“Sugar cane’s byproduct and its effect on Thai farmers’ revenue”

Abstract

Ethanol is a substance that everybody use either directly or indirectly in everyday life but who would think about those behind the product who making it. Most farmers has long been suffer from low income problem including cane’s farmer who is having a high cost of production but a low revenue. The problem comes from the calculation of final cane price which it miscalculate the revenue from molasses’ products. It only calculate molasses revenue as it is an end product but not the further use of it which such as ethanol, alcohol etc. which it is against the article 4 in the Cane and Sugar Act of 1984. In this paper, the hidden revenue of cane’s byproducts will be calculated back and find out the appropriate revenue that farmers should get.

I have use a revenue comparative analysis to see the hidden revenue in 4 main cases which are export all molasses, 100% uses as ethanol, OCSB price and real products’ demand case. The result comes out that if you use the real market demand case comparing with the OCSB given price the difference is almost 30%. If farmers could get hands on this part of revenue, government subsidy could be relieve and could be used for others important projects.

In conclusion, the slip-up calculation of cane’s by-products do really have an effect on farmers’ income as expected. If there is a reformation of the system or more strictly imposed of law, farmers’ low revenue compare to cost and government subsidy problem will be relieved and they will now on can live on their own legs.

Introduction

Profit sharing scheme has long been established to alleviate the agency problem between two parties that have conflict of interest between each other. It might sound fair enough when two parties comes and make agreement but sometimes reality doesn't happen that way. Those who has more bargaining power is obviously taking control of the game. Revision of the scheme is also the another thing that need to be concern of since as times go by things may change and the rules that has been set before might not be as well considered as a "fair" game as before.

Contract farming involves the buyer specifying the quality required and the price with the farmer's agreement to deliver the goods in the future date. Many crops and poultry business has use this program to guarantee the price and market for farmers and in the other way to make the firm easier to calculate the future income without much cost price fluctuation.

Sugar cane is one of the example of the agricultural business in Thailand that use profit sharing scheme for a very long time. The basic rules has been set with 70:30 between farmers and sugar mill factory. It may seems good for the early time they have been used but after times goes by technology gets better, some by-products worth some amount of money. Now it sounds not fair for the farmer since the revenue they calculate for the farmer's income only involve from the selling of sugar product but the "real" revenue from by-products that the factory made is partly not going in farmer's pocket which has contribute much loss in income for them.

If this problem is solved, sugar cane farmers would get more revenue from the by-products and could generate more circular flow of money in the system and might somehow increase some of the domestic spending and bring back of what the farmers should get from what they made.

Biofuels are usually defined as an organic primary and/or secondary fuels derived from biomass which can be used for the thermal energy by combustion or by using other technology (Peskett, Slater, Stevens and Dufey 1). The most common form of biofuels that we are all usually see in our daily life are bioethanol or gasohol and biodiesel. Bioethanol is an alcohol derived from sugar or starch crops (e.g. sugar beet, sugar cane, or maze) by fermentation which in the case of Thailand, it's mostly derived from molasses whereas Biodiesel is derived from vegetable oils (e.g. rapeseed oil, jatropha, soy or palm oil, waste cooking fat) by reaction of oil with methanol. Ethanol usage in for a vehicle fuel is not a new thing. Henry Ford and other early automakers are suspected to be the world's primary fuel before gasoline became so commonly available.

