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Romio MORI*, Kaoru NABESHIMA**
and Nanae YAMADA**

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Keywords: China, eels, agro-food trade, food safety, port rejection

JEL classification: F23, L66, Q13, Q17, Q18

* Director, Guangzhou Office, PRC, Japan External Trade Organization (JETRO) (Romio_Mori@jetro.go.jp).

** Chief Senior Researcher, Institute of Developing Economies (IDE-JETRO) (Kaoru_Nabeshima@ide.go.jp).

*** Researcher, Environment and Natural Resource Studies Group, Inter-disciplinary Studies Center, IDE-JETRO (Nanae_Yamada@ide.go.jp).

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INSTITUTE OF DEVELOPING ECONOMIES (IDE), JETRO
3-2-2, WAKABA, MIHAMA-KU, CHIBA-SHI
CHIBA 261-8545, JAPAN

Food Safety Control System of Chinese Eel Exports and its Challenges[1]

Romio MORI[2], Kaoru NABESHIMA[3], and Nanae YAMADA[4]

Abstract

This paper analyzes factors associated with the rejection of products at ports of importer countries and remedial actions taken by producers in China. As an example, it uses one of the most competitive agro-food products of China: live and processed eels. This paper provides an overview of eel production and trade trends in China. In addition, it identifies the causes of port rejection of Chinese eel products as veterinary drug residues by examining the detailed case studies of export firms and the countermeasures taken by the government and firms.

I. Introduction

Japan consumes the largest amount of eels in the world, accounting for 70% of the global consumption ("Eel eateries," 2012). At its peak in 2000, Japan consumed 160,000 tons of eels; however, in 2011 the shipment volume of eels declined to 56,000 tons because of the rising eel prices.[5] China is the largest eel-producing country in the world. Since the opening of its economy, China has steadily increased productions of both freshwater and marine products (Figure 1). Japan has been the largest export market for Chinese aquatic products, accounting for about one-fifth of the export, followed by the United States and the European Union (Figure 2). More than half of the Chinese products are exported to other countries in the East Asia region. Eels account for about 8% of Chinese aquatic product exports (Table 1).

In general, eels used for consumption are either the Japanese eel (Anguilla japonica) or the European eel (Anguilla anguilla). The eel market is fairly unstable,

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1 The research conducted for this paper is a part of the IDE-UNIDO joint research on trade compliance in Asia.

2 Director, Guangzhou Office, PRC, Japan External Trade Organization (JETRO).

3 Chief Senior Researcher, Institute of Developing Economies.

4 Researcher, Institute of Developing Economies.

5 From the Eel Growers Associations, http://www.wbs.ne.jp/bt/nichimanren/yousyoku.html

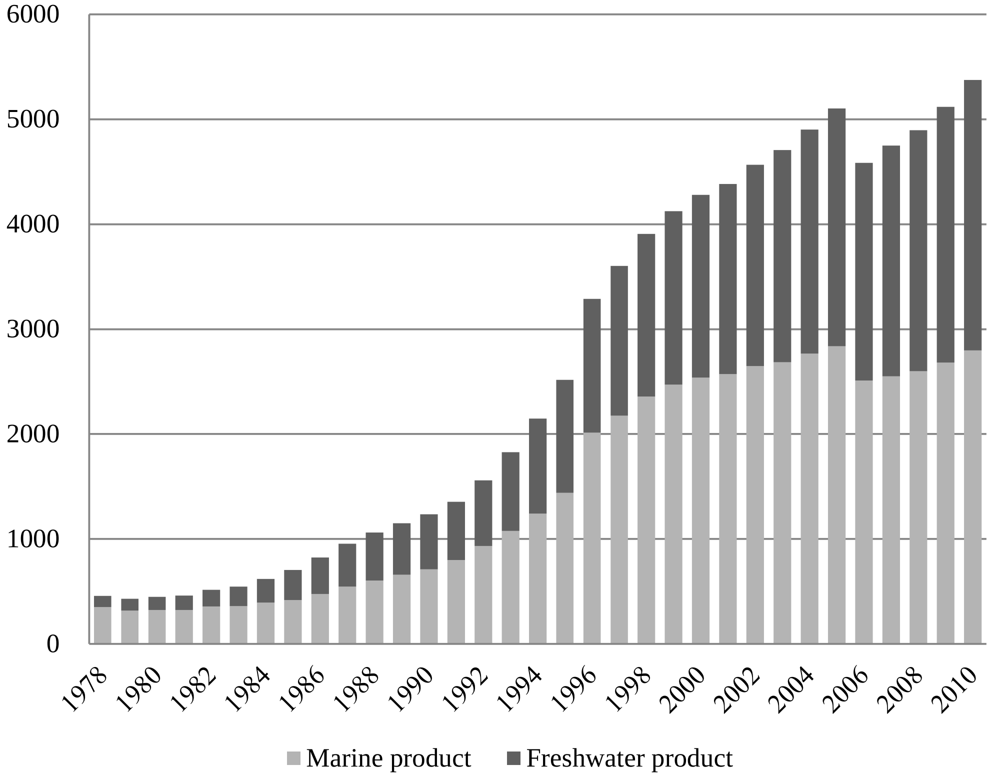
influenced greatly by the changes in the natural environment and overfishing of leptocephali (the fry of eel). This results in large fluctuations in the eel prices. Although the eel prices have increased sharply several times in the past, the increase was most significant in 2012. This price instability is caused by the lack of an economical way to artificially incubate eels and secure sufficient supply of leptocephali. To halt the rapid decline of the European eel, the leptocephalus of the European eel has been designated as a protected species under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (the Washington Convention) in 2007 following an EU proposal to that effect. Because of this, the trade of European eel has been highly restricted and this in turn has led to higher demand and prices for the Japanese eel.

While the high price of eel is currently making headlines in Japan, the largest consumer of eel, a more significant problem is the food safety issues related to imported eel. More than 90% of the live and processed eel imports of Japan come from China. Ever since—among other incidents—malachite green[6] was detected in the eel imported from China in 2003, there has been a renewed focus on the safety of imported food, particularly from China.

This case study focuses on live and processed eel imports from China and analyzes the factors associated with the rejections of these products at Japanese ports. In the following sections, we examine the trends in the trade of these products, document causes of rejections at Japanese ports by the Ministry of Health, Labour and Welfare (MHLW), and provide an overview of policies implemented by Japan and China to secure the safety of these products as well as analyze the current conditions facing cultured eel producers and eel processors in China.

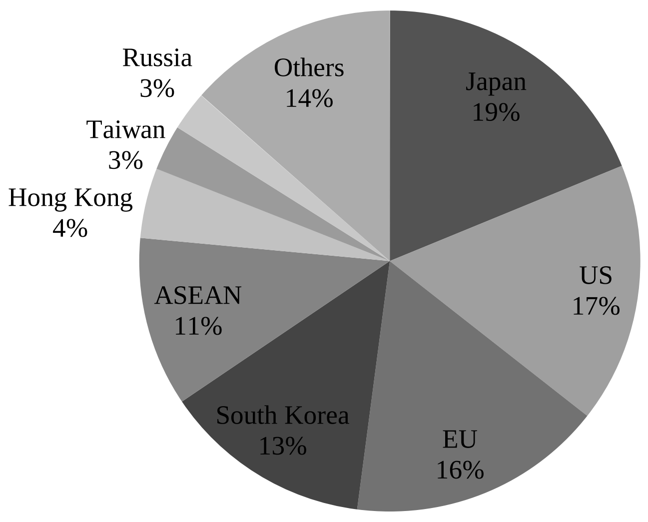
[6] Malachite green is a synthetic antibacterial drug that has been banned from food in the United States since 1981 and in the European Union since 2002. Japan, too, bans the use of this substance in food.

Figure 1: Production of aquatic product in China, 1978-2010



Source: Ministry of Agriculture (China) 2009.

Figure 2: M**ain export market of Chinese aquatic products in 2010 (**volume-base**)**



Source: Bureau of Fisheries Ministry of Agriculture (China) (various years).

Table 1: Main aquatic product exports from China in 2010

Items	Percentage of total export value of aquatic product (%)	Amount (ten thousand tons)	Value (hundred million dollars)
Shrimp	16.3	21.61	15.36
Shellfish	12.3	26.07	11.58
Tilapia	10.7	32.28	10.06
Eel	8.4	4.52	7.9
Pseudosciaena crocea	2.2	5.01	2.07
Others		134.81	47.24
Total		224.3	94.21

Source: Bureau of Fisheries Ministry of Agriculture (China) (various years).

