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Attaining Sufficient Yield of Sugarcane in Bangladesh: An Empirical Approach

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Abstract: The study contains an empirical research approach on the demand and supply analysis for sugarcane in Bangladesh. Based upon the analysis, how sufficient yield of sugarcane could be achieved as well as sustained in the country is discussed in the study along with exploring its strengths, weakness, opportunities and threat.

Key words: Sufficient yield, demand deficit, sugarcane belt, gur, import, market area

INTRODUCTION

Bangladesh has a yearly production of 6.005882 million metric ton of sugarcane which comes from the cultivation of 3,54,701 acres land (BBS, 2007). However, the amount of production seems merely sufficient to meet the increasing demand for sugar and gur at national level.

The average yearly demand for sugar in Bangladesh is 1.4 million metric ton while the figure is only 0.3 million metric ton for gur (BSFIC, 2013a). On average, 0.175 million metric ton of sugar is processed from 2.31 million metric ton of sugarcane in the country each year (BSRI, 2013a). The production amount points to the yearly demand deficit of sugar by 1.225 million metric ton. The country needs to import 1.26 million metric ton of sugar on average to overcome this national demand deficit each year (Khan, 2009).

On an average 11 kg sugar is produced from 100 kg of good quality of sugarcane (Russel, 2002). However, the local rate of sugar processing from sugarcane in Bangladesh is below the international standard. In Bangladesh, 1 kg of sugar is processed from 13.2 kg of sugarcane (BSRI, 2013a). Considering the local standard, 16.632 million metric ton of sugarcane is needed to produce in addition to the current production in our country to fulfill the total national demand for sugar each year.

The average sugarcane production rate in Bangladesh is 17.258 metric ton acre^{-1} (BBS, 2007) which points to the requirement of additional 9,63,726.97 acres land under sugarcane cultivation scheme for an average of 7 months period (mid October to mid April) (BBS, 2010) in order to meet the demand deficit for sugar.

Objective of the study:

- To analyze monetary benefit of local yield of sugarcane against the import of sugar in Bangladesh
- To formulate policies with view to sustaining the local yield in long run

MATERIALS AND METHODS

Study methodology adopted for conducting the research is described.

Study area selection: Two districts are selected as study areas for conducting the survey. The criteria based on which study areas are selected are mentioned below:

District's average sugarcane production rate (metric ton/acre): District with the highest sugarcane production rate figure is considered with priority.

Mill-zone/non-mill zone area: Out of two study areas one should be located at mill-zone and another at non-mill zone area so that variation in crop yield as well as production cost rate data is captured well.

Proximity to Dhaka: Distance of districts (in kilometer) from Dhaka is considered as well for the convenience of survey.

Regional variation: In case of contiguous districts, the district fulfilling earlier mentioned criteria better than other(s) is considered in order to ensure data authenticity.

The average sugarcane production rate in Bangladesh is 17.258 metric ton acre^{-1} aforementioned

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Table 1: Key information on the initially selected districts

Districts	Sugar cane production		Production rate (metric tons/acre)	Name of sugar mill located within the district††	Distance of districts from Dhaka (km)†††
	Area (acres)†	Production (metric ton)†			
Manikganj	7,705	1,488,789	193.2238	-	63
Thakurgaon	1,525	245,455	160.9541	Thakurgaon Sugar Mill	407
Khagrachari	1,489	75,188	50.4956	-	259
Barguna	270	7,044	26.0889	-	247
Netrokona	204	5,296	25.9613	-	158
Chandpur	1,852	47,120	25.4430	-	115
Chuadanga	32,088	801,736	24.9855	Carew & Co. Sugar Mill	215
Sherpur	531	13,242	24.9378	-	188
Gaibandha	8,152	187,802	23.0375	-	268
Patuakhali	109	2,445	22.4312	-	204
Nilphamari	551	11,321	20.5463	-	359
Tangail	9,009	181,203	20.1135	-	92
Jhenaidah	13,207	262,735	19.8936	Mobarakganj Sugar Mill	178
Joypurhat	3,665	69,387	18.9323	Joypurhat Sugar Mill	249
Kushtia	34,656	619,246	17.8683	Kushtia Sugar Mill	183

(BBS, 2007). Initially the districts with sugarcane production rate more than the country average are considered to ensure data quality. Table 1 shows that sugarcane production rate of Manikganj District is 193.2238 metric ton acre^{-1} which is the highest figure compared to all others. Moreover, the district is closest to Dhaka among all. Considering the criteria aforementioned and putting priority on the first and third, Manikganj District is selected firstly as study area.

