



**Asia-Pacific
Economic Cooperation**

2014/SCSC/WKSP1/008

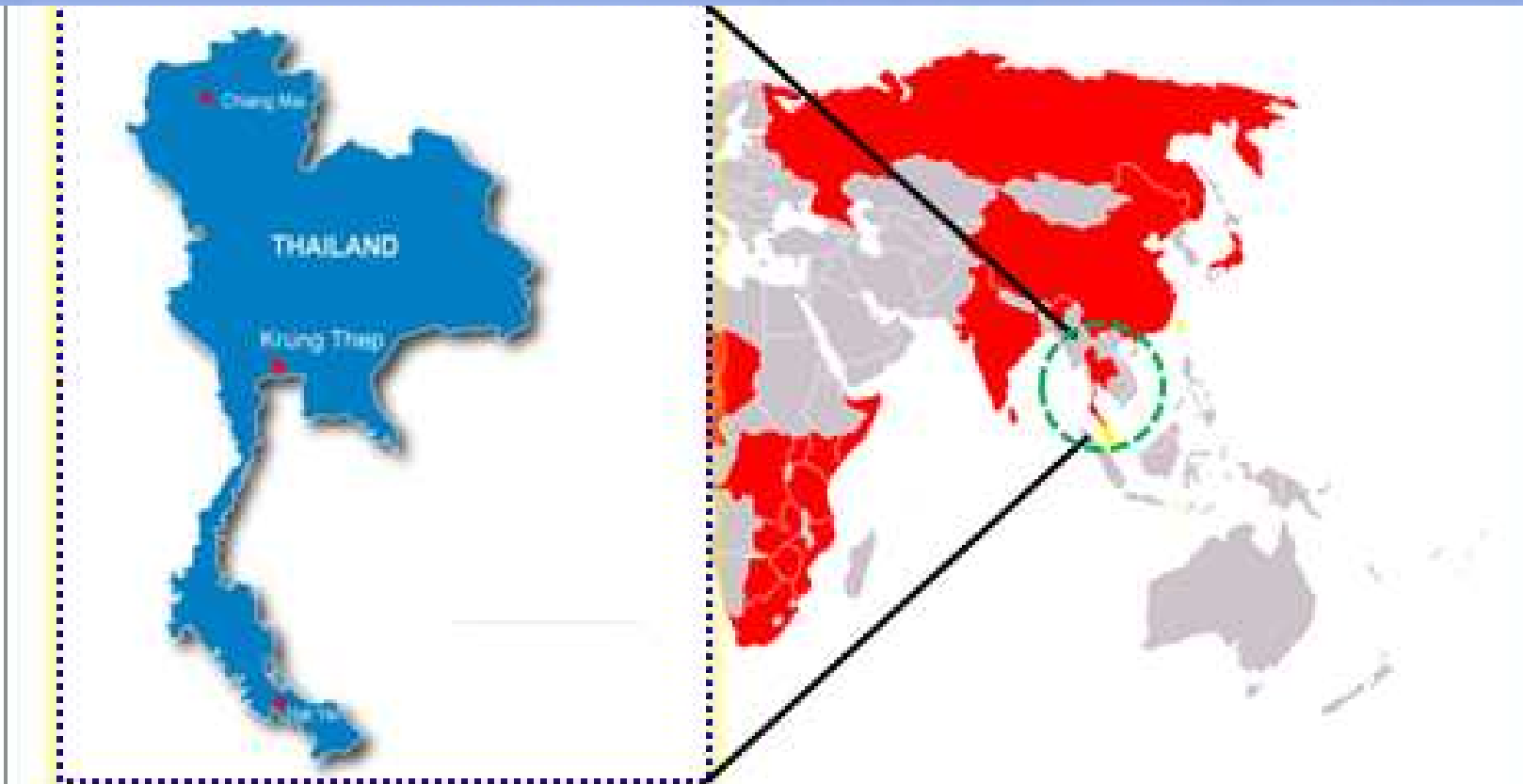
Risk-Based Food Safety Inspection During Incident Event in Thailand

Submitted by: Thailand



**Workshop on Improved Food Inspection
Capacity Building Based on Risk Analysis
Seoul, Korea
21-23 May 2014**

Risk-Based Food Safety Inspection during Incident Event in Thailand



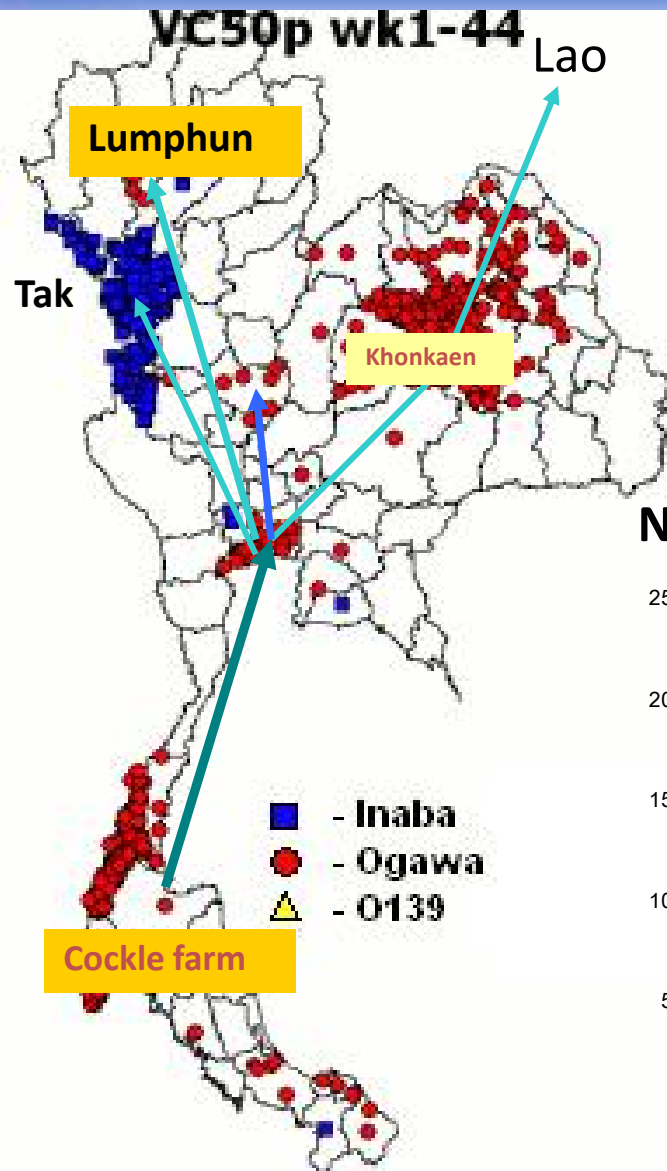
Dr. Waraluk Tangkanakul

Acting Deputy Director, Food Safety Extension and Support Bureau,
Ministry of Public Health, Thailand

Content

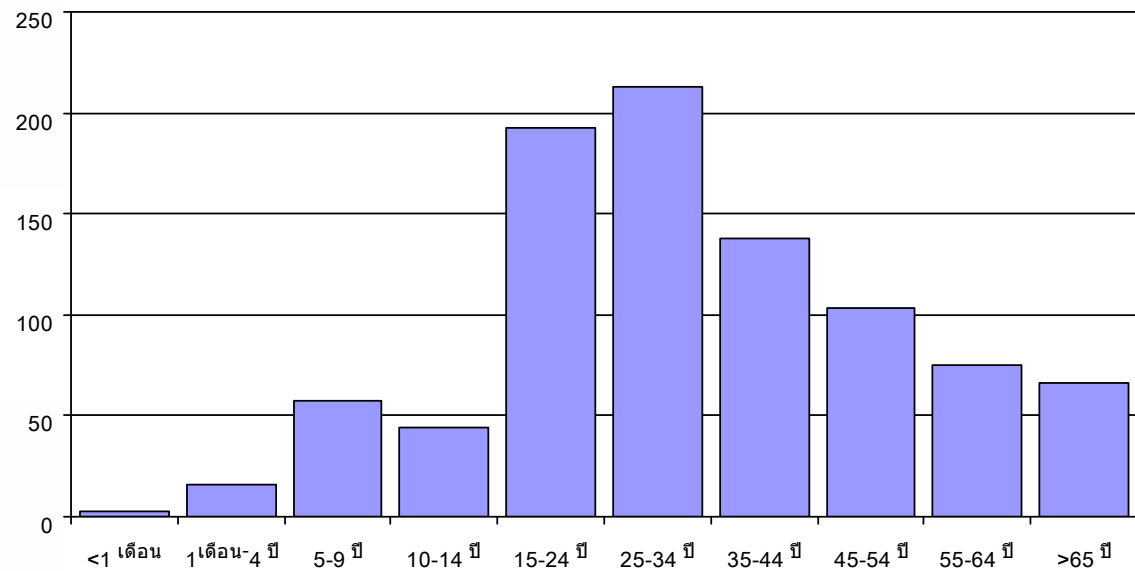
- **Investigation of a Multi-provinces Cholera Outbreak in Thailand which expanded to Laos People Democratic Republic in 2007**
- Investigation and develop risk-based inspection (RBI) along exported Cockles' food supply chain (from Thailand across several check points to Laos PDR)
- Future RBI during incident event uses Government Information Network (GIN) system

