

Risk and Uncertainty: A Side-Effect of a Natch Event on Residents in Japan

Giuseppe ALIPERTI⁽¹⁾, Ana Maria CRUZ, Francesco RIZZI⁽¹⁾ and Marco FREY⁽¹⁾

(1) Scuola Superiore Sant'Anna, Pisa, Italy

Synopsis

On 11 March 2011, the Great East Japan Earthquake and Tsunami (GEJET) triggered the Fukushima Dai-ichi Nuclear Power Plant (FDNPP) accident. This event caused immense damage releasing large amounts of radioisotopes to the environment. As consequence, safety concerns have arisen for food safety and marine products. Our research contributes to investigate Japanese residents' attitude toward consuming NON-Fukushima seafood (NFS) and Fukushima prefecture seafood (FS) in the mid-long term after the accident. A questionnaire was developed and data have been collected during the Festival of the Goden Community Association (Machizukuri) in Higashinada Ward, Kobe. Results show that the Natch accident is still influencing consumers' risk and uncertainty perceptions. In addition, a key role toward increasing the attitude is played by the grade of knowledge of Japanese consumers regarding local seafood contamination. Managerial implications have been discussed in order to refine marketing strategies able to promote Japanese seafood consumption. Suggestions for additional future research and limitations are also provided in the last section of the article.

Keywords: Risk, Uncertainty, Natch, Seafood consumption, Consumer behavior

1. Introduction

On 11 March 2011, a joint natural and technological event (Natch) hit Japan. The Great East Japan Earthquake and Tsunami (GEJET) triggered the Fukushima Dai-ichi Nuclear Power Plant (FDNPP) accident. This event caused immense damage to human society in and around Japan by releasing large amounts of radioisotopes to the environment (Okamura et al., 2016). As a consequence, safety concerns have arisen for food safety (Okamura et al., 2016; Chew & Jahari, 2014) and marine products (Chew & Jahari, 2014; Wada et al., 2013). The accident exacerbated the long-term seafood internal consumption crisis in Japan. In 2015, domestic Japanese per-capita consumption of fish had dropped by roughly 30 percent since a peak

in 2001, declining to levels last seen in the early 1960s (Japanese Ministry of Agriculture, Forestry and Fisheries - MAFF, 2016). Even considering the internal seafood consumption crisis, several wholesale fishery markets and fishery processing facilities in Iwate, Miyagi and Fukushima resumed operations nowadays (MAFF, 2016). New strategies to support their activity are requested in order to increase seafood consumption.

Consumption is influenced by perceived risk and perceived uncertainty. Previous research highlighted the necessity to examine whether people perceive risk and uncertainty consistently across situations that involve similar levels of objective risk or whether perceptions of risk and uncertainty are context-specific (Quintal et al., 2010). Our study focuses on the Japanese seafood consumption and

analyze the mid-long term effects of the Fukushima accident on the perceived risk and perceived uncertainty of Japanese consumers. We aim to contribute to the identification of the most potentially effective marketing strategies to be adopted to increase the intention to consume seafood in Japan.

This paper is organized as follows. In section 2, we present the academic contributions concerning the risk of radiation sickness or other health effects after the Fukushima accident. Then, we introduce the theoretical background and the measures of Perceived Risk (PR), Perceived uncertainty (PU), Objective Knowledge (KN) and trust (TRU) (section 3). After the identification of the hypotheses we focus on the methodology (section 4). We describe the questionnaire, the data collection process and the statistical analysis. In section 5, we present the results of the analysis. In the last section (6) we present a discussion of the results, identifying managerial implications, new research opportunities and limitations of the study.

