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Judul artikel : Feasibility Study of Combined, *Gracilaria verrucosa* Seaweed with Giant Tiger Prawn *Penaeus monodon*, Farming.

Jurnal : AACL Bioflux, 2021, Vol. 14, No 6, hal 3197-3203

Penulis : Rustam (Koresponden author), Rustam, dan Muhammad I. Wamnebo

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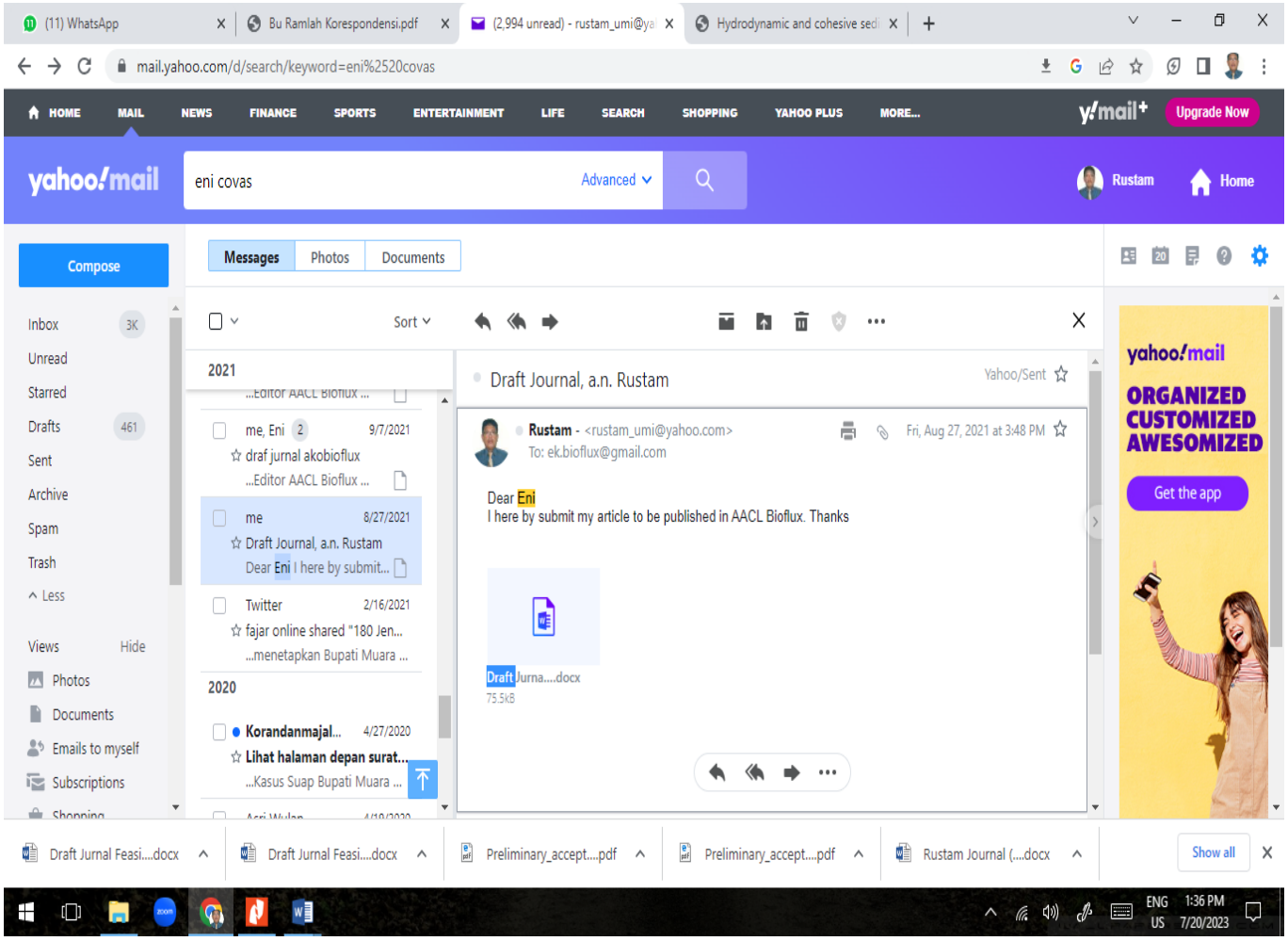

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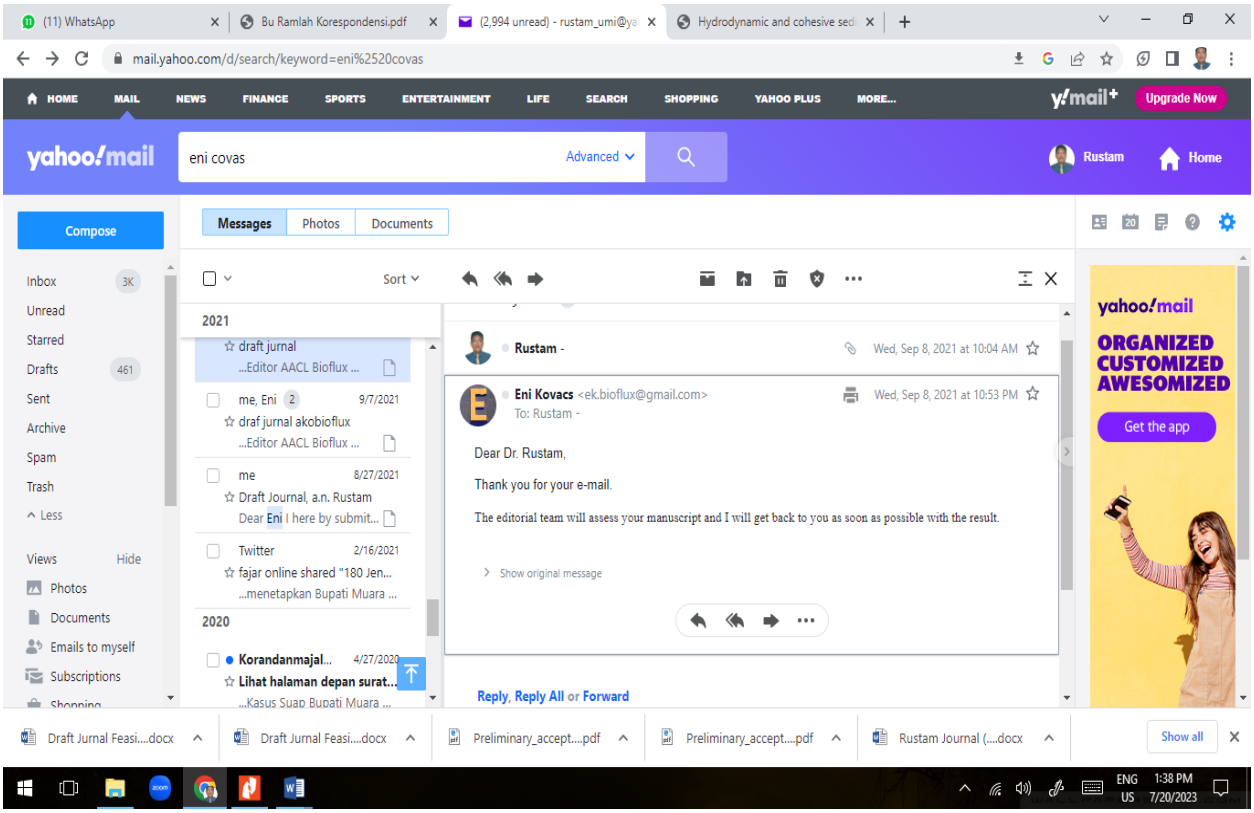

