Journal of Sugar Beet
http://jsb.sbsi.ir/
Journal of Sugar Beet 2012, 28(1)

Study of comparative advantage for sugar beet production in Iran

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Mohammadi H, Kaikha AA, Dehbashi V, Khaloee A.Study of comparative advantage for sugar beet production in Iran. J. Sugar Beet. 2012; 28(1): 45-50.

Received July 16, 2009; Accepted June 2, 2010

ABSTRACT

The main objective of this study is to investigate the comparative advantage for Sugar beet production in Iran. Sugar beet is one of the main crops which is considered as an important resource for energy supply. The importance of sugar beet (as a sugar source) in Iranian household food basket, price fluctuation and consumers' demand for sugar beet, social profitability and the impact of government polices and national market limitations on sugar beet growers was investigated using Policy Analysis Matrix (PAM) method in Iran for 2006-2007 growing season. The data of the study was obtained from documentary studies. The results of the Policy Analysis Matrix showed comparative advantage in sugar beet production in Iran (DRC=0.55). The nominal protection coefficient of the product also showed an indirect tax on sugar beet production (NPC=0.77), while Nominal protection coefficient of input indicates an indirect tax for inputs (NPI=2.55). However, effective protection coefficient proves that the indirect tax for sugar beet crop exceeds the corresponding subsidies paid by government to inputs. Therefore, government should plan to reform and to improve the inputs subsidy system to raise the efficiency.

Keywords: comparative advantage, Iran, policy analysis matrix, sugar beet

INTRODUCTION

The support for agricultural section has been considered as a real consensus for various reasons such as economic self-sufficiency and farmers incomes enhancement, creating employment and improvement of production in upperand lower industries of agriculture, making food security, being infrastructure of some of the agricultural stuffs in the nutrition basket of society, rural improvement and protecting the rural population structure and preventing from immigration to cities, etc. It seems that one of the most important goals for policy-makers in the agricultural section is maximizing the social profitability. This would be realizedwhen the products have the high comparative advantages (CA). Considering the principle of Allocation of Domestic Scarce Resources, the support for production of agricultural products must be accompanied with considering their comparative advantages. As Iran has an extensive area and considerable climate diversity, the agricultural production is the definite characteristic in the country, therefore the food production management and protection of natural resources and agricultural basic resources necessitates the recognition of the existing conditions.

In the field of comparative advantage, studies andresearches have been doneinside and outside the country, some of which are described below. Masters and Winter (1995) compared the domestic resources expenses indicesand the relativity of expenses to social benefits and ranking of 31 agricultural products in Kenya by using the two abovementioned indices. The results showed that while ranking with the domestic resources expenses, citrus wasat first rank whereason the basis of expenses to benefits it wasat the 3rd rank.

Peas which had the first rank in comparative advantage on the basis of comparing costs to benefits according to the criterion of domestic

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resources costs, ranks 4th.Zhonget al. (2002) determined the regional comparative advantage of cereals productionin China, based on production rate and the related expenses. On the basis of the results, the comparative advantage of the major crops, cultivated in different regions of China, had significant differences. Also, there were high potentiality for improving the allocation of resources and increasing production, caused by re-allocating the resources in the sections and China could compete in the world markets. The evaluation of the change in cropping pattern in producing sweet potato and the efficiency of replacing sweet potato with grain corn for livestock production was carried by Huang et al. (2003). The results showed there is a great deal of difference between the market and social profitability of sweet potato production, and if the government interfering policies are removed, the production of sweet potato willbe more beneficial, especially compared with grain corn.