Situation of Cholera in Thailand, 2007



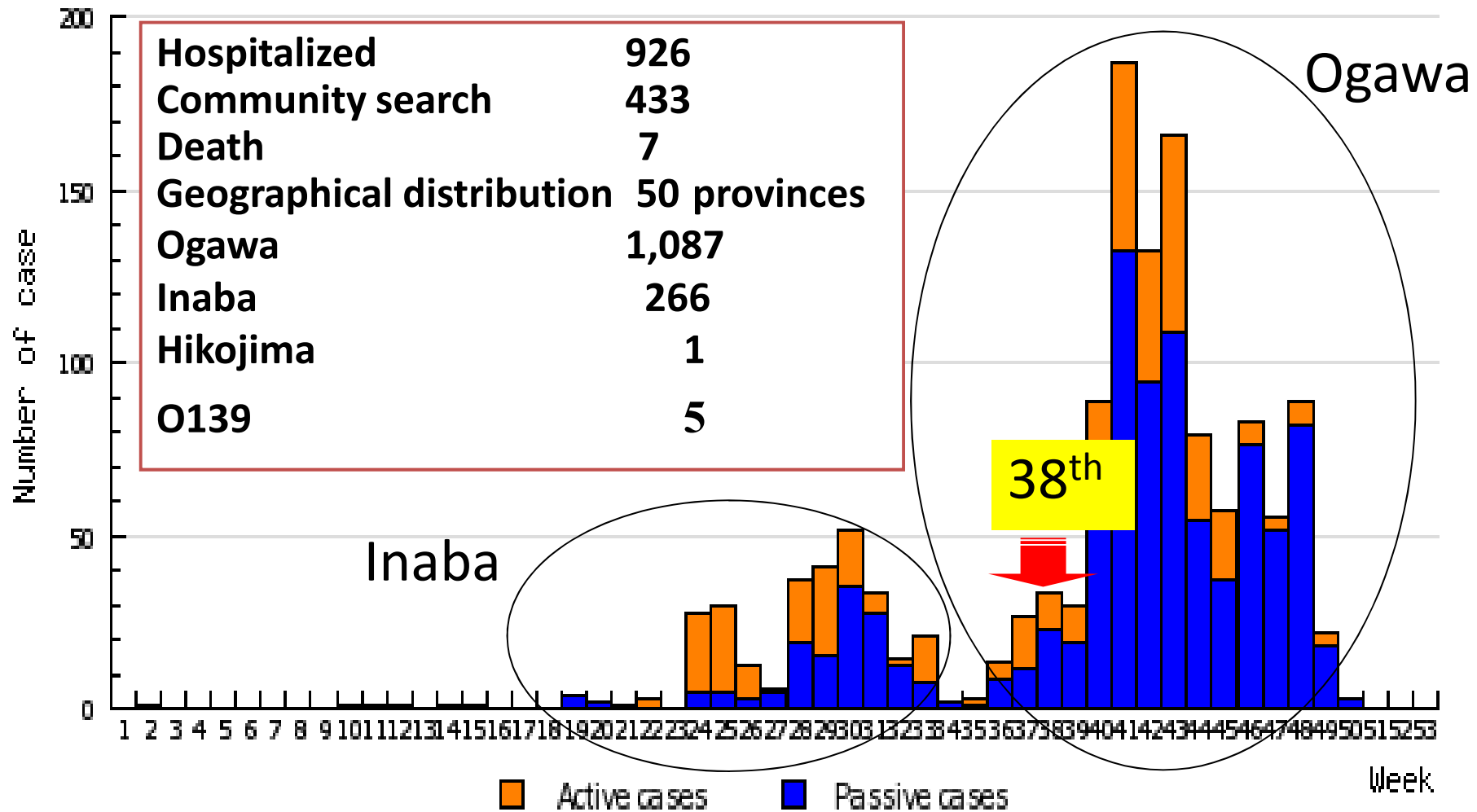
- 988 cases with 7 death (CFR 0.7%)
- spread to 50 provinces of total 76 provinces
- Inaba: most occur in Tak province
- Ogawa: distribute for the whole country
- age group 15-44 years

Number



Age group

Cholera cases by *V. cholerae* serotype in Thailand, 2007



Multi-provinces Cholera outbreak associated with cockles

In 2007: Cholera outbreak

Thailand



10 Oct. 2007
(38thwk), expanded to
Laos People
Democratic Republic

Most *V. cholerae* strains isolated from patients
“*V. cholerae* O1 serotype Ogawa”

The cockles were assumed to be
a source of cholera outbreak
(OR 2.24, 95% CI 1.43 – 4.02)

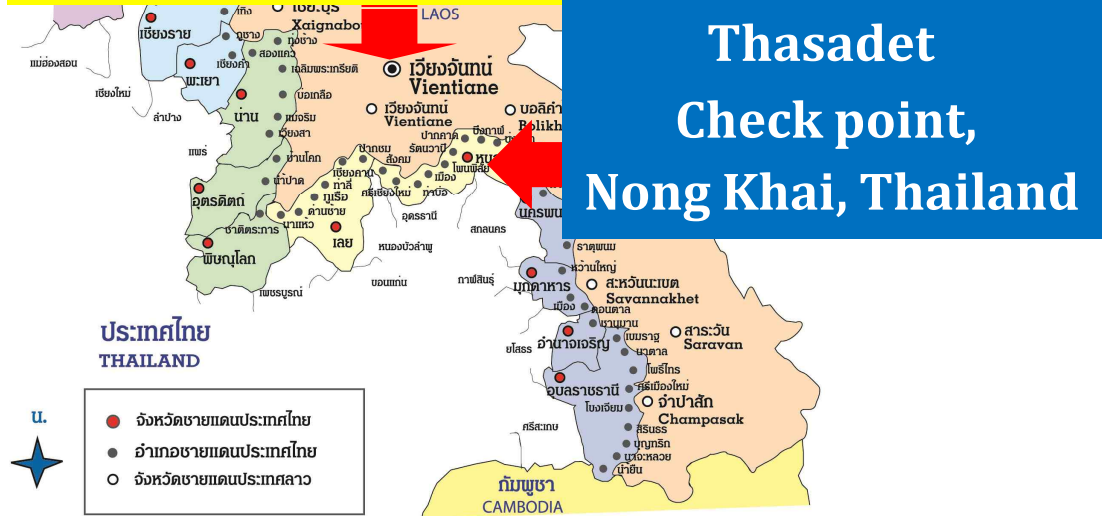


Thai-Laos 's Joint investigation on Cholera outbreak, 2007

Organism: RSC positive for *Vibrio cholerae* O1 El Tor Ogawa (10th Oct.)

Investigation : 120 workers in factory (80 living), 10 RSC sample found 1 positive the same organism (case's 2 months pregnant wife)

Vientiane, Laos PDR



● มีแนวชายแดนติดประเทศลาวประมาณ 1,754 กิโลเมตร
(Border country 1,754 km)

11 จังหวัด และ 48 อำเภอชายแดนประเทศไทย-ลาว (11 provinces and 48 Districts of Thailand-Laos Border)

