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Research Article

Analysis of factors determining supply of and demand for animal energy use in crop production

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SUMMARY : Energy is a critical input in crop production activity. Sufficient availability of right energy and its effective and efficient use are prerequisites for improved agricultural production. The present study was carried out Raichur district of Karnataka state during 2010. Both primary and secondary data were collected and analyzed for determining the factors influencing supply of and demand for animal energy use in crop production. The study revealed that the land holding pattern along with the age, experience in agriculture and the family size of the farmer influences the nature and quantum of energy used in agriculture. The total animate and mechanical sources of energy utilized for paddy cultivation by small farmers (1,913.20 MJ/acre) was found to be significantly higher than that of medium (1,382.50 MJ/acre) and large (1,480.30 MJ/acre) farmers. This indicated that energy utilization from draught animal source decreased with increase in the farm size. But in contrast, mechanical energy utilization increased with increase in farm size. It means that with increase in farm size draught animal energy was replaced by mechanical energy indicating that large farmers were more dependent on mechanical energy than the lower size group of farmers. Asset holding factor also influences the use of different types of energies in farm production which was evident from the fact that large farmers owning modern farm tools use more of mechanical energy in contrast to small farmers depending on human and draught energy. The total bullock energy requirement in major crops of Raichur district was 3,763.07 lakh MJ which was significantly higher (92.58%) against the total availability of just 279.24 lakh MJ due to significant lower bullock population. The factor of availability of energy source during the peak season was another major factor determining supply of and demand for animal energy use in crop production.

KEY WORDS :
Factor, Energy supply, Energy demand, Asset position, Energy availability, Energy requirement

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BACKGROUND AND OBJECTIVES

Energy is a critical input in the production, consumption, transportation and related activities. Improvement in consumption of energy plays an important role in the growth and development of any economy, particularly for developing country like India, where per capita energy consumption is quite low. India's per capita consumption of primary energy at 560 KOE (kg of oil equivalent) is much lower than that of USA (7,051 KOE) and China (1,695 KOE) (World Bank, 2012 and EIA, 2012). Agriculture is not only consumer of energy but also producer of energy in the form of crop output. Energy is invested in various forms in agriculture like human, animal and mechanical energy. Sufficient availability of right energy and its effective and efficient use are prerequisites for improved agricultural production. There exists a close nexus between farm power availability and increased agricultural productivity. The farm power availability and food grain productivity have been found to be positively correlated. The State of Punjab, with the highest farm power availability (3.50 Kw/ha) has recorded the highest food grain productivity (4032 kg/ha). Orissa with lowest farm power availability has the productivity level as low as 799 kg /ha (Pandey, 2009).

The structure of energy-use in Indian agriculture has changed substantially, with a significant shift from the animal and human power towards machines, electricity and diesel (Pachuri, 1998). The total commercial energy input in Indian agriculture has increased from 425.4 × 109 Mega Joules in 1980-81 to 2592.8 × 109 Mega Joules in 2006-07 (Jha, *et al.,*2012). Analysis of agriculture and energy relationship are more and more important due to intensification and market-orientation of agriculture which demands more of non-renewable sources of energy like tractor power, power tillers and diesel energy etc., as a result the use of non renewable sources of energy like human and animal energy is decreasing over a period of time leading to adverse effect on farm employment and income distribution. The draught animal power is a vital source of eco friendly renewable energy, and from the farmer's point of view, draught animals not only provide power-but also fertilizer and other services of economic value along with providing additional employment opportunities to the farmers especially small and marginal farmers. In this context the present study was attempted to analyse the factors determining supply of and demand for animal energy use in crop production.