2. Theoretical background

Several studies have been conducted in order to identify the level of contamination of Japanese seafood in the short and in the mid-long term after the Natch accident with mixed findings. Some findings show that the process of decontamination is slow (Buessler, 2014) and the level of contamination had not decreased one year (Buessler, 2012) and even a few years after the accident (Buessler, 2014). A different research stream seems to be more positive. A study from 2013 reveals that the overall radioactive concentrations in the total marine products have significantly decreased (Wada et al., 2013) after almost approximately one year from the Natch event. Additional studies report that radioactive cesium concentrations of marine products in Fukushima Prefecture have decreased drastically during the last five years (Wada et al., 2016). Fukushima should not be a serious food concern as freshwater fish used as food in Japan are usually not wild but cultured (Okamura et al., 2016). In addition, the contamination levels tend to decrease as the distance from the city's nuclear facilities increases (Okamura et al., 2016). Research

supported by the Japanese government promote a positive perspective. Several government reports (Japanese Ministry of Health, Labour and Welfare, 2015; MAFF, 2014; Consumer Affairs Agency, 2013) state a general decrease of seafood contamination. "Estimations of exposure (effective dose) to radioactive cesium in food are decreasing constantly and now less than 1% of 1mSv/year in Japan" (Japanese Ministry of Health, Labour and Welfare, 2015).

Japanese consumers have shown an increasing interest in information about seafood food contamination and its effect on health (Hosono et al., 2015). Currently, we do not know what determines their planned behavior and their intention to consume Japanese seafood. Our research aims to fill this gap by investigating consumers' perspective regarding the attitude (ATT) toward consuming Japanese seafood in consideration of their PR and PU.

PR and PU have been considered as two distinct constructs that have different impact on ATT (Quintal et al., 2010; Becker & Knudsen, 2005; Hofstede, 2001; Dholakia, 2001; Dowling & Staelin, 1994; Murray & Schlacter, 1990; Stone & Gronhaug, 1993; Sweeney, Soutar, & Johnson, 1999). The distinction between the two concepts has been introduced in marketing studies by Bauer (1960). In the case of PR, there is an expectation of potential loss in which some measure of probability can be attached to each possible outcome (Quintal et al., 2010; Dholakia, 2001; Dowling & Staelin, 1994; Murray & Schlacter, 1990; Stone & Gronhaug, 1993; Sweeney, Soutar, & Johnson, 1999). In the case of PU, there is an ambiguity about a potential loss, in which no measure of probability can be attached to each possible outcome (Quintal et al., 2010; Becker & Knudsen, 2005).

Our contribution aims to provide a more in-depth analysis of the influence of PR and PU on the ATT of the consumers. We suppose that these relationships strongly depend on the specific setting of the research study and on the time factor. Wilcock et al. (2004) find that a higher grade of PU may generate a higher optimistic bias in the mid-long period after the accident. This might depend on the illusion of relative invulnerability that makes consumers less likely to adopt health-seeking

behaviors (Raats & Sparks, 1995). Subsequently, this optimistic bias could positively affect the ATT. On the other hand, in the cases where there is an expectation of potential loss in which some measure of probability can be attached to each possible outcome (PR), a person's attitude toward consuming Japanese seafood will probably become more negative. This leads us to propose that:

H1: In our specific mid-long term setting, the more the PU increases, the more the attitude toward Japanese seafood will increase (a). The more the PR increases, the more the attitude toward Japanese seafood will decrease (b).

Consumers' attitudes towards the safety of foods are strongly associated with how much they trust government agencies that are responsible for ensuring food safety (Wilcock et al., 2004). Trust in information sources is positively linked with knowledge (Gambetta, 1988), which is problematic in our setting because of contrasting nature of information that are influencing the knowledge of the people. However, since the official data emerging by the local government reports (Japanese Ministry of Health, Labour and Welfare, 2015; MAFF, 2014; Consumer Affairs Agency, 2013) state a general decrease of seafood contamination, which is also supported by the majority of academic contributions, we suppose that the currently amount of officially information increases trust and reduces PR and PU. Similarly, we also hypothesize that an increasing grade of knowledge could improve the attitude toward consuming NFS and FS.

H2: In our specific setting, an increased grade of knowledge of the problem will generate a higher trust on safety control (a). At the same time, it will also facilitate a decrease of PR (b) and PU (c). In addition, an increasing grade of knowledge will allow to increase the attitude (d).

