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Economic returns from seaweed *Euchema cottonii* cultivation in Amal beach old village Tarakan, North Kalimantan province of Indonesia

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Abstract

This paper calculated Volume- Cost Profit or Profit- Loss a technique to gauge economic return and total factors productivity of a pioneer farm in Amal Beach Old Village of Tarakan in North Kalimantan province of Indonesia. Profit –Loss for round one to four in 2012 were calculated based on primary data collated from interviews with pioneer farmer and his preferred buyer cum owner of collection centre. From round five in 2013 to round 18 in June 2016, Profit-Loss were calculated using data compiled from; (i) telephone calls to farmer and buyer at the end of each round; (ii) transactions records and buyer's book keeping. Results from Volume- Cost Profit from round one to round 18 are as follows; (I) Total factor productivity in four rounds of propagating initial seedlings worth IDR3, 000,00) was IDR3, 610,000 (in 2016 rate was USD1 = IDR 13,315.6; (II) Dried seaweed produced in round four was equivalent to value of initial seedling plus 20% added value; (III) Break- Even point was in round six, after that round the farm was making profits until round 18; (IV) Pay Back Period was six rounds or equivalent to nine farming months and an economic rate of return or Internal Rate of Return up until round 18 was 57.6%; (V) An accounting rate of return or Return on Investment at 57%, pioneer farmer invested IDR877, 291 but earned only IDR1, 383,166 per round; (VI) It took 13 rounds for the pioneer farm of Amal Beach Old Village to reach Revenue- Cost Ratio of 1.03; (VII) Mean production of two labourers farming 1,000kg in four rounds was 112.5kg dried or equivalent to each unit labour cost IDR 294,840 producing 56.25kg dried seaweed per round.

Keywords: Economic Returns; Profit-Loss; Value Added; *Euchema Cottonii* Cultivation; Amal Beach Old Village Tarakan

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1. Introduction

Having produced 651,485 metric tonnes (m.t) dried seaweed in 2012, Republic Indonesia maintained its position as the world number one producer (Razali et al., 2015). By 2016, Indonesia was the second largest producer of carrageenan in Asia with carrageenan exports valued at USD112.4 million after Philippines (Mordor Intelligence 2016). Red seaweed of *Euchema Cottonii/Kappaphycus alverazii* species from which Kappa carrageenan is being extracted have been cultivated all over Indonesia archipelago for many decades.

It is estimated at least 500ha around Tarakan Island including Kelurahan Amal Beach has a high potential for seaweed *E. Cottonii and spinosum* cultivation (Rabanal, 1986). Analysed water samples from seaweed cultivation areas mapped by BAPPEDA, BPS - Tarakan in 2004 (Gatot et al., 2009). Their analysis used seven parameters; (i) dissolved oxygen; (ii) salinity; (iii) temperature; (iv) clarity; (v) PH (vi) turbidity and (vii) conductivity. Results shows that most of cultivated areas failed all parameters hence totally unsuitable for farming either E. Cottonii or E. Spinosum. The only sites considered most suitable were around Sekatak Gulf, south of Tarakan. East Coast of Tarakan including Amal Beach was categorized by Gatot et al. as “conditionally suitable”.

Seaweed E, Cottonii farming in Amal Beach started in 2009 as the result of declining fish catch from Tuguk - a traditional tidal fishing gear. According Mrs. Kasasiah – the principal author of a report, Tuguk was detrimental to small pelagic fisheries (SCFishproject Annual Report, 2012:14). Particularly because small mesh size used in Tuguk captured all sizes of fish at the coastal waters resulting in overexploitation of small, juvenile and fish larvae. The ultimate attraction of seaweed farming according the author was that it provided “certain (stable?) income” particularly when price of dried seaweed was on the increase due to high demand for exports. The report however, did not specify how many farmers were there in the beginning, but nevertheless mentioned that the pioneers were using rope system, each of them were having 10 ropes (10 meters in length). Total cost for planting was estimated IDR500, 000 and farmers were harvesting every 45 days. Price of dried seaweed at that time was IDR 7,500 and revenue from each round was between IDR 1.5 to 2 million. There was no detail break down on costing, cash outflows and inflows. No information on when the farm reached a break -even or how long was the Pay Back Period. The estimation by SCFishproject shows that the farm has recorded an impressive 200% Internal Rate of Returns (IRR) on investment. In addition, that report identified two problems with seaweed cultivation in Amal Beach; (i) big waves and strong currents damages the stakes and (ii) farmers does not follow zoning rules issued by the government, resulting in seaweed farms obstructing water ways of the traditional fishermen.

The first seaweed farm in North Kalimantan Province (KALTARA) was not in Amal Beach but in Sebatik Island and Nunukan Island. They – the Bugis, Tidong and Banjar ethnics first learned seaweed farming techniques while working in seaweed farms in Tawau and Lahad Datu in Sabah, Malaysia. In 2008 many of them returned to Sebatik Island and Nunukan Island in search of new seaweed farming areas. From there, farming techniques diffused to other areas including to Amal Beach in Kecamatan Tarakan Timur (Regency of East Tarakan).