จังหวัดเชียงราย (Chiangrai)	จังหวัดอุดรธานี (Uttaradit)	จังหวัดหนองคาย (Nongkhai)	จังหวัดมุกดาหาร (Mukdaham)
อ. เชียงแสน (Chiangsaen)	อ. บ้านโคก (Bankhok)	อ. สังคม (Sangkhom)	อ. ห้วยใหญ่ (Wanyai)
อ. เชียงของ (Chiangkhlong)	อ. น่าน (Nan)	อ. ศรีเชียงใหม่ (Sichiangmai)	อ. เมือง (Muang)
อ. เวียงแก่น (Waingkaen)	จังหวัดพิจิตร (Phitsanulok)	อ. ท่าบ่อ (Thabo)	อ. ดอนตาล (Dontan)
อ. เทิง (Thoeng)	อ. ชัยชนะ (Chattarakon)	อ. เมือง (Muang)	จังหวัดอำนาจเจริญ (Nakhompanum)
จังหวัดพะเยา (Phayao)	จังหวัดเลย (Loei)	อ. โพนพิสัย (Phonphisai)	อ. ชานุมาน (Chanuman)
อ. อ. พูซัง (Phusang)	อ. นาน (Nahaeo)	อ. ร้อยเอ็ด (Rattanakwapi)	จังหวัดอุบลราชธานี (Nakhompanum)
อ. เชียงคำ (Chiangkham)	อ. ด่านซ้าย (Damsai)	อ. ปากคาด (Pakhat)	อ. เขมมราฐ (Khemmarat)
จังหวัดน่าน (Nan)	อ. พูเรือ (Phuruca)	อ. บึงกาฬ (Bungkan)	อ. นาดาน (Natan)
อ. สองแคว (Songkhwa)	อ. ท่าลี่ (Thali)	อ. บุ่งคล้า (Bungkhla)	อ. โพนทราย (Phosai)
อ. ห้วยซำ (Thungchang)	อ. เชียงคาน (Chiangkhan)	อ. บึงหนองหลวง (Bungkhonglong)	อ. ศรีเมืองใหม่ (Simuangmai)
อ. เฉลิมพระเกียรติ (Chaloemprakiat)	อ. ปากชุม (Pakchom)	จังหวัดนครพนม (Nakhonphanom)	อ. โขงเจียม (Khongchiem)
อ. บ่อเกลือ (Bokluca)		อ. บ้านแพง (Banphaeng)	อ. สิริสุน (Sirinthon)
อ. แม่จริม (Maecharim)		อ. ท่าอุเทน (Thaughten)	อ. บุนนาค (Bundarik)
อ. เวียงสา (Wiangsa)		อ. เมือง (Muang)	อ. นาหวาย (Nachaluai)
		อ. ราษีไศล (Rathai)	อ. นามยูน (Namyun)

Content

- Investigation of a Multi-provinces Cholera Outbreak in Thailand which expanded to Laos People Democratic Republic in 2007
- **Investigation and develop risk-based inspection (RBI) along exported cockcles' food supply chain (from Thailand across several check points to Laos PDR)**
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Cockles: *Anadara granosa*

: marine animal which is habitat of marine microorganisms



In Thailand,
cockle is usually cooked by boiled or roasted



transmitted the pathogens
to human via contaminated cockle



Scientific classification

Kingdom: [Animalia](#)

Phylum: [Mollusca](#)

Class: [Bivalvia](#)

Subclass: [Pteriomorpha](#)

Order: [Arcoida](#)

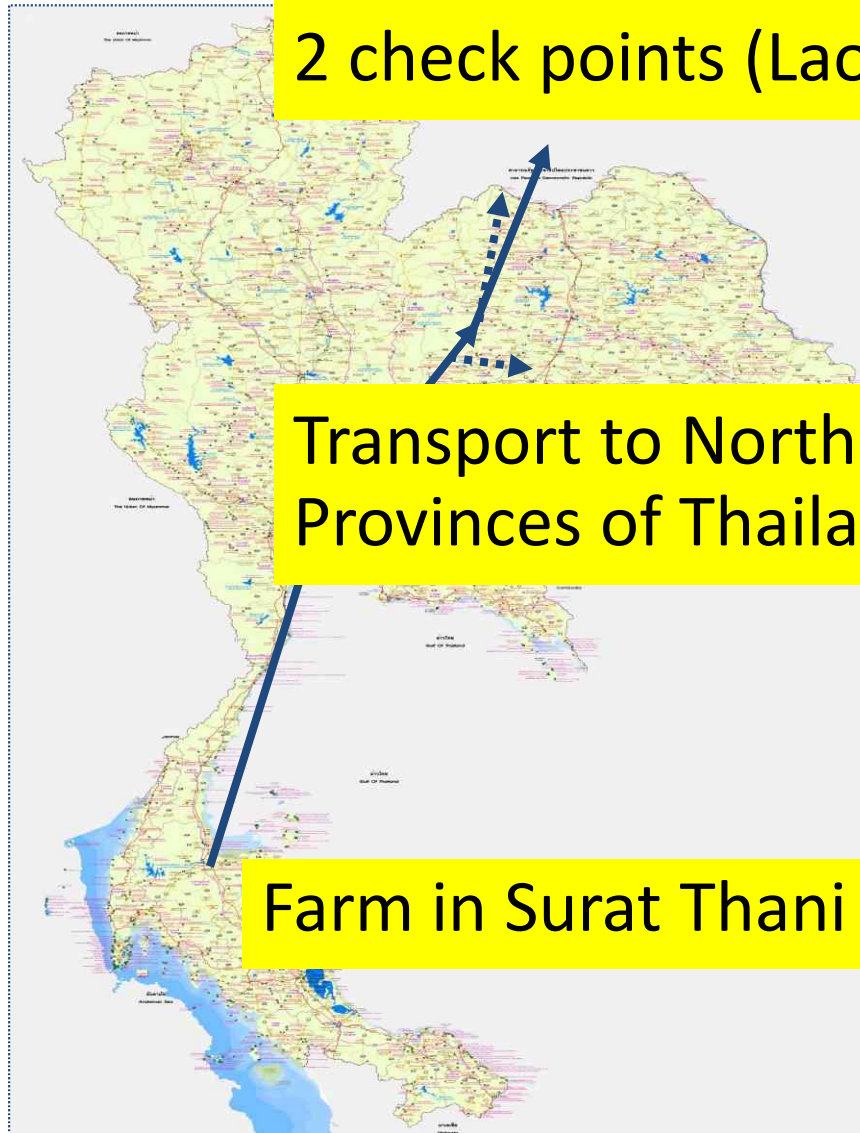
Family: [Arcidae](#)

Genus: [Anadara](#)

Species: *A. granosa*

Investigation of cockles' food supply chain from Thailand to Laos PDR

Pass out at 4 check points (Thailand) and enter at 2 check points (Laos PDR)



Transport to Northeastern Provinces of Thailand

Farm in Surat Thani



Inspection of cockles' farm

- **Departments of Fisheries**
Coastal Fisheries Research and Development Surat Thani: care, promote and monitor of water quality affecting cockle farming. The amount of salinity of sea water should be 10-30 ppt.
- **Fisheries Office Surat Thani :**
 1. Promote the coastal fishery and Good Aquaculture Standard (GAP) and registration cockles' farm.
 2. Research and monitor of water quality and aquatic products from Surat Thani.
 3. Check for contamination and quality of aquatic products.

Salinity of sea water in cockles' farm

14 ส.ค. 2550
28 ส.ค. 2550
5 ก.ย. 2550
24 ก.ย. 2550
5 ต.ค. 2550
29 ต.ค. 2550

จุดสำรวจ (Station)	อำเภอ	คุณสมบัติน้ำ																Coliforms (MPN/100 ml)		Plankton	Bt	
		Sali. (ppt)	Sali. (ppt)	Sali. (ppt)	Sali. (ppt)	Sali. (ppt)	Sali. (ppt)	pH	DO (mg/l)	BOD (mg/l)	Alk. (mg/l)	TSS (mg/l)	Chl-a (mg/l)	NH ₃ (mgN/l)	NO ₂ (mgN/l)	NO ₃ (mgN/l)	PO ₄ (mgP/l)	Total	Fecal			
ปากคลองคอนตึก	คอนตึก	27	26	25	26	22	9	7.61	4.26	0.6	78	72.00	*	0.1544	0.0837	0.0817	0.0547	170.0	46.0			
ปากคลองนุ้ย	คอนตึก	20	22	22	11	18	3	7.78	4.62													
ปากคลองท่าทอง	กาญจนดิษฐ์	12	10	5	6	10	0	7.85	3.85													
ปากคลองราม	กาญจนดิษฐ์	15	9	2	8	5	0	7.39	4.12													
ปากคลองเจงอ๊ะ	กาญจนดิษฐ์	0	11	0	12	10	1	7.08	3.88													
ปากแม่น้ำตาปี	เมือง	2	3	0	5	2	2	7.22	3.93													
ปากคลองสี่เต็ด	พุนพิน	2	1	0	0	0	0	7.30	3.36													
ปากคลองท่าฉาง	ท่าฉาง	12	10	0	0	0	0	7.09	3.56													
ปากคลองท่าปูน	ไชยา	10	2	10	2	2	0	7.05	3.68													
ปากคลองหัววัว	ไชยา	1	8	19	3	2	0	6.85	3.26													
ปากคลองพุมเรียง	ไชยา	29	26	22	20	21	20	7.66	4.16	1.2	39	54.67		0.0817	0.0185	0.0154	0.0345	49.0	6.8			
ปากคลองท่าม่วง	ท่าชนะ	15	6	4	5	4	2	7.20	3.28	0.2	30	43.67		0.0889	0.0742	0.0662	0.0600	27.0	6.8			
ปากคลองท่ากระชาย	ท่าชนะ	21	4	2	2	1	0	7.55	3.26	1.0	52	19.33		0.1728	0.0442	0.2418	0.0842	240.0	15.0			
ปากคลองกะแคะ	กาญจนดิษฐ์	3	3	1	2	8	0	7.28	3.89	0.2	54	52.67		0.1037	0.0558	0.0851	0.1856	350.0	17.0			
ปากคลองท่าทองใหม่	กาญจนดิษฐ์	0	2	0	4	0	0	7.62	3.69	0.6	58	33.00		0.1621	0.0159	0.0612	0.0453	2,400.0	350.0			
ค่ามาตรฐาน		29-35	29-35	29-35	29-35	29-35	29-35	7.5-8.9	>4	<10									<1,000	0		<1

In 2007, the salinity of sea water was less than 10 ppt. for long and continuous months (Aug. – Oct.)

