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Full Length Research Papers

Sustainable Self-Sufficient Food based on Energy Potential: Analysis in Sabah, Malaysia

Kazunobu Suzuki [*1,2], Nobuyuki Tsuji[3] and Mitsuru Osaki[4]

1 Graduate School of Agriculture, Hokkaido University, Japan
2 JICA-SDBEC (Project on Sustainable Development for Biodiversity and Ecosystems Conservation, Malaysia)
3 Center for Sustainability Science, Hokkaido University, Japan
4 Research Faculty of Agriculture, Hokkaido University, Japan

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This paper presents an analysis on the potential self-sufficiency of energy based food in Sabah, Malaysia. Data set was established from literature and statistical data, and collected data was analyzed for visualizing the ratio of self-sufficiency of energy-based food, and some scenarios were tested for future forecast. Results obtained indicated that its ratio was 46% in 2010, and it was clear that population growth and the decrease of the area designated for food production had an impact on food self-sufficiency. Thus, sustainable land management for food self-sufficiency became the top agenda item in Sabah. Land for food production should be strictly protected using natural function, and also it was established that a new relationship between city and rural area should be established such as materials recycling, ecotourism, and renewable energy production in rural, which contributes to food self-sufficiency in Sabah.

Keywords: Food supply, Food Security, Food Self-suffiency, Sabah

INTRODUCTION

In the twentieth century, large amounts of natural resources including food were used to maintain a lifestyle of mass production, mass consumption and mass disposal. Considering the limitation of such resources on the earth in the years to come, this type of lifestyle has to be changed and there has been a strong desire and pressing need to build a sustainable society where limited resources can be used in a sustainable manner. It has been said that the current agricultural practices might be defined as "converting oil into food" (Saito, 2009). In this light, our challenge is to reduce the dependence on petroleum as a source of energy. In other words, our society requires food and energy independence so that the area at either the national, regional or local level can become independent both materially and in terms of energy usage (Osaki, 2011). Population growth is another big factor which gives a high influence on food security. The expansion of food production and the improvement on farming productivity is, of course, indispensable for feeding growing populations. It is not too much to say that we are facing critical challenges in relation to food security. Food is the important material which is concerned with the national welfare and

*Corresponding author's Email: suzuki.kazunobu0624@gmail.com; Tel: 6088-422-120 FAX:6088-422-129.

the people's livelihood and social stability (Shutao, 2010). Investment in agriculture remains critical to sustainable long-term food security. Food security is the basic guarantee for the national security (FAO, 2011). Sabah State, Malaysia is such a case. Agriculture and Food Industries Minister said in the Daily Express newspaper dated 15th June, 2015 that the production of food especially staples such as rice in the state remains the focus of the State Government, and the state has been suffering from the shortage of food. Therefore, the state is still importing food to meet the State's needs. He also said that the State policy was to continuously improve the self-sufficiency level through increased productivity and increasing the areas under cultivation. It is pointed out that the Malaysian policy, namely the National Food Security Policy places priority on paddy and rice production, especially in Sabah in terms of food security, and that the policy measures targeted area expansion and productivity for securing sufficient food (Tey, 2010).

Considering the above, this paper examined the potential of the self-sufficiency of food to visualize the situation of food security in Sabah and identified some challenges in the future for food security.

MATERIALS AND METHODS

Data collection

Data were collected through the official publications such as the Yearbook of Statistics Sabah, Report on Crops Hectareage and Production in Sabah, and Annual Fisheries Statistics. Some data which were not found in the official publications were collected through separate and individual meetings with organizations/agencies concerned. Collected data include 1) industrial crops (Coconut, Cocoa, Coffee, Paddy, Sugar Cane, Tea, Tobacco and Sago); 2) agricultural crops (Fruit Crops - 34 species , Leafy Vegetables - 28 species, Fruit Vegetables - 18 species, Root Vegetables - 3 species, Cash Crops - 6 species, and Spices - 14 species); 3) livestock (Buffalo Beef, Cattle Beef, Pork, Chicken Meat, Duck Meat, Chicken Eggs, Duck Eggs and Liquid Milk); 4) fish (Landings of Marine Fish, Brackish water, Seaweed and freshwater fish). Published statistical data were mostly dated 2010 and data of 24 districts were collected. Rubber and oil palm which were categorized as industrial crops were not included in this research. It is partly because rubber can be considered as a non-food product. It is sometimes debatable whether or not oil palm is food. If oil palm is regarded as food, then the self-sufficiency ratio of food is more than 100% in all districts (even 19,282 % at Beluran district) except for Kota Kinabalu and Penampang district. Considering that palm oil calorie contributes to a meaningless conclusion in terms of energy based total self-sufficiency of food, palm oil was not included in this research.