Now regarding selecting the second study area, all criteria are tried to be met. Accordingly, Chuadanga District is opted as second study area as it includes a considerable production rate, falls within Carew and Co. Sugar Mill Zone area, feasible distance from Dhaka and regional variation with firstly selected Manikganj District.

Data collection: Data on sugarcane cultivation costs and earning from sugarcane are collected extensively from the survey on sugarcane farmers. The total number of farmers in Manikganj District is 1,71,068 while the figure is 1,73,698 in Chuadanga District (BBS, 2010). At 95% confidence level and confidence interval of 5, total 384 farmers are sampled for both districts to conduct the study on. The whole sample size then is divided into two according to the percentage share of districts to the total farmer. Accordingly, 191 farmers are surveyed in Manikganj District and 193 in Chuadanga.

Literature review: Miller *et al.* (1991) states that Location Quotient (LQ) yields a coefficient or a simple expression of how well represented a particular industry is in a given study region. According to Kiser (1992), the Location Quotient Technique describes a region's industry mix and determines whether or not a region has its fair share of each industry. Yuan and Fang (2009) indicates that while appraising the compared superiority of regional industry, especially industries in a small region, Location Quotient Analysis is one of the most basic methods. As a quantitative index of appraising specialization degree of a region's industry, location quotient may explain the specialization degree of a product or an industry's development. Yuan and Fang (2009) also shows how to calculate LQ value for an area for a profession or sector as following:

$$LQ_{ij} = \frac{L_{ij} / \sum_j L_{ij}}{\sum_i L_{ij} / \sum_i \sum_j L_{ij}}$$

Where:

i = The ith area (e.g., district)

j = The sector (e.g., sugarcane crop)

L_{ij} = The total output (or production) of the ith area and the jth sector

L_{qij} = Location quotient of the ith area, the jth sector

RESULTS AND DISCUSSION

Whether to import or to produce: Average yearly import amount of sugar in Bangladesh is 1.26 million metric ton (Khan, 2009) aforementioned which costs BDT 77,450.35 million in total as per sugar purchasing rate of BDT 61,468.532 ton^{-1} (including all types of duties and freight costs) (Sugaronline, 2012).

To avoid the import of 1.26 million metric ton of sugar, the amount of sugarcane required to produce locally is 16.632 million metric ton from cultivating 9,63,726.97 acres of land a year as mentioned earlier. Per acre sugarcane production cost is BDT 13,380 for a single (BBS, 2007; BSFIC, 2012; RHD, 2007) crop season

as presented in Appendix. Therefore to produce 16.632 million metric ton of sugarcane, production cost required is BDT 12,894.67 million. In sugar mill, cost for 1 metric ton sugarcane processing is BDT 3,344.02 (including packing and other raw materials cost, salary and wage at factory, repairing and maintenance, insurance, VAT, electricity and fuel costs and other costs) at 7.17% of recovery performance (BSFIC, 2013b). Therefore to process the total 16.632 million metric ton amount of sugarcane, processing cost required is BDT 55,617.74 million.

Study shows that the total cost required for producing and processing the required amount of sugar avoiding import is BDT 68,512.41 million year^{-1}. This indicates that local production of sugarcane rather import of sugar would save around BDT 8,937.94 million year^{-1}. In addition, production of sugar results to some by-products like molasses, chobra and spirit/alcohol which might contribute to the national GDP. In 2009-10 fiscal year, total 32716.69 metric ton of molasses, 3,13,527 metric ton of chobra and 43,52,000 L of spirit/alcohol are produced as by-products from the processing of total 8,66,573 metric ton of sugarcane at average 7.17% recovery rate of sugar (BSFIC, 2013c). The statistics indicates that on average 0.038 metric ton of molasses, 0.362 metric ton of chobra and 5.022 L of spirit/alcohol are produced as by-product from the processing of 1 metric ton of sugarcane. Therefore, the additional production of 16.632 million metric ton of sugarcane towards meeting the national demand deficit might result by-production of around 6,32,016 metric ton of molasses, 60,20,784 metric ton of chobra and 83.526 million L of spirit/alcohol.