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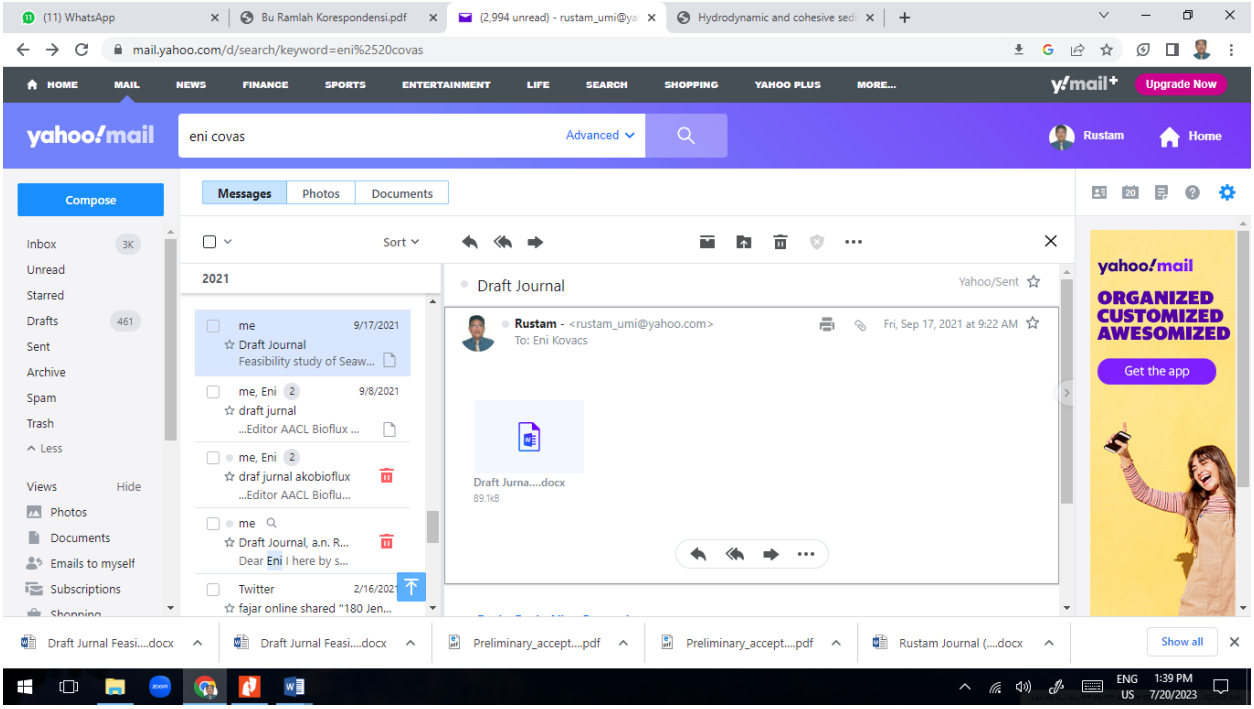

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Feasibility study of Seaweed Farming *Grasillaria* sp and Windu Shrimp *Penaeus monodon Fab*. for Increasing the Income of Pond Farmers

[1]Rustam Rustam, [2]Muhammad Ikhsan Wamnebo

[1]Department of Marine Science, Faculty of Fishery and Marine Sciences, Universitas Muslim Indonesia, Jl. Urip Sumoharjo Km. 05, Makassar, South Sulawesi, 90231, Indonesia; [2]Department of Aquaculture, Faculty of Fisheries and Marine Sciences, Indonesian Muslim University Jl. Urip Sumoharjo KM 05, Makassar, South Sulawesi 90231, Indonesia.
corresponding author: rustam_umi@yahoo.com

Abstract. Seaweed, Grasillaria sp. is one of the leading fisheries commodities that is very possible to be developed in ponds. In connection with the government's program for the development of seaweed aquaculture in order to overcome one of the problems in the cultivation of Windu shrimp (Penaeus monodon fab.) which often experience crop failure due to disease. Waste resulting from the rest of the feed that is not utilized by tiger shrimp cultivation is accused of being one of the causes of disease and failure of aquaculture. Seaweed cultivation is an alternative that can be combined with tiger shrimp cultivation, because seaweed cultivation can utilize nutrients/waste from tiger shrimp cultivation waste for the growth process in seaweed cultivation. This study aims to combine (polyculture) in tiger shrimp cultivation with seaweed, evaluate the density of aquaculture that is suitable to be developed through shrimp culture and seaweed cultivation which is considered feasible and suitable for polyculture. The method of observing and taking water samples at each observation location and the method of analysis refers to the American Public Health Association (APHA). To determine the prospects for developing tiger shrimp and seaweed farming, a business feasibility analysis was carried out. The combination of seaweed cultivation with tiger shrimp is carried out in ponds. The results showed that the water quality parameters that have an impact on water quality, namely total suspended solids (TSS) and COD have exceeded the threshold of quality standard requirements allowed for marine aquaculture and aquaculture. The results of the economic valuation of shrimp farming in ponds can be applied and developed as a profitable business, this can be seen from the calculation of the R/C ratio of more than 1, namely each tiger shrimp farming business with a density of 8, 11 and 13 fish/m2 in the area. Seaweed cultivation area is 50% planted with seaweed, respectively 2.11, 1.83, 1.37. The combination of tiger prawn cultivation with seaweed at each density level of 8, 11 and 13 tails/m2 gets a profit of Rp. . 85,946,800,- per year, Rp. 73,750,200,- per year, and Rp. 80,252,400,- per year.

