Big Data Project
Heva Yumi

Analysis of Fisheries Modernization in Indonesia: Study Case in East Kalimantan Province

Introduction

With its 81,000 km of coastline and 17,000 islands, Indonesia has an abundance of marine resources that should be exploited sustainably (Alder, 1994). However, Indonesia also faces challenges from the fisheries sector, primarily since almost 60% of the population occupies coastal areas where fishing activities exist (Elliott, 2001). Moreover, capture fisheries condition in Indonesia is still dominated by small scale fishing.

Generally, the vessel boat type in Indonesia is divided into three; without engine, outboard boat, and motor boat. Since many years ago, the Indonesian government aimed to modernize fishing vessel from no engine and outboard boat into motor boat. The basic idea was that without the modernization of the fleet, it seems not possible to maximize the production of fisheries.

This paper only focuses on East Kalimantan province. The determination is based on the consideration that I am working in it. I am interested to know about how strong the number of vessel affect production and how far the increase of motor boat impacts no engine boat or outboard boat. This is essential things to be analyzed statistically since until now, no particular attention has been devoted pertaining linear model correlation. Basic analysis is only executed through table and graph in excel.

Objective

The objectives of this big data analysis paper are:
1. To examine the relationship between fishing vessel and production
2. To examine the relationship between motor boat and no engine and outboard boat
3. To compare the number of boat each types and production in Kalimantan

**Output and limitation of study**

Although this paper seems still simple in analyzing some variables in fisheries, but the initial study finding about the correlation is essential for information before making any development program in fisheries. Moreover, R tool gives more chances to explore the type of graph which is more interesting in visualizing data. The data is obtained from two sources; Statistics Bureau of Indonesia and One Data of Ministry Marine Affairs and Fisheries of Indonesia (MMAF). However, the limitation of available data in online open source prevented the analysis further. No fish biology or maximum sustainable yield data could be found. Furthermore, the data is only provided in general based on Province. Hence, no online data in municipal/city is available.

Discussion

This discussion part will present table, graph and figure and analyze linear regression to understand the correlation between variables.

Table 1 The number of vessel, household and prod in East Kalimantan Province 2000-2015

