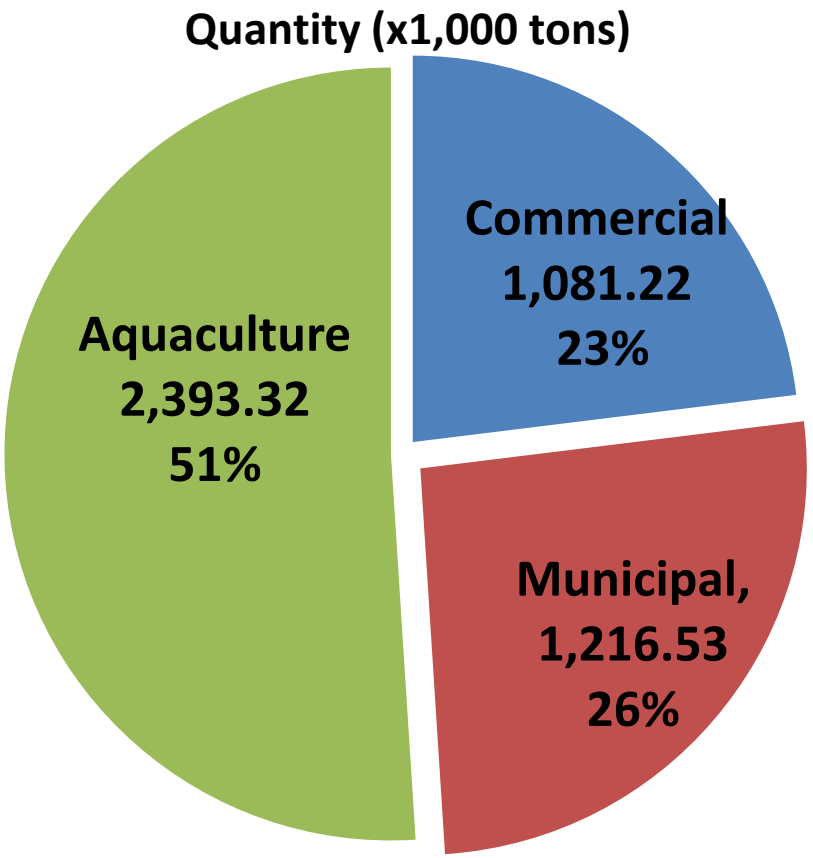
BEYOND MILKFISH AND TILAPIA:
FUTURE DIRECTIONS OF PHILIPPINE AQUACULTURE

National Academy of Science and Technology, Philippines (NAST PHL)

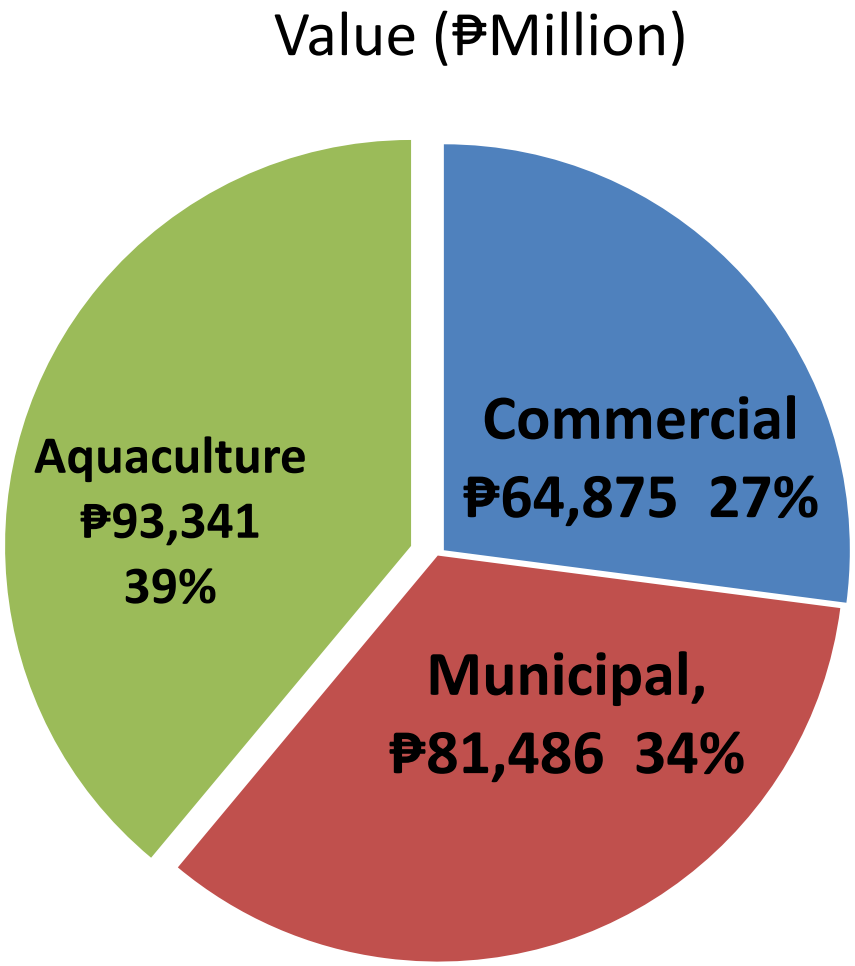
Manila Hotel

July 13, 2017

2015 **Volume** of Philippine Fisheries Production by Sub-sector



2015 **Value** of Philippine Fisheries Production by Sub-sector

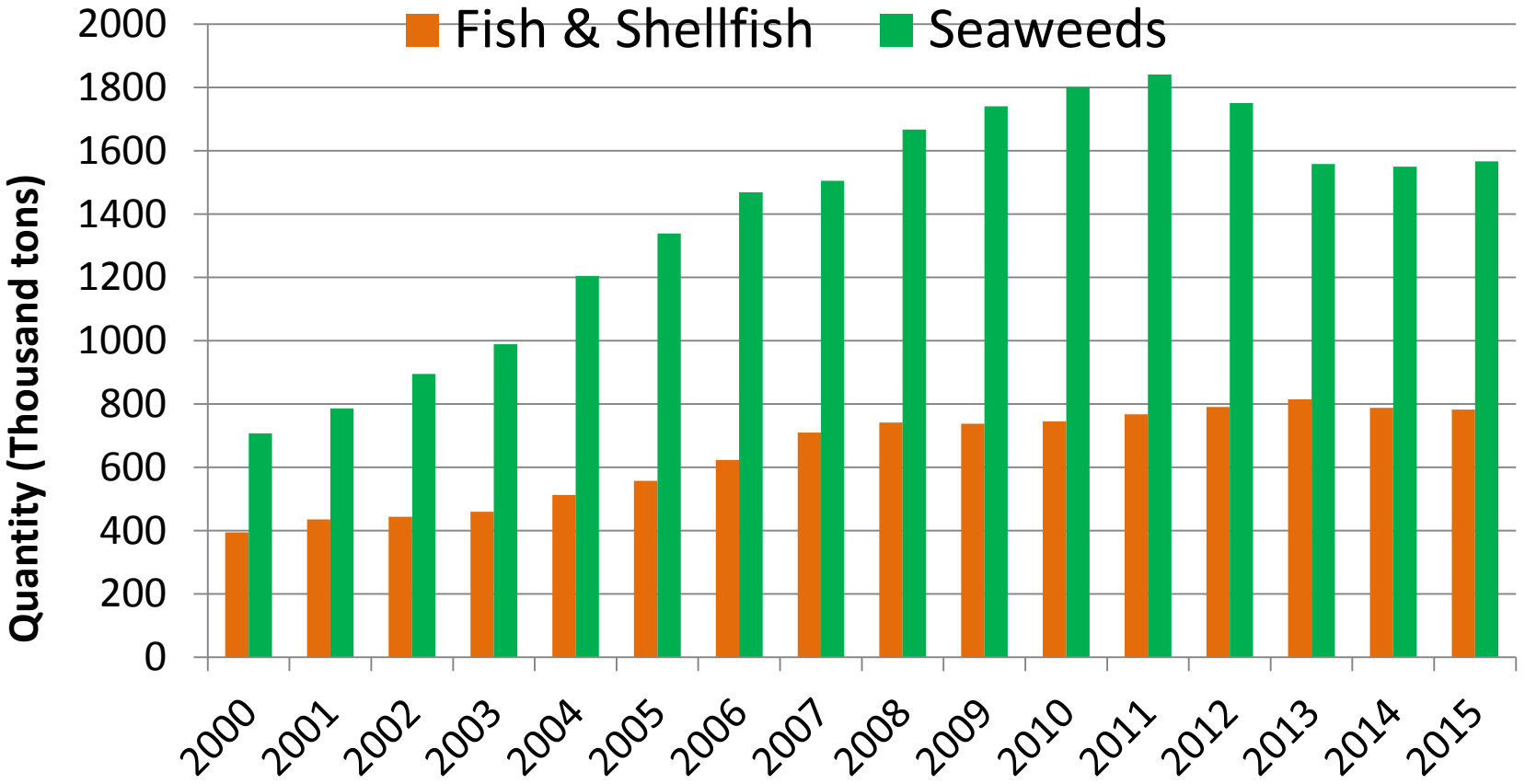


Overview of Philippine Aquaculture

- 2015 Production: 2,393,323 Tons by Volume and ₱ 93.341 Billion by Value
- Comprise 41% of total fisheries production by Volume and 39% by Value
- 63.5% of total production are seaweeds which comprise only 6.6% by value.
- After 2011 seaweed production declined and fish and shellfish production growth flattened