II. Trends in live and processed eel trade

In 2003, antibiotics were found in processed eel imported from China. This constituted a violation of the Food Sanitation Act in Japan, and consequently, administrative inspections were ordered and the volume of imports from China dropped significantly. In 2004, signs of recovery were seen; however, in August 2005, malachite green was again found in the eel imported from China. This led to the implementation of monitoring inspections of eels imported from Guangdong Province, the main cultured eel production site, and a temporary halt in all imports from there. In June 2006, the MHLW adopted the positive list system. The imports of eel from China increased in the first half of 2006 to avoid the possibility of import bans under the new system, and in the latter half of 2006, the import volumes tumbled. Around the same time, the media widely questioned whether it was safe to consume the eel imported from China.[7]

In preparing for the transition to a positive list system in Japan, the Ministry of Commerce of People's Republic of China (PRC) and the China Chamber of Commerce of Foodstuffs and Native Produce issued a report on the risk assessment of Chinese agricultural and food exports to Japan.[8] The report analyzed the impact of Japan's positive list system on 11 products (green onions, tea leaves, live and processed eel,

[7] Since 2002, eel imports from China violated a number of regulations. First, it was the detection of the antibiotics in eels, followed by the detection of malachite green. China has strengthened its domestic efforts to improve food safety by certifying the eel culture ponds and processing factories; however, problems continue to persist.

[8] See http://www.china-embassy.or.jp/jpn//jmhzs/t254123.htm (in Japanese).

matsutake mushroom, shiitake mushroom, and others) and grouped them into four categories based on the severity of the risk of violating Japanese food safety requirements. According to the report, live and processed eels were classified as products that were most at risk. Nonetheless, the imports of eels from China increased marginally in 2006, mainly reflecting the rush to export eels from China before the implementation of the positive list in June. In addition, the demand cycle for eel in Japan contributed to this. The high demand season for eel is April–July, and by August, the demand subsides.

Trends in live eel exports from China

Trends in live eel exports in terms of volume and unit prices from 2008 to the first half of 2012 are shown in Table 2. Since 2008, live eel exports from China have been decreasing. In 2008, China exported 14,369 tons of live eel to Japan; however, the amount decreased to less than one third of that in 2012 (although the figure is only for the first half of 2012). The main cause of this decline is the short supply of leptocephali. Accompanying the decrease in volume, the unit price of eel has been rising. In 2008, the unit price was $12.65. By 2012, the unit price almost tripled to $44.58.

Table 2: Trends in live eel exports, 2008–2012 (first half)

Unit: tons, US$/ton

	2008		2009		2010		2011		2012	
	Volume	Unit price	volume	Unit price	volume	Unit price	volume	Unit price	Volume	Unit price
Total	14,369	12.65	10,591	11.37	8,672	15.69	5,107	27.66	2,052	44.58
Japan	9,982	14.23	7,002	13.41	6,116	18.13	4,270	30.33	1,763	47.81
Hong Kong	1,956	7.45	1,759	7.98	1,203	10.92	632	17.70	253	25.20
Korea	2,431	10.53	1,809	6.86	1,353	8.92	203	13.60	13	29.80

Note: Data is the aggregation of volumes from January to December. For 2011, the data is from January to November, and for 2012, from January to June.
Source: Department of Foreign Trade, Ministry of Commerce of PRC.

The top destination for live eel exports from China is Japan, which imported a share of 66.1% in 2009. Even though the overall volume is decreasing, the proportion of exports to Japan increased to 85.9% in the first half of 2012 because of the rising prices in the Japanese market. The unit price in the Japanese market was $13.41 in 2009 but increased to $47.81 in 2012. The other major importers of Chinese eel are Hong Kong and Korea. These three markets account for almost all exports of live eel from China. Korea has been unable to import live eel from China since May 2011 because its prices were lower than those of other markets.

Trends in processed eel exports from China

The exports of processed eel from China increased steadily until 2007, reaching a high of 48,187 tons in 2007 (Table 3). In 2008, the export volume decreased to 28,650 tons and recovered to 32,088 tons in 2008 and 36,485 tons in 2010. However, in 2011, it decreased again to 35,221 tons. Even though the data is only for the first half of 2012, the expectation is that the decline will continue. The reason for more gradual decline in the exports of processed eels compared to live eels is because processed eels can be frozen for storage.

Similar to the case of live eel exports, the Japanese market is the largest destination market for processed eel. However, exports to the United States and Russia have increased recently mainly because of the rising popularity of Japanese cuisines in these markets. Until 2006, the Japanese market accounted for more than 80% of the processed eel exports from China. However, since 2007, this share of the Japanese market has been declining. It was 57.0% in 2008, increased to 69.1% in 2009, but declined again to 60.8% in 2011 and 57.6% in 2012. In contrast, the shares of the United States and Russia were only 3.3% and 0.7% in 2005, respectively; however, there has been tremendous growth in both markets ever since. In 2011, the shares of the United Stated and Russia were 11.1% and 9.6%, respectively. The share of Hong Kong declined from 8.1% in 2008 to 4.4% in 2011.

The movement in unit prices for processed eel is the opposite of the trend in volumes, as can be seen in Table 4. Prices have been increasing since 2007. Particularly noteworthy is the price increase since 2010, the first time that the price increased so rapidly. The unit price in 2011 is approximately double that of 2009, and the trend continues in 2012. The reasons for the ever-increasing prices for processed eel are twofold. First, the supply of leptocephali was low in recent years. Second, it is anticipated that the supply of leptocephali will not improve in the future but continue decreasing because of overfishing.[9] Unlike the price of live eels, there is little difference between the unit prices in the Japanese market and elsewhere. This is because the costs associated with maintaining food safety and quality of processed eel do not differ significantly across markets. In addition, processed eels destined for the Japanese market include both Japanese and European eels.

Table 3: Trends in processed eel exports from China, 2006–2012 (first half)

Unit: Tons

	2006	2007	2008	2009	2010	2011	2012
Total	46,646	48,187	28,650	32,089	36,485	35,221	18,002
Japan	38,874	37,197	16,338	22,175	23,371	21,427	10,382
US	2,452	2,560	3,176	2,901	4,424	3,896	2,130
Russia	811	1,742	1,903	1,944	2,765	3,369	2,534
Hong Kong	769	2,296	1,805	835	976	1,548	882
Taiwan	n.a	n.a	1,525	462	1,302	1,881	n.a
Ukraine	n.a	n.a	n.a	294	498	609	n.a
Korea	241	582	1,056	884	938	529	122
Singapore	180	434	457	475	686	381	128
Canada	n.a	n.a	288	477	306	350	n.a

Note: Data is the aggregation of volumes from January to December, and for 2012, from January to June.
Source: Department of Foreign Trade, Ministry of Commerce of PRC.

Table 4: Trends in processed eel exports from China, 2006–2012 (first half)

Unit: US$/kg

	2006	2007	2008	2009	2010	2011	2012
Total	12.6	11.9	12.6	12.8	18.0	25.6	34.3
Japan	12.8	11.9	12.9	12.9	17.9	25.3	34.4
US	10.8	11.3	12.7	12.6	18.5	28.8	40.4
Russia	10.8	12.0	12.6	13.1	18.5	27.5	36.0
Hong Kong	10.3	13.5	15.1	14.7	19.8	28.5	22.5
Taiwan	n.a	n.a	7.5	10.7	12.4	13.5	n.a
Ukraine	n.a	n.a	n.a	12.6	18.7	26.0	n.a
Korea	9.7	12.6	10.4	12.0	19.2	24.5	25.6
Singapore	12.3	13.9	15.9	14.7	19.9	28.3	37.1
Canada	n.a	n.a	13.5	12.3	19.8	29.9	n.a

Note: Data is the aggregation of volumes from January to December. For 2012, from January to June.
Source: Department of Foreign Trade, Ministry of Commerce of PRC.

[9] The United States is considering putting all species of eel under the Washington Convention. Currently, only the European eel is listed.

III. Port Rejection Cases

This section analyzes the underlying reasons for port rejections and food safety violations using examples from past cases. We analyze the case of live and processed eel exported from China to Japan. The MHLW publicizes the violations of food safety, detected as a result of regular inspections at various ports of Japan on their website.[10] The information provided by the MHLW includes the reasons for food safety violations, firms responsible for production, and importing firms. On the basis of this data, we analyze in which stage of production the violations were likely caused.