In Bangladesh, wholesale market price of molasses and spirit/alcohol are, respectively BDT 18,496.69 per metric ton and BDT 59.324 L^{-1} as recorded at 2009-10 fiscal year (BSFIC, 2013d). This indicates that local production of 16.632 million metric ton of sugarcane has potentials to generate a rough additional income of BDT 11,690.20 million by the by-production of molasses and BDT 4,955.09 million by spirit/alcohol.

Moreover, 60,20,784 metric ton of chobra produced as by-product would contribute to this additional income by considerable percentage.

In 2003-04 fiscal year, these by-products of sugar contributes 4.23% GDP within the sugarcane economy which results 0.03% GDP contribution to the national economy (BSRI, 2013b).

The study findings henceforth recommends for the sustainable local production of sugarcane rather import which involves wasting huge amount of money both in terms of loss of capital and opportunities. Now, the study therefore is proceeded to the policy formulations for attaining sufficient as well as sustainable local yield.

Concept of sugarcane-belt: Application of belt concept in sugarcane production could counter-act to the disadvantages of haphazard cultivation of the crop. In this concept, high sugarcane yielding areas or the areas having potentials to contribute to both local and national sugarcane economy could form a belt from where additional quantities of sugarcane required to meet the national demand deficit would be cultivated. The belt should have self-sufficiency as well in terms of provision of labor forces and lands required to cultivate the given amount.

The belt concept could be implemented by patronizing sugarcane cultivation within the belt through ensuring availability of good quality seeds, inputs and other technical supports.

In this study, the sugarcane-belt is proposed covering Gaibandha, Sherpur, Jamalpur, Tangail, Pabna, Manikganj, Rajbari and Kushtia Districts. In total, 98,013 acres of agricultural lands in these 8 districts are under sugarcane cultivation and this proposed belt has current production of 29,65,927 metric ton of sugarcane in a year (BBS, 2007).

Basis for selecting the belt districts

Location Quotient (LQ): The Location Quotient (LQ) value of a district for sugarcane production points to the district's contribution to the national sugarcane production.

The average LQ of Bangladesh for sugarcane production is 19.7659 as calculated from the district wise agricultural production data provided in BBS (2007). The equation used to calculate LQ for a district for sugarcane production is as following:

$$LQ \text{ for District "X"} = \frac{\dfrac{\text{Quantity of sugarcane produced and district "X"}}{\text{Quantity of total agriculture products produced in district "X"}}}{\dfrac{\text{Total quantity of sugarcane produced in the whole country}}{\text{Total quantity of agricultural products produced in the whole country}}}$$

