Energy Output-Input Ratio in Sugarcane Production

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Energy is the basic driving force in man's development. With the increase of human population the demand of food has also increases instantly. The traditional farming system can not cope with that increased demand due to shortage of commercial energy. In the transition from traditional to modern farming, the commercial energy uses increase sharply. Improved varieties, a key element in modern farming, require commercial energy for their production and distribution. Adoption of appropriate machinery either hand operated or animal powered or machine operated can solve the problems of energy shortage for land preparation, intercultural operation, harvesting, crushing and post harvest operation and hence ensure timeliness of an operation. The average energy input and output per hectare of land from agricultural farming are 6674 MJ and 60992 MJ respectively and average energy output-input ratio is 9.13 (Rahman and Ali, 1997). The energy needs for the production of different crops in different ecosystems as influenced by landholding, level of agricultural inputs and other factors pertinent to crop production and to various household activities varies from crop to crop. Energy inputs in the form of seed, fertilizers, chemicals, irrigation, human, animal and prime movers and output in the form of grain yield and by product were measured periodically. It was reported that the unit gross power available was 1.77 kW/ha and power available for mobile operations was 1.65 kW/ha (Surendra *et al.*1991). A comparative analysis of energy requirements for tilling, fertilizer, irrigation, threshing and harvesting are calculated by Bala and Hussain (1992) for aus and aman rice and jute grown in wet season and boro rice and wheat grown in dry season for three villages of Bangladesh. Among the various operations tillage, irrigation, harvesting and threshing were the main operations consuming bulk of energy in the farm. The present study was conducted to assess energy output-input ratio in sugarcane production.

An experiment was conducted on the old Himalayan piedmont plain region of non-calcareous brown flood plain soils (Typic Haplaquept) at North Regional Station (NRS) farm of Bangladesh Sugarcane Research Institute (BSRI), Thakurgaon during 1998-99 cropping seasons. Total area of the experimental plot was one hectare. Pertinent data were collected, analysed and tabulated to arrive at meaningful conclusion. For determining different energy inputs and outputs on production of sugarcane, various equation, energy co-efficient and fertilizer recommendation guide were used. After harvesting sugarcane the trash was measured separately and observed that the weight of trash was approximately 20% of the weight of sugarcane.

Energy input components in sugarcane production:

(i) Energy from human labour:

The equation for computing energy from human labour is:

$$E_h = N_h \times O_t \times C_h$$

Where,

Eh = Energy available or consumption from human labour (MJ)

Nh = No. of human labour (No. of unit)

Ot = Use/operating time taken for the operation (hr)

Ch = Human labour energy coefficient (MJ/hr)

(ii) Energy from tractor:

The equation for computing energy from tractor is:

Ept = Ot× Cf × F

Where,

Ept = Energy available or consumption from tractor (MJ)

Ot = Use/operating time taken for the operation (hr)

Cf = Fuel (diesel) average energy coefficient (MJ/l)

F = Fuel used for tractor operation (l)

(iii) Energy inputs from irrigation pumps:

The equation for computing energy from irrigation pump is:

Efi= F × Cf

Where,

Efi = Energy used for irrigation (MJ).

F = Fuel used for irrigation (l)

Cf = Energy co-efficient of fuel (MJ/l)

(iv) Energy inputs from fertilizer and pesticides:

The equation for computing energy from fertilizer and insecticide/pesticide is:

Efp = N × Cn + P × Cp + K × Ck + I × Ci

Where,

Efp = Energy content of fertilizer and insecticides/pesticides (MJ)

N,P & K = Amount of N,P&K fertilizer used (kg)

Cn ,Cp & Ck= Energy coefficient of N,P&K (MJ/kg)

I = Amount of insecticides/pesticides (kg)

Ci = Energy coefficient of insecticide/pesticides (MJ/kg)

The total energy inputs for sugarcane production is, therefore, given by

EI = Eh + Ept + Efi + Efp

The total energy output was calculated by the following equation:

Eo = R × Cr + S× Cb

Where,

Eo = Total energy output (MJ)

R = Total amount of sugarcane (kg)

S = Total amount of sugarcane trash (kg)

Cr, Cb = Energy coefficient of cane and trash (MJ/kg)

The various energy coefficients used for calculating the input and output energy are given in Table1.

Table 1. Energy coefficient for various input/output components

Component	Energy Coefficient
Human labour (average)	0.2014 MJ/hr
Fertilizer N	60.10 MJ/kg
P	10.35 MJ/kg
K(av.)	11.10 MJ/kg
MgO	12.43 MJ/kg
$ZnSO_4$	11.57 MJ/kg
Sugarcane	15.13 MJ/kg
Sugarcane Trash	14.21 MJ/kg
Insecticides (av.)	120 MJ/kg
Irrigation = Pump h_p × Time (hr) × Conversion Factor	
Conversion Factor = h_p×746/h_p× 3600/hr×MJ/1000000=2.6856	
Tractor= Horse Power×0.65×2.6856=MJ/hr	

Source : Hussain (1995) and Bala (1998)

The component wise energy input and energy output in sugarcane production was computed and given in Table 2. The labour requirement for sugarcane cultivation is much higher

Table 2. Component wise value of energy input-output in sugarcane production

Various Component	Energy input - output (MJ)
Energy input:	
Sugarcane two eyed soil bed settling	18085
Fertilizer application	
(a) Urea	45390
(b) TSP	19533
(c) MP	2588
(d) MgO	1998
(e) $ZnSO_4$	2362
Pesticide application	105
Irrigation	8472
Total labour involved in all activities	28683
(includes harvesting, tying, transportation etc.)	987
Total Energy input	128203
Energy output:	
Sugarcane	1664300
Sugarcane Trash	292620
Total Energy output	1956920
Energy output-input ratio	15.26

than any other crop. Because most of the operations such as sett cutting, transplanting, fertilizer and pesticide application, weeding, mulching, tying and harvesting are usually completed manually. But energy value was low because of lower energy coefficient. Highest input energy was consumed in fertilizer followed by human labour, sugarcane seed, tractor, irrigation and insecticides. The total energy input is 128203 MJ. The average total energy outputs from sugarcane and trash was 1956920 MJ. The value of output-input ratio was found to be 15.26.

REFERENCES

Rahman. M and Ali. K.1997. Sugarcane Cultivation: Transferable high technology and technique. Bangladesh Sugarcane Research Institute, Ishurdi, Pabna.p.4

Anonymous,1989. Fertilizer Recommendation Guide. Bangladesh Agricultural Research Council, Farmgate. Dhaka. Bangladesh.p.93.

Bala, B.K and Hussain, M.D. 1992. Energy Use Pattern for Crop Production in Bangladesh. *J. of Engineering for International Development.* **13** (1) : .23.

Surendra, S: Singh, M. P.; Rana, R.S; Mittel, V.K and Rupa. B. 1991. Energy and cost requirements for cultivation of rice (Oryza Sativa) , Wheat (Triticum aestivum) and maize (Zea mays) wheat rotations. Indian Journal of Agricultural Sciences. **59**(9) : 558-560.