Total rainfall in Surat Thani in 2007

สถานีอุตุนิยมวิทยาสurat Thani

ประจำปี พ.ศ.2550

รายนาม	ค่าเฉลี่ย	อุณหภูมิ	อุณหภูมิ	ค่าเฉลี่ย	ความชื้น	ความชื้น	ค่าเฉลี่ย	จำนวนน้ำ		กำลังลมสูงสุด		จำนวน ฝนรวม ทั้งเดือน (มม.)	จำนวน วันที่มี ฝนตก (วัน)	จำนวน ฝนเฉลี่ย เป็นวัน (มม.)	ค่าปกติ จำนวนฝน ประจำปี (มม.)	พายุ ไม่ผ่าน สถานี (วัน)	พายุ ผ่าน สถานี (วัน)	พายุ นอก (วัน)	หมายเหตุ
	ความกด	สูงสุด	ต่ำสุด	อุณหภูมิ	สัมพัทธ์	สัมพัทธ์	ความชื้น	ทั้งหมด (มม.)		ทิศทาง/ (กม./ชม.)									
	อากาศ	(%)	(%)	อากาศ	(%)	(%)	(%)	ทิศ	ถาดน้ำระเหย	(องศา)/ (กม./ชม.)	(องศา)/ (กม./ชม.)								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
ว.ค.	12.35	33.0	19.3	26.04	94	48	83.94	40.50	100.14	360	43	41.3	9	1.33	-	0	0	2	
ว.พ.	11.37	35.8	19.0	26.81	98	44	75.76	62.80	139.50	050	41	0.0	0						
ว.ค.	09.71	38.3	19.3	28.02	98	52	76.15	70.70	158.00	360	43	37.8	5						
ว.ค.	09.48	37.6	22.2	28.84	97	40	79.05	56.50	132.63	060	48	69.6	7						
ว.ค.	08.60	36.0	23.4	27.60	97	54	85.06	40.20	121.14	190	48	48.1	21						
ว.ค.	07.40	36.4	20.5	27.91	97	52	84.90	41.40	125.66	220	41	108.6	16						
ว.ค.	08.62	35.0	22.5	27.13	98	56	85.19	38.20	127.05	050	37	136.3	21						
ว.ค.	08.36	35.5	23.0	27.50	97	45	81.96	48.8	118.58	210	46	62.1	15						
ว.ค.	08.68	33.3	23.8	28.55	84	53	84.08	48.7	121.11	270	26	202.4	19						
ว.ค.	09.51	34.5	22.0	26.14	98	55	88.48	29.30	79.49	360	20	280.5	21						
ว.ค.	10.31	36.3	18.5	25.74	94	51	86.73	30.60	81.55	030	20	216.5	14						
ว.ค.	10.14	32.8	19.8	25.97	99	53	86.26	36.40	96.83	040	22	76.7	10						
รวม																			
เฉลี่ย																			

In 2007, total rainfall in Surat Thani was more than 90.1 millimeter.

(.....)
เจ้าหน้าที่อุตุนิยมวิทยา

Food quality inspection for *V.cholerae*

Date	Sample no.	Lab code	ชื่อ/ชนิด ตัวอย่าง	TVC cfu/ml,g	Coliform MPN/100ml,100g	Fecal coliform MPN/100ml,100g	E.coli MPN/100ml,100g	Salmonella /25g	<i>V.cholerae</i> /25g	g Vibrio	Vibrio ทั้งหมด	<i>V.vulnificus</i>	<i>V.parva</i> MPN/100m
9/7/50	N50400755	CC/3	พริกผง	3800	13000	230	78	ND	ND	900	3400		
6/8/50	N50400844	CA/1	พริกผง	9600	1700	1100	78	ND	DETECTED	800	850		
6/8/50	N50400845	CA/2	พริกผง	12000	3500	3500	20	ND	ND	1400	1600		
6/8/50	N50400846	CA/3	พริกผง	4700	2400	1300	<18	ND	DETECTED	650	650		
6/8/50	N50400856	CB/1	พริกผง	3300	78	20	<18	ND	DETECTED	1800	2200		
6/8/50	N50400857	CB/2	พริกผง	3600	68	45	110	ND	ND	200	600		
6/8/50	N50400858	CB/3	พริกผง	4300	330	330	18	ND	DETECTED	4600	8200		
6/8/50	N50400867	CC/1	พริกผง	3800	330	<18	<18	ND	ND	500	3000		
6/8/50	N50400868	CC/2	พริกผง	870	130	20	<18	ND	ND	550	750		
6/8/50	N50400869	CC/3	พริกผง	2300	78	20	<18	ND	DETECTED	2400	6600		

Conclusion of Cholera Investigation (1)

- The outbreak of cholera in Laos – Thailand linked together because the investigation revealed that the suspect food was exported - imported cockles which found *V. cholerae*
- Decreasing of sea water's salinity in 2007 which promoted the high prevalence of *V. cholerae* might be because of heavy rain fall.

Conclusion of Cholera Investigation (2)

- Transportation time of cockles from Surat Thani through Loas PDR was greater than 20 hours may be an important factor in inducing the increasing number of *V. cholerae* until reaching infective dose (10^9).
- To prove the hypothesis, pulse field gel electrophoresis should be used to identify *Vibrio cholerae* strain caused this outbreak was the same or not ?
- GAP should be strengthened by regulatory agencies.

RBI for cholera outbreak during 2007 to 2010, Thailand

Cockles samples } (N= 161)

Rectal swab samples
- Patients, family } (N=328)
members, neighboring

Detection of *Vibrio cholerae* from specimens by culture method

Detection of *Vibrio cholerae* serogroups by Uniplex and Duplex PCR, PFGE, Ribotyping, MLVA techniques.

V. cholerae O1

V. cholerae non-O1

PCR : Polymerase Chain Reaction, PFGE : Pulsed field gel electrophoresis
MLVA : Ribotyping, multiple-locus variable-number tandem-repeat analysis

Risk based inspection for cockles, 2010



Sample collection

1. Khon Kaen province : 30 samples
2. Udon Thani province : 7 samples
3. Nong Khai province : 56 samples
4. Exported cockles: 68 Samples (sample from truck (once/ month from Mar. to Nov. 2010))