Problem number (ii) mentioned in SCFishproject Annual Report requires further explanation. According to Article 7 (para.1) of Regulation 18/2010, seaweed farming is allowed 50-400 meters away from the lowest tide mark. This rule was drafted by the office of Mrs. Kasasiah - Ministry of Maritime Affairs and Fisheries. She was then the deputy director for Networks, Data and Information of Conservation. In April 2010 her department conducted a survey before drafting the regulation and zoning of seaweed cultivation sites. At the time the sampling areas i.e. four villagers namely (i) Juwata Sea (ii) Mamburungan (iii) Lingkas Reef Edge and (iv) Hope or Sadau Island was in a mad rush of seaweed farming. Local fishermen who previously cultivating Gracilaria spp. (Agar) were abandoning their Gracilaria ponds on land instead rushing to farming E. Cottonii at the shallow coastal waters. Much to the consternation of local government in Tarakan, it was very difficult to enforce rules or regulation on zoning. The pre-existed seaweed farms were resisting top down attempts to spatially reorganize them. Resistance was also coming from the new entrants from South Sulawesi who moved into RT6 or RT11 (RT stands for Rumah Tangga meaning household) in Desa Binalatung.

Avianti (2016) sampled 11 stations located in Amal Beach, Mamburungan beaches and Sadau Island. She used remote sensing oceanographic technology to determine the most suitable location for farming *E. Cottonii* in Tarakan waters (Avianti, 2016). The author analysed environmental changes of sea surface – temperature, chlorophyll-a and surface current in Tarakan water against ENSO and Monsoon variability in order to know the dynamical oceanography during El Nino, La Nina, Neutral period, North West and South West Monsoons. She finds the Eastern coast of Tarakan has better suitability level than Western Tarakan. Based on her results, top cultivation site was Cape of Simaya with the highest suitability during El Nino, La Nina, Neutral Period, North West and South East Monsoon. Second was Amal Beach – highest suitability during El Nino, North West and South East Monsoon. Also ranked second was Juwata Sea- highest suitability during La Nina, North West and South East Monsoon. Ranked third was Cape Selayang-highest suitability during the North West and South East Monsoon. Cape Binalatung has the highest suitability only during Neutral Period.

Imam (2016) from Universitas Mulawarman, Sulawesi described in details the roles of Ministry for Maritime Affairs and Fisheries in empowering seaweed farmers in Tarakan. This graduation exercise highlighted that the budgets allocated by government was overwhelmed by ever increasing number of seaweed farmers in three ways; (i) training were not given to all farmers but only to leaders of clusters or Kelompok Budibudaya Ikan Rumput Laut (in short POKDAKAN); (ii) subsidies through Pengembangan Usaha Mina Pendesaan Budibudaya (PUMP-PB) amounted to IDR100 million per- cluster disbursed gradually in 2012 and 2013 to 547 farmers in the forms of seedlings, ropes and floats (Imam, 2016); (iii) a factory built by the Ministry operating since 2012 was buying and processing only 10% of production in Tarakan while the rest bought by collectors or middlemen known locally as *Tengkulak* (Imam, 2016). He reported on the average a family farm cultivated between 1,000 to 10,000 long lines, each about 15 *depa* (meters?). Seaweed produced in Amal Beach was sold at a price IDR 10,000 to 15,000 per kg, but the quality was not as good as in Sebatik Island Kabupaten (Regency) Nunukan (Imam, 2016).

In 2012, number of farmers in Amal Beach Old Village increased to 40 households (around 200 individual farmers, head count conducted by the authors). Children of the pioneers previously holding menial jobs in brackish water aquaculture or in coal mining have returned home to assist their parents in farming seaweed. Pioneer seaweed farmers in Amal Beach are predominantly Bugis originated from South Sulawesi - one of

Indonesia's largest producers of seaweed. They have been in Tarakan for decades but maintain a close family ties with distant relatives in South Sulawesi. So, during seaweed fever, distant relatives of the pioneers arrived in a big number to help at the farms. They – the newly arrived brought with them seedling known as "*bibit* (propagules) *Takalar*", named after their place of origin.

New farmers in Amal Beach have been farming maximum five to six rounds a year. In contrast the pioneers are farming only four rounds between May to October to avoid strong waves in November until March. Competition over cultivation space intensified from 2014 onwards, there was a symptom of market bubble, and price of dried seaweed reached IDR17, 000 per kg within two months. Seaweed farming euphoria was partly created by the Ministry of Maritime and Fisheries Affairs decision to build a seaweed processing factory in Amal Beach. The factory was built in 2012 but operating since mid-2014 with a capacity to buy around 6 to 10 m.t per day or 300 m.t dried seaweed per month and process it into semi-refined carrageenan. It was expected primarily to reduce export of dried seaweed from Tarakan. Secondly to influence and stabilize wholesale or ex-farm gate prices and thirdly, so that in the long run farmers will not be manipulated by middlemen (Radartarakan: 2013). From that year until 2013 the Ministry of Maritime was investing huge amount of taxpayers' money in providing subsidies and basic training to new farmers.