Philippine Aquaculture Production

Seaweeds vs Fish & Shellfish (2000 – 2015)



Phil. Stat. Authority

Volume and Value of Major Philippine Aquaculture Species (2016)

	Quantity (1,000 tons)	Percent (%)	Value (₱Million)	Percent (%)
Seaweeds	1,404.5	63.58%	6,100.9	6.55%
Milkfish	398.1	18.02%	35,033.1	37.62%
Tilapia	259.0	11.73%	18,325.6	19.68%
Tiger Shrimp	48.1	2.22%	20,926.0	22.47%
Oyster	19.5	0.88%	203.4	0.22%
Mussel	18.8	0.85%	273.7	0.29%
Mangrove Crab	16.9	0.76%	6,255.4	6.72%
Carps	16.2	0.76%	413	0.44%
Vannamei	8.8	0.40%	2,008.0	2.16%
ALL SPECIES	2,209.7	100.00%	93,136.8	100.00%

PSA, 2017

Volume and Value of Major Philippine Aquaculture Species (2010)

	Quantity (1,000 tons)	Percent (%)	Value (₱Million)	Percent (%)
Seaweeds	1,801.3	70.6%	11,974.70	14.97%
Milkfish	349.4	13.7%	27,673.80	34.59%
Tilapia	258.8	10.2%	16,516.70	20.65%
Tiger Shrimp	47.8	1.9%	18,224.20	22.78%
Oyster	19.9	0.5%	158.2	0.20%
Mussel	19.9	0.8%	195.8	0.24%
Mangrove Crab	13.7	0.8%	3,900.60	4.88%
Carps	15.7	0.6%	369.3	0.46%
Vannamei	5.0	0.2%	987.9	1.23%
ALL SPECIES	2,550.1	100.0%	80,001.30	

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Who is doing what R&D?

National Agencies Funding or Implementing Aquaculture Research

- DOST-PCAARRD – SUCs and private universities
- DA – Bureau of Agricultural Research (BAR)
- DA – National Fisheries Research Dev't Institute (NFRDI) – In house projects
- Commission on Higher Education (CHED) – To SUCs under the National Agriculture and Fisheries Education System

DOST- PCAARRD Commodity Based Industry Strategic S & T Programs (ISPs)

ISPs under Inland Aquaculture Resources Division (IARD)

- **Milkfish**
- **Tilapia**
- **Shrimps**
- Mussels
- **Mangrove Crab**
- **Aquafeeds**

ISPs Under Marine Resources Division (MRD)

- Seaweeds
- Abalone
- Sea Cucumber
- Oysters
- Blue Swimming Crab

Research Areas Covered

- Propagation (Hatchery Technology Development)
- Grow-out systems
- Nutrition and Feed Development
- Health and Pathology
- Genomics

Results Achieved

The Case of Improved Tilapia Strains

Research & Development Results:

- Production of all-male tilapia through sex reversal using male hormone first commercialized
- Fast growing strains such as GIFT first developed in the Philippines

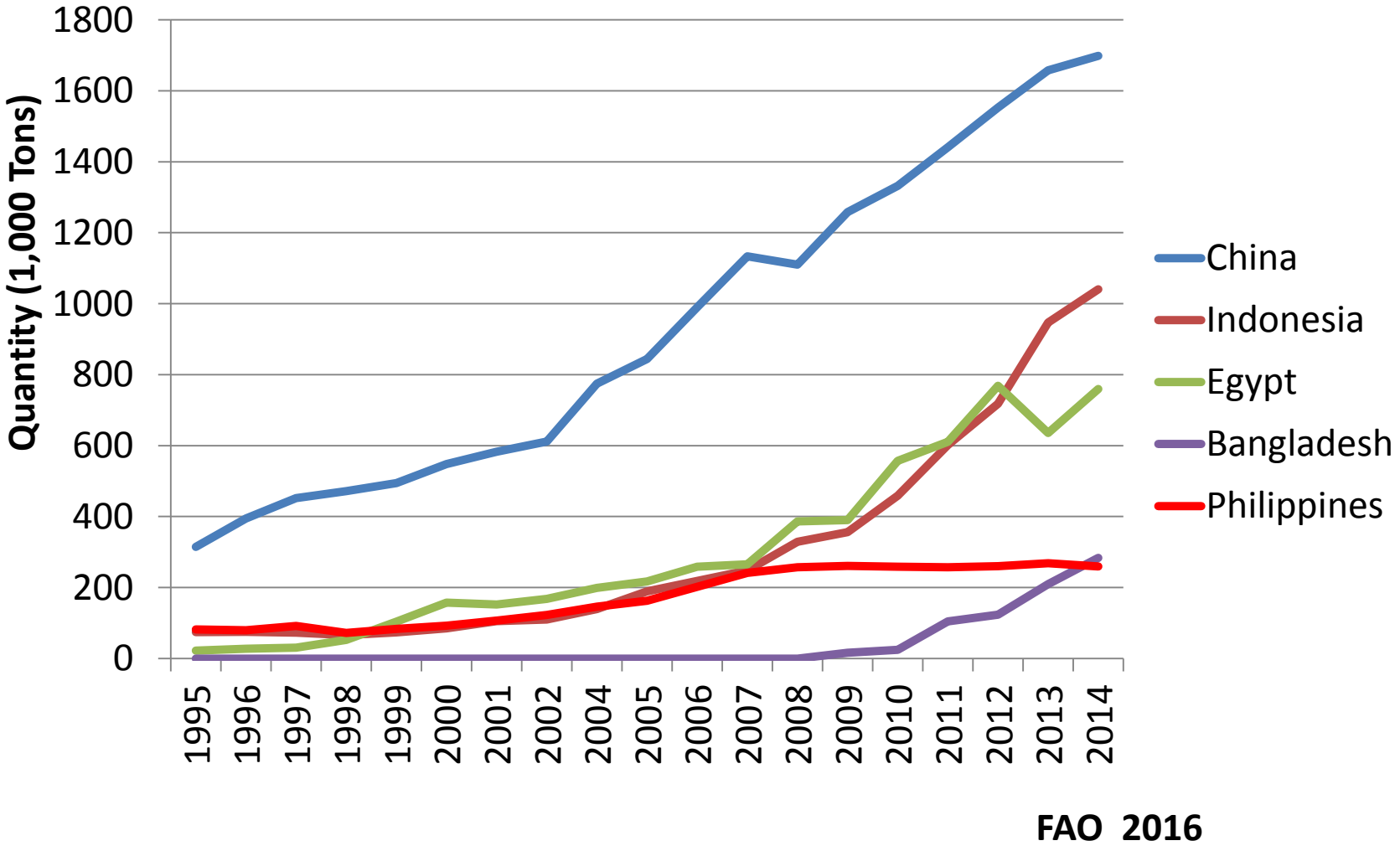
Results Unutilized

The Case of Improved Tilapia Strains

Industry Application conditions:

- Local demand for small size tilapia (200 -300 g)
- Lack of investment and government incentives in tilapia fillet processing facility for tilapia (800g up)
- **Tilapia harvested before faster growth of all male and improved strain is expressed fully**
- Technology not appreciated locally but fully used in China, Indonesia, Thailand and Malaysia where tilapia is harvested only when ABW size is 1 to 1.2 kilo

Tilapia Industry Growth: Top 5 Countries



FAO 2016

Mismatch

The Case of Tilapia Vaccine

Research and Development result:

- Vaccines developed for tilapia for Streptococcus bacteria
- Vaccines have to be injected into the body of the fish
- Oral vaccines through nannotechnology has been presented but has not received financial support