Study method

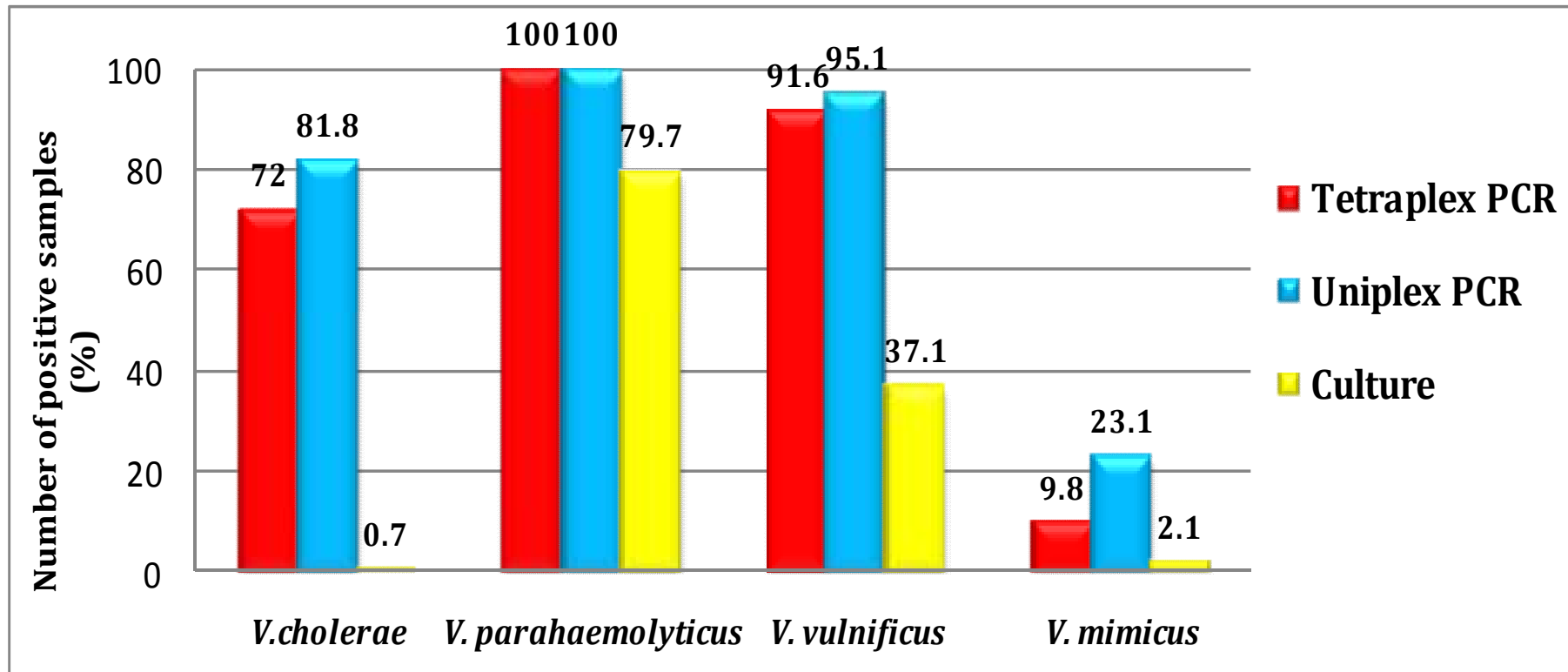
1. Standard culture method
2. PCR

Obj: To define the prevalence of *V. cholerae* in cockles

Detection of *Vibrio* spp. in cockles from 3- sources of collection

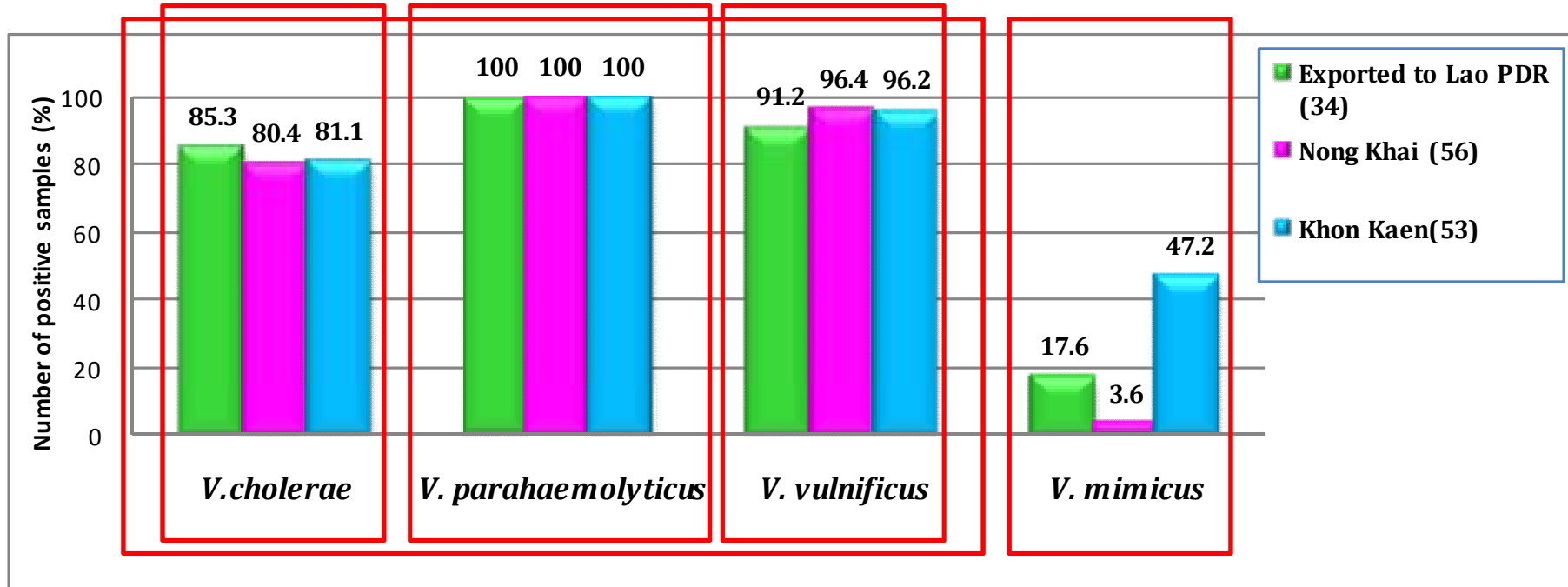


Prevalence of *Vibrio* spp. in 143 cockles detected by tetraplex PCR, uniplex PCR and culture method



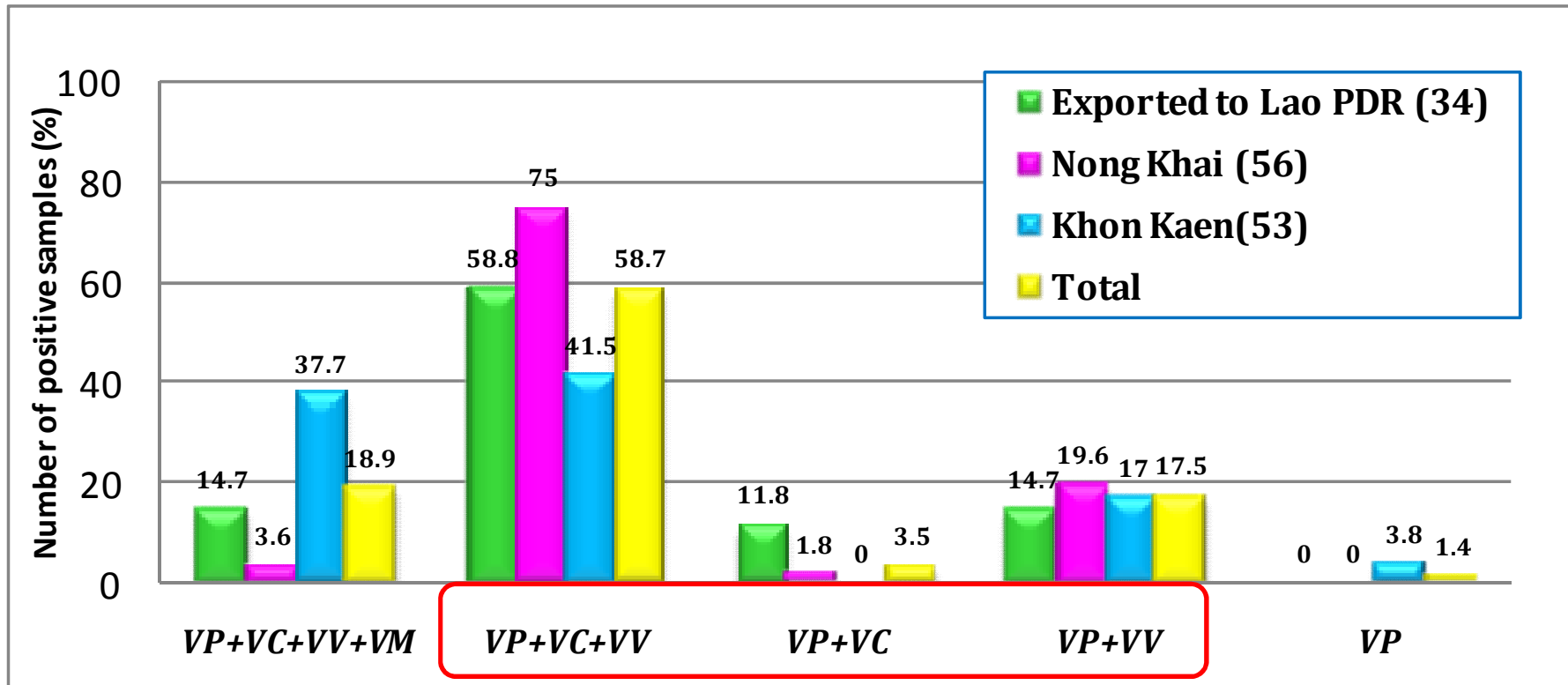
The prevalence of *Vibrio* spp. detected by tetraplex PCR was slightly lower than uniplex PCR however, it higher than culture method

Prevalence of *Vibrio* spp. in three different sources of cockle samples (uniplex PCR)



- *Vibrio* spp. among three sources were not significantly different, except *V. mimicus* was found very high (47.2%) in Khon Kaen
- *V. parahaemolyticus* was found in 100% in all 3 sources
- *V. vulnificus* was found about 90% in all 3 sources
- *V. cholerae* was found about 80% in all 3 sources

Mixed *Vibrio* spp. found in cockle samples in the northeastern Thailand



Most of cockle samples were contaminated with combination of various species of *Vibrio*.