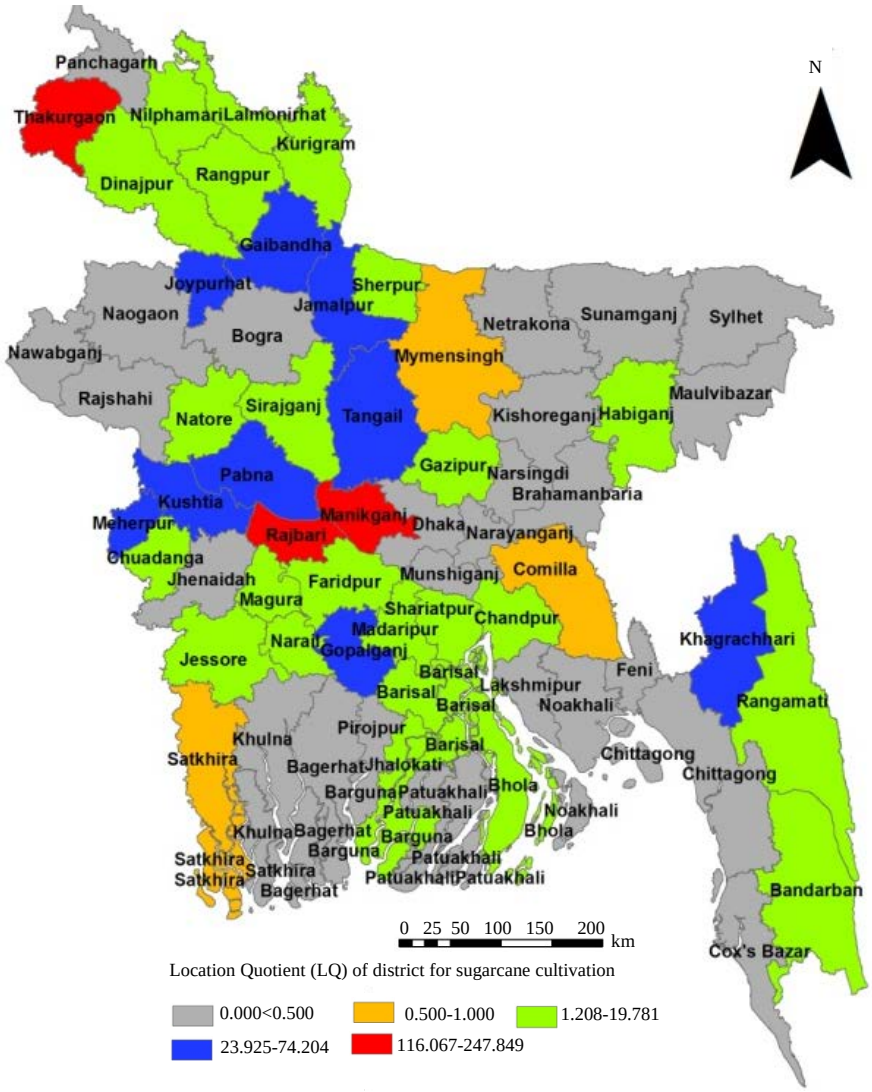

Fig. 1: Overall district-wise distribution of sugarcane production in Bangladesh

Table 2: LQ value and production rate of districts for sugarcane production

Districts	Location Quotient (LQ) value	Production rate (ton/acre)
Manikgonj	247.740	193.2238
Thakurgaon	143.156	160.9540
Rajbari	116.011	14.1516
Meherpur	74.169	13.3909
Tangail	53.676	20.1135
Pabna	48.492	3.9147
Gaibandha	45.363	23.0375
Jamalpur	34.877	14.1625
Kushtia	32.942	17.8684
Khagrachari	30.469	50.4956
Gopalganj	29.645	13.1094
Sherpur	6.191	24.9378

BBS (2007)

Figure 1 shows the comparative LQ values of districts of Bangladesh for sugarcane production. The districts having Location Quotient (LQ) value of more than the country average are considered initially to form the belt. Table 2 presents the list of eleven districts fulfilling the criterion. However, LQ value of a district cannot sufficiently elucidate its productivity as this tool is concerned of the district's total output but the production rate. A district with larger cultivable land area can produce higher quantity and therefore may hold bigger LQ value. In transposition, the quantity of output produced by a small district may seem off-set to the national level production though the district might have greater productivity in terms of production per acre than the larger district. While selecting districts to form a special crop-belt, therefore, per acre production of district should also be considered to ensure sufficient yield of that crop from minimal utilization of lands.

Production rate (metric ton/acre): Production rate of a district indicates how prolific or productive the district is

for cultivating the given type of crops. The country average of production rate is 16.948 metric ton acre^{-1} for sugarcane cultivation (BBS, 2007). The districts with production rate greater than the country average are considered initially and then validated by LQ values of those districts to be selected for the belt. Other districts with considerable LQ values but lower production rates (and vice-versa) are also considered based upon the location factor or geographical contiguity to the belt areas.

Location factor: Manikganj, Rajbari, Tangail, Gaibandha, Jamalpur and Kushtia with LQ values and production rates both greater than the country averages are selected to form the sugarcane belt. Pabna holds considerable LQ value but very low production rate as showed in Table 2. Nevertheless, Pabna District is considered to form the belt as it is geographically contiguous to the primarily selected sugarcane belt. Accordingly, Sherpur District with lower LQ value but higher production rate than country average has been considered for its geographical contiguity.

On the other hand, Thakurgaon, Meherpur, Khagrachari and Gopalgonj districts have considerable productivity but are geographically isolated. Therefore, these districts are not considered in forming the belt area.

Availability of lands under crop cultivation: The proposal of this research is to produce the additional 16.632 million metric ton of sugarcane required to meet the national demand deficit per year, in the proposed sugarcane-belt. In order to produce this huge amount of sugarcane total land area required is 9,63,726.97 acres as mentioned above. Manikganj, Rajbari, Tangail, Gaibandha, Jamalpur, Kushtia, Sherpur and Pabna- these eight districts have in total 24,79,167 acres of agricultural lands under crop cultivation (BBS, 2010).