ที่	โรงงาน	จังหวัดที่ตั้งโรงงาน	กำลังผลิต (ลิตร/วัน)	วัตถุดิบการผลิต	วัตถุดิบหลักในการผลิต	การผลิตในเชิงพาณิชย์
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7	บริษัท เพโทรกรีน จำกัด (กาฬสินธุ์)	กาฬสินธุ์	230,000	กากน้ำตาล/(น้ำอ้อย)	กากน้ำตาล	ม.ค. 2551
8	บริษัท มิตรผล ไบโอฟูเอล จำกัด (ชัยภูมิ)	ชัยภูมิ	230,000	กากน้ำตาล/(น้ำอ้อย)	กากน้ำตาล	ธ.ค. 2549
9	บริษัท เอกรัฐพัฒนา จำกัด	นครสวรรค์	230,000	กากน้ำตาล	กากน้ำตาล	มี.ค. 2551
10	บริษัท ไทยรุ่งเรืองพลังงาน จำกัด	สระบุรี	120,000	กากน้ำตาล/(น้ำอ้อย)	กากน้ำตาล	มี.ค. 2552
11	บริษัท ราชบุรีเอทานอล จำกัด	ราชบุรี	150,000	มันเส้น/กากน้ำตาล	กากน้ำตาล	ม.ค. 2552
12	บริษัท อี เอส เพาเวอร์ จำกัด	สระแก้ว	150,000	กากน้ำตาล/ มันเส้น	กากน้ำตาล	ม.ค. 2552
13	บริษัท แม่สอดพลังงานสะอาด จำกัด	ตาก	200,000	น้ำอ้อย	น้ำอ้อย	พ.ค. 2552
14	บริษัท ทรัพย์ทิพย์ จำกัด	ลพบุรี	200,000	มันเส้น	มันเส้น	พ.ค. 2553
15	บริษัท ไทผิงเอทานอล	สระแก้ว	150,000	มันสด/(มันเส้น)	มันสด	ก.ค. 2552
16	บริษัท พี เอส ซี สตาร์ช โปรดักส์ชั่น	ชลบุรี	150,000	มันสด/(มันเส้น)	มันเส้น	ส.ค. 2552
17	บริษัท มิตรผล ไบโอฟูเอล จำกัด (ด่านช้าง)	สุพรรณบุรี	200,000	กากน้ำตาล/(น้ำอ้อย)	กากน้ำตาล	ธ.ค. 2552
18	บริษัท ขอนแก่น แอลกอฮอล์ จำกัด (บ่อพลอย)	กาญจนบุรี	200,000	กากน้ำตาล/(น้ำอ้อย)	กากน้ำตาล	ต.ค. 2554
19	บริษัท ไทยอะโกร เอนเนอจี จำกัด (ด่านช้าง) เฟส 2	สุพรรณบุรี	200,000	กากน้ำตาล/มันเส้น	กากน้ำตาล	เม.ย. 2555
20	บริษัท ดับเบิ้ลเอ เอทานอล จำกัด เฟส 1	ปราจีนบุรี	250,000	มันสด /น้ำแป้ง	มันสด	ธ.ค. 2555
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รวม	กำลังการผลิตในปัจจุบัน		3,890,000			

Ethanol in Thailand is produced by the main 21 distillers located among all the provinces which mostly they will choose the location close to the feed stock supply because of the low transportation cost (Department of alternative energy development and efficiency). Two main products that are used in the production are molasses, by-product from sugar refining process which if we crushing a ton of sugarcane would normally derive 45 kg of molasses, and another feedstock is cassava (Russell, Paul Frymier).

Standard Costs of Ethanol Production

Description	Tapioca	Molasses
1. Labor Cost	1.10	1.10
2. Energy Cost	1.60	1.57
3. Raw Water / Chemical Cost	1.53	0.33
4. Repairing / Maintenance Cost	0.27	0.27
5. Depreciation Cost	0.97	0.97
6. Interest Expense	0.58	0.58
7. Environmental Treatment Cost	0.40	0.65
8. Administrative and Marketing Cost	0.50	0.50
9. Insurance Cost	0.15	0.15
Total Cost of Ethanol Production / Liter	7.10	6.12

The reason that why most of the distillers in Thailand mainly use molasses is because of the low production cost as you can see from the table (Siamphakdee, "Ethanol Industry, an open market for Farmers"). Energy Policy & Planning Office, Ministry of Energy is the organization that control the price of ethanol selling in Thailand which they will use the average price and quantity of ethanol produced by cassava and molasses to determine the selling price which some of the producers say it's unfair because the molasses distillers who has a lower production cost have to share the cost of

cassava distillers. From all of what state above, it may seems like an ethanol purely dominated the market without any threat for now but in the future there's a new closed substitute that seems to be at close as commercialized as ethanol would be a butanol. Like ethanol, the colorless butanol can be brewed from corn but it holds 84 percent of the energy content of gasoline, more than ethanol's 66 percent which Butamax Advanced Biofuel LLC, funded by DuPont Co. and BP Plc which will be making in commercial value in 2015 (Fountain F4).