RESOURCES AND METHODS

The present study was carried out in irrigated situations of Raichur district of Karnataka state during 2010. Both primary and secondary data were collected and analyzed for determining the factors influencing supply of and demand for animal energy use in crop production. In order to get opinion from the farmers a multi-stage random sampling procedure was adopted for the selection of the taluks, villages and farmers. In the first stage, three taluks were selected based on the highest area under irrigation namely Sindhanur (59,334 ha), Manvi (44,392 ha) and Raichur (17,894 ha). In the second stage, three villages were selected based on highest irrigated area under paddy cultivation from each of the selected taluks. In the final stage, ten farmers from each selected village comprising of small, medium and large farmers were selected randomly. Thus, the total sample size constituted 90 farmers. Secondary data pertaining to animal census, area under irrigation, area under crops in Raichur district were collected from District Statistical office and Animal Husbandry Department in Raichur district.

In order to discuss energy quantitatively, it is necessary to adopt a unit of measurement. The precisely defined, and recommended, scientific unit for energy is joule (J). Energy from inputs and outputs were calculated by converting the physical units of inputs and outputs into respective energy units by using appropriate energy equivalents. Energy equivalent have been standardized for use in the All India Co-ordinated Research Project (AICRP) on Energy Requirement in Agricultural Sector (ERAS) for calculation of energy requirement (Anonymous, 1996; Anonymous, 1999).

Scoring technique:

It is likely that some factors influence the animal energy use in crop production and they were quantified by giving scores to the factors. The following scores were assigned to each factor of using animal and mechanical energy in crop production. The scores assigned were '1' for low strong reason, '2' for medium strong reason, '3' for very strong reason. The summation of the scores indicates intensity of the factors of using animal energy in crop production.

Estimation of animal energy supply and demand- The following formula was used to estimate the animal energy supply and demand in Raichur district.

OBSERVATIONS AND ANALYSIS

The results of the present study as well as relevant discussion have been summarized under following heads:

Socio-economic factor:

The land holding pattern along with the age, experience in agriculture and the family size of a particular farmer influences the source and quantum of energy used in agriculture. In this context the socio economic status of the sample farmers were analysed and the results evidently indicated that the average age of the small, medium, and large farmers was around 39, 42 and 45 years, respectively. However, average experience in farming of large farmers (23 years) was relatively higher than that of medium (20 years) and small (19 years) farmers (Table 1).

The present study analysis was made to determine the impact of land holding on energy use. The total animate and mechanical sources of energy utilized for paddy cultivation by small farmers (1,913.20 MJ/acre) (table 2) was found to be significantly higher than that of medium (1,382.50 MJ/acre) and large (1,480.30 MJ/acre) farmers. This indicated that energy utilization from draught animal source decreased with increase in the farm size, the results were in conformity with the results obtained by Halim *et al*. (1999). But in contrast, mechanical energy utilization increased with increase in farm size. It means that with increase in farm size draught animal energy was replaced by mechanical energy indicating that large farmers were more dependent on mechanical energy than the lower size group of farmers. This is mainly because large farmers can not maintain animals due to scarcity of labour. On the other hand large farmers can afford to use machines in crop production. Large farmers prefer to use mechanical energy compared to animal energy because of the time constraint during sowing and harvesting period.

Asset position factor:

The availability of farm equipment also determines the supply of and demand for animal energy in a particular locality.

Table 1 : Socio-economic characteristics of sample farmers in study area

Sr. No.	Particulars	Unit	Small farmer	Medium farmer	Large farmer
1.	Sample size	Number	39.00	28.00	23.00
2.	Average age of the farmer	Years	38.89	42.35	44.65
3.	Average experience in farming	Years	19.33	22.92	20.39
4.	Average family members in farm work	Number	3.43	4.17	4.21
5.	Average size of the family				
	Male	Number	2.50	2.92	3.69
	Female	Number	1.80	2.32	2.87
	Children	Number	2.10	2.53	2.52
	Total	Number	6.40	7.77	9.08
6.	Education level				
	Illiterate	Per cent	33.33	28.57	4.35
	Primary	Per cent	48.72	14.29	30.43
	High	Per cent	10.26	46.43	30.43
	College and above	Per cent	7.69	10.71	34.78
	Total	Per cent	100.00	100.00	100.00
7.	Land holding				
	Irrigated	Acre	3.18	7.04	20.31
	Rainfed	Acre	1.00	1.66	4.60
	Total	Acre	4.18	8.70	24.91