The role of trust is particularly important in conditions of uncertainty (Gambetta, 1988) and risk (Kim et al., 2008). Public health recommendations are one of the most trusted information regarding seafood consumption and risks (Pienak et al., 2008). Therefore, due to the positive available

governmental data and in line with Kim et al. (2008) and Quintal et al. (2010), we expect a negative correlation between TRU and PR and between TRU and PU. Finally, we expect that an increase TRU directly and positively influences ATT, confirming the influence of TRU in the seafood consumption (Pienak et al., 2008; Wilcock et al., 2004).

H3: In our specific setting, an increased grade of trust will generate a decrease of perceived risk (a) and uncertainty (b). In addition, an increasing trust will positively influence attitude (c).

3. Methodology

A questionnaire composed by 17 grounded-in-theory questions has been developed. It is composed of an introduction to the topic and further 3 sections. The first section seeks for additional information regarding ATT, PR and PU associated with the seafood consumption. The second section measures the grade of knowledge regarding health-related risk linked to NFS and FS consumption, and evaluate the grade of trust on the Governmental safety control system. The final section collected background information, including gender, age, income, education.

All the items were measured using previously validated questionnaire items, modified to assess our specific case study. Attitudes were assessed following Quintal et al. (2010), Bagozzi et al. (2003) and Ajzen (2002). PU and PR were both measured on the basis of previous studies on health risk perception regarding seafood consumption (Jacobs et al., 2015; Quintal et al., 2010; Pienak et al., 2008). Knowledge about the risk to getting ill due to NFS/FS consumption has been measured focusing on objective and subjective knowledge (Mascarello et al., 2015; Pinto et al.; 2015). Trust on safety control has been measured adopting the approach proposed by Poortinga and Pidgeon (2003).

Participants to the survey were contacted during winter 2016/2017. Residents have been interviewed during the Festival of the Goden Community Association (Machizukuri) in Higashinada Ward, Kobe. The collected completed questionnaires have been 156; 53.2% were females, 46.8% were males. The majority of the interviewed has at least a

bachelor degree (85.9%). Most of respondents has born between 1966 and 1994 (86.5%) with a general prevalence (77.2%) of the so-called Millennials, or Generation Y, born between 1980 and 2000 (Gurău, 2012).

4. Results

4.1 Data analysis

Initially, we launched a Shapiro-Wilk W test in order to test the normality of the observed variable. The reliability of the constructs has been checked through the definition of Cronbach's α for each of the composite construct (max 0.99; min 0.72) (See Tab.1). In the cases of constructs identified by multiple items a factor analysis has been developed. It confirmed the presence of a unique retained factor identified for each construct. We then launched the Kaiser Meyer-Olkin test in order to define the sampling adequacy of the new latent variables.

We checked the correlation between all the factors in order to check the discriminant validity. According to Bagozzi & Heatherton (1994) discriminant validity issues became problematic when values are higher than 0.80 score. All the correlation included in the model are under this limit (See Tab.2). Lastly, path analysis has been used to

estimate the relationship of the variables in both studies.

4.2 Descriptive analysis

Table 1 shows: the number of items considered in order to identify each construct; the number of the emerging retained factors; the means of the constructs; the construct reliability (α); and the correlation for each construct in the analyzed sample. Focusing on means, different values emerge when considering NFS or FS (Tab. 2).

The consumers show high values of ATT (90.4%) toward eating NFS seafood. However, the values tend to decrease when considering FS instead of NFS. The difference between NFS and FS is high when considering ATT (delta 28.4%). This trend highlights the fact that a "Fukushima effect" is still influencing market dynamics. This information suggests that people still have in mind the Fukushima accident and the related release of large amounts of radioisotopes to the environment, including to the sea. As confirmation, PR increases when considering FS instead of NFS.