Oil has long been a significant factor that we all depends on for a living since most factor of production in the economy has depended on oil as a main source of energy to drive. It has caused almost 20% of inflation in most of the third-world country including us which from that Thailand The 1973 oil price crisis has been a good lesson for all countries all over the globe to concern about alternative energy which could alleviate the fluctuation of world oil price. Since then, ethanol has become one of the things that most government try to achieve a commercialized use of it. It is easy to understand that as the price of oil increase, there would be a higher demand of ethanol since it is a closed substitute for oil and in many countries including Thailand, it's a complementary good since it is part of the petrol that we're using now. From the basic theory of demand and supply, since the demand of ethanol is rising surely the price would increase and it would generate more income for the farmers who producing it. There is an evidence in Tanzania, a low-income countries that see biofuel as an opportunity of growth, which after they try to promote the biofuel production, labor demand, labor productivity and wages rise (Arnd, Pauw, and Thurlow 1928). Moreover, national GDP also rises with more jobs created in biofuel sectors which later leads to welfare gains. However, Cororaton, Timilsina see it differently. They found out that GDP per capita of countries which is less advanced in biofuels production such as China, Russia, India for an example have to bear the losses but there's still a common ground with the previous argument in a way that there's also an increase in GDP per capita in advanced biofuel countries like Brazil, Argentina and Indonesia (Cororaton, Timilsina 30). As income rises,

Table 3.1 Employment in Biofuels Production

Country	Current (no of people)	Additional jobs in the future (no of people)
US (ethanol only)	147 – 200,000	
Brazil (ethanol)	500,000	
France		25,000 by 2010
Colombia		170,000 by approx 2010
Venezuela		1,000,000 by 2012
China		9,000,000 in the long term
Sub-Saharan Africa		700 – 1,100,000

employment also surge as well. Kojima and Johnson stated that "Biofuel hold the promise of contributing to rural development by creating jobs in feedstock production" (1) which it match up with what Arnd, Pauw, and Thurlow found in Tanzania but there is also a conflict in a way that in Brazil where sugar cane production is so much advanced than other countries, there's a data showing that the total number of employees in sugar cane production in Brazil fell by one-third (Peskett, Slater, Stevens and Dufey 11) so that it should be a concern for a government that try to achieve this scheme but only looking at the bright side of it.

FOOD PRICE INCREASE

Food price increase is another concern of the problem of shifting to produce biofuel feedstock because there would be no point of getting more money but the food expense also coming up. Runge and Senauer have stated in his paper that "the world's poorest people already spent 50-80% of their total household income on food" (5). It means that if the food price rise only a little bit it would affect their residual income a lot. Biofuel is considered to be one of the main causes that drive the world food's price in recent year since there's more demand coming up from the pressure of rising world crude oil price and more demand from developed countries which the main biofuel consumption comes from U.S and E.U countries (Runge, Senauer 2). The drives of price increase is happened because the three main food staples that indicate the world food price are wheat, rice and maize. As they are all a perfect substitute for each other price will move together so after maize is heavily used in ethanol production in the U.S, it creates a hike in food price which poor people will suffered from a double shock of increase in both food prices and oil prices. Similar studies has shown the same result that biofuel demands from both developing countries and massive energy consumption countries like U.S and E.U has contribute in the world food price increase in the recent year (Charles, Godfray 812)(Mitchell 7) (Cororaton, Timilsina 30).

