UDC 639

IDENTIFICATION OF COASTAL SPACE FOR VANNAMEI SHRIMP (LITOPENAEUS VANNAMEI) AQUACULTURE BASED ON GEOGRAPHICAL INFORMATION SYSTEM IN CEMPI BAY (DOMPU REGENCY, WEST NUSA TENGGARA)

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ABSTRACT
The research was conducted in February 2018 at the coast of Cempi Bay, Dompu Regency, West Nusa Tenggara. The objective of this research is to identify coastal area space to be utilized as *vannamei* shrimp aquaculture properly based on land carrying capacity. Data were analyzed using ArcGIS 10.2 software. Land carrying capacity and fisheries scale comparison data obtained in the coast of Cempi Bay were as follows: temperature (29.1 - 31.67 ° C), dissolved oxygen (3.84 - 5.9 mg / L), brightness (42.34 - 68), Nitrate (0.027 - 0.156 mg / L), phosphate (0.001-0.026 mg / L) and water pH 6,7-7,77). The land carrying capacity of Cempi Bay coastal land obtained from the overlay result consists of 2 Class conformity. Scores for the suitable land are 19835 with an area of 2699,480713 Ha and a fairly suitable land 285 with an area of 38,735236 Ha.

KEY WORDS
Land carrying capacity, land suitability, Cempi Bay, shrimp.

Vannamei shrimp is aquaculture commodity in Cempi Bay possessing high economic value. The high economic value is exhibited in the form of increased production in the region. The production of Vannamei shrimp has increased from 68.40 tons in 2013 to 293.63 tons in 2016 (DKP Dompu Regency, 2017). Increased production of Vannamei shrimp aquaculture area is followed by an increase of aquaculture area from 1,405 Ha in 2013 to 2,725 ha in 2016 (BPS Dompu, 2017). The increase of pond area in Cempi Bay is caused by the conversion of mangrove forest area to aquaculture (Nastiti et al., 2015)

Land function transfer to aquaculture resulted in the reduction of mangrove forest area. Reduced mangrove forest may potentially disrupt the aquaculture activities, as mangrove forest acts as protective area. Therefore the utilization must be controlled to deter damage in aquaculture environment (Utojo et al., 2010; Purnamawati et al., 2007). Hence, it is necessary to study coastal area space of Cempi Bay to be utilized as vannamei shrimp aquaculture area by identifying existing vannamei aquaculture area without changing the function of mangrove forest for establishing new fisheries.

Identification of vannamei shrimp aquaculture area can be done by analyzing the land carrying capacity of the area. Analysis of land carrying capacity aimed to obtain land suitability based on the criteria of vannamei shrimp aquaculture. Therefore land use for vannamei aquaculture activities in the area can be used suitablely and purposefully. Several studies exhibited that the criteria for the analysis of land carrying capacity of vannamei shrimp aquaculture are temperature, salinity, pH, ammonia, nitrate, phosphate, dissolved oxygen and brightness (Rekha et al, 2015; Hossain and Das, 2010; Santoso, 2016; Mustafa, 2012; Bray et al., 1994; Pance-palatox et al., 1997). One method used to obtain the level of land suitability of vannamei shrimp aquaculture based land carrying capacity criteria could be conducted using Geographic Information System (GIS)

METHODS OF RESEARCH

The study was conducted on the coast of Cempi Bay on 18 observation stations spread in Woja, Dompu, and Pajo district. Map of research station distribution is presented in Figure 1. Research method used is survey method using Geographic Information System (GIS)

approach. Survey method is a method that aims to describe current or past phenomena by interviewing and distributing questionnaires (Hamdi and Bahruddin, 2014; Nazir, 2011). The questionnaire data obtained is used for the purposes of pairwise comparison of land carrying capacity parameters using AHP analysis (Analytical Hierarchy Process) priority scale of land carrying capacity.