Keywords: Cultivation, Seaweed, Tiger Shrimp, Business Feasibility

Introduction. Seaweed Grasillaria sp. is one of the leading fisheries commodities with great potential to be developed in ponds (Widiastuti, 2011; Irsan, 2021). In connection with the government's program for the development of seaweed cultivation business, to overcome the problems of tiger shrimp cultivation so far, namely waste from the rest of the feed that is not utilized is accused as one of the causes of disease and failure of

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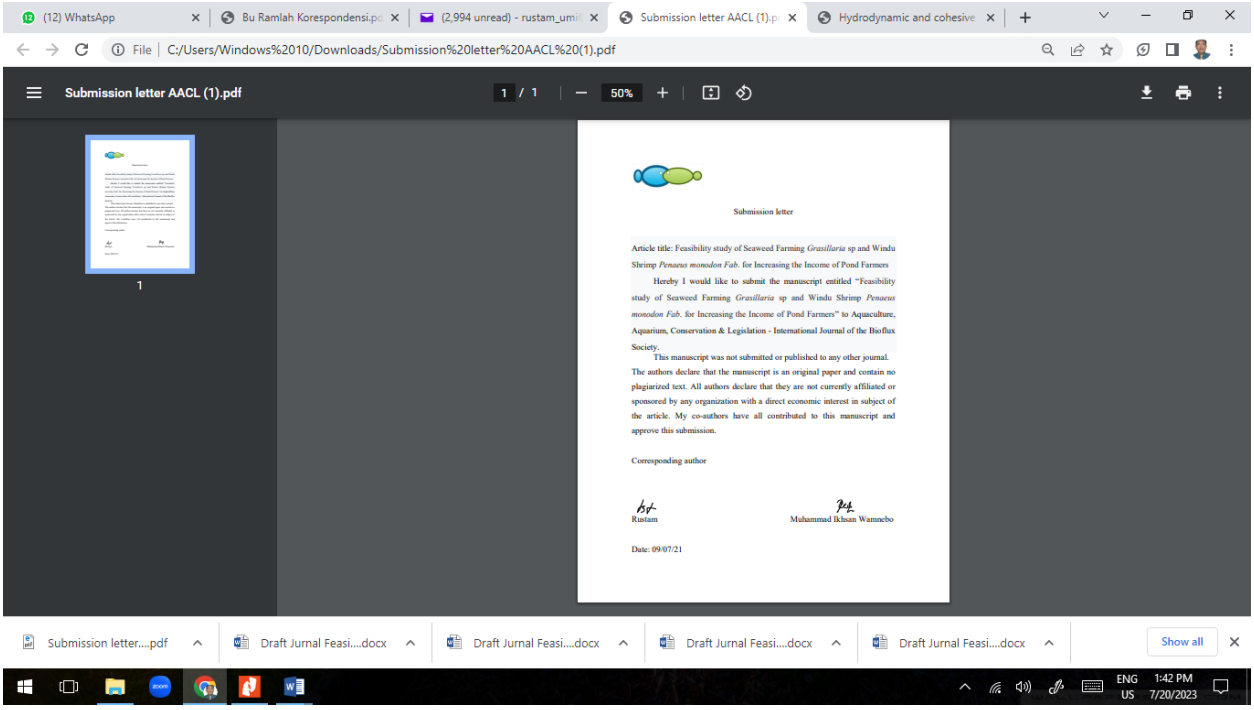

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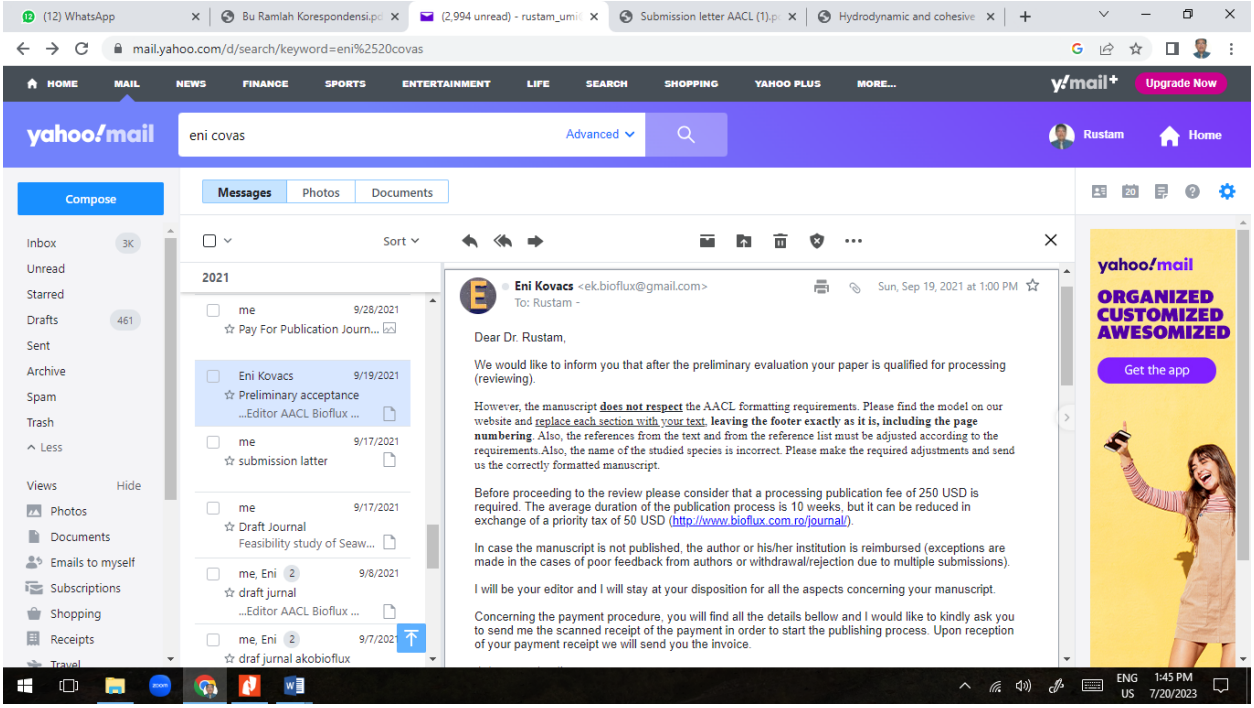