Moreover, Manikganj, Rajbari, Gaibandha, Kushtia and Pabna Districts are located on the bank of three major rivers of Bangladesh-Padma, Jamuna and Brahmaputra. Therefore, these districts have huge amount of lands in 'char' area. It should be mentioned here that char lands are highly suitable for sugarcane cultivation (BSS, 2012).

Key information on the proposed sugarcane-belt: Sugarcane-belt is consists of 8 districts of Bangladesh; namely Manikganj, Rajbari, Tangail, Gaibandha, Jamalpur, Kushtia, Sherpur and Pabna as showed in Table 3 and Fig. 2. These districts are characterized by high sugarcane productivity as well as contribution to the national sugarcane production.

The average sugarcane production rate of the selected belt is 38.93 metric ton acre^{-1} whereas the country average is 16.948 metric ton acre^{-}. In collective manner, the Location Quotient value of the belt area is 73.1615. Information on other aspects, such as area under sugarcane cultivation, production amount, number of agricultural labor, amount of lands under crop cultivation and culturable waste and fallow lands associated with the belt area are given in Table 3.

Policy recommendations

Emphasizing char area production: River-side sandy soil or char areas are highly suitable for sugarcane cultivation. Tangail, Pabna, Jamalpur and Kushtia, these four districts of the selected sugarcane-belt have around 1,53,000 acres of fallow and 23,000 acres of culturable waste lands as showed in Table 3 (BBS, 2011).

Moreover, being situated on the bank of river, Gaibandha, Pabna, Manikganj, Kushtia and Rajbari districts have huge amount of cultivable or cultivable fallow lands in char area. These char areas along with other fallow lands and culturable waste lands could be brought under the sugarcane cultivation scheme which would ensure maximum utilization of char lands and thus higher production possibility of sugarcane. Proper patronization (e.g., extension of irrigation, provision of seeds, inputs and training, etc.) from the Ministry of Agriculture (MoA) or Bangladesh Sugarcane Research Institute (BSRI) would be helping in this regard in bringing those lands under sugarcane cultivation.

Agricultural labor policy: On an average 24 labor days are required to cultivate 1 acre of sugarcane throughout the 7 months of sugarcane growing period. Now as mentioned above, 9,63,726.97 acres of land are required to be cultivated with sugarcane within the selected belt area in order to meet the national demand deficit for sugar. Therefore in total 23.13 million labor days would be required to cultivate the required amount in a season. The statistics indicates that 1,10,140 labors-days, on a rough estimate would be required per day in the sugarcane field within the belt area.

However, the selected sugarcane-belt area has supply of around 13,56,180 agricultural labors as showed in Table 3 (Agriculture labor is defined as labor exchanged for wages in cash or kind or both for agricultural activities on land operated by other households) (Agricultural Census, 2008).

It should be mentioned here that the number of actual agricultural labors available within the belt area could be bigger since land-owners are also found sometimes giving labor to their own fields.

Land renting policy: Study shows that average agricultural (sugarcane) labor charge in the rural parts of Bangladesh is BDT 120 day^{-1}. Therefore, considering

Table 3: Information on the proposed sugarcane-belt

Districts forming sugarcane-belt	Area under sugarcane cultivation (acres)†	Production amount of sugarcane (metric ton)†	Sugarcane production rate (metric ton/acre)	Number of agricultural labor††	Amount of Area under crop cultivation (acres)†††	Culturable waste (acres)††††	Fallow land (acres)††††
Manikganj	7,705	1,488,789	193.2238	81,957	186696	-	-
Jamalpur	29,576	418,872	14.1625	212,634	391038	8000	38000
Tangail	9,009	181,203	20.1135	213,685	498146	4000	57000
Rajbari	12,384	175,254	14.1516	76,716	149109	-	-
Kushtia	34,656	619,246	17.8684	150,564	259317	3000	2000
Pabna	35,295	138,170	3.9147	198,378	387463	8000	56000
Sherpur	531	13,242	24.9379	142,024	248681	-	-
Gaibandha	8,152	187,802	23.0375	280,222	358717	-	-
Total	137,308	3,222,578	(average) 38.93	1,356,180	2,479,167	23000	153000

