

West Java's Rice Consumption Ecological Footprint: the Past and Now

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ABSTRACT

Crowned as the one of the most productive area of paddy farming and also the largest rice consumers in Indonesia, West Java's now facing an imminent obstacle of losing its capability of fulfilling the demand for rice. It all due to both land use changed and a rise of total rice consumption throughout years. To acknowledging this condition, this paper aims to calculate demand of rice in West Java based on number of productive land requires. Ecological Footprint (EF) calculations were conducted to show current level of EF and available biological capacity (BC) in West Java. Both results then compared to indicate whether there are biological capacity surpluses or deficits.

Keywords: West Java, rice consumption, Ecological Footprint

1. INTRODUCTION

Since a long time ago, rice has been “justified” as the most consumed staple food in Indonesia, which also is in West Java. Though not all people are consuming rice, its viability is considered vital. West Java as one of the largest producer of rice, in a same time also consumed a large amount of rice due to its largest population among provinces. In term of rice producing, while a large margin of increase in production performed by other areas, West Java suffers a continual lag in increasing the production (Badan Pusat Statistik, 2016). During 2011, the increase of rice production was only 0.05% from the previous year, which considered as a low increase compared to other province which are able to achieve up to 2% of production increase (Dinas Pertanian, 2014; Badan Pusat Statistik, 2014). In the other hand, the average population growth of West Java is reaching up to 1.64% per year, the highest population growth in Java (Badan Pusat Statistik, 2013).

The lag for production is increasing due to a lot of disruption from land used change of paddy field that occur, caused by both private sectors and government decision as the establishment of infrastructure (Firman, 2000; Irawan, 2005; Kementerian Pertanian 2014). Based on Agricultural Ministry data, during 1998 until 2002, the agriculture land use changed in Indonesia is 110,000 ha/year more or less. While Mawardi (2006) pointed out that in Java during 1997 until 2000, the total agriculture land use changed is 700,000 ha, equals to 54% of total land use changed, or 230,000 ha/year. Most of the land use changes were changed into settlement area (69%) and industrial area (20%). In accord to these facts, there lays a worry for the current capability of West Java's paddy field in term of fulfilling the demand of rice.

The human being's demand of product, particularly food, is connected to Earth's capability as producer (Braat and Rudolf de Groot, 2012; Rudolf de Groot et al., 2012), which also applies for the rice demand in West Java. Thus, comparing the demand in form of land with its resources availability might able to indicate the trade-off between human demand and earth capability. Ecological Footprint (EF) is a usable tool to compare consumption and nature's ability to support this consumption (Zhen and Du, 2017; Wackernagel and Rees, 1998).

EF measurement would be able to comparing the rice consumption (in form of EF) with the West Java's capability of producing rice, in form of biological capacity or biocapacity (BC) (Zhen and Du,

2017; Kitzes et al., 2009). ASEAN was measured to have exceeded its BC in food EF and reaching overshoot point in 1990 (Iha et al., 2015), and Indonesia, in general, is also assessed has reached its overshoot in 2007 (Kementerian Pekerjaan Umum, 2010). The most consumed food in Indonesia is rice, which take a large part of portion of the total EF of consumption product, and so is West Java. Ensuring a land for rice farming to meet the demand of rice could consider as the main purpose of maintaining agriculture area. Thus, based on this fact, there is a possibility that rice consumption in West Java might already overshooting their biological capacities.

2. DATA AND METHODS

Most data were acquired from West Java Bureau of Statistic and other affiliated governmental offices, particularly the rice consumption per capita, total population and available paddy field. Consumption per capita data were multiplied by total population, in order to get total consumption data. Then, those data were converted into the EF and BC value through the following calculation (Ewing, et al., 2010):

$$EF = \frac{TCons}{\hat{Y}} \cdot YF \cdot EQF \quad (1)$$

Where:

EF = calculated ecological footprint of total rice consumption

\hat{Y} = average rice production yield per year

YF = yield factor of West Java's and national

EQF = equivalent factor for the cultivated land

Consumption EF and BC calculated is based on the regional area of West Java, in which used the comparison of West Java's yield and national yield, thus instead of using gha (global hectare), nsha (national standard hectare) is considered to be more appropriate (Chen et al., 2010). For the BC calculation, 0,64 were inserted as the national conversion rate of paddy-to-rice in Indonesia (Dinas Pertanian Jawa Barat, 2013), which will indicate the real value of biocapacity. BC was calculated through (Ewing, et al., 2010; Chen at al., 2010):

$$BC = Area \cdot 0.64 \cdot YF \cdot EQF \quad (2)$$

Where:

BC = calculated biocapacity within West Java

Area = existing paddy field of respective year

0.64 = conversion rate of paddy-to-rice

YF = yield factor of West Java

EQF = equivalent factor for the cultivated land

Both of *EF* and *BC* values were compared to identify, whether there is a biocapacity surplus or deficit in West Java (Kitzes, et al, 2007; Borucke, et al., 2013).

$$Biocapacity\ Deficit = BC - EF \quad (3)$$

Positive value indicates that West Java is still capable of fulfilling its demand of rice for the consumption and might have a spare/unused biocapacity left or biocapacity surplus. In contrary, when it resulting on a negative value, it's indicating that there are biological capacity deficit in West Java, which means that the balance between consumption and production is off, and requires more lands to fulfilling the consumption. In common, EF calculation includes product's trade-off market, both export and/or import, and waste produced during consumption (Wackernagel and Rees, 1998; Kitzes, et al., 2007; Kitzes, et al., 2009; Ewing, et al., 2010; Borucke, et al., 2013), however for West Java's rice consumption there are barely trade off occurs and waste produced, which means most of consumed rice were came from itself and none of it were exported to the outside (Dinas Ketahanan Pangan Jawa Barat, 2012).

3. RESULTS

The result showed that there was an indication of decreasing trend in rice consumption per capita and paddy field availability. However, as the population grows even bigger, the total rice consumptions are increased (**Table 1**). In most South East Asian countries, the declining of rice consumption is due to exposure of westernized diet which leads most South East Asian people to change their diets (Pingali, 2006; Chung and Than, 2015).

Table 1. EF and BC of West Java from 1990 until 2016

Year	Variable						
	Population (people)	Per capita consumption (kg/cap/year)	Existing Paddy Field (ha)	Avg. Yield (kg/ha)	EF (nsha)	BC (nsha)	Biocapacity Deficit* (nsha)
1990	27,906,932	137.96	1,174,230.00	9.764	1,002,138.21	1,909,955.55	907,817.33
1991	28,414,513	138.35	1,177,541.00	9.950	1,004,121.84	1,915,341.09	911,219.25
1992	28,735,637	137.79	1,175,550.00	9.940	1,012,376.97	1,912,102.61	899,725.63
1993	29,292,517	139.28	1,184,628.00	10.054	1,031,327.70	1,926,868.52	895,540.82
1994	29,354,440	140.37	1,174,906.00	10.060	1,040,974.84	1,911,055.10	870,080.26
1995	30,486,671	139.28	1,154,131.00	10.116	1,066,792.75	1,877,263.32	810,470.57
1996	31,847,716	140.28	1,139,428.00	10.144	1,119,321.70	1,853,348.01	734,026.31
1997	32,106,844	142.3	1,129,209.00	10.146	1,144,452.50	1,836,726.19	692,273.69
1998	33,261,409	141.75	1,129,019.00	8.986	1,333,482.77	1,836,417.14	502,934.37
1999	34,555,622	130.89	1,123,240.00	9.162	1,254,656.99	1,827,017.25	572,360.27
2000	35,500,611	133.36	1,123,303.00	9.824	1,224,794.35	1,827,119.73	602,325.38
2001	36,075,322	131.54	933,490.00	9.900	1,218,212.28	1,518,377.49	300,165.21
2002	36,914,883	129.71	881,637.00	10.230	1,189,568.45	1,434,035.48	244,467.03
2003	37,980,422	127.89	934,095.00	10.544	1,170,795.62	1,519,361.56	348,565.94
2004	38,472,185	126.63	930,347.00	10.214	1,212,209.60	1,513,265.22	301,055.61
2005	39,960,869	108.21	924,382.00	10.330	1,063,878.70	1,503,562.79	439,684.09
2006	40,737,594	107.06	923,432.00	10.476	1,058,076.91	1,502,017.55	443,940.64
2007	41,483,729	113.85	939,228.00	10.840	1,107,316.20	1,527,710.70	420,394.49
2008	42,194,869	125.85	944,888.00	11.212	1,203,704.51	1,536,917.03	333,212.52
2009	42,696,512	118.97	949,941.00	11.612	1,111,764.87	1,545,136.03	433,371.16
2010	43,053,732	109.99	942,441.00	11.520	1,044,724.16	1,532,936.83	488,212.67
2011	43,826,775	107.91	942,974.00	11.844	1,014,829.12	1,533,803.79	518,974.67
2012	44,548,431	104.66	938,058.00	11.748	1,008,647.27	1,525,807.62	517,160.35
2013	45,340,799	92.55	939,353.00	11.906	895,756.21	1,527,914.02	632,157.81
2014	46,029,668	97.33	936,529.00	11.764	967,875.87	1,523,320.61	555,444.74
2015	46,709,569	114.37	912,794.00	12.244	1,108,880.57	1,484,714.21	375,833.64

