ASSESSMENT OF FEEDING PRACTICES AND STATUS OF CERTAIN MINERALS IN DAIRY ANIMALS OF NAVSARI DISTRICT OF SOUTH GUJARAT

A
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OF

MASTER OF VETERINARY SCIENCE

IN

ANIMAL NUTRITION

BY

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Place : Anand

Date : 23/ 01/ 2007

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DECLARATION

This is to declare that the whole of the research work reported in this thesis for partial fulfillment of the requirement for the degree of **"MASTER OF VETERINARY SCIENCE"** in **ANIMAL NUTRITION** by the undersigned is the result of investigations done by me under direct guidance and supervision of **Dr. SUBHASH PARNERKR**, Research Scientist and Head, Animal Nutrition Research Station, College of Veterinary Science and Animal Husbandry, Anand Agricultural University, Anand, and that no part of the work has been submitted for any other degree so far.

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C E R T I F I C A T E

This is to certify that the thesis entitled **"ASSESSMENT OF FEEDING PRACTICES AND STATUS OF CERTAIN MINERALS IN DAIRY ANIMALS OF NAVSARI DISTRICT OF SOUTH GUJARAT"** Submitted by **Mr. KATARIYA M.A.** in partial fulfillment of the requirements for the award of the degree of **"MASTER OF VETERINARY SCIENCE" (ANIMAL NUTRITION)** is a record of bonafide research work carried out by him under my guidance and supervision and the thesis has not previously formed the basis for the award of any degree, diploma or other similar title.

SUBHASH PARNERKAR

(MAJOR ADVISOR)

Place: Anand
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ABSTRACT

ASSESSMENT OF FEEDING PRACTICES AND STATUS OF CERTAIN MINERALS IN DAIRY ANIMALS OF NAVSARI DISTRICT OF SOUTH GUJARAT

-: Name of Student: -

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A survey of Navsari district was conducted during February-March 2005 to: i) record feeding practices followed by dairy farmers and collect samples of feeds and fodder, ii) estimate proximate constituents and contents of certain minerals in feeds and fodder in order to assess feeding practices and generate information on mineral status of dairy animals and iii) suggest corrections in the feeding practices within available resources and pronounce appropriate mineral mixtures for supplementing dairy animal diets.

The survey was conducted in five talukas viz. Vansda, Chikhli, Jalalpore, Gandevi and Navsari. Multistage Random Sampling technique was used to select the respondents. Two villages were selected in each taluka,

which were geographically located apart in direction and truly represented the animal husbandry practices of the taluka. In each village, 10 farmers who own cows producing at least 10 kg or more and buffaloes producing at least 8 kg milk per day were selected. The selected farmers were interviewed on the basis of questionnaire developed.

Most of the owners selected keep their animals stall-fed either at home or at farm within a limited area. The quantity of concentrate fed (kg/day) to buffaloes in different talukas ranged between 4.83 and 5.21 and the maximum being 5.21 in Gandevi taluka. The district average was 4.98 kg/day. The same in cows surveyed in different talukas ranged between 4.79 to 6.96 kg/day. The maximum of 6.96 kg/day was recorded in Chikhli taluka. The district average was 6.17 kg/day.

The feeding of green fodders to buffaloes in different talukas ranged between 12.60 and 16.83 kg/day. The district average worked out as 15.42 kg/day. In cows it ranged between 10.92 and 15.68 kg/day. The district average was 13.15 kg/day. The dry roughage feeding ranged between 3.71 and 7.20, and 4.00 and 4.39 kg/day in buffaloes and cows, respectively. The district average

for dry roughages worked out as 5.52 and 4.24 kg/day, respectively for buffaloes and cows.

The average concentrate to roughage ratio in buffaloes of different talukas ranged between 30.94:69.06 and 35.94:64.06. In cows, the concentrate to roughage ratio ranged between 34.96:65.04 and 47.61:52.39. The majority of farmers mixed *Sumuldan* (compound cattle feed) with one grain, one cake or a mixture of grains and cakes and a few of them fed *Sumuldan* alone, at the time of milking.

The dry and green roughages contained Cu below 7.86ppm except hybrid napier (8.98±1.21), lucerne (21.03±2.35), para grass (12.09±0.86), bajra green (8.34±0.06), sudan grass (14.55±0.12) and bajra straw (16.45± 2.45). *Sumuldan* contained 25.30ppm Cu. Most of the green fodders contained reasonable amount of Mn (31.01± 3.11 to 106.66 ± 8.70 ppm), grains 19.87 ± 0.62 to 79.87 ± 0.69, dry roughage contained 35.09±1.66 to 218.18±39.29 and *Sumuldan* contained 195.23±1.40 ppm Mn. Most of the dry roughages contained less Zn (< 24.86 ppm). The Zn content of green roughages ranged between 26.14 and 74.32, of grains 18.65 and 46.27, *Sumuldan* 171.28± 0.73 ppm. Amongst the feeding stuffs, 13.33,

20.00 and 20.0 % of concentrates, 37.50, 25.00 and 12.50 % of the green roughages and 60.0, 60.0 and 20.0 % of the dry roughages had below critical levels of Cu, Zn and Mn, respectively.

The buffaloes produced daily on an average 8.33 to 9.50 kg whole milk and 9.61 to 11.40 kg 6 % FCM. The cows produced 11.20 to 14.33 kg whole milk and 11.37 to 14.55 kg 4 %FCM daily. The average DCP intake of buffaloes in entire Navsari district ranged between 83.80 and 96.27 % of requirement. The buffaloes underfed with respect to DCP were 50.00, 40.00, 66.66, 71.43 and 71.43 % and the cows 0.00, 15.79, 10.53, 15.00 and 15.79 % in Vansda, Chikhli, Jalalpore, Gandevi and Navsari, respectively.

The over all average TDN intakes in the buffaloes in the district ranged between 90.14 to 110.53 % of requirement. The buffaloes with respect to TDN were 0.00, 0.00, 16.66, 0.00 and 42.86 % underfed; 50.00, 60.00, 33.33, 85.71 and 42.86 % moderately underfed and 50.00, 40.00, 50.00, 14.29 and 14.29 % adequately fed in Vansda, Chikhli, Jalalpore, Gandevi and Navsari taluka, respectively. The cows with respect to TDN were 0.0, 15.79, 26.32, 10.0 and 0.0 % underfed; 15.79, 15.79, 5.26, 15.00 and 31.58 % moderately underfed and 0.0,

5.26, 15.79, 5.00 and 5.26 % overfed in Vansda, Chikhli, Jalalpore, Gandevi and Navsari taluka, respectively. Wherever necessary, recommendations have been made for balancing the protein and energy supply of dairy animals.

The over all average Cu intake as % of requirement in the buffaloes in Navsari district was 130.30 percent and in the cows was 138.94. The cows and buffaloes of entire district exhibit adequate levels of Cu intake.

The over all average Mn intake as % of requirement in cows was 300.57 to 370.22 % and the same in the buffaloes in district was 284.24 to 408.89 percent. The cows and buffaloes of entire district exhibit adequate levels of Mn intake.

The over all Zn intakes as % of requirement in cows was 63.11 and 99.04 % and the same in the buffaloes was 66.10 and 82.27 %. The cows and buffaloes of all the talukas and villages showed deficit Zn intake. However, the trend was reverse with respect to Mn. The extent of supplementation (mg/day) required for obviating Zn deficiency in buffaloes and cows is suggested.

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Having expressed these thoughts, I am at once aware that such acknowledgement in no way project either the depth or extent of my gratitude to the few above-mentioned and whole unmentioned helps extenders. To all who deserve such thanks, my apologies for the omissions and the inadequacy for these written words.

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ABBREVIATIONS USED

Ca	:	Calcium
CF	:	Crude Fibre
CP	:	Crude Protein
Cu	:	Copper
d	:	Day
DCP	:	Digestible Crude Protein
DCPI	:	Digestible Crude Protein Intake
DM	:	Dry Matter
DMI	:	Dry Matter Intake
EE	:	Ether Extract
FCM	:	Fat-Corrected Milk
g	:	Gram
HMCM	:	Home Made Concentrate Mixture
kg	:	Kilogram
mg	:	Milligram
Mn	:	Manganese
MY	:	Milk Yield
NFE	:	Nitrogen Free Extract
P	:	Phosphorus
ppm	:	Parts Per Million
SE	:	Standard Error
SNF	:	Solid Not Fat
TDN	:	Total Digestible Nutrients
TDNI	:	Total Digestible Nutrients Intake
Zn	:	Zinc

I. INTRODUCTION

Adequate supply of feeds and fodders is a critical factor affecting performance of animals. There is limited information about the extent of nutrient availability from various feeds and fodders to dairy animals in South Gujarat region. In order that cows and buffaloes with high milk yielding potential, which this country is looking forward to having in large number, produce milk to their inherited capacity, it will be necessary to provide adequate and balanced nutrition. Over feeding, under feeding and imbalanced diets lead to nutritional and reproductive disorders. Therefore, it is essential to conduct survey to make objective assessment of the adequacy of feeding of dairy animals by way of studying existing animal husbandry practices and the plane of nutrition of dairy animals and to suggest necessary modifications in the feeding practices within the available resources and supplement.

Micronutrients, particularly the mineral elements are considered to be inevitable for the normal metabolic and physiological processes of animal systems. The under-supply of minerals in livestock rations is the most common

feature. Especially, marginal deficiencies are expressed as unthriftiness or sub-normal growth, fertility or production that are difficult to diagnose and cause significant economic losses. The deficiency of certain minerals may not affect crops yields but their availability from such forages may be inadequate for requirement of livestock. It is therefore necessary to generate information on mineral status, zone-wise, so as to identify deficiencies or toxicities (Hinders, 1999). Regional mapping of elements in feed and fodder is relatively a rapid, reliable and cost effective method of providing baseline data on the levels of macro and microelements. There is an urgent need to formulate special mineral mixtures for livestock based on these baseline data (Udar *et al.,* 2003; Garg *et al.,* 2002[b]; Das *et al.,* 2003; Gowda *et al.,* 2001; Ramana *et al.,* 2001; Garg *et al.*,2004). There is a need for effective mineral supplementation through specifically tailored, high quality; economically feasible mineral supplements that contain only required minerals for correction of disorders (Garg *et al.,* 2000; Gowda *et al.,* 2001; Ramana *et al.,* 2001; Garg *et al.*,2004).

Keeping the above facts in mind, the current investigation was planned with following objectives:

1. Survey of feeding practices followed by dairy farmers and collection of samples of feeds and fodders used in the Navsari district of South Gujarat.
2. Estimation of proximate constituents and contents of certain minerals in feeds and fodders of the district in order to assess feeding practices and generate information on mineral status of dairy animals.
3. To suggest corrections in the feeding practices followed by dairy farmers in the district within available resources and pronounce appropriate mineral mixtures for supplementing dairy animal diets.

II. REVIEW OF LITERATURE

The literature pertaining to the assessment of feeding practices followed by dairy farmers in different parts of India and also the mineral content of feeds and fodders including mineral status of animals has been reviewed under following headings.

2.1 : Researches on Feeding Practices and Nutritional Status of Dairy Animals in India.

When dairy animals are kept under required management conditions, more than half of the total expense goes for feed; the remainder represents labour, depreciation, interest on fixed capital and other miscellaneous items. The labour and other items are practically the same regardless of the total milk production. Therefore, increasing the level of milk production of a cow or buffalo increases the profit per unit of milk produced. Although high producing cows consume more feed than low producing animals, the increased milk they produce pays more than the additional feed costs. This is because a portion of the total feed input is

required to maintain the cow at her constant body weight regardless of the level of production. Therefore, a farmer should make sure that his dairy animals receive adequate nutrition to enable full exploitation of their producing ability (Pradhan, 1981a). It is imperative to make an objective assessment of the adequacy of feeding of dairy animals by district wise surveys. The salient findings of researches on this aspect in different States of India are presented in this section of review of literature.