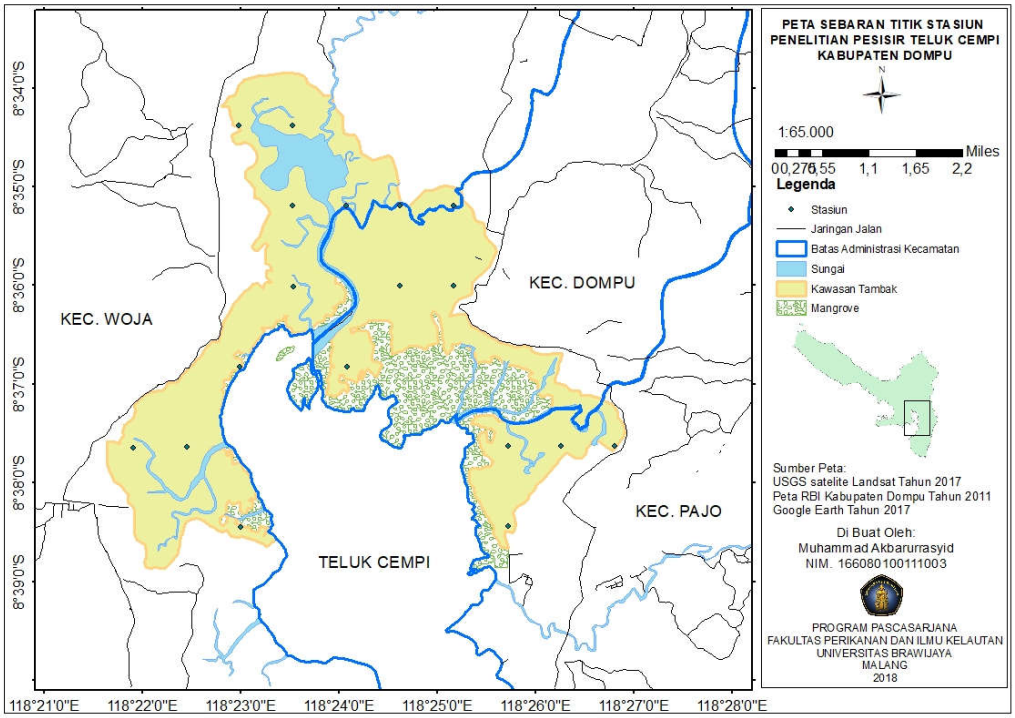

Figure 1 – Map of observation stations distribution

The survey data is then processed using ArcGIS 10.2 software to obtain a thematic map model related to the level of suitability of coastal space for vannamei aquaculture. Conformity analysis was conducted by designing land suitability matrix based on land carrying capacity criteria that contains scoring and weighting. It was then overlaid to obtain the level of conformity. The conformity matrix is presented in Table 1. The level of suitability is divided into 4 conformity classes, namely: S1 class: very suitable, S2 class: Suitable, S3 class: Adequately Suitable and S4 Class: Not Suitable (Mustafa, 2012).

Table 1 – Land Suitability Matrix

No	Parameter	Land Suitability				Weight (%)
		S1	S2	S3	S4	
1	Dissolved oxygen (mg/L)	4-5	3,5-4 ; 5-5,5	3-3,5 ; 5,5-6	<3 and >6	19,9
2	Brightness (cm)	30-50	25-30 ; 50-55	20-25 ; 55-60	<20 and >60	3,4
3	Temperature (°C)	28-30	20-28 ; 30-32	18-20 ; 32-35	<20 and >35	32,7
4	Salinity (ppt)	15-20	10-15 ; 20-25	5-10 ; 25-30	>30	7,3
5	Ammonia (mg/L)	<0,1	0,1-0,2	0,2-0,3	>0,3	12
6	Nitrate (mg/L)	0,3-0,5	0,1-0,3	0,5-0,6	<0,1 and >0,6	10,2
7	Phosphate (mg/L)	0,10-0,20	0,01-0,10	0,20-0,30	<0,01 and >0,30	8,6
8	Water pH	7,5-8	6-7,5 ; 8-8,5	4-6 ; 8,5-9	<4 and >9	5,8

Source: Susatyo and santoso, (2016); Bray et al., (1994); Pance-palatox et al., (1997); KKP, (2016); and Modification result, (2018).

RESULTS AND DISCUSSION

The parameters of land carrying capacity observed were the parameters of vannamei shrimp aquaculture requirements. The parameters of land carrying capacity observed on the

coast of Cempi Bay indicate a value that varies between points of observation. The observation results of the land carrying capacity parameters are presented in Table 2. The observed results are grouped into their respective classes for scoring and weighting analysis.