Year	Vessel	Household	Prod
2000	1 796	10,658	71,937
2001	3 218	19,871	82,715
2002	3 316	19,900	84,089
2003	6 460	21,976	87,803
2004	5 259	20,673	93,511
2005	3 156	24,072	99,692
2006	3 739	27,732	90,825
2007	3 957	30,829	95,740
2008	6 445	33,966	92,176
2009	4 391	34,742	93,762
2010	2 813	24,490	115,601
2011	3 281	27,704	102,907
2012	2 052	26,840	105,393
2013	2 308	27,806	107,147
2014	2 447	28,176	111,199
2015	1 454	22,262	99,940
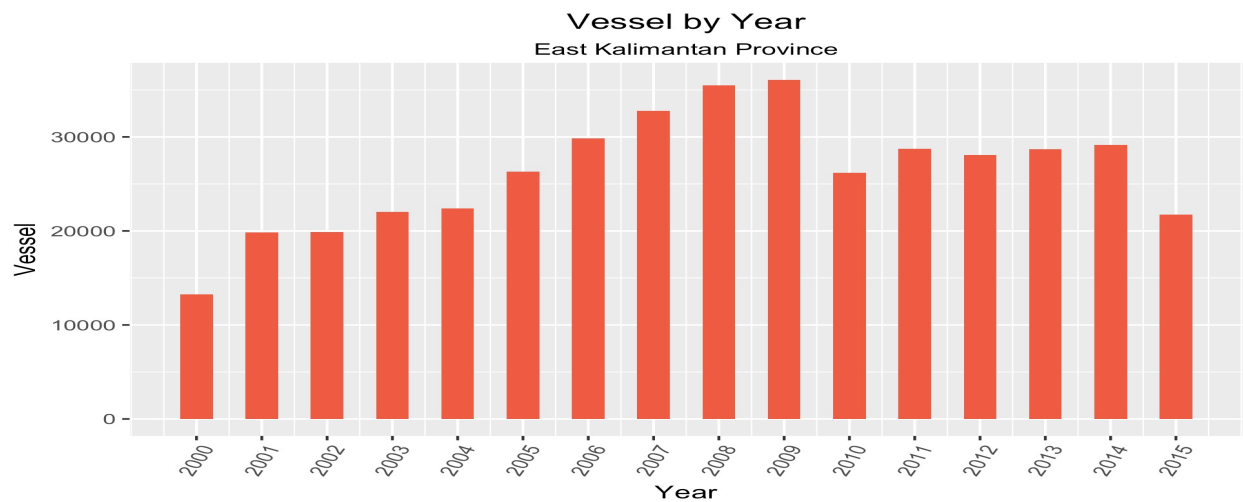
Graph 1 The number of vessel by year 2000-2015 in East Kalimantan Province
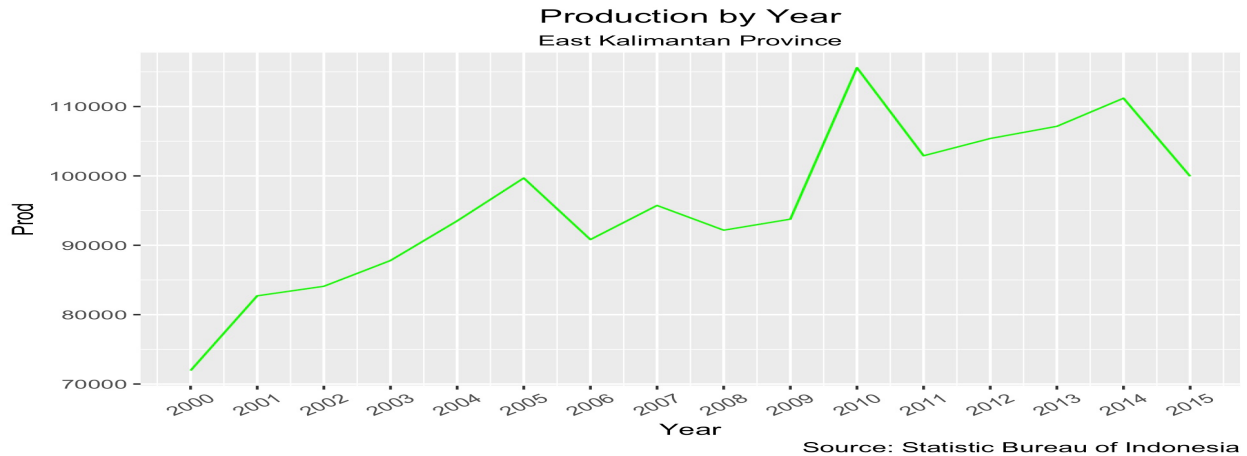
Graph 2 The total production each year 2000-2015 in East Kalimantan province

```
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 3.615e+01  1.207e+04   0.003   0.9977
Prod        2.737e-01  1.250e-01   2.189   0.0461 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 5481 on 14 degrees of freedom
Multiple R-squared:  0.255,   Adjusted R-squared:  0.2017
F-statistic: 4.791 on 1 and 14 DF,  p-value: 0.04605
```

Figure 1 Linear regression vessel and production in East Kalimantan province

From the statistically test, there is relationship between vessel and production. The p value 0.04 which is less than 0.05 has rejected the NULL hypothesis (no correlation). Every increase of 1 unit boat will increase the production of 2.737e-01 ton. Multiple square is 0.25 which means that the model explains that 25% of the variability data is around mean.

Table 2 The type of boat in East Kalimantan province 2000-2015

year	none	outboard	motorboat	total
2000	1796	3012	8453	13261
2001	3218	5830	10812	19860
2002	3316	4851	11736	19903
2003	6460	5713	9850	22023
2004	5259	6667	10451	22377
2005	3156	4492	18667	26315
2006	3739	5685	20439	29863
2007	3957	5333	23495	32785
2008	6445	12079	16958	35482
2009	4391	14893	16798	36082
2010	2813	6319	17036	26168
2011	3281	5644	19813	28738
2012	2052	6545	19475	28072

2013	2308	6950	19438	28696
2014	2447	6727	19956	29130
2015	1454	3424	16864	21742

```
Residual standard error: 4649 on 14 degrees of freedom
Multiple R-squared:  0.0239, Adjusted R-squared:  -0.04583
F-statistic: 0.3427 on 1 and 14 DF,  p-value: 0.5676
```

