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Energy Utilization Pattern in Crop Production

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Energy is the physical entity indispensable for performing work. It comes in different forms: mechanical, kinetic, thermal, radiative, electric, magnetic, chemical, nuclear, gravitational and others. Energy can be transformed to different forms at various efficiencies. An energy source can also be called a fuel. All natural energy on earth comes from the radiative energy of the sun, heat in the Earth's mantle (geothermal energy), and gravity.

About 0.01% of solar energy is converted to plants. Over millions of years residues of living matter have been transformed under the soil and the sea to fossil hydrocarbon energy in the form of coal, oil and natural gas. These energy sources are limited and not renewable. Potential energy in it is transformed to usable power by burning. The rest products are greenhouse gasses, causing global warming and climate change. Energy can also be converted directly from solar radiation, gravity, the Earth crust And living plants by human technology (wind, solar, hydroelectric, geothermal and biomass power). These energy forms are renewable. In addition, the Earth crust contains uranium and thorium isotopes, that release high amounts of heat energy upon nuclear fission. Human-made hydrogen can also become a sustainable source of energy in the future.

Energy use in agriculture

Energy use in agriculture can be divided into two categories. Direct use of energy for pumping and Mechanization (tractors, power tiller, etc.) and Indirect use of energy in the form of fertilizers and pesticides.

Types of energy used in agriculture

- Electrical energy: suitable for powering water pumps, milling machines, fridges.
- Mechanical energy: suitable for production and processing e.g. for harvesters or tractors, most of the machines, etc.
- Thermal energy: suitable for different value-adding processes e.g. cooking, drying, cooling (thermally driven cooling systems)
- Animal energy
- Man energy

Challenges faced by Agriculture and power

- The FAO projects that by 2050 global food production will need to increase 70 percent over 2005-2007 levels to meet the demand of a growing world population expected to reach 9.6 billion people. Agri-food supply chain accounts for 30% of the world's energy consumption as reported by the International Renewable Energy Agency.
- Achieving universal energy access De-coupling from fossil fuels.
- Producing and consuming energy more efficiently.
- Minimizing costly waste.

- Preserving natural resource base

Farm Energy Consumption

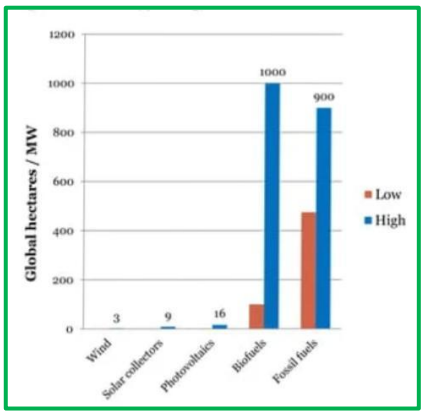
- At the farm level, energy use is classified as either direct or indirect.
- Direct energy use in agriculture is primarily petroleum-based fuels to operate tractors, 5HP engines, pickups, and trucks as well as machinery for preparing fields, planting and harvesting crops, applying chemicals, and transporting inputs and outputs to and from market.
- Natural gas, liquid propane, and electricity also are used to power crop dryers and irrigation equipment. Electricity is used largely for lighting, heating, and cooling in homes and barns.
- Dairies also require electricity for operating milking systems, cooling milk, and supplying hot water for sanitation.
- In addition, oils and lubricants are needed for all types of farm Machinery.

Trends in Energy-Use Pattern

- With economic growth, the demand for commercial energy is rising. The consumption of commercial energy has increased 3.2-times since 1980-81.
- While the industrial sector continues to be the largest consumer of commercial energy, its share has declined from 54% in 1980-81 to 45% in 2016-17.
- On the other hand, the share of agriculture sector has increased from 2 to 7% during this period.
- Energy-use in the agriculture sector has registered the highest Growth rate of 10.4 %, while its use in industry sectors has grown at 3.6% during the past 2.5 decades.
- The structure of energy consumption in the Indian agriculture has changed substantially, with a significant shift from animal and human labour towards tractor for different farming operations and electricity and diesel for irrigation.
- Reports indicated that in 1970-71, agricultural workers and draught animals contributed considerably to the total energy-use in agriculture (15% and 45 %, respectively).
- while electricity and fossil energy together provided 40% energy.
- In a span of 5 decades, the share of these energy inputs in agriculture has undergone a drastic change the contribution of electricity and fossil energy together has gone up to 86 per cent and of agricultural workers and draught animals has come down to 6% and 8%.
- The total commercial energy input in Indian agriculture has increased from 425.4 x 109 Mega Joules in 1980-81 to 2592.8 × 109 Mega Joules in 2016-77.
- This shift, coupled with increasing commercialization and Diversification towards high-value crops, will require more Commercial energy.

Land surface occupied for energy

The figure shows the huge differences between energy types, solar and wind facilities occupying much smaller land area than bio- and fossil fuel facilities. Both low and high estimates (depending on the study) are given.



Energy policies in agriculture

- FAO has been active in assisting developing countries to meet their energy requirements in agriculture, forestry and fisheries as a means of achieving sustainable rural development.
- An integrated approach to incorporating energy into rural and agricultural planning has been promoted,

together with the Increased use of modern energy technologies.

- Activities sponsored by FAO have included, for example, a Project in China, which integrated alcohol production from sorghum with biogas, pyrolysis, solar and wind energy systems (FAO, 1994).
- This work also examined energy conservation and the potential of various renewable energy sources in specific farm activities. The project is presently being expanded to produce ethyl tertiary butyl ether (ETBE) from ethanol.
- ETBE is then mixed with gasoline and offers reduced air pollution and CO, emissions from transport. Trials are planned for Shanghai and Shenyang.

