INDONESIA DEVELOPMENT FORUM 2019
INSPIRE · IMAGINE · INNOVATE · INITIATE

Kementerian PPN/ Bappenas

KNOWLEDGE SECTOR INITIATIVE

Australian Government

Aquaculture 4.0: Transforming Indonesia’s Future Fisheries SMEs

Sub-theme:
Development of Micro, Small, and Medium Enterprises that are Globally Competitive

Muhammad Nabil Satria Faradis
The University of Melbourne

1. Background: Tremendous growth of Aquaculture

World

- Aquaculture production reached a new record which provides almost half with 73.8 million tons in 2014
- Meanwhile capture fishing already saturated since 1990
- 18.7 million people engaged in fish farming sector

(FAO, 2016a; FAO, 2016b; World Bank, 2014)

Indonesia

- Aquaculture becomes the key-factor of fish supply growth in recent years
- The share of farmed fish with total fish supply increase from 10.6% in 1960 to 40.2% in 2014
- Projected to reach more than half in the next decades
- Pond area = 541000 HA, unfortunately 80% traditional system

(FishStatJ, 2016; Trana, Rodriguezb, & Chana, 2017; Phillips, et al., 2016).)

INDONESIA DEVELOPMENT FORUM 2019
INSPIRE · IMAGINE · INNOVATE · INITIATE

Kementerian PPN/ Bappenas

KNOWLEDGE SECTOR INITIATIVE

Australian Government

Recent reports agree that this sector will significantly contribute to providing adequate nutrition and achieving food security to feed 9.7 billion global population by 2050

(Dupont, Cousin, & Dupont, 2018; World Bank, 2014)

1. Background: Problems

- Technology does not change for decades
- Limited pond area – need intensify the available ponds
- Lack of clean water resources
- Ineffective feeding method
- Relatively low income
- Prone to Climate Change

HOW DO THEY FACE INDUSTRY 4.0?

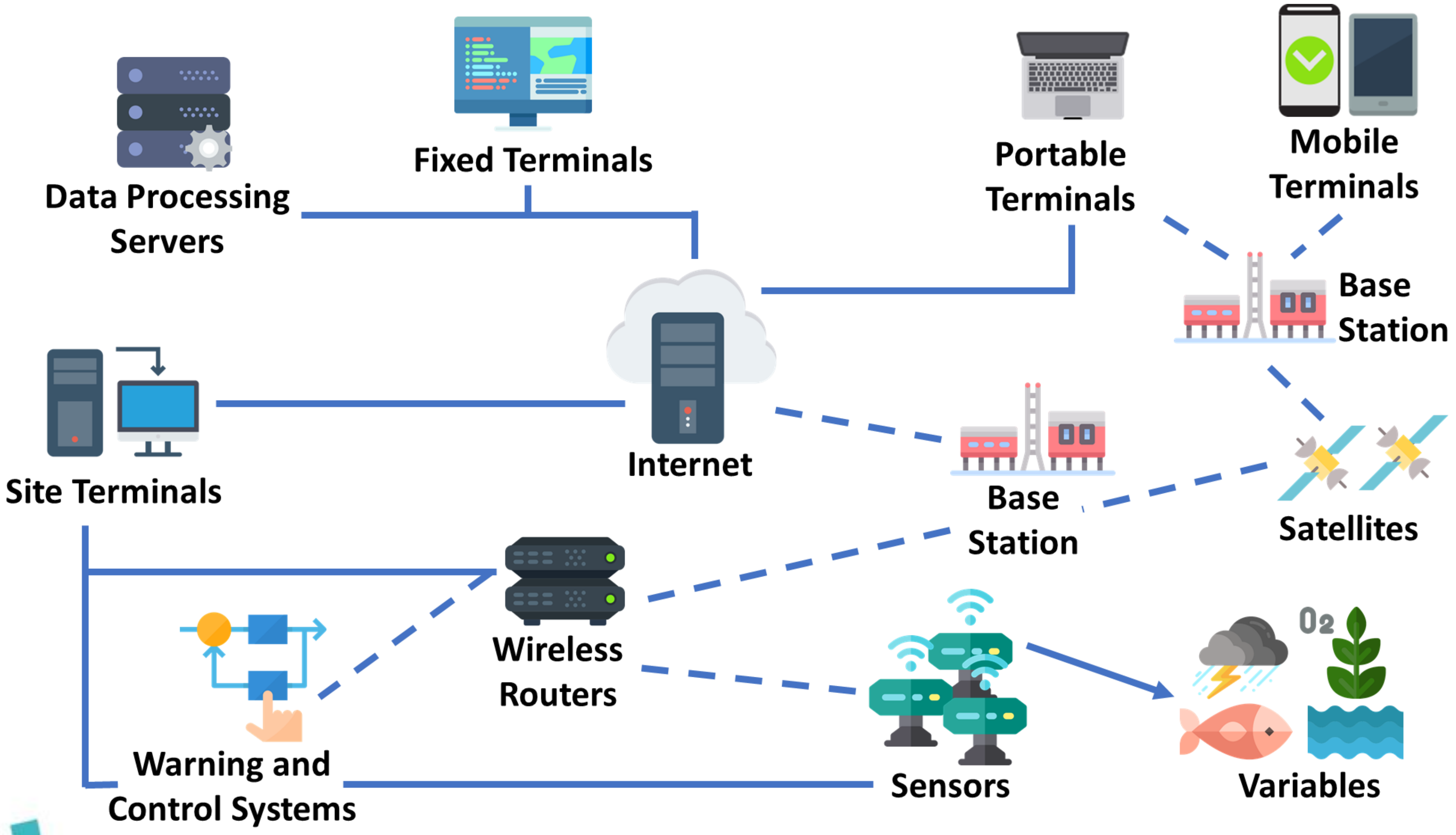
A Breakthrough Approach is Urgently Needed