Widely publicised project to support seaweed farmers in Amal Beach was the joint efforts by PT Pertamina and Universitas Borneo to develop portable dryers (National Geographic –Indonesia 2014). The pyramid shaped prototypes has filters to reduce UV rays and ventilator fan on top so that seaweed would evenly dried and not damaged by the direct or intense sunlight. If successful, the prototypes were expected to reduce dependency on weather condition and be able to shorten drying time. Although never been disclosed, cost to build one most likely beyond the means of a vast majority of poor seaweed farmers. Using charcoal or fire woods to dry seaweed made the prototypes inadvertently very costly in terms of deforestation of mangrove. In June 2015, PT Pertamina initiated another good will project by giving boats and in-board engines to sea farmers in Amal Beach (PERTAMINA EP 2015). PT PERTAMINA spending considerable amount of corporate social responsibilities money on farmers in Amal Beach is expected because one of its biggest oil fields - EP Field Tarakan (Asset 5) is located offshore from Amal Beach. Despite massive publicities on the Ministry efforts and CSR money from PT PERTAMINA, there was no information on how efficient were seaweed farmers in Amal Beach. Also not known was the criteria for selecting the recipients.

The production of dried seaweed from two regencies - Nunukan and Tarakan have increased substantially over the years, from 39,321 m.t in 2009 to 150,310 m.t. in 2012 and increased to 206,713 m.t in 2013 (Prayogo 2016). Of that total, Amal Beach was estimated to have 1,272 seaweed farmers contributed 5,000 m.t. in 2013 and 8,000 m.t. in 2014 (Imam 2016:3). Another source (KALTIM Post 2014) estimated that KALTARA monthly production in 2009 was 500 m.t and in 2014 it was increased to 2,400 m.t. most likely produced by the 30 clusters or 5,000-6,000 farmers along Amal Beach. These estimations show the following trends; (i) production increased 73.8% in three years (2009 to 2012) and increased 27% in a year (2012-2013); (ii) in 2012, both regencies contributed 23% of Indonesia's entire dried seaweed production; (iii) In 2013, seaweed farmers in Amal Beach contributed 2.4% to production in KALTARA. Trend (iii) is particularly interesting and require further investigation.

Other than estimations in SCFishproject Annual Report, there was no Volume-Cost Profit or Profit-Loss estimation on long line seaweed farming located in Amal Beach. Previous Volume-Cost Profit studies on long line seaweed farming was conducted at different provinces of Indonesia. This technique is one of ways to gauge efficiency or total factors productivity of a seaweed farm. Most important study was by Firdausy and Tisdell (1991) who have estimated 123% accounting rate of return, 153% Internal Rate of Return (economic return) and 7.8 months' (or 5 rounds) Pay Back Period from 1-ha (2.5 acres) award winning farms in Jungut Bali and in Nusa Penida, Bali Indonesia. Long-line farms in Ambon city and Western Southeast of Maluku was reported by Ferdinandus et al. (2016) earned revenue of IDR 39,200,000 after 7 rounds. Capital investment and operation cost was recovered in round 7 equivalent to one year Pay Back Period. Return on investment was 9.36% equivalent to IDR 9,360 per every IDR100 capital invested slightly higher than economic return of 9.02%. Break Even Point was 1,892.50 kg of dried seaweed. Whereas Revenue Cost Ratio was 10.36 (R/C >1) indicated that selling dried seaweed was a viable or profitable business in their study sites. There were no details costing for inputs of production. A long line in Pajukuang Rappoa Bantaeng was estimated by Yuliana (2017) to have a Revenue Cost Ratio of 2.38, and Break Even at 264kg dried seaweed (when the price at IDR5,461 per/kg). Yuliana included in detail the costing on inputs for production.

In similar manner, this paper calculated the Volume –Cost-Profit from 1 - acre farm owned by one of the pioneers in Amal Beach Old Village. They have been cultivating the sites identified by Gatot as "conditionally suitable" and ranked By Avianti as "second best site". In addition, this farmer never received any assistance from Indonesian government, making it an ideal farm to be studied.

2. Materials and methods

2.1. Study site

Amal Beach Old Village is one of the villages in Kelurahan Pantai (Beach) Amal of Kecamatan Tarakan Timur (East) Kota (city) Tarakan. It is located twelve Kilometres from Tarakan city centre– the capital of North Kalimantan, about 10 minutes' drive from the Universitas Borneo. Farming seaweed at this very historical place are particularly challenging. In 2014, Navy Chief for Tarakan (Letkol Laut) Commander Aries Cahyono warned seaweed farmers and fishermen in these areas of the grave danger from the old mines and bombs (ranjau) planted or buried under seabed during World War Two (Rahmadi 2014:1).

Almost all villagers in Amal beach and Bunyu Island where offshore oilrigs are located are involved in seaweed farming. Amal Beach Old Village is the home of seaweed farming pioneers mostly Bugis people who "homestead" the areas after the WW2. At the entrance of the Amal Beach Old Village is a promenade which is used by the pioneers to dry their seaweed. There is also tuck shops, stalls selling seafood because this beach is a popular site for family outing during weekends or public holidays. The pioneer lives in houses clustered along the main road leading to Mamburungan and at mouth of a river. The river is important for transporting seaweed from the farms located few kilometres away at the sea to the Old village. The sea area in Amal Beach Old Village is not as densely cultivated as in Binalatung and Kelurahan Juwata (near the airport).

There is no well -established private property rights over cultivation sites along Amal Beach. Everyone has a right way of passage to the beach and sea areas (for boats). The norms were that residents of Amal Beach Old Village claim rights to cultivate certain area based on prior occupation, they were homesteading the sea areas in-front of their village. These norms were abided by pioneers but not by outsiders recently arrived new farmers. This is the main reason why many pioneers have entered informal share-cropping arrangements with the new seaweed farmers. Under this system, the pioneers who first occupied and worked in that particular sites claim their right to rent it out to the new farmers.