Summary of the sensitivity of the tetraplex PCR and uniplex PCR compared with culture method using spiked *Vibrio* spp. in sterile cockle samples

Pathogens	Tetraplex PCR				Uniplex PCR				Culture method			
	0 h	3 h	6 h	18 h	0 h	3 h	6 h	18 h	0 h	3 h	6 h	18 h
<i>V. cholerae</i>	-	1	1	1	-	1	1	1	-	10 ¹	1	1
<i>V. parahaemolyticus</i>	-	10 ¹	1	1	-	1	1	1	-	10 ²	10 ¹	1
<i>V. vulnificus</i>	-	10 ²	1	1	-	10 ¹	1	1	-	10 ²	10 ¹	1
<i>V. mimicus</i>	-	10 ²	10 ²	10 ²	-	10 ¹	10 ¹	10 ¹	-	10 ³	10 ²	10 ²

After 6 h of enrichment in APW is sufficient for detection of *Vibrio* spp. in cockle samples because as few as 1 CFU can be detected by tetraplex PCR

Food standard

cockle samples were presence of
***V. parahaemolyticus* and *V. cholerae* in 10 g of cockle sample**
whereas the criteria for *V. parahaemolyticus* and *V. cholerae* require
has to be **absent in 25 g** of food sample
(frozen and chilled fishery product)

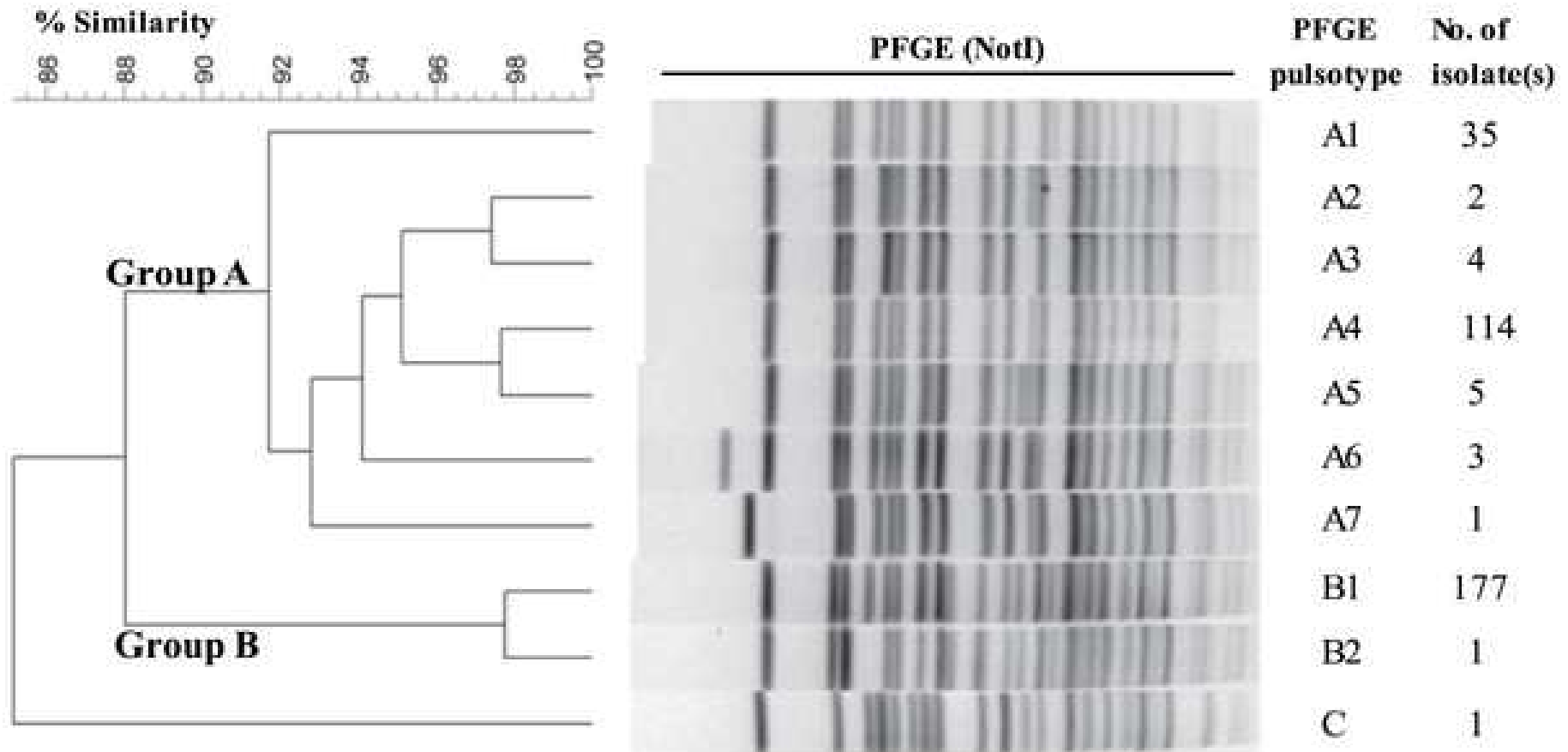
Conclusion RBI on cockles, 2010

- *V. cholerae* was detected only by PCR method.
- Enrichment at least 6 hr was increased the detection.
- The reason of low prevalence of *V. cholerae* by culture method because of it might be in the stage of viable but non-culturable (VBNC)
- The results showed the important of cockles to spread *V. cholerae* and demonstrated PCR should be used for RBI

Conclusion RBI on human samples, 2007 -2010, Thailand (1)

- The cholera outbreak in Thailand during 2007 – 2010 were exclusively caused by the *V. cholerae O1* El Tor variant carrying the classical *ctxB* and El Tor *rstR* genes. It probably appeared in Thailand during recent years.
- PFGE differentiated Thai El Tor variant isolates into nine pulsotypes that share the similarity of 88%.

Figure 1. Pulsed-field gel electrophoresis (PFGE) patterns among 343 Thai *V. cholerae* O1 isolates.

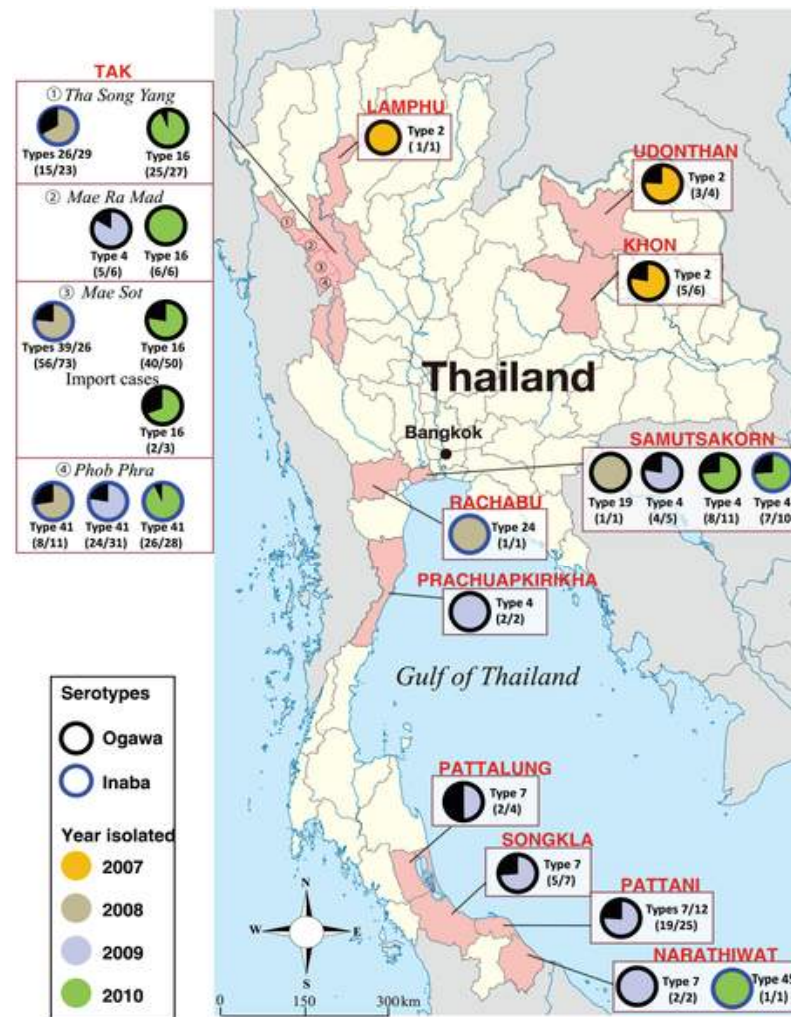


Okada K, Roobthaisong A, Nakagawa I, Hamada S, et al. (2012) Genotypic and PFGE/MLVA Analyses of *Vibrio cholerae* O1: Geographical Spread and Temporal Changes during the 2007–2010 Cholera Outbreaks in Thailand. *PLoS ONE* 7(1): e30863. doi:10.1371/journal.pone.0030863
<http://www.plosone.org/article/info:doi/10.1371/journal.pone.0030863>

