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An Overview of Farm Power and Energy in Agriculture

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ABSTRACT
Tillage, plant safety, planting, threshing, and harvesting machines, as well as other stationary jobs like irrigation, threshers, sellers, cleaners, graders, and so on, all require farm electricity. Agriculture's direct and indirect energy consumption can be separated. Direct energy requirements include land planning, planting, harvesting, irrigation, food production, post-harvest processing, storage, and transportation of agricultural outputs and inputs. Farm power is now used to assist in agriculture at various stages and to do comfort farming with the aid of various farm power. The author of this study examined farm power and energy in agriculture, as well as how farm power aids agriculture at various levels. The author also covered human, mechanical, and animal power, as well as electrical, solar, and renewable energy in this review study. Farm electricity will be utilized in huge numbers in the future, which will benefit those working in agriculture.

Keywords
Agriculture, Energy, Farm Power, Human, Productivity.

1. INTRODUCTION
Farm power is an important component in agriculture for timely field activities that boost land production and growth. Tillage, plant safety, planting, threshing, and harvesting equipment, as well as other stationary jobs like irrigation, threshers, cleaners, sellers, graders, and so on, all need farm electricity. On the farm, power is required to run a variety of equipment and implements as well as to carry out a variety of agricultural tasks. Although mobile powers are utilized for a variety of field activities, stationary powers are used to raise water and run irrigation equipment, as well as threshers, decorticators, graders, cleaners, and other post-harvest operations. Mobile farm power comes from humans, draught animals, power tillers, tractors, and self-propelled equipment, while stationary farm power comes from oil engines (kerosene, diesel, and gas) and electric motors [1].

Access to adequate agricultural electricity is essential for timely farming operations that boost productivity and output while reducing crop losses. Increased cropping intensity reduces improvement time, making it impossible to thresh and harvest standing crops on the one hand, while also preparing seed beds and performing timely sowing operations for the following crops on the other, in the limited time available, unless sufficient farming power is available [2].

Agriculture technology developed during the green revolution, which was backed up by agricultural scientists, including agricultural engineers, and aided by favorable policy, generous public funding for agricultural research and development, and farmers' tireless efforts, is largely responsible for this expansion. Power is required on the farm to run different equipment and implements, as well as to conduct a variety of agricultural activities. Although mobile power is utilized for a variety of activities in the field, stationary power is needed to raise water and run irrigation equipment, as well as threshers, decorticators, shellers, graders, cleaners, and other post-harvest operations. Mobile farm power comes from humans, draught animals, power tillers, tractors, and self-propelled equipment, while stationary farm power comes from oil engines (diesel, kerosene, gas), and electric motors. Access to adequate agricultural electricity is essential for timely farming operations that boost productivity and output while reducing crop losses [3,4].

With increased cropping intensity, turnaround time is significantly shortened, and it is impossible to thresh and harvest standing crops while also preparing seed beds and performing timely sowing operations for the following crops in the limited time available, unless sufficient farming power is available. Precision farming, conservation tillage, expanding irrigation area, straw management, and agricultural diversification all need more electricity. Increased productivity has been shown to be linked to the availability of agricultural electricity. In general, states with more farm power produce more than those with less farm power [5-9].

As the labor-to-land ratio has risen through time, technical advances arising from the mechanization process have tended to be land-saving in nature, with a focus on improving land productivity. As a consequence, India's mechanization process did not include the generation of excess agricultural labor for use in the industrial sector.

While the number of agricultural employees as a percentage of rural populations has decreased from around 70.4 percent in 2014 to around 60.7 percent in 2018, the number of agricultural employees available in rural ranges has increased in absolute terms from 116 million in 2017-18 to 249 million in 2018-19, a 7.4% annual compound growth rate. Agricultural workers are engaged in a range of farm operations and depend on agriculture for their living, even if they are not fully employed throughout the year. Due to excessive labor participation in different agricultural activities, the cost of manufacturing most crops in our nation is extremely expensive in comparison to other countries.

2. AGRICULTURAL POWERS

2.1. Human Powers
The energy or labor generated by the human body is referred to as human power. It may also refer to human production (rate of work per unit of time). In circumstances when there is no alternative source of electricity, human-powered equipment is sometimes utilized to generate and store electrical energy [10].