Mismatch

The Case of Tilapia Vaccine

Industry Application conditions:

- Local practice of stocking below 1 gram directly from hatchery to pond until harvest
- Mortality occurs in first 30 days (at less than 5 grams)
- **Fry stocking size does not allow such vaccine injection**
- Indonesia and Malaysia practice vaccination prior to stocking to floating cages

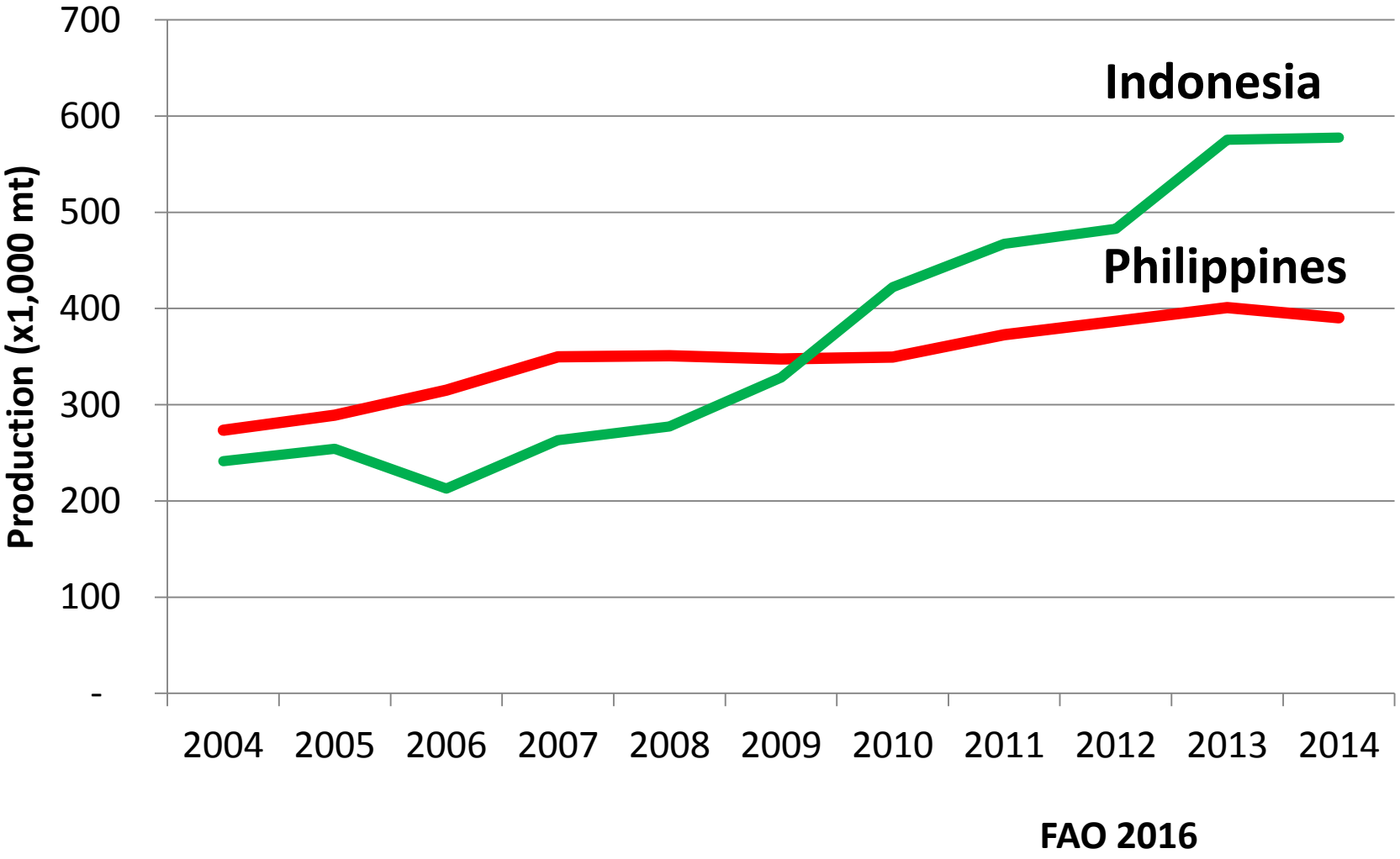
Vaccinating Tilapia Fingerlings by Injection, Trapia Farm, Malaysia

Missed Opportunity

The Case of Milkfish

- Milkfish was first spawned in captivity in the Philippines in late 1970s which led to development of hatchery technology
- But Taiwan was ahead in commercializing technology followed by Indonesia
- Very few local investment in milkfish hatchery of which only one is large scale.
- Now Philippines imports more than 50% of its 2 Billion fry annual requirement from Indonesia

Milkfish Production by Quantity, Philippines vs Indonesia



Results Under Utilized

- Development or refinement of hatchery and grow-out technology and feeds for milkfish, tilapia, mangrove crab, shrimps has not been followed by corresponding investment from the private sector.
- After decades of involvement in aquaculture, we now realize that Philippine R&D efforts have benefited those countries that have the political, fiscal structures and physical infrastructures to scale up, mass produce and process for export.
- Local practices and market demand unable to take advantage of technolgical development.

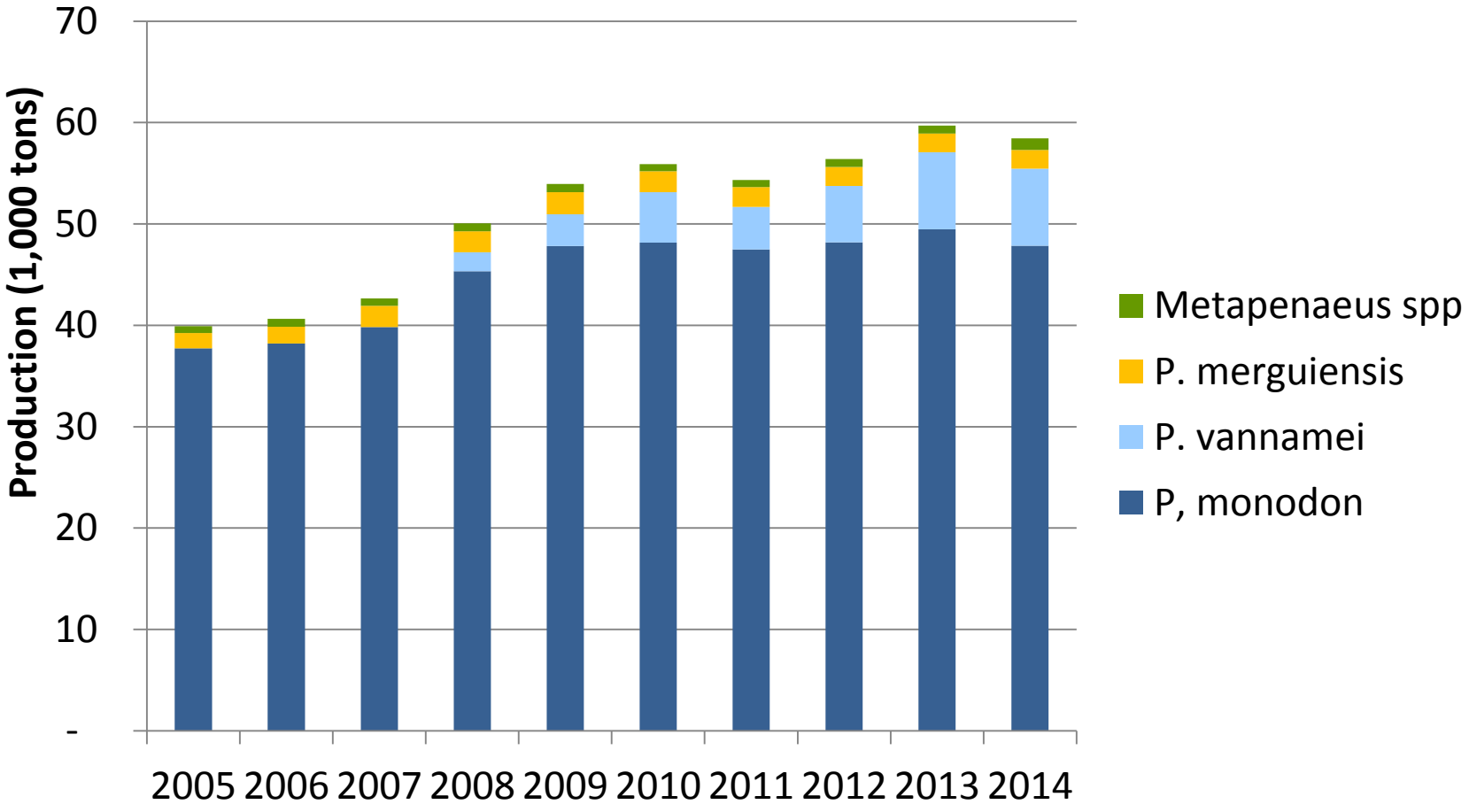
Other Commercially Viable Species to Develop