Table 2 – Land Carrying Capacity Parameters

No	Station	Parameter							
		Dissolved oxygen (mg/L)	Brightness (m)	Temperature (°C)	Salinity (ppt)	Ammonia (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)	Water pH
Dompu District									
1	W1	4,94	47,17	31,27	17,33	0,141	0,134	0,003	7,14
2	W2	4,37	49,5	32,04	18,34	0,133	0,126	0,005	7,37
3	W3	3,84	50,67	32,2	19,34	0,162	0,156	0,006	7,3
4	W4	5,04	47,34	31,17	19,67	0,155	0,147	0,004	7,14
5	W5	4	51,67	32,34	19,67	0,152	0,145	0,001	7,7
6	W6	5,2	47	31,04	21,33	0,091	0,079	0,003	7,2
7	W7	5,57	44,67	30,07	24,33	0,072	0,065	0,009	6,97
8	W8	4,64	46,17	30,64	21,33	0,097	0,084	0,006	7
9	W9	4,9	47	30,9	22,67	0,061	0,054	0,003	7,07
10	W10	5,9	42,34	29,77	23,67	0,043	0,027	0,007	6,74
Dompu District									
11	D1	4,6	54,84	31,47	19,67	0,143	0,134	0,011	7
12	D2	4,7	52,84	31,17	21,67	0,141	0,133	0,018	6,87
13	D3	4,64	52,84	31,3	23,34	0,139	0,131	0,012	6,97
14	D4	4,57	48	30,7	25,67	0,083	0,064	0,014	6,6
Pajo District									
15	P1	4,24	53,67	31,54	20,67	0,133	0,115	0,021	6,64
16	P2	4,14	57,34	31,97	22,67	0,121	0,101	0,024	6,87
17	P3	4	56,34	31,84	25,34	0,099	0,085	0,023	6,9
18	P4	3,87	69	32,2	25,34	0,089	0,074	0,026	7,3

Land Carrying Capacity. Aquaculture Ponds require close proximity to freshwater and saltwater sources as vannamei shrimp growth medium. The distance between beach and ponds on the coast of Cempi Bay ranges from 83.33 to 4,094.1 meters. The distance between vannamei shrimp aquaculture ponds to coast requires distance between 0 to 200 meters, while distances ranging from 300 to 4000 meters are still in fairly suitable categories (Susetyo and Santoso, 2016; Yulianda, 2008). The distance between ponds and rivers ranges from 29.22 – 1,861.26. The distance between ponds with a river suitable for vannamei shrimp aquaculture ranges from 0-500 meters. The distance of 500-1,500 meters from the river makes it still possible to obtain fresh water. Nevertheless, it requires technology support, hence requiring additional production costs (Ristiyani, 2012; Syaugi, 2013).

Pond water temperatures can affect various biological, physical and chemical processes. Water temperature can affect survival, morphological growth, reproduction, behavior, moulting process and shrimp metabolism (Suwarsih et al., 2016). Pond temperatures on the coast of Cempi Bay ranges from 29.1 - 31.67 ° C. The range of suitable temperature values for vannamei shrimp aquaculture ranges from 26 to 31 ° C and has a tolerance value of 16 - 36 ° C, the growth of good vannamei shrimp ranges from 29 ° -32 ° C and optimal growth occurs at 26 ° C (Pasongli et al., 2015; Farkan, 2016). Ponds temperature affects the salinity of the pond. Salinity affects osmotic pressure on vannamei shrimp. The salinity of ponds on the coast of Cempi Bay ranges from 16.34 - 25.34 ppt. The suitable salinity value for vannamei shrimp aquaculture ranges from 5 - 40 ppt and grows optimally at a salinity of 15-20 ppt (Bray et al., 1994; Asbar, 2007).

Ammonia, nitrates, and phosphates greatly affect the productivity of ponds. The value of ammonia in the Cempi Bay coast ranges from 0.043 - 0.161 mg / l. The range of ammonia values required for Vannamei aquaculture activities ranges from 0.3 to 1 mg / l. Vanamei shrimp can grow optimally at ammonia value <0.05 mg / l. Ammonia values less than 0.01 ppm and exceeding 0.45 ppm can inhibit shrimp growth by up to 50% (Susetyo and Santoso,

2016; Kilawati and Maimunah, 2014). The value of nitrate ranges from 0.027 - 0.156. The range of nitrate values required for vannamei shrimp aquaculture ranges from 0.3 to 0.5 mg / L (Susetyo and Santoso, 2016). Phosphate value ranges from 0.001 to 0.026 mg / L. Bathnagar et al., (2004) said the phosphate value of 0.05-0.07 mg / l encourages optimum and productive vannamei aquaculture. According to Asbar, (2007), phosphate value between 0.09 to 0.45 ppm is still within the optimal range for shrimp culture

Land Carrying Capacity Suitability. The suitability of the carrying capacity comprises the spatial distribution of dissolved oxygen temperature, salinity, ammonia, nitrate, phosphate and brightness that have been overlapped. The suitability of land carrying capacity is interpreted in the form of a map showing the difference of color degradation based on the conformity level of the limiting criteria for vannamei shrimp aquaculture. The land suitability conformity map is presented in Figure 2.