2.2. Draught animal power (DAP)

Draught animal power (DAP) has long been a significant source of tractive energy for agriculture, rural agro-processing, and transportation in India and other emerging Asian, African, and Latin American nations, mainly generated from milch animals. In traditional Indian agriculture, this power source was used for tillage, weeding, sowing, water raising, threshing (by animal trampling), sugarcane crushing, oil extraction, and transportation. Because of the modernisation of the agricultural production system and the utilization of mechanical power resources, draught animals are used significantly in power-intensive activities such as oil extraction, water lifting, and threshing.

The amount of time available, the options available (including bespoke recruitment services), and the associated costs all play a factor in choosing the kind of farm power to be utilized for a certain task. Tractors and combines are difficult to operate in muddy hill areas and on tiny fields, therefore draught animals will likely continue to be used in addition to human effort. Farmers have been forced to reduce the number of draught animals they possess as much as possible due to rising animal care expenses. Aside from its economic importance, livestock has a symbiotic connection with farmers [11,12].

2.3. Tractors and power tillers provide mobile power

To satisfy the increasing need for mobile power for suitable agricultural operations and higher cropping intensity, more power is mainly available from power and tractors tillers. Because they offer transportable fuel, self-propelled reapers and combines are helpful for harvesting activities.

India is the world's biggest tractor manufacturer at the moment. More than 20 tractor manufacturers in the United States produce about 60 tractor models in different horsepower levels. India's tractor population has grown at a compound annual growth rate of approximately 10% over the past 50 years, from 0.037 million units in 2017-2018 to 4.464 million units in 2019-20 [13].

2.4. Diesel Engines and Electric Motors for Stationary Power

In agriculture, stationary power sources such as electric motors and diesel engines are utilized for irrigation equipment, threshers, and other stationary devices. Diesel engines and electric motors are mainly used by farmers to lift irrigation water and run stationary agricultural equipment such as threshers and chaff cutters. The population of these primary movers has increased since the green revolution [14-18].

3. ENERGY USED IN AGRICULTURE

Since the industrial revolution, agriculture has shifted from human labor to automation. Because of the equipment and chemicals used in agriculture, energy has become one of the most significant inputs. Solar energy has long been utilized in agriculture, with the energy being stored in the product, which is subsequently used as food, fuel, or other things.

3.1. Agricultural Energy and Production

Agriculture is an energy transmission process in and of itself, turning solar energy into human food and animal feed via photosynthesis. Primitive agriculture involved scattering seeds over a large region of land and accepting the little return. Modern agriculture requires energy at every step of growth, including direct energy usage in farm equipment, irrigation, water management, harvesting, and cultivation. Post-harvest energy is used for food preparation, transportation, and storage to markets. Mineral fertilizer, organic insecticides, pesticides, and herbicides are other examples of indirect or confiscated energy inputs in agriculture.

Although wealthy nations have benefited from increased agricultural energy supplies, emerging countries have not been so fortunate. Energizing food manufacturing chains has been a major aspect of agricultural development in recent history, and it is one of the most important components in attaining food security. In terms of simplifying their agricultural energy input, developing nations have fallen behind industrialized ones.

The energy required by agro-industries for food distribution and transportation is not included in the statistics for agricultural energy use. It is believed that these activities use up to twice as much energy as agriculture. Many of these phases are devoid of conclusive data, which is particularly problematic when evaluating energy statistics in poor nations. Furthermore, the statistics obscure the impact of these energy inputs on agricultural production. As a consequence, the most intriguing relationships are those between the amounts and types of direct vitality input to agriculture and the resultant productive output [19-20].

3.2. Agriculture's Energy Requirements

Agricultural practices in many underdeveloped nations continue to depend largely on animal and human resources. Because there is inadequate mechanical and electrical energy for agriculture, the potential gains in agricultural production that might be obtained by deploying modern energy services are not being realized. Agriculture's direct and indirect energy needs may be separated. Direct energy requirements include land planning, planting, harvesting, irrigation, post-harvest processing, storage, food production, and transportation of agricultural outputs and inputs. Indirect energy requirements are met by sequestered energy in fertilizers, pesticides, herbicides, and insecticides.

Humanity has adapted a variety of resources to generate energy for agriculture. Windmills have been around for almost 1,000 years, while water wheels have been in use for over 2,000 years. For over 8,000 years, animal breeze power has been developed from the interbreeding of livestock, horses, and other animals, animal draught powers have been generated from the domestication of horses, cattle, and other animals, and animal strong bow power has been derived from the interbreeding. Agriculture has always relied on direct solar energy for drying and biomass fuels for warmth.