An additional emerging information is that respondents feel that there is still more than 40% of

Table 1 Descriptive Analysis

	Items	Retained Factor	Mean*	% value	α	KN	SK	TRU	PR	PU	ATT	
NFS												
	KN	1	na	1.52	30.4	na	1.00					
	SK	3	1	2.75	55	0.94	0.03	1.00				
	TRU	3	1	2.90	58	0.92	-0.16	-0.14	1.00			
	PR	3	1	2.38	47.6	0.97	-0.01	0.33	-0.49	1.00		
	PU	3	1	3.68	73.6	0.95	-0.14	-0.19	0.44	-0.68	1.00	
	ATT	3	1	4.52	90.4	0.72	0.21	-0.14	0.11	-0.21	0.12	1.00
FS												
	KN	1	na	1.52	30.4	na	1.00					
	SK	3	1	2.75	55	0.94	0.03	1.00				
	TRU	3	1	2.90	58	0.92	-0.16	-0.14	1.00			
	PR	3	1	3.12	62.4	0.99	0.13	0.19	-0.44	1.00		
	PU	3	1	3.15	63	0.99	-0.11	-0.09	0.50	-0.79	1.00	
	ATT	3	1	3.10	62	0.97	0.11	0.13	0.34	-0.53	0.52	1.00

Table 2 Means comparison (% values)

ATT			
	NFS	FS	Delta
	90.4	62	28.4
PR/PU			
	NFS	FS	Delta
PR	47.6	62.4	-14.8
PU	73.6	63	10.6
KN, SK, TRU			
KN	30.4		
SK	55		
TRU	58		

risk of radiation sickness or other health effect even when considering NFS (47,6%).

On the other side, PU tends to decrease when considering FS (63%) instead of NFS (73,6%). This suggests that focusing on FS, the perceived certainty to getting ill due to seafood contamination is higher (PU delta 10,6%). This result is linked to the process of measurement of the item. In particular, we have measured PU following Quintal et al., 2010 (i.e. The certainty that eating Fukushima Prefecture seafood will lead to getting ill due to radioactive contamination is “extremely uncertain”– “extremely certain”).

A further comment is related to the analysis of knowledge. There is a consistent difference between what people think to know (SK) and what they really

know (KN).

Regarding TRU, 56% of participants to the survey fell confident regarding Japanese government information. There is room for improving TRU and it is probably existing the necessity for the Government to find new and more effective strategies of communication.

4.3 Hypotheses testing

Path analysis was used to estimate the relationship between the variables. We analyzed how PR, PU, KN, and TRU, influence ATT. Tab. 3 summarizes the data emerging from the study. The model fitted the data reasonable well in the FS setting. On the other side, the model does have a minimum explanatory power in the NFS setting. However, the low weighted adjusted R-squares do not represent a source of concern. Our study represents the first explorative step regarding consumers’ planned behavior in the specific setting of radio-active risk contamination of seafood and the endogenous relationships are not intended to enable prediction but simply to shed light on the interaction among behavioral determinants (Lobb et al., 2007).

The number of significant correlations tends to increase in the FS setting. The more PR and PU increase the more they have concrete effect on consumers’ behavior. In the FS setting, PU has a significant positive correlation with ATT. It is in line with Hypothesis 1a. This Hypothesis is not validated in the NFS case. In addition, as expected PR has a

Table 3 Hypotheses Testing

			PR - NFS	PR - FS	PU - NFS	PU - FS	
H1a:	PU	→	ATT	na	na	0.93	0.47***
H1b:	PR	→	ATT	-0.15*	-0.48***	na	na
H2a:	KN	→	TRU	-0.16	-0.16	-0.16	-0.16
H2b:	KN	→	PR	-0.07	0.05	na	na
H2c:	KN	→	PU	na	na	-0.52	-0.21
H2d:	KN	→	ATT	0.14**	0.15**	0.16**	0.14**
H3a:	TRU	→	PR	-0.52***	-0.49***	na	na
H3b:	TRU	→	PU	na	na	0.43***	0.51***
H3c:	TRU	→	ATT	0.05	0.16*	0.93	0.13
			Adj R ²	0.07	0.32	0.06	0.3
			N	153	153	153	153

significant negative correlation with ATT in both cases (Hypothesis 1b).

