Application of Big Data on Food Safety in Taiwan

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Outline

1. Introduction: recent food safety crisis in Taiwan
2. Food safety management system in Taiwan
3. Development of big data application on food safety
4. Exercise examples
5. Conclusions

Introduction: recent food safety crisis in Taiwan

Introduction: recent food safety crisis in Taiwan

行政院衛生署
Department of Health, Executive Yuan, R.O.C. (TAIWAN)

2010-2012 food crisis events

2010 Vacuum packed dried tofu- *Clostridium botulinum*

2010 Bis-phenol A, BPA plastic infant-feeding bottles

2011全國食品安全會議

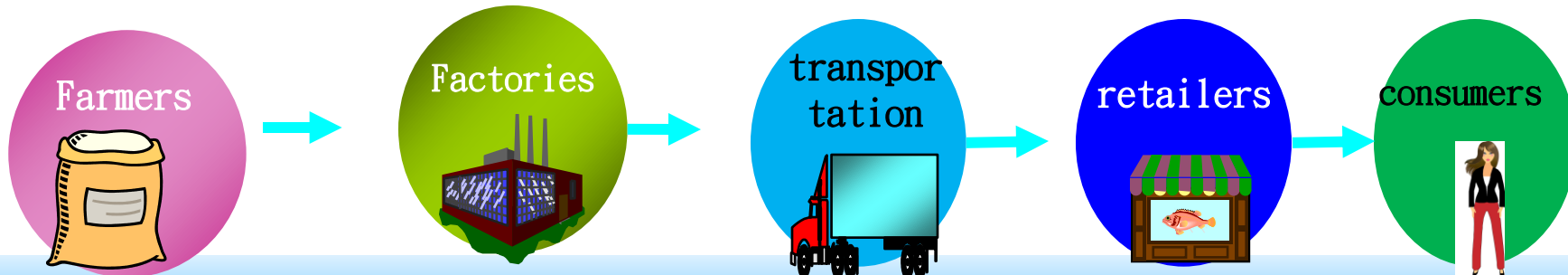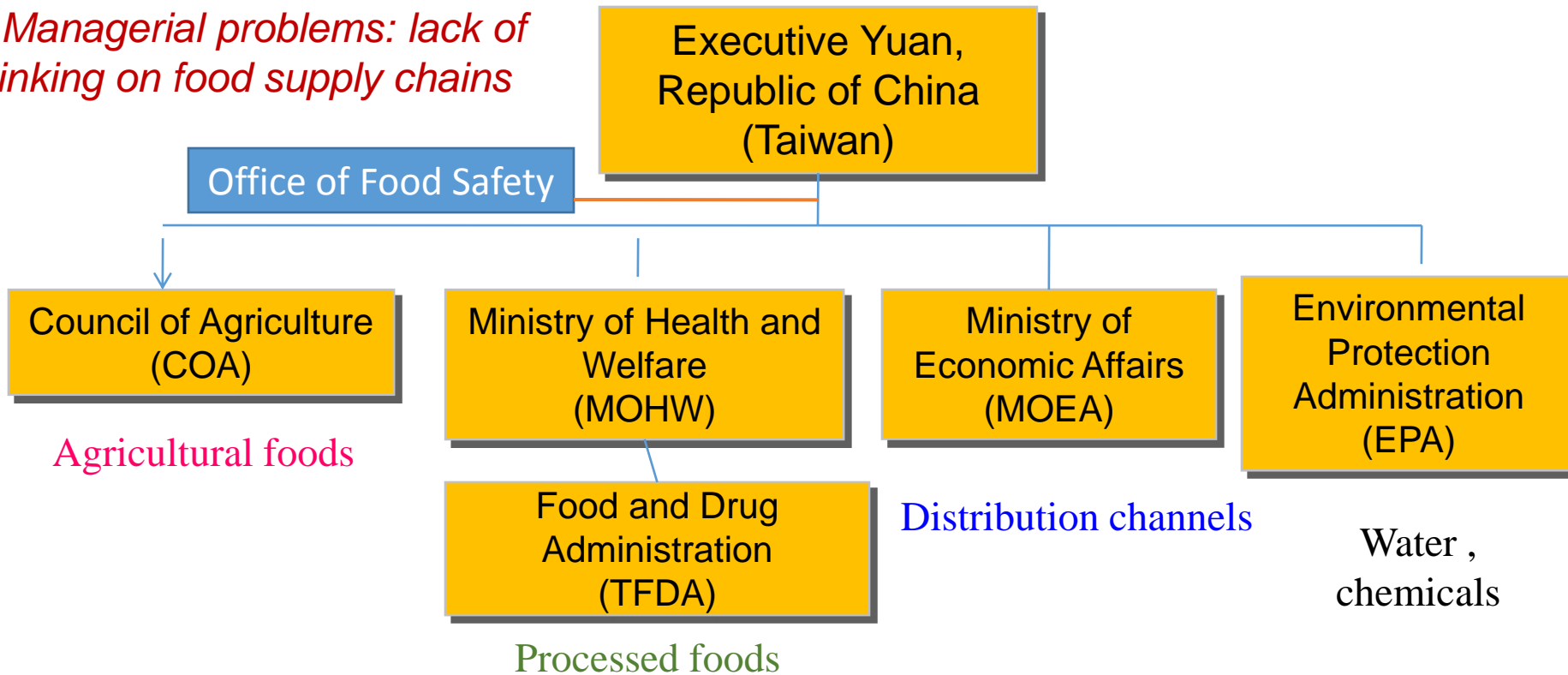# Introduction: recent food safety crisis in Taiwan

2010-2012 food crisis events

2011 Use of plasticizer-DEHP to replace palm oil in food as a clouding agent

Food safety management system in Taiwan

• *Managerial problems: lack of linking on food supply chains*

Executive Yuan, Republic of China (Taiwan)

Office of Food Safety

Council of Agriculture (COA)

Agricultural foods

Ministry of Health and Welfare (MOHW)

Food and Drug Administration (TFDA)

Processed foods

Ministry of Economic Affairs (MOEA)

Distribution channels

Environmental Protection Administration (EPA)

Water , chemicals

Farmers → Factories → transportation → retailers → consumers

Development of Big Data application on food safety in Taiwan

◆Motivations:

- To alert authorities to food safety risks and allows for faster tracing of products and ingredients

- To ensure the data can flow properly across different agencies,

◆"Food cloud" platform

- Using big data technology, the food cloud gathers, shares and analyzes information in a methodical and systematic manner.