Data on livestock was gained from the Department of Veterinary Services and Animal Industry, Sabah since such data was not found in the official publications. The Department merged some districts into one. Kunak, Kinabatangan, Beluran, Sipitang and Nabawan were merged with Tawau, Sandakan, Sandakan, Beaufort and Keningau, respectively. Data on fish has the same issue. Data on landings of marine fish was available in only 16 districts. No data in 8 districts, namely Kinabatangan, Tongod, Ranau, Penampang, Tenom, Keningau, Tambunan, Nabawan was available.

Data analysis

Figures on food calorie were basically referred to in official publications such as Nutrient Composition of Malaysian Foods 4th Edition. Where figures were not available in Sabah or Malaysia, the food calorie figures available in Japan were applied. By using such calorie figures, the supplied calorie of industrial crops, agricultural crops, livestock and fish at all 24 districts was calculated. Then the necessary calorie based on population was calculated. Finally, the self-sufficient food ratio was calculated based on the supply and consumption calorie.

RESULTS AND DISCUSSIONS

Self-sufficiency Food ratio

Total Industrial Crop Supply, Total Agricultural Crop Supply, Total Livestock Supply and Total Fish Supply were 408,055 Gcal, 180,334 Gcal, 200,652 Gcal and 158,673 Gcal, respectively (Figure.1). In terms of area balance, eastern parts in Sabah were in a critical situation from the food supply point of view except for livestock while the western and northern parts had a relatively good potential for food production.

Considering the population in Sabah, the self-sufficient food ratio was calculated based on the supply and consumption calorie. The result was 46.4 0%. The ratio in each district is shown in Table.1. and Figure.2.

Some districts, most of which are located in the western and northern part in Sabah, have more than 100% ratio, indicating that such districts such as Kuala Penyu, Pitas and Kota Belud have the capacity to accommodate people with sufficient food. On the contrary, most of the eastern parts are in a very critical situation. Especially, Kinabatangan, Kunak and Sandakan which are the worst districts. It should be reminded, however, that data of livestock in Kunak and Kinabatangan was not available and that data of Kunal and Kinabatangan might have been

