Ind. Jn. of Agri. Econ.
Vol. 54, No. 1, Jan.-March 1999

SUMMARIES OF GROUP DISCUSSION

Subject I

Economics of Energy Use in Agriculture

Rapporteur: Raj Vir Singh*

The session on the economics of energy use in agriculture was surfaced for discussion with the keynote paper of R.K. Pachauri. The paper which covered many interesting and intricate issues on economics of energy use, aptly highlighted that agriculture is not only a user of energy, but also an important supplier of energy. He made a striking observation that the structure of energy consumption in Indian agriculture is changing with a marked shift from animal and human labour towards tractors for farming operations and rising utilisation of electricity and diesel for lifting groundwater for irrigation. Quantitative assessment indicated that during 1950-51, animal labour and human labour contributed considerably to the total energy use in agriculture (56.33 and 36.18 per cent respectively), while electricity and tractors (fossil energy) together shared hardly 7.5 per cent of the total energy consumption in agriculture. In a span of four decades and a half, the share of these energy inputs in agriculture underwent drastic change and as a sequel, electricity and fossil energy together subscribed 80 per cent of energy use in agriculture, leaving 8 per cent to human labour and 12 per cent to animal labour. This pronounced shift of non-renewable sources of energy use in agriculture is apprehended to cause displacement of human and animal power, the abundantly available renewable resources of Indian economy. Discussions were centred on whether this trend be allowed to continue in future as well, which might entail three options, namely, (i) promoting a significant increase of area under the energy intensive crops, following a very high energy agriculture, (ii) still better management of marginal farming, which still employs traditional technology and very limited use of fertilisers or pesticides, and (iii) intensifying research in biotechnology as it applies to agriculture. Since these options are not mutually exclusive, it was suggested that a sound energy use strategy would require initiatives having a rational combination of all the three options.

Economics of energy use in agriculture had captured the attention of many researchers, which culminated into 44 papers submitted for discussion. The papers encompassed wide ranging issues such as energy use pattern, energy requirements and energy use efficiency in agriculture, comparative economics of animal energy and mechanical energy; determinants of energy use; employment effects of sources of energy; exploitation of non-conventional energy use and their economics; and costing of energy.

* Principal Scientist and Head, Division of Dairy Economics, Statistics and Management, National Dairy Research Institute, Karnal-132 001.

Energy Use Pattern, Energy Requirements and Energy Use Efficiency

Upon detailed deliberations, the Group observed that there are wide variations in the energy use pattern across different crops and regions. Paddy, cotton, potato, wheat and sugarcane represented high energy use crops, while least energy use was the feature of pulses, millets, guar and jowar crops. The energy use in irrigated agriculture was notably higher than that in unirrigated agriculture. High-yielding milch animals also required more energy than their native low-yielding counterparts. Among the different energy inputs in agriculture, manure, fertilisers, electricity, seed and human labour accounted for major shares in the total energy use. The energy in agriculture also presented varying use efficiency among crop enterprises. As anticipated, it was higher in commercial crops and irrigated farming conditions, as compared to the subsistence food crops and unirrigated farming. However, the Group expressed the concern over the declining tendency of energy output-input ratio over time. Upon detailed discussions, the participants were of the view that this decline is not a matter of very serious concern, since higher use of energy input in the production process has shifted the use of energy input from the first stage of production to the second stage of production.

It was inferred that energy output-input ratio was not the sole appropriate criterion for measuring energy efficiency. Besides, marginal analysis of incremental returns and cost resulting from the use of energy inputs in agriculture should also be accorded due importance. The energy output was believed to depend not only on the levels of energy inputs use, but also on their effective use. Since adequate research information on the energy demand and supply estimates for different farming systems in different agro-climatic regions are not available, in-depth studies were suggested to be conducted to fill this information gap.

Comparative Economics of Animal Energy and Mechanical Energy Use in Agriculture

It was generally noticed that in the agriculturally developed areas, there has been a proclivity on the part of entrepreneurs to substitute mechanical power for animal power largely to facilitate timely accomplishment of farm operations. The mechanised farms are found to have intensive farming, and higher output and returns per hectare. Some participants were of the view that though for smaller farms and in hill agriculture, bullocks would continue to be useful, the availability of tractor on custom hiring has enabled even the small farmers to utilise the services of tractors and mechanised implements.

