STUDIES ON OPTIMISATION OF ENERGY REQUIREMENTS FOR SELECTED CROPS IN WESTERN UTTAR PRADESH

By
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Dedicated to
my parents Late Shri R.L. Adlakha and
Late Shrimati P.B. Adlakha, whose ideas and thoughts have always inspired me.

CERTIFICATE

This is to certify that thesis entitled "**Studies on Optimisation of Energy Requirements for Selected Crops in Western Uttar Pradesh**" being submitted by **Mr. Surendra Kumar Adlakha** to the Indian Institute of Technology, New Delhi for the award of the degree of **Doctor of Philosophy** is a record of bonafide research work carried out by him. Mr. Surendra Kumar Adlakha worked under our guidance and supervision and has fulfilled the requirements for submission of this thesis, which is to our knowledge has reached the required standards. The results contained in this thesis have not been submitted in part or in full to any other university or institute for award of any degree or diploma.

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ABSTRACT

Intensive agriculture while enhancing output upto a point is proved to be energy inefficient and unsustainable in the long run. In the light of this, energy optimisation on the farms has become important. This has to be based on an indepth study of the availability of resources in the farms and current agicultural practices and the corresponding energy use patterns. Based on these data, the effect of energy inputs can be correlated to crop yields/energy output and net energy returns can be optimised. As there are large variations with the nature of crops, geoclimatic conditions and sociocultural practices, such studies have to be location specific.

The main objective of the study was to under take an energy audit in the green revolution belt of India with specific reference to western Uttar Pradesh. The energy consumption patterns and net energy returns for the three most common crops of the area namely wheat, sugarcane and sorghum were studied on marginal, small, medium and large farms in Meerut district of Western Uttar Pradesh.

Randomly 20 villages were selected from all the 18 blocks of the study area. In all 320 farms, 80 under each category of farms (i.e. small, marginal, medium and large) were studied. Information on availability of power sources and farm machinery was collected. Data related to crop production, human labour use, irrigation, farm inputs, use of animate energy, tractor power, diesel and electric power were collected for wheat, sugarcane and sorghum by personal interview and observations.

The data collected were computerised using lotus package and were converted into energy units on per hectare basis, using appropriate conversion factors. Sourcewise and operationwise energy use patterns were determined. The effect of various input energy factors on output was studied. ANOVA analysis was done to find out the significant differences between the different sizes of farm in terms of energy inputs and outputs. Energy inputs through fertilizer, irrigation and farm operation were seen to be most important and were optimised using linear programming technique.

It was seen that availability of tractor power was 16.5 ha per tractor which is quite high as compared to the national average. The power intensity was 6.8 ha per bullock, 3.4 ha per male buffalo and 3.5 ha per pump unit. Among the tractor drawn implements the most commonly used were trailed type disc harrow, cultivator and trailor. Availability of seed cum fertilizer drills, vertical conveyor reaper and planter was very limited. Animal carts fitted with pneumatic wheels were commonly used by all size farms. The total input energy used by wheat, sugarcane and sorghum was 19107, 51573 and 8234 MJ/ha respectively. The total operational input energy utilized by wheat, sugarcane and sorghum was 10473, 18226 and 4044 MJ/ha respectively. The crop output energy of 82288, 323004 and 163995 MJ/ha was observed for wheat, sugarcane and sorghum respectively.

Sugarcane was the most energy intensive crop followed by wheat and sorghum. Use of human energy was also maximum for sugarcane. Seed energy in sugarcane consumed about 50 per cent total energy inputs. Apart from this, consumption of fertilizer energy was maximum on all

size farms and for all crops. Large and marginal farms consumed more mechanical energy. The use of animate energy was highest on medium size farms for all the crops. Operationwise irrigation consumed maximum energy out of total operational input energy invested in raising the crops.

Optimisation of energy use in fertilizer, irrigation and farm operations revealed that not much energy saving seems possible within the current agricultural practices. However, certain new technological practices which have shown to consume less energy in terms of fertilizer, irrigation and other productional inputs are available and these may be introduced. For example, the energy in irrigation operation could be reduced by proper management of water, improving the pumping system efficiency, use of sprinkler irrigation etc. Biological methods of enhancing soil fertility, should be considered.

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