Study Tour of South Korean Abalone Aquaculture

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Project No. 2012/748

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Australian Government
Fisheries Research and Development Corporation

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CRC AUSTRALIA

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NON-TECHNICAL SUMMARY
PROJECT NO: 2012/748

TITLE: Study Tour of South Korean Aquaculture Industry

PRINCIPAL INVESTIGATOR: Australian Abalone Growers Association (AAGA)

ADDRESS: PO Box 1190, Booragoon WA 6954

(PROJECT) OBJECTIVES OF RESEARCH TRAVEL GRANT/ INDUSTRY BURSARY

The objective of the study tour program was to further build relationships and identify technology that would assist the both the industries improve their productivity, and opportunity for research collaboration between Australia and South Korea. The three key areas were:

- Hatchery technology and selective breeding programs
- Offshore aquaculture technology; and
- Harvest and grading mechanisation.

NON TECHNICAL SUMMARY:
The objective of the study tour program was to further build relationships and identify technology that would assist the both the industries improve their productivity, and opportunity for research collaboration between the Australia and South Korea.

OUTCOMES ACHIEVED TO DATE

AAGA and the Korean Federation of Abalone Industry Association developed and executed a study tour itinerary that involved the following site visits and forums. The delegation included five (5) Australian Abalone Growers Association Members and Drs Nick Elliot (CSIRO) and Graham Mair (Seafood Cooperative Research Centre).

Date	Site Visits	Organisations
24 October 2012	Noryangjin Fisheries Wholesale Market	Korea-Australia Special Seminar on the Abalone Industries held at the Korea Maritime Institute (KMI) &
October 25th and 26th **Hosted by the Korea Federation of Abalone Industry Association**	Visited Abalone nursery, Jindo Abalone sea-based growout farm sites within Special Abalone Zone of Wando, discussions with	Ocean and Fishery Science Institute (JeollaNamdo) in Wando. Industry members including cage and nursery, and grading, equipment manufacturers and suppliers.
October 27th **Hosted by the Win Win Seafood Co.**	On-shore flounder farms and potential on-shore abalone farm sites, Jeju Island.	

The study tour built on established relationships and enabled all parties to share knowledge and experience in abalone aquaculture. A summary of the key technology understandings, with images and video is provided in Appendix 1 of this report. An outline of the activities is provided below.

(PROJECT) OUTPUTS DEVELOPED AS RESULT OF TRAVEL GRANT/ INDUSTRY BURSARY:

Description
1. Meetings with key industry leaders and government officials regarding future collaboration between the two countries.
2. Reciprocal presentations on the status and future of the abalone aquaculture industries in Korea & Australia.
3. Site visit to seafood market and abalone distribution businesses.
4. Site visits to abalone nursery and Growout facility.
5. Site visit to abalone farming equipment suppliers.
6. Site visit to on-shore flounder farms.
7. Developed a list of key contact for the Korean aquaculture industry and research.

BACKGROUND AND NEED

Korea has long history in abalone aquaculture and is currently the second largest producer of abalone, after China. Given this history, the Australian abalone industry considers it would benefit from building business and institutional relations with the Korean Abalone industry and government. The objective of the study is to advance the Australian abalone industry by

- Fostering relations with the Korean Aquaculture Research Institutions and Industry;
- Undertaking technology transfer in four specific areas:
    - Hatchery Technology
    - Sea-based aquaculture;
    - Mechanisation; and
    - The structure and function of their selective breeding programs.

RESULTS

AAGA and the Korean Federation of Abalone Industry Association developed tour itinerary involved the following site visits and forums

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October 27th	On-shore flounder farms and potential on-shore abalone farm sites, Jeju Island.	

A summary of the key technology understandings, with images and video is provided in Appendix 1 of this report. An outline of the activities is provided below.

Figure 1: Map of South Korea indicating the locations of the site visits and forums held as part of the study tour.

October 24th.

1) Visit to Noryangjin Fisheries Wholesale Market – observe (1) abalone auction and (2) specialised, wholesale distribution business of live abalone.

2) *Korea-Australia Special Seminar on the Abalone Industries held at the Korea Maritime Institute (KMI) offices in Seoul*. The Australian delegation was welcomed and hosted by Dr Huk-So Kim, President KMI and Dr Jung-Uie Lee, Director General, NFRDI.

Presentations were made on:

- Korean abalone aquaculture Industry (Dr Jong-oh Nam, KMI)
- Australian abalone aquaculture industry (Dan Machin, AAGA)
- Abalone breeding in Korea (Choul-ji Park, NFRDI)
- Australian abalone selective breeding program (Nick Elliott, CSIRO)
- Korean aquaculture industry and opportunities for collaboration (Joung-gon Ryu, KMI)

Selected points on Korean aquaculture:

- Is seen as a business for social and economic benefit, strong emphasis on social
- Began in 1960s with seaweed, moved then into shellfish, and then to finfish
- Future seen by some in Government as high technology integrated aquaculture
- Aquaculture volume (ca. 1.5 m t in 2010) overtook fisheries in 2006
- Value (ca. $1.8b in 2010)
- Seaweed 900K t, $380m; Shellfish 356K t, $509m; fish 80K t; $868m; crustacean 3K t; $36m
- Predominantly sea based culture with 9,815 licences and covering 141,015 ha (5,699 licenses over 50,000 ha shellfish; 2,709 and 82,000 ha seaweed; 1,437 and 9,000 ha fish)
- On-shore marine culture 1,329 licenses on 1,416 ha; mainly fish licenses (789) but large area for shrimp production (861 ha)
- Issues include: shortage of marine sites; natural disasters, marine pollution; rising electricity costs; excess demand; distances to consumer markets.