In underdeveloped nations, human and animal labor contribute for the bulk of direct energy input, particularly in the maintenance agricultural sector. Although human labor produces a modest amount of product, humans are flexible, nimble, and capable of making choices while at work. Because of this, humans have an advantage in professional activities like as transplanting, harvesting fruits, weeding, and vegetables, as well as dealing with fiber. Soil preparation and water lifting require less skill but more exertion.

4. DISCUSSION

In the agricultural areas, farming power is a highly important component. Agriculture operations are completed on schedule to improve land productivity and output. Farming power is used to operate many kinds of equipment such as harvesting, plant protection, and so on. Farm power may be split into groups based on this premise [21-25].

- Tractive Work: This comprises seed bed prep, harvesting, activation, and transportation.

- Stationary Labor: This kind of work mostly consists of field work such as cutting, threshing, winnowing, irrigation, sifting, and irrigation of crops.

A variety of farm power sources are utilized in agricultural activities. These may be categorized as follows:

4.1. Human Strength

The most essential source of agriculture that cannot be started is human power. Small activities such as installation tools, chaff cutting, water raising, and winnowing are done with human strength. Human power has the greatest benefit in that it is readily accessible for a variety of tasks such as harvesting, post-contract labor, and so on. It does, however, have a disadvantage in terms of efficiency and expense, as well as the fact that it requires fuel maintenance even when not in use. The Human Power in Agriculture effect shown in Figure 1.

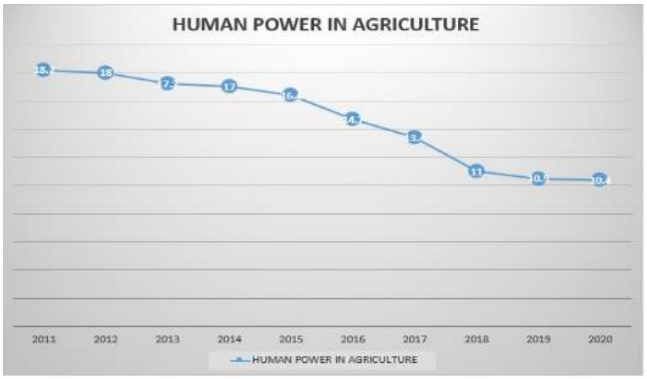

Figure 1: Illustrates the graphical representation of human power in agriculture

4.2. Animal Strength

Animals play an essential part in the farming industry. Animals are used to assist with land preparation, crop threshing, and other tasks. Animals were employed for shaping and transporting labor when there were no cars, thus this may be considered one of the earliest agricultural techniques. Buffalo, cow, donkey, and horses are all essential in this process. Bullocks were utilized to produce electricity in the past, which was then employed in farming. Animal power is also readily accessible and may be utilized for a variety of tasks such as meat, milk, everyday goods, and so on. However, animals need complete care in order to operate more effectively, which can be expensive and time-consuming.

4.3. Mechanical Strength

Mechanical power is defined as anything that has a mechanical process in its engines. Mechanical power is shown through oil, tractors, and self-prepared combines. Figure 2 depicts the growth of mechanical power in agriculture. There are two kinds of internal combustion engines used to convert liquid fuels into mechanical work:

- Compression Ignition Engines: These engines are diesel-powered.
- Spark Ignition Engines: These engines run on gasoline or kerosene.