*Biocapacity value estimated to be in a deficit condition when the results are showing negative (EF>BC)

Although most ASEAN countries were measured to already reach their overshoot, West Java specifically had not yet met its overshoot point. This might cause by the high paddy yield capability of West Java. As EF is being affected directly by the yield of the land, and eventually decreasing as yield is increasing (Kitzes at al., 2009). Borucke et al. (2013) also mentioned that EF based on a cultivated land, would never exceeding their biocapacity, because cultivated is a human-managed land that has ability to increase its yield, and eventually increase its BC. However, BC is strictly limited by the current available cultivated land, which is the reason why when the land use changed happen, it also directly decreasing the BC (Verburg et al., 1999). The overshoot had not been meet during rice consumption of 1990 until 2015, as West Java was considered to have 375,833.64 nsha “unused” biocapacity. EF value might also consistently decrease as the average yield in West Java was increased. However, within a condition of paddy fields were degrading continuously within those years, it may not be far for West Java to meet its overshoot point. In the future, the risk of the overshadowing-overshoot point might threaten rice security in West Java.

4. DISCUSSION

The rice consumption EF of West Java had not yet exceeding its biocapacity (**Table 1**). The value of EF was showed to be fluctuated, while BC was considerably decreasing by years. It was caused by the decrease of paddy field in West Java, as BC was directly being affected by available paddy field (Verburg et al., 1999). The government already took an act to prevent further paddy field loss in West Java, for example by implementing the policy of Perennial Food Land or opening a new area of cultivation for paddy farming practices. On the contrary, this policy was considered as a failure (Kementerian Pekerjaan Umum, 2015) and any increased in paddy field area was taken from other type of land, primarily taken from forest area (Lucas, 2014; Marliana and Ruhë, 2014). Those forest areas were converted, which could come from the government policy or the act of local people (Seymour and Busch, 2016). Unfortunately, as much as they trying to increase the number of paddy field, it could not do much as they meant to be, as the paddy fields are still on continual decrease, yet the forest area also depleting (**Fig. 1**).

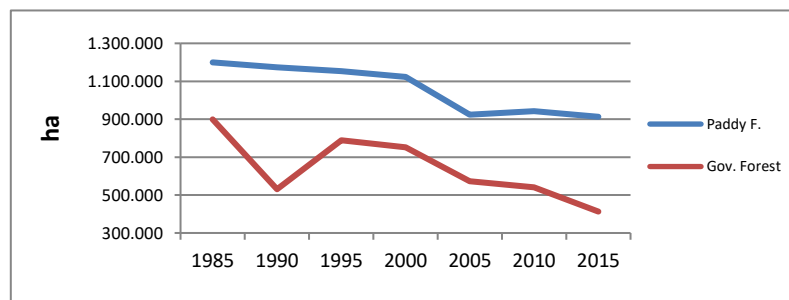


Figure 1. Existing paddy field and governmental forest in West Java (Source: West Java Statistic Bureau Centre)