BBS (2007); ††Agricultural Census (2008); †††BBS (2010); ††††BBS (2011); Sign indicates that the data for the district is not available

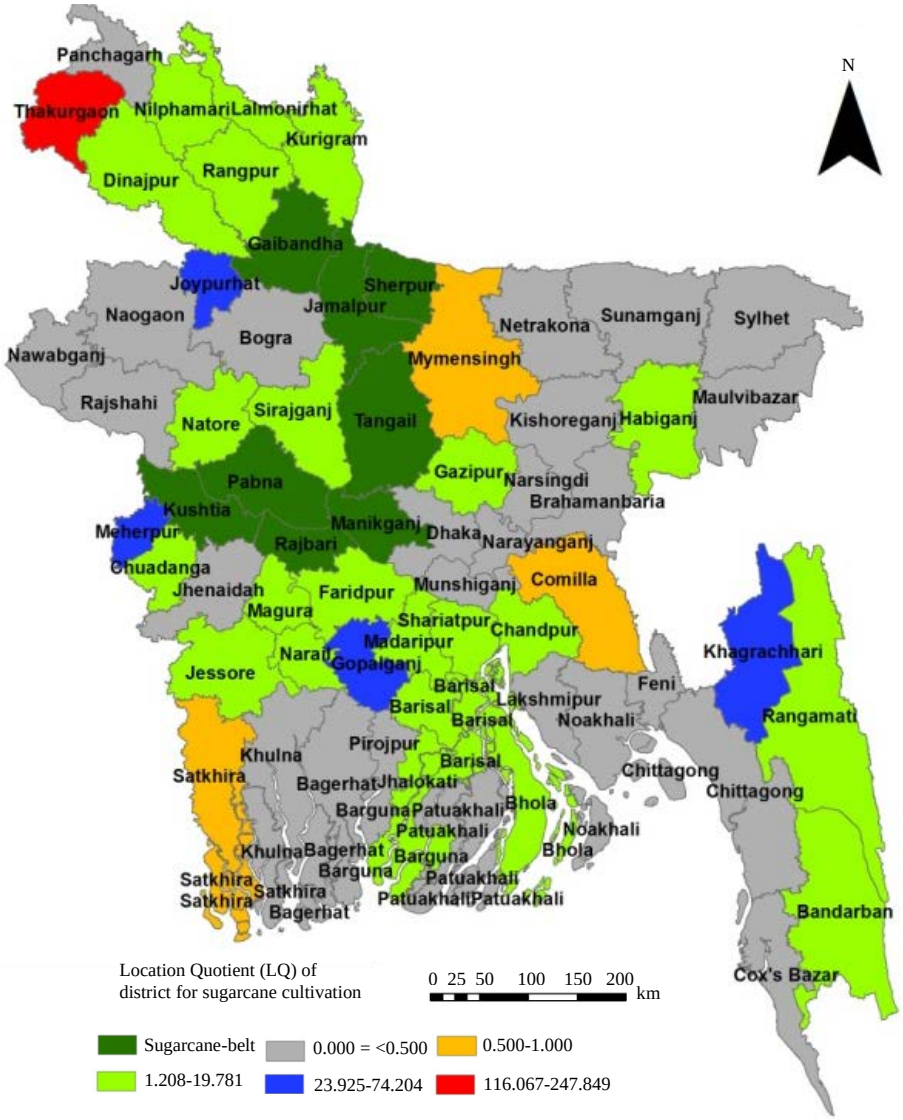

Fig. 2: District-wise distribution of sugarcane production in Bangladesh Location of the proposed sugarcane-belt

25 working days in a month, a sugarcane laborer can earn BDT 3000 monthly. However, a rural family with average 4 family members would need BDT 3000-3500 month^{-1} to be run properly.

Monthly income of BDT 3000 of a laborer, therefore is merely sufficient to run his family since there might happen some unexpected costs.

Considering the issue, land renting policy is proposed here with a view to enhancing the earning capability of those laborers. Under this policy, all agricultural laborers within the belt area are supposed to cultivate at least 1 Bigha (1 Bigha = 1/3 acre) land with sugarcane on land renting basis each year. A local body for sugarcane is recommended to be built up within the belt area in this regard who would look for implementing the proposed land renting policy.