Development of big data application on food safety in Taiwan

- 2010 Dec- Food cloud platform was initiated
  - five information systems established, including Registration, Tracing, Reporting, Testing and Inspection
- 2015 Sep- Food and Drug Intelligence Center was established
  - the MOHW on September 2, 2015 established a food and drug intelligence center as a mechanism for managing food safety risks and crises on the national level. The technologies for big data management and mega data analysis will enable authorities to better manage food sources and protect consumer health.

Concepts of "food cloud" platform
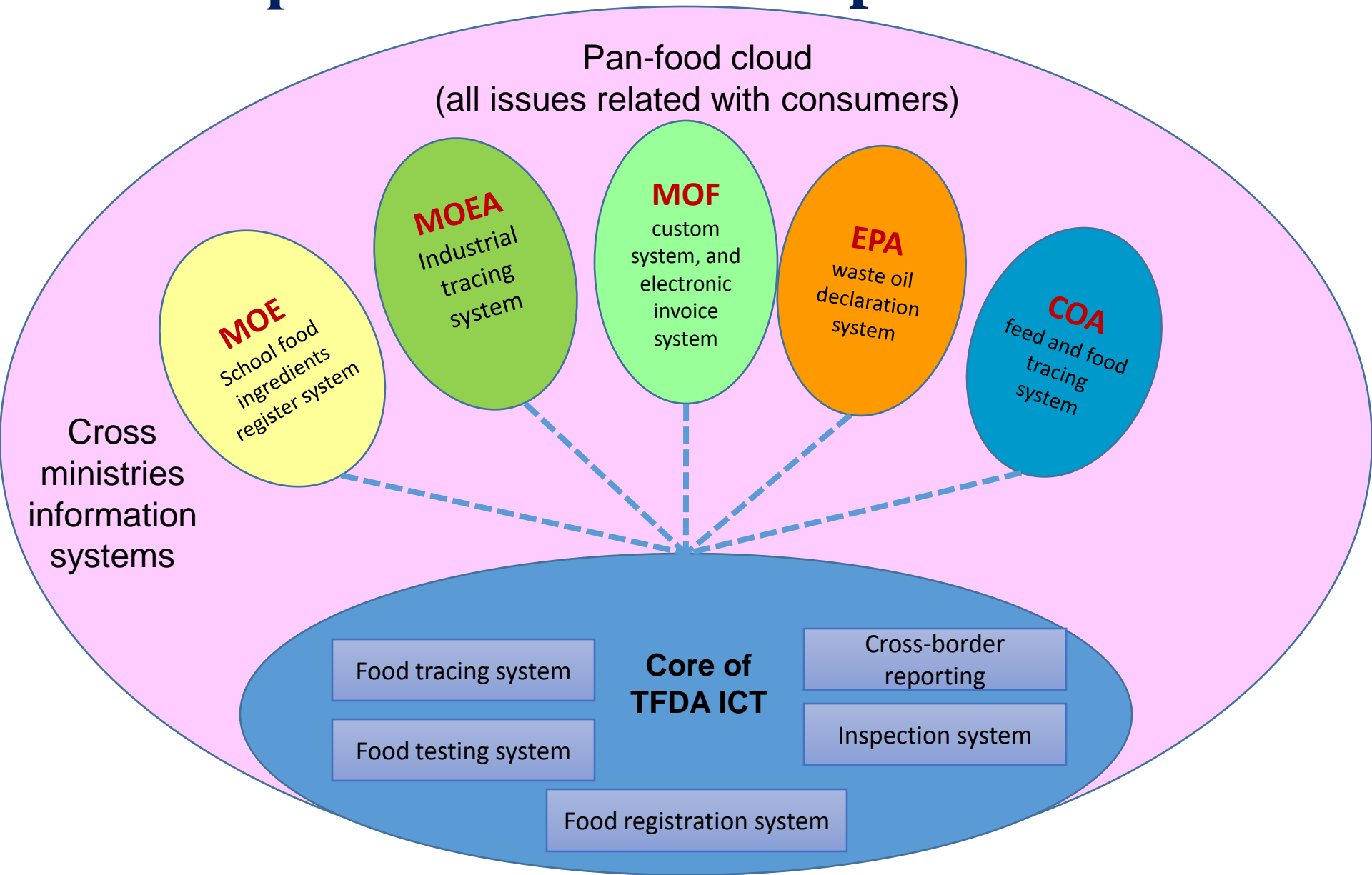## Establishing food safety management database

☐ **Health database**

- 23 million people deceases data

☐ **Food safety management database**

- 600 thousand business operators database

  - ✓ Scope: food manufacturers, food service companies, food packaging companies …

  - ✓ Operations: food processing, import, selling..