The loss of paddy fields in most area of Indonesia could be caused by two factors, short of labors working in agriculture sector (Teruoka, 2008) and rice selling price for the farmers (Suputra et al., 2012; Anggraeni et al., 2017), which poorly escalated throughout years. This might also the main causes in West Java, as the numbers of labor were continually decreased while rice price was considered stagnant (**Fig. 2**). The lack of fresh and encouraging investment for the farming practices intensify the stigma of paddy farming as a disfavored occupation, and encouraged farmers to sell their lands (Suputra et al., 2012). Government’s intervention in maintaining rice price on the farmer’s selling price, also lead farmers

to get a small fare for their farming practices, while rice price for the consumer was still decided by the market (Arifin, 2005; Grabowski and Self, 2016; Suputra et al., 2012).

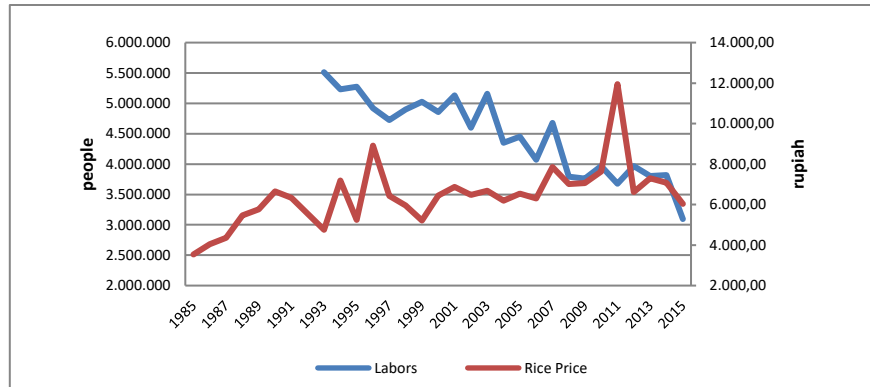


Figure 2. Number of labors and farmer rice price of West Java's (Source: West Java Statistic Bureau Centre; Rice price were converted into 2010's value)

High selling price, yet low income becomes a discouraging factor for both old time farmers to continue their farming, and also for youngster who want to enter into rice farming practices. Sometimes, the large margin between of these prices was a result from a long market chain that commonly found in Indonesia (Arifin, 2005). A lack of labors would eventually decrease the total capability to manage paddy fields, and when it happened, there was only an option left, sell their lands, and the buyer had the right to change it into whatever type of land used the want as long as they have the legal certificate.



Figure 3. Map the main developing region in West Java. (Source: West Java Data Centre Bureau)

The loss of paddy fields within West Java might happen continuously if most of stakeholders still placing productive paddy field as an expendable capital which could be drawn anytime. If we were looking by a land suitability analysis, West Java had a lot potential area that could be used as a concentrated area for rice farming practices (**Fig. 3**), however these areas were also located within the capital of developing cities or district in West Java (**Fig. 4**), which lead to a competition for land use.