Table 2 : Source wise energy use in paddy cultivation across different size group of farmers

Source/ category of farmers	Human		Draft animals		Machine		Total
	Energy (MJ/acre)	Percentage (%)	Energy (MJ/acre)	Percentage (%)	Energy (MJ/acre)	Percentage (%)	Energy (MJ/acre)
Small farmer	722.2	37.8	539.2	28.2	651.8	34.1	1913.2
Medium farmer	608.3	44.0	87.4	6.3	686.7	49.7	1382.5
Large farmer	604.2	40.8	59.4	4.0	816.7	55.2	1480.3
Average	644.9	40.5	228.7	14.4	718.4	45.1	1592.0

An attempt was made to ascertain the position of assets owned by each category of farmers and the results of the study showed that (Table 3) large farmers were well equipped with mechanical/ modern farm equipments by having more machinery such as tractors (71.44%), tractor trailor (76.93%), combine harvesters (100%), sprayer (55.56%), and tractor implements like MB plough (63.64%), cultivators (76.93%), puddler (72.73%) and harrow (62.50%) than that of medium and small farmers.

Small farmers were also well positioned by owning more number of bullocks (55.55%), cows (48.10%), young stock of cows (53.33%), cattle shed (50.00%) and animal operated implements such as wooden plough (52.63%), harrow (45.00%), bullock carts (41.67%), and seed drill (66.66%) than medium and large farmers, but number of buffaloes are more in large (39.66%) and medium (31.03%) farmers as compared to small farmers (29.31%) as they are mainly reared for milk production.

Energy availability factor:

The estimation of energy availability from bullock power in Raichur district (Table 4) revealed that the total bullock energy availability from Raichur district was 279.24 lakh MJ. However, among the talukas of Raichur district, the bullock energy availability in Lingasugur (131.38 lakh MJ) was found to be highest. Further, the bullock energy availability from Sindhanur, Manvi, Raichur and Deodurga taluks accounted for 51.15, 41.03, 35.39 and 20.30 lakh MJ, respectively. Higher bullock population in Lingasugur taluka as compared to other talukas of Raichur district resulted in highest bullock energy availability from Lingasugur taluka. Whereas the bullock population in other taluks of Raichur district was found to be significantly lower resulting in lower availability of bullock energy. Rearing of bullocks provides additional employment opportunity to the farmer and also farmyard manure which is important source of energy in crop production in addition to draught power. Hence, it is necessary to motivate the farmers to practice good animal husbandry practices in farms so as to increase the animal energy availability. Farm mechanization being an important agenda in the budget allocation for agriculture at the national level, more emphasis is being laid

Table 3:- Asset position of the sample farmers in the study area (Percentages)

Sr. No.	Assets	Small farmer	Medium farmer	Large farmer	Total
1.	Tractor	7.14	21.42	71.44	100.00
2.	Tractor trailor	7.69	15.38	76.93	100.00
3.	Tractor implements				
	MB plough	9.09	27.27	63.64	100.00
	Cultivator	7.69	15.38	76.93	100.00
	Puddler	9.09	18.18	72.73	100.00
	Harrow	12.50	25.00	62.50	100.00
4.	Combine harvester	0.00	0.00	100.00	100.00
5.	Sprayer	13.88	30.56	55.56	100.00
6.	Bullocks	55.55	23.61	20.84	100.00
7.	Cows	48.10	30..37	51.90	100.00
8.	Buffaloes	29.31	31.03	39.66	100.00
9.	Young stock of cows	53.33	23.33	23.34	100.00
10.	Young stock of buffaloes	35.71	35.71	28.58	100.00
11.	Cattle shed	50.00	16.66	33.34	100.00
12.	Animal power operated		Implements		
	Wooden plough	52.63	26.31	21.06	100.00
	Harrow	45.00	35.00	20.00	100.00
	Bullock cart	41.67	41.66	16.67	100.00
	Seed drill	66.66	33.33	0.01	100.00
	Hand Tools	29.57	24.95	45.48	100.00

on credit disbursement for purchase of tractors and tractor equipments by nationalized banks, the same has to be extended to improve the present situation of draught animals.