Korean abalone aquaculture:

- Rapid expansion from 2001 with introduction of sea-cage culture, annual rate of increase of 20% in 2006 to 2010.
- 2011 value ca.$238b; ca 7,000 tons (80% from the Wando Region)
- Production area is ca 6,800 ha, with 1,200 licenses and 5,000 farmers
- 652,000 sea-cages in 2012;
- ca 50 kg produced per cage at ca.$1,750 value
- 7 to 12 months nursery phase and 23 to 36 months in sea (high mortality in sea)
- Small size used in Korean soup, medium and large for sushi, gift sets and live export

- Vision is to remain as 2nd in world production with 35,000 t in 2020, and be 1st in abalone export with 14,000 t in 2020.

Korea suggestions for Korea-Australia cooperation in aquaculture include:

- Development of technologies such as breeding, nursery, feeds, production systems
- Development of environmentally friendly technologies
- Exchange of human resources, experts and training cooperation
- MOU with specific institutes; KMI-CSIRO e,g, social sciences; NFRDI-KMI-CSIRO
- Hosting joint seminars and workshops, including World Aquaculture 2015 (WAS) and the International Abalone Symposium (IAS) 2015.

October 25th and 26th

Hosted by the Korean Federation of Abalone Industry Association, visited nursery and sea-cage farm sites in Wando area, discussions with industry members including cage and nursery, and grading, equipment manufacturers. This included presentations at Ocean and Fishery Science Institute (JeollaNamdo) in Wando.

October 27th

Visit to on-shore flounder farms and potential on-shore abalone farm sites on Jeju Island. Over 200 flounder farms on island producing bulk of 43K t annual production, sold mainly live including export to Japan.

PROJECT OUTCOMES (THAT INITIATED CHANGE IN INDUSTRY)

The key benefits will be as follows:

- New international, business-to-business relationships between Australia and Korea aquaculture industries.
- Technology transfer of
    - Hatchery technology;
    - Nursery technology; and
    - mechanisation - abalone grading equipment;

SUMMARY OF CHANGE IN INDUSTRY

Description	Next Actions 6-12 months	WHAT FUTURE AND ONGOING CHANGES ARE EXPECTED? Medium term (12-36 months)
1. Building institution and industry relations	AAGA to make six monthly email contact with our hosts	AAGA to make six monthly email contact with our hosts.
2. Hatchery settlement plates to be trialled on Australia Farms.	Samples to be trialled on farms, using samples already imported into Australia, already.	1,000,000 plates if 100% of the industry uptake by AAGA members..
3. Nursery Hides to be trialled on Australia Farms	Samples to be trialled on farms	25,000 if 100% of the industry uptake by AAGA members. The expected productivity gains will result from improved growth and survival rates
4. Graders for abalone for juveniles & adults	Assess the transport cost and technical feasibility of the abalone graders.	If technically and economically feasibility 2 graders will be purchased for trials. The expected productivity gains will result from improved growth and survival rates and reduction in anaesthetic use and labour
5. Reciprocal Investment in Korean/Australian aquaculture in land based abalone aquaculture	1-2 page of introduction to AAGA members	$10 million joint venture on Jeju island. Investment in Australian abalone aquaculture. 10,000m² vacant land adjacent flounder farm. Consistent year round temp. If investment proceeds, staff exchange.
6. Sales and marketing of Australian (Wild) abalone into Korea, as a part of long-term marketing strategy to position Australian abalone (wild & Farmed) into the Korean market.	Through the CRC present this opportunity to both AAGA and Australia Council of Abalone.	Phase 1: $30,000 sales (520 kg) trial to high end restaurants in Korea.
7. Human Mobility – professional exchange trips in the following areas 8. Biosecurity 9. Genetics (commercialization; independent review/benchmarking) 10. Environmental Impacts 11. Joint Study Group meetings	Through Seafood CRC, CSIRO and Australian Korea Foundation facilitate professional exchange between the two countries. Feb 2013 host delegation of three scientists from Ocean & Fishery Science Institute regarding abalone health and biosecurity.	Through Seafood CRC, CSIRO and Australian Korea Foundation facilitate professional exchange between the two countries.
12. Institution relations between Australian and Korean Research Institutions	Refer to FRDC/CSIRO and Australian Korea Foundation, Dept. of Foreign affairs and trade.	March 2013 make application to Australian Korea Foundation under the themes of (1) Partnerships and Collaborations in the fields of Technology, Environment and Agriculture Science; and (2) Youth and Capacity Building for the Future.
13. Government to Government study tour on investment and support for aquaculture production.	Refer to National Aquaculture Council.	
14. Support for WAS & IAS 2015	Refer to National Aquaculture Council. Immediate actions should be for WA 2014 to arrange suitable Korean contact to ensure strong participation in Adelaide by industry and Government. CRC to the abalone cooking competition to be held at the IAS 2015.	Medium term outcomes – strong industry, research and government participation at 2015 conference.
15. Technology transfer regarding large scale pump	Presentation of information to Marine Fish Farmers	March 2013 make application to Australian Korea Foundation

ashore facilities.	Association.	under the themes of (1) Partnerships and Collaborations in the fields of Technology, Environment and Agriculture Science; and (2) Youth and Capacity Building for the Future
16. Introduction of Uvella to the Korean abalone hatchery industry to assist them improve their larval settlement survival rates.	AAGA to the Korea Federation of Abalone Industry Association	

The items above, shaded in blue will be monitored by AAGA and reported to the CRC. Those items that are un-shaded will be the responsibility of the agencies referred too, if they choose to take up the opportunity.

WHAT BARRIERS ARE THERE FOR CHANGES TO OCCUR?