2.1.1 : Gujarat State

Pande and Gupta (2001) compiled the information on availability and utilization of livestock feed resources in different agro-climatic zones of Gujarat. Based on rainfall pattern, topography, soil characteristics, climate in general and the cropping pattern the State can be divided into eight agro-climatic zones as under.

- South Gujarat Heavy Rainfall Zone
- South Gujarat Zone
- Middle Gujarat Zone
- North Gujarat Zone
- North West Zone

- North Saurashtra Zone
- South Saurashtra Zone

South Gujarat Heavy Rainfall Zone:

This zone has intensive rainfall of over 1500 mm and up to 2000 mm per annum in the month of July and August. The sub zones I (a) consist of hilly areas of district Dang and Valsad. The sub zone 1 (b) consists of plain areas of Valsad district and four talukas of Surat district. Transplanted rice is a major crop of this area with some beans, wheat, gram, black gram etc. Mango, sapota (*chiku*), banana and vegetables are also grown. Their total annual requirements for concentrates, dry fodder and green fodders will be 3.72, 5.52 and 14.75 lakh tones, respectively. The availability of dry fodder is found to be 9.18 lakh tones, which is quite higher than the requirement. This is because of more cropped area is covered by paddy and sugarcane due to suitable climatic conditions.

The survey conducted in this area suggested that 50-60 % animals were overfed for energy. However, more

numbers of animals were under fed for protein (30-76 %) while only 14-19 % animals were fed adequately for protein and energy (Anon., 1985-86).

South Gujarat Zone:

This is an area of medium rainfall, which varies from 1000 to 15000 mm per annum and comprised of nine talukas each of Surat and Bharuch district. The annual requirements of concentrate, dry fodder and green fodder for cattle and buffaloes of this zone will be 5.79, 15.29 and 22.95 lakh tones, respectively. The availability of dry fodder is around 13.19 lakh tones, which is slightly lower than the quantity of dry fodder required. In this region more than 90 % animal were under fed for protein during summer season. However more number of cows and buffaloes were over fed for energy mostly in all seasons (Anon., 1986-87).

Middle Gujarat Zone:

The Middle Gujarat Zone consists of entire Panchmahal, Kheda and Vadodara district and part of Ahmedabad. The requirement for concentrate, dry fodder and green fodder will be 19.27, 51.36 and 77.07 lakh

tones per year, respectively. The quantity of dry fodder available is around 40.89 lakh tones and is less by 10.50 lakh tones than requirement that is deficit of around 20 %. In this region more number of buffaloes and cows are adequately fed in Ahmedabad district than Vadodara district.

North Gujarat Zone:

This agro-climatic zone consists of semi arid and arid areas with erratic rainfall (500-1014 mm). It consists of Sabarkantha and Gandhinagar districts and three, five and nine talukas of Ahmedabad, Banaskantha and Mehsana districts. The main crops grown are pear millet, sorghum, wheat, cotton, groundnut, sesamum, pigeon pea, castor, isabgul etc. Livestock rearing is an important occupation and the cattle population is higher than human population in this area. The requirement of dry fodder for cattle and buffaloes for one year is 44.01 lakh tones. However, the similar figures for concentrate and green fodders are 16.68 and 66.06 lakh tones, respectively. The dry fodder available in this zone is far less (26.40 lakh tonnes) than its requirement.

North West Zone:

The zone consists of whole of Kutch and parts of Rajkot, Surendranagar, Mehsana and other districts. In this area the principal crops are pearl millet, sorghum, wheat, cotton, groundnut, sesamum, castor and kharif pulses. The requirements for concentrates, dry fodders and green fodders per year will be 8.14, 14.40 and 78.12 lakh tones, respectively. The available quantity of dry fodder for this area is 32.08 lakh tones, which shows deficit of 21.35 %. In this area more number of animals is adequately fed in Kutch district, while these are under fed for protein in Surendranagar district (Anon., 1998-99).

North Saurashtra Zone:

This is the main drought prone area of Gujarat covering districts of Jamnagar and Amreli (7 talukas) and parts of other adjoining districts like Rajkot, Surendranagar and Bhavnagar. Groundnut is the main crop. The requirement of concentrates, dry fodder and green fodder is 5.50, 13.20 and 19.81 lakh tones, respectively. However, the availability of dry fodder in this region is 27.71 lakh tones per annum, which is more than

the double of requirement. In this region larger numbers of animals are adequately fed specifically for energy. However, under feeding of protein is also prevalent to the extent of 28 to 69 % during different seasons and different categories of animals (Anon., 2000).

South Saurashtra Zone:

South Saurashtra Zone consists of Southern Saurashtra comprising whole Junagadh district, three talukas each of Bhavnagar, Amreli and Rajkot districts. The principal crops are groundnut, pearl millet, sorghum, cotton, wheat and sugarcane. The requirement of feeds in terms of concentrate, dry fodder and green fodder is found to be 6.75, 19.51 and 29.29 lakh tones, respectively. The dry fodder is available to the tune of 39.60 lakh tones. In this zone, over feeding of energy during winter and Monsoon is common. Mostly cows and buffaloes were found to be adequately fed for protein in this zone.

Anonymous (1991) conducted a preliminary Animal Nutrition Survey during summer, monsoon and winter seasons in the year 1990-91. Two villages each of five talukas of Mehsana, Kadi, Patan, Kheralu and Vijapur

were selected for survey work. In all 100 buffalo owners were contacted during survey work in each season. Samples of concentrates, green fodder and dry fodder fed were collected. The buffalo owners mainly utilized seeds of *jowar*, *bajri*, barley, wheat and cotton or mixture of it, isabgul, cottonseed cake and *Sabardan* (compound cattle feed). Green fodders such as lucerne, *jowar*, *bajri*, barley, mature castor leaves, green tur leaves and grasses were fed. In monsoon, most of buffalo owners let loose animals for grazing for 4 to 6 hours per day. Dry fodders such as straws of *jowar*, wheat and *bajri* or Kamalpara (*Sorghum bicolor*) are used for feeding to the animals.

It could be inferred (**Table 2.1**) that in Summer season 10, 45 and 44 % buffaloes were under fed, adequately fed or over fed for DCP while 20, 62 and 17 % buffaloes were under fed, adequately fed and overfed for TDN intake, respectively. In Monsoon season, 24, 59 and 17 % buffaloes were underfed, adequately fed and over fed for DCP, while 19, 52 and 28 % buffaloes were under fed, adequately fed and over fed for TDN intake, respectively. In Winter season, 7, 40 and 51 % buffaloes were under fed, adequately fed and overfed for DCP while 35, 50 and

15 % buffaloes were under fed, adequately fed and over fed for TDN intake, respectively.

Looking to the average percentage intake of DCP and TDN by buffaloes in different seasons on an average about 15 % of buffaloes was found under fed for DCP and 20 % were found under fed for energy. It is recommended that high-energy feeds should be fed to the buffaloes for overcoming the energy shortage and co-operative dairy may manufacture the feed accordingly.

Chavda (2003) conducted a survey of Patan district in 2002. Two villages each of five talukas of Siddhpur, Patan, Chanasma, Harij and Sami were selected. The average DCP intake of buffaloes ranged between 96.33 to 104.03 % (**Table 2.2),** and that of cows ranged between 83.76 to 112.57 % of requirement in different talukas in the district (**Table 2.3**). The buffaloes in Patan taluka were found in short supply with respect to DCP (**Table 2.4**), whereas, the same is deficit in cows in Nagwasan villge (**Table 2.5**). The buffaloes of different taluka did not differ significantly. However, the same differed significantly ($p<0.01$) between village within talukas. The

buffaloes underfed with respect to DCP were 6.98, 32.14, 22.58, 23.26 and 31.28 % in Siddhpur Patan Chanasma, Harij and Sami taluka, respectively (**Table 2.6**). There were 27.27 and 77.77 % of cows in village Methan and Nagvasan, respectively found to be underfed (**Table 2.7**).

The over all average TDN intake in Patan district ranged between 102.79 to 127.06 % and that of cows ranged between 100.33 to 131.14 % of requirement. In this respect, the buffaloes of different talukas did not differ significantly. However, the same differed significantly ($p<0.01$) between village within talukas. The buffaloes with respect to TDN were 23.25, 7.14, 3.23, 0.0 and 9.09 % moderately underfed in Siddhpur, Patan, Chanasma, Harij and Sami taluka, respectively. The cows in village Methan and Nagwasan were found underfed to the extent of 27.77%. In the same villages respectively 27.27 and 61.11 % of cows were moderately underfed.

Ghogale (2003) reported that the average DCP intake of buffaloes ranged between 83.99 to 109.21 % (**Table 2.8**), and that of cows ranged between 84.79 to 108.05 % of requirement in different taluka in Sabarkantha district

of Gujarat (**Table 2.9**). The buffaloes of different taluka did not differ significantly. However, the same differed significantly ($p<0.05$) between village within talukas. The buffaloes in Bayad and Modasa were found in short supply with respect to DCP (**Table 2.10**); whereas, the same is deficit in cows in Bayad taluka (**Table 2.11**) taluka. The over all average TDN intake in Sabarkantha district ranged between 100.90 to 113.47 % and in cows ranged between 98.10 to 114.49 % of requirement. In this respect, the buffaloes of different taluka as well as villages within taluka did not differ significantly. The buffaloes underfed with respect to DCP were 42.10, 24.24, 25.00, 50.00 and 22.72% (**Table 2.12**) and cows 24.13, 22.22, 41.17, 48.00 and 30.00% (**Table 2.13**) in Khedbrahma, Idar, Bhiloda, Bayad and Modasa taluka, respectively. The buffaloes with respect to TDN were 5.0, 12.12, 3.57, 5.00 and 0.00% underfed 21.77, 21.21, 46.42, 40.00 and 11.00 % moderately overfed and 5.0, 9.09, 10.71, and 3.00 % overfed in Khedbrahma, Idar, Bhiloda, Bayad and Modasa taluka, respectively. The cows with respect to TDN were 3.00, 0.00, 17.64, 20.00 and 10.00 % underfed; 27.0, 33.33, 58.82, 28.00 and 40.00 % moderately overfed and 10.0, 0.00, 11.76, 0.00 and 20.00 % overfed in

Khedbrahma, Idar, Bhiloda, Bayad and Modasa taluka, respectively.

Parnerkar *et al.* (2006) observed that 73, 66, and 61% of cows and 58, 56 and 40% of buffaloes were undefed with respect to DCP and 12, 52 and 36 % of cows and 18, 38 and 30 % of buffaloes were undefed with respect to TDN in winter, Summer and Monsoon seasons, respectively in Surendranagar district of Gujarat (**Table 2.14**).

2.1.2 : Haryana State

A random survey of the feeding practices followed for milch buffaloes was carried out by Lal *et al.* (1995) in the month of January to March in some of the villages in Hisar district. A total of 23 farmers having 45 milch buffaloes covering about 10 per cent of total buffalo population were selected randomly and interviewed for the study. The data on actual quantity of feeds and fodder offered in a day, approximate body weights, stage of lactation and milk yield per day were collected with the help of a questionnaire. After the data collection buffaloes were grouped into two categories as I and II on the basis of their milk yield. Category I included low to medium

yielding buffaloes (4-8 kg/day), which were kept by farmers mostly for domestic consumption of milk. Buffaloes under category II were high yielding (8-20 kg/day) and were mostly kept by dairy owners/entrepreneurs purely for business.

Data about the quantity of feeds and fodders offered by the farmers was obtained with fair amount of precision with the cooperation of farmers. Dry animals were excluded from the present study because feeding schedule of such animals (especially in category I) could not be ascertained to a satisfactory level, as these animals were let loose for grazing during most of the day. The time spent for grazing was variable. Lesser number of dairy owners could be made available in the present study under category II, but number of animals per owner and average milk yield per animal was higher than the animals in category I. The dry fodder consisted of mainly wheat straw and maize '*Kadbi*'. Green fodder consisted of locally available green grass in category I and berseem in category II. Dairy owners of category II were even purchasing green fodder (berseem) @ Rs. 30-40 per quintal when not produced by them. Feeding of cotton seed cake (CSC) was a common practice and 1/2 to 1 kg wheat flour was also

given to these animals. However, some of the dairy owners maintaining high yielding buffaloes, were more skillful in formulating their ration for feeding of buffaloes and replaced 20-40 % of the CSC with guar/gram/urd churri etc. Replacing CSC with other agro-industrial byproducts definitely brings down the cost of feeds; however, CSC was the main ingredient of choice by all the farmers in this area. '*Sanni*' was the traditional practice being followed for feeding milch buffaloes, which helps in increasing the overall DM intake of animals.