2. Solution:

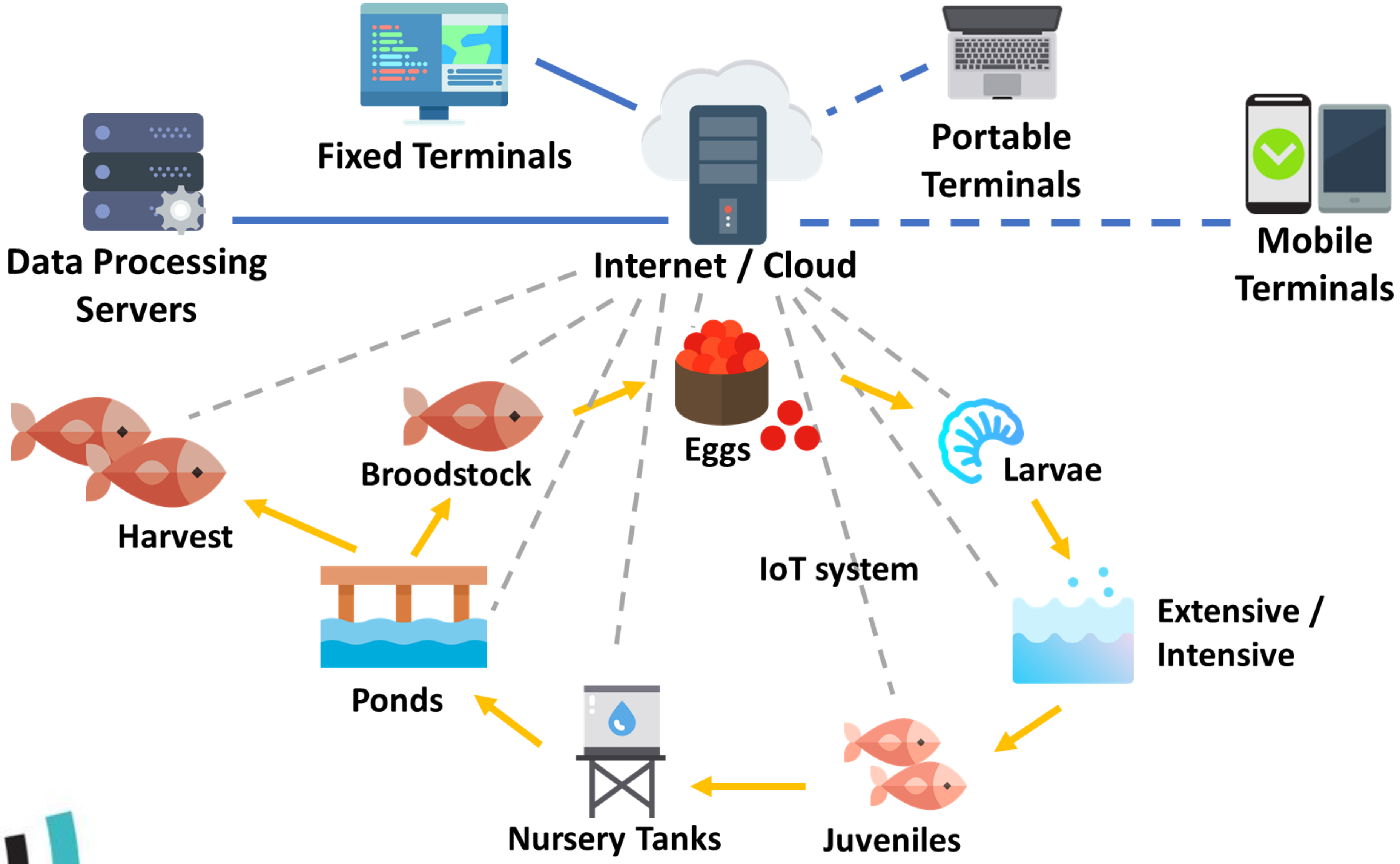
AQUACULTURE 4.0

- A smart farm solution for intensifying production by utilizing the Internet of Things (IoT)
- IoT will lead the fish farmer with a new era of affordable, smart, efficient and reliable technology
- Artificial Intelligence (AI) processing important information from smart sensors and satellites
- Addressing critical challenges for an eco-friendly solution and increase production