Since June 2006, there have been 39 cases of violations associated with live eel imports from China to Japan (Table 5). The most violations were in 2006 with 23 cases. The number of violations was reduced to 10 in 2007, and since then, only a handful of cases were found. Within the last six years, the violation of the compositional and element standard were the predominant violation, with detections of malachite green as the major cause. Other causes include detections of furazolidone (AOZ), dicofol, and endosulfan. In some cases, the reasons for such compositional standard violations were identified, including the mixing of live eels with accumulated malachite green with those without malachite green; residue of these drugs and chemicals in the soils where culture ponds are located; use of eel with accumulated malachite green as feed; and discharge of agricultural chemicals into culture ponds.

Table 5: Violations of live eel imports from China, 2006–2011

		Detection	Reasons; Measures taken	Inspection Measures
1	2011	Violation of compositional standard (furazolidone [as AOZ] 0.001 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
2	2010	Violation of element standard (malachite green [as leucomalachite green] 0.002 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
3		Violation of element standard (malachite green[as leucomalachite green] 0.004 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
4	2009	Violation of compositional standard (leucomalachite green 0.002 ppm detection)	Mixing of old eel with accumulated leucomalachite green; abandonment or return	Inspection ordered

[10] See http://www.mhlw.go.jp/english/topics/importedfoods/index.html.

			of the cargo is directed (the whole quantity is kept)	
5		Detection of an amount unlikely to cause damage to human health according to the provision of Paragraph 3, Article 11 of the Food Sanitation Law (dicofol 0.03 ppm detection)	Abandonment or return of the cargo is directed (Under investigation)	Monitoring inspection
6	2008	Violation of compositional standard (leucomalachite green 0.002 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
7	2007	Violation of element standard (SEM 55 ppb detection)	Shortage of management on the eel farm; abandonment or return of the cargo is directed (the whole quantity is kept)	Independent inspection
8		Violation of element standard (SEM 20 ppb detection)	Shortage of management on the eel farm, abandonment or return of the cargo is directed (the whole quantity is kept)	Independent inspection
9		Violation of element standard (SEM 85 ppb detection)	Shortage of management on the eel farm, abandonment or return of the cargo is directed (the whole quantity is kept)	Independent e inspection
10		Violation of element standard (SEM 29 ppb detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Independent inspection
11		Violation of element standard (SEM 35 ppb detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Independent inspection
12		Violation of element standard (SEM 6 ppb detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Independent inspection
13		Violation of element standard (SEM 20 ppb detection)	Abandonment or return of the cargo is directed (the whole quantity is returned)	Independent inspection
14		Violation of element standard (Leucomalachite green 0.004 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
15		Violation of element standard(Leucomalachite green 0.002 ppm detection)	Drug residue in the soil of the culture pond; abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
16		Violation of element standard (AOZ 0.002 ppb detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
17	2006	Detection over the amount unlikely to cause damage to human health according to the provision of Paragraph 3, Article 11 of the Food Sanitation Law (Leucomalachite green 0.04 ppm detection)	Use of cultured eel with leucomalachite green residue as feed	Command inspection
18		Detection over the amount unlikely to cause damage to human health according to the provision of Paragraph 3, Article 11 of the Food Sanitation Law (Leucomalachite	Under investigation	Command inspection

		green 0.02 ppm detection)		
19		Detection over the amount unlikely to cause damage to human health according to the provision of Paragraph 3, Article 11 of the Food Sanitation Law (Leucomalachite green 0.02 ppm detection)	Under investigation	Command inspection
20		Detection over the amount unlikely to cause damage to human health according to the provision of Paragraph 3, Article 11 of the Food Sanitation Law (Leucomalachite green 0.02 ppm detection)	Shortage of management of materials	Command inspection
21		Detection over the amount unlikely to cause damage to human health according to the provision of Paragraph 3, Article 11 of the Food Sanitation Law (Leucomalachite green 0.02 ppm detection)	Under investigation	Command inspection
22		Detection over the amount unlikely to cause damage to human health according to the provision of Paragraph 3, Article 11 of the Food Sanitation Law (Leucomalachite green 0.02 ppm detection)	Under investigation	Command inspection
23		Violation of element standard (endosulfan 0.007 ppm detection)	Under investigation	Monitoring inspection
24		Violation of element standard (endosulfan 0.089 ppm detection)	Under investigation	Monitoring inspection
25		Violation of element standard (AOZ 0.002 ppm detection)	Drug residue in the soil of the culture pond	Monitoring inspection
26		Violation of element standard (AOZ 0.002 ppm detection)	Drug residue in the soil of the culture pond	Monitoring inspection
27		Violation of element standard (endosulfan 0.008 ppm detection)	Use of agricultural chemicals around the culture ponds	Independent inspection
28		Violation of element standard (endosulfan 0.009 ppm detection)	Pollutions from the agricultural chemicals discharged into ponds	Monitoring inspection
29		Violation of element standard (endosulfan 0.012 ppm detection)	Lack of management of agricultural chemicals in the surrounding areas	Independent inspection
30		Violation of element standard (endosulfan 0.010 ppm detection)	Under investigation	Independent inspection
31		Violation of element standard (Aoz 0.002 ppm detection)	Under investigation	Command inspection
32		Violation of element standard (Aoz 0.001 ppm detection)	Under investigation	Command inspection
33		Violation of element standard (Aoz 0.001 ppm detection)	Under investigation	Command inspection
34		Violation of element standard (Aoz 0.002ppb detection)	Drug residue in the soil of the culture pond	Inspection ordered
35		Violation of element standard (Aoz 0.001ppb detection)	Drug residue in the soil of the culture pond	Inspection ordered
36		Detection over the amount unlikely to cause damage to human health	Under investigation	Inspection ordered

		according to the provision of Paragraph 3, Article 11 of the Food Sanitation Law (Leucomalachite green 0.05 ppm detection)		
37		Violation of element standard (Endosulfan 0.008 ppm detection)	Under investigation	Monitoring inspection
38		Detection over the amount unlikely to cause damage to human health that the provision of Paragraph 3, Article 11 of the Food Sanitation Law (Leucomalachite green 0.03 ppm detection)	Under investigation	Inspection ordered
39		Detection over the amount unlikely to cause damage to human health that the provision of Paragraph 3, Article 11 of the Food Sanitation Law (Leucomalachite green 0.17 ppm detection)	Under investigation	Inspection ordered

Note: Data for 2006 is from June.
Source: Created by author on the basis of information from the MHLW (http://www.mhlw.go.jp/topics/yunyu/tp0130-1ae.html).

Leucomalachite green[11] is created when an organism metabolizes malachite green, which is a synthetic antibacterial agent. Malachite green has been used as a dyestuff and anti-mold agent for ornamental fish. In Japan, malachite green is a banned substance in cultured seafood and foodstuff by the Pharmaceutical Affairs Law. A study conducted by the Food Safety Committee of Japan in November 2005 on the effects of malachite green and leucomalachite green on human health revealed no conclusive effects of these substances on the risk of developing cancer. However, similar experiments on rodents suggest that these substances could be carcinogenic and genotoxic. In addition, they recommended that it is inappropriate to set an acceptable daily intake (ADI) for these substances.

In China, malachite green was included in the "list of banned drugs and chemicals for use on animals mainly as food consumption" in May 2002. After this inclusion, the use of malachite green was completely banned. However, cases involving leucomalachite green have not seemed to cease, as can be seen from Table 5. In the United States and European Union, the possible carcinogenic properties of malachite green were identified as early as in the 1970s. The United States banned its use for food in 1981 and the European Union (along with Norway) in 2002.

[11] It is also used in forensic science, mainly for detection of latent blood.

Endosulfan is a chlorine-based agricultural chemical, mainly used as an insecticide and anti-mold agent. It is effective on a wide range of insects, and its superior bioaccumulation characteristics lead to a lasting effect. This, in turn, has caused a controversy about its use. Because of its toxicity to human health, the ban on this chemical was negotiated under the Stockholm Convention in April 2011 and ratified. The ban took effect in 2012; however, many countries, including the United States and European Union, have already banned its use. The MHLW reported that the detection of endosulfan in live eels imported from China resulted from agricultural effluents containing endosulfan from nearby farms discharged into culture ponds.

Dicofol, detected in 2009, is a pesticide (particularly effective on red spider mites) closely related to DDT. The MHLW has not publicized the reasons for its detection in live eel imported from China. Furazolidone, detected in 2011, is a synthetic antibiotic. Even though it is effective as an antibiotic, concerns of severe side-effects and the fact that it has been identified as a possible carcinogenic prompted the FDA to ban its use since 1991.