The average estimated level of nutrients supplied to buffaloes in comparison to their calculated requirements is presented in **Table 2.15.**

A survey regarding feeding practices followed by farmers for milch buffaloes was carried out by Lal *et al.* (1998[a]) in the month of July to September 1995 in three villages of Hisar district. A total of 243 farmers having 635 milch buffalo covering about 30% of total buffaloes population in the area surveyed and were interviewed. The data about actual quantity of feed and fodders offered in a day, approximate body weights and actual milk

production level per day were collected with the fair degree precision on a questionnaire. Certain weighments / measurements about feed and milk etc. were made over the period and taken as the range. After the data collection, the buffaloes were grouped into three categories based on their daily milk yield and type of ration that were offered by the farmers. The DM content of feeds and fodders and the plane of nutrition of the buffaloes were estimated. The nutrient requirement of the buffaloes was calculated category-wise for the level of milk production and mean body weights with the help of nutrient requirement table.

The DM intake of individual feed ingredient calculated on bases of mean values and plane of nutrition of these buffaloes calculated in terms of DCP and TDN (**Table 2.16**) revealed that buffaloes were marginally deficient in protein and energy to the extent of 5.5 to 9.3% short in category – II and 0.0 to 6.5 % short in category – III, respectively as compared to standards. The DM intake appears to have been meet in these two categories. Replacing a portion of straw with some energy rich feed ingredients or increasing the level of green and decreasing

the level of straws in ration of these buffaloes in categories – II & III can further improve the supply of nutrient of these buffaloes significantly. The nutrient status of buffaloes in category – I could not be ascertained to a satisfactory level and then was not calculated as these animals were let loose for grazing for most of the day.

Lal *et al.* (1999) evaluated nutritional status of high yielding buffaloes producing more than 20 kg milk/d in Hisar district. The information about the actual quantity of feeds and fodders offered in a day, approximate body weight was calculated by measurement and actual milk production was collected with fair degree of precision on questionnaires in two seasons viz., winter and summer. The plane of nutrition of these buffaloes was estimated on basis of amount of DM of individual feed ingredients consumed and quantities of digestible nutrients they contained taking the standard values form composition tables. The nutrient requirement of buffaloes was calculated (Pathak and Verma, 1993). Finally the estimated supply of nutrients was compared with nutrients required during two seasons. The authors observed that

these high yielding buffaloes met their daily requirements for DM and DCP, while they showed marginal deficiency of energy during winter season (**Table 2.17)**. But that too might have been compensated by excess protein intake. The authors concluded that the feeding practices for high-producing buffaloes were though traditional method but was more scientific.

A survey was conducted by Singh *et al.* (2001) to study the conventional feeding practices and plane of nutrition of milch buffaloes in Hisar district during December 1996 and January 1997. A total of 351 farmers (117 each of the landless, marginal and large medium category) and 344 milch buffaloes were surveyed. The data on actual quantity of feeds/fodders offered daily, approximate body weight; daily milk yield, etc. were precisely recorded on a detailed questionnaire. Buffaloes were grouped into three categories based on their milk yield i.e. up to 5 kg, 5.5 -10 kg and above 10 kg. The plane of nutrition of these buffaloes was estimated with a fair degree of precision on the basis of dry matter consumed and digestible nutrients (DCP and TDN). Requirements of the buffaloes were calculated based on

data on milk production and mean body weights following specifications.

Feeding of milch buffaloes was found adequate in excess of their requirement as calculated form the data on feed intake (**Table 2.18**). Three hundred forty four milch buffaloes included in this study having mean body weight 526.04±4.03 kg and yielding 8.77±0.21 kg milk daily were found to fed 7.4 % and 14.89 % excess TDN and CP, respectively.

The data analyzed for comparison of nutrient requirements and supply on 217 milch buffaloes yielding 5.5-10 kg milk revealed that they were being overfed. However, TDN supply was 6.42 % higher than its requirements. The protein on the other hand was in excess by 13.15 %. The 103 buffaloes yielding more that 10 kg milk per day had an average yield of 12.60±0.16 kg milk. Analysis revealed that TDN supplied was 5.56 % in excess and protein by 15.52 % (**Table 2.18).**

2.1.3 : Uttar Pradesh

Lal *et al.* (1998[b]) randomly selected two hundred fifty farmers (5 from each categories from 5 block of 10 villages of Faizabad district on the basis of land holding capacity i.e. landless farmers, marginal farmers (> 1 ha), small farmers (1 to 2 ha), medium farmers (2 to 3 ha) and large farmers (> 3 ha). The data on availability of feed and fodders and their supply to the animals, collected from selected farmers through personal contact and observation for a period of 1 year were recorded in accordance with three seasons. The quantity of feed and fodders offered to lactating buffaloes during 24 hrs. was recorded by actual weighing. The nutrient supplied to the dairy animals round the year was calculated based on proximate composition and quantity on feed and fodders offered to the buffaloes. Daily Milk production was recorded by attending milking and the body weight of buffaloes was calculated from the body measurement. The supply of nutrients was compared with recommended values. The average supply of DM (kg/d) to the animals was 12.12$\pm$0.25 maximum being in case of small farmers (12.40$\pm$0.24) and in winter (12.84$\pm$0.21). Over all supply of DM to animals on yearly basis averaged 11.57$\pm$0.19,

12.21±0.22, 12.41±0.24, 12.37±0.17 and 12.17 kg/h/d by milch animals of landless, marginal, small, medium and large farmers, respectively (**Table 2.19**). DM consumption varied significantly ($P<0.01$) between seasons, whereas, between categories it varied significantly except in winter season. The authors reported the average DCP supply as 0.58±0.03 kg/h/d with maximum value (0.67±0.03 kg/h/d) in case of medium farmers. Among season, maximum of 0.65±0.02 kg/h/d DCP was supplied in winter season, due to large availability of berseem. All categories of farmers supplied deficient DCP to the animals over requirements. DCP consumption varied significantly between seasons and between categories. The overall average supply of TDN was 6.45±0.16 kg/h/d and maximum (6.77±0.18 kg/h/d) was supplied by medium farmers. Similarly maximum level of TDN was supplied in winter season. All category of farmers supplied deficient TDN to the animal over requirement. The results indicated that the availability of DCP and TDN was less in all the category of dairy farmers, possibly due to poor knowledge of farmers about feeding and less fodder production in the area under study.

Singh *et al.* (1998) studied nutritional status of buffaloes in rural areas of Azamgarh district of Uttar Pradesh. A survey was carried out with 100 farmers in 25 villages having 216 buffalo heads. In each village, the livestock owners were categorized as per their land holding capacity, viz. landless (Group – I), marginal (0.1 to 2 ha, Group – II), small (2.1 to 4 ha, Group – III) and large (above 4 hector, Group – IV). The buffaloes heads were categorized as calves (category – I), non milch (category – II) and milch (category – III). Data were collected by supplying pre-tested questionnaire during visit to individual farmers and also by actual observations for a period of one year from July 1995 to June 1996. The quantity of feed and fodders offered to various groups of buffaloes during 24 hrs. were recorded by actual weighing and then samples were analyzed for proximate principles. Milk production of buffaloes was recorded fortnightly by attending the milking and body weights were calculated from their body measurements. The amount of DM, DCP and TDN available to different categories of buffaloes (**Table 2.20**) were calculated from the records of intake of feed and fodders using average digestibility co-efficient value.

The study revealed surplus supply of DM for all the categories of animal under different land holding groups which ranges between 0.630-1.078, 0.249-1.158 and 0.222-0.813 kg/d for calves, non-milch buffaloes and milch buffaloes, respectively. The DCP available to the calves (0.160-0.185 kg/d) was deficient irrespective of category of farmers. The deficit supply of DCP in non-milch buffaloes ranged from 0.043-0.088 kg/d. In milch buffaloes deficit supply of DCP ranged from 0.102-0.206 kg/d in all land holding groups. The deficit of DCP supply in calves of all land holding groups was due to their poor management practices. While, in non-milch and milch buffaloes DCP supply might be due to the poor scientific concept of feeding livestock by the farmers on one side and availability of resources on the other as well as the tendency to neglect the unproductive animals. The availability of TDN was significantly ($P<0.05$) lower in calves (0.759-1.32 kg/d) and milch buffaloes (0.077-0.370 kg/d) in different categories of farmers, while it was surplus in non-milch buffaloes (0.088-0.619 kg/d). Surplus TDN intake could be due to slightly higher intake of ration by non-milch buffaloes for maintenances as compared to other classes of animals where TDN was

required for maintenance and production. The authors concluded that the availability of DCP and TDN was less (except higher TDN intake in dry buffaloes), while DM was more than requirement in all categories of buffaloes, irrespective of group of farmers.

Singh *et al.* (2003[a]) conducted a study to evaluate the availability of nutrients from prevailing feeds and fodders to dairy animals in Eastern Plain Zone of Uttar Pradesh. Two districts viz., Ghazipur and Varanasi of eastern U.P. plain were selected for the study. Two NES blocks from each district and two randomly choosen villages from each block and twelve families from each village were selected. Four types of farmer families (Land less, small, medium and large farmer) were classified from each village for investigation.

Deficit of dry matter has been observed in all the categories of farmers, except in case of large farmers in Rawatipur block of Ghazipur (+41.98). Deficiency of DM varied from 56.0 to 59.58 in all categories of farmers. Without any exception deficiency was uniformly high in Harahuwa block of Varanasi, whereas, in Chiraigaon block

it was 36.90 % in large farmers and 58.21 % in Karanda block of Ghazipur, deficiency was less in landless and small farmers, whereas, in large farmers it was more. A large farmer of Rewatipur block of Ghazipur district exhibited minor (-0.55 %) deficiency of DM, however, maximum was recorded (-25.98 %) in case of medium farmers.

DCP deficiency was quite substantial in small and medium farmers in both the districts. In case of buffaloes, the deficiency of DCP was uniformly high in all categories of farmers in Karanda block of Ghazipur district followed by Chairaigaon and Harahuwas blocks of Varanasi district. In cows, the deficiency of DCP was highest in Karanda block of Ghazipur (AV. -74.20) followed by Chairaigaon block of Varanasi district (-62.06). In Rewatipur block, medium farmers exhibited positive values (+7.68). The position of Harahuwas block of Varanasi was better than the other three blocks showing -25.85 % an average deficiency of DCP. Within this block, the deficiency was highest in medium farmers, whereas, in small farmers it has positive value of + 10.98 %, in respect of DCP, no definite trend has been observed between the categories of

farmers and block of these districts. TDN consumption in buffaloes and cows of two district, four blocks and different categories of farmers revealed that the position of Rewatipur block was better than the rest of block regarding TDN availability. In case of buffaloes, in small and large farmers the consumption was surplus by about 50 % and the position of large farmers was found better than the small farmers.

2.1.4 : Himachal Pradesh

Sharma and Chander (1968) reported the nutritional status of cattle in the temperate region of Kangra district of Himachal Pradesh. In order to make an objective assessment of the inadequacy of feeding in this area, a survey was conducted during the lean winter months when there is practically no grazing available, taking into consideration only the stall fed animals, the feed supplies of which could be accurately checked. Five randomly selected villages in Palampur Tehsil of Kangra district viz., (i) Mundhi, (ii) Bhadgwar, (iii) Nanaun, (iv) Dhorni, and (v) Holta, situated at elevations from 884 to 1220 meters above sea level and having an average annual rainfall of 2,681 mm., were taken up for this study. In each village,

eight house holds keeping cattle, were randomly selected and the detailed of feeding of all the stall fed animals in these households were noted for a period of 2-3 days. Without causing the least disturbance to the feeding schedule of the animals, each feed offered to the stall-fed animals during the whole day from early morning to late in the night was weighed. No estimate of the residue left by the animals could be had as the residual feed material was trampled in the katchha cattle barns. The milk let down of the milch animals during the observation period was measured.