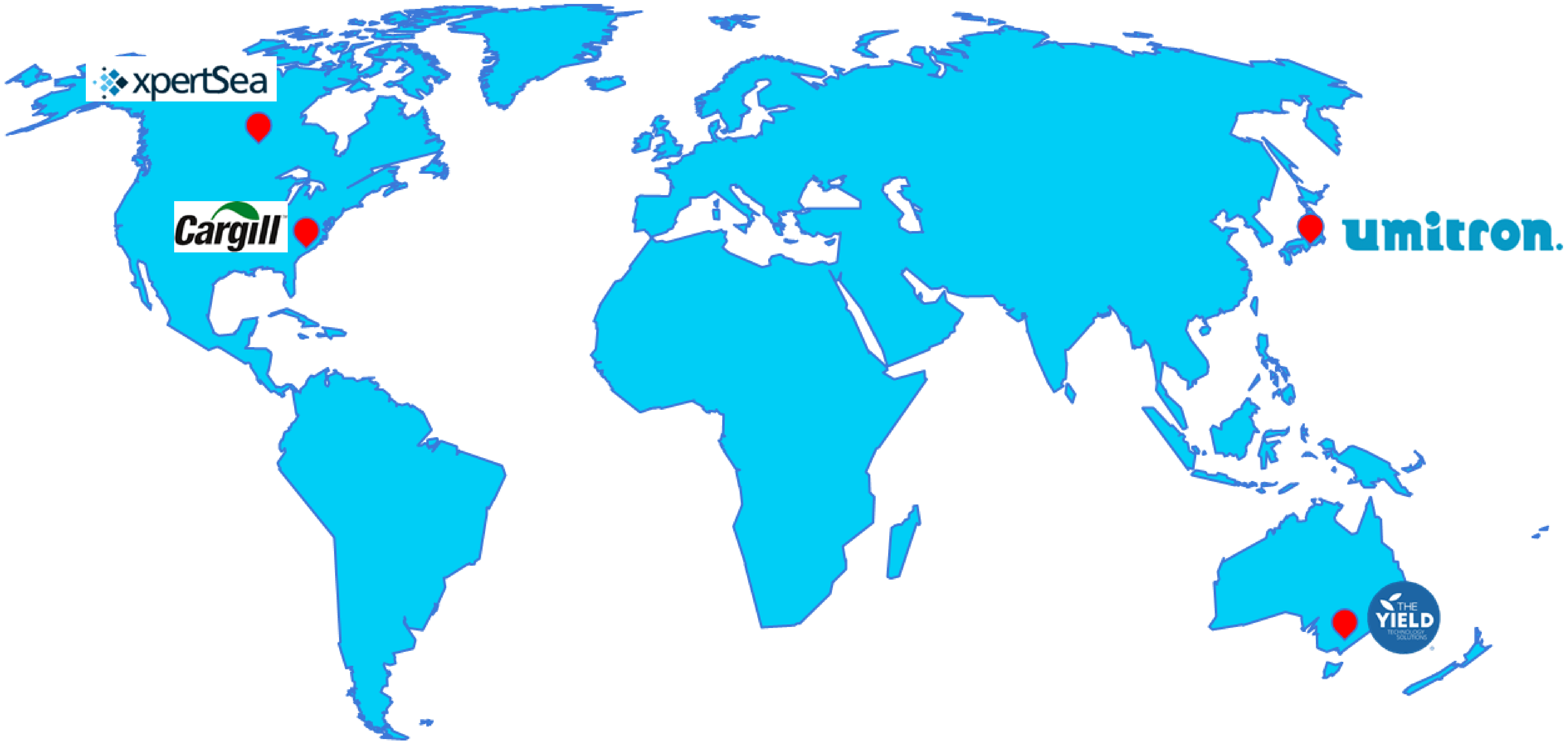
2. Idea: schematic framework for Aquaculture 4.0



2. Idea: Growth cycle framework for Aquaculture 4.0



Aquaculture 4.0 worldwide – Global Stepping stone



Aquaculture 4.0 worldwide – Global Stepping stone

Cargill

Cargill (2018) released iQShrimp in the US, a platform that gathered data in shrimp size, feeding, weather and water conditions. Thus, the algorithms could deliver a reference such as feeding plans and ideal harvest dates

THE YIELD TECHNOLOGY SOLUTIONS

The Yield (2014) in Australia, collected important climate condition such as salinity, temperature and depth of water, pressure and sea-tide height. Thought cloud platform, the AI could forecast three-days of local weather and harvesting condition

xpertSea

XpertSea (2009) from Canada, utilized computer vision and AI to accelerate and increase the accuracy of shrimp larvae count by 60%

umitron.

Umitron (2016) in Japan, used sensors and machine learning to watching fish behaviour. The analysis could determine the best feed-time to avoid over-feeding and the behaviours of different fish species

Aquaculture 4.0 – Current Stage in Indonesia

eFisheries (2013)

Produced automatic feeder and track hungry fish by monitoring their movement and water ripple