Table 6 lists the violations in processed eel imports from China to Japan from the second half of 2006 to the first half of 2012. There were 50 violations in the 6-year span. The reasons for the rejections are mainly violations of elemental and compositional standards, of which leucomalachite green accounted for 25 cases. In addition, there were seven cases each of coliform and enrofloxacin and three of furazolidone (there were several cases with multiple violations). Even for processed eel, violations because of leucomalachite green were the most prevalent. In addition to these chemical residues, there were seven cases with coliform violations related to the sanitary conditions of factories. Enrofloxacin is an antibiotic mainly used for domestic animals (such as pigs and rabbits). The reported side effects of enrofloxacin include skin rashes and vomiting. In Japan, the use of enrofloxacin as a food additive is prohibited.

Based on the publicly available data, the reasons for leucomalachite green violations are 1) accidental inclusion of eels rejected during prior inspections; 2) inclusion of leftovers from the previous year; 3) lack of proper management at the eel culture farm; 4) accidental inclusion of eels destined for the Chinese market or other countries; 5) soil contamination by malachite green; 6) soil contamination by other drugs and chemicals; and 7) storage of eels to stabilize output.

Table 6: Violations of Processed Eel Imports from China, 2006–2011

		Detection	Reasons; Measures taken	Inspection Measures
1	2012	Violation of element standard (Leucomalachite green 0.006 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
2		Violation of compositional standard (coliform bacteria positive)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Independent inspection
3	2011	Violation of compositional standard (enrofloxacin 0.02 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
4		Violation of element standard (leucomalachite green 0.11ppm、furazolidone (as AOZ) 0.002 ppm detection)	Possibility of mixing of rejected eels with others; Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
5		Violation of element standard (Leucomalachite green 0.005 ppm detection)	Mixing of live eel from outside vendors for inspection services; Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
6	2010	Violation of element standard (Leucomalachite green 0.004 ppm detection)	Leftovers from the last fiscal year; Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
7		Violation of compositional standard (enrofloxacin 0.01 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
8		Violation of compositional standard (enrofloxacin 0.01 ppm detection)	Improper inspection at local site; Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
9		Violation of element standard (malachite green 0.012 ppm detection, leucomalachite green) 0.11ppm detection)	Lack of proper management at the farm; Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
10		Violation of element standard (Leucomalachite green 0.006 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
11		Violation of element standard (Leucomalachite green 0.17 ppm detection)	Products destined for Chinese market accidentally exported to Japan; Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
12		Violation of compositional standard (furazolidone [as AOZ] 0.001, 0.005 ppm detection)	Products destined to other countries accidentally exported to Japan; Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
13		Violation of compositional	Abandonment or return of the	Inspection ordered

		standard (coliform bacteria positive)	cargo is directed (the whole quantity is kept)	
14	2009	Violation of compositional standard (enrofloxacin 0.02 ppm detection)	Possibly caused by agricultural effluents; Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
15		Violation of compositional standard (furazolidone (as AOZ) 0.002 ppm detection)	Contamination of the soil; Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
16		Violation of compositional standard (enrofloxacin 0.01, 0.02 ppm detection)	Possibility of effluents and contaminated feeds; Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
17		Violation of compositional standard (coliform bacteria positive)	Contamination by materials while in storage; Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
18		Violation of compositional standard (enrofloxacin 0.01,0.02 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
19		Violation of compositional standard (enrofloxacin 0.01, 0.01 ppm detection)	Possibly caused by agricultural effluents, Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
20	2008	Violation of element standard (difloxacin 0.01 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Independent inspection
21	2007	Violation of element standard (Leucomalachite green 0.062 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
22		Violation of element standard (Leucomalachite green 0.002 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
23		Violation of element standard (Leucomalachite green 0.002 ppm detection)	Soil contaminated with malachite green; Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
24		Violation of element standard (Leucomalachite green 0.002 ppm detection)	Soil contaminated with drug residue; Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
25		Violation of element standard (Leucomalachite green 0.059 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
26		Violation of element standard (Leucomalachite green 0.009 ppm detection)	we directed abandonment or return of the cargo(the whole quantity is kept)	Inspection ordered
27		Violation of element standard (aoz 0.001 ppm, malachite green 0.018 ppm, Leucomalachite green 2.9 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
28		Violation of element standard (coliform bacteria positive)	Abandonment or return of the cargo is directed (the whole	Inspection ordered

			quantity is kept)	
29		Violation of element standard (SEM 0.001 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Independent inspection
30		Violation of element standard (Leucomalachite green 0.005 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
31		Violation of element standard (Leucomalachite green 0.10 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
32		Violation of element standard (Leucomalachite green 0.006 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
33		Violation of element standard (Leucomalachite green 0.007 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
34		Violation of element standard (Leucomalachite green 0.005 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
35		Violation of element standard (Leucomalachite green 0.003 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
36		Violation of element standard (Leucomalachite green 0.087 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
37		Violation of element standard (live bacteria count 1.9×10^5/g)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Independent inspection
38		Violation of element standard (coliform bacteria positive)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
39		Violation of element standard (leicomalachite green 0.008 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
40		Violation of element standard (leicomalachite green 0.004 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
41		Violation of element standard (live bacteria count 3.9×10^6/g)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Independent inspection
42		Violation of element standard (leicomalachite green 0.002 ppm, 0.003 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Inspection ordered
43	2006	Violation of element standard (coliform bacteria positive)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Command inspection
44		Violation of element standard (coliform bacteria positive)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Command inspection
45		Detection over the amount unlikely to cause damage to human health that the provision of Paragraph 3, Article 11 of the Food Sanitation Law (Leucomalachite green 0.02 ppm	Abandonment or return of the cargo is directed (the whole quantity is kept)	Command inspection

		detection)		
46		Detection over the amount unlikely to cause damage to human health that the provision of Paragraph 3, Article 11 of the Food Sanitation Law (Leucomalachite green 0.28 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Command inspection
47		Violation of element standard (aoz 1 ppb detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Command inspection
48		Violation of element standard (aoz 0.011 ppm detection) and detection over the amount unlikely to cause damage to human health that the provision of Paragraph 3, Article 11 of the Food Sanitation Law (Leucomalachite green 0.35 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Command inspection
49		Detection over the amount unlikely to cause damage to human health that the provision of Paragraph 3, Article 11 of the Food Sanitation Law (Leucomalachite green 0.03 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Command inspection
50		Violation of element standard (aoz 0.001 ppm detection)	Abandonment or return of the cargo is directed (the whole quantity is kept)	Command inspection

Note: Data for 2006 is from June.
Source: Created by author based on the information from the MHLW (http://www.mhlw.go.jp/topics/yunyu/tp0130-1ae.html).

An analysis of the rejection and violation data made public by the MHLW indicates that the causes of food safety violations of live and processed eels originate mainly at the eel culture farms. The predominant reason for violations for live and processed eel is the detection of prohibited chemicals such as malachite green. Relatively, violations (such as detection of coliform) caused at the factories or in transit are few in number. In addition, there are several cases where agricultural chemicals have been discharged into ponds where eels are cultured. In the next section, we focus on quality control at eel culture farms.

IV. Eel production in China

Moving locations of main production sites

In the 1970s and 80s, live eels imported by Japan came mainly from Taiwan. However, because of the rapid economic development in Taiwan and associated appreciation in land prices, many eel culture farms were converted to other uses. In addition, manufacturing facilities that sprung up near eel culture farms caused severe water pollution. At the same time, with the opening of China to the global market, it became an attractive place for eel culture because of availability of abundant cheap land, proper climate conditions, and ease of exports. Gradually, the center of eel culture moved from Taiwan to China.

In the 2000s, Taiwanese eel culture farmers chose Guangdong Province as the most favorable for relocation of their activities. Guangdong Province is located in China's coastal region. Particularly significant was the mouth of the Pearl River, where the leptocephali swim up to from the ocean. Because of this geographical advantage, the necessary leptocephali could be caught, and eel culture ponds could be established along with processing factories. An agglomeration of eel industries appeared in Shunde, located in the western part of the Pearl River delta. However, with the rapid economic growth of Shunde, the concentration of eel culture ponds has shifted to Taishan, farther westward in the Pearl River Delta (PRD) in search of cheap abundant land.

Characteristics of eel production in China

In the latter half of the 2000s, eel production spread from Guangdong and Fujian provinces to Shandong and Jiangxi provinces. In China, people associated with eel industries are mostly part of firms, rather than farmers. However, in some areas, large farmers with adequate financial resources operate eel culture ponds. Culturing or processing eels requires substantial capital, and small-holder famers are unable to enter this industry in China.