The estimated quantities of the dry matter and digestible nutrients offered to the different categories of the animals and their actual requirements in accordance with Morrison Standard are given in **Table 2.21**.

The dry matter offered to the animals ranged from 0.97 to 2.11 times the requirement. Except in case of buffaloes, dry or in milk, the total dry matter offered to the animals was much in excess of the requirement. The over abundant supply led the animals to select their feed resulting in wastage of the coarse roughages.

The total quantity of DCP offered to all the categories of animals in their feeds was much less than the required amount. Cow-calves and buffalo-heifers received the lowest amounts, while the bullock, which received the maximum amount in relation to the requirements could at best meet only about three-fourths of the actual requirement, provided the feed offered was consumed in full. But as the dry matter offered was much in excess of the requirement the bullock could hardly meet about 50 per cent of the actual requirement of this nutrient.

The TDN requirement of all the categories of animals was, in general, supplied in excess by feed offered to the animals. However, the conclusion that the animals were over supplied with energy may not be justified, as most of the dry matter was offered in the form of coarse roughages.

The authors observed from the present study that in this region, during the lean periods, the animals kept under stall-feeding conditions were maintained on highly unbalanced feeding schedules. By feeding the animals on a scientific basis, the wastage of the fodder supplied over

the requirement could be avoided. The shortage of DCP in the daily ration schedule required to be made up. This could however, be made good only by mobilizing the locally available resources, as the economic conditions of the farmers do not allow the purchase of concentrated feeds on any large scale.

Sharma and Chander (1971) conducted a survey to evaluate the nutritional status of animals in the Kangara district of Himachal Pradesh. The quantity of feeds offered to the animals of each household on the day of the visit during 24 hours was recorded by actual weighment. The quantity of nutrients offered to the stall-fed animals in their feed was calculated on the basis of data published by Sharma & Gill (1968), Sharma *et al.* (1966), Sharma *et al.* (1967), Chawla & Negi (1968), and Morrison (1956). The production requirements for milch animals were calculated on the assumption that milk from cows and buffaloes contained 3.5 % and 6.5 % fat, respectively. The dry matter requirement for adult cattle and buffaloes was taken at 2.25 % and 2.5 % of live weight respectively (Chawla & Negi, 1968). The calculation of requirement of other nutrients for maintenance or production is based on

the Morrison (1956) standard, which is presented in the **Table 2.22**.

On an average basis, the quantity of dry matter available to the different categories of animals was found to be short of requirements, indicating that the dry matter fed to most of the animals was on the lower side.

The amount of DCP available to the different categories of animals was invariably short of the requirement. The extent of shortage being of the order of 28-42 % in the case of milch animals, 71-76 % in the case of dry cows and buffaloes.

Despite the short supply of dry matter on an overall average basis, the TDN available to the milch animals was generally adequate, being 95-128 % of the requirement.

The authors concluded that the present observations lend support to the finding of the basic irrationality of feeding animals in the region, as described by Gill *et al.* (1970). There is urgent need of culling the uneconomic animals and the upgrading of the productive ones by scientific breeding and feeding them on balanced rations, which in the region may be profitably based on fodder

crops and pastures grown and managed economically, utilizing the modern production techniques.

2.1.5 : Maharastra State

Randhe *et al.* (1993) studied the nutritional status of buffaloes in rural areas of Parbhani district of Maharastra State. Survey was carried out in villages having at least 200 buffalo heads and a co-operative dairy society with daily milk collection of 300 l/d. In each village, the livestock owners were grouped as per their land holding capacity viz. landless (I), land holding up to 2 ha (II), 2-4 ha (III), 4-6 ha (IV), 6-8 ha (V), 8-10 ha (VI) and above 10 ha (VII). The buffalo heads were categorized as growing calves, heifers, dry buffaloes and milch buffaloes. The feeding practices adopted by the farmers under survey included concentrate feeding to milking animals only. Other categories of animals were fed local grasses and straws in addition to 5-6 hrs grazing on waste land.

The data on nutritional status of animals is given in **Tables 2.23 and 2.24**. The dry buffaloes in first four groups had low DM supply, though the deficit was significant ($P<0.05$) for group I and group III only. The remaining groups depicted higher DMI, than recommended

values but the value was significantly (P<0.05) higher in group V only. The DM supply to milch buffaloes was significantly (P<0.05) deficit in all the land holding groups. The highest deficit was in group II.

The availability of DCP to dry buffaloes was in excess (2.74 to 56.01 %) in all the land holding groups with significantly (P<0.05) higher supply in groups V and VII. This could be due to lack of information on mode of feeding of such animals. In milch buffaloes, however, only a marginal deficiency (1.56 to 17.60 %) in DCP availability in all the land holding groups was observed. Among the different groups significantly higher (P<0.05) deficiency of DCP was observed in group III followed by group IV.

The availability of TDN to all categories of buffaloes in all the land holding groups was significantly higher (P<0.05). The surplus range between 113.65 to 160.35 and 28.71 to 38.70 % in dry and milch buffaloes, respectively. The authors concluded that higher level of TDN intake could be attributed to higher proportion of crop residues in the ration. Moreover, the concentrates fed in the form of groundnut cake and cotton seed cake are also rich in TDN content. The overall results of this study indicated that

the availability of DM and DCP was less while TDN was more than required by all the categories of buffaloes, in all the land holding groups essentially because ignorance of farmers about concepts of nutrition and their significance.

Nutrient availability to milch Marathawadi buffaloes in their home tract was studied (Patange *et al.,* 2002) by selecting 15 villages using multistage random sampling technique from three districts viz., Parbhani, Jalna and Beed of Marathwada region. Survey included 160 farmers rearing 210 buffaloes. The buffalo owners were categorized on the basis of land holding as landless (I), below 2 ha land (II-marginal), 2.1-4.0 ha land (III-small), 4.1-6 ha land (IV-medium), 6.1 ha and above land (V-large farmer). Information about the feeding practices followed by farmers for their milch buffaloes was elicited on a pre-tested questionnaire through personal interviews during three seasons viz., monsoon, winter and summer. Average daily milk production of the buffaloes covered in this survey varied from 3.40 kg-4.50 kg in various farmer groups with an average of 4.14 kg.

The overall average of DMI/h/d was 7.61±0.13 kg throughout the year in buffaloes. During various seasons

and also on overall basis DMI raised significantly ($P \leq 0.05$) over category I to V (**Table 2.25**).

The ration of surveyed buffaloes was marginally deficit in DCP and energy to the extent of 10.8 and 5.8 per cent when compared with recommendations. In such cases, the authors suggested that the farmers maintaining low to medium yielding buffaloes need to augment the nutrient supply by providing more of greens, concentrate and dry roughages to support the production potential. Among the different categories, significantly higher ($P \leq 0.05$) deficiency of DCP was observed (**Table 2.26**) in buffaloes reared by medium farmer (33.07 %) followed by small land holding group (13.71 %), which cannot be explained as there was no specific relationship observed between land holding and nutritional status of milch buffaloes. Among seasons, the maximum level of DCP (0.47 ± 0.002 kg/h/d) was supplied in summer.

Authors reported overall supply of TDN as 4.65 ± 0.02 kg/h/d (**Table 2.26)** and maximum (5.35 ± 0.02 kg) was supplied by large land owners. Amongst season, the maximum supply of TDN (5.10 ± 0.09 kg) was in summer

season. The TDN supply of buffaloes by category I to III farmer was significantly ($P \leq 0.05$) short by 8.6 to 23.5 per cent, while it was over and above the recommendations in increased land holding categories.

Authors concluded that the DM supply to the milch Marathawadi buffaloes raised with land holding of the owner. The TDN supply, which was deficient in category I to III and surplus in other groups also indicated definite rising trend with the resource availability of owner, while no such trend is apparent for DCP intake.

2.1.6 : Punjab State

Handa and Gill (1989) randomly selected forty four dairy farmers from the two clusters of the three villages each around Doraha and Jagraon blocks of Ludhiana and categorized on the basis of number of animals and land holding capacity. The data on the availability of feeds and fodders and their supply to the animals collected from the selected farmers through personal contact and observation for a period of one year were recorded in accordance with

the four seasons. The nutrients supplied to dairy animals round the year were calculated after Sen *et al.* (1978).

The overall supply of DM, DCP and TDN to the animal on a yearly basis is given in **Table 2.27**. The averaged DM supply to the animals was 11.102 ± 0.240 kg/h/d although maximum DM (12.696 ± 0.202 kg/h/d) was supplied by category IV farmers. Similarly, average DM supply (11.750 ± 0.415 kg/h/d) was the highest in autumn season.

The overall average DCP supplied was 0.67 ± 0.074 kg/h/d throughout the year. The maximum level (0.818 ± 0.055 kg/h/d) was being fed to animals by Category II farmers. Among four seasons, the maximum level of DCP (0.993 ± 0.083 kg/h/d) was supplied in the spring season. The authors reported that the category I farmer could supply only 89.6 per cent of DCP whereas the farmers of other categories supplied more DCP than required by their animals.

The overall average supply of TDN to the animal throughout the year was 6.465 ± 0.184 kg/h/d and the maximum (7.913 ± 0.164 kg/h/d) was supplied by category IV farmers. Similarly the maximum level of TDN (6.692 ± 0.368 kg/h/d) was supplied in autumn season. The

authors reported that the TDN supply of dairy animals by category I farmers was short by 11.7 per cent, while it was over supplied by other categories of farmers.

2.1.7 : Bihar State

Badal and Dhaka (1998) carried out an analysis of feeding pattern and cost of milk production in Gopalganj district of Bihar. The study was carried out in four village of the district (two each from the two sub-divisions of Gopalganj) selected by multi-stage random sampling. For the purpose of detailed investigation, about 10 % of the total milk producers from each village were selected from three herd-size categories viz. small (1-2 animals), medium (3-4 animals) and large (5 or more animals) on the basis of probability proportion to number of households in each category subject to the condition that minimum three households are selected from each category. This was preceded by a complete enumeration of milk producer households in each village to form the three herd size categories using cumulative cube root method of stratification. The study covered the agricultural year 1992-93. Data for 175 milch animals from 67 sample

households were collected in each of the three seasons (monsoon, winter and summer) through personal interview method.

The local cows were most neglected as indicated by the TDN and DCP intake given in **Table 2.28**. The animals were underfed as compared with the recommended nutritional standards (ICAR, 1985).

2.2 : Recommendations regarding feeding plane/nutritional status of dairy animals in India based on survey of different districts.

Sharma and Chander (1968) reported that during the lean periods, the animals kept under stall-feeding conditions were maintained on highly unbalanced schedules. The DCP intake was 58 and 54 % of the requirement in cows and buffaloes in milk, respectively, however, the TDN supply was 147 and 111 % of requirement for the respective animals. By feeding the animals on a scientific basis, the wastage of the fodder supply over the requirement could be avoided. The shortage of DCP in the daily ration schedule required to be made up. This could however, be made good only by

mobilizing the locally available resources, as the economic conditions of the farmers do not allow the purchase of concentrate feeds on any large scale. The provision of mineral feed supplement, particularly rich in phosphorus content, will further ensure the adequacy of feeding animals in this region.

Sharma and Chander (1971) reported that stall-fed milch animals of Kangra district of Himachal Pradesh were found to be short in DCP to the extent of 28 to 42 percent. The TDN requirement was generally adequate.

Hand and Gill (1989) reported DCP and TDN supply as 89.6 and 88.3 % of requirement in category of farmers keeping up to two lactating animals in Ludhiana district of Punjab. The farmers keeping 5 to 7, 10 to 12 and above 15 lactating animals supplied more DCP (109.9 to 128.3 %) and TDN (115.5 to 134.7 %).