Moving to Hypothesis 2, we have never found significant correlation between KN and TRU (Hypothesis 2a) and between KN and PR (Hypothesis 2b). This trend suggests a potential presence of an emotional dimension able to influence the TRU and further research could investigate this aspect. This trend may be also justified by the fact that consumers usually tend to collect data from different sources and the presence of contrasting information is not facilitating an increasing of TRU. The correlation between KN and ATT (Hypotheses 2d), has significant values in all the settings (NFS; FS). The coefficients are significant and positive (confirming the hypothesis). However, they are characterized by a low value (b between 0.04 and 0.5; $p < 0.01$). These data suggest that the correlation between KN and ATT become significant when the consumers feel the need to act in a rational way. As Japanese people daily live the issue, there is a tendency to behave in a rational way when considering both, FS and NFS. TRU has always a significant negative correlation with PR. It is in line with Hypotheses 3a. Even in the case of radioactive risk-contamination of seafood, the public health recommendations seem to be the most trusted information regarding seafood consumption. This finding has a confirmative value as it is in line with Pienak et al., 2008. TRU has also a significant positive correlation with PU. This positive correlation is not in line with our Hypothesis 3b. It means the an increasing TRU will not help to decrease the PU, on the contrary, it will contribute to increase it. This trend may be explained by the fact that an increased TRU will generate a decrease of certainty to getting ill due to the radioactive contamination. Lastly, TRU has in the FS case a significant positive correlation with ATT. This relationship is characterized by low coefficient. However, it demonstrates that an increased grade of TRU is able to increase ATT when the grade of PR is higher (FS case). The more the PR increases, the more the consumers tend to trust to the government and this fact should be taken in consideration by the local government in order to enhance the image of FS.

5. Discussion and conclusions

Previous research highlighted the necessity to examine whether people perceive risk and uncertainty consistently across situations that involve similar levels of objective risk or whether perceptions of risk and uncertainty are context-specific (Quintal et al., 2010). This unique study contributed to fill this research gap focusing on radioactive risk-contamination in seafood and, in particular, analyzing the mid-long term effect provoked by the Great East Japan Earthquake and Tsunami (GEJET) triggering of the Fukushima Dai-ichi Nuclear Power Plant (FDNPP) accident on 11 March 2011. The aim of the study was to examine whether residents perceive risk and uncertainty consistently in situations with significant levels of objective risk and whether such perceptions influence their attitude toward consuming Japanese seafood. The results highlight that perceptions of risk and uncertainty are context-specific, i.e. differ when referring to Fukushima Seafood (FS) and NON-Fukushima Seafood (NFS).

The emerging findings show that the Fukushima nuclear accident is still influencing consumers' risk and uncertainty perceptions. Local government and Japanese fisheries, should consider Fukushima accident as one of the causes of the current internal seafood consumption. As expected, PR negatively influences consumers' attitude toward consuming FS and NFS seafood. This trend is confirmed in all the analyzed cases confirming the central role of PR in the generation of the ATT. Instead, PU has a significant correlation with ATT only in the specific setting of the FS. This correlation is positive and the results is strictly linked to the way we have measured PU (based on Quintal et al., 2010). This information suggests that blurry and undefined worries (uncertainty) significantly influence ATT in the mid-long term and this influence result to be positive, even in presence of concrete risk (FS). This finding is in line with our Hypothesis 1a showing a potential presence of an optimistic bias (Wilcock et al., 2004) facilitated by the passage of time since the accident. Further research could investigate more in-depth this aspect in order to identify additional reasons standing behind this positive correlation between PU and ATT.

Japanese government should encourage

additional campaigns able to increase its own overall reliability. These campaigns do not need to be strictly linked to the seafood risk-contamination issue (as there is no evidence of link between KN and TRU). The main target is to increase the general TRU due to its ability to positive influence residents' behavior in both cases (NFS and FS).

The positive influence of KN on ATT is valid in all the analyzed cases. It means that a more effective dissemination of the current positive results regarding seafood contamination emerged by governmental reports should be realized.

The study presents some limitations. The sample size has been strongly influenced by the length of the questionnaire. This limitation has been already discussed in section 5.3 referring to the explanatory power of the model. Due to the explorative intent of the study, the relatively low rate of filled questionnaire does not represent a source of concern (Lobb et al., 2007).