- million food products database

Concept of "Food Cloud" platform

Pan-food cloud
(all issues related with consumers)

Cross ministries information systems

MOE School food ingredients register system

MOEA Industrial tracing system

MOF custom system, and electronic invoice system

EPA waste oil declaration system

COA feed and food tracing system

Core of TFDA ICT

Food tracing system

Food testing system

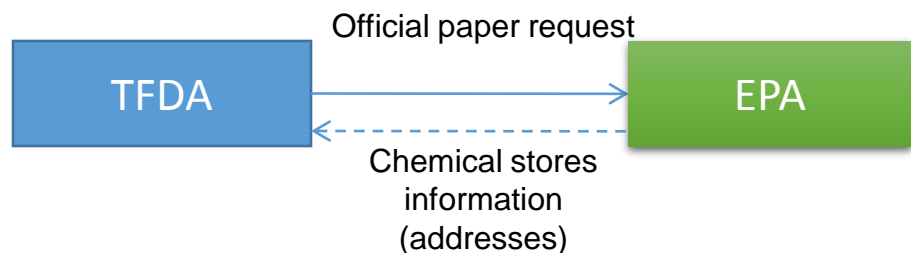Cross-border reporting

Inspection system

Food registration system

Benefits of food cloud: increasing tracing speeds

Exercise example: how to trace upstream and downstream flow of non-food grade sodium nitrite added in hot dogs ?
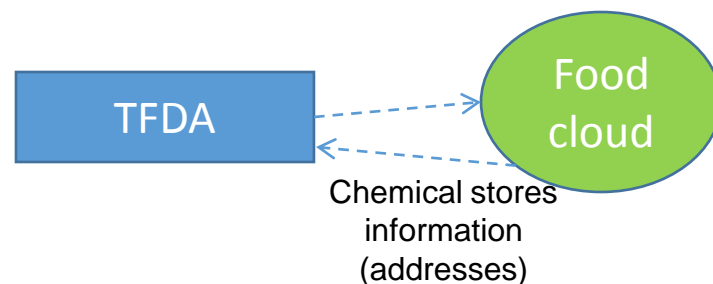
Past

- **What?:** tracing problematic products and flow

- **How?**: TFDA send official paper request to ask for chemical stores information from the Ministry of Environmental Protection (EPA).

- **Time spend**: at least one month

Official paper request

TFDA → EPA

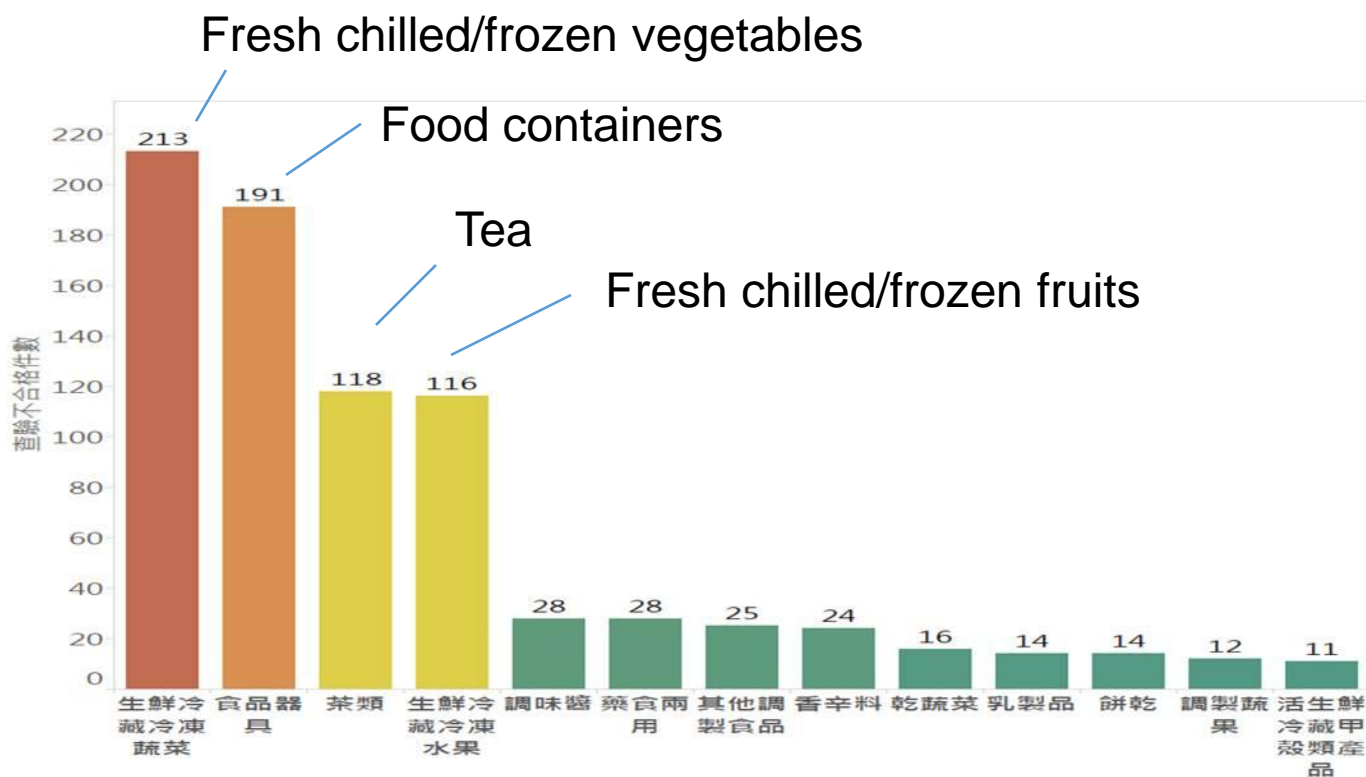Chemical stores information (addresses)