Description	Barriers
1. Building institution and industry relations	Nil
2. Hatchery settlement plates to be trialled on Australia Farms.	Ensuring the order is significant enough to minimise the transportation cost. Different capital investment horizons, return on capital thresholds and assessments of productivity gains from the technology transfer.
3. Nursery Hides to be trialled on Australia Farms	
4. Graders for abalone for juveniles & adults	
5. Reciprocal Investment in Korean/Australian aquaculture in land based abalone aquaculture	Nil
6. Sales and marketing of Australian (Wild) abalone into Korea, as a part of long-term marketing strategy to position Australian abalone (wild & Farmed) into the Korean market.	Import Tariffs. The solution is the completion of the Korea and Australian Free Trade Agreement negotiations.
7. Human Mobility – professional exchange trips in the following areas a. Biosecurity b. Genetics (commercialization; independent review/benchmarking) c. Environmental Impacts d. Joint Study Group meetings	Nil
8. Institution relations between Australian and Korean Research Institutions	Nil
9. Government to Government study tour on investment and support for aquaculture production.	Nil
10. Support for WAS & IAS 2015	Nil
11. Technology transfer regarding large scale pump ashore facilities.	Nil
12. Introduction of Uvella to the Korean industry.	Nil

IF NOT ALREADY HAPPENING, WHEN WILL THE CHANGES OCCUR?

See summary table above.

WHAT IS THE LIKELIHOOD THAT THESE CHANGES WILL OCCUR?

Description	Likelihood Next Actions (6-12 months)	Likelihood Medium term (12-36 months)
1. Building institution and industry relations	100%	100%
2. Hatchery settlement plates to be trialled on Australia Farms.	100%	50%
3. Nursery Hides to be trialled on Australia Farms		50%
4. Graders for abalone for juveniles & adults	50%	50%
5. Reciprocal Investment in Korean/Australian aquaculture in land based abalone aquaculture	50%	50%
6. Sales and marketing of Australian (Wild) abalone into Korea, as a part of long-term marketing strategy to position Australian abalone (wild & Farmed) into the Korean market.	0%	75% Conditional on the Korea – Australia Free Trade agreement.
7. Human Mobility – professional exchange trips in the following areas • Biosecurity • Genetics (commercialization; independent review/benchmarking) • Environmental Impacts • Joint Study Group meetings	100%	50%
8. Institution relations between Australian and Korean Research Institutions	100%	100%
9. Government to Government study tour on investment and support for aquaculture production.	0%	25%
10. Support for WAS & IAS 2015	100%	100%
11. Technology transfer regarding large scale pump ashore facilities.	100%	50%
12. Introduction of Uvella to the Korean industry.	100%	50%

WHAT BARRIERS ARE THERE TO ADOPTION OF THESE CHANGES AND WHAT ACTION COULD BE TAKEN TO OVERCOME THESE?

	Action to overcome barriers to adoption
1. Building institution and industry relations	Nil
2. Hatchery settlement plates to be trialled on Australia Farms.	Independently examine the technical and financial feasibility of this technology, using an honours student.
3. Nursery Hides to be trialled on Australia Farms	
4. Graders for abalone for juveniles & adults	
5. Reciprocal Investment in Korean/Australian aquaculture in land based abalone aquaculture	Nil
6. Sales and marketing of Australian (Wild) abalone into Korea, as a part of long-term marketing strategy to position Australian abalone (wild & Farmed) into the Korean market.	Through Seafood Services Australia with Department of Foreign affairs and Trade, and our potential Korean trading partners to progress the Free Trade agreement.
7. Human Mobility – professional exchange trips in the following areas • Biosecurity • Genetics (commercialization; independent review/benchmarking) • Environmental Impacts • Joint Study Group meetings	This would be aiding through travel bursaries and other related grants.
8. Institution relations between Australian and Korean Research Institutions.	Nil
9. Government to Government study tour on investment and support for aquaculture production.	Nil
10. Support for WAS & IAS 2015	Nil
11. Technology transfer regarding large scale pump ashore facilities.	Nil
12. Introduction of Uvella to the Korean industry.	This would be aiding through travel bursaries and other related grants.

COMMUNICATION OF PROJECT/EXTENSION ACTIVITIES

WHAT IS THE OUTPUT THAT NEEDS TO BE COMMUNICATED?

- Key "take home" findings from the trip.
- Video and images that support the above findings.
- Key business contacts to enable any business or institution to follow up any leads or ideas.

WHO IS/ARE THE TARGET AUDIENCE/S?

Industry

- Australian Abalone Growers Association and its members
- Commercial Fishing Industry
- National Aquaculture Council and its members

Institutions

- Australian Korean Foundation
- Seafood CRC and its members
- CSIRO
- FRDC

WHAT ARE THE KEY MESSAGES?

- Key take home findings from the trip
- Opportunities for future collaboration
- The value of study tours in fostering trade and innovation.

WHAT IS THE CALL TO ACTION?

- Note the key findings.
- Collaborate in the evaluation of the nursery technology;
- Build relations with Korean Companies, for example, Win Win Corporation regarding marketing and reciprocal business investment opportunities;
- Increased industry to take up Seafood CRC and FRDC people development and travel bursary opportunities;
- Industry and institutional support for Korean visit to Australia in 2013/2014
- Industry and institutional support for Korean aquaculture conferences in 2015.

COMMUNICATION CHANNELS

Channel	***Who by***	***When***
AAGA	*Nick Savva & Dan Machin*	*February 2012*
Staff and Board of Great Southern Waters	*Luke McPherson*	*Completed*
Staff and Board of SOM	*Hamish Ebery*	*February 2012*
Staff and Board of Southseas Abalone Limited	*Craig Marshall*	*Completed*
Tasmanian Research Advisory Group for Shellfish	*Nick Savva & Nick Elliot*	*Completed*
Board of National Aquaculture Council	*Dan Machin*	*By Feb 2013*
Board of Aquaculture Council of Western Australia	*Dan Machin*	*By Feb 2013*
Korean Australian Foundation	*Dan Machin*	*Final Report to be provided to the Foundation.*

A communiqué of the key outcomes and outputs and report has been provided to AAGA members; CSIRO, CRC and delegates businesses before the 5 November 2012.