Two main producing regions, Guangdong and Fujian differ in their characteristics. Guangdong Province mainly rears Japanese eel, while Fujian Province specializes in European eel. Because Guangdong Province produces Japanese eel, its eel products are mainly destined for the Japanese market. The necessary technologies for eel culture and processing come from Taiwan. Since the reason for the relocation of production from Taiwan to China was the lack of available land in Taiwan, it follows that the land areas for eel culture operated by Taiwanese firms are fairly large in Guangdong Province. Since their products are for the Japanese market, the unit prices are also high. About 70% of the firms in the eel industry in Guangdong Province specialize in exports. The remaining 30% or so produce mainly for the Chinese domestic market. Since Guangdong Province is subtropical with warm temperatures throughout the year, the culture ponds are located outside the province.

Since Fujian Province specializes in European eel, which is not marketed widely in Japan, they do not export live eels to Japan but focus on processed eel exports. There are many small to medium firms culturing leptocephalus in Fujian Province, and many firms export to the United States, Russia, and the European Union. In addition, more firms in Fujian Province produce for the Chinese domestic market than in Guangdong Province. Because the distance between Taiwan and Fujian Province is less, some Taiwanese firms also established operations in Fujian Province. However, since the late 2000s, Chinese firms with ample financial resources have also entered the industry in the area. Since the average temperature in Fujian Province is lower than that in Guangdong Province, eel culturing is mainly done inside a building.

The lifecycle of an eel is still largely a mystery. However, it is known that they are spawned somewhere in the ocean, and the leptocephali swim along the Kuroshio current (the Japan Current) and make their way northward from the Philippines toward Taiwan and Japan. There are specialized dealers for leptocephali, and eel culture firms buy from them. A brief schedule of eel culture is shown in Figure 5. The “eel year” begins in August and lasts until July. The season begins in August because by that time, the eels have grown sufficiently to be harvested and shipped. It takes about a year for eels to grow from leptocephali to elvers (young eels) and from elvers to eels. The weight of leptocephali is about 5000 pieces/kg, while grown eels are 4–5 pieces/kg. Typically, leptocephali are caught in November and are put into rearing ponds in December. Toward the end of January and beginning of February, they are grown in the ponds, and by August, they are ready for cultivation.

V. Case Study of Firm Y

Firm Y's local headquarters are located in Shunde, Guangdong Province. Originally, it was established in Taiwan as a seafood processing firm. It began exporting live eels from Taiwan to Japan in 1985, and in 2001, it established a local live eel processing subsidiary in Shunde with an initial capital of $5.65 million. Since 2004, it has operated eel culture ponds in China, and since 2005, it has cultured eels from leptocephali to fully grown eels. In 2006, it produced 5 million eels, and in 2007, 3 million eels. In addition to four directly managed ponds, Firm Y procures live eels from 16 different firms (Table 7). Some of these live eels are processed and some are exported to Japan.

Firm Y employs approximately 200 workers at its Shunde location, of which 120 work in the processing plant. The plant covers an area of 50,000 m^2, of which the building area covers 25,000 m^2. The plant has obtained HACCP and ISO9000 standards and is certified by the EU. It produces roasted eel (long kabayaki, skewered kabayaki, and cut kabayaki).

Within the property of Firm Y, the processing plant, fry ponds, and inspection buildings are located. Firm Y purchases Japanese eel leptocephali from specialized dealers and rears them in their ponds until they grow into elvers. It then transports these elvers by trucks to the growing ponds located in Taishan, which takes about two hours.

The size of each growing pond in Firm Y is about 10–15 mu.[12] Each pond can house 3,000 eels. Alongside the growing ponds, the firm has a processing plant. The feed for the eels is prepared by the firm itself to assure the safety and quality of the feed. Some small- and medium-scale eel culture firms buy feed of unknown quality (and ingredients) from outside vendors. Feed so purchased from outside vendors can lead to food safety and quality violations.

[12] Mu is a traditional way of measuring land areas in China. One mu is approximately 0.067 ha.

Table 7: Basic characteristics of eel culture of firms dealing with Firm Y

	Location	Size of ponds (10,000 m^2)	Annual output (ton)	Number of fry ponds (10,000 pieces)
Firm 1	Zhongshan City	75.4	500	220
Firm 2	Taishan City Doushan Township	60.0	750	200～300
Firm 3	Taishan City Doushan Township	66.6	1,100	400～500
Firm 4	Taishan City Doushan Township	22.0	300	200
Firm 5	Shunde District Lundun Township	20.0	200	80～100
Firm 6	Shunde District Lundun Township	8.9	150	50
Firm 7	Taishan City Doushan Township	70.0	2,000	800
Firm 8	Shunde District Junan Township	16.8	150	50～62
Directly managed pond 1	Sanshui City	35.0	500	20
Firm 9	Taishan City Chonglou Township	21.4	200	80
Firm 10	Taishan City Duanfen Township	53.2	800	300
Firm 11	Taishan City Doushan Township	20.0	200	80
Firm 12	Shunde District	33.3	500	200
Firm 13	Taishan City Haiyan Township	53.3	370	150
Directly managed pond 2	Enping City Hengbei Township	30.0	200	75
Directly managed pond 3	Enping City Hengbei Township	23.0	200	75
Firm 14	Taishan City Chixi Township	40.0	700	200
Directly managed pond 4	Taishan City	23.0	300	130
Firm 15	Zhongshan City Minzhong Township	25.0	500	200
Firm 16	Taishan City Wencun Township	26.0	550	150

Source: Compiled by the author on the basis of an interview with Firm Y.

Firm Y manages drugs and medicines for the eels by establishing a specific warehouse for these chemicals next to the administrative office. The warehouse is kept locked at all times, and only certain personnel have the right to unlock it. These specialized personnel are responsible for maintaining records of the use of drugs and inventories in the custom electronic system of the firm to ensure transparency in drug use. In addition, Firm Y hires security guards to guard the chemical warehouse and eel ponds to prevent theft. According to the managers of Firm Y, such a large firm is capable of investing in the necessary facilities and processes to control the quality and safety of the eels. However, smaller firms may not have enough resources for these investments, and their quality control can fall short of export quality. Therefore, many of these smaller firms concentrate on the Chinese domestic market instead.

One of the main concerns in raising eel is the outbreak of diseases, which tend to occur from spring to fall when the fluctuations of temperatures are more volatile.

The export of live eels by Firm Y is based on the eels raised in their own ponds, where the quality of eels can be assured and traced. Firm Y procures eels from outside growers for processed eel exports. Firm Y procures eels from 16 firms, all located in the PRD region. The production capacity of all the ponds together is 35.82 million leptocephali. Firm Y provides technical assistance to these outside growers, the main assistance being the use of feed, such as what feed to buy, where to buy the feed from, and the timing and amount of feeding. Such technical assistance to outside growers is necessary to ensure the final quality of eels.

Manufacture and export of processed eels

Table 8 lists the typical steps associated with eel processing. The plant of Firm Y has obtained international certification, such as HACCP and ISO.

When Firm Y prepares eels for processing, the first step involves checking for agricultural chemicals, drug residues, and existence of heavy metals. This is done voluntarily to ensure that the quality of eels used meets the safety regulations of the export market. After eels pass the inspection, they are cut, cleansed, and charcoal broiled. After the initial broiling, a taste inspection is conducted to check for taste, smell, texture, and aesthetics. After the taste inspection, the eels are steamed and broiled again.[13] These steps constitute the primary processing of eels. Depending on customer requests, the firm also provides secondary processing. Secondary processing involves cutting the processed eels for sushi, Unaju (eel bowl), and Uzaku (eel and cucumber salad). Typical customers requesting secondary processing include grocery stores, gyudon chains, and convenience stores.

[13] This is a typical preparation method in the Kanto region of Japan. In the Kansai region, eels are prepared without steaming.

The processed eels are vacuum sealed, frozen, and packed in a box. Once these boxes are loaded onto trucks, they pass through the Shunde Government Export Quarantine and are exported from the Shunde port to Japan via Hong Kong. Live eels are transported from Taishan to Guangzhou Airport, and from there, they are exported to Narita Airport. Those destined for Nagoya or Kansai Airport are exported from Guangzhou Airport via Shanghai Airport.

Figure 3 shows the flows of inspections during Firm Y's production process. The growing ponds listed in Table 7 were registered as "growing ponds for exports" at Guangdong China Import–Export Inspection and Quarantine (CIQ). Firm Y conducts sample inspections of eels purchased from outside growers. Once these eels pass the inspection, Firm Y reports the eels as destined for processing and export to the Shunde CIQ, where their processing factory is located. If the eels do not pass the inspection, Firm Y may cancel the cultivation of eels from that pond or purchase them for eel products destined for the Chinese market or for selling to eel traders. The inspection standards at this stage are based on the standards of Guangdong CIQ but modified by Firm Y.