Anonymous (1991) reported that in different seasons on an average about 15 % Mehsani buffaloes were underfed for DCP and 20 % for energy. They recommended that high-energy feeds should be fed to the buffaloes for overcoming the shortage and dairy co-operative may manufacture the feed accordingly.

Randhe *et al.* (1993) reported the availability of DCP was less to the extent of 8.9 % in the milch buffaloes of Parbhani district of Maharashtra State. However, the TDN supply was significantly ($p< 0.05$) surplus by 32.4 percent. This was attributed to the ignorance of farmers about the concepts of nutrition and their significance.

Badal and Dhaka (1998) carried out an analysis of feeding pattern and cost of milk production on Gopalganj district which falls in the North-West Alluvial Plain zone of Bihar. They reported deficiency of TDN supply as 24.16, 11.72 and 39.50 % in buffaloes, crossbred cows and local cows and that of DCP 49.52, 21.91 and 58.72 percent, respectively.

Lal *et al.* (1995) reported that unscientific feeding practices were followed under field conditions and needed balancing of nutrients. DM offered in category I was less by 10-40 per cent resulting in deficiency in the TDN intake of animals. DCP intake by the animals in category I was also in short supply to the extent of 8-50 per cent than the requirement. The authors opined that the farmers maintaining low to medium yielding buffaloes are needed to balance the nutrients supply by adding more inputs in the form of greens, concentrate and dry roughages. Such

vagaries in feeding of animals under village conditions have also been reported elsewhere in the country (Pradhan, 1981b and CLFMA, 1994).

Dairy owners in category II owning high yielders (10-20 kg milk/day) appeared to be more skillful in feeding their buffaloes as compared to buffaloes maintained by farmers under category I (4 to 8 kg milk/d). DM requirement of buffaloes was met fully, CP was marginally deficient and TDN was short by 18-40 per cent in buffaloes of category II. This could be one reason for decline in milk production or body weight loss during early lactation. Meeting the energy requirements of high yielding animals is itself a challenge to Dairymen, which can be met by adding high-energy grains, or some oil to the ration. The availability of nutrients in terms of quality and quantity much depends on knowledge and financial condition of the farmers. The ration of these animals studied above also needs balancing. It was suggested by the authors that farmers as well as dairy owners are following the traditional feeding practice for their milch animals, and there is need to educate the farmers in correct and improved feeding practices, so as to meet the nutritional requirements of animals for optimum production. The

authors opined that change in traditional feeding practices using cheaper concentrate ingredients would not only reduce the cost but also improve the availability of DCP and TDN. Systematic and concerted efforts by scientist and field workers are required to motivate the farmers to follow improved feeding practices.

Lal *et al.* (1998[b]) reported deficient supply of DCP and TDN to Murrah buffaloes kept by different categories of farmers of Faizabad district in U.P. The consumption of DCP and TDN varies significantly ($p < 0.01$) between seasons and categories. The authors opined that these were possibly due to poor knowledge of farmers about feeding and less fodder production in the area under study.

Lal *et al.* (1999) reported for buffaloes of Hisar district marginal deficiency of protein and energy to the extent of 5.5 and 9.3 % in case of small and marginal farmers (5 to 8 kg milk yield/d) and 0.0 and 6.5 % in medium and rich farmers (10 to 14 kg milk yield/d) when compared with standards. The authors suggested that for buffaloes reared by these categories of farmers replacing a portion of straw with some energy rich feed ingredient or increasing the level of green and decreasing the level of

straw in the rations would further improve the supply of nutrients to these animals significantly.

But suggesting for increase in the level of green fodder in the above ration was a bit difficult as discussed with the farmers, because supply of green fodder was very much seasonal. The daily supply of green fodder to the level of 15-25 kg/animal/day was only in the beginning of the '*rabi*' and '*kharif*' seasons, which declined to 5-10 kg/animal/day or even less during the lean months.

Singh *et al.* (2001) while reporting results of survey in Hisar district of Haryana concluded that all the milch buffaloes of the area were being adequately fed in terms of energy and proteins. Overall, there has been an improvement in feeding standards of buffaloes. In 1960 a survey conducted in Hisar (Ahlawat *et al.*, 1960) on feeding status of buffaloes indicated that the animals were underfed and TDN was deficient by even 2.9 kg. Moreover, the milk yield recorded at that time was 2.3 to 5.5 kg that has been increased to 8.8 kg (4-18 kg) in 1996 and instead of underfeeding buffaloes are now being more or less overfed.

Patange *et al.* (2002) reported deficit of DCP in Marathwadi milch buffaloes throughout the year irrespective of category of farmers. The TDN supply was significantly ($p \leq 0.05$) short by 8.6 to 23.45 percent in landless, marginal and small farmers, while it was over and above the recommendations in medium and large farmers.

Singh *et al.* (2003[a]) reported quite substantial deficiency of DCP in cattle (-25.85 to –74.20 %) and buffaloes (-51.58 to –52.77 %) of Ghazipur and Varanasi of eastern U.P. plain. The extent of deficiency was different in different blocks of the district surveyed. The position of TDN supplied was satisfactory and incase of buffaloes in small and large farmers the consumption was surplus by above 50 percent.

2.2 : Indian researches on status of macro and micro-minerals in feeds and fodder.

Mineral deficiency exists widely in livestock (McDowell *et al.*, 1983) and the severity of the deficiency depends upon the type of feed, physiological status of the animals and the agro- climatic condition of the region.

However, toxicity of selenium, molybdenum and fluorine has also been observed due to their excess quantities in feedstuffs (Jackson, 1993; Tiffany *et al.,* 2000). For efficient production and maintenance of normal health in animals, it is necessary to provide essential nutrients in appropriate proportion (Garg *et al.,* 2000). Unlike protein and energy, micronutrients though required in small amounts, play an important role in the reproductive performance and health of animals. With the intensification of cultivation and changes in agricultural practices, the soil fertility is being affected, which in turn affects the uptake of minerals by the plants and animals. As indiscriminate supplementation of minerals through mineral mixture is neither economical nor practical, it will be useful to know the mineral status of feeds and fodders to ascertain the extent of deficiency/ excess (Garg *et al.,* 2002[a]).

Deficiency of certain minerals may not affect crop yields but their availability from such forages may be inadequate for requirements of livestock. It is therefore, necessary to generate information on mineral status, zone wise, so as to identify deficiencies or toxicities. Regional

mapping of elements in feeds and fodders is relatively a rapid reliable and cost effective method of providing base line data on the levels of macro and microelements (Aggett *et al.,* 1988).

The Indian Council of Agricultural Research, New Delhi provided financial support under the Network project on micronutrients to several State Agricultural University and National Institute of Animal Nutrition and Physiology, Bangalore. This section of review of literature deals with the researches on status of minerals of different Indian States.

2.3.1 : Gujarat State

Desai *et al.* (1984) evaluated trace element content in cattle feeds of Panchmahal district. A survey was carried out throughout the district with ut most care taken to select at least one village in most of talukas representing true *adivasi* villages. The samples collected during the survey were analyzed on Atomic Absorption Spectrophotometer, using wet digestion technique. The trace element content of feed and fodder samples collected

during different seasons from Panchmahal district is given in **Table 2.29.** The results indicated that most of the concentrates and roughages were deficient in zinc (less than 40 ppm). However *tandaljo* (156.6 ppm), wheat bran (81.6 ppm), *chil* (92.0 ppm), and cotton ball green (154.4 ppm) had very high Zn content. Concentrates like *chunies, bhardo* and concentrate mixtures were rich in manganese. Copper content in maize, milo, barley, *bhardo, mix bhardo*, polish, *kuski*, bran, hulls, *chhala,* some green grasses, straws and few *gotars* were deficient. Some concentrates and most tree leaves were adequate in copper.

Desai *et al.* (1985) carried out a survey of cattle feeds and feeding practices in Banaskantha district. During the animal nutrition survey, information on feeding practices followed by cattle owners for feeding of their animals together with samples of feeds and fodders were collected in different seasons. The trace element content of feeds and fodder samples collected from Banaskantha district is given **Table 2.30.** Almost all fodder samples were found deficient in Zn (< 40 ppm). Most of the cereal straws and some of the *gotar*s were found deficient in Cu. Green fodders and tree leaves have adequate amount of copper.

Most of the concentrate samples were deficient in zinc except *sheria*, sesame cake and deoiled rice bran. Some of the compounded feeds as well as homemade concentrate mixtures were also found deficient in Zn content. Majority of the concentrates were adequate in Mn and Fe content.

Garg *et al.* (1999) conducted a study to assess the mineral status of feeds and fodders in Mehsana district of Gujarat State, for formulating appropriate mineral mixture for that area. One randomly selected village in taluka of Mehsana district was included in the survey. For collecting the samples of feeds and fodders from within the village, four or five farmers were identified with the help of village dairy co-operative society and Mehsana District Milk Producers' Union. Details regarding total number of livestock, irrigated or non- irrigated land holdings, fodder or other crops grown were recorded. Selection of farmers was based on the location of their agricultural land, so as to cover the soil types in northern, eastern, western and southern sides of the village. Fodder and feed samples fed to the animals were collected and analyzed for Ca, Mg, Cu, Zn, Mn, Fe and Co contents. Fodders were mostly straws and stovers harvested at maturity for removal of grains.

Concentrates were mostly unconventional and wholesome available in the region. Green fodders were grown by some farmers such as lucerne, but grew only in limited areas, and limited quantity was fed usually to milch animals. Other green fodders grown by farmers were green sorghum and green oat. Carrot tops was green subsidiary fodder fed to milch stock.

The mineral status of feeds and fodders in Mehsana district of Gujarat State is given in **Table 2.31.** The Ca content was low in most of the crop residues particularly in straws and stovers (0.28 %). As usual, lucerne green being leguminous was able to pick up Ca from the soil selectively and had about 1.74 % Ca. *Chikodi* also exhibited somewhat similar picture with 1.60 % Ca. Most of the concentrate ingredients being fed to livestock in this region have less than 0.1% Ca, indicating that its supplementation was necessary to make up requirement. Cotton seed cake contained 0.30 % Ca, matching with some other non-leguminous fodder crops. The data further revealed that transfer of Ca from leaves and stems to seeds was quite disproportionate in non-leguminous crops. Surprisingly, carrot tops being fed by some farmers, were

extra ordinarily rich in Ca (1.24%) and this might be favorable to milk production, because of availability of carotene and other micronutrients. It was further evident that Ca percent varied significantly ($p<0.05$; $p<0.01$) between similar samples of certain feeds from different villages, which might be the effect of soil type, geochemically. Such a trend was noticed in *bajri* grain, *bajri* straw, *bajri* husk, sorghum straw and wheat grain. Certain other feeds such as hybrid napier, local grass, lucerne green, oat green and wheat straw did not show significant variations in Ca levels between samples from different villages. If farmers were feeding their own feed mixtures without use of *Sagardan*, Ca intakes were adequate because lucerne green, carrot tops or *chikodi* was one of the ingredient rich in Ca. On the other hand, adequate Ca levels were recorded when *Sagardan* was one of the components of the total ration for milch animals. Those animals not given *Sagardan* or green fodder were mostly deficient in calcium. In case of P, the authors were found values as expected in crop residues (0.12 %) were much less than Ca. The ratio of Ca: P varied from 2:1 to 5:1 in straws of wheat, *bajri*, sorghum and rice. Mean values of P (0.38%) in lucerne green and *chikodi* were quite

substantial but about 4 times less than Ca. Hybrid napier contained P to the extent that it gave a Ca: P ratio of 2:1. In *bajri* and isabgul husks, P values were 0.23 % and were equal to Ca content. Local grass, which was in fact an admixture of a number of plant species, had P about one half to one third of Ca content. Carrot tops showed Ca: P ratio of 5:1. Oat green and sorghum green from various locations had variable P content. Most of the grains studied in this investigation, showed a very different trend of P levels (0.28%), which was more than the Ca levels present in grains. Cotton seed cake contains a level of 0.50 % P which was about double the quantity present in grains. *Sagardan* had about equal quantities of P and Ca. Variations in P content in samples from different villages did not differ in *bajri* grain, cotton seed cake, *chikodi*, isabgul husk, sorghum straw, local grasses, lucerne green and wheat straw. Magnesium level in wheat straw, *bajri* straw, sorghum straw, *bajri* husk rice straw and isabgul husk were similar (0.20 %) to P. However, Mg level (0.30 %) was better in lucerne green, hybrid napier, local grass, chicory, carrot tops, oat green and sorghum green. *Bajri* wheat and maize grains were found to be poor source of Mg (0.13%). Cotton seed cake showed substantial level of

Mg (0.60%), about 1.5 times more than P. *Sagardan* contained a level of 0.53 percent of Mg. Village to village variation in Mg content is observed in some of the ingredients, whereas, it was not so in *bajri* husk, cotton seed cake, *chikodi*, hybrid napier and oat green. It was apparent from the feeding systems in the villages, that the requirement of Mg was being met even without incorporation of *Sagardan* or with or without green fodder.