2.2. Data collection

In 2012, the first author visited and interviewed six pioneer farmers in Amal Beach Old Village and calculated economic returns i.e. profit -loss from one-acre farm belong to one of them. The owner of a collection centre who have been buying from the pioneer were also interviewed. At the collection centre, dried seaweed was manually cleaned from impurities. It was then graded, baled and shipped to the semi- refined carrageenan factories in Surabaya, Makassar, Jakarta, Bali and sometimes smuggled out via Nunukan – Sungai Nyamuk Sebatik Island routes to Tawau in Sabah Malaysia. Between 2013 until round 18 (in June 2016), unable to visit the pioneer farm the authors collected data on quantity of seaweed harvested, dried (sold), and ex-farm gate prices through telephone calls to the farmer and his preferred buyer at the end of each round.

In June 2016, the authors revisited the same pioneer farm. It was discovered the pioneer farmer did not keep any sales receipts ever since he started in 2009. His memory on the costing was extremely unreliable. Lucky, his preferred buyer who owned a collection centre maintain a book keeping of transactions data between them ever since 2012. The authors used both to compile transactions data from April 2012 to June 2016, corroborated it with the data collected from telephone calls and then compared it with the calculated Profit-loss from round one to round 18.

2.3. Species and techniques

The pioneers have been cultivating Red seaweed (Euchema Cottonii or Kappaphycus alverazii) propagated from original seedlings that was smuggled from neighbouring Sabah towns of Tawau and Lahad Datu way back in 2009. Bibit Takalar i.e. the seedlings brought in from Makassar are identified by the pioneers based on its colours- green, red or brown, but species are not known. An attempt was made to cultivate *E. denticulatum or Spinosum* type for extraction of Iota carrageenan back in 2010. *Spinosum* took longer time to grow but grows quite well in the area with strong current and deep water. Unfortunately, the price was very low so they have given up planting it. Up until 2012, almost all farming took place from April to September or October, during these months one could see the floats (PET bottles and Styrofoam) of the long lines at the sea, 200-400 meters away from the long retention wall reinforced with tetrapod shaped wave breakers (*Siring*). During planting months, women were busy all day long, preparing seaweed propagules at night and operating seafood stalls during the day. Planting, maintaining the farm (farm is called “*Pondasi*”), harvesting and dealing with buyers are mostly done by men. Hanging long line, planting techniques, harvesting and post harvesting was described in great details (Hurtado, 2014; Alin, 2009).

Never been described in previous literature is the traditional tool used by the pioneers to haul or lift harvested wet seaweed from boat to platform. It is one of know -how originated but not necessarily invented by seaweed farmers of South Sulawesi origins. This ingenious tool works like a winch. The vertical spool (elongated wooden drum) placed on top of concrete retention wall that used as a platform has a thick fibre rope wrapped around it functioning as a cable wire. This mechanical device made it easier and faster to haul down propagules from platform to boat. The propagules are tied to tie-tie raffia by members of the family in the evening either at home or under the make-shift tents erected in the promenade area.

3. Results

The pioneer farmed seaweed four rounds in a year. As shown in table 1- total cost in round 1 (R1) from April to mid-May 2012 was IDR 14,311,800 in which 79 % fixed cost, the rest were operating or variable cost. After 45 days or end of R1, initial seedling grown doubled into 2000 kg wet. Farmer kept half of it especially fast growing strains as seedling stock for Round Two (R2). At the end of R1, his farm produced seedlings stock (wet seaweed) worth IDR3, 000,000. From R2 onwards pioneer farmer no longer have to purchase item 3 (in table 1) because he was producing its own seedling. It usual takes four sunny days to dry 1000 kg for reducing its moisture content to around 35% and to reduce the weight (10 times) into 100 kg dried seaweed. Dried seaweed was sold at IDR7, 500 per/kg, his revenue as shown in table 2, was IDR 750, 000 hence his farm was in deficit (revenue < total cost) of – 13,561,800. His preferred buyer i.e. owner of collection centres in Tarakan city set a rule of thumb. Well dried seaweed covered with salt crystals supposedly reduce spoilage of carrageenan, should have rubbery texture and when squeezed no water should drip from it.

Table 1. Initial Investment for 1 - acre *E. Cottonii* by one of the pioneer farmers, in Amal Beach Old Village, Tarakan City, Province of North Kalimantan, Indonesia, October 2012

(A) Initial (fixed) cost	Cost (IDR/Indonesian Rupiah)	Life (depreciation rate?)
1.wooden boat (could carry a maximum of 500kg wet seaweed)	1,500,000	10 years
2. Pump engine	3,600,000	10 years
3. Seedlings	3,000,000 (3,000 X 1000kg)	5 years/ 20 planting cycles (4 planting cycles in a year)
4. Stakes (mangrove wood/ nibung palm *oncosperma tigillarium* spp.	800,000	5 years
5. Polyethylene (PE nylon) ropes	900,000 (6mm X 10 bundles X 200m)	2 years
6. Ropes for tying weights	225, 000 (75,000 X 3 bundles)	2 years
7. weight (as anchor)	126,000 (9000 X 14 pieces of 5' X3cm iron rods)	5 years
8. Floats	120,000 (300 X 400 big PET bottles)	2 years
9. Tools to construct and maintenance work	600,720 (wires, hammer, plier etc.)	10 years

