CHAPTER I

INTRODUCTION

1. 1 General

Development and application of energy resources are the key components for the higher level of agricultural and industrial productions required to improve the standard of living of the people. There is fairly an uniform correlation between the consumption of the total energy and that of electrical energy (81), which applies to most countries (the ratio being five to one) and also there is a close correlation between the electrical energy consumption and per capita annual gross national product. In the developed countries, a person consumes on an average 7,000 kwh annually where as in India the per capita consumption stands at 25 kwh. Based on the assumption that a man is capable of performing work equivalent to about 150 kwh energy a year, the developed nations consume energy equivalent to 45 electrical helpers per head of population per year.

There are two main categories of energy sources for agriculture ; the animate energy from human and animal sources and the inanimate energy or physical energy which is utilized by transforming physical sources like fuel, water and minerals into mechanical power or useful heat. The conventional farming practices have been utilizing mainly animate power for agriculture production. However, during last two decades considerable development has taken place in Indian agriculture.

The pattern of energy utilization has gone through a transformation and there is a clear trend of substitution of animate energy by inanimate one. Bullock power is now preferred over human power as much as mechanical and electrical powers over bullock power for most of farm operations.

1. 2 Status of Energy Use on Indian Farms

In India total estimated power for agriculture in March 1971 was about 61.64 million horsepower (hp). Of which 8.44 million h.p. from 126 million farm labourers, 34.0 million hp from 85 million draft animals, 11.34 million hp from 1.26 million electric motors, 5.0 million hp from 1 million diesel engines and 2.86 million hp from 130,000 tractors. This has further increased in last decade and the increase has been mainly in the form of inanimate power. Widespread investments have been made in pumpsets, stationary machines using electric motors and diesel engines. The investments in tractors have been at the lower rates but for a substantial amount. According to the world wide survey, the power availability for intensive agriculture for countries such as India, should be of the order of 1 h.p per hectare. As against this, the current power availability on the Indian farms is barely 0.40 hp per hectare (54). This means that the existing power availability on the farms needs to be stepped up by 2.5 times to achieve the objectives of intensive agriculture. Acute shortage of power on the farms has become a major bottleneck in increasing the intensity of cropping from the present level.

1. 3 Energy Inputs and Agricultural Production

Agricultural production can be increased either by bringing more area under cultivation or increasing the yield per hectare or both. It can also be achieved by increasing the cropping intensity. The possibility of bringing much virgin land under production is not great. Hence the other two methods of achieving total higher production have to be resorted to. A substantial increase in yields of few cereals and coarse grains was possible due to factors such as varietal improvements, availability of irrigation water, application of fertilizers as well as the precise controls brought about by the power-machine systems in the crop production cycle. Thus power-machine systems have played an important role in implementing the new agricultural technology. Of course it is not easy to quantify the exact role played by these systems in increasing the agrigultural production. Interestingly enough, the power-machine systems play direct and indirect roles to achieve total higher yields. For an example, the intensity of cropping is one factor which can be monitored favourably if the availability of power is not a limiting factor. The intensity of cropping in the country as a whole in 1966-67 was only about 114 percent which increased to only 126 percent by 1975. It is estimated that the present cropping intensity would be about 130 percent. However, increase in cropping intensity has also been contributed by tubewells powered by electric motors. For example, during 1971-72, Meerut district of U.P. state had achieved the cropping intensity equivalent to 144 percent with 63 percent of the cultivated

area under irrigation (66). By introducing the inanimate sources of energy in agriculture, Punjab and Haryana States were able to increase the intensity of cropping and thereby production to a great extent.

Introduction of inanimate power lead to increased land and labour productivity and production. Pumpsets alone have contributed to about 4 percent of India's food grain production through increased yields and an additional 2 percent through increasing cropping intensity. Pumpsets and tractors were important factor in Punjab's successful increase in land productivity (28).

1. 4 Energy Input and Power Losses

Improper use of sources of power in general results in losses of power in various forms. This problem is more severe when we use inanimate power on farm operations. The losses occur due to improper matching of implements with power unit, adoption of components having lower conversion efficiency, and selection of improper operational and soil parameters at the time of their use. In case of tractive machines, it has been observed that on unfavourable soil conditions, losses in traction alone go as high as 50 percent. Even under good conditions losses may be as high as 20 percent (45). Therefore, before going in for large scale adoption of inanimate power on the farms, it is desirable to make assessment of their suitability and also that of their operational parameters with special reference to power losses.

1. 5 Energy Input and Timeliness of Operations

It has been observed that the increased use of inanimate energy has contributed towards increased crop yields. The main contributory factors for increased yields are timeliness of operation and precision achieved in placement of seeds and fertilizers. It is an established fact that most of farm operations, if performed timely certainly contribute to higher yields and in this context introduction of inanimate sources of power and proper size implements have greater role to play. Timely performance of operations is essential for allowing the crop full growing season and also for reducing crop losses due to inclement weather conditions. Indian farming is marked with wide variation in holding sizes and mostly these are small and medium (Table 1.1). Timeliness of operations gains greater importance for machine power unit selection under such conditions.

Table 1.1 Farm Holdings in India - Eastimated Number and Area Operated by Each Size (36)

S.No.	Category	Holding size ha	No. of holdings millions	Area operated million-ha	Percentage of total area
1	small	0 - 0.40	8.67	1.7	1.3
2	-do-	0.44-2.22	22.62	23.6	17.9
3	-do-	2.42-5.05	12.00	38.6	29.0
4	Medium	5.45-10.10	4.54	30.6	22.2
5	Large	10.50-20.20	1.77	29.1	17.3
6		Beyond 20.50	0.52	15.5	12.3

1. 6 Proposed Research Work and Objectives

In the background of above facts and in the light of the fact that farming is slowly becoming a commercial enterprise, decisions about use of scarce energy resources and adoption of certain power-machine combinations cannot be based on intuition and experience alone. There is a need for an improved method of analysis of production systems which will require informations about energy requirements, power sourcewise and associated power losses on individual activities of production process, power and machine performance coefficients and timeliness of individual activities.

This piece of research work aimed at accomplishing the objectives through field and laboratory studies as well as by adopting modern techniques of data analysis. The main objectives of the research work were as presented below :

1. To study effect of mechanization levels on energy requirement and production for paddy and wheat crops grown under different crop rotations. Also develop information on power source wise energy requirement for production of major crops of eastern India.
2. To study the effect of increased energy inputs on levels of production and energy requirements ;
3. To study the patterns of energy and cost inputs and their relationship with agricultural production under varying levels of mechanization ;
4. To develop data on power losses in farm operations for different power-machine combinations under

varying soil and operational parameters ;

5. To develop man, machine and power performance and timeliness coefficients for different farm operations under paddy production ; and ,

6. To identify optimum and near optimal machine combinations for paddy production (grown under paddy-wheat rotation) under human energy constraints for farm holdings from 1 to 30 ha in size.