Distribution of Fe was found to be unique in the sense that it exceeded the requirement in all the feed ingredients, being fed to livestock feed. Even the straw samples were quite rich in Fe (216.4 ppm). Lucerne green, hybrid napier, local grass, sorghum green, carrot tops, *chikodi*, and oat green showed an average of 446 ppm Fe. Grains had around 57.7 ppm, while CSC was exceptionally rich and had Fe 438.2 ppm. Fe incorporation into *Sagardan* was not a requirement instead it contains 806.7 ppm of Fe. Copper unlike Fe, seemed to be low in some of the collected samples. In feeds like wheat straw, sorghum straw *bajri* husk local grasses sorghum green and rice straw, the quantity was found 6.63 ppm. On the other hand lucerne green, *bajri* straw, hybrid napier carrot tops,

chikodi and oat green record levels more than 21.25 ppm. In grains, Cu levels were marginal (8.9 ppm), whereas, cotton seed cake contained 23 ppm Cu and *Sagardan* 36.4 ppm. Copper levels varied considerably from village to village, ingredient wise. However, exceptions were noticed with *bajri* husk, *chikodi*, isabgul husk local grasses and oat green, where variations were non significant. In some of the villages, the ingredients being fed were not adequate in Cu without *Sagardan*. Zinc is one element, which is reported to be most deficient in many geographical zones. As a result, plants do not contain this element in sufficient quantity so as to meet the requirement of livestock. From this surveillance, it was apparent that most of feed ingredients particularly straws and husks were unusually low in Zn content (11.5 ppm). Hybrid napier, local grasses, sorghum green, carrot tops, oat green and *chikodi* were showing somewhat better levels (24.87 ppm). Lucerne green was still better in its levels (35 ppm). It seemed that Zn transfer from plant segment to seeds was quite substantial i. e. about 4 times as apparent from the figures in *bajri* grain, wheat grain and maize grain. Zinc content in samples collected from different villages did not show any difference statistically. Only a

few ingredients such as *bajri* straw, *bajri* grain and CSC showed significant variations from village to village. Evidently, it is clear that Zn is deficient in fodders as well as in concentrates. Even with *Sagardan* feeding (58.27 ppm Zn), its quality remains deficient.

Most of green fodders offered to livestock contained reasonable amount of Mn (106.4 ppm) whereas, straws and stovers (47.3 ppm) were poor source. Carrot tops and *chikodi* were unusually rich and had 145.1 ppm of Mn. It seemed that transfer of Mn from plant segments to seeds is quite low, as grain showed level of 30.6 ppm only, though CSC had somewhat higher level (46.6 ppm). Village to village variations of Mn content in feed samples did not reveal any significant difference in *bajri* grain, *bajri* straw, *chikodi*, local grass Oat grain and wheat straw. Differences were however, observed between samples from different villages in *bajri* husk, CSC, hybrid napier, isabgul husk, sorghum green, sorghum straw, lucerne green and wheat grain.

Garg *et al.* (2002) studied mineral content of feeds and fodders in Junagadh district of Gujarat. A mineral

content of feedstuffs (% of DM) from different villages of Junagadh district is given in **Table 2.32.**

The calcium content in most straws except groundnut (1.78 %) was adequate, but low in P (0.10%). The concentrate ingredients commonly fed to livestock contained only 0.05 percent Ca, whereas, cottonseed and groundnut cakes were exception. Banyan and neem leaves were also good sources of Ca (1.80 %). Village to village variation in Ca content was noticed in cottonseed cake, Groundnut straw, sorghum green and local grasses. Groundnut cake, cottonseed cake and wheat bran provided P in substantial quantities (0.61 %). Local grasses, which was a mixture of number of species, was a good source of Ca, but poor in P. *Bajri* green, sorghum green and hybrid napier were medium in P (0.23 %). Most of the grains studied in this investigation, showed higher P levels (0.29 %) than Ca levels. Village to village variation in P content was noticed in *bajri* straw, sorghum straw, sugarcane tops and wheat bran.

Garg *et al.* (2002) studied the micro- mineral status of feed and fodders of Junagadh district of Gujarat. The

average copper content was consistently low in straws (6.36ppm) and green fodders (5.18ppm), whereas concentrate ingredient were better source of copper (14.36ppm) except grains. Likewise, Zn was acutely deficient in the region (23.0ppm) and needed to be supplied at a level of 80ppm in the total ration. Mn was adequate in most of the feds and fodder in the district (**Table 2.33**).

Chavda (2003) studied the trace mineral status of feed and fodders of Patan district of Gujarat. The trace mineral content of feeds and fodders of Patan district of Gujarat State is given in **Table 2.34.** The dry and green roughage contained Cu below 6.8 and most of the HMCM contained more than 10ppm. Most of the dry roughage were low (<11ppm) in Zn content, while Mn was found adequate in most of the green and dry roughages. The cows showed deficit of Cu in village Methan and Balisana as 0.56 and 23.97 % (**Table 2.35 and 2.36**) respectively and Zn in village Methan, Nagwasan, Balisana and Mujpur as 18.29, 9.78, 24.10 and 47.95 %, respectively. In Buffaloes, the average deficit was 3.69, 26.33, 29.64, 27.28 and 13.01 % for Cu and, 28.46, 40.93, 47.46, 48.17

and 66.82 % for Zn in Siddhpur, Patan, Chanasma, Harij and Sami taluka, respectively (**Table 2.37**).

Garg *et al.* (2003) studied the macro- mineral status of feed and fodders of Kutch district of Gujarat. The macronutrient content of feeds and fodders of Kutch district of Gujarat State is given in **Table 2.38.**

The Ca content was low (0.43 %) in most of the non leguminous than leguminous fodders (1.77 %). However, groundnut straw was exceptionally high in calcium content (2.22 %). The concentrate ingredients commonly fed to livestock contained 0.08 % calcium, with the exception of cottonseed cake and guar grain with higher (0.29 %) concentrations. The data further revealed that the transfer of calcium from leaves and stems to seeds was quite disproportionate in non-leguminous crops. Surprisingly, sweet potato creepers being fed by some farmers were extraordinarily rich in Ca (1.80 %) and this might be favorable to milk production, because of availability of carotene and other micronutrients. The values of P in crop residues (0.16 %) were much less than Ca. The ratio of Ca: P varied from 2.87:1 to 13: 1 in straws of groundnut,

wheat and sorghum. Mean value of P (0.28%) in lucerne green, cowpea green and sweet potato creepers were quite substantial but about 6 times less than Ca. Local grasses and sorghum green contained P to the extent that gave a Ca: P ratio of 1.80: 1. Coconut cake, cottonseed cake and wheat bran provided P in substantial quantities (0.67 %). Most of the grains studied, showed higher P (0.38 %) than the Ca levels.

Ghogale (2003) studied the trace mineral status of feed and fodders of Sabarkantha district of Gujarat. The trace mineral content of feeds and fodders of Sabarkantha district of Gujarat state is given in **Table 2.39**. The dry and green roughages contained Cu below 7.86 except chikory (16.65±2.45) leaves, *Sabardan*, 16.89 and most of the homemade concentrate mixtures contained more than 14ppm. Most of the green fodders contained reasonable amount of Mn (30.03±8.42 and 86.49±28.76 ppm), grains 5.40±0.34 to 9.49±2.29, the homemade concentrate mixtures 47.66 to 57.22 and *Sabardan* contained 71.89±0.21 ppm Mn. Most of the dry roughages contained less Zn (< 24.86 ppm). The Zn content of green roughages ranged between 17.81 and 30.61, of grains 25.56 and

48.61, of homemade concentrate mixtures 42.27 and 46.18 and that of *Sabardan* 107.54±1.84 ppm. Among the feeding stuffs, 37.5, 12.5, and 25.0 % of concentrates, 83.33, 33.33 and 83.33 % of the green roughages and 40.0, 90.0 and 90.0 % of the dry roughages had below critical levels of Cu, Mn and Zn, respectively (**Table 2.40**).

The over all average Cu, Mn and Zn intake as % of requirement in the buffaloes in Sabarkantha district was 75.41, 129.17 and 44.95, respectively (**Table2.41**). In buffaloes and cows the deficit supply of Cu was found in all the villages in the district, except in villages Morad and Phinchod. The cows and buffaloes of all the talukas and villages showed deficit Zn intake. However, the trend was reverse with respect to Mn but for buffaloes in village Ramnagar of Bhiloda taluka with a meager deficit of 0.22 percent (**Table 2.42 and 2.43**).

Garg *et al.* (2004) studied the trace mineral status of feed and fodders of Kutch district of Gujarat. The trace mineral content of feeds and fodders of Kutch district of Gujarat State is given in **Table 2.44.**

2.3.2 : West Bengal

Chaudhary and Gupta (1983) studied the trace element status of naturally available fodders in the hilly tracts of Darjeeling district of West Bengal and values for the same are given in **Table 2.45**. Although, the copper content in various samples ranged between 3.3 and 22.21 ppm, 20 % of tree leaves and 50 % grasses contained less than 10 ppm, which has been suggested as the minimum dietary requirement of cattle (NRC, 1971). Thus the tree leaves in general, were found to be a fairly good source of copper as compared to grasses. The concentration of manganese was found to range from 15.08 to 1423.69 ppm in tree leaves and from 80.42-1281.96 ppm in grasses, shrubs and creepers. Only one sample of tree leaf contained 15.8 ppm of manganese and rest all other samples contained more than 20 ppm. The concentration of zinc ranged from 12.74 to 108.47 ppm in various feeds and fodders. However 52 % of tree leaves and 62 % of grasses contained less than 40 ppm of zinc, which has been suggested to be minimum dietary requirement of cattle (NRC, 1971).

Biswas and Samanta (2002) evaluated mineral status of cattle and goats in relation to feeds and fodders of old alluvial zone of West Bengal. Mineral status of common roughages tree leaves in old alluvial zone of West Bengal is given in **Table 2.46.**

It was found that the guava tree leaves had the highest level of Ca, P, Zn, Cu and Mn where as Ca was highest in mango tree leaves and Fe content was highest in pasture grass. Very low level of Ca, P, Zn, and Cu were found in paddy straw. Among concentrates Ca and P contents were highest in compounded feeds.

Das *et al.* (2002[a]) reported micronutrient status of feeds and fodders of new alluvial zone of West Bengal, to find out the role of feeding practices and farm management system on certain micronutrient status of dairy cattle. The profile of Ca, P, and Zn in these feeds and fodders of new alluvial zone of West Bengal is presented in **Table 2.47.**

The Ca and P were deficient in paddy straw (0.07-0.17 and 0.01-0.07 % respectively). Calcium deficiency

was observed in wheat bran (0.09-0.15 %) and gram *chuni* (0.13-0.24 %). Iron concentration in all the feeds and fodders was far above the normal critical level. Marginal Cu deficiency in hybrid napier (2.7-3.0 ppm) and that of Zn was observed in para grass (20.0-23.0 ppm) and gram *chuni* (12.4-16.8 ppm) Other feeds and fodders were found to be fairly rich in these micronutrients which could fulfill the requirements of the animals within the limits of their intake.