Current

- **What?:** tracing problematic products and flow

- **How**: TFDA links food cloud-tax system platform to retrieve chemical stores information.
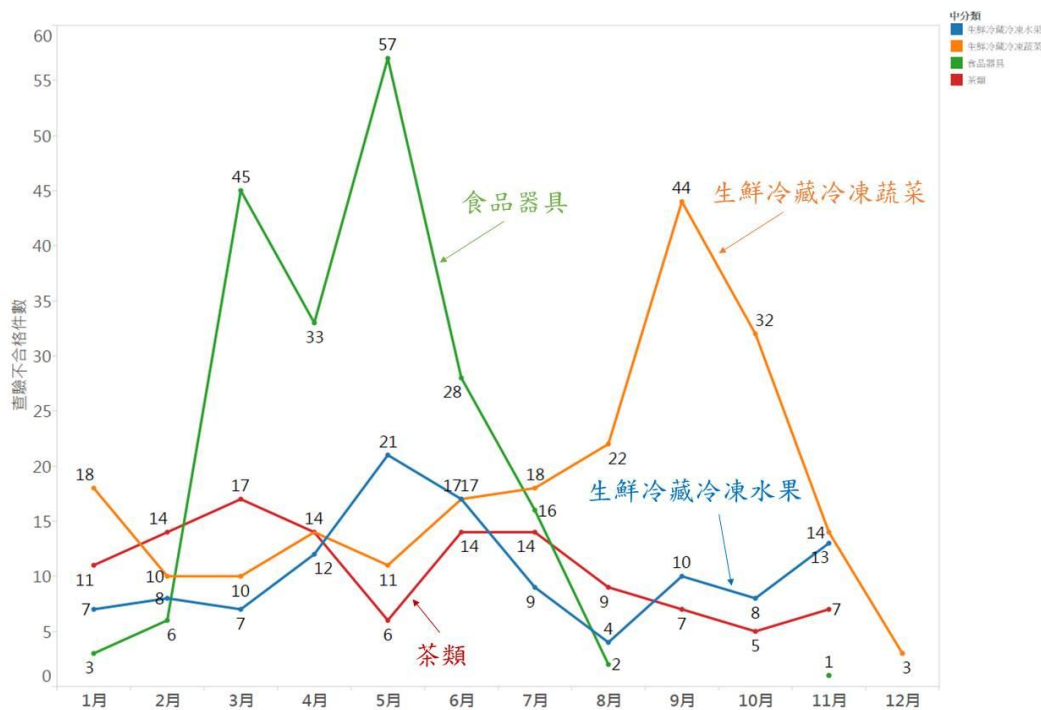
- **Time** spend: two days

TFDA ⇢ Food cloud

Chemical stores information (addresses)

(TFDA, 2015)

Benefits of food cloud: early warning

Exercise examples: how to identify potential problematic products from import data?

Fresh chilled/frozen vegetables

Food containers

Tea

Fresh chilled/frozen fruits

(TFDA, 2015)

Benefits of food cloud: early warning

Exercise examples: how to identify potential problematic products from import data?

圖二、產品中分類查驗不合格件數時間趨勢

Food containers

Fresh chilled/frozen vegetables

Fresh chilled/frozen fruits

Tea

Exercise example: climate change and food safety data

Is there a relationship between climatic change data and seafood safety?

