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Identification of mechanization gaps for different farm operations for fodder and crop cultivation in Pusa (Bihar) region

DHEERAJ KUMAR AND MANORANJAN KUMAR

ABSTRACT : The present study deals the status of mechanization gaps for different farm operations for sustainable farming in Pusa region. Cattle farms based on grassland are dynamic system and it's difficult to manage, mainly because of their compassion to uncontrollable environmental factors. There are so many challenging issues regarding management strategies for efficient use of inputs. To meet the growing demand of population and productivity of land, agriculture mechanization is one of the important promising approaches. The outcome obtained from the survey conducted in a cattle farm of Dr. Rajendra Prasad Central Agricultural University, Pusa (Samastipur) Bihar shows approx 0.87 hp/ha utilization of farm power in terms of available machinery for farm operations which was established less than reported a value of power utilization e.g. 1.5 hp/ha for successful farm operation through mechanization. Moreover, seeds loss can be reduced during sowing operation by using specific machine. Mechanization also facilitates interculturing activities and sowing operation too which intern produces a good quality fodder. Nutritious fodder is required to enhance the quality of milk. Mechanization is an essential step to maintain the health of cattle and its produce.

KEY WORDS : Farm mechanization, Status of farm, Milk quality, Mechanization gape

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INTRODUCTION

In developing countries the major constraint to livestock production scarcity is fluctuating quantity and quality feed supply of round the year (Olafadehan and Adewumi, 2009). The story of the development of agricultural mechanization in India is both fascinating and in many ways, quite remarkable. The country has a very diverse form of agriculture particularly due to varying soil and climatic conditions, with both irrigated and dry land areas, capable of producing most of the food and horticultural crops of the world. Domesticated livestock is an essential part of agricultural production. Livestock were usually too small holdings and were cared for in the strange time that the farmer would cover from nursing

MEMBERS OF RESEARCH FORUM

Address of the Correspondence : **DHEERAJ KUMAR,** Department of Agricultural and Food Engineering, Indian Institute of Technology, KHARAGPUR (W.B.) INDIA
Email: dheeraj650@gmail.com

Address of the Coopted Authors : MANORANJAN KUMAR, Department of Agricultural Engineering, Dr. Rajendra Prasad Central Agriculture University, PUSA (BIHAR) INDIA

