Single Exponential Smoothing on Pangasius Production Forecasting in South Sumatera (M.YAMIN)

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Research Paper

Single Exponential Smoothing on Pangasius Production Forecasting in South Sumatera

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Abstract
The product of inland waters in South Sumatra has potential, namely Catfish (*Pangasius Sp.*). South Sumatra is working on the export potential of catfish because production has penetrated the first rank in Indonesia. Sumatra Island is the largest contributor, namely 68.07% of the total national catfish production, while South Sumatra is recorded as the largest catfish aquaculture producer in Indonesia, which is around 47.4% of the total national production. As one of the production centers for catfish in Indonesia, it is hoped that there will be an increase in production to meet local and national demand. This study aimed to predict catfish production in South Sumatra in 2023 using the Single Exponential Smoothing Method. The Single Exponential Smoothing method is suitable for predicting random fluctuations. The data used was secondary data from the Ministry of Maritime Affairs and Fisheries and the Central Statistics Agency for South Sumatra in the form of catfish production data in South Sumatra from 2006 to 2022. Forecasting carried out by calculating the average error value using the MAPE method. MAPE is one of the criteria to see accurancy of the forecasting method. The results showed that the MAPE value of the catfish production forecasting model in South Sumatra was 43,58%. Forecasting catfish production in South Sumatra in 2023 is 53.111,15 tons.

Keywords
Forecasting, *Pangasius Production*, *Single Exponential Smoothing*

1. INTRODUCTION

Pangasius is one of the fastest growing freshwater fish commodities in the world (Thong et al., 2020). Several countries in Asia, including Malaysia, Cambodia, Laos, Bangladesh, China and Indonesia, have experienced an increase in local consumption and exports of Pangasius (Tien Thong et al., 2017). Pangasius is a leading national commodity. The Ministry of Maritime Affairs and Fisheries has made pangasius one of the focuses of developing Indonesian fisheries cultivation. The activity of developing aquaculture villages is one of the priority programs of the Ministry of Maritime Affairs and Fisheries in 2021-2024.

The water areas in South Sumatra mostly consist of general areas which include swamps, wetlands and rivers. So it is not surprising that fish from inland waters is one of the food choices that is popular with people in the local area. One of the inland water products in South Sumatra that has great potential is Pangasius. South Sumatra is working on the export potential of Pangasius because production has reached first place in Indonesia. This can be seen from the production figures for Catfish in South Sumatra in 2021, namely 72.758,84 kg. South Sumatra is recorded as the largest producer of Pangasius cultivation in Indonesia, namely around 47,4 percent of total national production. Table 1 shows the level of Pangasius production in Indonesia in 2021.

The level of fish consumption in South Sumatra has reached 45,14 kg/capita/year (The Ministry of Maritime Affairs and Fisheries, 2022). One of the factors for the high consumption of fish in South Sumatra is due to the existence of local specialties, namely pempek, pindang, smoked fish and the like, using fish as raw materials and a supply of fish that is always available. Pangasius is one of the raw materials for typical food in South Sumatra. To meet the needs of fish high then the government must try hard to prepare the availability of fish lots. To ensure production results aquaculture requires a method forecasting that can know/predict the results of the fisheries production with pinpoint accuracy.

Several studies have been carried out using the exponential smoothing method produce accurate forecasting values making writer interested in conducting similar research, such as Supriatin and Rohman (2020), Navalina et al. (2020),

Table 1. Pangasius Production in Indonesia in 2021

No.	Province	Volume of Production (kg)
1	Aceh	18,36
2	Bali	62,95
3	Banten	825,85
4	Bengkulu	4.273,74
5	DI Yogyakarta	279,30
6	DKI Jakarta	15,95
7	Gorontalo	17,24
8	Jambi	18.896,98
9	West Java	31.176,95
10	Central Java	4.934,81
11	East Java	22.706,52
12	West Kalimantan	10.152,43
13	South Kalimantan	46.282,00
14	Central Kalimantan	33.574,49
15	East Kalimantan	12.298,10
16	North Kalimantan	115,42
17	Bangka Belitung Islands	118,74
18	Riau Islands	1.537,67
19	Lampung	18.854,61
20	North Maluku	1,26
21	West Nusa Tenggara	178,73
22	East Nusa Tenggara	12,75
23	Papua	4,13
24	West Papua	6,65
25	Riau	31.230,75
26	West Sulawesi	85,75
27	South Sulawesi	4,77
28	Central Sulawesi	21,08
29	Southeast Sulawesi	57,34
30	North Sulawesi	19,06
31	West Sumatera	4.367,99
32	South Sumatera	72.758,84
33	North Sumatera	8.754,39

Lisnawati et al. (2022), Irfanullah and Claudia Sumanik (2021), Samad and Perdana (2021) Jalil et al. (2011). Then the writer will predict the amount Pangasius production in South Sumatra uses the exponential method smoothing. This research aims to obtain prediction of the amount of pangasius production in 2023 in Sumatera Selatan. Besides it is hoped that this research will be able to do that assist central and regional governments in preparing the availability of fish so that there are no advantages or disadvantages fish availability in subsequent years using previous year data. It is hoped that the results of this research can become government policy regarding the availability of catfish so that there is no shortage or excess of catfish stocks for the following year.