LESSONS LEARNED AND RECOMMENDED IMPROVEMENTS

WHAT IS YOUR FEEDBACK?

Importance mutual respect and hospitality
The Australian delegation was humbled by the significant effort and thoughtfulness put into the planning of our trip by our Korean hosts. Overall, the Australian delegation (1) felt only modestly prepared for the experience; and (2) the challenges for the Australia when it should need to reciprocate the Korean's hospitality. It is on these matters the authors make the following suggestions:

- The success of such trips is heavily dependent on the quality and willingness to the host and in evaluating such proposals the CRC should determine if suitable hosts have been identify and highlight the important of this issue in project planning.;
- All future Australia delegations need to develop solid cross-cultural understanding prior to its departure ie. It is well briefed on the host nations culture, business culture and traditions eg. Importance of name cards; relationship building; gift giving and toasting; and
- The FRDC, Seafood CRC and Department of Foreign Affairs and trade need to give to some thought to how future Australia delegations could be supported, so that the Australian industry does not cause offense.

FURTHER ACTION REQUIRED IN REGARDS TO COMMERCIALISATION?

AAGA's member's need to:

- Independently evaluate of the equipment trials data with respect to improved survival, growth and reduction in anaesthetics use;
- Monitor and evaluate technology.

ACKNOWLEDGEMENTS

Australian Abalone Growers Association Inc wishes to acknowledge the support that this project has received, without which AAGA would have not have succeeded in either starting or completing this project. In particular, the AAGA would like to acknowledge the following people:

- Mr Y T Choi, Chairman, The Korean Federation of Abalone Industry Association
- Dr H-S Kim, President, Korea Maritime Institute
- Dr J-U Lee, Director General, Northern Fisheries Research & Development Institute
- Mr H-G Woo, CEO, Korea Abalone Fisheries Union Co.
- Dr Yeon-soo Choi, President: Ocean & Fisheries Science Institute (belong to Jeolla Namdo Province)
- Dr Nick Elliot, Stream Leader, CSIRO
- Dr Graham Mair, Program Manager , Production Innovation Australian Seafood CRC

Australian Abalone Growers Association would like to extend a special thank you to Mr YB Park, Executive Vice President, Win Win Seafood Corp & Chairman, Abalone Studies Committee, The Korean Federation of Abalone Industry Association. Mr Park provided our delegation with significant and valuable insights into Korean aquaculture methods; potential areas for future collaboration and the established valuable personal relationships between our industries and researchers. He also ensured the trip provided with a wonderful glimpse at the beauty of the Korean culture. In the future, this tour will be consider a seminal moment for Korean - Australian seafood business relations.

Special Note: Australian Abalone Growers Association would like to extend an extra special thank you to the Korean Federation of Abalone Industry Association and its members for hosting our tour only a month after the typhoon “Sanba” that significantly damaged your businesses. We wish you a quick, speedy and full recovery.

APPENDIX 1: TECHNICAL NOTES, IMAGES AND VIDEO

Korean Marketing & Distribution Channels

Item	Key Metrics	Notes
Marketing Channels	Majority of the abalone is distributed and marketed through three specialized live abalone businesses in Seoul. A small amount is auctioned at the Seoul Fish Market each day. Small abs 35~40 per kg, WON25000/kg. Large 6~7 per kg WON 66,000/kg. Boxing for distribution to restaurants. Some water was included. Water chilled to 11-11.5 oC.	**See images** Auction Crates & Styrofoam boxes. **See video** Auction Live Abalone Distribution business Association spend $1.5 million on marketing and promotion, this includes working with chefs to provide PoS information, plus abalone live holding crates. Provided by the association levy and is an industry standard.

Video - Noryangjin Fisheries Wholesale Market

Video - Live Abalone Distribution business

Image – Abalone Buyers Inspecting product prior to the auction, Noryangjin Fisheries Wholesale Market 	**Image – Styrofoam boxes used to transport live abalone to restaurants in Seoul.** 

Image: - Live Abalone Transport Box	Image – Live Abalone Transport Box stacked near seafood restaurant, Wando.
	

Hatchery

Item	Key Metrics	Notes
Hatchery	The larvae are produced at a separate nearby site, which is also a nursery. Larvae ready to set in 3 ~ 4 days at 15 to 18oC. Set rate is 8 to 10%. (Later claimed to be higher. Didn't appear to use or know about Ulvella.) 20k to 40k larvae added per tank. (40,000 x10% = 4000 seed. 7 x 56 x41 panels =16,000) Discrepancy, however it may be that larvae are set at a higher rate per panels then split out with bare panels.)	**No images or videos –** no hatcheries were operation at the time of our visit. Korea has a total of 300 Abalone Hatcheries 500 Abalone Nurseries