Energy requirement factor:

The total bullock energy requirement in major crops of Raichur district was 3,763.07 lakh MJ. However, the total bullock energy requirement for cultivation of sunflower (1,220.02 lakh MJ) was found to be the highest (Table 5). This was mainly due to highest area under sunflower cultivation in Raichur district. Further, it was observed that (Table 6 and Fig. 1) the bullock energy demanded (3,763.07 lakh MJ) was significantly higher (92.58%) than that of total bullock energy supply (279.24 lakh MJ). The reason was due to significant lower bullock population in Raichur district. Further, due to scarcity of human labour, farmers were unable to maintain the

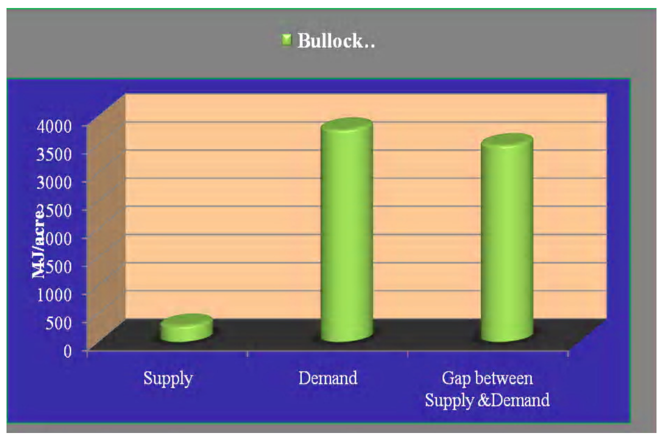

Fig. 1 : Estimates of bullock energy availability and its requirement for major crops in Raichur district

Table 4 : Estimation of energy availability from bullock power in Raichur district

Sr. No.	Taluka	Total no. of bullocks	No. of bullock energy used (Hours/year)	Energy equivalent of bullocks (MJ /hour)	Total energy (Lakh MJ)
1.	Lingasugur	2168	600	10.1	131.38
2.	Deodurga	335	600	10.1	20.30
3.	Raichur	584	600	10.1	35.39
4.	Manvi	677	600	10.1	41.03
5.	Sindhanur	844	600	10.1	51.15
6.	Total Energy	4608	600	10.1	279.24

Table 5 : Estimation of bullock power requirement in major crops of Raichur district

Sr. No.	Major crops	Area(Hectares)	Bullock energy required (MJ/ha)	Total energy requirement (Lakh MJ)
1.	Paddy	137768	571.68	787.59
2.	Jowar	122529	601.00	736.40
4.	Greengram	64084	572.00	366.56
5.	Redgram	13338	572.00	76.29
6.	Groundnut	39633	1000.00	396.33
7.	Sunflower	212547	574.00	1220.02
8.	Cotton	12783	1407.18	179.88
9.	Total	602682	5297.85	3763.07

Table 6 : Estimation of bullock energy availability and its requirement for major crops cultivation in Raichur district

Sr. No.	Items	Energy (Lakh MJ)
1.	Total energy availability	279.24
2.	Total energy requirement	3763.07
3.	Difference between energy available and its requirement	3483.82
4.	Percentage change in energy supply over its demand	-92.58

Table 7 : Factors determining animal energy use in crop production in Raichur district