H.I. Hsiao, M. S. Jan, H. J. Chi (2016), Impacts of Climatic Variability on *Vibrio pnarahaemolyticus* Outbreaks in Taiwan, *International Journal of Environmental Research and Public Health*, *13*(2), 188; doi:10.3390/ijerph13020188
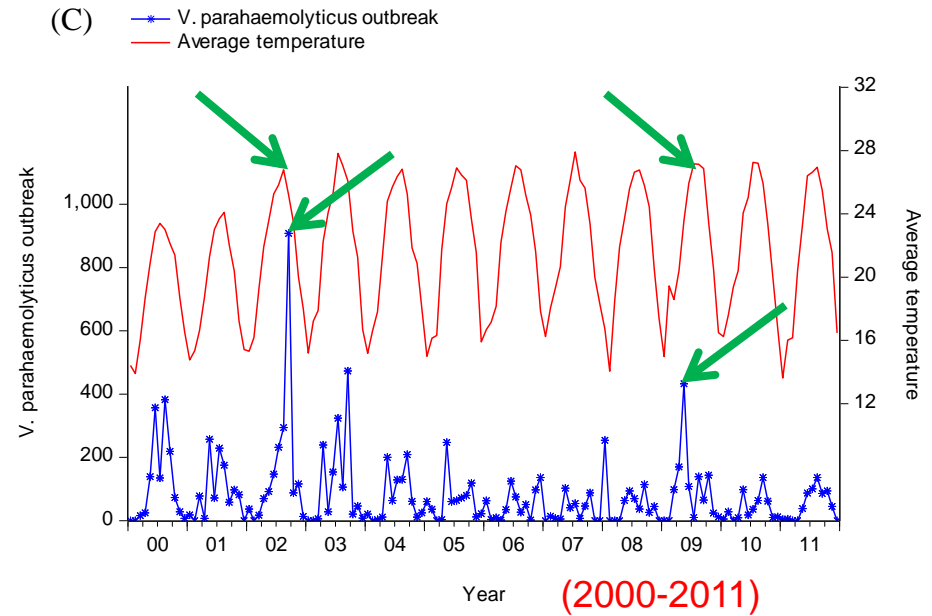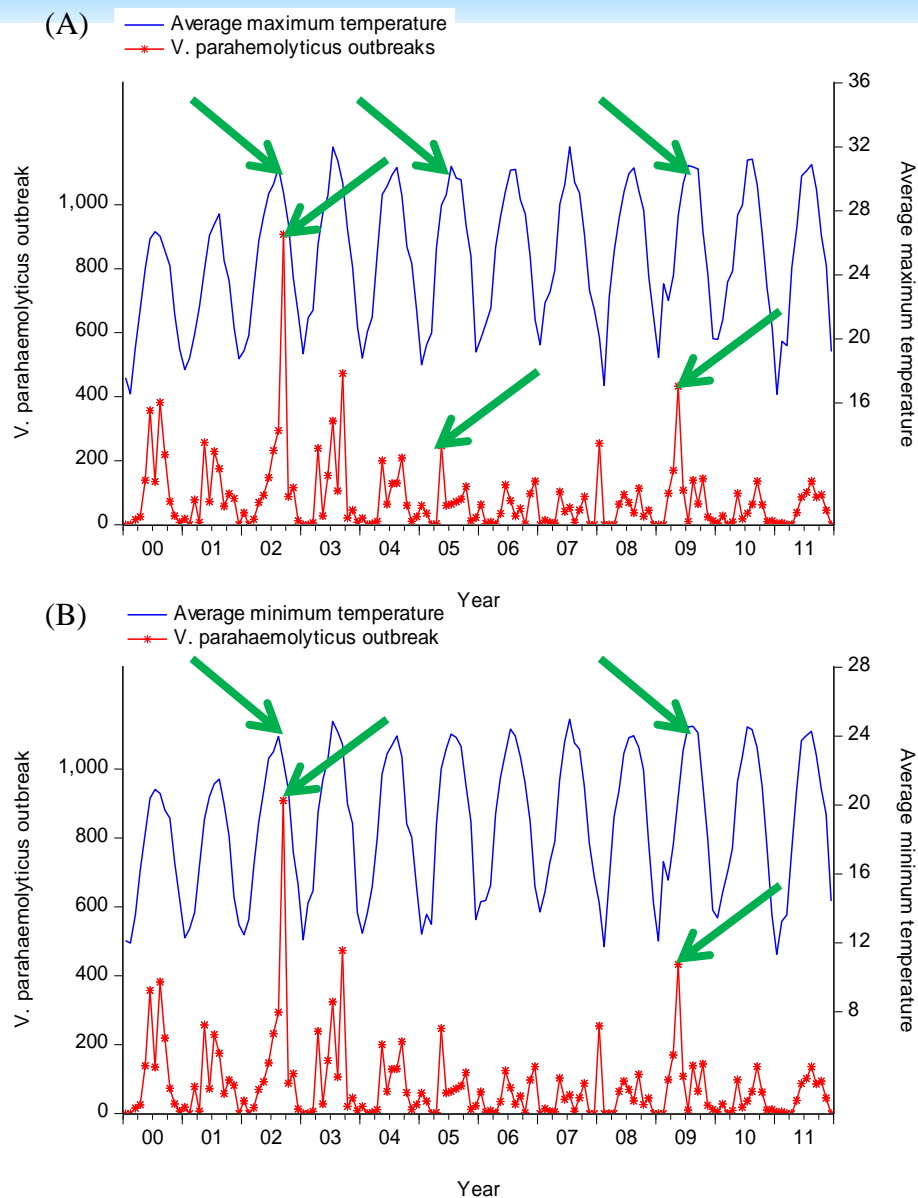
Figure 3.1 Trends of *V. parahaemolytics* with monthly:
(A)maximum temperature, (B)minimum temperature, (C)average temperature
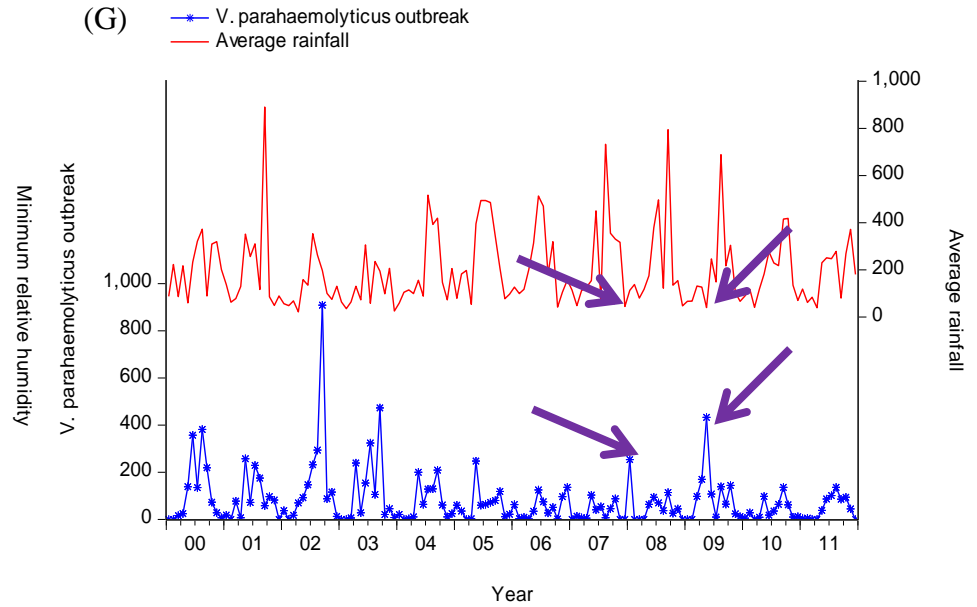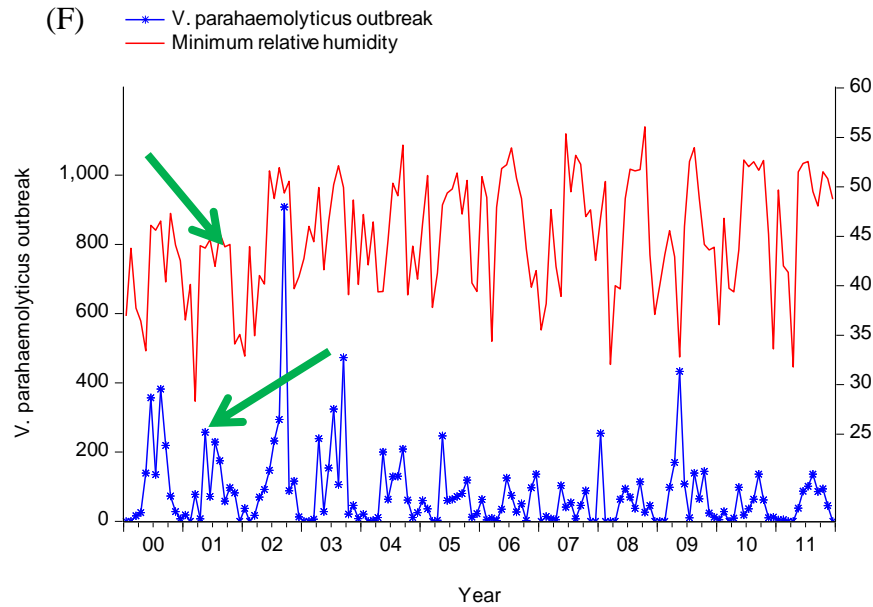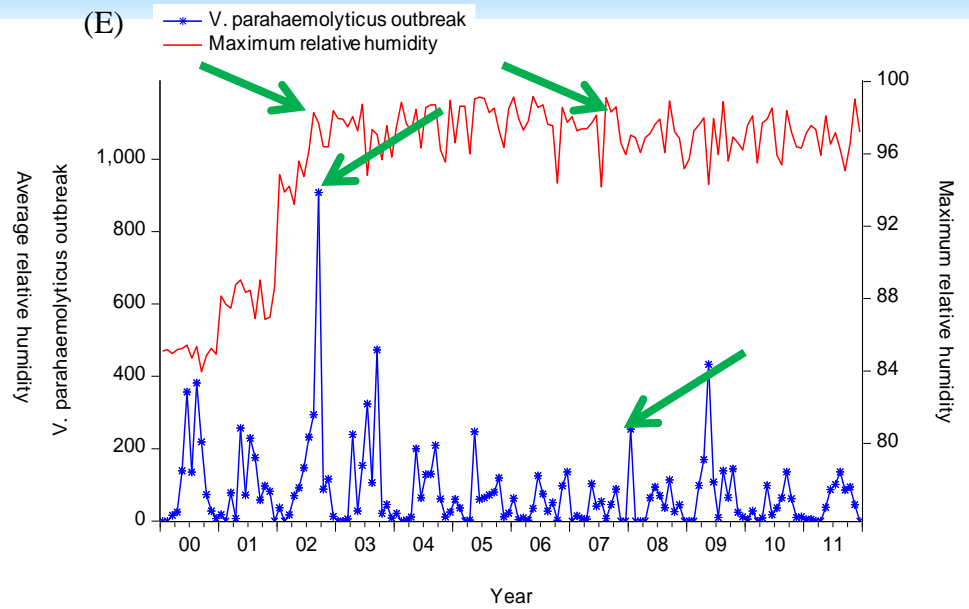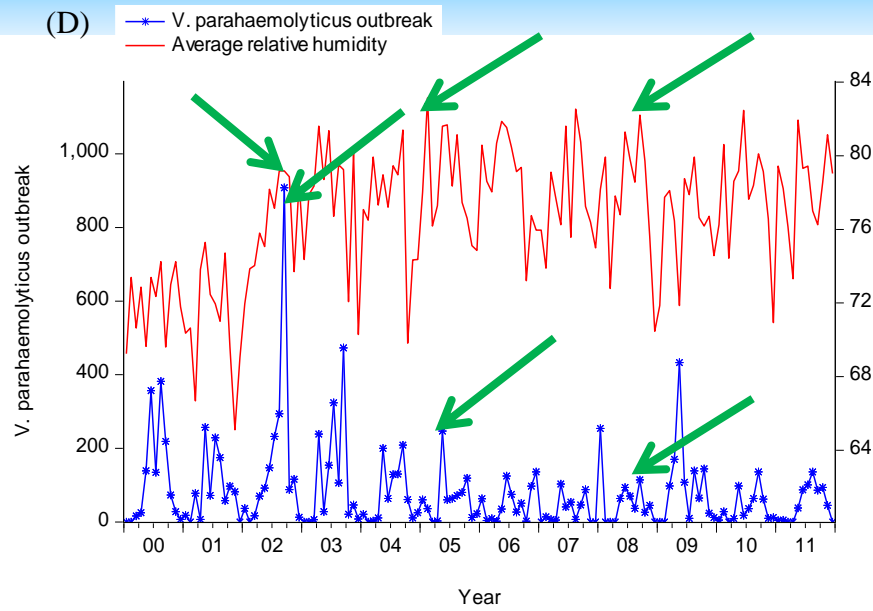
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Figure 3.1 (D)average relative humidity, (E)maximum relative humidity, (F)minimum relative humidity, (G) average rainfall (Continued).