Cultivation of sugarcane in 1 Bigha land generates seasonal profit of BDT 18,957 as calculated and presented in Appendix. Therefore, a laborer with 1 Bigha rented land cultivated with sugarcane would be able to earn an additional income of BDT 2708.14 month^{-1} for in total 7 months period. This additional earning would help laborers to have savings of a reasonable amount per month. Moreover, other crops could be cultivated in same land in other season(s) of the year. This might allow them to earn more which would improve their quality of life.

Industrial policy: Out of 15 government run sugar mills in Bangladesh, three (i.e., Zeal Bangla Sugar Mill, Pabna Sugar Mill and Kushtia Sugar Mill) are located within the proposed sugarcane-belt. Other nine sugar mills are located at geographically adjacent districts to the proposed belt area. All these mills should have maximum access to the belt area especially for raw materials (i.e., sugarcane). The market area for each of sugarcane mills should be defined geographically to ensure systematic and effective production of sugarcane in field. Improved transportation networks should be established between these mills and corresponding parts of the belt area.

SWOT analysis: The strengths, weakness, opportunities and threats to the local production of sugarcane within the proposed belt area, as obtained from the research are:

Strength

Char area: Availability of large amount of 'char lands' within the proposed belt area which are highly suitable for sugarcane cultivation.

Favorable environment: Most of the districts within the proposed belt area have favorable environment in terms of temperature, relative humidity and soil quality for sugarcane cultivation (Hoque, 2001).

Ngo activities: Most of the districts within the proposed sugarcane-belt area are characterized by adequate concentration of NGO activities (NGO Affairs Bureau, 2013). Some of these NGO's can offer financial help in micro-credit or other format to the farmers to promote the cultivation of sugarcane.

Availability of labors: There is sufficient supply of agricultural laborers within the proposed belt.

Optimum distance of the belt area from other parts of the country: The proposed sugarcane-belt is located almost at the central part of the country. This location factor would reduce the transportation cost of sugar as well as sugarcane throughout the country.

Weakness

Longer growing duration: Cultivation of sugarcane requires 7 months from plantation to harvesting time which might discourage farmers to grow this crop.

Illegal ownership of char lands: Most of the char lands in Bangladesh are occupied illegally by local influential people. They would locally try to resist any kind of government intervention in their illegally occupied lands. This issue might reduce the production possibility of sugarcane in those char areas.

Opportunity

Fuel: Crusted sugarcane or chobra and sugarcane leaves could be used as cheap fuel within the area.

Absorption of local agricultural laborers: Agricultural laborers would be required in sugarcane field on regular basis which could ensure their income certainty throughout the year.

Threat

Aggression of tobacco: For more profit farmers are being inclined in tobacco cultivation instead of sugarcane in Kushtia now-a-days (Akhter, 2011).

Flood prone area: Char lands lie in flood prone area and therefore, the production might get damaged on sudden basis.

CONCLUSION

Local production of sugarcane in Bangladesh would save wastage of BDT 8,937.94 million year^{-1}. Moreover, a huge amount of money would be earned in this sector through the by-production of molasses, spirit/alcohol and chobra. These two issues point to the logical reasoning behind going for sustainable local growing of sugarcane.

However, belt concept would help to get promoted production of sugarcane since regionalization, especially in case of agricultural activities, results efficient outcomes always.

The 8 districts are selected to form the sugarcane-belt based upon their location quotient value for sugarcane production, production rate, location factor and land supply ability. Policy recommendations are also made in the research to get enhanced production as well as improved quality of life of agricultural laborers within the proposed belt area.

APPINDEX

Costing and earning details for per Bigha sugarcane cultivation (in a single season)
(Note: 1 Bigha = 1/3 acre)
Production duration of sugarcane = 7 months
Average production cost in total:
Land preparation and plantation cost: BDT 2246
Irrigation cost: BDT 720 (Irrigation for 2-3 times)
Fertilizer cost: BDT 534 (20 kg Urea for 2 times, 1.5 kg of Nitrogen, 0.3 kg of Phosphorus and 3.25 kg of Potassium for single time)
Labor cost: BDT 960 (8 laborers in total)
Total production cost: BDT 4460 per Bigha
= BDT 13, 380 per acre
Average price per kg^{-1} of sugarcane: BDT 2.14
Average total earning from the cultivation of 1 Bigha: BDT 23,417
Net profit from the cultivation of 1 Bigha: BDT (23417-4460) = BDT 18957

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