Samanta and Samanta (2002) studied mineral profile of different feeds and fodders and their effect on plasma profile in ruminants of West Bengal. The mineral status of commonly available feeds and fodders and its influence on different categories of cattle and sheep in western and saline zone of West Bengal was studied. The composition of Ca, P, Fe, Cu and Mn in different feed and fodders is given in **Table 2.48.**

It was observed that the concentration of minerals like Ca, Fe, Cu, Mn and Zn were satisfactory in feeds and fodders. However, P content in most of the feeds and fodders was below the critical level. Though, feeds and

fodders contained sufficient amount of calcium but the blood Ca concentration of cattle was inadequate. Though, Mn content in feeds and fodders were adequate but its level was low in the plasma of calves and sheep. Deficient minerals in the plasma may require additional supplementation in the diets. The survey of feeding practices revealed that the cattle and small ruminants were maintained on grazing for 7-8 hrs per day. Feeding of dry roughage like paddy straw is the common practice. Lactating cattle were maintained 5-6 hrs/ day on grazing in addition to paddy straw with some amount of home made concentrate mixtures or compounded concentrate mixture. Supplementation of mineral mixture was rare.

Dandopath *et al.* (2002) studied trace and macro element status of cattle in red laterite zone of West Bengal. A survey was conducted on different physiological stages of cattle in two blocks, viz. Jhargram (block 1) and Sankrail (Block 2). Trace and macro element status of the feedstuffs in red laterite zone of West Bengal is given in **Table 2.49.**

Average Ca and P concentration in all the feed stuffs of both the blocks were above the respective critical levels of 0.3 % and 0.25% established by McDowell (1983), except paddy straw .The average Cu concentration of the paddy straw samples was below the critical concentration of 8.0 ppm as Stated by Mtimuni *et al.* (1990) in spite of fact that soil of the region was not deficient in Cu. Though Cu in the soil was adequate but it was not reflected in the plant samples probably because of the fixation of Cu associated with formation of organometallic complexes with Cu, which causes unavailability of Cu to the plant in rice soils. Moreover, all the feedstuffs analyzed for Zn content of soil in that area. On the contrary, Fe and Mn levels in the feedstuffs were above the critical levels of 50 ppm and 20 ppm, respectively (Mtimuni *et al.,* 1990).

Das *et al.* (2003) have studied micronutrient profile of feeds, fodders and animals in hill zone of Darjeeling district of West Bengal. Paddy straw the main dry roughage source in this zone was low in most of the minerals screened. Napier grasses the most commonly cultivated green fodder, showed moderate content of Ca (0.50 %), Fe (510.89 ppm) Zn (56.05 ppm) Mn (62.99ppm)

and low levels of P (0.20%) and Cu (7.06 %). The commonly available top feeds / tree leaves for animal feeding were ratnaula (*Polyganum polystachym*), titapat (*Artemisia vulgaris*), amlisho (*Thysanolena agortis*), chilaune (*Schima wallichii*), *kans* (*Saccharum sponteneum*), piple (*Bucklandia agortis)*, dhougree (*Leycesteri spp*.) etc. were good source of Cu. The micronutrient status of feeds and fodders / tree leaves in hill zone of West Bengal in given in **Table 2.50.**

The level of Ca (0.59 %), P (0.11 %) and Mn (25.19 ppm) were extremely deficient in paddy straw, however it contained moderate levels of Zn (40.75 ppm) Cu (8.43 ppm) and high levels of Fe (229.50ppm). Amongst the forages, napier was low in Cu (7.06 ppm). However, Ca content in *dhougree* (0.17%), and *ratnaula* (0.18 %) leaves were lower than the critical level (0.3 %). The reason for low to moderate level of Ca might be due to constant leaching of the water soluble minerals like Ca, K and Na and micro minerals (Cu, Fe, Zn and Mn) contents in all the tree levels were above the critical levels except in *kans* and *titapat*, which contained low levels of Zn. The concentrate feed of this zone confined to rice bran, maize

grain and home made compound feed. Maize grain contains low level of all minerals except P and Fe.

2.3.3 : Maharastra State

Udar *et al.* (2003) studied mineral status of soil, feeds and fodders and buffaloes in western agro climatic zone of Vidharbha region of India. The results for feeding stuffs are presented in **Table 2.51.**

The Ca was deficient in cotton seed cake (0.23 %) and cottonseeds (0.18 %). The P deficiency was observed in sorghum straw (0.12 %), *arhar* straw (0.09%), gram straw (0.14 %) and soyabean straw (0.10). The feeds and fodders are rich source of Cu (34.5-40.5 ppm), Mn (32.92-68.03 ppm) and Fe (116.66-203.75 ppm) but deficient in Zn (15.53-27.04ppm). The Ca content of cotton seed cake (0.23-0.42 %) and cottonseeds (0.18-0.25 %) were comparatively lower than that of straws and pasture grasses. The fodders were rich source of iron as compared to concentrate feeds.

2.3.4 : Karnataka State

Ramana *et al.* (2000) studied mineral (Calcium, Phosphorus, Copper, Zinc and Iron) profile of soil, feeds, fodders and blood plasma in southern transition zone of Karnataka. The micronutrient content of feeds and fodders in southern transition zone of Karnataka are given in **Table 2.52.**

Paddy straw, ragi straw and *jowar kadbi* are the major sources of roughage in this region, contained low levels of all minerals screened. Leguminous green fodders contained higher amount of all the minerals as compared to cultivated fodders and local grasses, which were moderate sources of Ca, P, Mg, Zn and Cu. The iron content was very high in all the green fodders. Tree leaves/ top feeds were very good sources of all the minerals tested and comparable to those of leguminous fodders. Amongst the concentrate supplements, oil cake and brans contained 1-2 % P, 0.4-0.7 % Mg, 43-60 ppm Zn and 120-550 ppm Fe. However, they were low in Ca (0.36-0.41 %) and Cu (10-20 ppm). Amongst the unconventional

feeds that are used for cattle feeding, groundnut haulms and horse gram pods were good source of Ca and Mg.

Gowda *et al.* (2001) studied the mineral (Calcium magnesium, copper, zinc and iron) status of soils, feeds fodders and animals in coastal Agri-Eco Zone of Karnataka. Micronutrient content of feeds and fodders in coastal zone of Karnataka are given in **Table 2.53.**

Paddy straw, which is the major roughage source of this zone, contained high silica (10.92-11.15%) and was low in most of the minerals estimated. Cultivated green fodders and local grasses were moderate to good source of Ca, Mg, Cu, Zn and Fe. Tree leaves and top feeds contained higher amounts of Ca (0.8-1.70 %), Zn (82-110 ppm) and Fe (457-668 ppm).

Amongst the tree leaves / top feeds available for animals feeding in these region, leaves of banana, Erythrina (haluvana) and glyricidia (green manure) contained good amount of Ca (0.8-1.7 %), Cu (31-33 ppm), Zn (82-110 ppm) and Fe (1480-2710 ppm) as the tree leaves and leguminous fodders are superior in mineral

uptake than the grasses due to genetic differences. Among the energy supplements, maize, *ragi, jowar* and broken rice grains contained low Ca, P, Mg and Cu. Wheat bran and rice polish contained high P (1.5-2 %) and Fe (457-668 ppm). Most of the protein meals were good sources of P, Zn and Fe. Samples of commercial mineral mixtures available in this zone contained adequate Ca, P, Zn and Fe. Amongst the miscellaneous feeds gram husk contained high Ca (1.4 %), Zn (84 ppm) and Fe (595 ppm).

Ramana *et al.* (2001) studied levels of micronutrients in soil, feed, fodder and animals of north-east transition and dry zones of Karnataka. Micronutrients in soil feed, fodder and animals of north-east transition and dry zones of Karnataka are given in **Table 2.54.**

Paddy straw contained high silica (10.7%) and was low in most of the micronutrients. *Jowar kadbi* was also found to be poor source of Ca, P, Mg and Cu but contained moderate levels of zinc and iron. Cultivated green fodders maize fodder and *jowar* fodder in both the zones were moderate to good source of all micronutrients. However, as very few farmers cultivated them their availability was limited. Several cultivated grasses in north east transition

zone were found to be good source of Ca (0.6-2.00 %), Mg (0.25 %), Cu (30 ppm) and Zn (90 ppm). Most of the cultivated fodders/ grasses and local grasses were found to contain exceptionally high levels of Fe (1000-4000 ppm). The black gram fodder from north east transition zone and the green gram fodder from north dry zone were found to contain high levels of Ca (2-2.06%). Top feed like subabul fodder, glyricidia, neem leaves available in both zones were found to be very good source of Ca, Zn and Fe. The presence of tannins and oxalates in top feeds could limit their use for supplementing minerals but needs to be investigated about their availability. The concentrate feeds in these two zones were limited to rice bran, rice husk and homemade concentrate mixture of *bajri jowar* grain and rice bran. Rice bran contained high levels of P (0.7-1.8%) but grains were poor source of most of the micronutrients except Fe. Grains were especially low in Mg content. The homemade mixtures were moderate sources of some of the minerals. Amongst the miscellaneous feeds, gram husk, groundnut haulms were found to be good source of Zn and Fe. Oilcakes were not commonly fed to the animals in these two zones. Concentrate supplementation being limited to provide brans, husk, broken grain the problems

could have been confounded. Low plane of nutrition could affect the micronutrient utilization of animal.

Gowda *et al.* (2002) conducted a study to assess the mineral status of Ca, P, Mg, Cu, Zn, and Fe of soil, feed/ fodders and blood samples of animals in hilly and central dry zone of Karnataka. Amongst the dry fodders in both zones paddy straw (6-13 %) contained high silica. Ragi straw (2.8-6.2 %), mixed local grasses 2.0-12.7 % and cultivated green fodders (3.0-8.7%) also contained considerable amount of silica, which impair the utilization of Ca, Mg and Zn by forming chelates (Underwood, 1981). Mineral status of feeds and fodders in hilly zone and central dry zone is given in **Table 2.55.**

The dry fodders in both the zones screened were mostly deficient in Ca, P, Cu, and Zn as compared to the critical levels (NRC 1989). Green fodders and local grasses were moderate to good sources of Ca, Mg, Cu and Zn and contain higher levels of Fe (206-2090 ppm). High levels of Fe could be partly be attributable to soil and surface contamination. Certain legume fodders (lablab, cowpea, and soybean) available in central dry zone were good

source of Ca (1.8-2.4 %), Cu (35-63 ppm), Zn (44-284 ppm) and Fe (652-2752 ppm). Similarly, tree leaves like *Erythrina* species; *gliricidia*, neem, mulberry and *subabul* also had higher Ca (2.48 %) followed by Cu, Zn and Fe. Top feeds like banana leaves and sugarcane tops were also moderate to good sources of most of the minerals analyzed. Among the concentrates cereal grains (maize, ragi and broken rice) showed low ash (1.1-3.5 %) compared to byproducts and cakes (4.0-9.7 %) in both the zones. Cakes, brans and rice polish were good sources of P (1-2.95 %). The content of Ca (0.2-0.8 %), Mg (0.02-0.88 %), Cu (2-27 ppm), Zn (31-90 ppm) and Fe (135-3547 ppm) amongst different concentrate feed ingredients varied considerably. Compounded feeds had a varied mineral content and the average values were closer to the required levels. Samples of mineral mixtures obtained in central dry zone had an average Ca and P content of 22.2 and 8.0 %, respectively. Some of the unconventional feeds like gram husk and coffee seed available in hilly zone contained low P and Zn and moderate to adequate levels of Cu and Fe, whereas, the creeper leaves contained higher Ca (1.56%) and Fe (357 ppm). In central dry zone, among the miscellaneous unconventional feed resources sprouted

green gram, horse gram, soybean husk and groundnut haulms contained higher Fe (702-2901 ppm) and Zn (31-213ppm). Groundnut haulms, horse gram pods and horse gram also contained adequate Ca (1.1-1.9 %). The Cu content amongst the different unconventional feed ingredients varied considerably (13.7-95.4 ppm).