After this, the eels are subjected to random sampling by the Guangdong and Shunde CIQ. If they pass the inspections, then Firm Y begins the export process by obtaining the necessary certification for the cultivation of cultured eels. Once the eels arrive at the processing factory in Shunde by truck, they are sorted according to their size. At this stage, Firm Y conducts further inspections. If the eels purchased from outside growers fail the inspection, they are returned. If the eels grown in ponds managed by Firm Y fail, they are directed to eel products meant for the Chinese domestic market or sold to eel traders. Those that pass the inspection are then processed for export.

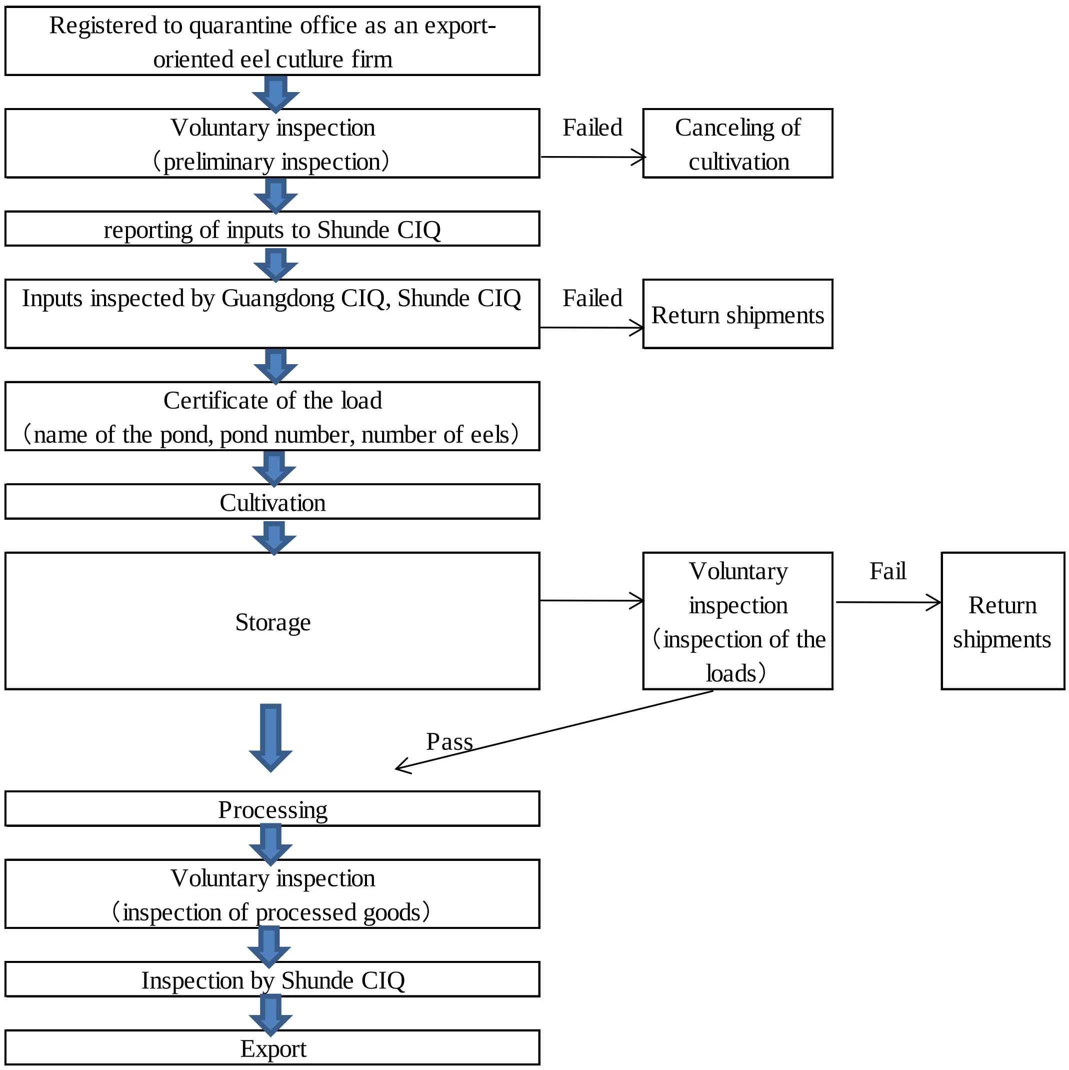
Table 8: Steps for processing eels

	Stages	Processes	Location
1	Culture	Purchase of fry	Shunde
2		Rearing of fry (in-house facility)	
3		Culturing of elvers (vertical buckets, 150 pieces/bucket)	
4		Transferring of elvers to the firm's ponds (company trucks)	Taishan
5		Cultivation (in the firm's ponds)	
6	Input procurement	Transfer of grown eels from ponds to factory (company truck)	Shunde
7		Purchase of grown eel from outside growers (trucks of logistics firms)	
8		Storing in vertical bucket (for one day, removal of mud, weighing, cutting of tails)	
9	Inspection	Voluntary inspection for agricultural chemicals, drugs, heavy metals (two days)	
10	Primary processing	Cutting of eels, cleansing	
11		Butterflying and skewering	
12		Charcoal broiling	
13		Checking temperature of meat	
14		Checking for taste	
15		Steaming	
16		Kabayaki (additional broiling)	
17		Rapid freezing (50 min)	
18	Secondary processing	Defrosting	
19		Cutting based on orders from customers	
20		Vacuum sealing	
21		Inspection	
22		Rapid freezing (120 min)	
23	Inspection	Metal inspection	
24	Shipping	Sorting	
25		Sorting by a lot (5 kg, typically 43 pieces)	
26		Boxing, labeling	
27		Loading into trucks	
28		Recording and photographing the shipment	
29	Export	China Export quarantine	
30		To Hong Kong (one-day trip from Shunde to Hong Kong, ship every Friday)	Hong Kong
31		Loading into containers	
32		Arriving at Japan (six days from Shunde to Japan, arriving on Thursdays)	Japan

Source: Created by author based on interview with Firm Y.

During the processing stage, Firm Y conducts inspections, as noted in Table 8. The inspections focus on metal detection. Once products pass all the inspections, they go through final inspections by Shunde CIQ, which has jurisdiction over the port of Shunde, where the firm exports from. The export inspection is conducted by officials from Shunde CIQ, within the facility of Firm Y. The inspection of live eels for export is conducted by Taishan CIQ, where the growing ponds are located.

Figure 3: Flow of inspections for processed eel in China



Source: Created by author based on interview with Firm Y.

Inspection of growing ponds by the Chinese government

The inspections by CIQs are conducted at three different stages: before purchase, at the time of purchase, and at the time of export. CIQs also conduct additional irregular inspections on the management and chemical usage of registered growing ponds for live and processed eels destined for the Japanese market. The standards adopted by CIQs for each inspection are listed in Table 9.

Table 9: Materials inspected by the CIQ

Before purchase	
Inspections for residual synthetic antibacterial drugs (HPLC method)	
Sulfonamide	100ppb
Oxolinic acid	10ppb
Enrofloxacin	20ppb
Malachite green	2ppb
Leucomalachite green	2ppb
Furazolidone	0.5ppb
Semicarbazide	0.5ppb
(Monitoring inspection: CP: 0.3 ppb; CIP: 20 ppb; NOR: 20 ppb)	
Inspections for heavy metals (AAS method)	
Mercury	300ppb
Cadmium	50ppb
Once the products pass the inspections, they can be ordered.	
At the time of purchase	
Inspections for residual synthetic antibacterial drugs (HPLC method)	
Oxolinic acid	10ppb
Enrofloxacin	20ppb
Malachite green	2ppb
Leucomalachite green	2ppb
Furazolidone	0.5ppb
Semicarbazide	0.5ppb
Furaltadone	0.5ppb
Nitrofurantoin	0.5ppb
(Monitoring inspection:	
Sulfonamide	100ppb
Oxolinic acid	10ppb
Chloramphenicol	0.3ppb
Ciprofloxacin	20ppb
Norfloxacin	20ppb
Endosulfan	2ppb
Inspections for heavy metals (AAS method)	
Mercury	300ppb
Cadmium	50ppb
Once the products pass the inspections, they can be exported to Japan	
At the time of export	
Inspections for residual synthetic antibacterial drugs (HPLC method)	
Oxolinic acid	10ppb
Enrofloxacin	20ppb
malachite green	2ppb

Leucomalachite green	2ppb
Furazolidone	0.5ppb
Semicarbazide	0.5ppb
Furaltadone	0.5ppb
Nitrofurantoin	0.5ppb
Inspections for residual synthetic antibacterial drugs (GC method)	
Endosulfan	2ppb

Note: HPLC is high performance liquid chromatography; AAS is atomic absorption spectrometry; GC is gas chromatography.
Source: Created by author based on interview with firm Y.