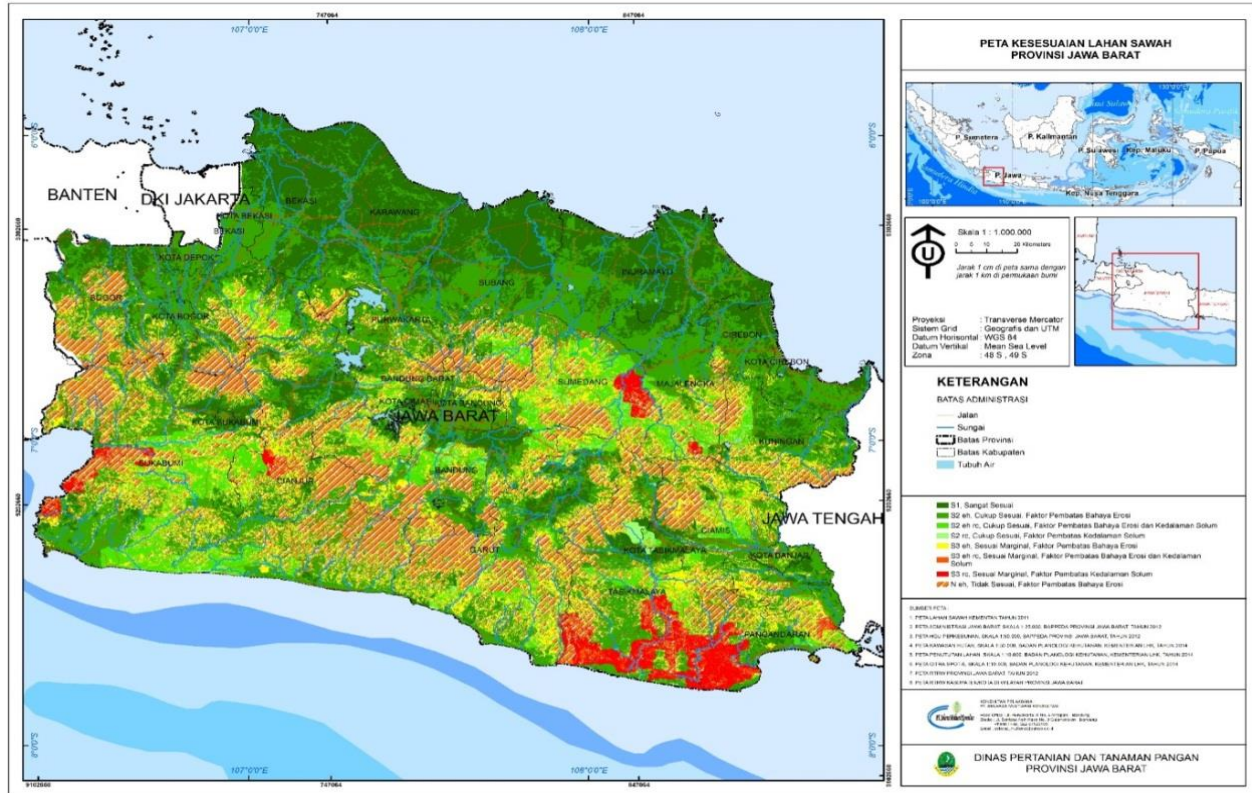


Figure 4. Map of land suitability of West Java for paddy farming practices (green marked area is considered as more suitable). (Sources: West Java Data Centre Bureau)

In Indonesia, the policy for protecting the productive lands for food production had been declared within the Undang-undang No. 41 in 2009 about Perennial Food Land Protection. This policy, however, only mention that an area is within the protection if the local government are agreed to do so, which mean it all depends to the local government, whether determine their paddy fields as a protected productive area or just an expendable farming area for land used change. It also lack of punishment mechanisms for those who did not play their part as they should be (Kementerian Pekerjaan Umum, 2015).

Most of the decisional policies for those lands were not determined by the economical calculation of when if the land used was changed, how it would be interrupted or even vanquished the current agriculture investment that had been placed and planned for the future, or the benefit and cost ratio in exchanging the land use of a productive paddy fields (Firman, 2000). A strong governmental role in securing those lands requires in a large portion to prevent more paddy field diminished before it too late and its getting more difficult to deal with (Palacios-Agundez et al., 2015, Yue at al., 2011; Iqbal and Sumaryanto, 2007; Engelke and Biehl, 2010).

It is not impossible for West Java to actually loss all of its BC if the current land used changed cannot be halted or stopped. And as mention before, it needs a lot works from all participants, which may

require a lot of time and continual monitoring. A brand new policies or regulations are in highly needs. It must be able to manage every stakeholder to get involved and comes with a strict punishment for those who does not doing their part promptly, to ensure these land still exist for 20 or even more years. Furthermore, a forecasting for the future year EF and BC might be able to predict when will West Java comes to its overshoot if the paddy field losses were not halted or stopped.

5. CONCLUSIONS

The total EF of rice consumption in West Java had not yet exceeded its own BC up until 2015. Lessen rice consumption per capita and large quantity of BC, were among the factors that helped West Java maintains their EF. However, during the observed year, the different between EF and BC was considerably diminished. It mostly due to land used changed of productive paddy field in West Java that caused them to lose a large portion of their BC in a short time of period. This land used changes are caused by many factor involved and it requires a lot of time and work to prevent it to spread even further.

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