Goudarzi (2009) determined the comparative advantage of different varieties of rice in province of Mazandaran by using the domestic resources costs indices during 1981-2007. The results showed that, during this period, in Mazandaran, the production of high quality long grain, and the high quality medium grain ricebetween 2000 and 2007 and short grain rice in 2009 and between2000 and 2007 had comparative advantages. Determination of comparative advantage of grain corn in Fars province, by applying the linear programming, by Abediet al. (2009) showed that although grain corn hadthe comparative advantage in all evaluated towns of the province, only in town of Neiriz the CA increased. Also, the comparison of the optimum cropping pattern from linear programming models, with ranking of crops based on comparative advantage index, represents that the limitation and the accessibility to the resources leads to the transmission of CA in production from one crop to another. The factors like the supportive policies, crop rotation and the limitation of resources could also be efficient in comparative advantage, composition and optimum quantities of cultivation. Determination of comparative advantage of the agricultural crops in Fars province and town of Marv-Dasht, by using the Policy Analysis Matrix method by Mohammadi and Boustani (2009) showed that in Fars province, the crops such as irrigated barley, grain corn, watermelon, melon, onion, potato, cotton, irrigated lentils, beans, tomato and irrigated peas had the comparative advantage, but the crops like irrigated wheat, rice, cucumber, rain-fed lentil lack CA. In town of Marv-Dasht the crops such as irrigated wheat, rain-fed barley, grain corn, watermelon, melon, cucumber, onion, potato, bean, tomato and irrigated peas had CA, but the crops like rain-fed wheat, irrigated lentil andrain-fed lentil lack CA. Hadad and Rabiee (1997) determinedthecomparative advantage of agricultural crops of Iran in 1997, by using the Domestic Resources Costs method, was done by. The crops like potato, onion, wheat, barley, apple, beanandcitrus had the comparative advantage in production. Also, the Domestic Resource Costs for bean, sugar beet and soybeanwas more than 1;in other words, these crops had no CA in production. Azizi andZibayi(2001) evaluated the CA for rice in 2008 in provinces of Guilan, Mazandaran and Fars by using 3 indices of social pure profit, domestic resourcescosts and the costs compared with social profits by. The results showed that the provinces of Guilan and Mazandaran in rice production, in comparison with other countries like Syria, Turkmenistan, Thailand and Kuwait have comparative advantage, but compared with the countries such as India, Azerbaijan, Vietnam, Pakistan and Uruguay have no comparative advantage and province of Fars has CA only compared with Syria, Turkmenistan and Thailand.

According to the above-mentioned matters, the study concerning the comparative advantage of sugar beet crop in Iran by using Policy Analysis Matrix could provide researchers with three important analytical means for determination of Inputs Utilization Efficiency in Production procedure, comparative advantage, and recognition of government interference in production.

MATERIALS AND METHODS

Policy Analysis Matrix (PAM)

Policy Analysis Matrix (PAM) enables researchers, beside the calculation of indices, to deal with policy analysis, and grant the policy recommendations. The framework of PAM is shown in Table 1. The Matricesof the first line, A,B,C, and D, represent the incomes, costs (the trading inputs and domestic factors) and profits based on market prices in the domestic market. The matricesare calculated on the basis of the producedcrop unit and inputs used in producing a crop unit, and the column of profit calculates the differences between the costs and incomes. The matricesof the second line,E_j, F_{ij}, G_{ij}, H_i, are the same quantities of

Table 1. The framework of policy analysis matrix

Basis of calculation	profit	costs		income
		Domestic factors	tradable inputs	
Market-based Prices	Di	Cij	Bij	Ai
Shadow-based prices	Hi	Cij	Fij	Ej
Subtraction (of first and second row)	Li	Kji	Jij	Ii

the first line based on shadow prices and the matrices of the third line, I_i, K_{ij}, L_{ij}, J_{ij},calculates the differences between the first and second lines.

Comparative advantage indices

The following indices were extracted from Table 1:

1. Domestic Resource Cost (DRC)

The quantity of DRC is calculated through the method of PAM as below:

$$\mathrm{DRC} = \frac{\mathrm{G}}{\mathrm{E} - \mathrm{F}}$$

In this case, DRC calculates the ratio of the domestic factors costs, in terms of shadow price, to the subtraction of incomes and the trading inputs costs, also in terms of shadow prices. If DRC>1, it shows that the studied area lacks comparative advantage and if DRC<1, the area has the comparative advantage for production of the crop.

