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Animal and land resource management practices leading to ecological sustainability of smallholder dairy farms in different agro-ecozones of West Bengal, India

THE LATE E K CHAKI[1], S PAN[2], A K SANTRA[3], DURGA CHAURASIA[4], KIRAN KUMARI[5] and NISHMA SINGH[6]

West Bengal University of Animal and Fishery Sciences, Kolkata, West Bengal 700 037 India

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ABSTRACT

A study was conducted on the existing animal and land resource management of small holder dairy farms in 3 agro-ecozones of West Bengal. The study revealed that overall average dairy herd size was 5.47 LU in agro-ecozone I (sub-humid with red and lateritic soils of Purulia) followed by agro-ecozone II [(2.64 LU), warm per-humid with brown and red hill soils and agro-ecozone of Darjeeling], III [(2.63 LU), hot subhumid to humid with alluvial soils of North 24 Parganas]. Proportions of large and medium sized herds were also considerably higher i.e. 58.9 and 30%, respectively, in agro-ecozone I. This showed greater ecological pressure from dairy animals in agro-ecozone I. It was also further revealed that 78.7% of total stock comprising nondescript cattle and buffaloes in agro-ecozone I while farmers, in agro-ecozone II kept crossbred cattle (83.3%) in their herds. Favourable climatic conditions, long term crossbreeding by dairy cooperatives and availability of green fodder might be the reasons of raising higher concentration of crossbred cattle in this agro-ecozone. In agro-ecozone III owing to hot and humid climatic condition and higher intensity of crop production, farms maintained both nondescript (33%) and crossbred cattle (67%) of total herd strength in low density depending upon their financial capabilities. These animals were mostly raised on crop residues and byproducts under stall-fed condition thus creating lesser ecological pressures as compared to those of other 2 zones. It was also further revealed that 100% respondents farms in agro-ecozone I used pastures and post harvested croplands regularly and 31% used forestlands occasionally or regularly for grazing their stock. Farms in this zone practiced on an average 6.7 h of grazing/day which was much higher than agro-ecozone II (0.37 h) and agro-ecozone III (1.55 h). The differences in the utilization pattern of different types of grazing lands between 2 dairying sectors were not remarkable except that use of forest under unorganized sectors was much higher than organized sector in agro-ecozone I.

Key words: Ecological pressure, Forest land, Grazing, Herd size, Humid zone, Soil type

Ecological sustainability is regarded as the ability of the system to maintain ecological balance or ecosystem health through conservation of natural resources such as soil, water and genetic richness of populations (Woodhouse *et al*. 2000). Certainly this would be dependent upon the type of activities involved and their possible impact on the existing ecosystems of which the livestock production system under study is a part. Sustainable agriculture consists of environment friendly methods of farming that allow the production of crops or livestock without damage to human or natural system (Falk 2013). Thus an ecologically sustained livestock production system would not only meet the present and future needs of mankind for animal products and services but also be ecofriendly such that it does not allow degradation of land and genetic resources. Land is the most limiting factor in livestock production in developing countries. In India, the free grazing plots are both arable and non-arable. Wastelands around villages and urban areas mostly belong to the government. Pasture land resources are mostly located in low rainfall areas where climatic factors and soil characteristics coupled with low fertility limit plant production (Bhat and Taneja 1998). In the present investigation, therefore, ecological sustainability of small holder dairy production system under organized and unorganized dairy sectors in 3 different agro-ecozones of West Bengal was evaluated in terms of animal and land resource management.

Present address: [1]Associate Professor, [2]Professor and Head, Department of Livestock Production and Management. [3]Professor, Department of Livestock Production and Management, [4]Assistant Professor (durgavet2010@gmail.com), Department of Anatomy, [5]Assistant Professor (drkirankumari22@gmail.com), Department of Instructional Livestock Farm Complex, College Of Veterinary Science And Animal Husbandry, Anjora, Durg. [6]S.M.S., K.V.K., Rajnandgaon.

MATERIALS AND METHODS

The present study was undertaken in 3 agro-ecological

zones of West Bengal (Sehgal *et al*. 1992). The zone I is characterized by hot sub-humid with red and lateritic soils of Purulia; zone II by warm per-humid with brown and red hill soils of Darjeeling; and zone III by hot sub-humid to humid with alluvial soils of North 24 Parganas. Using stratified 2 stage random sampling technique 9 villages comprising 6 organized sectors and 3 unorganized sectors from each zone were selected and a total of 270 small holder dairy farms comprising 180 under organized sectors and 90 under unorganized sectors were chosen for the study. The relevant information from the selected sample respondents in each study zone were collected by using various forms of rapid rural appraisal (RRA) techniques (Schonhuth *et al*. 1995). Dairy herd size for all selected dairy farms was calculated and categorized into 3 groups, viz. small (1–2 LU), medium (>2–4 U) and large (>4 LU) by using the scale given by Singh (Singh R 1998). To assess the ecological impact of the existing livestock resources management system it was considered necessary to examine the inputs in terms of cattle and buffalo and land utilization pattern by dairy animals as important factors of control indicators of ecological sustainability.