Investments in inspection infrastructure

Since 2005, Firm Y has strengthened its own inspection capabilities. There are two reasons why Firm Y has invested in developing its own inspection capability. First, the costs of inspection by outside vendors have increased substantially, making it economical for Firm Y to have its own testing equipment. Second, with an in-house testing facility, Firm Y can offer inspection services to other firms, generating additional cash flow. Firm Y has invested in creating a specialized room for inspection, purchased necessary testing equipment, and hired specialized personnel.

Firm Y had sufficient financial resources to invest in its own testing facility. Only a handful of eel-related firms have sufficient resources to purchase such expensive equipment. The price of some equipment is as high as one million dollars (US). Firm Y even owns testing equipment that the Shunde District Administration of Quality Supervision, Inspection and Quarantine does not possess.

In its inspection room, Firm Y possesses testing equipment for chloramphenicol, various metals, malachite green, and AOZ, as well as liquid chromatography equipment (purchased in April 2006) and gas chromatography equipment (purchased in October 2006). In addition to the purchase of testing equipment, Firm Y has also strengthened its internal inspection routine to check for microorganisms (such as, coli form, staphylococcus, and salmonella), water quality, and chemical residues.

Firm Y has created an electronic system that provides the processing history and inspection results, aimed at potential buyers and governments within and outside of China. In this system, a user inputs an inspection number that will produce the history of the processing done. The production lot number is 15 digits long, composed of the pond number, eel grower number, production management number, and the date of production. In addition, Firm Y provides their drug usage records on their website. Users can input 14 digits drug record number and obtain reports that include the name of the drug used in the pond where the product came from, the dosage of the applied drug, and the date of usage. By using these two systems, users can access the records on water usage in the growing ponds, drug usage, feed records, and preserved samples by production lots.

Causes of residue agricultural chemicals and drugs

Rejections of live and processed eels exported to Japan at the ports peaked in 2006 and have since then been decreasing. In addition to the official reports of the MHLW on the reasons for these rejections (mainly inclusion of prohibited chemicals), we interviewed the CEO of Firm Y for the possible causes of problems of residue chemicals in eels. During the interview, seven possible causes were identified.

First is the impatience on the part of eel growers. There are specific periods that are required for eels to metabolize drugs, and as a safe practice, one needs to wait for certain a period before releasing eels into ponds after drugs are administered. However, some growers do not wait for the required waiting period and release the eels prematurely into ponds, leading to drug residue problems.

Second, some growers do not know how to administer drugs appropriately. Some growers administer too much drugs, which the eels cannot metabolize and start to accumulate in their bodies.

Third, the use of inappropriate feed and drugs such as those containing malachite green continues. In addition, some feed circulating in the market may contain inappropriate ingredients.

Fourth, water contamination in eel ponds can occur when a typhoon hits the region. The provinces of Guangdong and Fujian provinces are regularly hit by typhoons. Severe rainfall and consequent floods can cause water from agricultural fields, irrigation, and ponds for shrimp and other fish to intrude into the eel ponds. Those water sources could contain substances prohibited in eels.

Fifth is the problem of soil contamination. Some eel growers rotate the type of seafood they culture. This holds true particularly for this year, when leptocephali were difficult to obtain. Some eel growers are shifting to shrimp and blow fish culture. Furthermore, a rich farmer sometimes operates seafood culturing business on the side, and they determine what to grow depending on the price movements of seafood in the market. When a farmer grows shrimp, the typical length of the contract is for 2–3 years. Because cultured shrimp is mainly for the Chinese domestic market, the quality control and management of ponds are not as strict as for exported eels. Various types of drugs and chemicals can be used, which could accumulate in the soil. When these ponds are converted into eel growing ponds, problems associated with contaminated soils may occur.

Sixth, problems arise from the mixing of eels from different producers. Many small and medium firms grow eels for the Chinese domestic market. Some firms buy these eels and mix them with the eels meant for export.

Finally, the problem with the lack of proper management of agricultural chemicals and drugs is still persisting. Even though the laws concerning the management of agricultural chemicals and drugs are enacted and the regulations updated, the enforcement of these laws and regulations is still inadequate. On the production front, the problem of imitation and inferior products still exists. At the distribution and retail stage, there are a number of cases where prohibited chemicals and drugs are sold to sectors prohibited from using them, and in some cases, they are mixed with other materials and products. On the user’s side, there are still a number of growers who do not understand the proper usage of these chemicals and drugs. As for malachite green, even though it is now banned in China, one can still purchase it freely from small agricultural shops or over the Internet. The Chinese government is now considering revising the “Regulations on Pesticide Administration” (promulgated by Decree No. 216 of the State Council of the People’s Republic of China on May 8, 1997; amended in accordance with the Decision of the State Council on Amending the Regulations on Pesticide Administration on November 29, 2001). The revision would mandate the sellers of agricultural chemicals and drugs to maintain sales records, conduct inspections of the chemicals, implement licensing requirements for sellers of agricultural chemicals and drugs, as well as mandate that proper education be provided to buyers of these chemicals and drugs.

VI. Case Study of Firm T

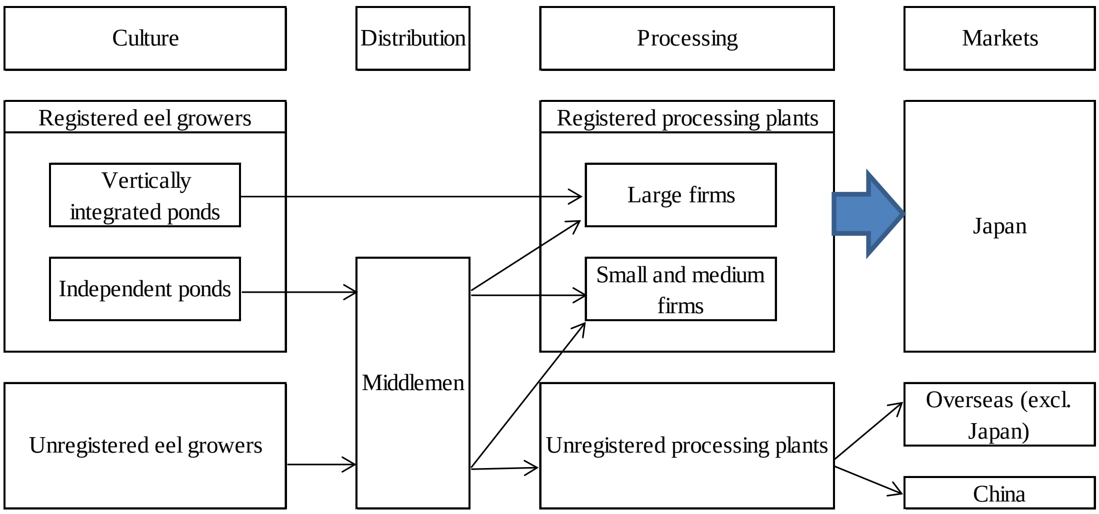
Firm T is a middleman with investment from Taiwan, located in Taixi in the western part of PRD. Their main line of business is the sale and purchase of eels for processing. The firm originally shifted from Taiwan to Shunde in 2002. When the growing ponds were migrating toward Taixi, Firm T also moved its local headquarters to Taixi four years ago. It purchases cultured eels from growers in Taixi, sorts them according to the size, and sells them to processing firms. There are 10 firms like Firm T in Taixi. Of these, five (including Firm T) specialize in dealing with eels for processing. Of these five, only Firm T has foreign investment, with the rest being domestically owned firms.

This year, there was a shortage of supply of leptocephali, and their price increased from 3 RMB to 45 RMB. Consequently, the price of eels that Firm T buys also increased to 45–50 RMB per piece in 2012, compared to only 12–13 RMB per piece in 2011. Typically, middlemen can make about 3 RMB/kg profit; however, in 2012, the profit was almost zero. The amount of eels for processing that Firm T dealt with has not changed significantly between 2011 (600–700 tons) and the first half of 2012 (200–300 tons), but has declined compared to 2010.