Philippine Shrimp Farming

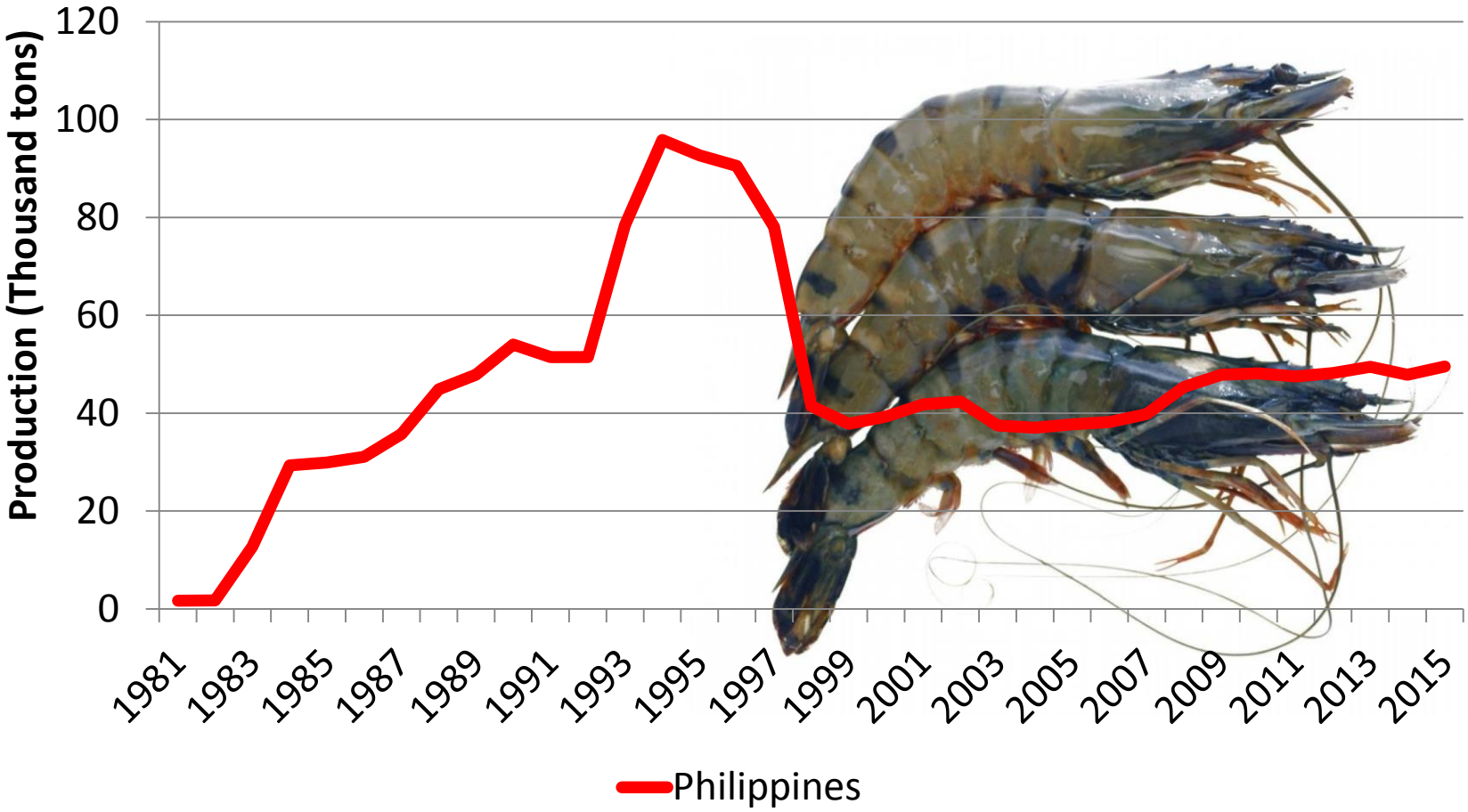
Black Tiger

Vanamei

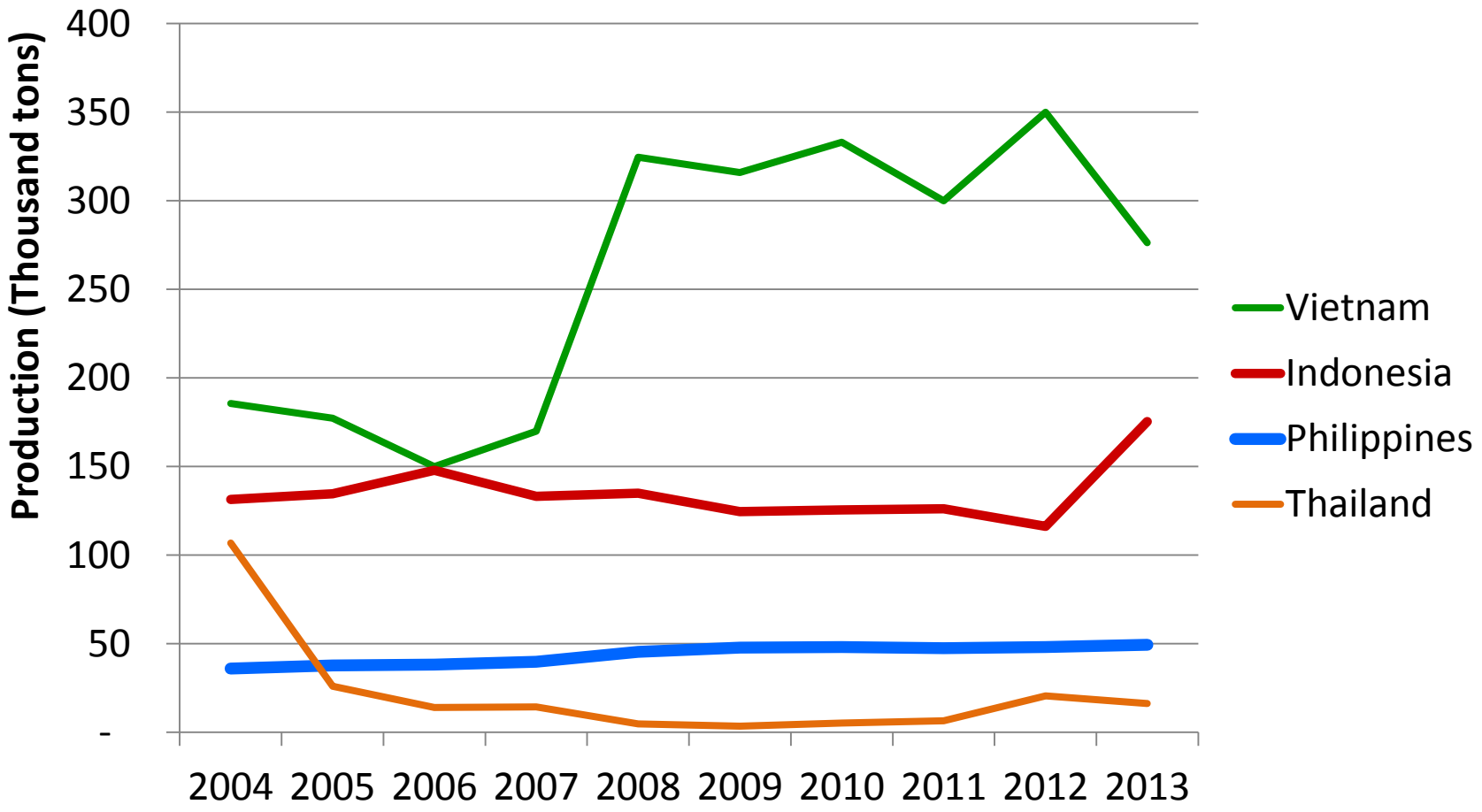
Philippine Shrimp Production 2005 to 2014



Philippine Black Tiger Shrimp (1981 to 2015)