Energy Saving in Farming Operations

In the cropping operation, significant amount of energy is being Consumed in tillage and seeding.

- Minimum Tillage : The tillage is the mechanical manipulation of soil surface to bring a good tilt bed. In tillage operation both commercial energy source (petroleum) and animate energy sources (human and animals) are being used. The most significant energy saving can be made through reducing liquid fuel consumption and animate energy consumption by means of adoption of minimum tillage techniques. In fact, the fuel saving through adopting minimum tillage techniques vary greatly from place to place.
- Use of Fallowing System: Tillage of fallows can be minimised by use of chemicals such as glyphosate and paraquet/diquat mixtures to produce a “Chemical fallow”. The direct fuel and energy savings can be significant. However, indirect energy content of the herbicides used is quite high in some situation.
- Elimination of some working, which are overworked. In same areas in our context, soils are often overworked.
- Cultivation at shallow depths and direct drilling (The placement of seed and fertiliser into grooves out simultaneously in uncultivated soil) can reduce cultivation requirement as well as soil erosion.
- Selection and use of implements that have a low draft.
- The pre-emergent application of trifluralin for grass control can reduce the need for cultivation.
- Minimum tillage benefit conservation, but also are not only for energy it takes into conservation, time and money saved, extension of the growing period, improved tractor support during drilling and spraying and improved timeliness of sowing.
- Change in the tractor operation can also yield saving in Energy.

Some tillage operation in this context are described below:

- It has been found that tractors having larger power consume less diesel per hectare of operation compared to smaller powered tractors. This advantage may need to be balanced against the need for a smaller tractor to carry out every-day farm operations or when smaller machinery is used.
- There is considerable impact of tractor weight on available power. Too heavy and too light tractors produce less power at drawbar as compared to tractor having just right weight.
- A diesel engine may yield best fuel economy when it is working on high load.
- It is important for implements to be well matched.
- It is unable to burn all the diesel fuel supplied through the injector and the engine is discharging unburnt fuel in the exhaust gases,
- which is, of-course, wasteful and consequently expensive.
- Engine speed also plays a vital role in fuel economy.

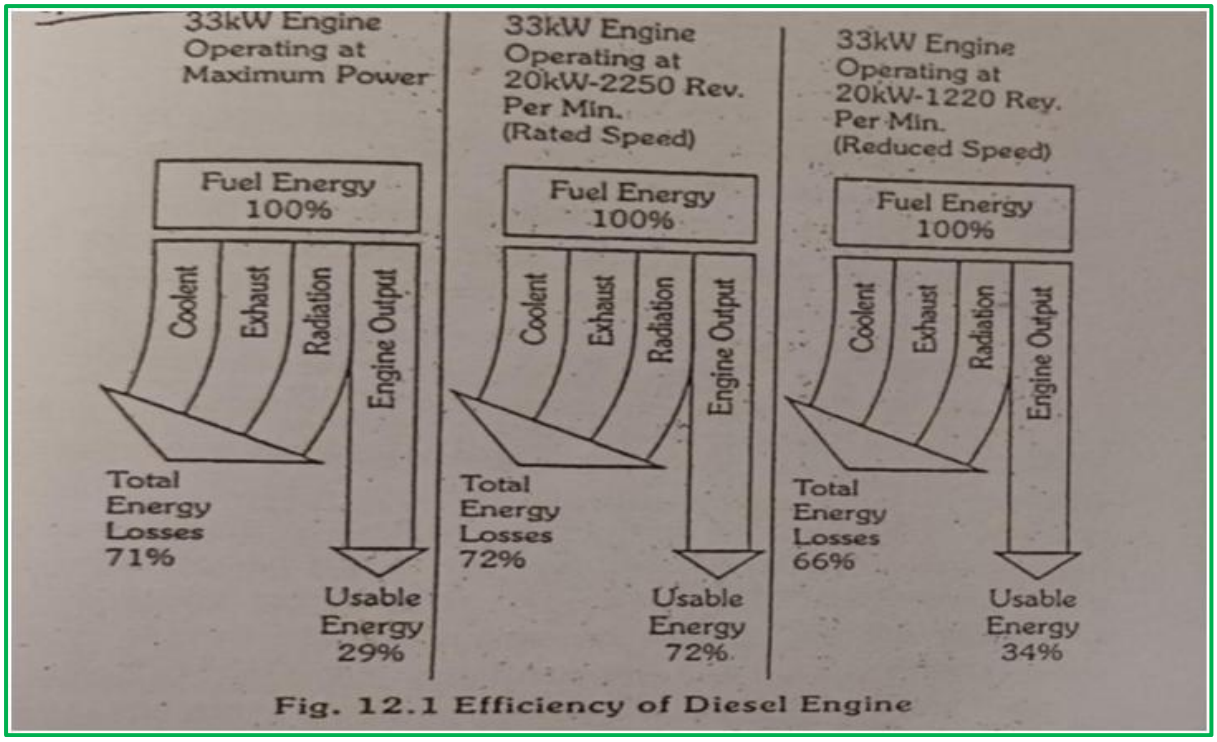


Fig. Efficiency of Diesel Engine

Energy Savings in Live stocks

Drought reserves such as hay, silage or grain must be held, but year to year seasonal requirements can be handled with the minimum pf energy use by :

- Running stock at conservation stocking rates in marginal agricultural areas so that pasture in the paddock can maintain stock during whole year.
- Managing the sheep production cycle to fit the pasture production cycle.
- Running easy care sheep to minimize handling for such things as fly control measures.
- Not over supervising stock, particularly at lambing when too much supervision can be counter productive.
- Using a motor bike or some other two wheelers for stock supervision rather than a utility or other large vehicle.