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Feed Utilisation and Productive Performance Impact of Work on Female Ruminant (A Review)

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ABSTRACT

The effects of work *per se* on female animal performances have been debatable. This was due to available publications has a huge variations in term of duration of work, load imposed, feed given, and the environmental where research was conducted. This review covered publications throughout the world, especially from developing countries where female animal still played an crucial role in their daily activities. This review mostly focused on the effect of work on female animal feed utilization (feed intake and digestibility) and production performance (milk yield, milk composition, live weight, and reproductive physiology).

Key words: review, working animal, female, physiology.

ABSTRAK

Pengaruh kerja *per se* terhadap performans ternak betina sampai saat ini masih menjadi perdebatan. Hal ini disebabkan karena hasil-hasil penelitian yang dipublikasi mempunyai variasi yang cukup lebar dalam beberapa hal, termasuk didalamnya adalah perbedaan dalam lama kerja, beban kerja, jenis pakan yang digunakan, dan lingkungan tempat penelitian dilakukan. Review ini akan mencakup beberapa hasil penelitian diseluruh dunia, terutama dari negara-negara berkembang yang sampai saat ini masih bergantung pada penggunaan ternak kerja betina. Pada review ini akan dibahas pengaruh kerja pada ternak betina terhadap penggunaan pakan (konsumsi pakan dan kecernaan) dan performans produksi (produksi susu, komposisi susu, berat badan, dan fisiologi reproduksi).

Kata kunci: review, ternak kerja, betina, fisiologi.

INTRODUCTION

The use of animals for draught purposes is probably the most important application of livestock to farming in developing countries. Draught Animal Power (DAP) provides energy for cultivation of nearly 50% of the world's cultivated area as well as for pulling over 25 millions carts (Ramaswamy, 1985). Replacement of DAP by petrol-based power could cost between US$200 and US$300 billion with an annual running cost of approximately US$5 billion (Ramaswamy, 1985). Investments of such magnitude would be unacceptable to any government at the present time (Campbell, 1992). Ramaswamy (1985) estimated that two billion people in developing countries depended on DA systems in 100 million farm holdings of less than two hectares. In fields where

tractors cannot access, namely terraced hillsides, and on small-scale enterprise farms where limited finance rules out the use of tractors, DAP represents the farmers' only means of cultivating the land, other than by hand (Pearson and Dijkman, 1994).

On smallholder farms, where available land area is limited and DAP is an important resource input to farm production and income the use of female animals for work is the most efficient way of using animal and feed resources (Teleni and Hogan, 1989). Not only do such animals provide power for land cultivation, for example, but they also provide calves and milk. It is not surprising therefore, that in regions of the developing world where land and animal feed resources are scarce, female ruminant animals are generally used by farmers for work (Matthewman, 1987; Matthewman *et al*., 1993).

Feed utilisation

Feed intake

Three factors appear to be highly relevant to any consideration of the effect of work on feed intake, namely length of time available to working animals to eat and ruminate, increased heat load, and the increased energy demand (Teleni and Murray, 1991). Reduced time available for eating and ruminating due to the work regime employed could result in reduced feed intake. Increased body temperature could result in reduction in rumen motility and rate of passage of digesta (Young, 1982) which would tend to reduce appetite. Weston (1985) postulated that increased energy demand by an animal would increase rumen capacity and increase digesta outflow, thus increasing feed intake.

The hypothesis that work may stimulate appetite because it creates an increase in energy demand has been difficult to assess in draught ruminant animals. Although appetite may be stimulated, this effect may be counteracted by the reduced time available for eating that often occurs on working days. Working stress, particularly in hot conditions, may also lower intake indirectly by reducing the animal's desire to feed immediately after work.