Black Tiger Shrimp Production
Philippines vs Vietnam, Indonesia & Thailand

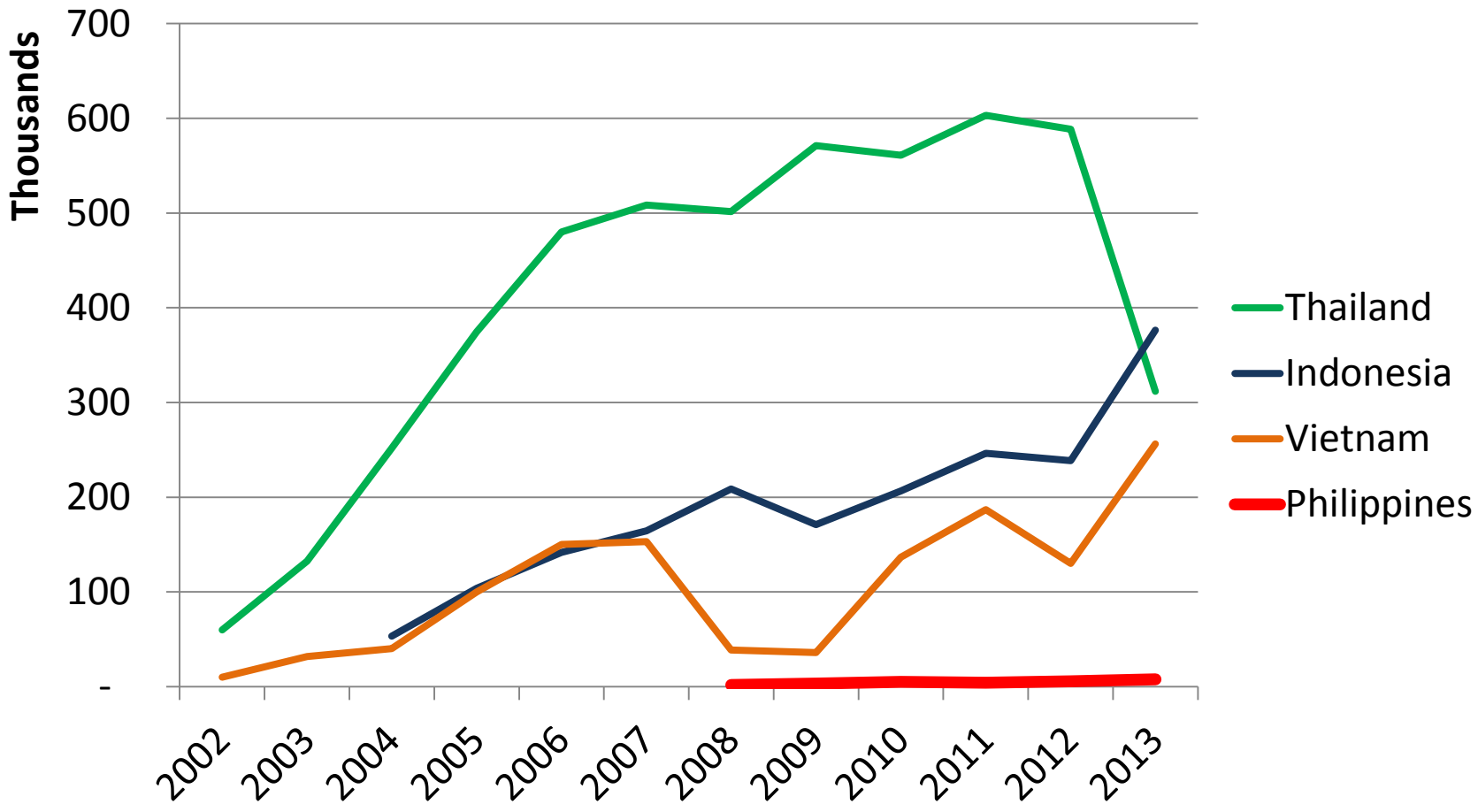


Vanamei Shrimp

Industry conditions:

- Available technology and successful models
- Sustained local demand and favourable international market
- Restrictive government policy

P. Vannamei Production
Philippines vs Thailand, Indonesia & Vietnam



What Santeh is Doing

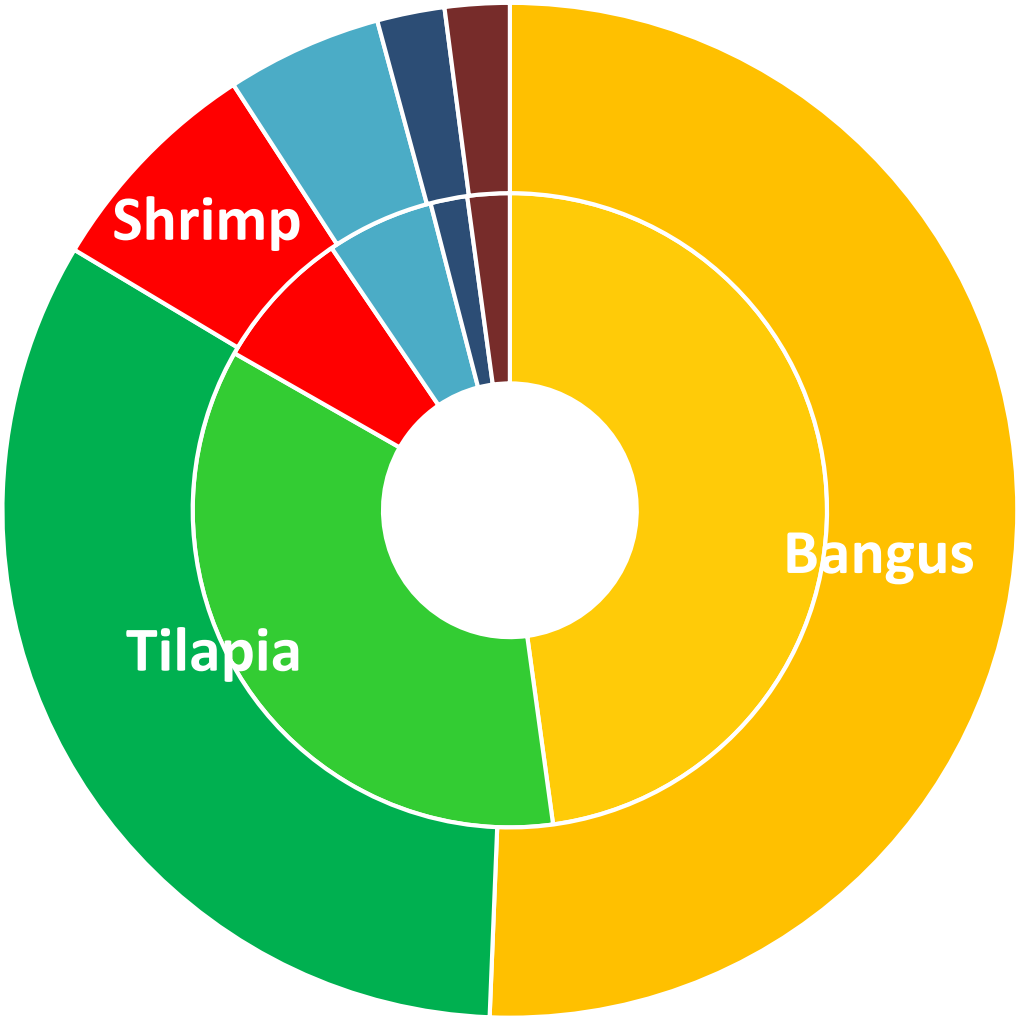
- We lobbied for lifting the prohibition in 2003 and launched “White is Right” campaign
- We have set up two model farms in Manapla, Negros Occidental
- We are offering farm management seminars
- We can enter into farm management or JV schemes
- We offer to buy back harvests of farmers

Mangrove Crab

Successful Industry application conditions:

- Hatchery technology package complete
- There is thriving crab fattening industry
- Acute shortage of wild caught crablets for growing
- Very strong demand for alimango