Figure 2 Linear regression motor boat and outboard boat

```
Residual standard error: 4592 on 14 degrees of freedom
Multiple R-squared:  0.04749,    Adjusted R-squared:  -0.02055
F-statistic: 0.698 on 1 and 14 DF,  p-value: 0.4175
```
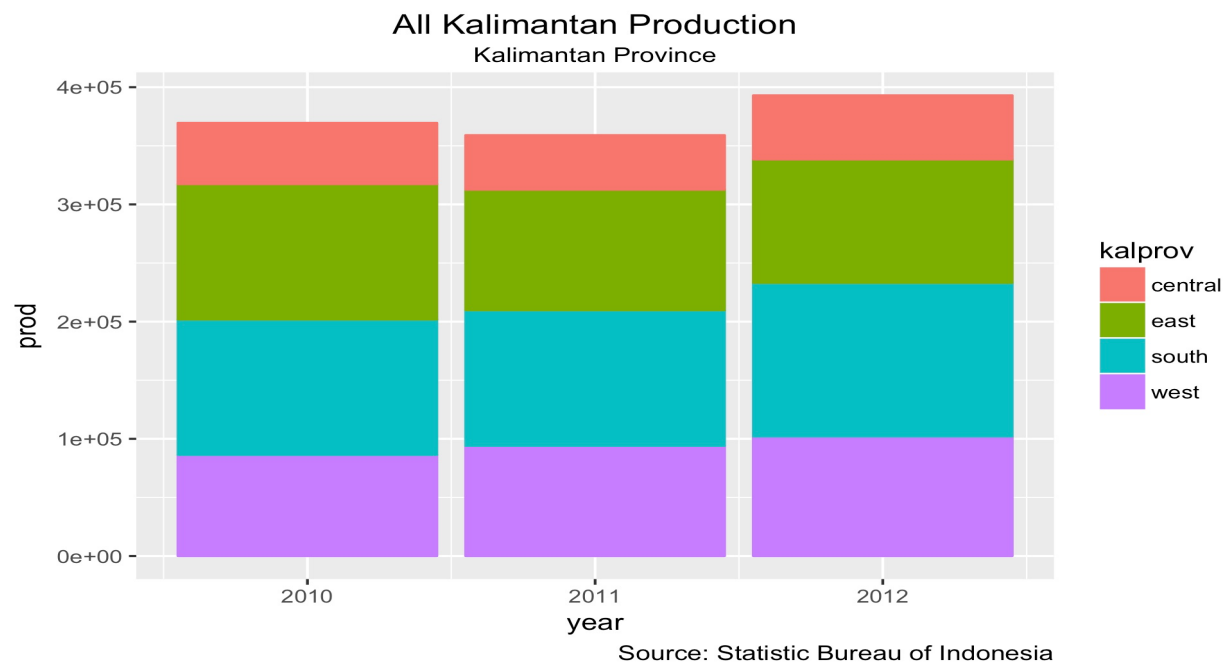
Figure 3 Linear regression motor boat and no engine boat

From the test, it is known that the increase of motor boat does not affect both no engine boat and outboard boat because p value > 0.05. Therefore, no relationship among them. However, align with the purpose of modernization fishing vessel, it should have been correlation among them. It means that the increases of motor boat will decrease the number of no engine and outboard boat which is evidently not true. However, the largest number of boat is motorboat which is 44-77% of total types. The outboard is in range of 15-41%. However, without engine type has the smallest portion which is only 6-13%. Nevertheless, in Indonesia the motor boat is categorized into three size: < 5 gross tonnages (GT), 5-10 GT, and >10 GT which < 10 GT of motor boat takes the highest proportion. The <10 GT was 86% of the total number of boat, compare to >10 GT which was only 14% (MMAF, 2005). The small-scale fisheries play important role to determine the status of production and status of fisheries resources (over, under or stagnant).

Another graph about total production in Kalimantan province is depicted below. From the graph, we can easily find that East Kalimantan occupies the third rank of fisheries production.