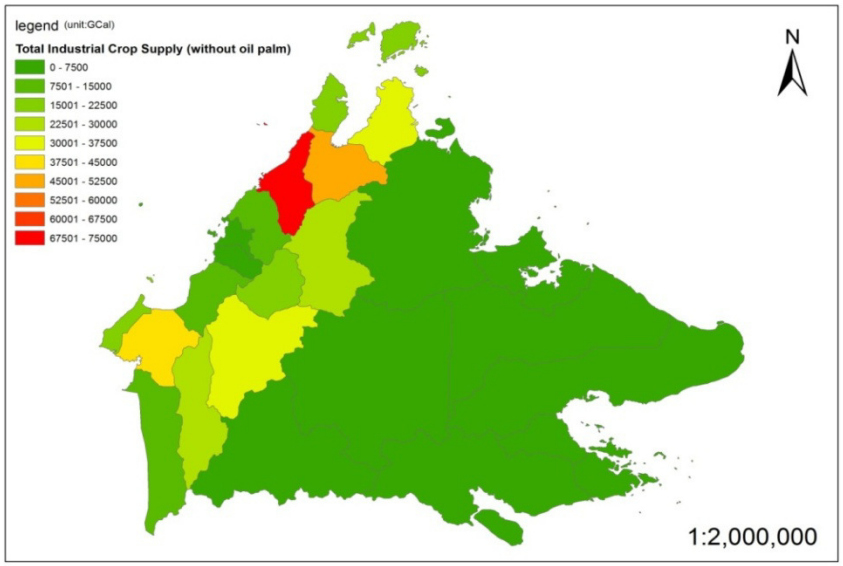

Figure 1: (a) Total Industrial Crop supply

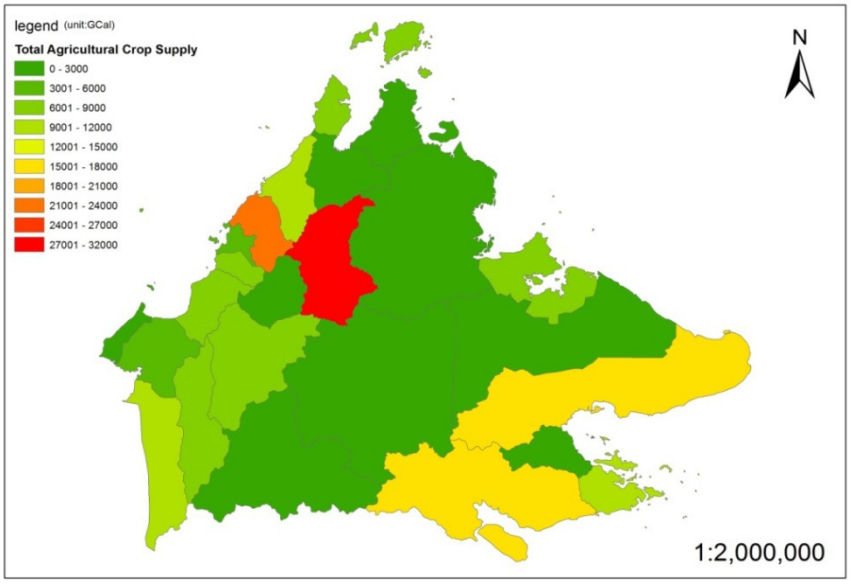

Figure 1: (b) Total Agricultural Crop Supply

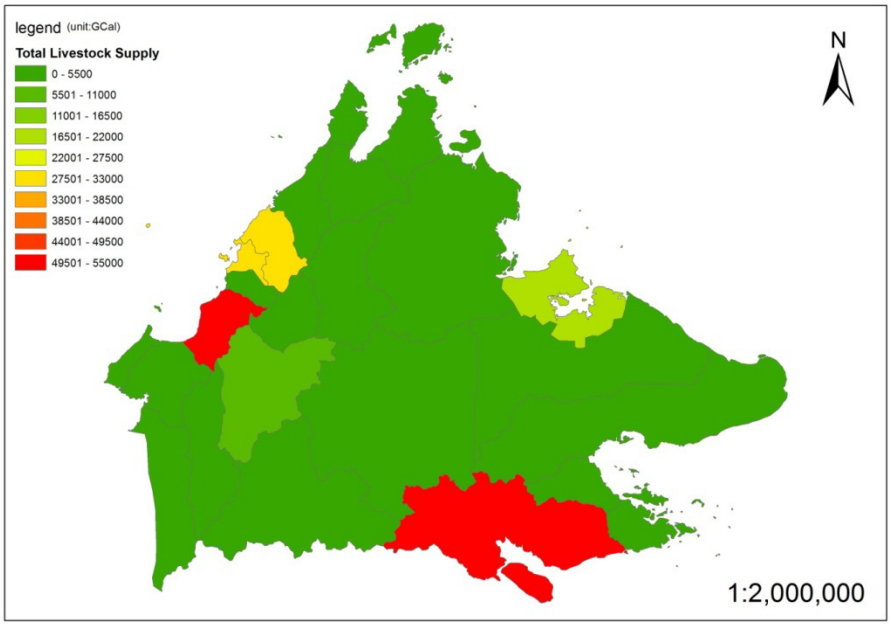

Figure 1: (C) Total Livestock Supply

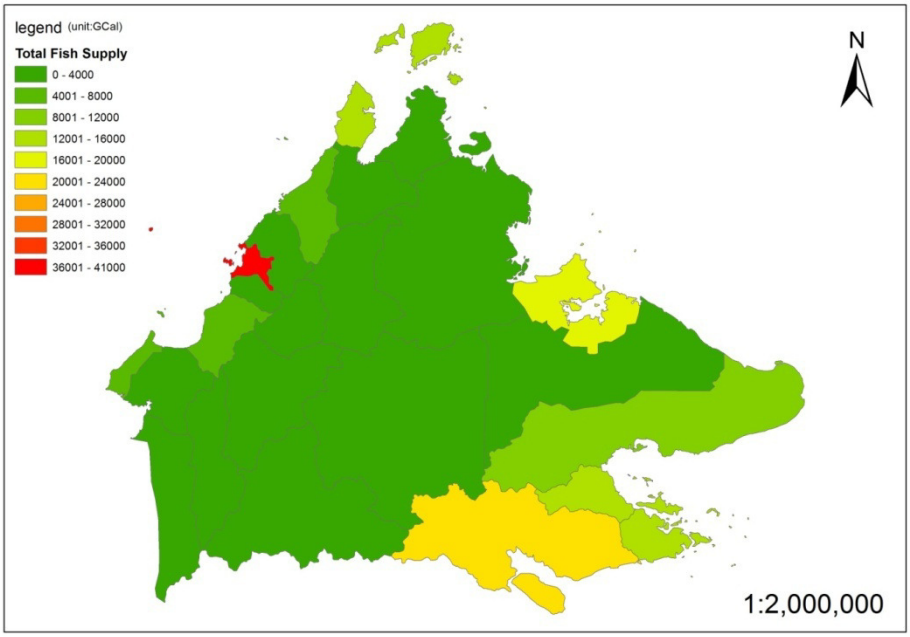

Figure 1: (d) Total Fish Supply

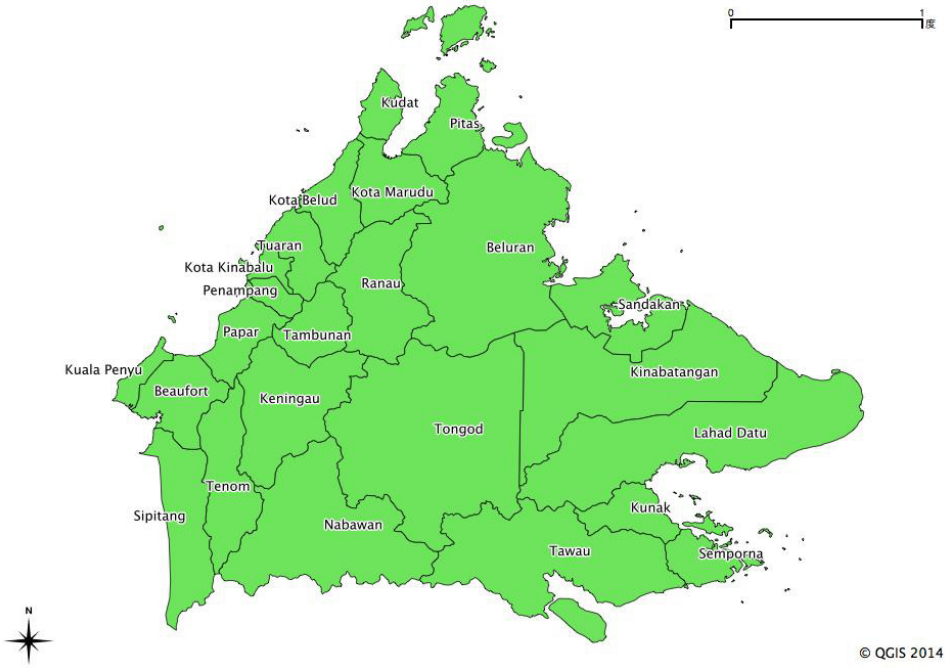

Figure 1: (e) Reference sabah Map

Table 1. Food self-sufficiency ratio at each district

District	Self-sufficiency ratio (%)	District	Self-sufficiency ratio (%)
Tawau	37	Ranau	97
Sempoma	34	Tuaran	95
LahadDatu	24	Kota Kinabalu	25
Kunak	36	Penampang	18
Sandakan	17	Papar	90
Kinabatangan	0.2	Beaufout	105
Tongod	30	Sipitang	94
Beluran	11	Kuala Penyu	178
Kudat	767	Tenom	109
Pitas	153	Keningau	39
Kota Marudu	121	Tambunan	81
Kota Belud	147	Nabawan	30
Total food self-sufficiency ratio: 46 %			