2. Nominal Protection Coefficient (NPC)

Nominal Protection Coefficient (NPC)of a crop measures the ratio of income, in terms of market price to the income in terms of shadow price:

$$\mathrm{NPC} = \frac{\mathrm{A}}{E}$$

If NPC>1, there is a indirect subsidy for the production of crop and if NPC<1, it shows andindirect tax for the crop production, and if NPC=1, it means that there is no support for the crop.

3. Nominal Protection Coefficient in Inputs (NPI)

The coefficient calculates the ratio of tradable inputs cost, in terms of market price, to the tradable inputs cost, in terms of shadow price:

$$\mathrm{NPI} = \frac{\mathrm{B}}{\mathrm{F}}$$

If NPI>1, it means that there is an indirect tax for the tradable inputs, and if NPI<1, it means that there is an indirect subsidy for the tradable inputs, and if NPI=1, it means that no supportive policy is applied for the inputs.

4. Effective Protection Coefficient (EPC)

This criterion measures the ratio of additive value of the crop production, in terms of market price, to the additive value of the crop production, in terms of shadow price. Through this coefficient, one could evaluate the effects of government interference in the crop market coincidentally:

$$\mathrm{EPC} = \frac{\mathrm{A}-\mathrm{B}}{\mathrm{E}-\mathrm{F}}$$

If EPC>1, it means that the government policies support the crop production procedures, if EPC<1, it signifies that the government interferences have harmed the crop production and if EPC=1, there is no policy for the crop from the government.

5. Net Social Profit (NSP)

This index is resulted by subtraction of shadow costs from the shadow income: NSP=(E-F-G)

If NSP>1, it means that production and export of the crop is beneficial and if NSP<1, it means that production and export are not beneficial.

Calculation of Shadow Price of Agricultural Crops

In order to value the PAM in addition to the market prices of inputs and the incomes of crop production, there is also a need for their shadow prices. The inputs are generally divided into two groups:the tradable inputs, which include machineries, chemical fertilizers and biocides, and the domestic inputs, which include land, water, manure, seed and work forces. Shadow price is calculated in different methods as below:

1. The Shadow Price of Machinery

In the case of machinery, determination of shadow price is a dual case. Haji-Rahimi (1997) and Azizi and Zibayee (2001) calculated machinery costs in two cases, i.e. 36% of the machinery costs is calculated under the title of the tradable input cost and 64% of which is estimated as the tradable. Therefore, in the currentresearch this method wasused.

2. The Shadow Price of Chemical Fertilizers

In the case of chemical fertilizers, as they are produced both domestically and some part imported, for the different types of imported chemical fertilizers, 98% of the price is tradable.

3. Biocides Shadow Price

The most important consumed biocides for the field crops are herbicides, insecticides and fungicides. In the case of chemical biocides, by using the CIF price which has been announced bySupportive Services Company, their shadow prices were calculated.Additionally,according to the available knowledge it is supposed that the price for different types of chemical biocides was 90% tradable.

4. The Shadow Price of Lots

For measuring the shadow price of lots, there are various methods. For the first method, which isbased on the studies of Gonzales (1993), Haji Rahimi(1997) and Azizi and Zibayee (2001), the average land rental as the shadow price, by using coefficient of 85%, has been used. The coefficient is applied because the subsidies granted to the tradable inputs would cause the price of land rental to become more than reality Therefore, the land rental price in the major regions of cultivation, by applying coefficient of 85%, was considered as the shadow price for the lands. For the second method, the profit of the crops in the same group of the selected crops or one-fourth of the price of produced crops is considered as the land opportunity cost. This method has been used in the studies of Macintire and Delgado (1985) and Nourbakhsh (1996). In the third method, the depreciation of total investment for the land preparation during the functional lifetime was calculated and then added to shadow price of the land before preparation and the two would be the total shadow price. In the studies done by Solaee (1966) which were about the horticulturalcrops, this method has been applied. In the present study, the second method was used.