Conclusion RBI on human samples, 2007 -2010, Thailand (2)

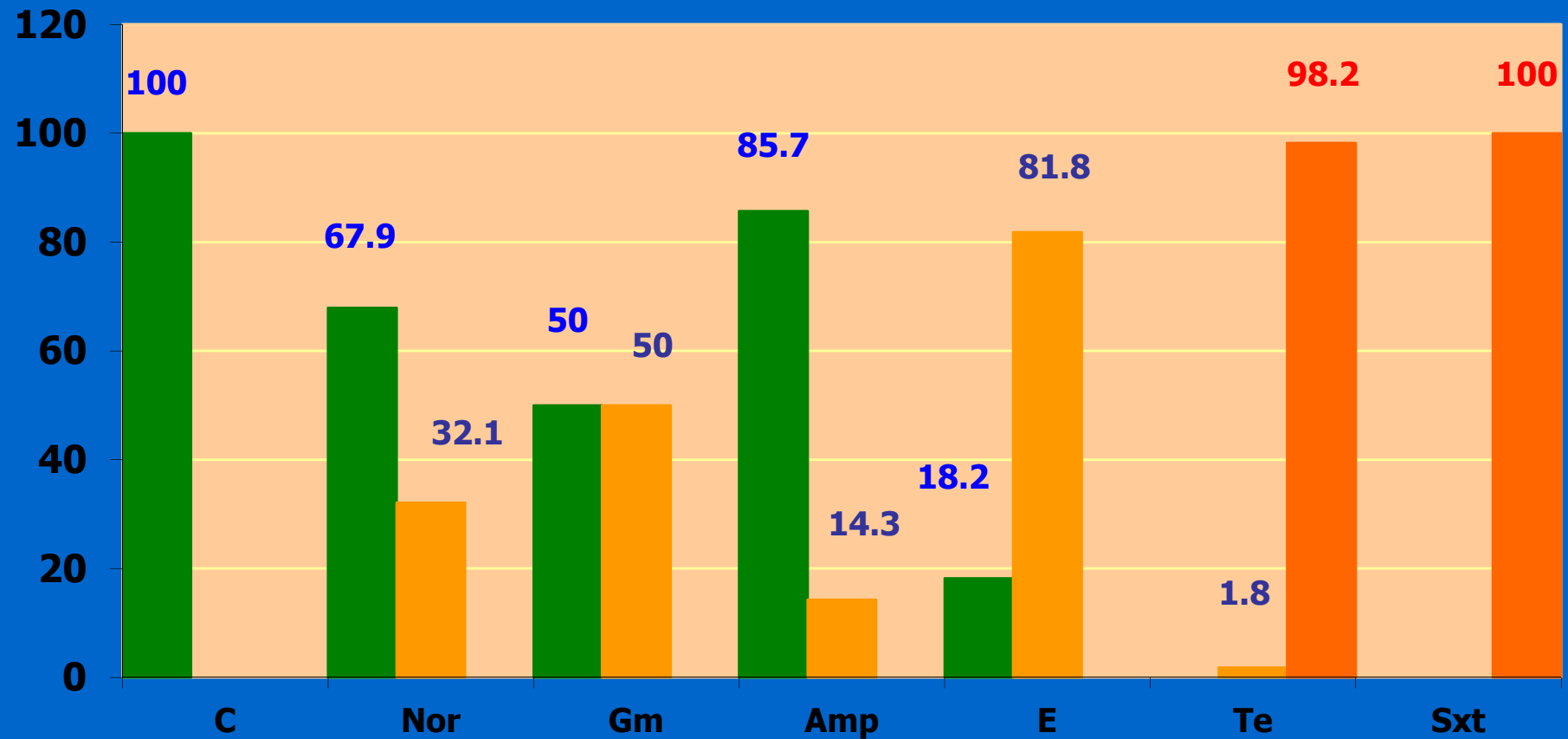
- MLVA typing among isolates during outbreak episodes in different geographical and association of causative *V. cholerae* in cholera outbreak showed the different of MLVA typing.. In 2007, in northeastern region were triggered by the consumption of cockles contaminated with *V. cholerae* MLVA type 2.
- The study can be the data to trace the emergence, year long survival , or disappearance of a particular type (s) of isolate in terms of spatial and temporal association

Figure 3. Distribution of major MLVA types of *V. cholerae* O1 isolates during the 2007–2010 cholera outbreaks in Thailand.



Okada K, Roobthaisong A, Nakagawa I, Hamada S, et al. (2012) Genotypic and PFGE/MLVA Analyses of *Vibrio cholerae* O1: Geographical Spread and Temporal Changes during the 2007–2010 Cholera Outbreaks in Thailand. *PLoS ONE* 7(1): e30863. doi:10.1371/journal.pone.0030863 <http://www.plosone.org/article/info:doi/10.1371/journal.pone.0030863>

Drug sensitivity of *V.cholerae* Ogawa



Green: sensitive, light orange = intermediate, thick orange = resistance

Content

- Investigation of a Multi-provinces Cholera Outbreak in Thailand which expanded to Laos People Democratic Republic in 2007
- Investigation and develop risk-based inspection (RBI) along exported Cockcles food supply chain (from Thailand across several check points to Laos PDR)
- **Future RBI during incident event uses Government Information Network (GIN) system**