10. baskets to put fresh seedlings / used during harvesting-post harvest	145,000 (36,250 X 4 baskets)	5 years
11. Plastic sheets / bamboo mats for drying	300,360 (37,545 X 8 units)	5 years
Sub-total (A) or total initial cash outflows	11,317,080	
(B) Variable /operation costs		
12. Labour	2,358,720 (2 labourers i.e. Husband and wife X 80 hours X 14,742)	
13. Raffia to tie 5,000 propagules Each propagule= 200grams	36,000 (12,000 X 3 big bundles)	
14. Fuel	600,000 (IDR 4,000 X 150 litres of Solar (Diesel)	
Sub-total (B)	2,994,720	
Total farming cost/cash outflows (A)+ (B)	14,311,800	
(C)Cash Inflows There are 4 rounds or harvests in a year		
(D)Profit (C-B) without depreciation		
Payback period (A/D X --- months) and ROI		

Note: Cost data based on 2016 exchange rate; USD1 = IDR 13,315.6
Item 12- excluding child labour in preparing propagules i.e. cutting propagule or cultivar and tying it to raffia. Each labour spent around 80 working hours at the farm per round. Minimum wage for North Kalimantan was IDR 2,358,800 calculated by the Indonesian Government based on IDR14, 742 multiple by 160 working hours a month (40 hours a week or 6 working days in a week) under Subsection (2) of the Act No. 13/2003.

Item 14- Diesel (solar) IDR 4,000 per litre was cheaper than Petrol (Petramax) IDR9, 000 per litre.
Source- Interviews with the pioneer farmer in Amal Beach Old Village, and interviews with owner of collection centres in Tarakan city North Kalimantan Province of Indonesia in October, 2012.

Table 2. Cash outflows and inflows (in IDR) of 1-acre *E. Cottonii* farm in Amal Beach Old Village, Tarakan City Province of North Kalimantan, Indonesia in 2012

Y 2012	R1	R2	R3	R4
(A)Fixed cost	11,317,080	8,317,080 (A) in R1 - 3,000,000 (his own seedlings)	5,317,080 (A) in R2 - 3,000,000	2,317,080 (A)in R3- 3,000,000
(B)Variable cost	2,994,720	2,994,720	2,994,720	2,994,720
Total cost= cash outflows	14,311,800	11,311,800	8,311,800	5,311,800
Total Revenue= cash inflows	750,000 (100 kg dried)	900,000 (120kg dried)	880,000 (110kg dried)	1,080,000 (120kg dried)
Profit-Loss	-13,561,800	-10,411,800	-7,431,800	-4,231,800

Note- ex-farm gate price for dried seaweed was IDR 7,500 per/kg from R1 to R2 but increased to IDR8, 000 in R3 and IDR9, 000 in R4. Ex-farm gate price for fast growing seaweed strains for replanting was IDR3, 000 from R1 to R4.
Source- Book Keeping – recorded transactions between owner of collection centres and farmer; interviews with farmer in October 2012

Table 3. Cash outflows and inflows (in IDR) of 1-acre E. Cottonii farm in Amal Beach Old Village, Tarakan City Province of North Kalimantan, Indonesia in 2013

Y 2013	R5	R6	R7	R8
(A)Fixed cost	Paid for + 682,920	Paid for +3,000,000	Paid for +3,000,000	-1,245,000* plus 3,000,000
(B) Variable cost	2,994,720	2,994,720	2,994,720	2,994,720
Total cost= cash outflow	2,311,800 (B) – (A)	+5,280	+5,280	1,239,720
Total Revenue= cash inflows	1,150,000 (115kg dried)	1,320,000 (120kg dried)	1,540,000 (110kg dried)	1,708,000 (122kg dried)
Profit-Loss	-1,161,800	+1,325,280	+1,581,280	+468,280

*Note-ex-farm gate price for dried seaweed was IDR 10,000 in R5 but IDR11, 000 in R6 and IDR14, 000 in R7 to R8. * Depreciation 100% = replacement on items (5), (6) and (8) of table 1.*
Source- Book Keeping -recorded transactions between owner of collection centres cum trader and farmer; telephone calls to trader and farmer at the end R5 to R8 in 2013.

Table 4. Cash outflows and inflows (in IDR) of 1-acre *E. Cottonii* farm in Amal Beach Old Village, Tarakan City Province of North Kalimantan, Indonesia in 2014

Y 2014	R9	R10	R11	R12
(A)Fixed cost	Paid for + 4,000,000	Paid for + 4,000,000	Paid for + 4,000,000	Paid for + 4,000,000
(B) Variable cost	2,994,720	2,994,720	2,994,720	2,994,720
Total cost= cash outflows	+1,005,280	+1,005,280	+1,005,280	+1,005,280
Total Revenue= cash inflows	1,526,000 (109kg dried)	1,554,000 (111kg dried)	1,680,000 (120kg dried	1,750,000 (125kg dried)
Profit-Loss	+2,531,280	+2,559,280	+2,685,280	+2,755,280