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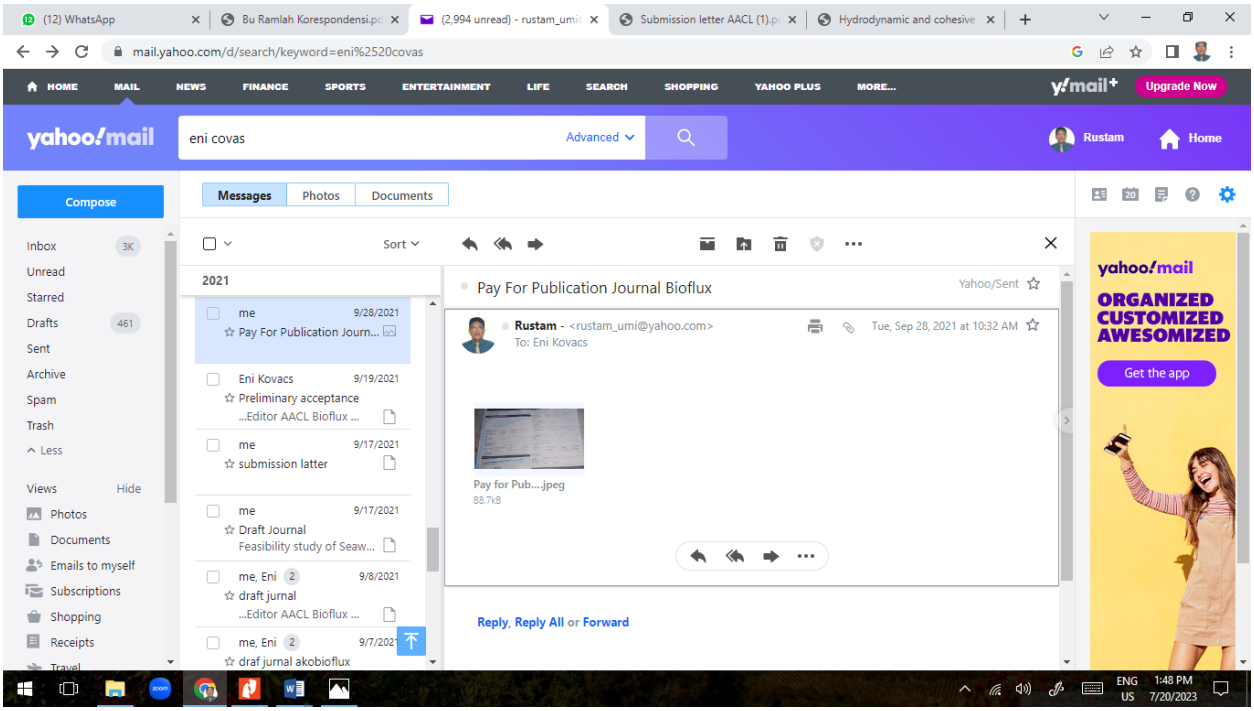

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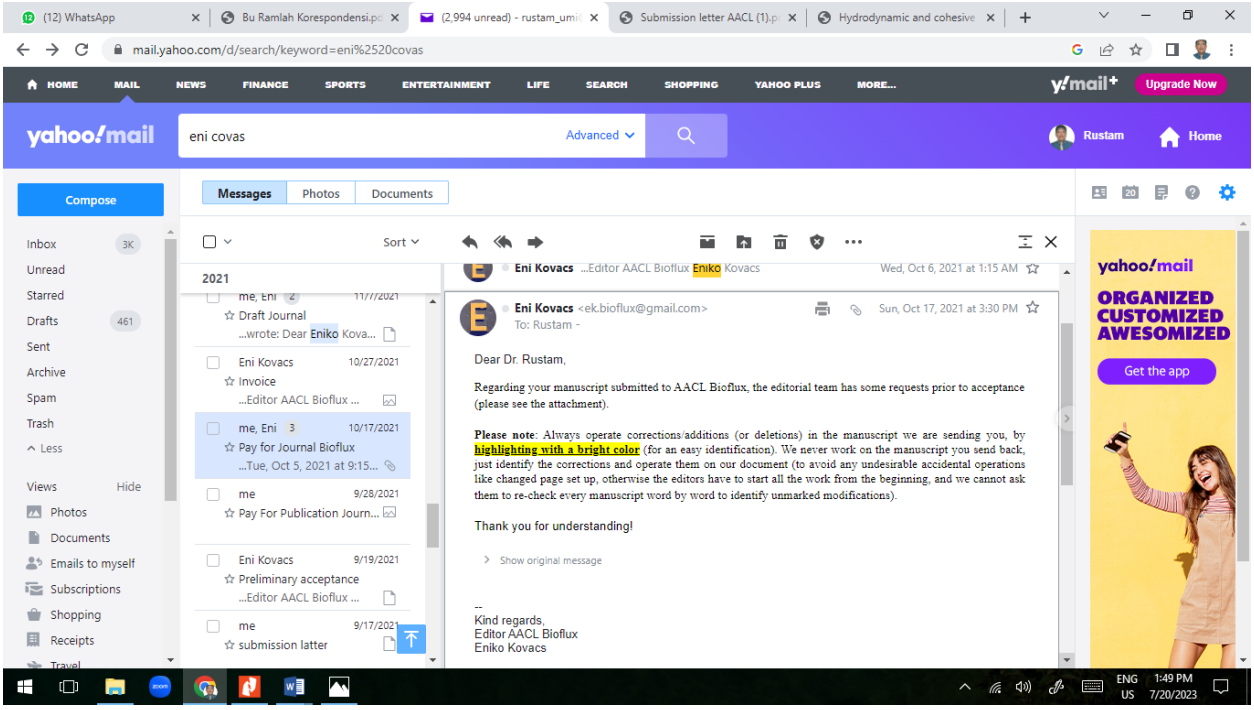