RESULTS AND DISCUSSION

Impact of animal resource management: The results (Table 1) revealed that overall average dairy herd size was much higher (5.47 LU) in agro-ecozone than those of other 2 agro-ecozones. Overall average herd sizes in agro-ecozones II and III were almost equal i.e. 2.64 and 2.63 LU respectively. Proportions of large and medium sized herds were also considerably higher (58.9 and 30% respectively) in agro-ecozone I than other 2 zones (16.7 and 48.9% in agro-ecozone II and 8.9 and 52.2% in agro-ecozone III, respectively). Thus, there existed greater ecological pressure from dairy animals in agro-ecozone I as compared to other 2 regions. The differences in dairy herd sizes and frequencies of herd size groups between 2 dairying sectors in respective agro-ecozone and overall were negligible. Farmers in agro-ecozone I mostly kept non-descript cattle and buffaloes, which constituted about 78.7% of their total stock. Descript buffalo and crossbred cattle together constituted only 21.3% of the total herd strength. As regard to herd management, average farms maintained only about 49.7% of total stock as milch cows (wet and dry) and the rest as male/ female followers (43.4%) and male breeding stock (6.9%). This typical herd structure contributed to higher stocking rates, higher ongoing feed requirements and crowdedness of holding facilities, which in turn resulted in poor hygiene, improper waste management, increased pressure on natural resource base and unsustainability. Skunmun *et al.* (1998) also observed similar situation while studying smallholder dairy farming systems at 'irrigated', municipality' and 'factory' locations in Thailand.

The size of dairy herds in the farming households may be influenced by several factors among which financial capabilities, resource situations, type of needs/ production objectives, marketing infrastructure, agro-climatic factors and intensity of using the animals are the important ones. With very low reproductive and productive efficiencies, non-descript cattle and buffaloes are acclimatized in harsh agro-climatic conditions owing to their higher disease resistance power and stress bearing capacity. They can be raised on grazing with supplementation of crop-residues and by-products and personal management by the farm women and children too. For better exploitation of these desirable characteristics of non-descript bovine species and due to limited availability of capital and other resources as well as lack of assured market for milk and milk products, farmers in agro-ecozone I had been maintaining relatively larger herd sizes to fulfill multiple objectives including sufficient quantities of organic manure production for their crop fields. To intensify the use of these animals, farmers of this region often used female stock both for milk and draught purposes and male stock for draught and breeding purposes. Farmers in agro-ecozone II mostly (83.3% of total herd strength) kept crossbred cattle with limited non-descript stock (only 16.7% of total herd strength) in their herds. On an average, farms in this zone maintained about 59.8, 36.8 and 3.4% of total stock as milch (wet and dry), male/female followers and male breeding stock, which was not ideal composition of dairy herd with respect to animal category. Favourable climatic conditions (lower night and day temperature), long term crossbreeding by dairy cooperatives and availability of green fodder/forage mostly of forest origin might be the reason behind raising higher concentration of crossbred cattle in this agro-ecozone. Feed intake and production potential of these animals were much higher than those of non-descript ones. However, reproductive inefficiency in both crossbred and non-descript animals resulting from unscientific management of feeding, breeding and herd health that exerted enormous pressure on delicate hill agro-ecosystem for increased requirements of feed and fodder, was identified as a potential risk to ecological sustainability in this region. Singh and Raman (1994) also observed ecological problems such as higher intensity of soil erosion, gully formation and thinning of forest due to intensive lopping in the mountain regions of Western Himalayas in Himachal Pradesh, all of which had resulted from increased livestock population. In agro-ecozone III, owing to hot and humid climatic condition and higher intensity of crop production, farmers maintained both non-descript (33%) and crossbred cattle (67%) in low density depending upon their financial capabilities. The animals were mostly raised on crop-residues and by-products under stall-fed condition thus creating lesser ecological pressures as compared to those of other two zones.

Further analysis of data revealed that the concentration of descript and graded/crossbred stock was more under organized sector than unorganized sector in all 3 agro-ecozones and in overall. This could be attributed to relatively better milk marketing situation under organized sector except in agro-ecozone I where classical pattern of cooperative milk marketing was absent.

Table 1. Animal and land resources management practices in smallholder dairy production systems under organized and unorganized sectors in different agro-ecozones of West Bengal