Total Production
Kalimantan Province

Source: Statistic Bureau of Indonesia
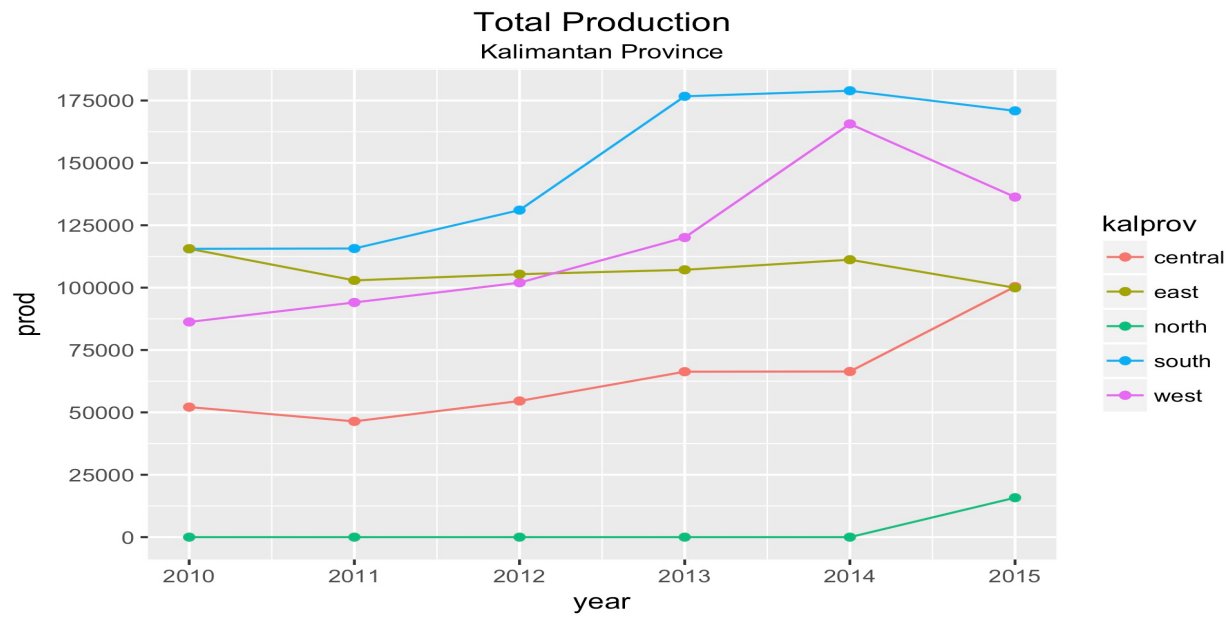
Graph 3 Total Production in Kalimantan Province

All Kalimantan Production
Kalimantan Province

Source: Statistic Bureau of Indonesia

Graph 4 Total Production in Kalimantan Province

The graph 3 and graph 4 are similar to compare among Kalimantan province. With R, we can make many various data visualization depending on the purpose. In graph 3, the visualization more emphasizes to the trend series. Hence, by looking the graph, we know about the fluctuation more easily. On the other hand, the graph 4 combined the variable into one bar which more portrays about ratio or proportion.

The last statistical model is to know the correlation between the number of fishermen and production which is not related as described below.

```
Residual standard error: 24360 on 10 degrees of freedom
Multiple R-squared:  0.1063,  Adjusted R-squared:   0.01691
F-statistic: 1.189 on 1 and 10 DF,   p-value: 0.3011
```

Figure 4 Linear regression of the number of fishermen and production

From p value: 0.3 (>0.05), this model does not reject H0. There is no correlation between the number of fishermen and the total production.

Conclusion

Modernization is a good program to improve economy and prosperity of coastal community because commonly the small-scale fishers use traditional fleet and gear for fishing. However, modernization is only about the changes of technology where the government strongly encourage the fishermen to convert their fleet to bigger level. However, at this point, to incorporate statistical analysis is crucial to get know the correlation among data. Combining data and analysis it will be beneficial to get more information. R package is open access source that could be used as a tool for analysis.

Source data:
https://www.bps.go.id/statictable/2014/01/16/1711/produksi-perikanan-menurut-subsektor-ribu-ton-1999-2015.html
https://data.go.id/dataset/jumlah-nelayan-nasional