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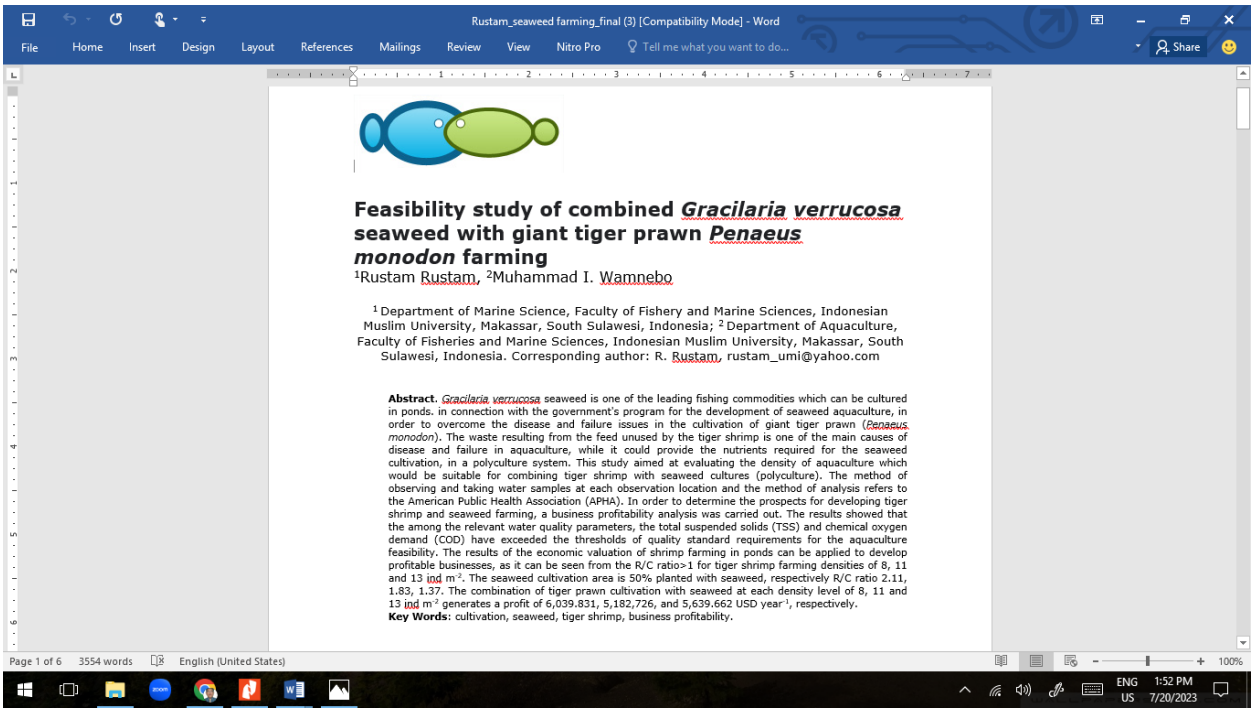

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Feasibility study of combined *Gracilaria verrucosa* seaweed with giant tiger prawn *Penaeus monodon* farming

[1]Rustam Rustam, [2]Muhammad I. Wamnebo

[1] Department of Marine Science, Faculty of Fishery and Marine Sciences, Indonesian Muslim University, Makassar, South Sulawesi, Indonesia; [2] Department of Aquaculture, Faculty of Fisheries and Marine Sciences, Indonesian Muslim University, Makassar, South Sulawesi, Indonesia. Corresponding author: R. Rustam, rustam_umi@yahoo.com

Abstract. *Gracilaria verrucosa* seaweed is one of the leading fishing commodities which can be cultured in ponds. in connection with the government's program for the development of seaweed aquaculture, in order to overcome the disease and failure issues in the cultivation of giant tiger prawn (*Penaeus monodon*). The waste resulting from the feed unused by the tiger shrimp is one of the main causes of disease and failure in aquaculture, while it could provide the nutrients required for the seaweed cultivation, in a polyculture system. This study aimed at evaluating the density of aquaculture which would be suitable for combining tiger shrimp with seaweed cultures (polyculture). The method of observing and taking water samples at each observation location and the method of analysis refers to the American Public Health Association (APHA). In order to determine the prospects for developing tiger shrimp and seaweed farming, a business profitability analysis was carried out. The results showed that the among the relevant water quality parameters, the total suspended solids (TSS) and chemical oxygen demand (COD) have exceeded the thresholds of quality standard requirements for the aquaculture feasibility. The results of the economic valuation of shrimp farming in ponds can be applied to develop profitable businesses, as it can be seen from the R/C ratio>1 for tiger shrimp farming densities of 8, 11 and 13 ind m^{-2}. The seaweed cultivation area is 50% planted with seaweed, respectively R/C ratio 2.11, 1.83, 1.37. The combination of tiger prawn cultivation with seaweed at each density level of 8, 11 and 13 ind m^{-2} generates a profit of 6,039.831, 5,182,726, and 5,639.662 USD $year^{-1}$, respectively.

Key Words: cultivation, seaweed, tiger shrimp, business profitability.

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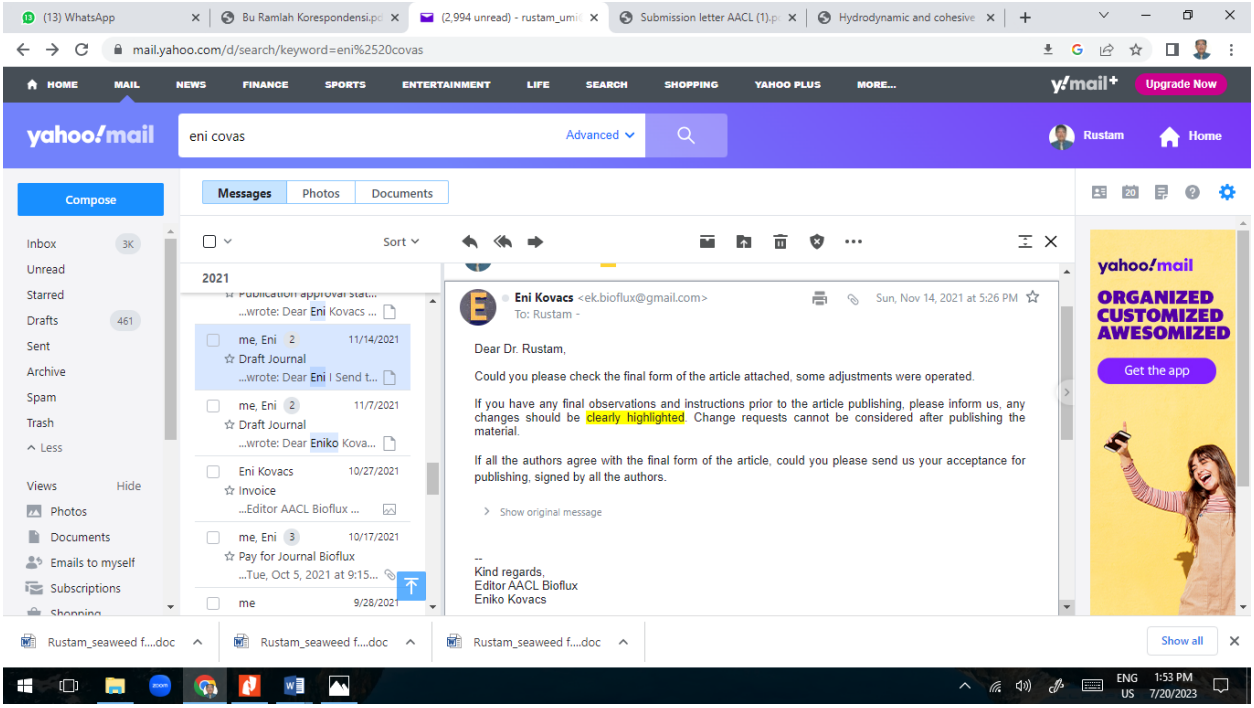