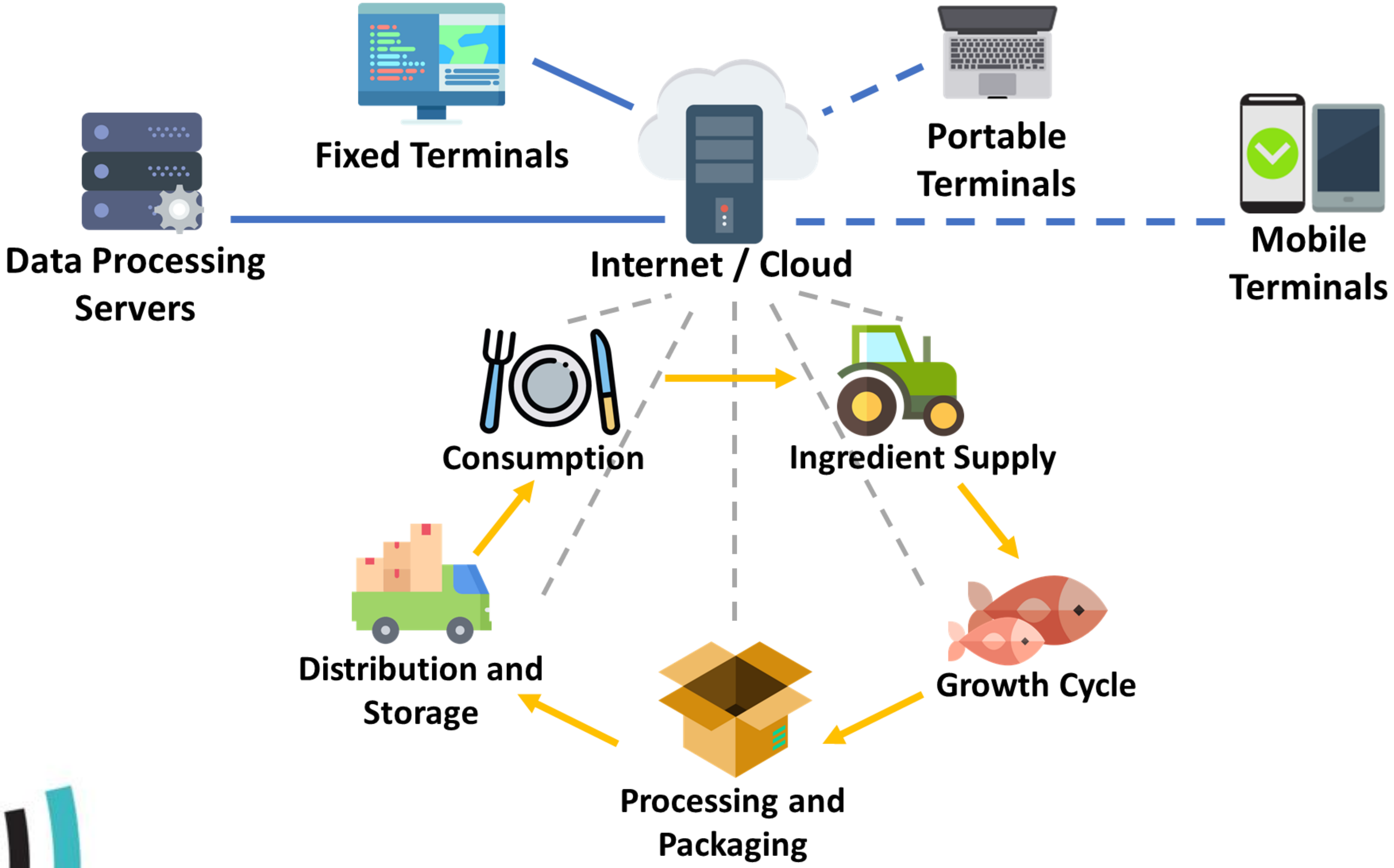
JALA (2015)

Provided all-in-one device measurement including DO (Dissolved Oxygen), salinity, temperature, pH, humidity and total dissolved solid with corrective algorithms

MINO (2016)

Created microbubble technology to increase dissolved oxygen on ponds controlled by DO sensors. The technology could increase the fish weight up to 40%

2. Idea: Life cycle framework of Aquaculture 4.0



2. Idea: Example of Application – Life Cycle framework

Life Cycle Framework	Example of Aquaculture 4.0 Application
Ingredient supply	• Ingredient inventory environment monitoring • Automatic ingredient ordering • Ingredient detection and tracing • Ingredient transportation monitoring • Ingredient cultivation and production monitoring
Growth Cycle	• Water quality monitoring • Fish behaviour detection • Feeding precision system • Weather prediction • Data analysis and control system
Processing and Packaging	• Environment control processing • Intelligent labels formulation • Aquaculture product automatic classification
Distribution and storage	• Refrigerated warehouse management • Refrigerated truck monitoring and controlling • Aquaculture product real-time tracking • Aquaculture product automatic sorting
Consumption	• Aquaculture product identification • Aquaculture product life cycle evaluation • Aquaculture product quality detection • Aquaculture product precise recall