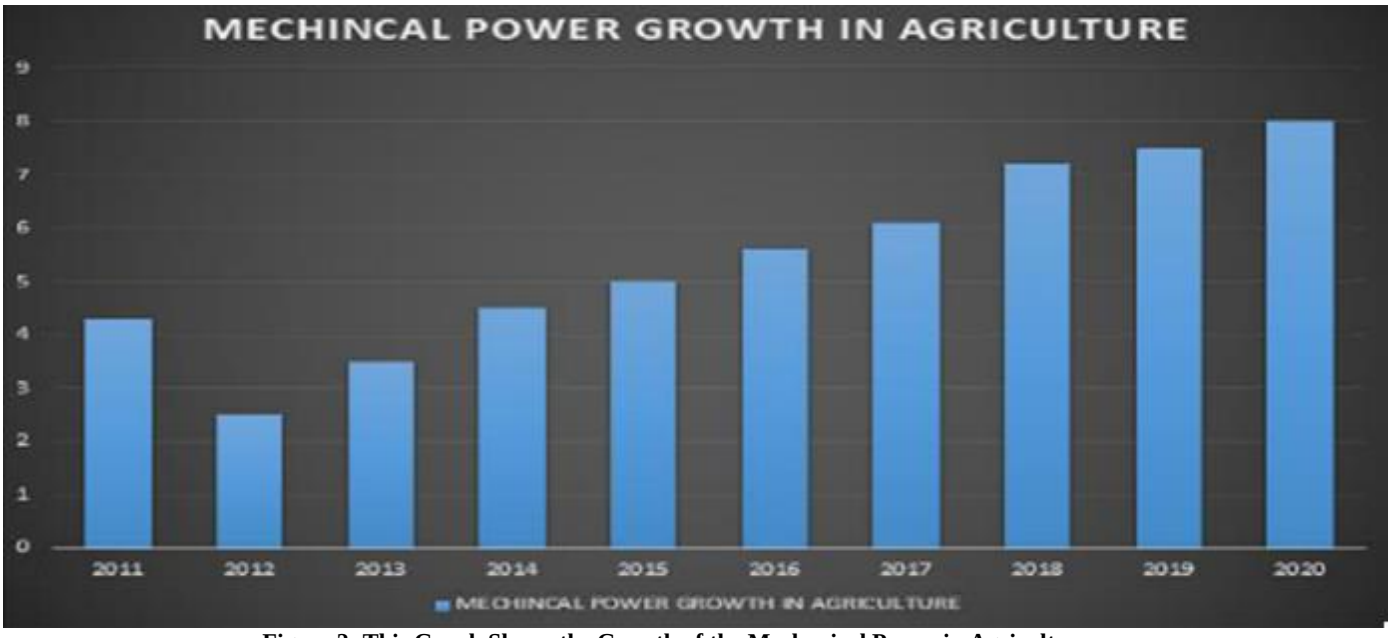

Figure 2: This Graph Shows the Growth of the Mechanical Power in Agriculture

The majority of tractors today have diesel engines and are used to operate sugarcane crushers, irrigation pumps, and winnowers, among other things. When compared to persons and animals, they have a high efficiency, are not influenced by weather, and can

work in a variety of circumstances. Although they are expensive due to the fuel they consume, their repair costs are also significant, and their upkeep requires technical expertise.

4.4. Electrical Energy

Electricity is one of the most significant sources of energy in agriculture. Electric motors are now widely utilized for water and other electrical tasks. Electric power is virtually everywhere for the energy needed, from dairy industries, water pumping, cold storage, fruit industry, agricultural product processing, and many other things, and it is a very inexpensive type of power compared to others, with minimal maintenance costs. Everything, however, comes with a warning sign. Similarly, if this power is not managed correctly, it may be very dangerous.

4.5. Wind Power

With the assistance of an Indian solar plant, this energy is produced from the amount. The KAMUTHI SOLAR POWER PROJECT, which is situated in Tamil Nadu, can provide electricity to about 150,000 households.

4.6. Biomass Energy

Gasifiers are used to create gases, while pyrolysis is used to make liquid fuel. Other examples of renewable energies include geothermal energy, tidal energy, and others, which are used to produce heat and power. This is extremely
essential in farming since they are supplied by nature and just need catch, so they do not take much work and can be replenished again.

5. CONCLUSION

Mechanization in agriculture holds the key to sustainable development in terms of increasing output via timely farm operations, decreasing losses, cutting operating costs through effective management of costly inputs, and enhancing natural resource efficiency. It also aids in the reduction of drudgery in agricultural activities. Mechanized agricultural techniques and operations have been implemented at various levels by the farming community, reflecting the varied situations in different regions of the globe. Farm power is a critical input in the agriculture industry for timely field operations, such as operating irrigation machinery, shellers, threshers, graders, cleaners, and various post-harvest equipment, as well as stationary jobs, such as operating irrigation equipment, threshers, graders, cleaners, shellers, and various post-harvest equipment. These sophisticated gadgets, precision agriculture, and robotic systems would make farms more productive, effective, secure, and ecologically friendly. Energy ratios in agricultural production may be improved by reducing bought inputs and increasing marketable outputs. Increased yields would be less significant in the future, when resources are limited and quality is deteriorating, than shifting crop land from supplemental animal nutrition to crop for direct human use. While we enjoy the luxury of high energy prices from fossil fuels, the infrastructure and research needed to expand agriculture using renewable energy sources should be built right now.

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