Comparative Volume of Major Philippine Aquaculture Species **(2010 vs 2016)**



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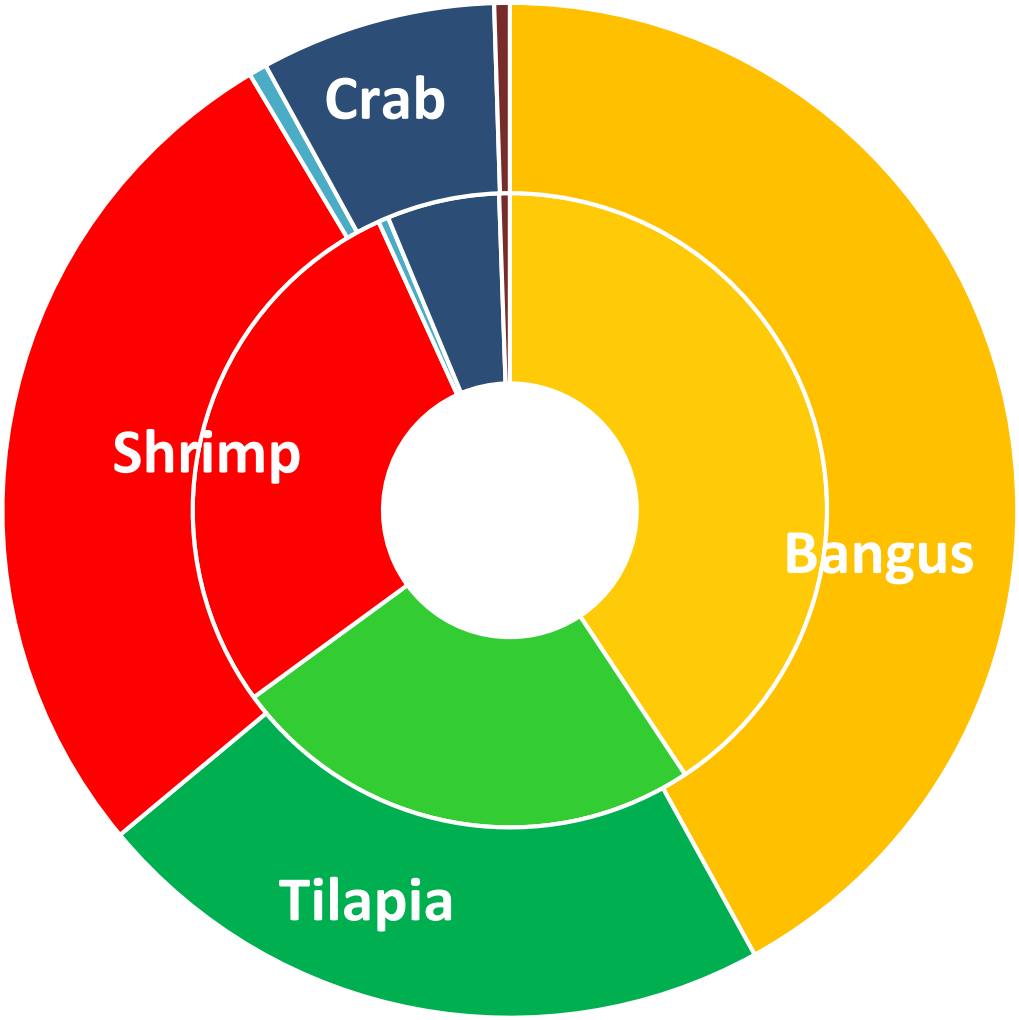
Comparative Value of Major Philippine Aquaculture Species **(2010 vs 2016)**



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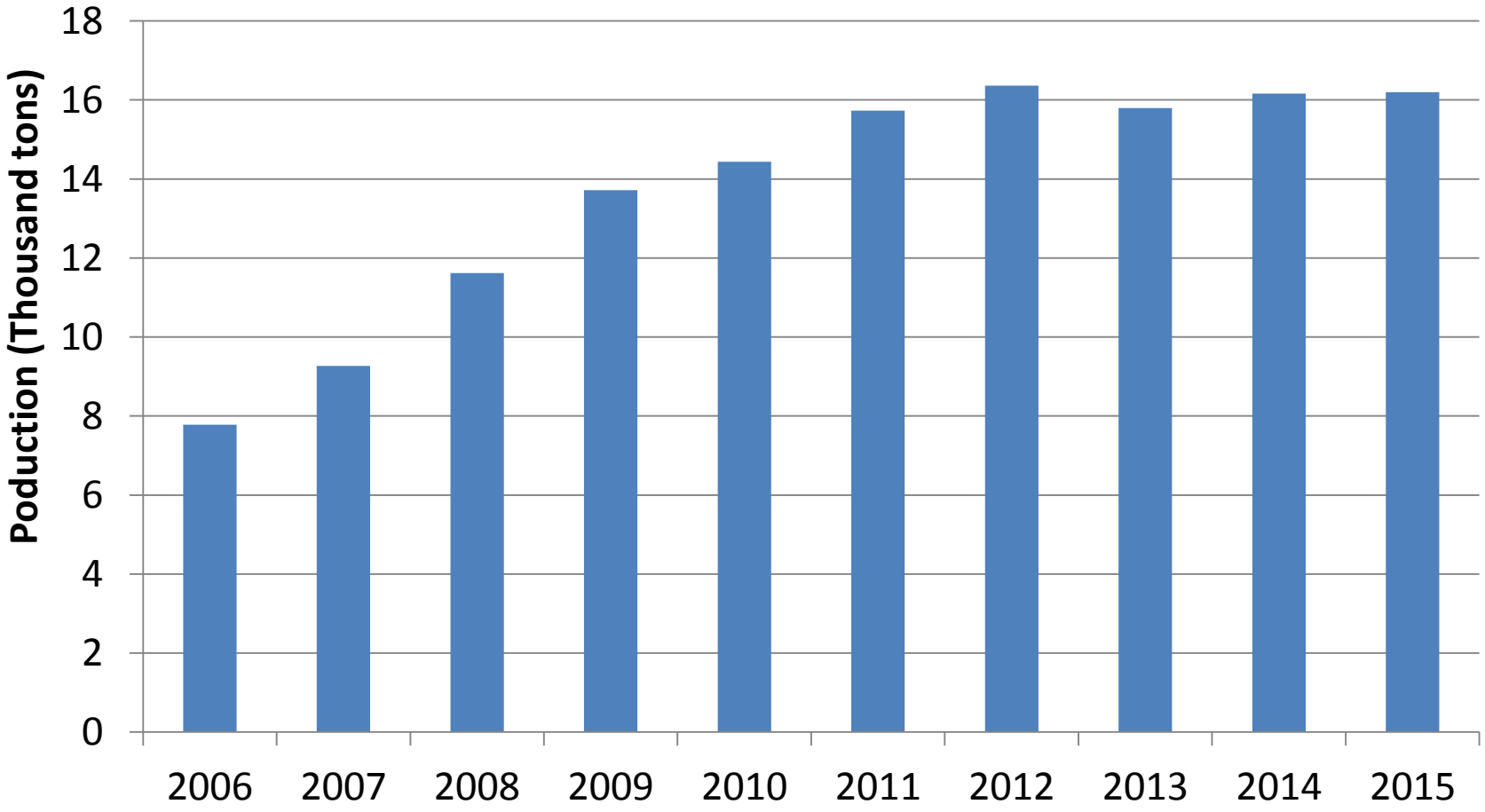
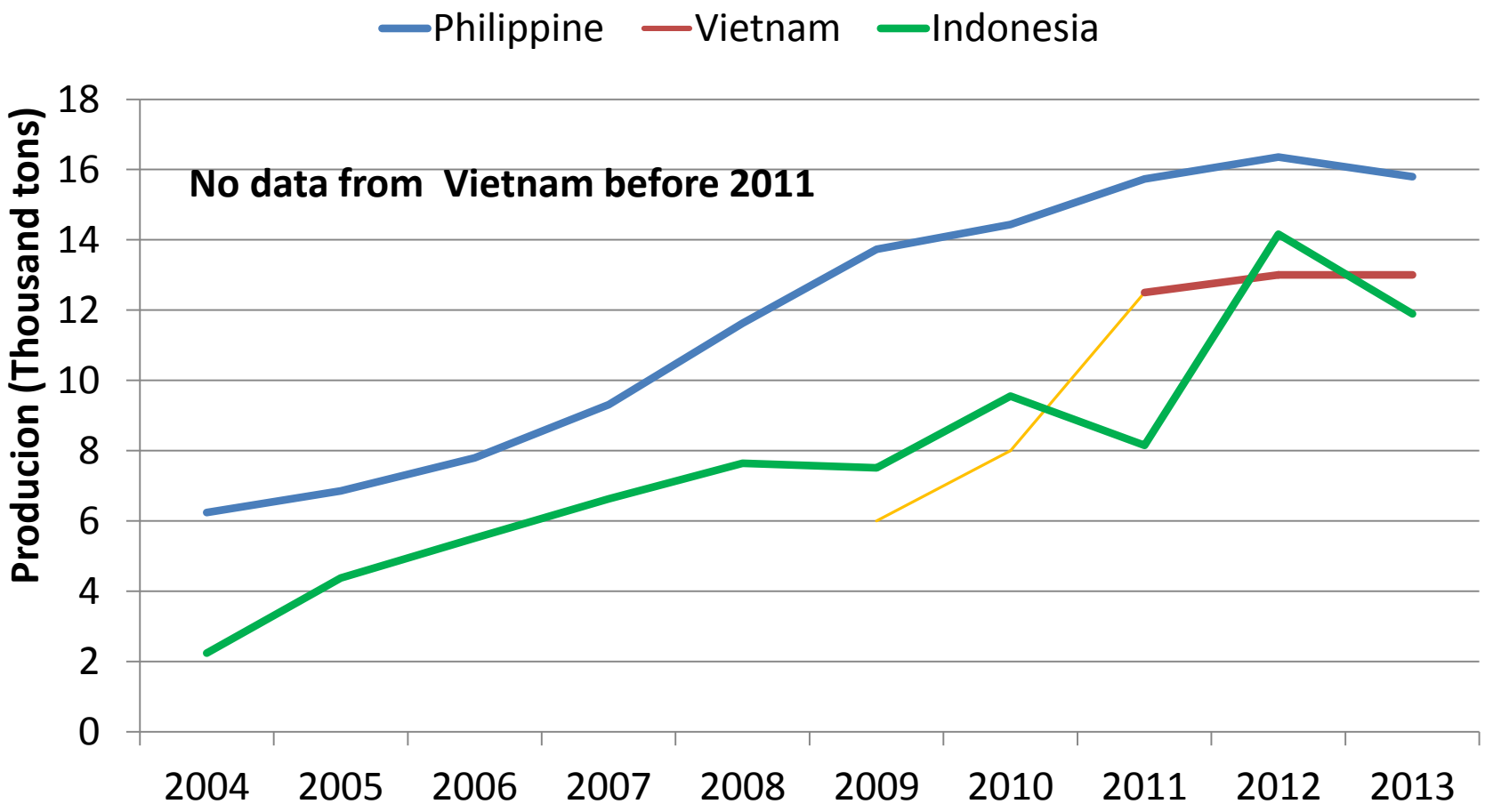
Mangrove Crab Production 2006-2015