crops. Dairy production is solitary livestock activities to be mechanized (Puckett, 1980). The fodder and crop production in India has undergone a rapid technology revolution during last 30 years with the adoption of new production technology in earlier decades and globalization of fodder production in present decade. The main difficulty in developing countries is financing to agriculture in order to produce more and to step up the technological change in Indian cattle farm under new economic environments, farmers need to increase more expenses on improved inputs and marketing which must be financed either out of saving or borrowing but one of the striking features. The declining in growth rate of agricultural production was highlighted by economic survey (1996-97). In precedent six year, the development of Agricultural production has been 1.7 per cent slower than that of population at 1.9 per cent the micro-economic impact of this short fall will be cause of fairly strict so it is during necessitate to believe about mechanization of Agriculture (Reijntjes *et al.*, 1992). Agriculture is the most effective route to reducing poverty in many of the poorest parts of the world. One per cent growth in the agricultural economy results in a 6 per cent increase in spending by poorest 10 per cent of population. Far less income filters down to the poor from the growth of other sectors of economy (World Bank, 2008). In accordance with NSSO data given that the rural male employment improved by 46 per cent (making a shift from self employment and regular employment to casual and regular employment) and female employment by 12% (shifting towards self employment and regular wage employment) during the time, the displacement is captivated in the nonfarm actions. Further, more rapidly average annual turn down in rural poverty during 2004-11 (2.32%) than during 1993-2004 (0.81%) and decrease in the break of rural urban poverty indicates add to in the standard of living (Moharpatra, 2016). To meet the growing demand of population, productivity of land has to be enhanced. This can be done by timely application of improved technology (Baogang, 2006). Mechanization of cattle farm fodder cultivation is the application of engineering and technology in Agricultural operation to do a job in improved way. To improve the milk productivity is only includes the use of machines, tillage operation, harvesting operation or threshing operation and mixing feed for precise application of seed and fertilizers, mechanically metered seed drill and seed-cum fertilizer drill operated by tractor have been specific to crop and regions for sowing/planting of fodder and crop. A multipurpose tool frame is being operated where a sowing/planting attachment can be mounted besides tillage tools. Singh (2001) concluded that cropping intensity was mainly dependent on annual water availability and the farm power available. The dominant variable on any livestock farm is the supply of feed frequently because of poor planning aggravated by inefficient production practices and adverse weather conditions, basic feed supply are erratic and inadequate. It is not economic to plug these gaps with concentrates with the price ratio of milk, the concentrates are supplementary feeds and not staples. The main objective of fodder production planning is to match the production capabilities of the farm with the animal's requirements in order to obtain the greatest margin over feed costs within safe limits of natural resource utilization through mechanization. The annual fodder requirements of every 100 cows and their associated replacements and from the assessment of the farms fodder production capacity through mechanization. When herd size and mechanization of fodder production capacity have been reconciled, one must consider the costs and returns. The scheme must show and adequate margin over fodder production costs to cover overheads and a return to management. Forages have many advantages and are important part of any farming system suitable for the hill ecosystem to provide green fodders for livestock (Ghosh *et al.*, 2009), diminish runoff (Saha *et al.*, 2012b) and get better soil quality (Choudhury *et al.*, 2013). The planning of mechanization and managing the fodder flow is not only one of the most critical of all management functions; it can also be one of the most satisfying financially, psychologically and aesthetically. Not only does a good fodder flow provide the soundest basis of profitable operation. The three major division of Fodder production planning are namely the principles of fodder production planning, planning in practice and implementation of the plan (Jones, 1983). A careful assessment of the land and farm implement is needed. Considering soils and water, the area of land that can be irrigated is of vital importance, since it determines how much green grazing will be available to cattle farm in dry season. Although, a careful assessment of the land and farm implement is needed for sustainable agriculture (Bassett and Boyle, 1992). A sound run off control plan is fundamental to the safe use of resources. A recent estimate indicates that the deficiency in the total forage availability in about 53 per cent for dry and about 68 per cent for green fodder. Agriculture has a dual role as user and supplier of energy (FAO, 2000). Mechanization also includes irrigation systems, food processing and related technologies and equipment. To make cattle farming economically attractive, milk production and productivity has to be enhanced. This is possible only by making available good quality feed and fodder in adequate quantity and using modern farm implement for fodder production for cattle's. The distribution of livestock is more editable than that of land in India. In order to maximize income from dairy farming, it is essential to probe into the input- output relationship governing the milk production activity. Mechanization in fodder production capacity have been reconciled one must consider the costs and returns. Therefore, it showed some advantage over traditional methods of cultivation. However, all these measures only hold increasing production target to a certain level. There is need of mechanization of farm because most of the work for fodder and crop production is carried manually. In this manuscript, an extensive study has been done to explore the mechanization gap in cattle farm of Dr. Rajendra Prasad Central Agricultural University, Pusa and nearby places.

EXPERIMENTAL METHODS

Project area :

The study was conducted in RAU cattle farm which farm which is located in Main Campus of University at Pusa farm on the embankment of Gandak River. The study area situated between $25^0$42' and $26^0$52' North latitude and $45^0$42' and 86^0 02' east longitudes.

Data collection and analysis :

The data were collected based on cropping pattern, Agricultural practices, mechanization gap and available farm mechanics. The obtained data were encompassed main information regarding inventory of implements, machinery distribution for each hectare of crop land, availability of power source, land utilization pattern and irrigation structure. In addition, survey was also conducted to get information regarding cattle family description, farm machinery, cropping pattern and operation wise power utilization. Total gross cultivable area (GCA) was calculated as suggested by Bardhan (1973). The difference between fodder production and consumption was estimated. If the consumption was found higher than production then available machinery and un-utilized crop area was checked. Finally, suitable implementation of farm machinery and utilization of un-utilized land to enhance the fodder production to meet the annual demand of fodder was suggested.

Field measurement :

The main observations were taken at the time of tractor and bullock operation, area covered and time taken along with human power used.

Field capacity:

The field capacity was calculated on the basis of area covered in a specific time for a particular operation. The field capacity was calculated as under:

$$\textbf{Theoretical field capacity} = \frac{\textbf{S x W}}{\textbf{10}}; \textbf{(ha/hr)}$$

where, S is linear speed of travel of tractor (km/hr), W is effective width of implement (m).

Tillage operation data:

Knowing the field capacity and number of times the operations performed on different crops, the total hours of use for each implement were determined.

Sowing operation data:

Knowing the total area covered in sowing/ Transplanting operation and all power source in valued, in terms of hours total human and animal hours were calculated.

Inter culturing operation data:

Inter culturing operation consumer large amount of human power by knowing the total area covered by total number of man or women in specified time total human hours were calculated.

Harvesting operation data:

Harvesting is one of the main operations in valued in fodder and crop production which consumes a large amount of human power. Knowing total human's hours were calculated.