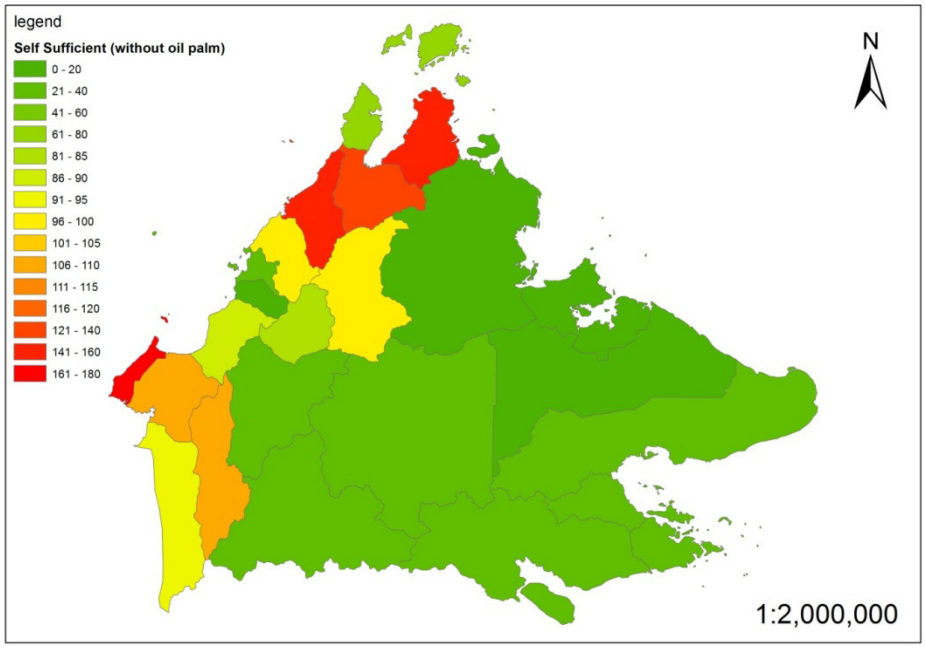

Figure 2: Food Self-Sufficient ratio at each district

integrated into that of Sandakan. Nevertheless, though inconsistent statistical data was found, Kinabatangan, Kunak and Sandakan districts had reached a critical food supply shortage. In these districts, more than half of the terrestrial areas were covered by oil palm plantation (in case of Kunak, 70.21% of total area was for oil palm.) and had no sufficient land for food production. More seriously, population growth at these districts was quite high compared to other districts. For example, average annual population growth rate from 2000 to 2010 at Kinabatangan District was 4.4% while average of whole Sabah during same period was 2.1%. Limited area for food production and high population growth were a big driving force to accelerate the decrease in local food supply.

Future forecast

As for the self-sufficiency food ratio based on supply and consumption calorie, population growth and land for food production might be a factor giving a big impact on the ratio. Recognizing this, a rough simulation was carried out for future forecast. The first case was based on the scenario that the population in Sabah continues at the pace of 2%. In this case, self-sufficiency food ratio would be slightly down to 45.49 % from 46.40%. Considering that rice remained as the most important staple in Sabah as Agriculture and Food Industries Minister in Sabah said, next scenario was designed for taking the area for rice production into consideration. In addition to continued population growth of 2%, if rice production area decreased by 5 % per year, calculation indicated that the ratio goes down to 44.47%. Though it was a rough simulation, there is no doubt that population growth and area scale for food production influenced food self-sufficiency and these critical issues need to be carefully considered for future actions.

In Sabah, the issue is about how to secure food in a sustainable manner with some pressures such as population growth, conversion of a large scale food production land into housing and plantation industry areas. It might be nice to improve productivity by utilizing modern technology. More importantly, however, land for food production should be secured and protected for food security in a long term. Protected areas for food production and food supply are a minimum requirement to accommodate human needs. Sabah has three big cities namely, Kotakinabalu, Sandakan and Towau which are consuming a significant amount of food. Such cities depend on rural areas in northen and western parts in Sabah for food supply. It might be possible to consider whether Sabah's food security should be based on basic domestic self-sufficiency or it should be substituted by import (Shutao 2010). Though this needs to be further discussed especially at the political level, recognizing that rural areas in the northern and western parts in Sabah still have the potential to produce surplus food, it is important to establish a linkage between the city and rural areas. Rural areas can

provide people in the city with food and a place for doing agricultural activities for their self-consumption. On the other hand, city areas can provide people in the rural areas, particularly famers with technical and financial support for sustainable food production. In addition, the linkage between city and rural area can be a potential for realizing a material recycling society through making composts in the rural area, and producing renewable energy by using food such as rice husk and coconut shell. As the case in Japan indicates (Sato, 2012), this kind of linkage and partnership between two areas can serve as a basis for food-related business such as eco-tourism, thereby making the self-sufficiency of food more stable. Lastly, Sabah is still suffering from poverty, especially in the rural area (poverty rate in 2012 is around 8 % according to the Department of Statistics of Malaysia, 2014). City-rural partnership for improving food security could contribute to poverty alleviation.

It has been pointed out that food production is influenced by the combined effects such as population growth, nutrition transition, energy, water, climate change and so on. This research focused on energy based food self-sufficiency ratio in Sabah. It can be concluded that the situation on energy based on the self-sufficiency of food in Sabah should not be optimistic, but rather a critical situation. This research can visualize the situation on energy based self-sufficiency food ratio in Sabah by utilizing available data, and provide reliable and persuadable figures for future actions. This research is the first of its kind, and hopefully can contribute to relevant policy development and compliment other food-related researches in the future.

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