Mangrove Crab Production: Philippines vs Indonesia & Vietnam



What Santeh is Doing

- We have launched our crab feed in both pellet and dough format
- We have set up model nursery for langaw langaw to peso coin size
- We are adopting hatchery technology developed by SEAFDEC
- We offer to buy back harvests of farmers

Opportunities in **Local** High Value Species

APAHAP or SEABASS

SNAPPER

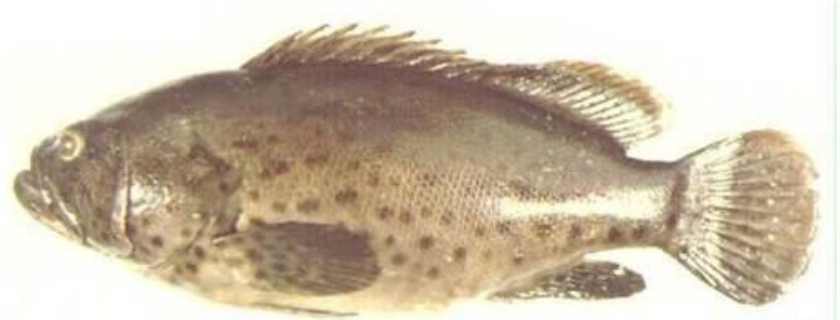
PAMPANO

MALAGA or SIGANID

3 Major Grouper Species

Suno (Coral Trout

Señorita
(Humpback grouper)



Lapulapu (Orange spotted grouper)

High Value Marine Fish

- SEAFDEC has developed technology for hatchery and grow out of **Grouper, Snapper, Pampano, Siganid and Seabass**
- Finfish Hatcheries Inc and Palawan Aquaculture Corp. are large commercial operations producing grouper fry
- Many local traders specialize in live fish delivery and export by live fish carriers
- However mono culture of these species are still not popular. Cost of fingerling and long growing period is a disincentive.

SEAFDEC AQD Demo Farms in Igang

What Santeh is Doing

- We have introduced marine fish feeds since 2005
- We are continuously improving the feed and substituting fishmeal with other proteins
- We operate marine cage farms for pompano

Pampano Sea Cages in Silanguin Bay, Zambales

Other Areas to Develop

Suggested Research Areas to make Philippines Competitive in the Medium to Long Term

- Climate Change adaptation
- Affordable diagnostic kits for diseases
- Micro-algae production and extraction,
- Developing fish meal substitutes: single cell proteins, fermentation of agricultural by-products
- Electronic monitoring and data gathering systems

Climate Change Adaptation

- Refinements to Deep-water fishponds for milkfish and tilapia
- Development of Fish cages that are resistant to strong wind and waves.
- Design of Recirculating aquaculture systems with minimal to zero water change particularly for high value species like shrimp and groupers nurseries.

Marine Cage System

Recirculating Aquaculture System

Affordable Diagnostics

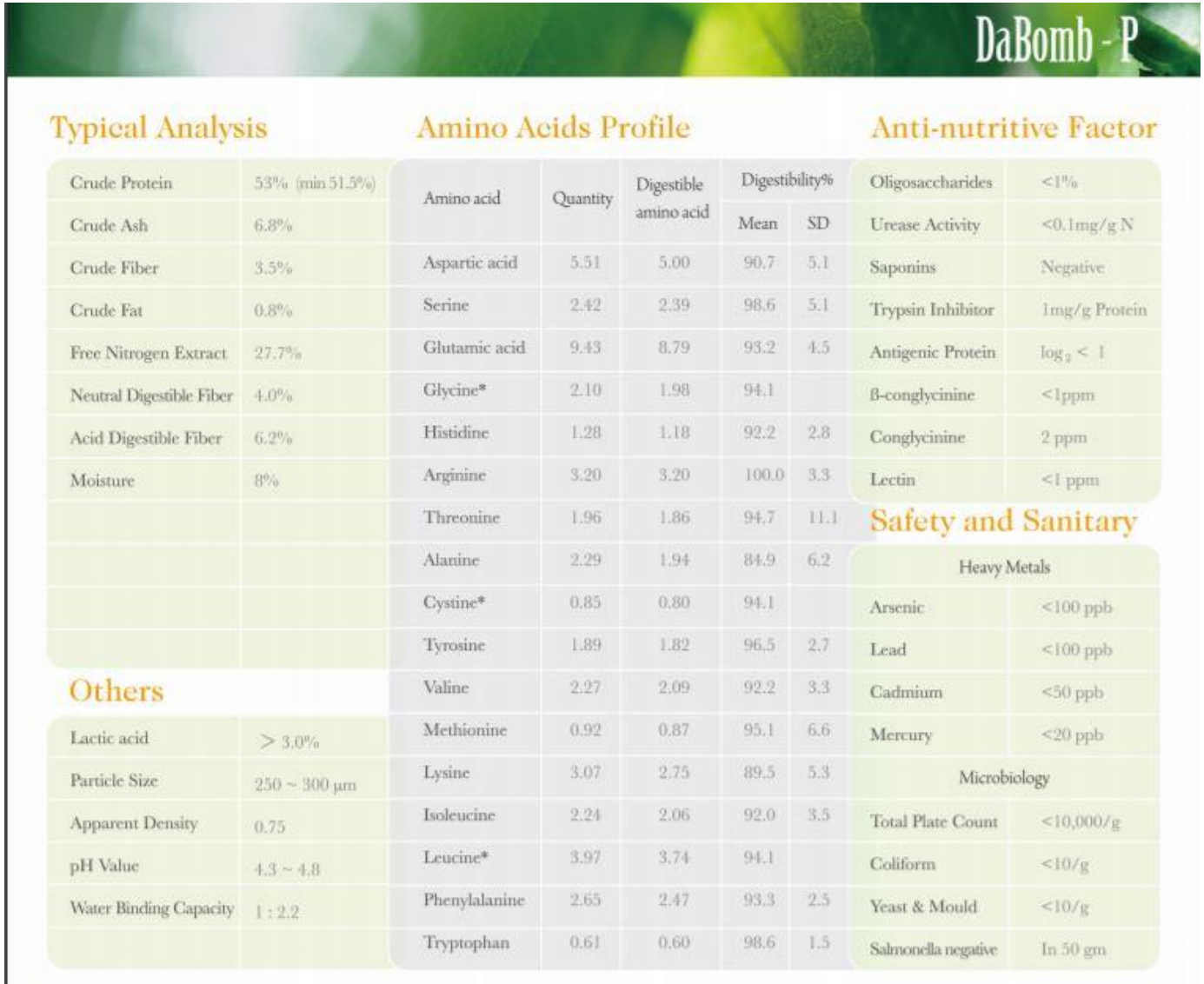
- Diagnosis particularly for shrimps is expensive and samples have to be taken to laboratories so that results may be received too late for any remedial action.
- **LAMP based diagnostics** developed by UST scientist with DOST assistance. Hardware cost only a fraction of imported models. Current kit good only for white spot virus in shrimps but other kits can and should be developed to cover other diseases in aquaculture, livestock and crops. Affordable but effective and faster alternative to PCR. Farmer friendly.