3. Benefits of AQUACULTURE 4.0

AI algorithms suggest feed, harvest, weather with energy and eco manners

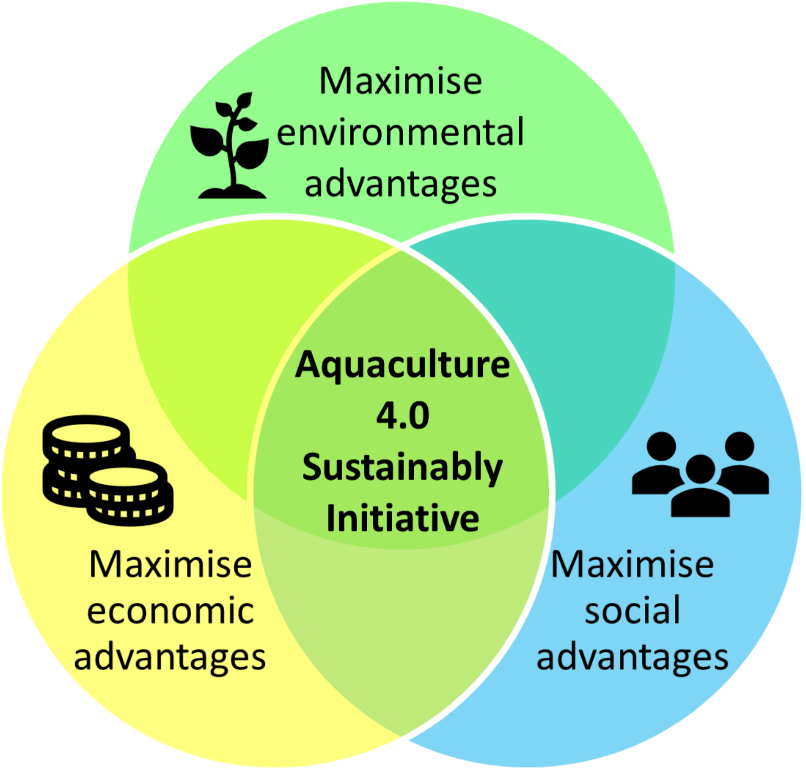
Real-time data Integration – sharing with peers

Reduce risk, intensify resources (land – water) and improve productivity

Better understanding fish behavior

3. Aquaculture 4.0 Sustainably Initiative

Environment Advantage:
- Managing and protecting ecosystem services
- Improving water quality and reducing waste by-product
- Providing intensive systems for water usage and fish seeds
- Intensifying pond without require further land clearance
- Developing the technology by renewable energy sources



Economic Advantage:
- Opening more jobs opportunities in engaged sector on chain and logistic system
- Creating more opportunities for investors
- Improving infrastructure and transport

Social Advantage:
- Empowering marginalised groups and creating equal job opportunities
- Improving safety and security for worker
- Providing decent rural employment
- Improving the quality of life and enterprise development

4. Implication for Policy & Practice: (TFOM) analysis

Technology

- Aquaculture sensors design
- Wireless sensor network
- Communication protocols in Aquaculture
- Aquaculture big data and AI system

Finance

- Investment in Aquaculture 4.0 system in fish farm
- Aquaculture 4.0, supply chain, big data finance
- Incentives, risk and benefit analysis

Operation

- Sensor and system dis design
- Network for rechanging a repairing services
- Ponds to door supply chain optimisation
- Aquaculture 4.0 based reception box layout

Management

- Integrating development under solid and collaborative partnerships
- Aquaculture 4.0 devices, data, quality and traceability management