Note- ex- farm gate price for dried seaweed was IDR14, 000 from R9 to R12. Ex-farm gate price for fast growing strain seaweed for planting was IDR 4,000 per/kg from R9 to R12.
Source- Book Keeping -recorded transactions between owner of collection centres cum trader and farmer in 2014; telephone calls to trader and farmer at the end of R9 to R12 in 2014

Table 5 Cash outflows and inflows (in IDR) of 1-acre *E. Cottonii* farm in Amal Beach Old Village, Tarakan City Province of North Kalimantan, Indonesia in 2015

Y 2015	R13	R14	R15	R16
(A)Fixed cost	Paid for + 4,000,000	Paid for + 4,000,000	Paid for + 4,000,000	-1,245,000** plus 4,000,000
(B) Variable cost	2,994,720	2,994,720	2,994,720	2,994,720
Total cost= cash outflows	+1,005,280	+1,005,280	+1,005,280	239,720
Total Revenue= cash inflows	1,560,000 (120kg dried)	1,664,000 (128kg dried)	1,690,000 (130kg dried	1,625,000 (125kg dried)
Profit-Loss	+2,565,280	+2,669,280	+2,695,280	+1,385,280

*Note- ex- farm gate price for dried seaweed was IDR13, 000 from R13 to R16. Ex-farm gate price for fast growing strain seaweed for planting was 4,000 per/kg from R13 to R16. ** Depreciation 100%= replacement of items (5), (6) and (9).*
Source- Book Keeping -recorded transactions between owner of collection centres cum trader and the farmer in 2015, telephone calls to trader and farmer end of round 13 to 16 in 2015.

Table 6. Cash outflows and inflows (in IDR) of 1-acre *E. Cottonii* farm in Amal Beach Old Village, Tarakan City Province of North Kalimantan, Indonesia during the first two rounds in 2016

Y 2016	R17	R18
(A)Fixed cost	Paid for + 3,000,000	Paid for + 3,000,000
(B) Variable cost	2,994,720	2,994,720
Total cost= cash outflows	5,280	5,280
Total Revenue= cash inflows	1,200,000 (100kg/dried)	1,320,000 (110kg/dried)
Profit-Loss	+1,205,280	+1,325,280

Note- ex- farm gate price for dried seaweed was IDR12, 000 from R17 to R18. Ex-farm gate price for fast growing strain seaweed for planting was IDR 3,000 per/kg from R17 to R18.
Source- Book Keeping -recorded transactions between owner of collection centres /trader and farmer in R17 and R18 in 2016, telephone calls to trader and farmer at the end of R17 and interviews with farmer in Round 18, June 2016.

The pioneer farmer produced 450kg dried seaweed in 2012. As shown in table 2, revenue in R4 (September, 2012) was IDR1, 080,000 not so far off from the quantity estimated by SCFishproject Annual Report (2012). His farm reached break -even point (revenue= total cost) as well as made profits (revenue> total cost) from R6 in June 2013 onwards all the way to R18 – two rounds away from the end of this farm's production cycle (fifth year). Payback Period was nine months i.e. after farming for six rounds.

Further observations are as follows;

i. from R2 onwards farmer was generating revenue in addition to producing its own seedling. The fast-growing strains used for seedling are so valuable that it has its own market prices. Number of farmers and the speed of seaweed cultivation expansion has positive relationship with the demand for seedlings.

ii. The value of produced seedling paid for entire fixed cost from R5 onwards except in R8 and R16. It also covers variable cost from R6 onwards except in R8 and R16. This is due to yield from initial 1,000 kg wet seaweed (in R1) that was doubled in R2 and increased 3.5 times in R4 (2012), 3.67 times in R8 (2013), 3.65 times in R12, 4 times in R16 and 1.1 times in R18. Or in other words, in 2012 he cultivated a 1000 kg wet seaweed and after 18 rounds it's was multiplied into a staggering 209,200kg wet seaweed.

iii. Most desirable scenario are R6 and R7 when the cash outflows was positive followed by R17 and R18 when cash outflows was the lowest.

iv. An increase in the fixed cost to pay for replacement of items (5), (6) and (8) as shown in table 3 and 5 caused the profit to plunge to a record low in R8 and R16.

v. End of September or October each year, the pioneer took a take a long break from farming. Instead he became a lender by loaning his fast growing seedling strains to his relatives and new farmers. As shown in table 7 below, fast growing seedling strains were much more valuable alive (wet) than dried. At the end of R4 (September 2012) the pioneer divided his 1,200kg seedling equally to two relatives and two new farmers. The first relative (denote borrower 1) cultivated in Cape of Simaya area while the second relative (borrower 2) cultivated in Sekatak Gulf south of Tarakan. The new farmers (borrower 3 and 4) entered a sharecropping arrangement to cultivate sites owned by pioneer of Amal Beach Old Village. Established norm was that each borrower repay IDR225, 000 or quarter of market value for the borrowed seedlings (IDR900, 000= 300kg wet X IDR 3,000) to the lender after every round. In this case, the lender should receive IDR 3,600,000 from 16 rounds (4 rounds X 4 borrowers). In reality he collected only IDR675, 000 equivalent to 90kg dried seaweed from the four borrowers. So by the following year April 2013, the 1,200kg wet/alive seaweed seedlings (300kg wet X four borrowers) were returned to the lender right on time for him to start R5.