Threshing operating data:

The total grain production was calculated by multiplying the average yield of grain and area cropped under Maize Napier, Jowar, Jai, Bar seem etc.

Following expression was used to compute total time required for thresher.

$$\text{Hour of threshing} = \frac{\text{Total wheat / Paddy production}}{\text{Output of thresher}}$$

Hours of threshing were estimated by considering all the threshing operation to be completed by tractor, electric motor and diesel engine etc.

Pumping operation data:

Cattle farm used electric meter and diesel engine for pumping operation were considered to obtained the pumping hours (In terms of discharge, output) and total area irrigated. The equation used to estimate hours of pumping is written as :

$$\text{Hour of pumping} = \frac{\text{Area irrigated (ha) x Depth of irrigation (m)}}{\text{Discharge (output)}}$$

Farm power availability:

Farm power availability from different sources of power such as human, animal, mechanical and electrical were analyzed and power available per hectare cultivable area is given as

$$\text{KW/ha} = \frac{\text{Total power (kw)}}{\text{Cultivation area (ha) x No. of } \frac{\text{Crop}}{\text{Year}}}$$

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present investigation as well as relevant discussion have been summarized under the following heads :

Land holding pattern of the projected area :

Land holding pattern of the projected area as obtained from official record of cattle farm. The total land area of cattle farm are 96 ha in which 16 ha are under bund having 250 per cent cropping intensity and rest 78 ha are undulating, full of shrubs and tree and under the teeth of river Gandak. Out of 78 ha of land in Dhab area only 24.24 ha are cultivable that also having only 100 per cent ensured cropping intensity in *Rabi* season.

Increasing the cropping intensity Cattle farm power source must be about 1.5 hp per hectare. Farm power is needed on the farm for operating different implement and during various Farm operations, while mobile power is used for doing different field jobs. The mobile farm power comes from human, draft animals, power tiller and self propelled machines. In cattle farm only two 35 hp tractor is available for field operation but for increasing cropping intensity power source must be about 1.5 hp/ ha. Since the cattle farm governs the 96 ha land so power required is 144 hp for performing the operation. But at cattle farm there is only 70 hp power is available for field operation. Hence a deficit was observed in farm power source for different fodder production operation. It was about 74 hp (Table 1).

In the Table 2 agricultural operation wise available implement data are presented and was critically observed. The first major operation in agricultural practice is tillage. Under this operation two type of tillage practised one is primary tillage and another is secondary tillage. Under primary tillage operation cattle farm have 3-bottom m.b plough, 3- bottom disc plough, 2- bottom disc plough and six operational indigenous plough. Under secondary tillage practices one disc harrow and one cultivator was there. The second most important operation of farm is sowing. It was observed that there was no any sowing implement, plant protection implement and harvesting implement.

Table 1 : Status of farm power available, gap and requirement

Sr. No.	Name of power source	Available		Requirement	Total gap
		Capacity	Condition		
1.	Tractor	35hp Massy forgushan Model No 1035	Functional	One 145 hp Tractor	62hp
		35hp Massy forgushan Model No 1035			
2.	Power tiller	Nil	Nil	12 hp	12 hp
3.	Electric motor	1hp	Functional	Nil	Nil
		15 hp			
4.	Generator/diesel engine	5 hp	Functional	Nil	Nil
		5 hp			

Most of the weeding operation was done by own labour *Khurpi*. Weeding control in the field of fodder under irrigated and rain fed field during *Kharif* is a serious problem and the yield is affected to the extent of 20 per cent-60 per cent if not controlled. The *Khurpi* is most versatile hand hoe for removal of weeds but it takes 300 to 700 man-hours to cover one hectare (FIM REPORT). Use of long handle wheel hoe and peg type weeders, reduce this weeding time to 100-125 hours. The sowing practice of fodder in the cattle farm was found not in raw and wider spacing because sowing was conducting by broad casting of seed. Plant protection equipment was not available at RAU cattle farm and there no any plant protection insecticides and pesticides are used fodder production. However chemical in the form of liquid or power will be directly adverse effect the animal food (Table 3).