The estimation results of ARIMA$(1,0,1)_{12}$ for *Vibrio parahaemolyticus* outbreak series with climatic variables: Covariate models

Variable	Covariate #1	Covariate #2	Covariate #3	Covariate #4
Intercept	-344.9471	-368.2690	-364.3913*	-310.1019
AR at lag 12		0.3518***		-0.0211
MA at lag 12			0.3230***	0.5153***
avgtemp	3.8521**	4.7055***	2.3822	3.5590***
avgtemp at lag1			2.2843	
maxrfd	-0.1022	-0.1630*	-0.1401 *	-0.0151
maxrfd at lag1	-0.1307	-0.1368*	-0.1682**	-0.1734**
avgrh	1.1641	1.2892	1.2607	0.9559
avgrh at lag9	-4.2791***	-3.7936***	-4.0850***	-4.5770***
octemp	4.7350***	4.1967***	4.4053***	4.5140***
ocsant at lag6	13.0870**	12.2781**	12.8271**	13.4580***
AIC	10.8543	10.8054	10.7346	10.5413
RMSE	51.8809	54.5196	51.3805	48.5625

[a] Single, double, and triple asterisks (*) indicate significance at the 10%, 5%, and 1% level of probability, respectively.

Exercise example: climate change and food safety data

- Concluding remarks:

  - Ambient temperature, ocean temperature, ocean salinity and rainfall had impacts on microbial seafood safety.

  - Knowing the effects of multiple climate factors on food-borne diseases was necessary for an intensive examination of accuracy in predicting disease.

Exercise example: import price and food safety data

The Difference Analysis on Farm Price and Import Price of Mackerel, Scad, Sardine and Squid in Taiwan

Project leader: Ching-Ta Chuang

Team members: Hsin-I Hsiao et al.