GIN system

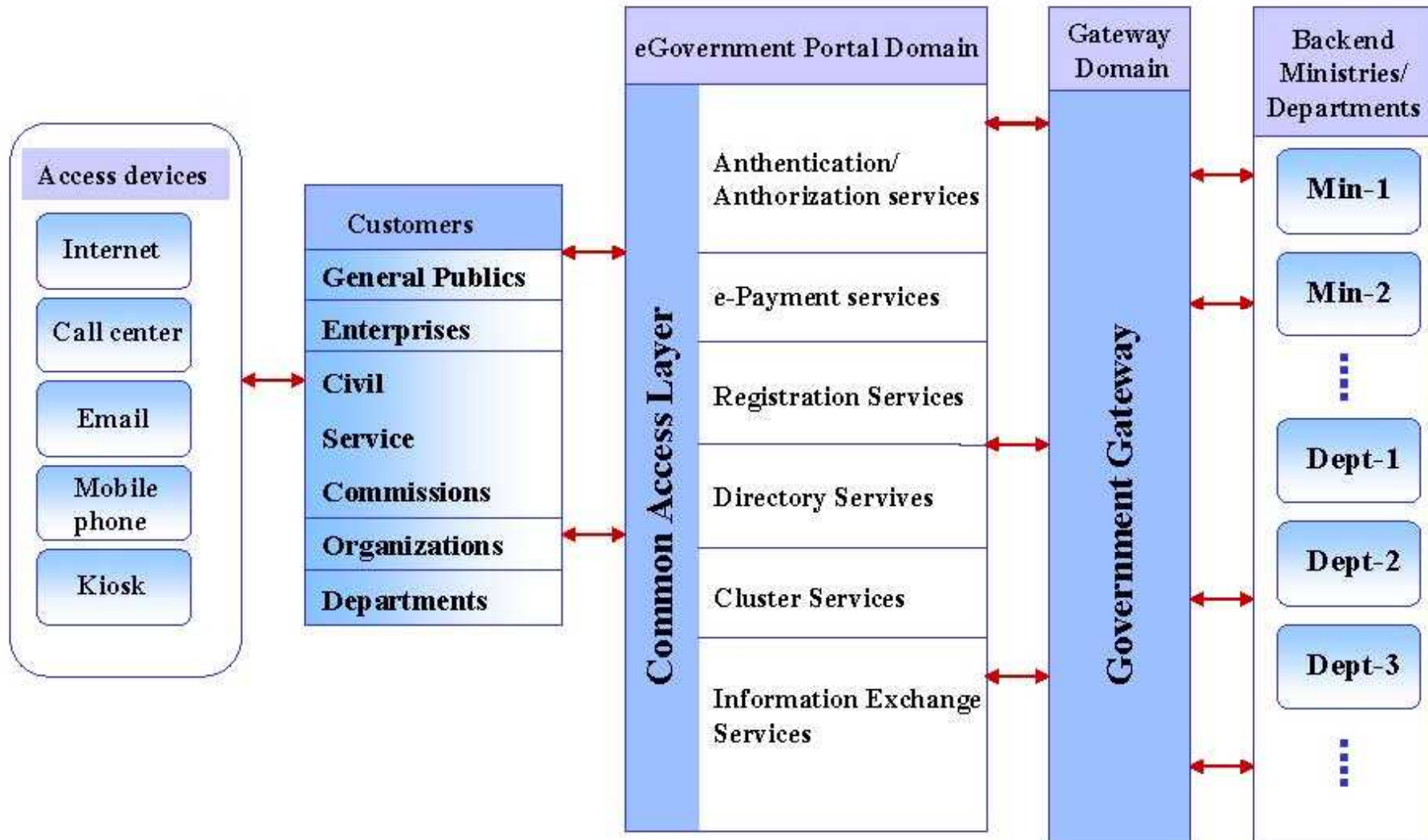


Development Strategies

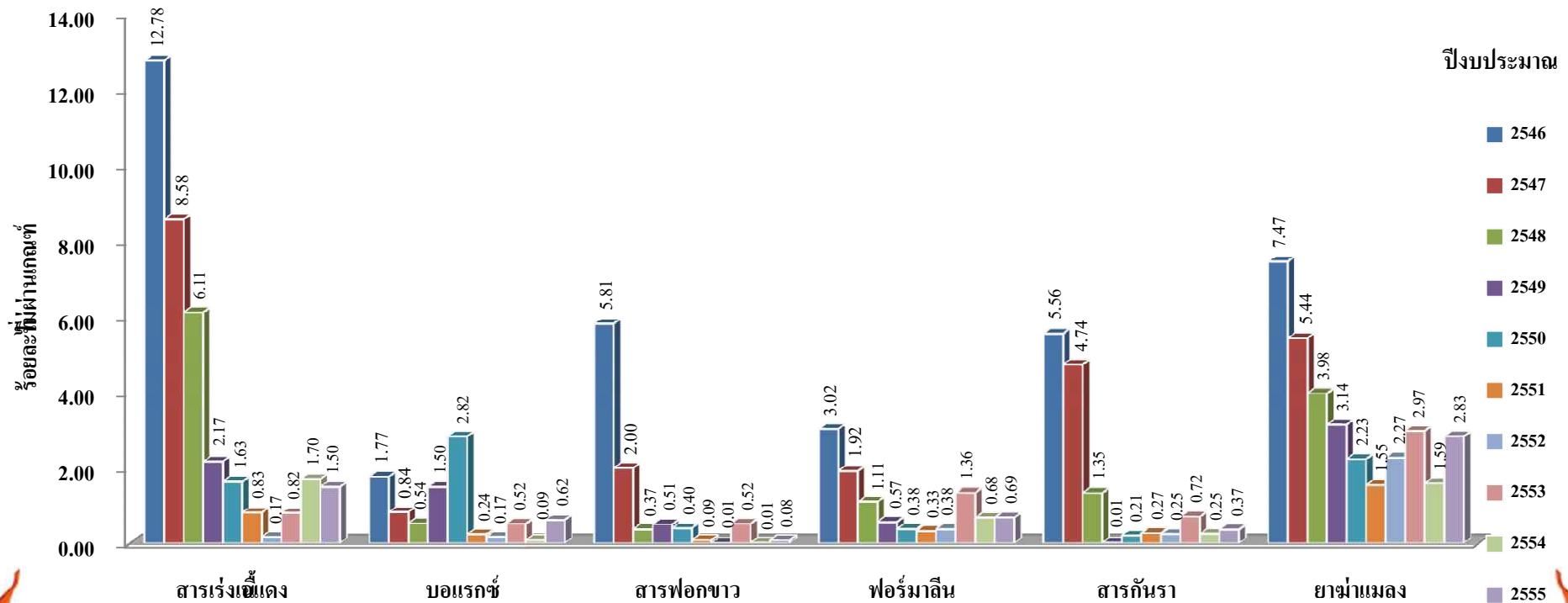


1. Leadership and management,
2. Development of e-Government services,
3. Infrastructure development,
4. Development and improvement of laws, regulations and obligations relating to government servicing process.

Integrated e-government Services Architecture

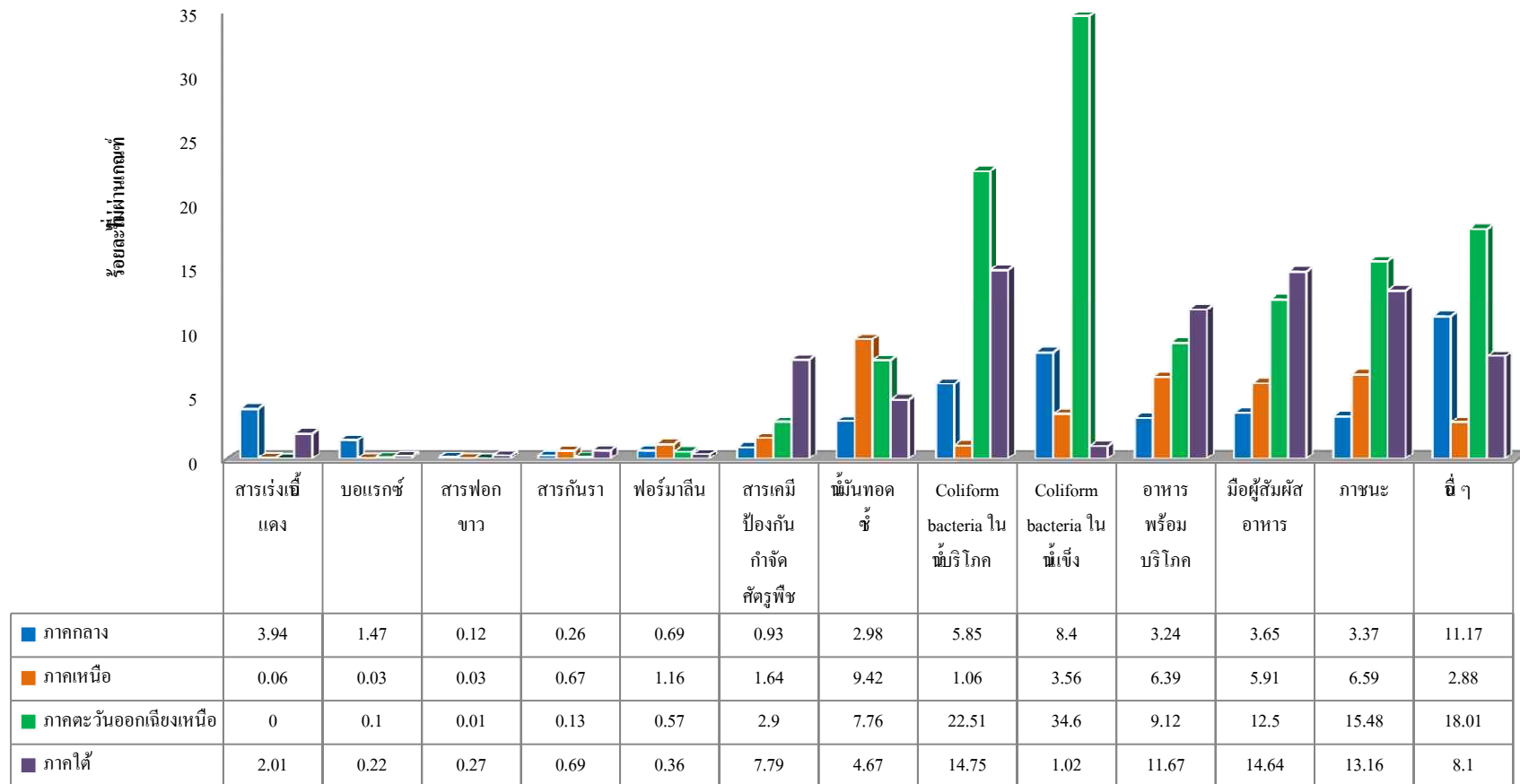


Percentage of 6 Major chemical contamination, 2003 - 2012



Beta agonist, Borax, Sodium hydrosulfite, Formalin,
anti fungal, pesticide residue

Percentage of 6 Major chemical contamination by region, 2012



Risk based monitoring is needed?