2. EXPERIMENTAL SECTION

2.1 Research Location

This research was conducted in South Sumatra, Indonesia. Analysis data was using the Microsoft Excel application.

2.2 Data Collection

This study used secondary data from the Ministry of Maritime Affairs and Fisheries and the Central Statistics Agency for South Sumatra in the form of pangasius production data in South Sumatra from 2006 to 2022.

2.3 Data Analysis

The analysis used is forecasting method using exponential smoothing. As for the exponential method. The smoothing used is simple exponential smoothing. The Single Exponential Smoothing method is suitable for predicting random fluctuations (Ambarwati and Supardi, 2020). Exponential smoothing is a weighted moving average forecasting technique where data is weighted by an exponential function (Lisnawati et al., 2022). Single exponential smoothing gave slightly but consistently compared with other models such as ARIMA, double (Brown) exponential smoothing, linear (Holt) exponential smoothing and damped-trend linear exponential smoothing (Bezabih et al., 2023). The single exponential smoothing formula is as follows:

$$F_t = Ft-1+\alpha(At-1-Ft-1) \quad (1)$$

Information:
Ft = Forecast for time period t
Ft-1 = Forecast for the previous period
α = Smoothing constant (weighting) ($0 \leq \alpha \leq 1$)
At-1 = Actual demand for the previous period

The smaller the value of α, the less weight is attached to the most recent observation (Prestwich et al., 2014). The analysis most widely used in publications regarding forecasting is Mean Square Error (MSE), Mean Percent Absolute Error (MAPE), Mean Absolute Error (MAE) and Relative Mean Square Error (RMSE) (Mediavilla et al., 2022; Sezer et al., 2020). To measure the accuracy of forecasting results, historical error calculations are carried out using the following analysis:

a. Average absolute deviation / MAD (mean absolute deviation) MAD is a method of evaluating forecasting techniques, a measure of the difference between forecast and actual demand. The smaller the MAD, the more accurate the forecast value. The formula for calculating MAD is as follows:

$$\text{MAD} = \frac{1}{n}\sum_{t=1}^{n}|A_t - F_t| \quad (2)$$

Information:
MAD = Mean Absolute Deviation
n = Number of Samples
At = Actual value
Ft = Forecast value

b. Mean squared error / MSE (mean squared error) MSE is an alternative method for evaluating forecasting techniques. Each error (the difference between actual data and forecast data) is squared, then added up and divided by the amount of data. The formula for calculating MSE is as follows:

$$\text{MSE} = \frac{1}{n}\sum_{t=1}^{n}(A_t - F_t)^2 \quad (3)$$

Information:
MSE = Mean Square Error
n = Number of Samples
At = Actual value
Ft = Forecast value

c. Average absolute percentage error / MAPE (mean absolute percent error) MAPE is a percentage calculated from the absolute value of the error in each period and divided by the amount of actual data and then the average error is found.

$$\text{MAPE} = \frac{1}{n}\sum_{t=1}^{n}\left|\frac{A_t - F_t}{A_t}\right| \times 100 \quad (4)$$

Information:
MAPE = Mean Absolute Percent Error
n = Number of Samples
At = Actual value
Ft = Forecast value

Accuracy Criteria by using MAPE there are four criteria (Chang et al., 2007). The MAPE value is based on forecasting results with a value of 1–10 considered a very accurate forecast, 10–30 considered a good forecast and above 50 is considered an inaccurate forecast (Shaikh and Ji, 2016). In more details for the MAPE value categories can be seen in Table 2.

Table 2. MAPE Value Criteria

MAPE Value	Criteria
< 10%	Highly Accurate Forecasting
10% - 20%	Good Forecasting
20% - 50%	Reasonable Forecasting
>50%	Inaccurate Forecasting

3. RESULT AND DISCUSSION

Based on secondary data obtained from the South Sumatra Province Central Statistics Agency, the results of Pangasius production in South Sumatra are shown in Table 2 below :

Table 3. Pangasius Production in South Sumatera (2006-2022)

No.	Year	Pangasius Production (ton)
1	2006	773,8
2	2007	695,6
3	2008	29.064,90
4	2009	32.872,30
5	2010	55.582,40
6	2011	117.040,00
7	2012	218.100,00
8	2013	220.577,00
9	2014	231.258,00
10	2015	160.136,57
11	2016	192.500,00
12	2017	122.982,12
13	2018	137.662,05
14	2019	137.662,00
15	2020	38.494,28
16	2021	74.068,00
17	2022	48.660,00

The Covid 19 pandemic had shaken all fishery commodity markets in the world. Each country had a policy of closing most economic activities, one of which can cause a decrease in demand for fishery products. Khan et al. (2023) regarding the impact of the Covid 19 pandemic on the fisheries sector in Bangladesh which caused market demand to decline dramatically as a result of the level of fish consumption which also decreased. However, catfish production in Vietnam (the world's largest global pangasius supplier) experienced a surplus of cultivated catfish stocks due to the lockdown in 2021(FAO, 2023).