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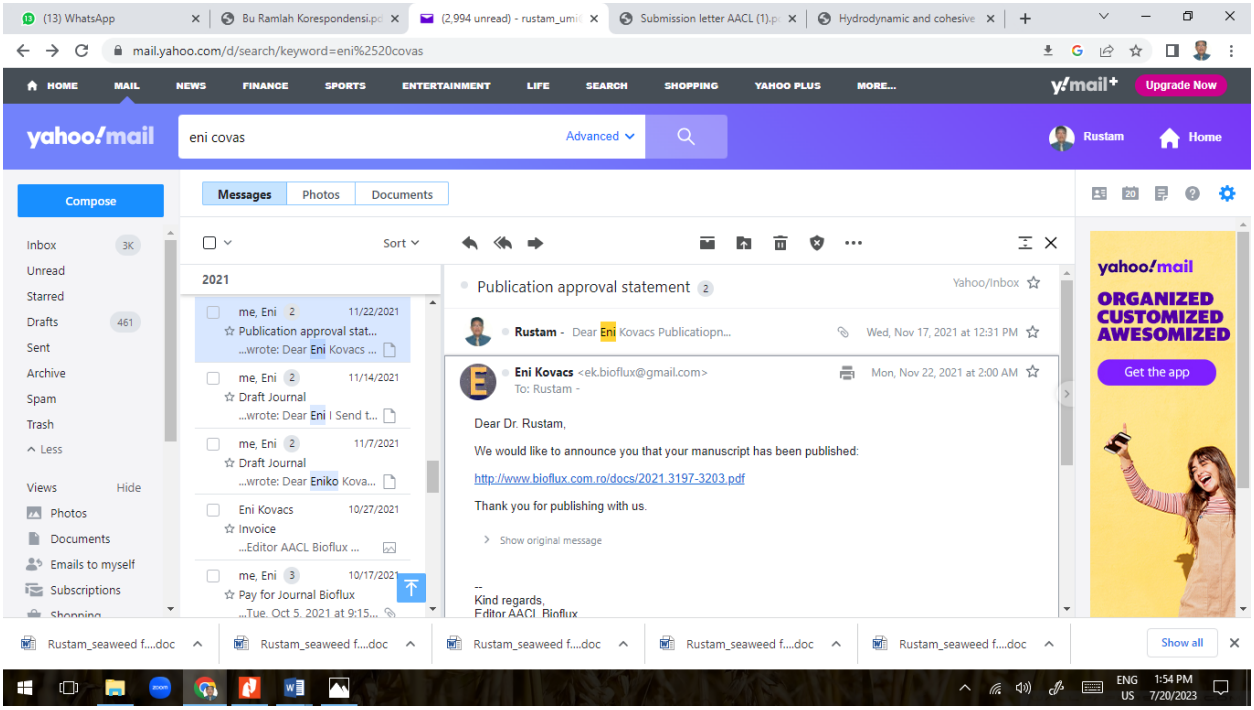

