box lunches from Fukushima were also being inhibited by consumers' awareness of "Anxiety about radiation and nuclear power plants."

This study, like past studies (Kudo and Nakayachi [4],

Hori et al. [5]), revealed that the dual-process theory's two systems had acted on consumers' purchase intentions regarding fresh agricultural products, sliced and packed vegetables, and box lunches from Fukushima. In the light of the fact, as described above, that "Knowledge-based judgment" is based on accurate knowledge of food and radiation, and that "Rational judgment" is a type of judgment that can be paraphrased by logical and hypothetical judgments [11], it became clear that enhancement of "Knowledge-based judgment," or, in other words, obtaining accurate knowledge about radioactivity and the raw materials used in processed foods, would suppress "Anxiety about radiation and nuclear power plants." It was also shown that obtaining accurate knowledge of radiation and processed foods increased the awareness of "Support for disaster-stricken areas." These results therefore suggest that publication of information that helps educate people about sliced and packed vegetables and box lunches from Fukushima, is effective as a countermeasure to damage caused by harmful rumors.

The limitations of this study and future tasks and challenges include the following. This study investigated sliced and packed vegetables and box lunches as examples of foods with Fukushima-sourced ingredients; however, we conducted a questionnaire survey without mentioning where the products had been manufactured and/or sold. Since purchases of ready-made meals will likely continue to increase, it will be necessary to consider the influence of the place of manufacture and sale of such items. In addition, the survey carried out in this study was limited to the areas of Tokyo and Osaka. Researchers have revealed that consumer assessments of agricultural products from Fukushima vary from region to region (Ujiie [3]; Hori et al. [5]; Otgonchimeg et al. [20]), so it will be necessary to conduct similar surveys for other regions as well. Lastly, this investigation did not delve deeply into the content of consumer education as a measure for countering reluctant purchasing behaviors, such as what sort of information was effective, and whether or not such provision was effective in reducing "Anxiety about radiation and nuclear power plants." Which sort of consumer education activities help to minimize consumers' reluctant purchasing behaviors is a research task that is of considerable interest, both academically and in terms of business practicality.

5. Conclusions

This study demonstrates the importance of providing information on levels of radioactivity in agricultural products. Our findings also showed the need to provide information on radioactive substances contained not only in fresh agricultural products, but also in foods with Fukushima-sourced ingredients, such as sliced and packed vegetables and box lunches. Ujiie [3] points out the risk that limiting education to consumers will increase consumer reluctance, since they have no choice but to decide on their purchases according to the place of origin. The findings of our study suggest that the consumers' awareness of "Anxiety about radiation and nuclear power plants" has decreased compared to 2013. This may have been a result that demonstrates the beneficial effects of specialized institutions providing information on radioactive substances. There also is a possibility that, as a result of having been able to obtain accurate knowledge through consumer education, consumers' awareness of supporting disaster-stricken areas increased, which suppressed their reluctance for making purchases.

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Disclosure

The authors have no relevant financial interests in this article and no potential conflicts of interest to disclose. The data were acquired and processed from public participants by the authors unaffiliated with any commercial entity.

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