4. Guidelines for **Sustainability**

Focus: **Collaboration models from all stakeholders and incentives alignment**

Strategies	Action by	Key Opportunity	Key Risk
1. Providing structural incentives in order to encourage the prioritisation of sustainability objectives at the design stage of the Aquaculture 4.0	Government All	Maximising sustainable development impact of the Aquaculture 4.0	Sustainability continues to be an "accidental afterthought"
2. Integrating and researching Aquaculture 4.0 technologies and drive use cases-based development under solid and collaborative partnerships to overcome the restrictions of fragmentation	Business, Academic All	Delivering results despite quite immature market and fragmented landscape	Loss of business opportunities as customers wait for industry consolidation
3. Prioritising infrastructure solutions, to enable business models and facilitate scale	Government Business	Reveal economic value to the global economy	Subdued or sub-standard progress from promising segments
4. Simplifying legal frameworks, accelerating procurement processes and engaging the experts to enhance the pace of Aquaculture 4.0 deployments and decrease the jeopardy of political cycles	All	Streamlining procedures to attain the full scale of the opportunities efficiently	Subdued or sub-standard progress from promising segments
5. Establishing early the data governance terms for ownership, privacy, usage and sharing as a central pillar of the partnership	Government	Leveraging the full potential of data	Possible conflicts and failure in delivering the promised results

4. Guidelines for Sustainability

Focus: Business and investment models

Strategies	Action by	Key Opportunity	Key Risk
6. Exercising flexibility in designing and executing business models	Business All	Maximizing revenue chances in a moderately nascent industry	Missed profits and development opportunities
7. Developing cross-industry solutions to bring mutual benefits and enabling to create a new monetisation models	Academia Business	Innovation driving new revenue streams	Missed profits and development opportunities
8. Achieving scale by demand consolidation and bundling to attract alternative funding sources (e.g., institutional investors)	All	Achieving the true scale of opportunities by bringing in new class of investors	Missed profits and development opportunities

4. Guidelines for Sustainability

Focus: Impact measurement

Strategies	Action by	Key Opportunity	Key Risk
9. Embracing a sustainability awareness culture to respond to new generational demand, enhancing brand reputation and attracting top talent	Business All	Indonesian bonus demographic – align with priorities	Decreased competitiveness and brand obscurity
10. Adopting a framework based on UN Sustainable Development Goals (SDGs) to estimate possible effect and measuring outcomes	Business All	Homogenising the language and goals used for sustainable development	Sector/industry specific impact measurement not understood by the broader community
11. Identifying potential Sustainable Development Goals and targets addressable by Aquaculture 4.0 project and incorporating them into the commercial design	Business All	Maximizing sustainable development impact of Aquaculture 4.0	Sustainability continues to be an “accidental afterthought”

5. Conclusion

Local Community

Aquaculture 4.0 applications will help Fisheries SMEs better approach to increase their production

Business

Several examples of technologies could be the best practice to be implemented in Indonesia

Government

Facilitate all stakeholders to create years plant to prepare the local Aquaculture SMEs and labor force for facing and adapting this technology disruption.

Academic

Prepare the transition of IoT technology for increased economic growth, environmental sustainability and food security in the fisheries sector

5. Conclusion

- The complete application of Aquaculture 4.0 will help Fisheries SMEs to achieve the idea of precision and intensive aquaculture. It would remarkably contribute to solving the worlds and Indonesia food problem with an increasing population.
- In the growth cycle, several examples of technologies could be the best practice to be implemented in Indonesia.
- Life cycle Aquaculture 4.0 is necessary to solve the challenge by helping fish-farmers recognise the quality of agriculture ingredients, improve the yields as well as the quality, and produce creditable aquaculture-products for the market.
- Besides technical issues, emerging finance, operation, and management issues are gradually observed in the Aquaculture 4.0.
- The local business, academic, government, and business (quadruple helix) should prepare the transition of IoT technology for increased economic growth, environmental awareness and food security in the aquaculture sector with sustainable manner.