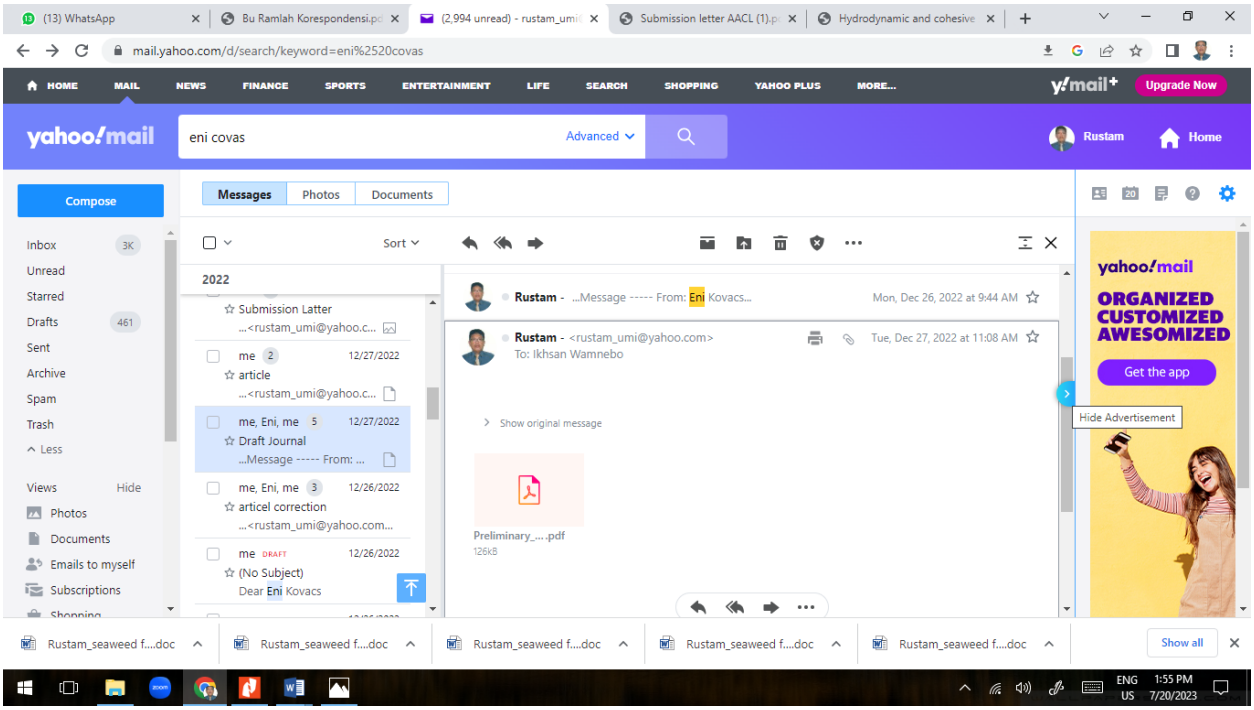
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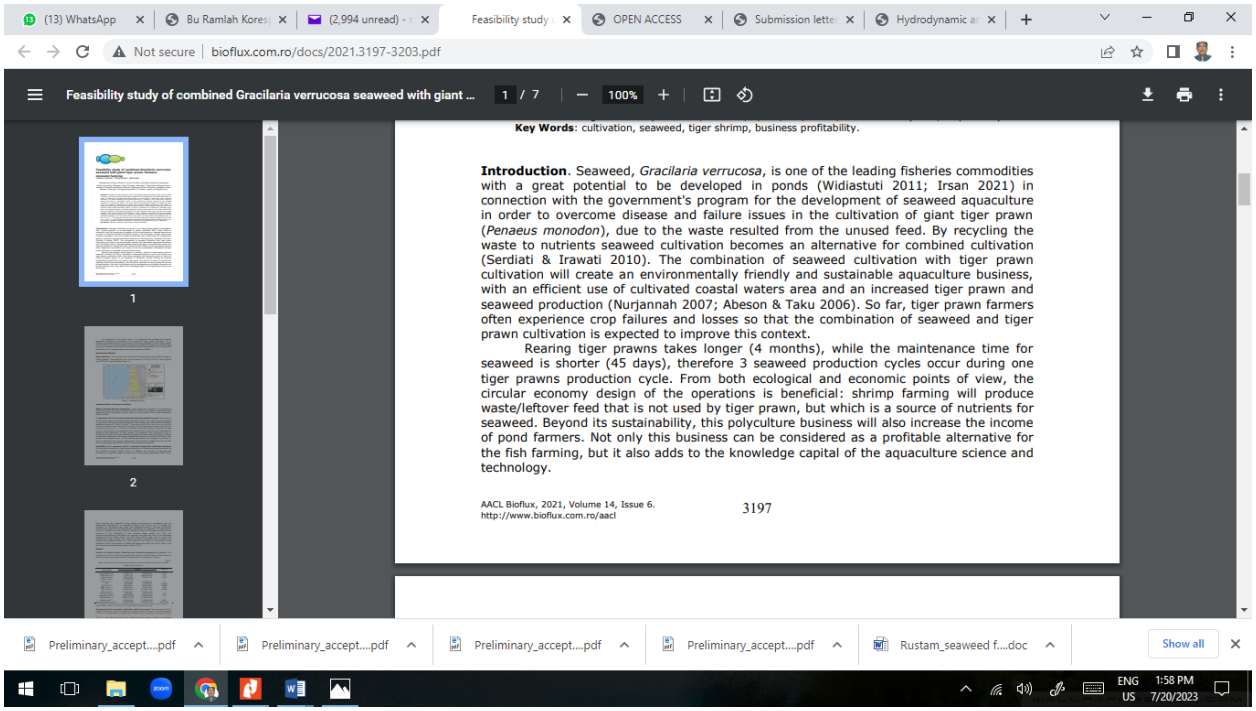
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Introduction. Seaweed, Gracilaria verrucosa, is one of the leading fisheries commodities with a great potential to be developed in ponds (Widiastuti 2011; Irsan 2021) in connection with the government's program for the development of seaweed aquaculture in order to overcome disease and failure issues in the cultivation of giant tiger prawn (Penaeus monodon), due to the waste resulted from the unused feed. By recycling the waste to nutrients seaweed cultivation becomes an alternative for combined cultivation (Serdiati & Irawati 2010). The combination of seaweed cultivation with tiger prawn cultivation will create an environmentally friendly and sustainable aquaculture business, with an efficient use of cultivated coastal waters area and an increased tiger prawn and seaweed production (Nurjannah 2007; Abeson & Taku 2006). So far, tiger prawn farmers often experience crop failures and losses so that the combination of seaweed and tiger prawn cultivation is expected to improve this context.
Rearing tiger prawns takes longer (4 months), while the maintenance time for seaweed is shorter (45 days), therefore 3 seaweed production cycles occur during one tiger prawns production cycle. From both ecological and economic points of view, the circular economy design of the operations is beneficial: shrimp farming will produce waste/leftover feed that is not used by tiger prawn, but which is a source of nutrients for seaweed. Beyond its sustainability, this polyculture business will also increase the income of pond farmers. Not only this business can be considered as a profitable alternative for the fish farming, but it also adds to the knowledge capital of the aquaculture science and technology.
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The objectives of this study were: (1) to determine the physical and chemical parameters defining the suitability of the waters for tiger prawn cultivation; (2) to determine the priority scale of the aquatic environment suitability for both tiger prawns, and seaweed; (3) to test the aquatic environment suitability through the combined tiger prawn and seaweed cultivation at the locations deemed appropriate; (4) to evaluate the profitability of an integrated tiger shrimp and seaweed cultivation.

Material and Method

Data collection. This research was conducted in the aquaculture area of Barru Regency, South Sulawesi. Geographically this area is located at 4°5'49"-4°47'35" south latitude and 119°49'16" east longitude (Figure 1).

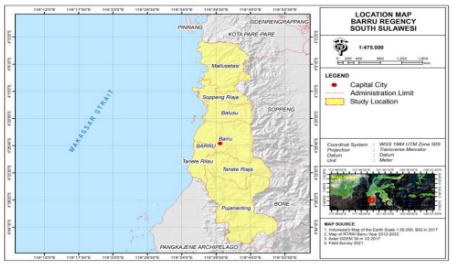

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Figure 1. Research location.

Implementation of research activities

Water chemical physical parameter. In-situ data were collected at 24 observation points determined by using a GPS tool (Raufet al 2020). The method of observation and sampling at each observation location refers to the American Public Health Association (APHA) (1992).

P. monodon and G. verrucosa production farming methods in pond. Pond areas of ±0.25 ha were used for rearing seaweed and tiger prawns. The rearing system consisted of pond plots 50% planted with seaweed and 50% stocked with tiger prawns at different densities, namely 8, 11 and 13 ind m^{-2}. Seaweed area and tiger prawn rearing area are limited by waring to allow water to flow from and to the tiger prawn rearing area with the assumption that there is a mutually beneficial relationship between seaweed and tiger prawns. In this study, the maintenance was carried out in 2 cycles and was replicated. To determine the production of tiger prawns, the conditions and outcomes of the *G. verrucosa* cultivation and of the combined seaweed and tiger prawns cultivation in shrimp ponds were examined by maintaining seaweed and shrimp for a period of 120 days. Tiger prawns were weighed every 2 weeks and seaweed plants were weighed every week, in order to determine their growth performance. The observed variables were the survival rate for tiger prawns and growth rates for tiger prawns and seaweed.