5. The Shadow Price of Water

Determination of shadow price of water, in various regions, is different. In the areas wherethere is a plenty of water and the irrigation of the fields is usually done by the water of springs, rivers etc., the shadow price would be calculated with irrigation efficiency of 45%, based on the highest cost of water, which may include water right, preservation andtransferring. Also, in the areas wherethe underground water is used, the finalcost of water should be considered, including digging ofwells, processing, transferring andpreservation, with the efficiency of 45%.

In the second method for the determination of water shadow price, 85% of the water rental price in the area is considered as the shadow cost.

This is the method used by Gonzales et al (1993). In the third method, the highest price of the ultimate water production used for various crops is supposed as the price in the region. Also, the price of this input could be estimatedthrough mathematical programming, but these kinds of methods require the time series inputs and the cross-section to acquire the production function of each crop in the region. In this study by using the first and second methods and according to the studies in the Ministry of Jihad-e-Agriculture, the input shadow price was determined for average water cost in one hectare.

6. The Shadow Price of Manure

Manure is not an economic product. It means that manure is a by-product material. Therefore, no rent or subsidy in its production is involved. Also, its price is determined in the competitive market or based on supply and demand. So, shadow price of manure is the same as its market price.

7. The Shadow Price of Work Force

In the case of work force, it is necessary to mention that because of no allocation of subsidy for supplying the work force and considering the fact that the work force in the cultivation activities should have expertise and special skills and the market is competitive, the shadow price is considered equal to the average market price in order to avoid different statistical errors (Mosanejad and Zarghami1994; Hadad and Rabeei1997).

8. The Shadow Price of Seeds

Seed is aninput produced and exchanged by the farmers themselves, thus, , its market price is considered as the shadow price as shown by Najafi and Mirzaei (2003), Mohammadi (2003), and Mehdipouret al. (2006).

9. Income in terms of Shadow Prices

In order to obtain the shadow income in a hectare, the value of 1 kg of the crop in the world market based on dollar is calculated, then it is multiplied to the shadow exchange rate;the outcome would be the Rial price of 1 kg of the export

price. Then, the crop yield in Kg is multiplied to the price in Rial; the result is the shadow income per hectarefor the supposed crop.

Table 2. Costs and incomes for one-hectare field of sugar beet based on market price

Costs of tradable inputs	
1. chemical manure	652956 Rials/ha
2. biocides	189563 Rials/ha
3. machineries	1269842 Rials/ha
Domestic factors	
1.land	1938600 Rials/ha
2.irrigation water	1476419 Rials/ha
3. labors	5393400 Rials/ha
4. manure	525826 Rials/ha
5. seeds	909361 Rials/ha
Total costs	13233730 Rials/ha
Value of gross production	17976140 Rials/ha
Gross profit	474241 Rials/ha

Reference: Ministry of Jihad-e-Agriculture, costs of agricultural crops for year 2006-7, General Office of Statistics and Information Technology

10. TheShadow Price of Exchange Rate

Foreign exchange rate in calculating the comparative advantage is of high significance. In fact this rate is the basis to reach the acceptable shadow price for the tradable crops and inputs. For the calculation of the shadow foreign exchange rate, various methods could be taken into consideration. One of the simple and usual methods which is accepted by many economists, is the method of Purchasing Power Parity (PPP) (Gardner and Rausser 1998). Therefore, in this study the shadow exchange rate was calculated by using the method of PPP in the absolute case. The quantity of this rate is calculated as follow:

$$Shadow\ exchange\ rate = \frac{PIg}{PDg} = 10650$$

where P_{Ig} is the price of one ounce gold in the domestic market (in Rial) and P_{Dg} is the price of one ounce gold in the world market (in dollar).