Over the past 14 years, the studies on voluntary feed intake have produced conflicting data. Some (Lawrence, 1985; Wanapat and Wachiraparakorn, 1987; Bamualim and Ffoulkes, 1988; Pearson *et al*. ,1989; Pearson, 1990; Soller *et al.,* 1991; Pearson and Lawrence, 1992; Fall *et al*., 1997) observed similar feed intakes between working animals and their non-working counterparts, while other studies detected either an increase (Bakrie *et al*., 1989; Winugroho *et al*., 1989) or a decrease (Pieterson and Teleni, 1991; Tarigan, 1993) compared with non-working controls.

Pearson and Lawrence (1992) observed that although little increase in feed intake occurred in their animals during working periods, feed intake by animals in the week immediately after a working period was often higher than that in the pre-work week. Because non-working animals that have been subjected to a similar period of feed restriction displayed a similar response in feed intake to that of the working animal in the week immediately after work periods, Pearson and Dijkman (1994) suggested that feed

intake response by working animals was due to time restrictions for eating rather than a response to work itself.

In a recent study using milking cows, Lawrence and Zerbini (1993) stated that cows were able to increase feed intake in response to work even when consuming hay diets. This experiment was conducted in the Ethiopian highlands where temperatures are somewhat cooler. It is possible therefore that cows were not as heat-stressed as swamp buffaloes used in tropical Indonesia by Ffoulkes (1986) and Ffoulkes *et al.* (1987).

Digestibility

It is possible that feed digestibility may increase as the result of a significant reduction in the rate of passage of digesta from the rumen due to an increase in body temperature (Young, 1982) in working animals. Ffoulkes (1986) and Ffoulkes *et al.* (1987) reported increases (6-13%) in digestibility of fibrous feed with working buffaloes. Whether these observations were due to a reduction in the rate of passage of digesta through the gut is uncertain. The fact that buffaloes are fairly susceptible to heat stress (NRC, 1981) and that the animals in the studies reported by Ffoulkes (1986) and Ffoulkes *et al.* (1987) were worked under tropical conditions (mean ambient temperature of 30^{O}C) would suggest that a reduction in the rate of passage of digesta might have played a significant role in the digestibility values observed. However, effects of work on apparent digestibility and gastrointestinal time are not always seen in o n (Pearson and Lawrence, 1992) or buffaloes (Bamualim and Ffoulkes, 1988) on fi d dietary allowances.

Another way in which digestibility could be improved in working animals is in a situation where diet is marginally or severely deficient in ruminally available nitrogen and there is an increased transfer of plasma urea to the rumen (Teleni and Hogan, 1989).

Matthewman *et al.* (1993) suggested that light work may be beneficial for allowing a greater mixing of rumen contents which may enhance microbial fermentation. Higher levels of work, on the other hand, may have more detrimental effects, due to a shift in blood supply from the gut to muscles and peripheral tissues.

Production performance

Studies on the effects of work by draught animals on production performance have been few and far between. Necessary details on some of the studies mentioned below are lacking and preclude a wider evaluation of the topic.

Milk yield

Results of studies on the effects of work on milk yield are contradictory; some show no effect of work (Krautforst, 1947; Rajapurohit 1979 cited by Matthewman *et al.*, 1993; Agyemang *et al.*, 1991; Gemeda *et al.*, 1995) while others show a reduction in milk yield due to work (Rizwan-ul-Muqtadir *et al.*, 1975; Jabbar, 1983; Barton, 1987 cited by Matthewman *et al.*, 1993 Matthewman *et al* ,1989). Studies describing these results are summarised in Table 1 which analyses the effects of working on ruminant milk yield.

It is clear from Table 1 that most of the studies described were undertaken in cooler climates and perhaps during the

experimental periods, the working cows were not subjected to the degree of heat load that might be experienced under tropical conditions of high mean ambient temperature and high humidity. Because of this situation, some negative physiological impacts of work (*e.g.*, increased heat load) might not have been expressed as reduced production performance in some of the studies. In addition, animals used may have been subjected to different work loads in different studies.