Nursery

Item	Key Metrics	Notes
Staffing	3 (owner and 2); plus casuals at harvest time	Owner feeds the fish.
Total Production	5,000, 000 juveniles	
Tunnel Construction	Very robust construction. Shade cloth (60-80%), black shade cloth over all tanks, laying flat supported by fine ropes. Poly cover over the hoops of the greenhouse is used when conditions are cool. Shade cloth can be rolled off, as required.	800 million spat per annum, 80% of which are used in Wando. If all these survived to be 50g production would be 40 000 T. Actual production is 8000T? Environmental conditions – temperature and O2.
Size at harvest	20-30 mm after 6 months	Spawned 15/4/12 now 30mm. Move to sea next month, November 14 day to transport to sea.
Harvest method	Take out black shelters and abalone allows to drop off. No anaesthetic used. Assumption: Abalone are graded prior to distributed to grow-out farms? YB.	Suggestion of some losses on transfer? Onion bags, then trucked to boat. The assumption is due to small distance that the abalone is transported out of water.
Sale price	Spat sell for $0.30 to $1.40 each depending on size.	
Survival	95%	
Duration	April – November (6 months)	
Transformer	22.9 kVa	
Pump station	2 x 75hp (75KVA)	2 intakes 300m long x 500mm dia. In 6 to 15m depth. 2 x 75 hp pumps in a large concrete sump bunker. Neat and tidy. Large concrete rectangular tank sand filters, backwashed each 3 hours. Incoming water was very cloudy. Flow to tanks was very clear. A large amount, (maybe half) the flow was running to waste. The sand filters double as header tanks, all gravity fed from there. 300mm deliver pipes, x 4
Suction head	Range 1-2m	
Head	10-12m	
No Tanks	300	
Sand filter	100um	Backwashed every 3 hours.
Flow rate per tank	0.5L/s ? Flow rate 500T per hour (138lps)between 300 tanks. 1.67T/hr per tank = 28lpm.).	No spray bar used. Claimed not to be a problem. Claim not supported by Mr. Young Park (institute)
No plates	700,000	(700 000 panels x 7 = 490 000 seed. 300 tanks x 56 panels x 41 sheets = 688 800 panels) May not turn their sheets.
No. shelters	17,500	Added after 2 months post settlement.
Abalone behaviour	All on the shelters Very active animal - See video of the abalone moving off the plate when exposed to light.	
Settlement	4-8%	
Tank set up	See image 56 sets of panels per tank, rest on 26 black shelters. 2 panel sets per shelter. (Larger shelters hold 4 panels).	There were very few abs on the floor, all underneath the shelters. The panels were all very clean, suitable for next set.

	Air lines (x4) run the length of each tank and support the shelters off the floor.	
Tank dimensions	10m long, 1.4m wide, 0.6m deep. Fall of 100mm over 10m length.	Despite the fall there was even gentle air distribution along the length of the tank. Tanks of concrete, wall thickness 150mm. Walls are poured first and the floors afterwards. In sets of 4 or 5. The tanks were 6 years old and appeared to be in good condition. 15 year old tanks at another site (not seen) reported to still be good.
Aeration Rate	See video	
Stocking density	7 per plate	
Start artificial feed (no. days)		
Feed size	3-4mm	formulated feed is fed after 2 months. Pellet size quite large.
Feed Rate	No information provided or requested.	FCR 1:1; estimate 80,000kg feed market.
Feed Cost	$100/20kg = $5000/t	
Nutrients added	Nil.	Wando water is tidal and the waters are nutrient rich and therefore productive
Cleaning Procedure	Every three days – 100% using a 150mm stand pipe % & hosed out.	
Shade cloth	30-40%	Need to understand difference in UV climate.
Grow-out shelters	No information provided or requested.	Needs adaptation for pellet feeding, eg feeding
Total Number of feed companies	100	
Total Number of hatcheries	300	
Total Number of nurseries	500	

Video – Abalone Nursery, Jindo, South Korea

Image – Business Signage for the abalone Nursery, Jindo	Image – Abalone Nursery tunnels, Jindo
	

Image – Large Sand Filter, Abalone Nursery, Jindo	Image – Large Sand Filter, Abalone Nursery, Jindo
	

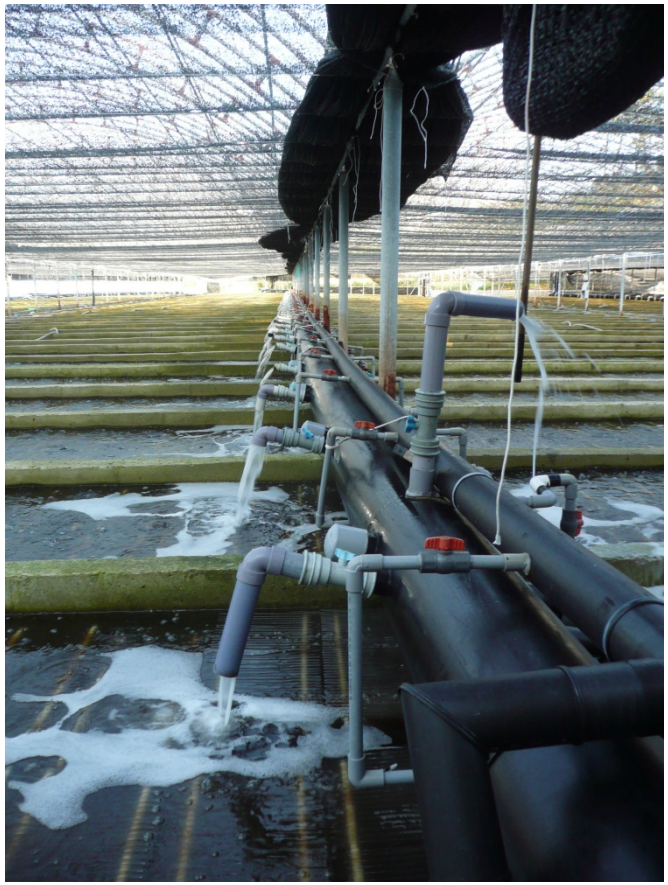
Image – Row of Tanks, Abalone Nursery, Jindo	Image –Tank set up, Abalone Nursery, Jindo
	