Sr. No.	Factors	Total score	Rank
1.	**Non availability of machines**		
	Tractors	243	I
	Power tillers	116	VI
	Power sprayers	106	VIII
	Combine harvester	85	XII
2.	**Adequate availability of draft animals**		
	Bullocks	199	II
	He Buffaloes	87	XI
3.	**Adequate availability of suitable animal drawn implements**		
	Ploughs	165	IV
	Blade harrows	144	V
	Seed drills	100	IX
4.	**Low maintenance cost of draft animals**		
	Bullocks	131	VII
	He buffaloes	62	IVX
5.	**Less cost of using animal power**		
	Bullocks	182	III
	He buffaloes	83	XIII
6.	Lower initial investment	90	X
7.	Govt. support through subsidy to purchase of animal drawn implements	23	IV

livestock. Instead, they preferred mechanical power in the form of tractors, threshers, etc., over animal power for agricultural operations. Under these circumstances, it is suggested that the district animal husbandry department to implement different animal husbandry development programmes intensively on a large scale and educate the farmers about importance of bullock energy in crop production. Farmers may also be encouraged to maintain and use bullock power in crop production which is cost effective so as to meet the deficit bullock energy supply in Raichur district.

Other factors determining animal energy use in paddy cultivation:

The survey on factors influencing the use of a specific source of energy reveled that (Table 7) that non availability of tractor during peak season (I Rank) was the prime reason for animal energy use in crop production. The reasons such as seasonal availability of bullocks (II Rank), lower cost of using bullock power (per MJ) (III Rank), adequate availability of suitable animal drawn implements like ploughs (IV Rank), government support through subsidy to purchase of animal drawn implements (IV Rank), adequate availability of blade harrows (V Rank), non availability of power tiller (VI Rank), low maintenance cost of bullocks (VII Rank) were other important reasons for use of animal power in crop production as expressed by farmers during opinion survey.

Conclusion:

There is a paradigm shift in the use of energy sources from animal energy (renewable) to mechanical energy (non renewable) in agriculture over a period of time due to intensification and market orientation of agriculture and non availability of draught animals leading to adverse effect on farm employment and income distribution and ecological imbalance. On other hand animal power in agriculture is a cost effective source of energy as it provides additional energy sources such as FYM. Rearing of bullocks provides additional employment opportunity especially to small and marginal farmers and also provides farmyard manure which is important source of energy in crop production in addition to draught power. Hence, it is necessary to motivate the farmers to perform good animal husbandry practices in farms so as to increase the animal energy availability in order to meet the demand for farm energy.

In view of the significant deficit in bullock energy supply in Raichur district it is suggested that the district animal husbandry department to implement different animal husbandry development programmes intensively on a large scale and educate the farmers about importance of bullock energy in crop production. Farm mechanization being an important agenda in the budget allocation for agriculture at the national level, more emphasis is being laid on credit disbursement for purchase of tractors and tractor equipments by nationalized banks, the same has to be extended to improve the present situation of draught animals and animal driven farm equipments. Farmers may also be encouraged to maintain and use bullocks on collective basis which will result in lower cost of maintenance and increased availability of animal power in agriculture. Alternatively, farmers can maintain duel purpose breeds of animal such as Hallikere breed which can be used for both milch and draught purpose.

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REFERENCES

Anonymous (1996). All India co-ordinated research project on energy requirement in agriculture sector. University of Agricultural Sciences, Dharwad, p. 6-7.

Anonymous (1999). Proceedings of XV annual workshop on energy requirement in agricultural sector. tech. rep. no. CIAE/ERAS/99/229.CIAE, Bhopal.

Halim, R.A., Saikia, H.C. and Bhowmick, B.C. (1999). Pattern of energy use in crop production: A critical analysis in Golaghat district of Assam. *Agric. Econ. Res. Rev*., **12**(1): 1-6.

Jha, Girish Kumar, Pal, Suresh and Singh, Alka (2012). Changing energy use pattern and demand projection for Indian agriculture. *Agric. Econ. Res. Rev*., **25**(1):61-68.

Pachauri, R.K. (1998). Economics of energy use in agriculture in India. *Indian J. Agric. Econ*., **53**(3): 213-222.

Pandey (2009). Indian agriculture- An introduction. Fourth Session of the Technical Committee of APCAEMkl, Chiang Rai, Thailand.