In irrigation it was found 2 pump sets operating with 8 hp diesel engine and 1 high capacity pump is under process. One boring was found which will be operated by electric motor has depth 300 feet. There was enough irrigation facility hence requirement is nil. There was

Table 2 : Status of farm implement for fodder production available at RAU cattle farm

Sr. No.	Operation	Implement	Available	FC_W, (ha/hr)	η, (%)	Condition
1.	Primary tillage	3 Bottom M.B plough	1 pc	0.42 to 0.50	60	Operational
		2 Bottom disc Plough	1 pc	0.30 to 0.40	62	Operational
		3 Bottom disc Plough	2 pc	0.45 to 0.50	65	Operational
		Indigenous plough (Bullock operated)	6 pc	0.20 to 0.30	61	Non- operational
	Secondary tillage	Cultivator 9 Tyne	2 pc	0.65 to 0.70	72	Operational
		Disc harrow 16disc	1 pc			
2.	Sowing implement	Nil	Nil	Nil	Nil	Nil
3.	Weeding implement	Hoe	1 pc	0.02	65	Operational
4.	Plant protection implement	Nil	Nil	Nil	Nil	Nil
5.	Irrigation pump	Pump set with 8 hp diesel	2 set	76000-95000	64.5	Operational
		Pump is under process, depth is 300 ft	1 set	L/h		Under construction
6.	Harvesting implement	Nil		Nil	Nil	Nil
7.	Threshing implement	Maize thresher	1 pc	60-70 kg/hr	64	Operational
8.	Chaff cutter	One chaff cutter operating with electric motor	1 pc	75kg/hr	70	Operational

FC_W = Working Field Capacity (ha/day), η = Field Efficiency.

Table 3 : Status of farm implement required for fodder production at RAU cattle farm

Sr. No.	Operation	Implement	FC_W (ha/h)	FC_A (ha/h)	A_T (ha/day)	D	P_S	Remarks
1.	Tillage implement							
	Primary tillage	One 3 M B plough	0.42	0.252	4.32	10 days	+ 5 days	Sufficient
		One 3 disc Plough		0.180				
	Secondary tillage	One cultivator	0.52	0.312		5 days	+ 10 days	Sufficient
		One disc harrow	0.65	0.390	9.36			
		One rotavator	0.65	0. 390				
2	Sowing implement	One seed cum fertilizer drill 11 Tine	0.50	0.310	2.496	9 days	+ 6 days	Sufficient
		One inclined plate multi crop planter	0.52	0.312	2.506			
3.	Harvesting implement	Green Fodder harvester with trolley	0.3	0.18	1.44	Sufficient	Sufficient	Sufficient
4.	Weeding	Hoe	0.02	0.012	0.096			Insufficient
		Peg type	0.10	0.60	0.48	22 days	-7 days	

FC_W = Working Field Capacity, FC_A = Actual Field Capacity with 60 per cent efficiency, A_T = Total Area covered per day, D = Numbers of days required to cover the area, P_S = Surplus Period (ha/day).

absence of sowing implement at cattle farm. For minimizing seed losses and proper seed germination it is necessary to deliver the seed at specified seed-rate and place seed in certain pattern. Hence, one seed cum fertilizer drill with field capacity 0.50-0.55 ha/hr and one inclined plate multi crop planter with 0.52-0.55 ha/hr is required. If the sowing will be carried by suggested seed drill and transplanter then weeding may be use by long handle wheel hoe and peg type weeder and reduce in time then area will be more cover.

Conclusion :

The cattle farm governs the 96 ha land so power required is 144 hp for performing the operation. But at cattle farm there is only 70 hp power is available for different field operations. Hence, a deficit was observed in farm power source for different fodder production operation. It was about 74 hp. There was enough irrigation facility hence, requirement is nil. The sowing practice of fodder in cattle farm was found not in row and wider spacing because sowing was conducting by broad casting of seed. If the sowing will be carried by suggested seed drill and transplanter then weeding may be use by long handle wheel hoe and peg type weeder and reduce in time then area will be more cover. There is need to level the undulated land and hence, one land leveler is essentially estimated implement under secondary tillage for maintaining the undulated land to enhance in area for fodder crop production. There are surplus implements available for primary tillage, but there is a big problem associated with repair and maintenance of these implements. For secondary tillage purposes there is need of one rotavator with field capacity 0.65 to 0.70 ha/hr and field efficiency 68 per cent. The studies also led to the following broad conclusions. Farm mechanization led to enlarge in inputs on relation of higher average cropping intensity and larger area and greater than before productivity of farm labour. Mechanization of cattle farm displaced animal power to the degree of 50 to 100 per cent but resulted in less significant time for farm job. Green fodders are helpful and essential sources of cheap feed for ruminant animals in many developing countries. To retain their green leaves and nutrient content during dry seasons, they bridge the gap normally created by decline in the nutritive potentials of natural pastures during this period. The ability of their foliages to remain green and uphold their protein content makes them potential sources of protein and energy (Olafadehan, 2013). The green fodder can be supplied to farm only with the timeliness in operations and it can be possible only with mechanization practices.

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