Table 7. Fast growing seaweed strains worth more as seedlings than dried

Year	Selling it as Alive/ wet seaweed Seedlings market value and quantity	Drying it market value and quantity
R4 End of Sept/Oct 2012	IDR 3,600,000 1,200 kg X IDR 3,000	IDR 900,000 120 kg X IDR 7,500
R8 End of Sept/Oct 2013	IDR 3,660,000 1,220 kg X IDR 3,000	IDR 1,708,000 122 kg X IDR 14,000
R12 End of September/Oct 2014	IDR 5,000,000 1250 kg X IDR 4,000	IDR 1,750,000 125 kg X IDR 14,000
R16 End of September/Oct 2015	IDR 5,000,000 1250 kg X IDR 4,000	IDR 1,625,000 125 kg X IDR 13,000

vi. Internal Rate of Return (IRR) of this 1-acre farm up to R18 was 57.6% derived from the following calculation; Cash inflow or revenue accumulated from R1 to R18 = IDR 24,897,000 minus cost of investment (IDR 15,791,240) divided by cost of investment multiplied by 100. This farm was doing relatively well financially in 2014 due to higher ex-farm gate price for dried seaweed. Specifically, the IRR was 51% in R9, 54% in R10, 67% in R11 and 74% in R12. Although the Ex-farm gate price went slightly down in 2014, IRR was 55% in R13, 65% in R14 and 68% in R15.

vii. Return on Investment (ROI) was equally low at 57%, farmer invested a total of IDR 15,791,240 but his wife and he worked very hard during 27 months or 18 rounds of farming yet the accumulated return or revenue was only IDR24, 897,000. Or put differently, ROI was low in which farmer invested on average IDR 877,291 per round, only earning on average of IDR1, 383,166 per round. His wife and he continue cultivating seaweed after R5 because by that time the only cash outflows was the operating cost i.e. fuel and combined physical labour (45 days per round) of husband and wife valued at IDR2, 358,720 not that far short from opportunity cost of working elsewhere equivalent to a Minimum (monthly) wage for Kalimantan Utara of IDR2, 358,800 monthly.

4. Discussions

Although not located in areas considered most suitable for seaweed cultivation, this 1- acre farm have performed relatively well financially. The pioneer farm obviously has not reached an economic of scale- a typical performance of family seaweed farming in this area. The IRR of 57.6% and ROI 57% are not quite at par with accounting rate of return and IRR or economic return from 1-ha farm in Jungut and Nusa Penida in Bali.

Nonetheless, determination of the pioneer farmer is beyond "average" considering the following;

i. Seedlings propagated by the pioneer of Amal Beach Old Village (IDR3, 000 per/kg in 2012) was sixty times more expensive than in Bali (IDR50 per/kg in 1988) and 1.5 times more than in Pajukuang (IDR2, 000 per/kg in 2015). Seedlings was 26% of initial fixed cost and 11% of total cost (in Round 1) compared to 12% and 11% in Bali. In Pajukuang, it was 10 % of fixed initial cost (IDR 18,661,500) and 8.6 % of total cost of IDR 22,090,982 (operating cost = IDR3, 429,482).

ii. Cost per unit labour employed by the pioneer farm was 4.9 times more expensive than in Bali. Specifically, the mean production of the pioneer farm which employed two labourers to farm 1,000kg in four rounds was 112.5kg dried or equivalent to 56.25kg dried seaweed per unit labour (cost IDR294, 840) per round. Whereas mean production in Bali which employed 15 labourers to farm 20,000kg in six rounds was 8,000kg dried seaweed per round or equal to 533.3kg dried seaweed per unit labour (cost IDR60,000) per round. Farm in Pajukuang took five rounds to propagate 960kg initial seedling (worth IDR1.92 million) into 7,200kg wet seaweed. Put differently, IDR300, 000 (workers for planting) produced an average of 1,440 wet or 144kg dried seaweed worth 1,872,000 per round.

iii. The pioneer of Amal Beach Old Village took 13 rounds to reach Revenue- Cost Ratio of 1.03 (> 1 indicating viable or profitable, < 1 indicating otherwise) compared to 1.11 at round six for farm in Bali as well as 2.72 at round 5 for farm in Pajukuang.

iv. In terms of value added, the pioneer of Amal Beach Old Village started with initial seedlings worth IDR3, 000,000 and total factor productivity (TFP) in R4 was IDR3, 610,000. Farmer in Pajukuang begin with initial seedlings valued at IDR1, 920,000 and at the end of R5, TFP was IDR9, 360,000. Whereas farmer in Bali started with seedlings worth IDR1, 000,000 but the TFP at the end of R6 was 19,200,000. Value added to seedlings were much lower than value added to dried seaweed. And both has positive relationship with ex-farm gate prices and farming rounds. Seedlings were selected fast growing strains thus had value added to it. And obviously good quality dried seaweed has more value added to it. Most of it were healthy seaweed separated from the diseased, not infected by ice-ice and Epiphytes, cleaned from impurities, well dried, and properly stored.