Though the farming conditions and economics, influence the choice of mechanical and bullock energy use in agriculture, yet the comparative economics of these two sources of energy vary under different situations. It was observed that with the custom hiring of tractor, bullock energy use has decreased drastically, while the use of human energy has increased due to intensive use of land and other resources including critical energy inputs, and timely conduct of farm operations. The emerging observations were that though the benefit-cost analysis would continue to be the main factor deciding the use of energy source at farmers' level, it is not a full capsule for deciding the economical use of energy, as the saving aspects of non-renewable sources of energy use should also be taken into account. At the macro level, social benefit-cost analysis is another criterion suggested by the Group. A rational

trade-off between short run gains and long-term benefits in the use of conventional vs. non-conventional and renewable vs. non-renewable sources of energy was suggested by the Group as a sustainable energy use strategy.

Determinants of Energy Use in Agriculture

The Group underlined that a slew of factors determine the use of energy in agriculture in different agro-climatic conditions. The identified factors include government support through subsidies, precipitation, farm size, credit availability, price support, extent of area under irrigation and high-yielding varieties, agricultural investments, enterprise mixes, cropping pattern, level of input use, commercialisation, family needs, environmental consequences, availability of natural sources of energy and production technologies.

Employment Effects of Sources of Energy Use in Agriculture

There was a general concordance that the use of mechanical power led to displacement of bullock labour use to a considerable extent, whose magnitude would vary in different situations. However, there were divergent views on the effect of mechanical power on human labour employment. A section of the participants was of the view that mechanised farms used less human labour per hectare, while the others felt that the mechanised farms generated employment for human labour due to increased cropping intensity, crop yield and also the indirect employment generated through adoption of mechanical sources of energy, thereby leading to establishment of agro-processing units and agro-service centres. It was, hence, suggested that empirical analysis should be done to quantify and document the effect of tractor and tubewells separately on human labour employment and on indirect employment generated through these mechanical sources of energy. It was interesting to observe from some of the participants that a few farmers kept the tractors sheerly for their social status and it was suggested that such over-capitalisation should be checked through providing incentives in developing small size multipurpose tractors/machinery suiting to the requirements of the small size holdings.

Exploitation of Non-Conventional Energy Sources and Their Economics

Increasing concerns were expressed by the participants over rising fossil energy use in Indian agriculture. The issue merited attention particularly when the danger of exhaustion of conventional energy sources, their increasing cost and adverse environmental consequences are likely to threaten the agrarian economy. Hence, the Group suggested the use of bio-mass energy sources including crop residues, agro-industrial wastes, animal wastes, municipal wastes, which are available in sufficient quantities for possible use in agriculture. Since India is endowed with abundant availability of solar radiation and large coastal line, the use of solar power, wind power and tidal power was also suggested for generation of energy. Since exploitation of these non-conventional sources may not be possible at individual level, the Group suggested that these could be established at community level. As at the prevailing prices of energy sources, the benefit-cost ratio may not be favourable to the non-conventional sources of energy, the Group suggested that appropriate mechanisms should be developed to encourage and suggest the use of the non-conventional energy in

agriculture. For making the non-conventional energy sources cost-effective, the need was underscored for initiating comprehensive research for development of suitable technologies in the domains of non-conventional energy system to meet the area-specific requirements. The use of non-conventional sources of energy needs to be popularised through appropriate extension education programmes and services to educate the people about the environmental consequences of over-use of the conventional sources of energy and benefits of use of non-conventional sources for sustainability in addition to governmental support and incentives.

Costing of Energy

There were conflicting views on subsidising certain sources of energy particularly supplying electricity to farm sector free of cost. Some of the participants felt that the subsidised electricity is being indiscriminantely used by the farmers in some areas and has led to over-exploitation of groundwater resources leading to degradation of soil, while the other participants were against such a generalisation.

The discussion came to a close with the realisation that there is a need to go for energy efficient eco-friendly crops, with diversifying the agriculture so as to check the degradation of natural resources, namely, land, water, ecology. This is hoped to improve the energy conservation and sustainability of agriculture in the country.

Issues for Further Research

Based on the themes of the published papers and the detailed deliberations, the following issues are identified for further research in the area of economics of energy use in agriculture:

1. Optimal energy use pattern, energy gaps and measures to improve energy efficiency particularly in the livestock enterprise, plantation crops and non-conventional farm enterprises.
2. Energy demand and supply estimates for different farming systems in different agro-climatic regions.
3. Socio-economic impact of commercialisation, cropping pattern, government support, subsidies, and trade liberalisation on energy use in agriculture.
4. Social benefit-cost analysis of farm mechanisation, ex-ante and ex-post evaluation of nature and extent of direct and indirect effects of farm mechanisation on human labour employment.
5. Technical feasibility and economic viability of development of suitable technologies of non-conventional sources of energy and appropriate extension network to meet the area-specific requirements.
6. Strategic research to exploit conventional and non-conventional sources of energy for sustainable energy use in the agricultural sector.