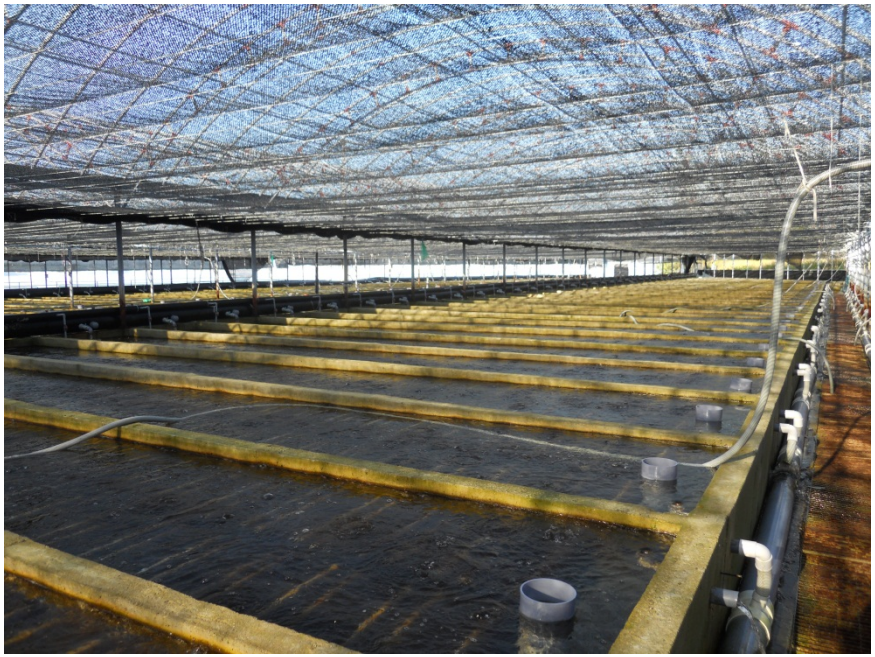
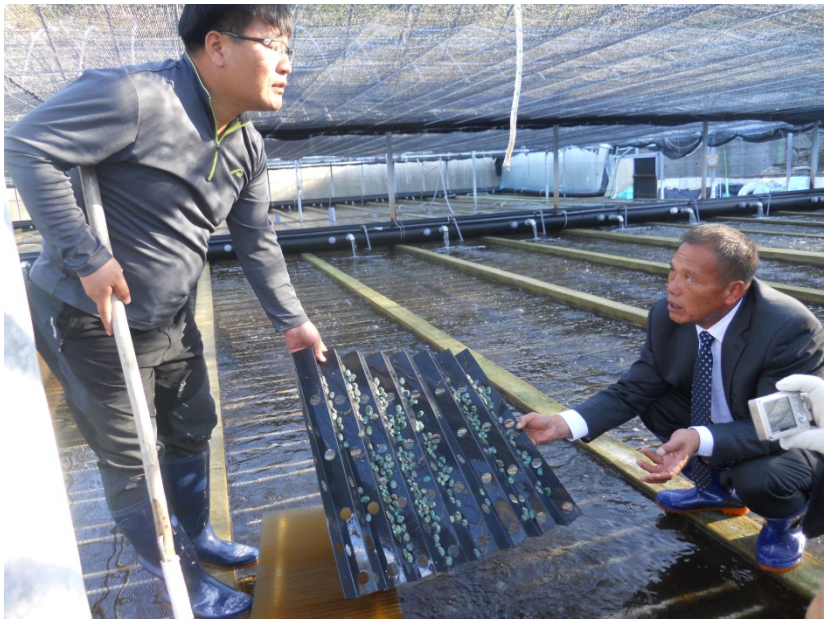
Image – Panorama of Abalone Nursery, Jindo	Image – juvenile shelters, Abalone Nursery, Jindo
	

Image – Close up juvenile shelters, Abalone Nursery, Jindo

Image – Tank set up & feed distribution, Abalone Nursery, Jindo

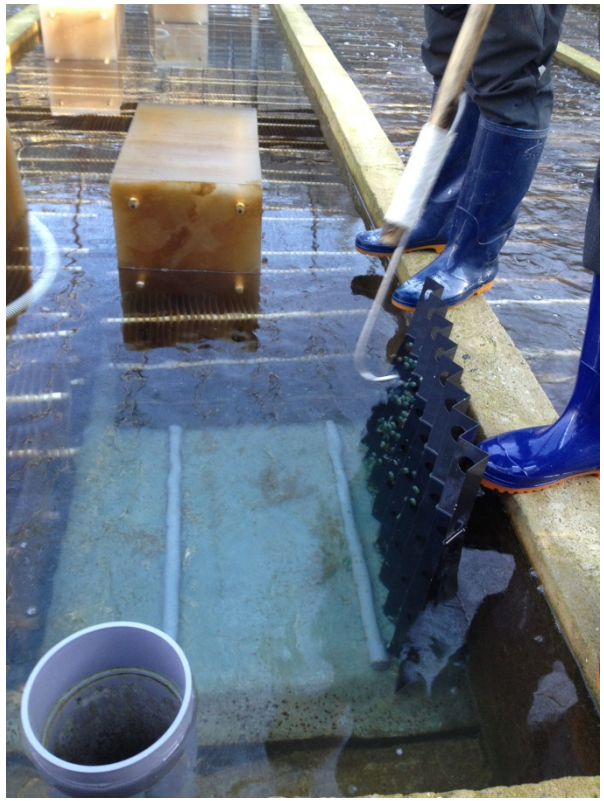


Image – pump shed and water discharge , Abalone Nursery, Jindo	Image – water intake and discharge , Abalone Nursery, Jindo
	