Based on the table above, the highest pangasius production in 2014 was 231.258 tons. Since 2007 there had been a significant increase in production until 2014. However, in 2015 it decreased by 50% to 160.136,57 tons. However, in 2016 there was a slight increase to 192.500 tons. And in 2017 it experienced a slight decrease again to 122.982,12 tons. Production decreased drastically in 2020 to around 38.494,28 tons as a result of the Covid-19 pandemic that hit the entire world. Special attention needs from the government so that the volume of Patin fish production increases in the following years. Steps that can be taken such as (Khan et al., 2021) by providing policies for easy access to credit services, training and counselling for small-scale cultivators. The productivity and profitability of Patin fish farming business will increase along with the increasing

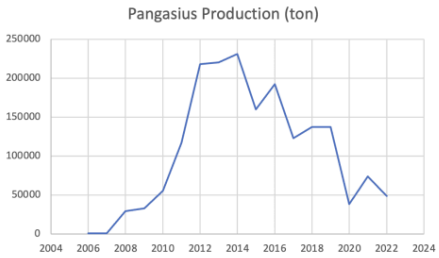

Figure 1. Pangasius Production in South Sumatera from 2006 to 2022

size of the aquaculture pond area.

By carrying out forecasting, it is hoped that it will be a stimulus for Catfish farmers to increase production to meet consumer demand which is starting to increase as the result of the recovery from the Covid 19 pandemic. From the data above it can be seen that the amount of catfish production in South Sumatra fluctuates from year to year. To see trends this change in catfish production is necessary a model was carried out for predict how things will change catfish production. Single Exponential Smoothing Method (SES) is one method forecasting in times series analysis which is used for data that is not has a certain tren (Putri et al., 2023). The graph below reflects data on catfish production in South Sumatra from 2006 to 2022.

The implementation of forecasting in fisheries industrialization can be applied in almost all fields, either aquaculture, capture and postharvest fisheries (Pamungkas et al., 2021). Forecasting accuracy is carried out to minimize prediction errors. Therefore, it is very necessary to calculate the magnitude of the error value from the predictions that have been made previously (Navalina et al., 2020). Single method exponential smoothing using data beforehand so that it is more accurate for predict short-term forecasts (Supriatin and Rohman, 2020). Results obtained for value exponential parameters by trying values between 0 and 1 are shown in the Table 3.

MAPE is used in this study to evaluate the performance of various kinds of forecasting models. A better fore- casting model can be found with smaller MAPE value (Chang et al., 2007). The results of processing using software obtained results that were predicted for 2023, pangasius production in South Sumatra will be 53,111.15 tons with the smallest MAPE value about 43,58%. The method for determining the MAPE value that can be used is by trial and error between 0 and 1 which has a value smallest MAPE. Based on the smallest MAPE value then used is 0.80. The results obtained show a MAPE value of 43.58, which means that the accuracy of the simple exponential smoothing method is within the sufficient criteria so that this method is accurate enough to predict catfish production results in South Sumatra. From the table 3 above, From the table above, select α which has the smallest MAPE value, namely α = 0.80.

Research using single exponential smoothing was also used by Supriatin and Rohman (2020), who concluded that aquaculture production in Malang Regency with a MAPE value of 17% was in the good category. Research related to fish projections and forecasting has previously been done, such as projections production of caught fish at the Nusantara Sibolga Fishing Port, North Sumatra Province, which concluded that in general the estimated results were up to in 2025 it is estimated that production will increase in skipjack tuna and krai tuna and decreased in yellowfin fish and Komo tuna. The MAPE value obtained is between 0.2% to 1.1% (Rahmah and Sitompul, 2023).

4. CONCLUSION

The results showed that the MAPE value of the pangasius production forecasting model in South Sumatra was 43,58% (Reasonable Forecasting). Forecasting pangasius production in South Sumatra in 2023 was 53.111,15 tons.

5. ACKNOWLEDGEMENT

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Table 4. Forecast Results and Alpha Values

α	MAD	MSE	MAPE (%)	Forecasting on 2023 (ton)
0,1	70.136,70	8.513.576.331,46	65,50	91.875,24
0,2	57.398,69	6.051.707.213,68	63,71	98.535,81
0,3	51.500,92	4.711.114.599,78	60,51	86.445,00
0,4	46.878,63	3.806.755.728,28	56,04	74.240,01
0,5	42.124,69	3.187.968.586,31	51,21	65.427,49
0,6	37.957,79	2.771.759.035,86	47,00	59.597,63
0,7	35.199,04	2.500.666.180,88	44,50	55.770,45
0,8	33.869,29	2.337.282.113,57	43,58	53.111,50
0,9	33.739,05	2.259.357.358,45	43,69	50.944,15
0,95	33.831,36	2.248.563.137,75	43,91	49.853,86

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