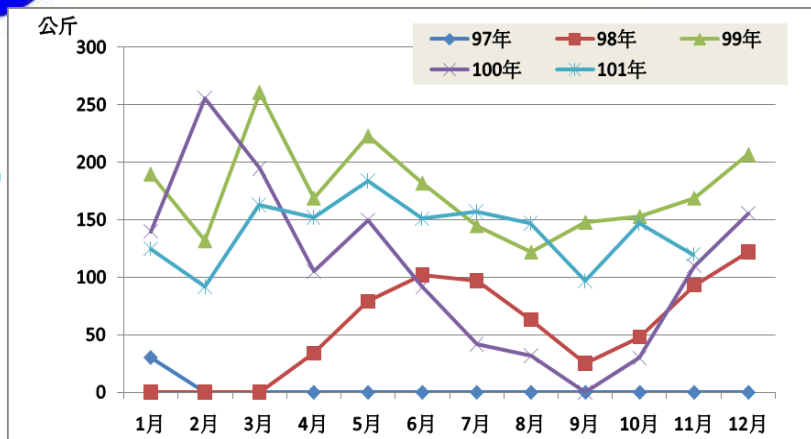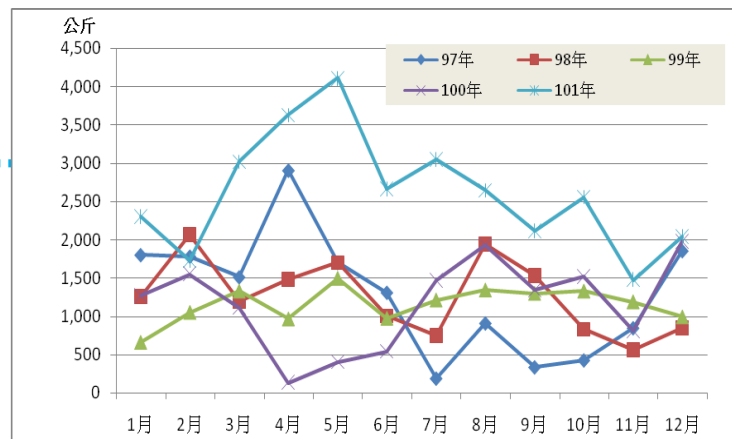Sponsor: Fisheries Agency, Council of Agriculture, Taiwan
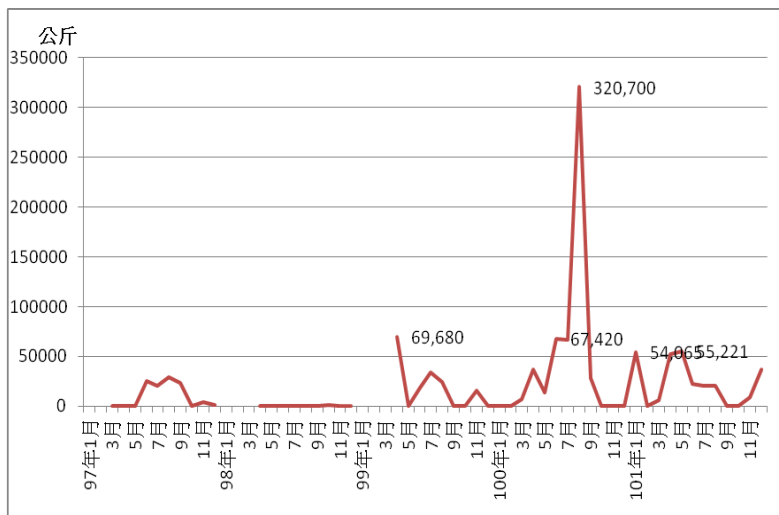
2013

Research motivations

- After entering to Word Trade Organization (WTO), our important seafood industry is expected receiving great impacts when tariff protection was slashed. Over the past years, we have observed that import prices of mackerels, carangid fishes, sardines, squids tend to be low than our local market prices.

- This research aims to investigate this phenomenon by analyzing its relationships with predatory pricing and with low product quality and finally provide suggest for government and seafood industry.

- Extra findings??

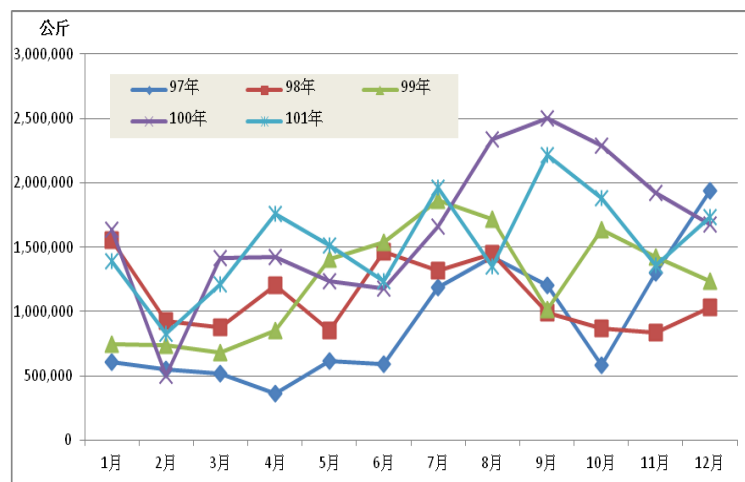Imported fresh and chilled mackerel between 2008-2012