Abalone Growout

Item	Key Metrics	Notes
Overview	2 year cycle	80% of production is in >Wando area. 60% of that in Wando. Is. group of 3. Nahwa-eup, Bogil, Soan-myea.
Staffing	4-8 people per household	5500 households
Wages	$84,000	
Total Production	Per household 1200kg	300 cages per household 5-10t per annum.
Size at harvest	90mm	
Seaweed	100m of rope culture per cage. 1 cage fed 100m worth of seaweed per cage per year. Boat carries 20T of seaweed.	30km rope for each household. 1;:1 area. Species- cultivated.
Survival	M. rate is not well understood by delegates	Driver farmer interested in 50-60kg productivity.
Duration	2 years growout, i.e. 2 year classes on farm.	30mm when stocked from nursery.
Production System	Floating cages with hided Each raft 100 cages. = 5T.	Mesh across centre of cage reduces wave action on exposed sites. Owner who hosted us has 300 cages, (actually 330) $400,000 production. 5-10T per annum. 200 x 50kg = 1000kg. All equipment required for growout: Set plates and shelters, cages structures, poly foam floats, pipes and joiners by Mr. Oh Young Tark.
Cage Dimensions	2.2m x 2.2 bottom at base. 2.4 x 2.4m at surface.	
Grading Frequency	No information provided or requested.	
Genetics	Well understood, but not commercialized. Check with Nick Elliot.	Government hatcheries provide improved lines to industry.
No. shelters	See image	
Stocking density	50-60kg/cage	
Feeding Procedure	11-20oC 50kg algae every 10 days 20oC 50kg algae every 7 days >25oC no feeding.	Smaller mesh with smaller abalone.
Mechanisation	Cup grader: 16 sorting sizes. +/- 1.5g	Plastic cups are more accurate, but not UV resistant. SS more expensice. $9000AUD SS, $8000AUD plastic AC/DC 220V Korean.

Video – Sea-Based Abalone Grow-out, Wando, South Korea

Video – Abalone Weighing, Graders and Counting Machines

Image – Wando Abalone Special Zone	Image – Live Fish transport Truck, Wando
	

Image – Panorama of one of the key growing areas within the Wando Abalone Special Zone

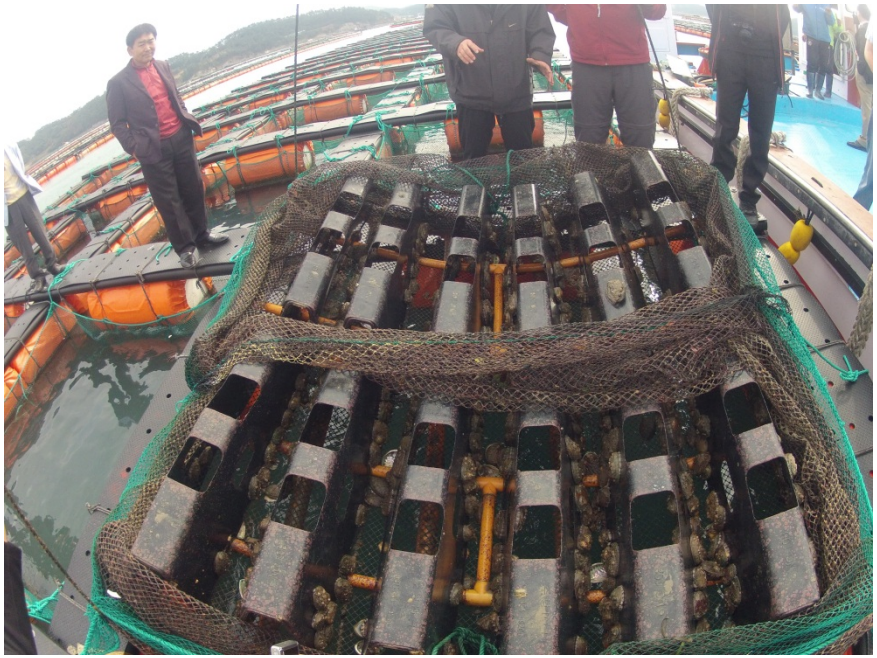
Image – abalone farming pontoons, Wando Abalone Special Zone	Image – Abalone pen, Wando Abalone Special Zone
	

Image – Group discussion on abalone farming system, Wando Abalone Special Zone	Image – indicative abalone distribution within hide structure, Wando Abalone Special Zone
	

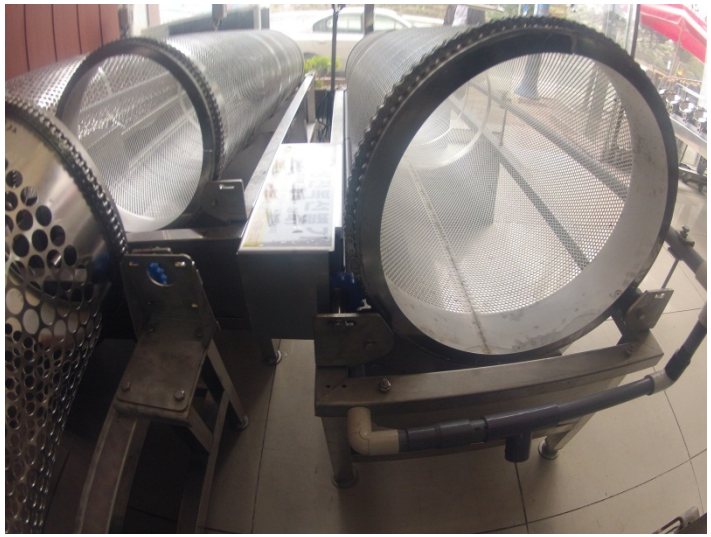
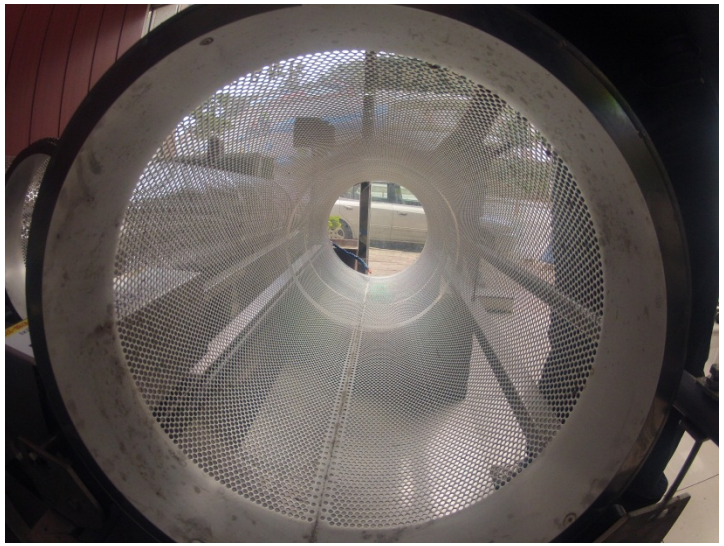
Image – Abalone Graders	Image – Abalone Graders
	