Feasibility of P. monodon and G. verrucosa integrated cultivation business. Environmental suitability for tiger shrimp cultivation is a supporting ecosystem service to the cultivators' benefit (Kasmir 2012). In addition, the success of cultivation will ultimately be evaluated trough the amount of income (profit) generated (Irsan 2021).

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After analyzing the suitability of the aquatic environment in accordance with the aquaculture requirements, a profitability analysis was carried out. To identify the prospects for developing tiger prawn and seaweed farming, a business profitability analysis was carried out. For assessing the profitability of a business, it is necessary to carry out a profits and costs analysis, intended to offer the entrepreneurs/farmers an overview of the profitability of the business being carried out. Thus, the entrepreneurs/farmers (cultivators) can evaluate the profit and loss of the developed business and the capital return. The R/C ratio analysis was used to assess the profitability of tiger shrimp and seaweed cultivation, profitability by comparing the revenue and production costs for 1 year. When the R/C ratio <1, the business is not profitable. An R/C ratio equal to 1 defines the break even point. For an R/C ratio>1, the business can be developed with profits (Kasmir 2012).

Results

Quality of coastal waters (physical and chemical parameters of waters). The average value of the results of measuring the quality of coastal waters in Barru Regency taken from each observation station (sea and ponds) is presented in Table 1.

Table 1
Value of water quality measurement results at marine stations and ponds in coastal waters, Barru Regency

Parameters	*Station*		*Quality standards*
	Sea	*Pond*	
Temperature (°C)	28.9±1.5	28.5±0.80	21-32
Brightness (%)	72.10±7.40	65.90±15.20	>5
Salinity (ppt)	30.8±1.25	30.12±1.18	5-35
Current (ms^{-1})	0.178±0.035	-	-
DO (mg L^{-1})	5.86±2.26	3.75±01.05	≥3
pH	7.90±0.08	7.60±0.19	6.5-8.5
TSS (mg L^{-1})	68,5±18.5	130.5±39.6*	25-80
BOD_5 (mg L^{-1})	5.64±2.14	6.54±1.70	<25

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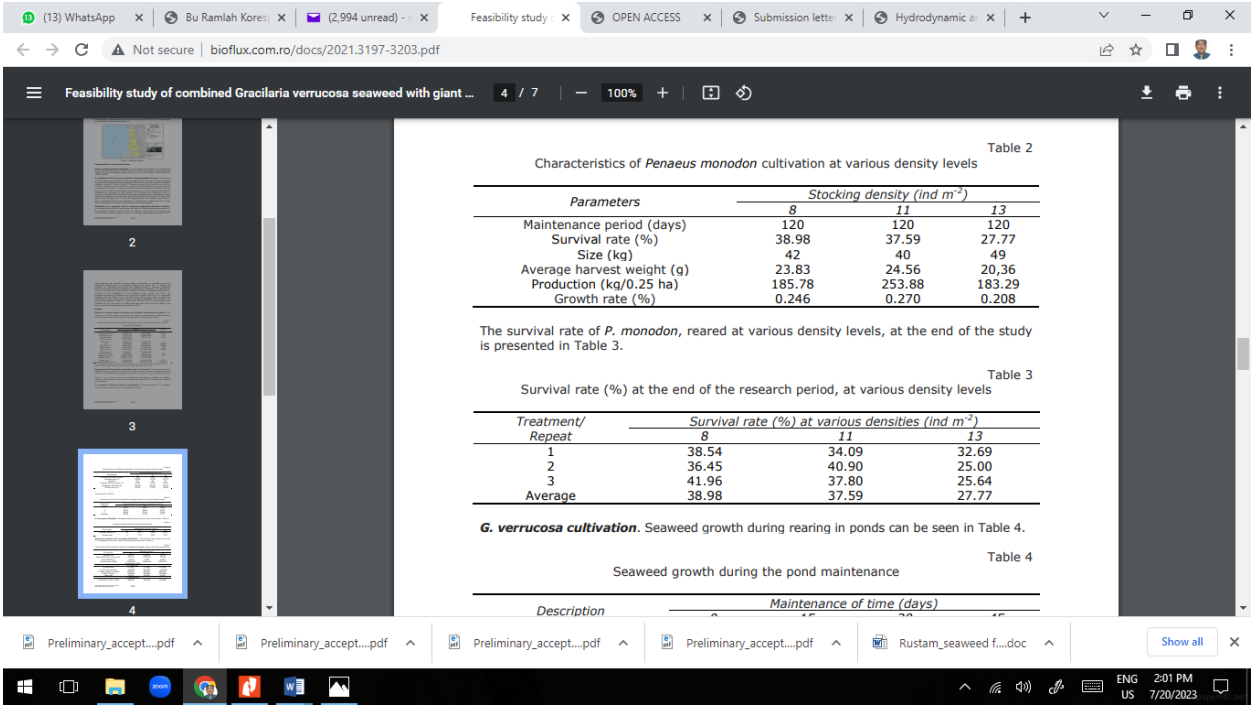

Table 2

Characteristics of *Penaeus monodon* cultivation at various density levels

Parameters	*Stocking density (ind m^{-2})*		
	8	*11*	*13*
Maintenance period (days)	120	120	120
Survival rate (%)	38.98	37.59	27.77
Size (kg)	42	40	49
Average harvest weight (g)	23.83	24.56	20,36
Production (kg/0.25 ha)	185.78	253.88	183.29
Growth rate (%)	0.246	0.270	0.208

The survival rate of *P. monodon*, reared at various density levels, at the end of the study is presented in Table 3.

Table 3

Survival rate (%) at the end of the research period, at various density levels

Treatment/ Repeat	*Survival rate (%) at various densities (ind m^{-2})*		
	8	*11*	*13*
1	38.54	34.09	32.69
2	36.45	40.90	25.00
3	41.96	37.80	25.64
Average	38.98	37.59	27.77

G. verrucosa cultivation. Seaweed growth during rearing in ponds can be seen in Table 4.

Table 4

Seaweed growth during the pond maintenance

Description	*Maintenance of time (days)*

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