Resources of ecological importance	Indicators	Agro-ecozone– I (Hot Subhumid Ecoregion with Red and Lateritic Soils: Purulia)			Agro-ecozone – II (Warm Perhumid Ecoregion with Brown and Red Hill Soils: Darjeeling)			Agro-ecozone – III (Hot Subhumid to Humid Ecoregion with Alluvium-derived Soils: North 24 Pgs)			Overall	
		Orgd. sector	Unorgd. sector	Overall	Orgd. sector	Unorgd. sector	Overall	Orgd. sector	Unorgd. sector	Overall sector	Orgd. sector	Unorgd.
A. Animal resource:	(a) Dairy herd size (LU):	5.5	5.42	5.47	2.64	2.63	2.64	2.65	2.61	2.63	3.6	3.55
Dairy animals (cattle and buffaloes)	(b) Distribution of dairy herd size groups (%):											
	(i) Large (above 4 LU)	53.3	70	58.9	15	20	16.7	10	6.7	8.9	26.1	32.2
	(ii) Medium (>2 to 4 LU)	33.3	23.3	30	50	46.7	48.9	53.3	50	52.2	45.6	40
	(iii) Small (up to 2 LU)	13.3	6. 7	11.1	35	33.3	34.4	36.7	43.3	38.9	28.3	27.8
	(c) Dairy herds composition (%):											
	(i) Non-descript stock	76.3	83.6	78.7	7.4	35.5	16.7	29.5	40.2	33	37.8	53.1
	(ii) Descript & crossbred stock	23.7	16.4	21.3	92.6	64.5	83.3	70.5	59.8	67	62.2	46.9
	(iii) Dairy cows (dry and milch)	50.9	47.4	49.7	59.9	59.5	59.8	62.3	56.3	60.3	57.7	54.4
	(iv) Male and female followers	42.8	44.6	43.4	38.8	32.9	36.8	37.7	43.7	39.7	39.8	40.4
B. Land resource: Land used for grazing	(v) Male breeding stock/bull	6.3	8	6.9	1.3	7.6	3.4	-	-	-	2.5	5.2
	(a) Farms practicing grazing (%):	100	100	100	13.3	6.7	11.1	76.7	93.3	82.2	63.3	66.7
	(b) Total duration of grazing per farm per day (h):	6.58	6.93	6.7	0.39	0.33	0.37	1.07	2.52	1.55	2.71	3.26
	(c) Farms using forest lands (%):	16.7	60	31.1	11.7	6.7	10	-	-	-	9.4	22.2
	(d) Farms using waste lands, pastures and govt. lands (%):	100	100	100	5	6.7	5.6	66.7	76.7	70	57.2	61.1
	(e) Farms using post harvested crop lands (%):	100	100	100	13.3	6.7	11.1	61.7	70	64.4	58.3	58.9

'–' stands for absence of specific indicator.

As it is evident from the results (Table 1) that 100% respondent farms in agro-ecozone I used wastelands/ pastures and post harvested croplands regularly and about 31.1% also of those used forestlands occasionally or regularly for grazing their stock. Farms in this zone practiced on an average 6.70 h of grazing per day, which was much higher than agro-ecozone II (0.37 h) and agro-ecozone III (1.55 h). In agro-ecozone II, only 11.1% of total respondent farms practiced occasional grazing on forestlands, waste/government lands or post-harvested croplands. About 82.2% of the total farms in agro-ecozone III used either or both waste/government lands and post-harvested croplands for grazing. Forestlands were not accessible to the farmers of this region. The differences in the utilization pattern of different types of grazing lands between 2 dairying sectors were not remarkable except that use of forestlands under unorganized sector was much higher than organized sector in agro-ecozone I.

Impact of land resource management: As it is evident from the results (Table 1) that the impact of using pastures/ wastelands and post-harvested croplands could be both positive in terms of dropping of animal excreta during grazing helped in maintaining integrity of soil and negative with reference to over-grazing encouraged soil erosion and loss of plant bio-diversity. The utilization patterns of grazing lands in the present investigation suggested that the overall negative impacts of the systems on soil and plant resources were higher in hot sub-humid with red and lateritic soils of Purulia (agro-ecozone I) and warm per-humid with brown and red hill soils of Darjeeling (agro-ecozone II) as compared to the hot sub-humid to humid with alluvial soils of North 24 Parganas (agro-ecozone III). Though intensive integrated livestock production systems could reduce grazing pressure and promote sustainability in the systems, traditional extensive system, however, results in overgrazing, loss of green cover and soil erosion those in turn encourage denudation and desertification (Mangurkar 1998).

It can be concluded that (keeping the above findings in view), farmers could be advised to lower their stocking rates (herd sizes) in order to reduce negative impact on life-supporting agro-ecosystem. They should adopt correct management strategies such as selecting/ breeding the cattle and buffalo breeds those are more adaptive and reasonably productive in specific agro-ecological niche viz., descript native breeds of cattle and buffalo in hot subhumid with red and lateritic soils, descript and crossbred cattle in the hot sub-humid to humid with alluvial soils and mostly the crossbred cattle in warm per-humid with brown and red hill soils, improving reproductive and productive efficiencies of animals through adoption of scientific feeding, breeding, health care and other welfare practices; maintaining only required number of replacement stock resorting vigorous culling of uneconomic stock and intensified (diversified) use of stock (e.g., use of male both for draught and breeding purposes and female for milk and draught purpose) depending upon the species and breeds of animals and farmers' needs in specific agro-ecozone. Finally sustainability reporting should be framed through the lens of 4 inter connected domains-ecology, economics, politics and culture (Magee 2013).

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