Image – Abalone Graders	Image – Abalone Graders
	

Image – Abalone Graders Screens	Image – Abalone counting machine
	

Image – Abalone plates and nursery shelters, Wando	Image – Abalone grow-out shelters, Wando
	

Flounder

Item	Key Metrics	Notes/Images
GROWOUT	45,000t ?60% from Jeju (check the KMI) Production is clustered Subsidy for power costs for aquaculture.	Cost of land is $200/m2.
Genetics	Well understood	Government hatcheries provide improved lines to industry.
Intake	Ambient intake 800m offshore 500mm diameter.	Limited issues with seaweed fouling
Staffing	10-12 per farms	
Total Production	300t over the two farm sites	
Stocking	3cm juveniles	
Size at harvest	• 1 -1.5 kg local market • 2kg for export	
Sale price	US$10/kg	
Survival	?	
Duration	20 months to harvest	
Transformer	Each farm 220 KVA	
Pump station	6 x 125 KVA (ambient 18oC) plus 6 ground well (12oC) See image of the PLC board & pumping station.	The two water sources are “shandied” together to provide consistent water temperature year round. Assumption – shandied in white pipes see NS photo
Suction head	1 m	
Head	8-10m	
No Tanks	102 at each farm	Tanks design is standardized to the square tank.
Sand filter	100um	
Flow rate per tank	As required	
Tank set up	Oxygenation using leaky pipe.	Abalone and flounder cannot be transported or cultivated together. Abalone suffer.
Tank dimensions	Various Industry standard is now 12m x 12 m depth 1600mm	Construction cost = $11,000 concrete only. Note: Structures stood up well to the typhoon and recovery was well under after month.
Stocking density	?	
Feed size	See images – (1) Eureka feeds & dye for MP. Moist Pellet & Dry pellet	

Feed Rate	Ab libitum, by hand 2-3 per day, no automatic feeding.	
Cleaning Procedure	Tanks	
Tank Flushing	See video of water flow and levels.	
Tunnels Shade cloth	2 x	
Challenges	Staff productivity and resistance to change	
Total Number of production companies	500	
Total Number of hatcheries	300	
Health Issues	Gill parasite issues.	
Oxygenation	Summer only, by bottle.	

Video – Flounder Farms, Jeju

Image – Sand filter and header tank, pump ashore, Flounder farm (win Win Seafood Corp), Jeju Island	**Image – Sand filter and header tank, pump ashore, Flounder farm (win Win Seafood Corp), Jeju Island**
	

Image – Sand filter and header tank, pump ashore, Flounder farm (win Win Seafood Corp), Jeju Island	**Image – Pumping station, pump ashore, Flounder farm (win Win Seafood Corp), Jeju Island**
	

Image – Pump, Flounder farm (win Win Seafood Corp), Jeju Island 	**Image – Pumping station pump ashore, Flounder farm (win Win Seafood Corp), Jeju Island** 

Image – Panorama of tanks, Flounder farm (win Win Seafood Corp), Jeju Island	**Image – Tunnels pump ashore, Flounder farm (win Win Seafood Corp), Jeju Island**
	

Image – Tanks, Flounder farm (win Win Seafood Corp), Jeju Island

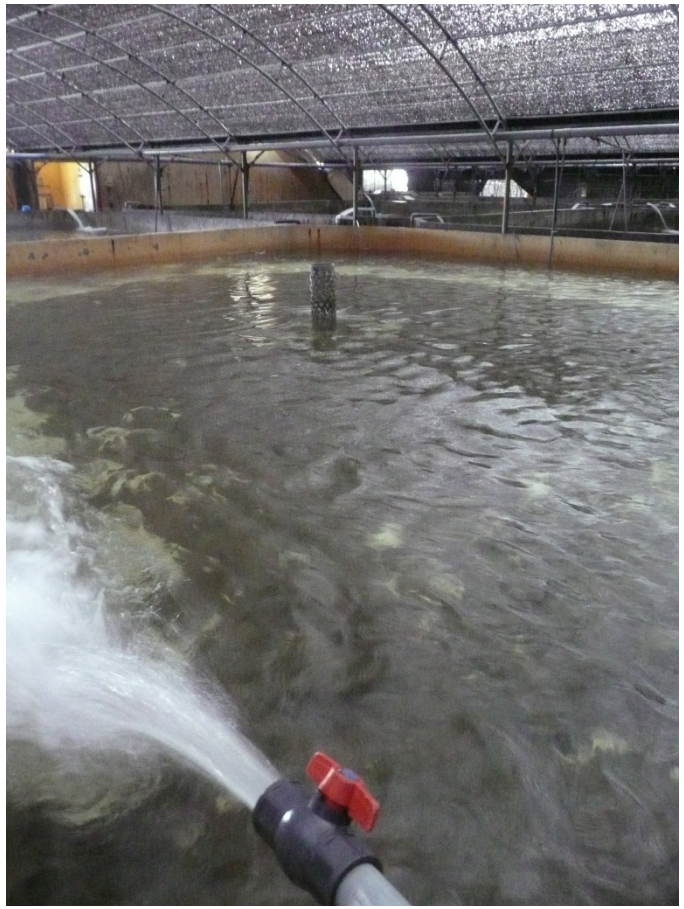


Image – Staff harvesting flounder, pump ashore, Flounder farm (win Win Seafood Corp), Jeju Island

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