Thank You

Research Experiences

Two years in Centre for Energy Studies UGM

A year to research the fluid dynamics application in Helmholtz-Zentrum Dresden-Rossendorf, Germany

Master candidate at Mechanical Engineering with Business with Australia Awards Scholarship

Two years of experience in developing the aquaculture technology

1st winner of YSEALI World for Food Innovation Challenge 2016 by US Department of State

1st winner of Ideas for Action 2018 held by World Bank - Wharton School of University of Pennsylvania

MUHAMMAD NABIL SATRIA FARADIS

References

- Bostock, J., McAndrew, B., Richards, R., Jauncey, K., Telfer, T., Lorenzen, K., ... & Corner, R. (2010). Aquaculture: global status and trends. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *365*(1554), 2897-2912.
- Chiang, C. T. (2017). A CMOS Seawater Salinity to Digital Converter for IoT Applications of Fish Farms. *IEEE Transactions on Circuits and Systems I: Regular Papers*, *64*(9), 2591-2597.
- Dupont, C., Cousin, P., & Dupont, S. (2018, June). IoT for aquaculture 4.0 smart and easy-to-deploy real-time water monitoring with IoT. In *2018 Global Internet of Things Summit (GIoTS)* (pp. 1-5). IEEE.
- Encinas, C., Ruiz, E., Cortez, J., & Espinoza, A. (2017, April). Design and implementation of a distributed IoT system for the monitoring of water quality in aquaculture. In *2017 Wireless Telecommunications Symposium (WTS)* (pp. 1-7). IEEE.
- FAO. (2016a). Contributing to food security and nutrition for all. Rome.
- FAO. (2016b). The State of Phillips, et. all.eries and Aquaculture 2016. Contributing to food security and nutrition for all. Rome. 200 pp.
- FishStatJ. (2016). Database and Software for Fishery Statistical Analysis. *United Nations FAO*.
- Kobayashi, M., Msangi, S., Batka, M., Vannuccini, S., Dey, M. M., & Anderson, J. L. (2015). Fish to 2030: the role and opportunity for aquaculture. *Aquaculture economics & management*, *19*(3), 282-300.
- Maurya, S., & Jain, V. K. (2017). Energy-Efficient Network Protocol for Precision Agriculture: Using threshold sensitive sensors for optimal performance. *IEEE Consumer Electronics Magazine*, *6*(3), 42-51.

References

- Phillips, M., Henriksson, P. J. G., Tran, N., Chan, C. Y., Mohan, C. V., Rodriguez, U. P., & Koeshendrajana, S. (2016). Menjelajahi masa depan perikanan budidaya Indonesia (Exploring Indonesian aquaculture futures).
- Rimmer, M. A., Sugama, K., Rakhmawati, D., Rofiq, R., & Habgood, R. H. (2013). A review and SWOT analysis of aquaculture development in Indonesia. *Reviews in Aquaculture*, *5*(4), 255-279.
- Ruan, J., Wang, Y., Chan, F. T. S., Hu, X., Zhao, M., Zhu, F., & Lin, F. (2019). A Life Cycle Framework of Green IoT-Based Agriculture and Its Finance, Operation, and Management Issues. *IEEE Communications Magazine*, *57*(3), 90-96.
- Subasinghe, R. P., Curry, D., McGladdery, S. E., & Bartley, D. (2003). Recent technological innovations in aquaculture. *FAO Fisheries Circular*, *886*, 85.
- Trana, N., Rodriguezb, U., Chana, C. Y., et.all. (2017). Indonesian aquaculture futures: An analysis of fish supply and demand in Indonesia to 2030 and role of aquaculture using the AsiaFish model. *Marine Policy 79 (2017) 25–32*
- World Bank. (2014). Reducing disease risk in aquaculture. *World Bank Report Number 88257-GL*. Agriculture and Environmental Services Discussion Paper 09.
- World Economic Forum. (2018). Future of Digital Economy and Society System Initiative: Internet of Things Guidelines for Sustainability. Retrieved from http://www3.weforum.org/docs/IoTGuidelinesforSustainability.pdf