LAND PROBLEM AND TRADE OFF BETWEEN FOOD AND BIOFUEL PRODUCTION

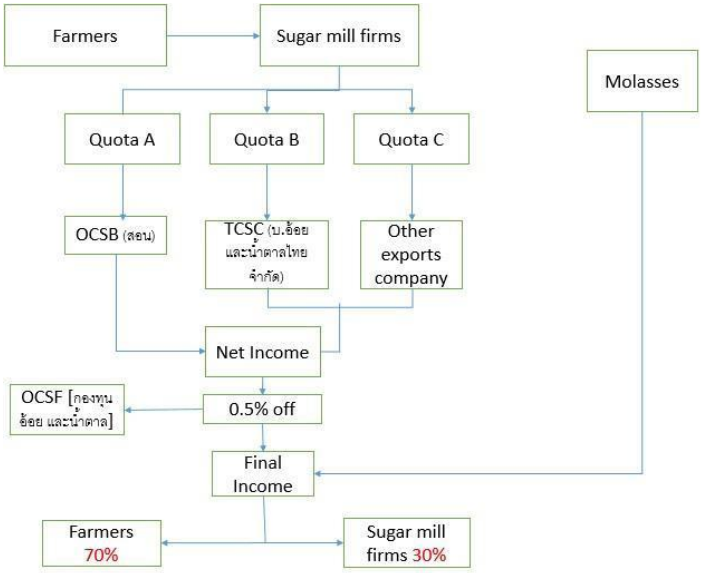
Since earth is composed of more than 70% of water, land become the scarce resource that one should use wisely. Urbanization has increasingly become a factor that bring less arable land in many countries especially developing one. Farmer somehow will has to come to a point to choose what kind of plant to grow to get the highest revenue in a common sense. The two main kind of choices would be either to plant food crops or biofuel crops. For the biofuel crops, there's a research showing that large area of land has been turned to plant oil seeds for the production of biofuel and the trends tends to be more single type of crops which biodiversity will become the next concern (Mitchell 10). Moreover, as more demand of biofuel grows countries with large area of arable land will expand its production of feedstock especially in South and Central America (Banse, Meijl, and Woltjer 28). From the same paper, it also indicate that maize has displaced soybeans in the U.S and they've found a similar result of plant diversion from foods to biofuel which also drive the wheat price as output of biofuel grows (11). However, there's a counter-example examined by Peskett, Slater, Stevens and Dufey which they found out that in Brazil where sugarcane production is popular, an additional income from its production has improves the general conditions for producing other crops which it could be food crops for an example and limited space of land is not a problem since as productivity of one's crop grow, it demand less land for occupation (11).

Since feedstock price is the main determinants of biofuel price, economies of scale has play a crucial role behind it. Frankly speaking, higher the price of ethanol higher the profit the large-scale farmers in developing countries would get because the history of agricultural crops in these countries like China, Nigeria, and Thailand, large producers will be the main beneficiaries and small producer will be just a price-taker (Runge, Senauer 4) which it also correspond to what Peskett, Slater, Stevens and Dufey said as well (10). From all the bad points we have talking about, there is still some good in its. As the production palm oil, crops used for biodiesel production, grows there is an expansion that could strengthen claims to land to where land rights are not recorded before which poor farmer could get a hand on it legally as well since it's hard to find a proper amount of land to go in growing demand of

biofuel production because of land concentration to few farmers due to economies of scale problem which we have discussed before.

Methodology

Figure 1



In order to understand the revenue that farmers gets from selling their cane, the flow chart must first be explained. Farmers' revenue come from the revenue of sugar selling [Quota A, B and C] and molasses which as shown in figure1 that revenue from selling sugar must be deducted by 5% to the cane and sugar fund whereas molasses do not have to and then 70% of the final income will go to farmers pocket and the rest is for the sugar millers. The revenue that that farmers get do not generally calculated by weight but by C.C.S as well. C.C.S is an estimate of pure sugar recoverable from cane or generally speaking as sweetness of the cane (CAC 82).

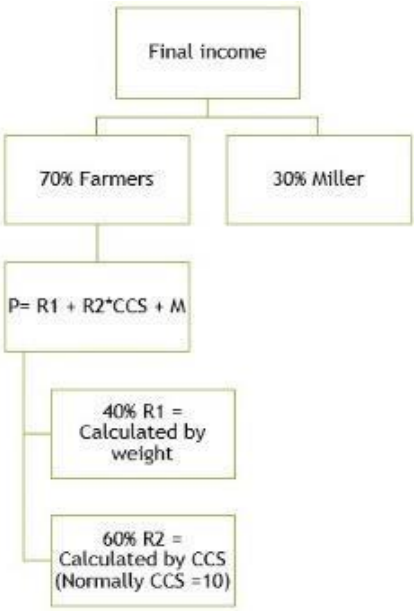


Figure 2

According to the CAC or the Committee on Agriculture and Cooperatives report, it states that the final price of cane is calculated by "P = R1 + R2*CCS + M" where R1 is the revenue from selling sugar calculated by weight which I assume the weight of calculation to be 60% where as R2 is the revenue calculated by CCS with the weight of calculation of 40% and CCS=10 [R2 = Final income/Total amount of cane*CCS] (82).