v. At the moment seaweed farming areas in Kelurahan Amal Beach shows no sign of slowing down. Impressive growth rate i.e. increase in acreage and quantity however were not accompanied by the increase in quality. Supply chain in this competitive market begin with primary producers – farmers either sell or lend seedlings to his relatives or/and sell dried seaweed to traders or collectors or middlemen. In both cases, price usually is mutually agreed upon by a seller and a buyer. Quality uncertainty tend to be less of a problem in seedling market. A farmer tends to be honest when selling seedlings to his own relatives or his tenants (sharecroppers) because he depends on them for seedlings in the following year. However, lending a low-quality seedling will hurt the tenant financially. Quality uncertainty are pervasive in wholesale market for dried seaweed where producers are much more numerous than buyers. The middlemen known locally as Tengkulak played an important role as intermediary between farmers and refiners in making sure good quality seaweed will not be driven out from market by bad quality seaweed especially during price bubble. Ex-farm gate prices paid by the traders to the pioneers fluctuated erratically. It was caused to a limited extent, by uncertainty in quality of dried seaweed.

vi. Corollary to the previous point is the intense contestation over farming space and time. The frontier of farming sites (some sites are more preferable than others) moved further to the open and deeper seas, away from designated coastal zone 50-400 meters (from lowest tide mark) thus ensuring more conflicts with fishermen. The pioneers can no longer leave their plots empty during Monsoon months lest it occupied by the new farmers. Many of them either lease to or enter sharecropping arrangements with new farmers. Consequently, farming are conducted even during monsoon months knowingly farms would be constantly exposed to strong currents, big waves and diseases (Bulungan Post 2017; KORAN KALTARA 2017). In 2012, Amal Beach Old Village had fringes of mangrove but in 2016 it was mostly gone due to severe erosion. Pioneers' cultivation sites located 400 meters or more from the promenade have been exposed more than ever before to siltation or sedimentation during rainy monsoon months. In the past it was avoided by letting plots fallow during monsoon months, and simultaneously starving off pestilence, ice-ice and Epiphytes diseases. New farmers are neither risk seeker nor inherent dishonest. They just poor and desperate. During monsoon months, Pondasi would be battered by the forces of nature, seedlings usually are stunted and easily broken and most would be washed away. Many new farmers ended up salvaging floating or lose seedlings by using fishing nets or collecting it by hands during low tide. Salvaged lose seedlings locally known as "rumput laut pukatan" when it is mixed with unwanted weeds exacerbates seaweed quality uncertainty problem.

5. Conclusions

The seaweed farming in Amal Beach Old Village in Tarakan City in the Province of North Kalimantan, Indonesia have been growing at the incredible rate both in number of farmers and cultivated areas. Since 2009 seaweed farming had liberated thousands of people from the shackle of hard-core poverty. Yet the economic efficiency at the farm level is not known and worst it's have been assumed to be very high. Previous studies to gauge it using Volume –Cost-Profit was accurate in calculating costs (cash outflows) but too optimistic in forecasting revenues (cash inflows) because they have factored in a zero or negligible Discount Rate resulting in gross inflated Net Present Value. Unlike in a manufacturing, a Volume-Cost –Profit for seaweed farming cannot be calculated with accuracy. Whereas a manufacturing firm has full control over its costing, quantity being produced as well as its retail prices, seaweed farmers has very limited control over its Fixed and Variable Costs because all of it must be purchased (cash out flows). Although initial propagules is known to grow in a factor of ten within 45 days or so, and a farmer could select strains of superior seedlings, he definitely bears high risk and face many uncertainties beyond its controls particularly seawater quality and surface temperature, bad weather, diseases and ex-farm gate prices. Similar to the previous studies we used Volume-Cost-Profit in calculating costs at the initial round (a fieldwork in 2012) from 1 - acre farm owned by one of the pioneers' seaweed farmers. The discount rate was not assumed at zero and we made no attempt to forecast future revenues. Instead, we analysed sales info from round 5 (2013) to round 17 provided by the farmer via telephone. In June 2016 we revisited the farming site and the collection centre we visited way back in 2012 where all transactions records were corroborated with our own ballpark calculations. It was found that sales data collected via telephone calls was inflated most of time when compared to sales receipts kept by the collection centre. Despite this unreconciled difference in cash inflows data, ours is first study to monitor the performance of a farm in action operated by the same farmer continuously over four years or 18 rounds which originated from initial propagules of 1,000 kg. Our results show although located in a site identified by Gatot et al. (2009) as "conditionally suitable" and ranked by Avianti (2016) as "second best site", the pioneer farm was no less efficient economically compared to other farming areas in different part of Indonesia. The pioneer farmer in Amal Beach Old Village took 13 rounds to reach Revenue-Cost Ratio of more than 1.03. Break Even Point was in round 6, and until round 18 pioneer farmers was making Net Profits. Put differently, Pay Back

Period was after six rounds equivalent of after nine farming months. Moreover, Internal Rate of Return and Accounting Rate of Return until round 18 both were meagre at 57%. That is to say the pioneer farmers invested IDR877, 291 but their Mean Earning from seaweed farming was just IDR1, 383,166 per round. Specifically Mean Production of two labourers which is the minimum amount of manpower, to propagate 1,000kg initial E.Cottonii seedling in 1-acre was 112.5kg per four rounds or equivalent to IDR294, 840 per unit labour to produce 56.25kg of dried seaweed per round. Value Added in seaweed farming is also miserable due to its labour-intensive nature and that is why it is popular occupational choice among people abundance with physical labour but poor in capital or lack access to it. The pioneer farmer is quite successful because he is economically efficient. But is the farm sustainable? That another empirical question can only be answered by calculating Technical and Allocative Efficiency of the farm. That is for future researchers to pick up.

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