A relatively recent study conducted by Gemeda *et al.* (1995) indicated that a reduction in milk yield resulting from work could be significantly halted by the provision of supplements to lactating cows. These authors maintained that supplements could enhance the ability of the rumen to ferment feed efficiently and hence increase feed intake, which could then improve the availability of nutrients needed for milk production.

Milk composition

The only available data on the effects of work on milk composition are from the research of Gemeda *et al.* (1995). Their data indicated that there was no adverse effect of work on milk composition. As in the case of milk yield, they recommended the use of feed supplements to significantly increase milk fat and protein.

Live weight

Draft animals in good condition and suitable live weight are essential requirements to ensure timeliness in soil preparation and planting. This is so because work output is a function of body size and working animals use fat reserves to fuel muscular activity during work. Under practical conditions, in Indonesia

Table 1. Summary of effect of working on ruminant milk yield

Animal	Work Regime	Country	Results	References
Cows	not available	Europe	No effect	Krautforst (1947)
Cows	not available	Egypt	No effect	Rajapurohit (1979 cited by Matthewman et al. 1993
Cows	walk 9 km/day at 2.9 km/h for 3 weeks	Edinburgh/UK	Reduction by 7-14%	Matthewman *et al.* (1989)
Buffaloes	plough 3 h/day 2.1-2.9 km/h	Pakistan	Reduction by 14%	Rizwan-ul-Muqtadir *et al*. (1975)
Cows	not available	Bangladesh	Reduction	Jabbar (1983)
Cows	plough 2-3 h/day 2.2 km/h 5 week	Bangladesh	Reduction by 23-40%	Barton (1987 cited by Matthewman *et al*. 1993)
Cows	cultivate 2.5 ha	Ethiopia	No effects	Agyemang *et al*. (1991)
Cows	pull sledges; 4 day/week; 4 h/day	Ethiopia	No effects	Gemeda *et al.* (1995)
Ewes	Pulling 3% body weight load, 30 days, 4 h/day	Australia	No effects	Dwatmadji (2000).

for example, most working animals lose weight (*e.g.,* Ffoulkes, 1986; Winugroho *et al.,* 1989) mainly because of the low quality of available diet since work is usually required to be undertaken at the end of the dry season (approximately five months - Santoso and Sumanto 1989) and at the beginning of the wet season. Depending on the duration of and the workload to which the cows are subjected intake and digestibility of available diets might be reduced thus resulting in energy deficits and live weight and body condition losses in those animals. Such losses would probably adversely affect production and reproduction efficiency of cows (Teleni and Hogan, 1989; Teleni *et al.,* 1989; Zerbini *et al.,* 1993) .

Reproductive physiology

Only a few studies had been reported in the literature on the effects of work on draught cows reproduction. There are a few, published reports however which speculate on possible effects of work on reproduction (Matthewman *et al.*,1994).

Work carried out during early lactation could delay return to estrous. Reduced blood sugar levels resulting from work could affect implantation if work is carried out around this time (Matthewman *et al.,* 1994). An Indonesian study reported by Bamualim *et al.* (1987) indicates that work has a negative effect on ovarian activity of swamp buffaloes. Live weight losses resulting from work, can indirectly reduce reproductive efficiency. In their study using Brahman cross heifers, Teleni *et al.* (1989) concluded that a loss of approximately 17% of live weight was detrimental to the reproductive function. The theory that adverse effects of work on reproductive efficiency might operate through live weight and body condition loss is consistent with the observation of Agyemang *et al.* (1991) who demonstrated that work had no significant effect on productive and reproductive performance when animals received adequate feeding and only worked for short periods.

CONCLUSION

The effect of work on female animal mostly dependent upon the severity of work imposed to the female animal. Under light regime, there were not any adverse effects of work on physiological and metabolical parameters. Light work with adequate feeding and for short timeframe would not have adverse affect on productive and reproductive of female animals.

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