Sugar selling's Revenue	*Before cost deduction
Domestic Revenue (Bht)	50,982,476,670.06
Exported Revenue (Bht)	95,474,495,643.00
Cane (Tonnes)	100,002,514.86
Molasse (Tonnes)	4,540,114.17
Av. Mollasse price/tonnes (13') (Bht)	3,170.00
[For sugar] Assume 20% as cost of selling and OCSF fund collection	
[For molasse] Assume 15% as cost of selling only	

Table 1(Net income)

Molasse price / tonnes (13')		
3,170.00		
1 Ton of Molasse =760 liter of spirit		
Alcohol price/ liter		48 bht/liter
Alcohol Rev./ Ton of mollase		36,480.00
1 ton of Molasse = 260 liter of ethanol		
Ethanol Price	=	25.97 BAHT/liter
Ethanol Rev./1 tonnes of molasse		6,752.20

Table 2

From the actual data from CAC report of the production year 12/13 as you can see from table 1 (net income), the domestic and exported revenue are equal to 50,982 million baht and 95,474 million baht respectively where the total amount of cane produced is at the level of 100,002,514.86 tonnes. The amount of molasses produced is normally at the rate of 4-5% of the total production and it is shown in the table 1 at the normal rate of 4,540 million tonnes (11, 12, and 109). For the price of molasses I use the average price of the year 2013 which is equal to 3,170 baht (Bank of Thailand 7).

Molasses can be sold and/or converted to several products but for this study, I would mainly for focused on its 3 main products which are exported molasses, ethanol and spirit. The conversion rate for each products are different which for the spirit production we would get a rate of 1 ton of molasses per 760 liter of spirit (Seltzer, Wissman and Hanrahan V.7). The price of alcohol per liter is calculated by the ex-factory price of 40 degree rice whisky times the amount of alcohol which will be equal to 48 baht/liter and if we times it to the amount of alcohol produced by tonnes of molasses we would get a revenue of 36,480 baht/tonnes as shown in table 2. Whereas for ethanol, the conversion rate from molasses is 260 liter of ethanol per ton of molasses (Russell, Paul Frymier). The revenue per ton of molasses of ethanol product would be 6,752 per ton of molasses with the assumption of the ethanol reference price of 25.97 baht/liter (Energy Policy and Planning Office).

Tax revenue from spirit's selling (Bht)		2,915,000,000.00
Spirit's revenue/liter (40 degree rice whisky) (Bht)		48.00
Total demand of spirit (liter)		60,729,166.67
Molasses Demand (Tonnes)		79,906.80
*1 Ton of Molasse =760 liter of spirit		

Table 3

2013 Domestic ethanol's demand (Million liter)		
Total gasoline demand		7,469.9 Million liter
E10 = 6364.3548		Ethanol 636.43548
E20 = 963.6171		Ethanol 192.72342
E85 = 141.9281		Ethanol 120.638885
Molasse Demand (Tonnes)		3,653,068.40
1 ton of Molasse = 260 liter of ethanol		

Table 4

In order to determine the appropriate amount of molasses for each product millers determine to produce, demand of each products of molasses need to be concern. As you can see from table 3 that the revenue from spirit selling is 2,915 million baht and we could calculate back the amount of alcohol from the tax revenue per liter of 40 degree rice whisky as an approximate base which will lead to the 79,906 tonnes of molasses needed (Fiscal Policy Office) (The Excise Department). For the ethanol demand, the total demand of gasoline for 2013 is around 7,649 million liter which the amount of ethanol needed for each product is shown in table 5 with the total demand of molasses of 3,653 million tonnes. With the total amount of 4,540 million tonnes of molasses we could get the needed of the exported molasses by the leftover of the other two products which is 807,138.97 tonnes. It's according to theory of the firm which stated that (corporations) exist and make decisions in order to maximize profits which in this case it is truly does with a given demand of each product.

CASE 4			
	Export Molasse	Ethanol	Alcohol
Molasse Quantity	807,138.97	3,653,068.40	79,906.80
Price/tonnes molasse	3,170.00	6,752.20	36,480.00
Revenue	2,174,835,961.54	20,966,311,204.98	2,477,750,000.00
*(after 15% cost deduction)			
Total Revenue	25,618,897,166.52		

*Table 5 (*Molasses' Revenue)

For the case that I have use the real demand of each molasses' products, it would be called case 4 which if we calculate the revenue for each products with a given quantity of molasses demand, it will result in 25,618 million baht of molasses revenue for this case.