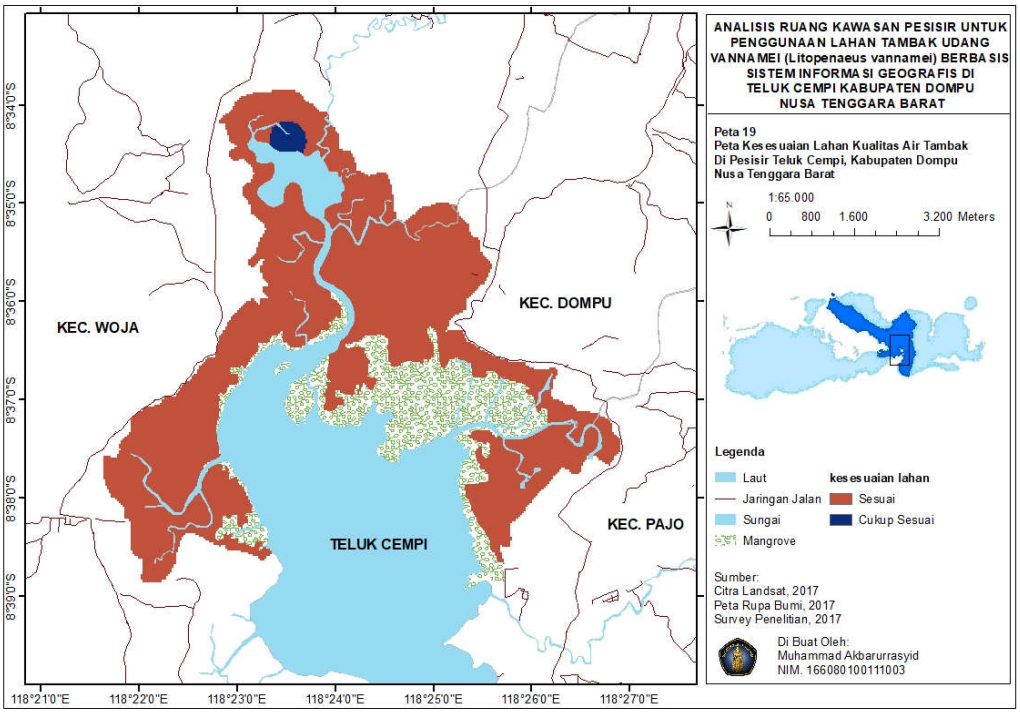

Figure 2 – Compatibility of land carrying capacity

The result of land suitability analysis as shown in Figure 2. Research result exhibited 2 classes of suitability based on the difference of color degradation. The red color shows the corresponding location of 2699,480713 Ha and the blue color shows a suitable location covering an area of 38,735236 Ha for vannamei aquaculture. Based on the suitability class obtained, the Cempi Bay coastal area is mostly suitable for vannamei shrimp aquaculture.

Land carrying capacity value in Cempi Bay coastal area reveals suitable category for vannamei aquaculture activities. The most influential parameters in aquaculture activities are temperature and dissolved oxygen. Temperature is an important factor for biological, physical and chemical reactions in pond waters. Dissolved oxygen is an important water quality conversion parameter in aquaculture activity. Dissolved oxygen has an important role in aquaculture activities. Reduced oxygen value causes decreased oxygen consumption, high respiratory activity and decreased appetite (Dede et al., 2014; Awanis et al., 2017; Farkan, 2016).

CONCLUSION

The carrying capacity of Cempi Bay coastal land obtained from an overlay of land carrying capacity map consists of 2 classes of conformity. Based on the results of the

comparative scale calculation using AHP, the following value were obtained: temperature weight 32,7%, dissolved oxygen 19,9%, brightness 3,4%, salinity 7.3%, ammonia 12% nitrate 10,2%, phosphate 8,6% and water pH 5.8%. Scores for suitable land are 19835 with an area of 2699,480713 Ha and a fairly suitable land 285 with an area of 38.735236 Ha.

SUGGESTIONS

This study exhibits the zone of the suitability of the use of coastal space for Vannamei shrimp cultivation activity based on land carrying capacity. Further research is needed in the development of coastal areas and the method of vannamei shrimp aquaculture that can be applied.

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