RESULTS AND DISCUSSION

As said, in order to obtain PAM and CAI, it is needed to know costs and incomes in market and shadow prices. Costs and incomes in market price are gained from the agricultural crops production costs, announced by the Ministry of Jihad-e- Agriculture. To obtain the costs and incomes in shadow price, different methods are applied as mentioned above. Tables 2 and 3 show costs and incomes for one hectare of sugar beet field in market and shadow prices. The necessary statistics and information in the study have been collected by the documentary studies and database of Ministry of Jihad-e Agriculture for 2006-2007.

Table 3. Costs and incomes for one hectare field of sugar beet based on shadow price

Costs of tradable inputs	
1.chemical manure	1136959 Rials/ha
2. biocides	1591200 Rials/ha
3. machineries	1277640 Rials/ha
Domestic factors	
1.land	1647810 Rials/ha
2.irrigation water	180000 Rials/ha
3. labors	5842850 Rials/ha
4. manure	525826 Rials/ha
5. seeds	909361 Rials/ha
Total costs	14723847 Rials/ha
Value of gross production	23265441 Rials/ha
Gross profit	8541594 Rials/ha

According to the fact that from each hectare of sugar beet field in 2006-2007, on average, 44441 Kg sugar beet was obtained. In Table 3, the PAM for one Kg of sugar beet has been represented.

Calculating the Domestic Resources Cost(DRC) is the representative of the existence of comparative advantage for sugar beet production in Iran. In other words, through producing sugar beet in the country, for every 100 Rials saved economically to avoid importing, 55 Rials has been paid, which, compared with the findings ofHadad and Rabiee (1997), Azizi and Zibayee (2001), Mohammadi and Boustani (2009), Abedi et al. (2009) and Goudarzi (2009), by using the DRC, the sugar beet crop has also the comparative advantage in Iran. The NPC is the representative of indirect tax for sugar beet production. It means that the government policies were not in the direct of support for domestic production. In other words, if sugar beet production in a free condition has 100 Rialsincome, in the condition of direct and indirect interferences of government and domestic market has the income of 77 Rials, which shows an indirect tax for sugar beet production in Iran. The estima-

Table 4. Policy analysis matrix for production of one kilogram of sugar beet (in Rial)

Basis of calculation	profit	costs		income
		Domestic factors	Tradable inputs	
Market-based Prices	112	62	230	404
Shadow-based prices	128	241	90	523
Subtraction	-16	-179	140	-119

Table 5. Results of the calculation of Policy analysis matrix

NSP	EPC	NPI	NPC	DRC
192	0.4	2.25	0.77	0.55

tion is that NPI>1 shows the lack of indirect subsidy for the tradable inputs. Therefore, government policies were not towardthe support for sugar beet production inputs in the market. For example, for 100 Rialscost which is paid for the tradable inputs from world market, the government calculates 255 Rialsfor producers and do not pay subsidy for the inputs. The estimation is that EPC<1, i.e. the government interferences have acted against this crop. In other words, the tax, which government has considered indirectly for sugar beet crop, is more than the subsidy paid for the inputs. It means that the addedvalue of 100 Rialsin the condition of free trade and with government and the domestic market interferences turns out to be 40 Rialsand also NSP>0, which means that production and exportation of sugar beet crop has social profits.

Finally, according to the results, the costs of tradable and untradeable inputs production are enumerated as important efficient factors for the comparative advantage of this crop, which either the quantity of consumption ofthe inputs should be optimized or, by using the high technology, the production cost of each crop unit would be decreased.

In other words, by the optimum applicationof inputs, the productivity and efficiency of each input could improve and the costs of each productive unit are reduced. In this case, it is suggested that the authorities involved in the production section of the agricultural crops (the Ministry of Jihad-e-Agriculture) cause to decrease the production costs and increase the comparative advantage through promotion of modern and innovative technologies, applying methods for the reduction of the crop waste, increasing the mechanization coefficient, etc.

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