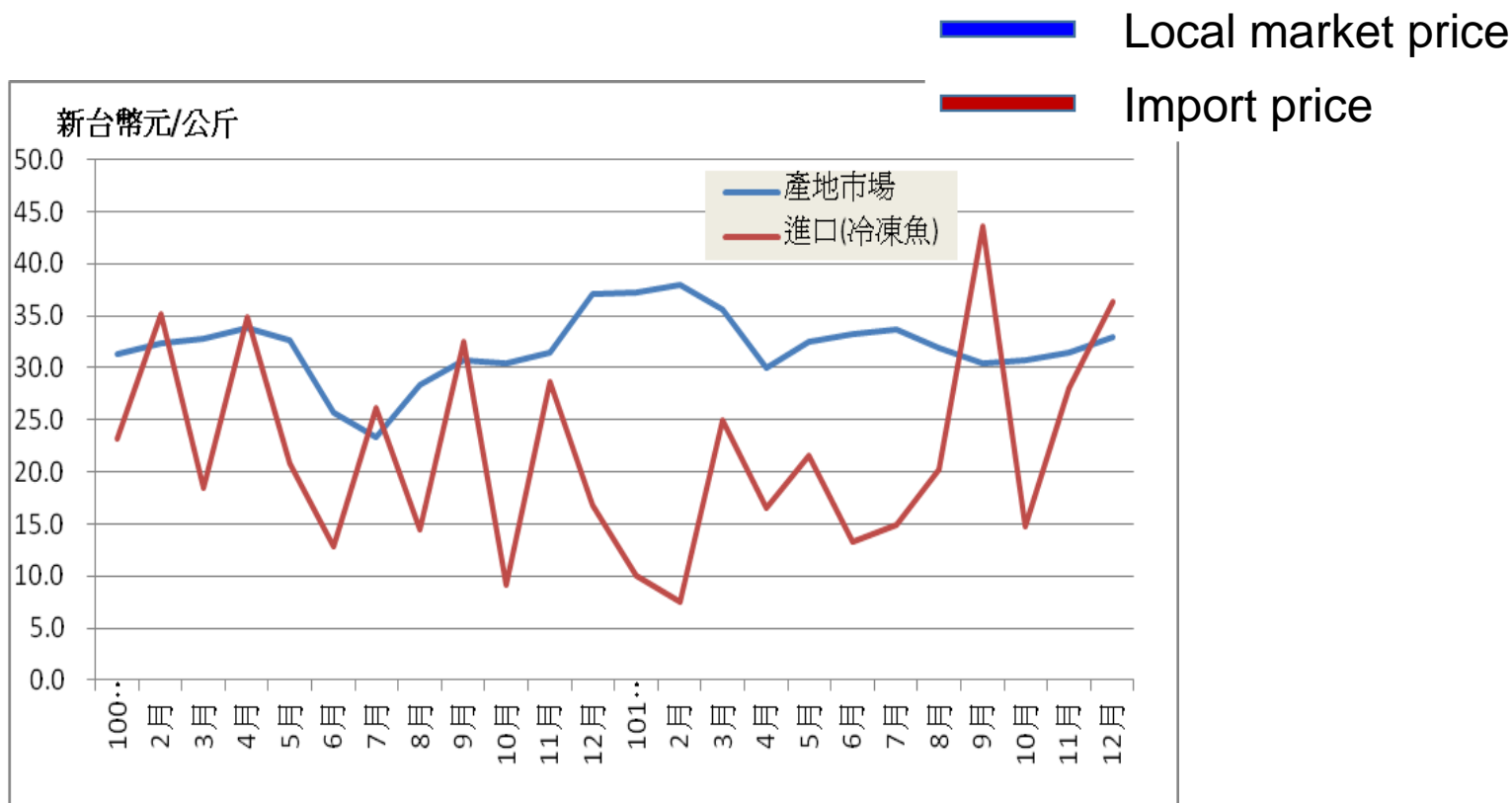Imported fresh and chilled sardine between 2008-2012

Imported frozen scad between 2008-2012

Imported frozen squid between 2008-2012

(Chuang, 2013)

Is there a relationship between price and quality of imported seafood?

Local market price

Import price

Price of local market and import of frozen sardine between 2008-2012

(Chuang, 2013)

Is there a relationship between price and quality of imported seafood?

Unqualified inspection data of import mackerel, scad, sardine and squid

Categories and code number	Time	Item name	Source countries	Results
Mackerel	-	-	-	-
Scad	-	-	-	-
Sardine	-	-	-	-
Squid				
03074912009	2011-01-18	Frozen squid	Philippine	Formaldehyde 37.3 ppm
03074912009	2011-01-28	Frozen squid	Vietnam	Formaldehyde 39.0 ppm
03074912009	2011-07-29	Frozen squid	Indonesia	Formaldehyde 23.7 ppm
03074912009	2011-10-04	Frozen squid	Philippine	Formaldehyde 10.8 ppm

a：〝-〞means qualified
b: data sources: TFDA (2013)

(Chuang, 2013)

Is there a relationship between price and quality of imported seafood?

Average price differences of frozen squid in the year of 2008-2012

	2008	2009	2010	2011	2012
Average price difference (NTD/kg)	68.66	75.87	-64.93	-119.72	-3.29

Is there a relationship between price and quality of imported seafood?

Average price differences of qualified group and disqualified groups (2011)

	Inspection outcomes	
	Qualified groups (N=7)	Disqualified groups (N=3)
Average price differences[2]	-93.51[a1]	-180.87[b]

[1]Different letters means there is a significant statistical differences. (p<0.05)。

[2]4April and September were not include due to there was no import record .

Data sources: this research

(Chuang, 2013)

Is there a relationship between price and quality of imported seafood?

Correlation between price differences and unqualified case number of monthly data 2008-2011

		Price differences	Unqualified case numbers
Price differences	Pearson correlation	1	-.289
	Significance (one-tailed)		.027
	Number	45	45
Unqualified case numbers	Pearson correlation	-.289*	1
	Significance (one-tailed)	.027	
	Number	45	45

(Chuang, 2013)

Is there a relationship between price and quality of imported seafood?

◆Concluding remarks:

- There is a negative relationship between price differences and unqualified case numbers.

- Low price can be used as a signal for low quality when considering of inspection strategy. Thus special attention can be paid on sampling, testing and quarantine regulations and on import commodity.

Conclusions: future direction

◆ **2016-2020 food safety white paper**

- ✓ Goal-1-integrative farm-to-fork management –(1) integrating information system across different ministries (2) uses of food cloud for risk management and early warning purposes.

- ✓ Goal-2-effective source management

- ✓ Goal -3-complete food factory management

- ✓ Goal-4-food distribution channel management

- ✓ Goal-5-risk identification capability

◆ **Challenges of large data set uses**

- ✓ Government: horizontal and vertical integration between different departments

- ✓ Business operators: different food types, different company sizes, import, export …

- ✓ Consumer: openness of data

Conclusions

◆Expected advantages of large data set uses

  ✓Identify risk sources-> prevention

  ✓Increase tracing speed

  ✓Identify policy direction-> planning

  ✓Looking for research direction

  ✓Looking for development for: value-added, economic opportunities, information development, investment, food habitat, new product development, consumer behaviors

◆The technologies for big data management and mega data analysis will enable authorities to better manage food sources and protect consumer health. Consumers gain trust from government, and governments get reputations.

Thank you!