References

- Adachi, T., Oka, F. and Mimura, M. (1987a): An elasto-viscoplastic theory for clay failure, Proc. 8th Asian Regional Conf. on Soil Mech. and Found. Eng., Vol. 1, pp. 5-8.
- IAHS Press (1995): Instructions to authors preparing papers for an IAHS Proceedings, Institute of Hydrology, UK.
- Randolph, M.F. (1981): The response of flexible piles to lateral loading, *Geotechnique*, Vol. 31, No. 2, pp. 247-259.
- Seed, H.B. (1987): Design problems in soil liquefaction, *Jour. of Geotech. Engng., Div., ASCE*, Vol. 113, No. GT8, pp. 827-845.
- Seed, H.B. and Idriss, I.M. (1971): Simplified procedures for evaluating soil liquefaction potential, *Jour. of Geotech. Engng. Div., ASCE*, Vol. 97, No. SM9, pp. 1249-1273.
- Ajzen, I., 2002. Perceived behavioral control, Self - Efficacy, locus of control, and the theory of planned Behavior. *Journal of applied social psychology*, 32(4), pp.665-683.
- Bagozzi, R.P. and Heatherton, T.F., 1994: A general approach to representing multifaceted personality constructs: Application to state self - esteem. *Structural Equation Modeling: A Multidisciplinary Journal*, 1(1), pp.35-67.
- Bagozzi, R.P., Dholakia, U.M. and Basuroy, S., 2003: How effortful decisions get enacted: The motivating role of decision processes, desires, and anticipated emotions. *Journal of Behavioral Decision Making*, 16(4), pp.273-295.
- Bauer, R., 1960: Consumer behavior as risk-taking. In R. S. Hancock (Ed.), *Dynamic marketing for a changing world* (pp. 389–398). Chicago, IL: American Marketing Association.
- Becker, M., & Knudsen, T., 2005: The role of routines in reducing pervasive uncertainty. *Journal of Business Research*, 58(6), 746–757.
- Buesseler K.O., 2012: Ecology. Fishing for answers off Fukushima. *Science* 338(6106), pp.480–482.
- Buesseler K.O., 2014: Fukushima and ocean radioactivity. *Oceanography (Wash DC)*, 27(1) pp92–105.
- Chew, E.Y.T. and Jahari, S.A., 2014: Destination image as a mediator between perceived risks and revisit intention: A case of post-disaster Japan. *Tourism Management*, 40, pp.382-393.
- Consumer Affairs Agency, 2013: Food and Radiation, Q & A http://www.caa.go.jp/jisin/pdf/130902_food_qa_en.pdf
- Dholakia, U., 2001: A motivational process model of product involvement and consumer risk perception. *Europ. Journ. of Marketing*, 35(11/12), 1340–1360.
- Dowling, G., & Staelin, R. (1994): A model of perceived risk and intended risk handling activity. *Journal of Consumer Research*, 21(1), 119–134.
- Gambetta D.G., 1988: Can We Trust Trust? in *Trust: Making and Breaking Cooperative Relations*, Gambetta, Ed., electronic edition, ed. Department of Sociology, University of Oxford, 213–237.
- Gurău, C., 2012: A life-stage analysis of consumer loyalty profile: comparing Generation X and Millennial consumers. *Journal of Consumer Marketing*, 29(2), pp.103-113.
- Hofstede, G., 2001: *Culture's consequences: Comparing values, behaviors, institutions and organizations across nations*. Beverly Hills, CA: Sage Publications.
- Hosono, H., Iwabuchi, M., Kumagai, Y. and Sekizaki, T., 2015: Japanese Consumers' Altruistic Attitude and Food Choice: Two Years After Fukushima Accident. In *Food Security and Food*