From table 6 below, the total revenue is calculated after cost deduction as what stated in table 1 where the sugar revenue 20% would be cost of selling and OCSF fund collection and for molasses revenue I would assume 15% as cost of selling only since it does not have to go through the OCSF fund. I have separated 4 main scenarios as you can see from the table above which case 1 would be a 100% export of molasses, case 2 for full capacity of molasses as ethanol production, case 3 for the normal OCSB given final cane price of 1060 baht/ton with 160 baht subsidy and case 4 for the real demand case (Khaosod online).

	Case1: Export Molasse	Case2: Ethanol	Case3: OCSB price	Case4: Special case
Total Revenue (Baht)	129,398,915,494.03	143,222,972,940.98	121,915,915,494.03	138,616,602,856.59
Total Cane (Tonnes)	100,002,514.86	100,002,514.86	100,002,514.86	100,002,514.86
70% = Farmer's Revenue	90,579,240,845.82	100,256,081,058.68	85,341,140,845.82	97,031,621,999.62
R1	362.31	401.01	341.36	388.12
R2	54.35	60.15	51.20	58.22
R2*CCS	543.46	601.52	512.03	582.18
Molasse	122.33	260.57	47.50	214.50
Final Cane Price/ Tonnes	1,028.10	1,263.10	900.89	1,184.80
160 baht subsidy	1,188.10	1,423.10	1,060.89	1,344.80
** [Assume] CCS=10, Weight R1= 40%, R2=60%				

Table 6

	(after cost deduction)
OCSB Rev.	25,136,500,007.23
OCSB Price Rev.	5,588,632,521.86
Export Rev.	14,392,161,933.62
Ethanol Rev.	30,655,758,930.03

Table 7

After we calculated by using the formula getting from OCSB where farmers get 70% of the final income, it results in 1,188.10, 1423.10, 1,060.89, 1,344.80 baht from case 1 to 4 respectively for a final cane price. Ethanol makes no surprise to be on the top of the list since it has the highest revenue per ton of molasses from all of the four cases and if we look closer only on the molasses revenue for each cases as represented in table 7 comparing between the real price by OCSB and the case 4 price which is the price farmers should really get since from article 4 in the Cane and Sugar Act of 1984 it's stated that if you use its byproducts to calculate the price of cane, byproducts will also be counted as sugar. So it means that the price of the final of the molasses should be accounted in the price of cane as seen in case 4 where it used the real demand and price of each products and reflected in the final cane price of 1,344.80 baht/ton compare

to 1,060 baht of OCSB price with a 26.76% difference which is roughly equal to 28 billion baht loss for the overall farmers holding that all of the assumptions given above remain true for this study.

Conclusion

The undercalculation of molasses revenue in the calculation of final cane price by the formula given by the Cane and Sugar Act of 1984 has made farmers lose a big chunk of revenue that they should get for almost 30 percent which is a lot if we look in term of the total production of the canes of a hundred million tonnes which means the lost revenue of almost 300,000 million baht of revenue of the system has gone to somewhere which some might say that the factory has used it as an advantage to make a further use of molasses which it does not have to go under the 70:30 system. May be it is a time for a government to make a change after 30 year usage of the act which it may be a good way at that point of times but when times change things also changes. Some point of the act which doesn't strictly imposed for a long time needed to be firmly use as you can see the difference from case 4 in the paper.

The methodology of this paper has used a lot of assumption since some of the data such as costs of selling, storage etc. of a fined sugar cannot be found or even the tax revenue gain from the selling of domestic liquor for an example cannot be found on the website which may give an inaccurate information when calculating the real amount of the demand of alcohol but it can still answer the question of this paper even though the number is not an exact one and the literature review of this paper is not quite directly fit the topic of the paper since the calculation system of cane in Thailand is quite unique in term of profit sharing scheme but after I go through the process of making this paper, there still an interesting point in the way of how Brazilian sugar miller share their profit among farmers which I think that this topic would help making this paper better but due to limited amount of time that I have, I would leave it for others for a further study.