Figure 4 shows the various routes associated with the distribution of eels in China. Specialized firms catch leptocephali and sell them to eel growers. Large firms typically rear leptocephali in a separate location until they become elvers. Small and medium firms usually grow leptocephali and elvers in the same location.

Large processing firms are usually vertically integrated and own growing ponds. Once the cultivation is done, eels are exported as live eels or sent to processing plants for further processing. In addition to eels from their own ponds, large firms also purchase from other ponds through middlemen. Small and medium processing firms do not typically own growing ponds and rely exclusively on middlemen for the eels, which they process and sell to the Chinese domestic market.

Figure 4: Distribution routes of live and processed eels in China



Source: Compiled by the author on the basis of interviews with local firms.

Quality control problem from the middlemen's perspective

Firm T purchases eels from eel growers and transports them to processing plants using their own trucks. Typically, the duration from purchase to delivery is less than nine hours. This is to maintain the freshness of the eels. Since operating and managing growing ponds is costly, only a handful of processing firms own them. While these large integrated firms take quality control matters in their own hands, small and medium firms rely on the middlemen for the quality control of eels. As traders, they need to ensure that they can handle a large quantity of eels. At the same time, the ability to secure sufficient high-quality eels is also important. At this point, if the processed eels are rejected at the ports of importing countries, the responsibility and liability lies with the traders, not on the processing firms. In addition, processing firms will not conduct business again with traders that supplied low-quality eels. Even though processing firms purchase eels from outside growers, they do not provide any technical assistance to these growers. It is the traders who need to ensure that the eels are of high quality, and are also the ones facing the most risk. For these reasons, and to ensure that they are able to secure sufficient high-quality eel, traders provide necessary information to eel growers. However, even with the best efforts, when the production of eels is low or when prices are high, the traders may be forced to purchase low-quality eels. This, in turn, could eventually lead to rejections at the ports of importing countries.

Concluding remarks

This study analyzes the causes of rejections of live and processed eels imported from China to Japan. Using publicly available data from the MHLW and field surveys in China, we examined possible causes. We believe that the following conclusions can be drawn.

First, the analysis of the data by the MHLW reveals that rejections of live and processed eels were mainly caused by the detection of malachite green in eels. Another reason for the rejections was the improper use of drugs at the eel growing ponds. Therefore, the most fruitful actions can be taken at the eel growing ponds; in particular, proper management of drugs and chemicals at the ponds is required. This particularly applies to processing firms and independent eel culture firms.

There were a number of cases of coli detections in processed eels. Improvements in sanitary conditions at the processing plants are essential to weed out this kind of problem.

Large firms tend to be vertically integrated and manage and operate their own growing ponds. However, directly managed ponds cannot supply enough eels, and even the large firms need to rely on traders to procure the necessary inputs from independent eel growers. By doing so, the firms cannot directly manage and ensure the quality of all the eels they use. The responsibility for the quality control is shifted to traders; this can eventually be a source of problems and needs to be addressed. However, changes in business practices are difficult, if not impossible, through policies.

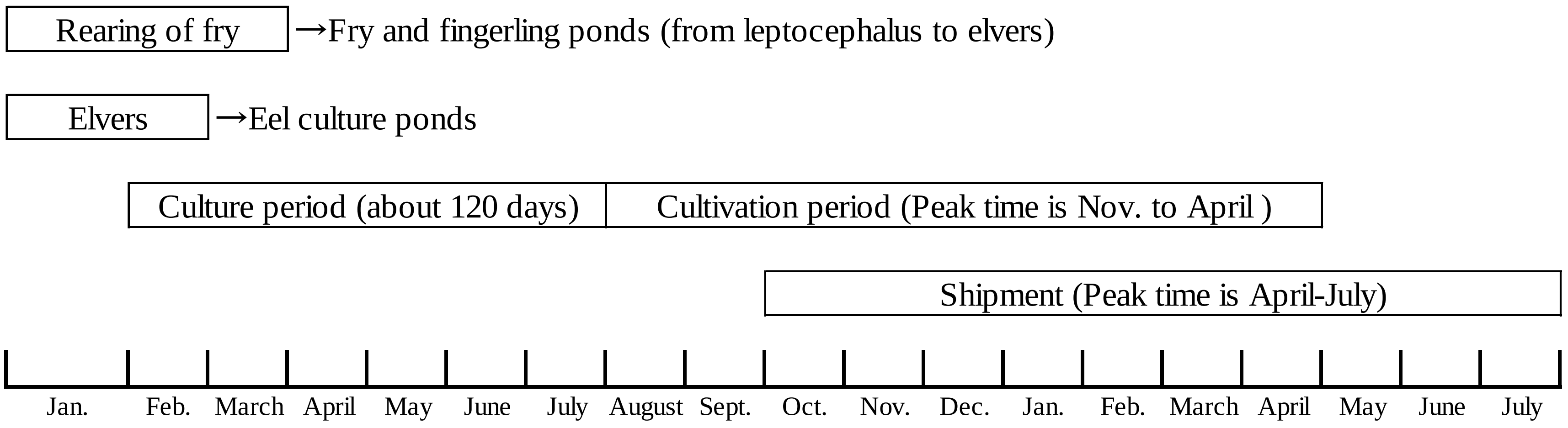
Instead, the policies should focus on providing technical assistance to independent eel growers so that they understand and can fully implement quality control. Similar training can be offered to traders. To sustain this kind of activities, funds will need to be allocated. Funding could be established by the local eel grower association. The funds can finance the cost of technicians and/or advisers who will be stationed in Taixi to provide technical assistance to small- and medium-sized growers.

In addition, agricultural chemicals and drugs can be managed by independent operators who can keep track of the use of chemicals by individual growers.

Even if the system of quality control is strengthened in the eel growing industry, if basic inputs such as drugs and other chemicals are mislabeled or imitation products are widely available, then the whole effort could be in vain. Therefore, a tougher enforcement laws for imitation products—particularly feed and agricultural chemicals and drugs—are essential.

Finally, as an awareness campaign on the importance of quality control, an "Eel-Growing Rule Book" can be created and distributed to small and medium firms and traders, along with the requirement of eel growers to post a schedule of proper drug application on their sites.

Figure 5: Timeline of eel culture



Source: Created by author based on interview with Firm Y.

Appendix: Cooperation between Japan and China on improving safety of food products exported from China: Registration requirements for eel culture and eel processing plants in China

There have been a number of cases where antibiotics and agricultural chemical residues that are prohibited in food products in Japan have been discovered in live and processed eel products imported from China. In principle, the import of eel is fully liberalized in Japan; however, if one wishes to import live eels and processed eel products for commercial purpose, importers need to notify the Office of the Import Food Safety of the MHLW, established under the Food Sanitation Act. If the office finds it necessary to verify that the commodities meet the safety standards, the commodities can be inspected. If no violations are found, the approval letter will be returned, and the importer will submit these along with other documentation to the Customs office.

In Japan, there were a couple of cases where the "eel laundering" (fraudulent claim on the origin of the eel, which greatly affects the price) were discovered. To counter these types of claims, eel products sold in Japan are now required to have proper labels under the Japanese Agriculture Standard (JAS) Law. For live eels, the labeling standards follow those established for fresh products and aquatic products. For processed eels, it depends on the type of product. For imported food, the country of origin needs to be clearly specified. After the "eel laundering" incidents, the revised JAS Law (revised in May 2009) has enacted strict punishments for fraudulent claims on the country of origin. The revised JAS Law now requires processed food products to bear a label specifying the country of origin and sets stricter standards for the quality and safety.

Within this context, there have been a number of cases where malachite green was detected in live eels and processed eel products imported from China to Japan. For such products, the MHLW conducts an "ordered inspection" based on the provision of Paragraph 3, Article 26 of the Food Sanitation Law. In addition, processed eel products (roasted eels and processed eel liver products) detected with enrofloxacin are also subject to ordered inspections. Because the volume of eel product exports to Japan plummeted after these incidents, the Chinese government started a registration system to certify eel growing ponds and processing plants so as to prevent the use of malachite green in the entire eel production destined for export.

In contrast, for the inspections for agricultural chemical residues such as oxolinic acid (mainly used as antibiotics) and sulfamethazine (growth enhancing chemicals), if certain conditions are met, the agreement between China and Japan does not require inspections. The conditions are that the raw materials (live eels) must come from registered eel growing ponds; products must be processed in registered processing firms; and for oxolinic acid, they must be certified by the CIQs.

In 2012, there were 86 registered eel culture firms for live eels in China, of which 66 are located in Guangdong Province and 13 in Fujian Province. There are 382 firms registered as exclusively for processing, and 55 processing plants are registered in China.

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