Micro-algae Protein or Lipid

- Micro algae is a good source of protein and lipids that can be excellent substitutes for fish meal and fish oil.
- Present effort in producing **algal paste** is a step in the right direction but product is still costly and usable only for direct feeding
- Research now concentrating on engineering for mass production to make product more practical as feed ingredient.

Fishmeal Substitute

DABOMB PROTEIN (Taiwan)



DaBomb - P

Typical Analysis

Crude Protein	53% (min 51.5%)
Crude Ash	6.8%
Crude Fiber	3.5%
Crude Fat	0.8%
Free Nitrogen Extract	27.7%
Neutral Digestible Fiber	4.0%
Acid Digestible Fiber	6.2%
Moisture	8%

Others

Lactic acid	> 3.0%
Particle Size	250 ~ 300 μm
Apparent Density	0.75
pH Value	4.3 ~ 4.8
Water Binding Capacity	1 : 2.2

Amino Acids Profile

Amino acid	Quantity	Digestible amino acid	Digestibility%	
			Mean	SD
Aspartic acid	5.51	5.00	90.7	5.1
Serine	2.42	2.39	98.6	5.1
Glutamic acid	9.43	8.79	93.2	4.5
Glycine*	2.10	1.98	94.1	
Histidine	1.28	1.18	92.2	2.8
Arginine	3.20	3.20	100.0	3.3
Threonine	1.96	1.86	94.7	11.1
Alanine	2.29	1.94	84.9	6.2
Cystine*	0.85	0.80	94.1	
Tyrosine	1.89	1.82	96.5	2.7
Valine	2.27	2.09	92.2	3.3
Methionine	0.92	0.87	95.1	6.6
Lysine	3.07	2.75	89.5	5.3
Isoleucine	2.24	2.06	92.0	3.5
Leucine*	3.97	3.74	94.1	
Phenylalanine	2.65	2.47	93.3	2.5
Tryptophan	0.61	0.60	98.6	1.5

Anti-nutritive Factor

Oligosaccharides	<1%
Urease Activity	<0.1mg/g N
Saponins	Negative
Trypsin Inhibitor	1mg/g Protein
Antigenic Protein	$\log_2 < 1$
ß-conglycinine	<1ppm
Conglycinine	2 ppm
Lectin	<1 ppm

Safety and Sanitary

Heavy Metals	
Arsenic	<100 ppb
Lead	<100 ppb
Cadmium	<50 ppb
Mercury	<20 ppb
Microbiology	
Total Plate Count	<10,000/g
Coliform	<10/g
Yeast & Mould	<10/g
Salmonella negative	In 50 gm

Fishmeal Substitute

DABOMB PROTEIN (Taiwan)

Hydrolysis Processing

DaBomb-P is a total vegetal origin from 100% soybean meal under fermentation processing by Lactobacillus acidophilus inoculation in order to hydrolysis soy antigen into smaller molecular weight to improve digestibility.

Properties

High protein solubility

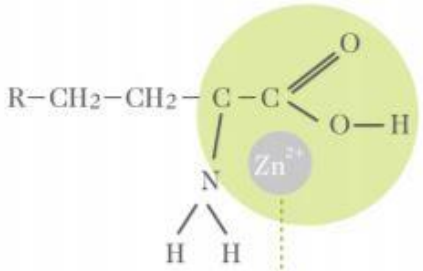
DaBomb-P with high protein solubility showed with high digestibility and absorbability in small intestines in livestock.

Excellent palatability

Poly-peptide and special free amino acid stimulates taste buds to elicit appetite. Taste of DaBomb-P mixes peptide, amino acid, lactic acid, galactose and fructose to raise livestock's appetite and also be a good attractant for aquaculture.

Mineral carrier

Peptide bond of DaBomb-P has functions of mild chelating with trace minerals from oral to guts. Metals have been chelated before feeds enter into alkaline gut and can be absorbed by active transport, ensure health of animals' fur and skin.



The carboxyl end of amino acid is a natural chelating agent for trace mineral, ie., Zn, Cu, Ca, Mg and Fe ion., the chelating form mineral will facilitate absorption in gut

Nature acidifier & Latobacillin

Containing 3.4% of L-Lactic acid after fermentation process is workable help for gastric digestion and pathogen control. Stress creates an alkali environment in the intestine in piglets, followed by the susceptible to bacteria infection. Lactic acid is a natural acidifier agent in gut for preventing diarrhea. By the way, Lactic acid is also a good Calcium transporting agent.

In addition,there are Lactobacillin which produced by lactobacillus, which have the inhibition of G + bacteria growth (Wang et al.,1999)

Fishmeal Substitute

CALYSTA PROTEIN

FeedKind® Protein: Natural Alternative to Fishmeal and Soy

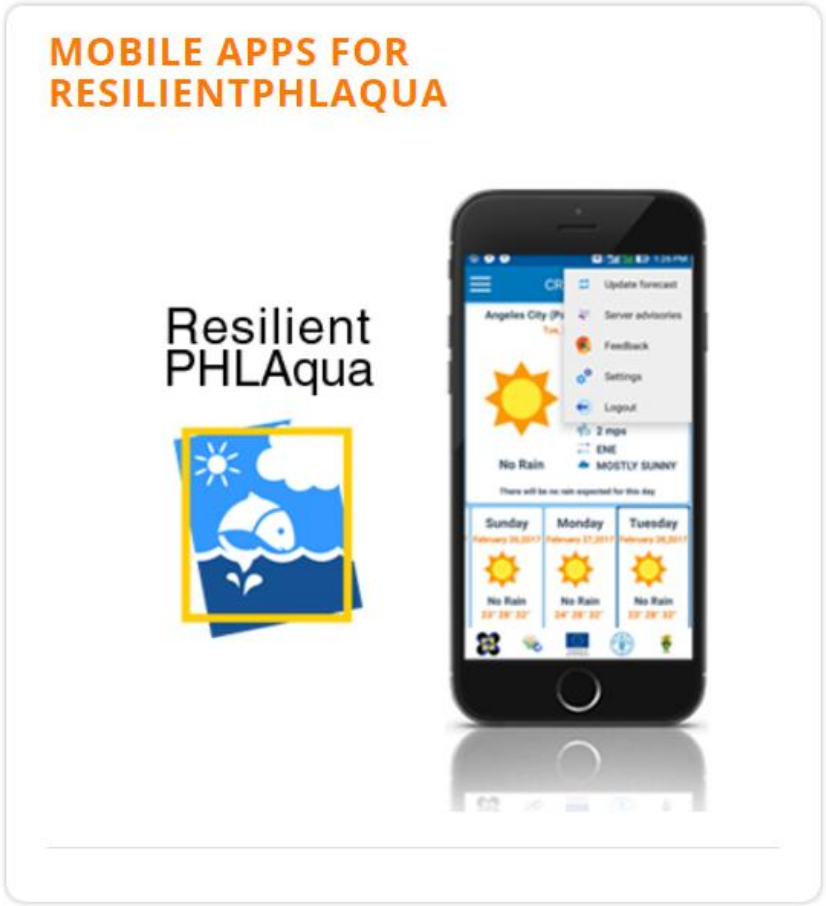
	FeedKind® Protein	Fishmeal
% Protein	71%	60-72%
% Fat	10%	6-10%
% Fiber	<1%	<1%
% Ash	7%	10-15%
Shelf Life	>12 months	3-9 months

Fishmeal Substitute

Protein Enriched Copra Meal (PECM)

- The PECM was developed by the National Institute of Molecular Biology and Biotechnology at UPLB with DOST assistance and is now in the pilot production stage.
- Through solid state fermentation technology the protein content of copra meal is doubled from 18%-20% to 36%-44% making it competitive with imported soya bean meal.
- There should be more of this kind of research.

Information Technology
Mobile Apps



Conclusion

- Philippine aquaculture should specialize in high value niche commodities since it is not competitive in products that require high volume to be in the market
- R&D is best done with an industry partner
- To translate research results to increased production there has to be corresponding political and economic support to make the investment climate in aquaculture more conducive. However, entrepreneurial risk taking is an indispensable prerequisite
- Fishery governance should be science based and production oriented instead of merely regulation–based enforcement.