Food price increase and land allocation problem are the another concerns that one should think of because even though you could increase the revenue of farmers by taking account of the undercalculation of molasses' products but if the expenses of farmers increased as well as result of shifting land to produce more cane products, it will both way drive down the market price of canes and increase the other staples crop's price. An additional study on this problem effects on the revenue of farmers would be a great contribution to the farmers and society.

One could say that Cane and sugar system in Thailand has somehow have a sweep under a carpet problem where a lots of things hidden behind and there're a lots of parties which has a conflict of interest which it could explain by how that why the government has led the problem to be unsolved. The proper way of the reformation of the whole cane and sugar system would be a good question that leaves one for a further study.

References

"Tax collection and spirit taxes calculation" The Excise Department, n.p. n.d. Web. 2 Oct 2014.

"Tax collection for fiscal year 2013" Fiscal Policy Office, n.p. n.d. Web. 2 Oct 2014

Arndta Channing, Pauwb Karl and James Thurlow. "Biofuels and economic development: A computable general equilibrium analysis for Tanzania" Energy Economics (2012) 34 (6): 1922–1930. Print

Bank of Thailand. North eastern department. Report on ethanol situation in Thailand 2013 and 2014 forecast, Bangkok: Bank of Thailand, 2013, Print

Banse, M., H. van Meijl, A. Tabeau, and G. Woltjer. "Will EU Biofuel Policies affect Global Agricultural Markets?" Eur Rev Agric Econ (2008) 35 (2): 117-141. Print

C. Ford Runge, and Benjamin Senauer. "How Biofuels Could Starve the Poor" Foreign Affairs, May/June 2007. Foreignaffairs.org. Web. 7 September 2014

Committee on Agriculture and Cooperatives, Report on cane and sugar, Bangkok: Legislative institutional Repository of Thailand, 2003, Print

Cororaton Caesar and Timilsina Govinda. "Impacts of Large-Scale Expansion of Biofuels on Global Poverty and Income Distribution" Policy Research Working Papers (2012): WPS6078. Print

Department of Alternative Energy Development and Efficiency (DEDE). ข้อมูลโรงงานผลิตเอทานอล,Ministry of energy, Jan 2014. Web. 6 Oct 2014.

Energy Policy and Planning Office, Ministry of Energy. Price structure of petroleum products in Bangkok, n.p, 24 Sep 2014. Web. 4 Oct 2014.

Fountain, Henry. "Corn Ethanol Makers Weigh Switch to Butanol" The New York Times 24 Oct. 2012: F4 Print.

H. Charles J. Godfray et al. "Food Security: The Challenge of Feeding 9 Billion People" Science 327, 812 (2010). Print

Khaosod Online. "ชาวไร่อ้อยเฮ!คสช.ประกาศราคาขั ้นสุดท้ายฤดู55/56 ที่999.20 บาทต่อตันอ้อย."

Http://www.khaosod.co.th/view_newsonline.php?newsid=TVRRd016WXdOamczT1E9PQ==. Khaosod online, 24 June 2014. Web. 6 Oct. 2014.

Kojima Masami, and Johnson Todd. "Potential for Biofuels for Transport in Developing Countries" KNOWLEDGE EXCHANGE Series 3, 4 (2006): 1. Print

Mitchell, Donald O. "Biofuels in Africa: opportunities, prospects, and challenges", Washington D.C. : World Bank, 2011. Print.

Office of the cane and sugar board. Summary on cane and sugar situation in Thailand for production year 12/13, Bangkok: Office of the cane and sugar board, 2013, Print

Peskett Leo, Slater Ratchel, and Dufey Anney. "Biofuels, Agriculture and Poverty Reduction" Overseas Development Institute AG0397 (2007). Print

Russell, Paul Frymier. “Bioethanol Production in Thailand: A Teaching Case Study Comparing Cassava and Sugar Cane Molasses” The Journal of Sustainability Education (JSE)(2012): n. pag. Web. 1 Oct 2014.

Seltzer, Wissman and Hanrahan. Economic Impact of Effluent Regulations on the Rum Industry, Puerto Rico and U.S virgin islands. Washington DC, 1979. Print.

Siamphakdee Sirivuthi. Thaitapiocastarch.com. Thai Tapioca Starch Association (TTSA), December 2011. Web. 29 September 2014.