- Safety for the Twenty-first Century (pp. 319-333). Springer Singapore.
- Jacobs, S., Sioen, I., Pieniak, Z., De Henauw, S., Maulvault, A.L., Reuver, M., Fait, G., Cano-Sancho, G. and Verbeke, W., 2015: Consumers' health risk-benefit perception of seafood and attitude toward the marine environment: Insights from five European countries. *Environmental research*, 143, pp.11-19.
- Japanese Ministry of Health, Labour and Welfare, 2015: Radioactive Materials in Food, current situations and protective measures http://www.mhlw.go.jp/english/topics/2011eq/dl/food-130926_1.pdf
- Kim, D.J., Ferrin, D.L. and Rao, H.R., 2008: A trust-based consumer decision-making model in electronic commerce: The role of trust, perceived risk, and their antecedents. *Decision support systems*, 44(2), pp.544-564.
- Lobb, A.E., Mazzocchi, M. and Traill, W.B., 2007. Modelling risk perception and trust in food safety information within the theory of planned behaviour. *Food Quality and Preference*, 18(2), pp.384-395.
- MAFF, 2014: Response to Radionuclide Contamination in Foods after the Nuclear Power Plant Accident http://www.maff.go.jp/e/quake/pdf/140812_response_to_emergenc.pdf
- MAFF, 2016: FY2015 Trends in Fisheries - FY2016 Fisheries Policy - White Paper on Fisheries: <http://www.jfa.maff.go.jp/j/kikaku/wpaper/attach/pdf/index-2.pdf>
- Mascarello, G., Pinto, A., Parise, N., Crovato, S. and Ravarotto, L., 2015: The perception of food quality. Profiling Italian consumers. *Appetite*, 89, pp.175-182.
- Murray, K.B. and Schlacter, J.L., 1990: The impact of services versus goods on consumers' assessment of perceived risk and variability. *Journal of the Academy of Marketing science*, 18(1), pp.51-65.
- Okamura, H., Ikeda, S., Morita, T. and Eguchi, S., 2016: Risk assessment of radioisotope contamination for aquatic living resources in and around Japan. *Proceedings of the National Academy of Sciences*, 113(14), pp.3838-3843.
- Quintal, V.A., Lee, J.A. and Soutar, G.N., 2010: Risk, uncertainty and the theory of planned behavior: A tourism example. *Tourism management*, 31(6), pp.797-805.
- Pieniak, Z., Verbeke, W., Scholderer, J., Brunsø, K. and Ottar Olsen, S., 2008: Impact of consumers' health beliefs, health involvement and risk perception on fish consumption: A study in five European countries. *British Food Journal*, 110(9), pp.898-915.
- Pinto, A., Mascarello, G., Parise, N., Bonaldo, S., Crovato, S. and Ravarotto, L., 2017: Italian consumers' attitudes towards food risks: self-protective and non-self-protective profiles for effective risk communication. *Journal of risk research*, 20(3), pp.366-384.
- Poortinga, W. and Pidgeon, N.F., 2003: Exploring the dimensionality of trust in risk regulation. *Risk analysis*, 23(5), pp.961-972.
- Raats, M.M. and Sparks, P., 1995: Unrealistic optimism about diet-related risks: implications for interventions. *Proceedings of the Nutrition Society*, 54(03), pp.737-745.
- Stone, R.N. and Grønhaug, K., 1993: Perceived risk: Further considerations for the marketing discipline. *European Journal of marketing*, 27(3), pp.39-50.
- Sweeney, J.C., Soutar, G.N. and Johnson, L.W., 1999: The role of perceived risk in the quality-value relationship: a study in a retail environment. *Journal of retailing*, 75(1), pp.77-105.
- Wada, T., Nemoto, Y., Shimamura, S., Fujita, T., Mizuno, T., Sohtome, T., Kamiyama, K., Morita, T. and Igarashi, S., 2013: Effects of the nuclear disaster on marine products in Fukushima. *Journal of environmental radioactivity*, 124, pp.246-254.
- Wada, T., Fujita, T., Nemoto, Y., Shimamura, S., Mizuno, T., Sohtome, T., Kamiyama, K., Narita, K., Watanabe, M., Hatta, N. and Ogata, Y., 2016: Effects of the nuclear disaster on marine products in Fukushima: An update after five years. *Journal of Environmental Radioactivity*, 164, pp.312-324.
- Wilcock, A., Pun, M., Khanona, J. and Aung, M., 2004: Consumer attitudes, knowledge and behaviour: a review of food safety issues. *Trends in Food Science & Technology*, 15(2), pp.56-66.

(Received June 13, 2017)