2.3.5 : Rajasthan State

Tripathi *et al.* (2002) have evaluated macro and micro-mineral status of grazing livestock on community rangeland of semi-arid Rajasthan. The mineral content of mixed pasture from various regions of semi-arid Rajasthan is given in **Table 2.56.** Micro- mineral content of forage (mg/kg DM) was 27.9, 36.3 and 117.9 mg, respectively, for copper, zinc and manganese. A wide variation in micro-mineral status of forage samples from different locations was observed.

2.3.6 : Uttar Pradesh

Khan *et al.* (1979) evaluated the copper status of soil plants and animals in Tarai area. The copper status of plants in Tarai area of Uttar Pradesh is given in **Table 2.57.**

The copper content of cereal straws varied widely, ranging from 1.13-9.58 (average 4.32) ppm in paddy straw and 1.30-6.69 (average 3.48) ppm in wheat straw. The green non leguminous fodders analyzed were chari, maize, sugarcane tops, oat and pearl millet. Most of these fodders on an average contained Cu in close range of 5.31-6.25 ppm on dry matter basis, further Cu concentration of these fodders was higher than the cereal straws. The range of Cu in berseem was 6.05-21.52 ppm (average 13.75) ppm. The other leguminous fodders surveyed showed similar trend in their Cu make up. Comparison of various fodders with regard to their copper make up showed that leguminous fodders contained highest amount of copper followed by non leguminous fodders and cereal straws.

Bhuvnesh Kumar *et al.* (2002) evaluated trace elements status of animals, feeds, fodder and soil with respect to Cu, Fe, Mn, Zn, and Co in central Himalayas, to find out whether soil, plants, feeds and animals contain adequate levels of trace elements to establish soil – plant - animal relationship. Apparently healthy dairy cattle HF x Sahiwal; 120 maintained at an altitude of 1700 m from mean sea level near Indo -Tibet and Nepal Borders were studied. Green as well as dry fodders fed during the

summer contained low Cu than the suggested level of 10 µg/g to meet dietary level of animals, however, maize fodder fed did not reveal copper deficiency in the hills of medium elevation. Significantly higher Cu in green fodder during winter might be because of significantly higher level of available Cu in soil as recorded in this study. Both dry and green fodders were deficient in Zn as compared to suggested level of 40 µg/g. The deficiency was observed in both seasons but it was more severe in summer fodder crops, which might be because of low levels of available Zn in soil as recorded in study.

2.3.7 : Haryana State

Yadav *et al.* (2002) conducted a survey during *rabi* season (February-March) in order to study the feeding pattern and the mineral status of buffaloes of Panipat district of Haryana State. Animals were mainly stall fed and confined within the limited area. Use of common salt and mineral mixture as supplement was not a common practice among farmers. Berseem was the major green fodder available and was fed liberally with mustard cake to dairy animals besides green oat and *guludana,* the common weed available with wheat crop. The Ca & P

contents in feeds and fodders were within the normal range. Zinc was found to be deficient in feeds and fodders like wheat straw, paddy straw, green oats mustard cake and wheat flour, while these feeds and fodders have more Fe than specified level. Berseem was found to be fairly rich in Cu and Mn but just optimum in case of Zn. The use of common salt and mineral mixture was not common practice except at some organized dairy farms or on recommendation of the veterinary practitioners. Though efforts was made but feed intake data could not be collected precisely as most of the farmers had no account of feeding berseem harvested. The mineral composition of feeds and fodders is given in **Table 2.58.**

The Ca and P contents in feeds and fodders were within the normal range and were found to be sufficient to meet the animals maintenance requirement as per NRC (1989). The concentration of Ca in berseem (1.29 %) was sufficient to meet even the production requirement of Ca. However, it was found that milch animals fed by dry roughages viz. wheat straw (0.38%) gulidanda (0.33%) or oat green (0.64%) along with concentrates even when fed at the observed quantities. Forages are poor in P and did

not supply adequate P to meet its requirement for high milking animals when fed as the sole feed. Moreover, Ca and P requirements are highly dependent on the levels of productivity especially for pregnant first calver that are producing milk and still growing to attain mature body weight. Therefore, strategic supplementation of these minerals is must. Though, feedstuffs contained required quantity of Cu but its interaction of Fe created its deficiency.

Mann *et al.* (2003) studied mineral status of feeds and fodders in Rohtak district of Haryana. The samples were analyzed for Ca, P, Zn, Cu, Mn and Fe contents, which are given in **Table 2.59**.

The Ca and P contents in roughages and concentrates were within the normal range. These feedstuffs could never meet 70-100 % of the requirement of the both Ca and P. The mean values for Zn content in wheat straw, berseem, oat, *phalaris* minor, cottonseed, CSC, wheat and rapeseed meal was 22.6, 23.1, 22.9, 8.6, 42.8, 51.1, 37.9, and 50.3 µg/g DM, respectively. On an average 4.4 to 100% of feed samples had less than 40 µg Zn / g DM. Copper in wheat

straw was 2.3, berseem 7.2, green oats 5.6, cotton seed 12.7 and in cake 14.9, wheat grain 11.1, rapeseed meal 13.8μg/g, DM. About 84-100 % of roughages and 8-28 % of concentrate feedstuffs were deficient in Cu. Iron concentration in all the feeds was found to be much higher than the recommended levels of 50 μg/g. The content of Mn in wheat straw, oats, berseem, cottonseeds, and cotton seed cake, wheat and rapeseed meal was 27.7, 54.5, 49.1, 44.6, 35.0, 33.0 and 29.8 μg/g, respectively. About 50 % of the feed ingredients were found to be deficient in Mn content. The results showed that wheat straw was highly deficient in Zn, Cu and Mn content. Green fodders were deficient in Zn, Cu and Mn to varied extent.

2.3.8 : Punjab

Singh *et al.* (2003[b]) studied trace mineral status of crossbred cattle from sub- mountains belt of Punjab in relation to soil and fodder. The mineral concentration in fodder of sub- mountains belt of Punjab is given in **Table 2.60.** Authors observed marked variation in the mineral content of leguminous and non-leguminous fodder samples, which influenced trace element status of animal during different season.

2.4 : Recommendations of various authors regarding status and supplementation of minerals in different parts of India.

Desai *et al.* (1984) observed that the elements viz. Cu and Zn were deficient at various levels and recommended that Zn and Cu be supplemented in the cattle ration in Panchmahal area of Gujarat State.

Desai *et al.* (1985) suggested that most of the fodders and feeds of Banaskantha district in Gujarat State, were deficient in Zn and there is a need to supplement zinc or zinc rich feeds such as oil cakes, deoiled rice bran or mineral mixture, while using deficient feedstuffs alone. Straw when mixed with *gotar* had better composition than straw alone. Therefore, straw should be fed after mixing with *gotar*.

Garg *et al.* (1999) inferred that milch cows and buffaloes in various talukas of Mehsana district are able to meet their mineral requirements, except Zn and occasionally Cu and Mn, when fed a ration with *Sagardan*

and green fodder. However, animals without green fodder are likely to be deficient in Ca, P, Zn and Mn. Quantity of *Sagardan* per day has an important bearing on the quantity of minerals being received by the animal.

Gowda *et al.* (2001) indicated that supplementing green fodders, top feeds, which are good sources of Cu and Zn, could be a cost effective approach to overcome the deficiency of Cu and Zn in animals of costal zone of Karnataka.. Providing region specific minerals with better availability or organo-mineral complexes could be an alternative approach.

Bhuvnesh Kumar *et al.* (2002) reported that in the areas near Indo-Tibet and Nepal Border, supplementation of animal diet with mineral mixture as per one standard specification might not necessarily fulfill the trace element requirement of herds maintained under different geographical and agro-climatic conditions. Therefore, zonal maps of trace element status of soil may be prepared to find out trace deficiency and subsequently to enrich the soil vis-à-vis animal diet for specific trace element(s) for

sustainable animal husbandry through effective herd health programme.

Garg *et al.* (2002[b]) reported that milch buffaloes yielding 8 kg milk per day in various talukas of Junagadh district are able to meet their mineral requirements, except zinc and copper and occasionally cobalt.

Tripathi *et al.* (2002) concluded that mixed pasture vegetation of community grazing land in semi arid Rajasthan contained adequate potassium, manganese, copper and magnesium, while sodium was below the critical level.

The milch buffaloes need supplementation of 20-30 g of limestone powder during lean period when green grass is not available (Yadav *et al.* 2002). Feeding of about 0.5-1.0 kg of wheat bran or rice bran instead of cakes in berseem based diet would not only reduce the cost of feeding but would also reduce nitrogen stress and chance of phosphorous deficiency. Farmers should also be apprised of feeding common salt. The biased feeding system of animals followed by the farmers has led to Ca

and P imbalances. Therefore, there is scope of manipulating feeding pattern through strategic supplementation within limited resources that the farmers have better animal performance.

Chavda (2003) suggested that the supplementation of mineral mixture in buffalo worked out as 50 and 40 gm in village Methan and Nagwasan of Siddhpur taluka ;61and 81 in villages balisana and Anavada of Patan taluka; 93 and 70 in villages Mithghariyal and Islampur of Chanasma taluka; 65 and 105 in villages Dunavada and Boratvada of Harij taluka; 112 and 125 in villages Mujpur and Rafu of Sami taluka, respectively would meet the requirement of Cu and Zn in Patan district.

Ghogale (2003) suggested that the supplementation of mineral mixture (g/day) in buffalo diets worked out as 77.37 and 85.23 in villages Matoda and Morad of Khedbrahma taluka; 64.10 and 88.04 in villages Phinchod and Kapoda of Idar taluka; 89.43 and 99.36 in villages Rajendranagar and Ramnagar of Bhiloda taluka; 98.71 and 95.77 in villages Demai and Ubharan of Bayad taluka; 95.65 and 92.45 in villages Dugarwada and Medhasan of

Modasa taluka, respectively would meet the Cu and Zn requirement in Sabarkantha district.

The quantity of mineral mixture (g/day) to be supplemented in cow diets worked out as 47.83and 49.33 in villages Matoda and Morad of Khedbrahma taluka and 47.16 in Phinchod in Idar taluka; 53.75 and 53.68 in villages Rajendranagar and Ramnagar of Bhiloda taluka; 63.36 and 65.81 in villages Demai and Ubharan of Bayad taluka; 73.92 and 70.15 in villages Dugarwada and Medhasan of Modasa taluka, respectively.

Udar *et al.* (2003) suggested that supplementation of area based mineral mixture is necessary to meet critical mineral requirement for growth and production of the buffaloes in Akola district of Vidharbh region.

Mann *et al.* (2003) concluded that supplementation of 10-15 mg of Mn, 4-6mg of Cu and 10-20 mg Zn per kg diet would meet the requirement these minerals Rohtak district of Haryana.

III MATERIALS & METHODS

A survey of Navsari district was conducted during February-March 2005 to study the conventional/prevailing feeding practices, plane of nutrition of dairy animals and to work out mineral requirement of animals to formulate area specific mineral mixture for the district. The total area of Navsari district (**Fig. 3.1 and 3.2**) is 2657.56 sq. km., distributed in 5 talukas, having 370 villages. The district lies between 20^0 45'- 21^0 10' N latitude and 72^0 50' – 73^0 30' E longitude in the state of Gujarat. This district is bounded on the North by Surat district, on the East by Dang district, on the South by Valsad district and on the West by the Gulf of Khambat.

The climate of Navsari district is generally humid to sub-humid. The summer season extends from March to June, with daytime temperature reaching to 36^0 C. The monsoon is from July to September. The annual rainfall in the district varies between 1493 to 2197 mm with average rainy days of 76-91. Winter season sets in during October and extends till February. The average minimum and maximum temperature ranges from 14.4-28.6° C to 28.4-

35.7 °C and relative humidity 70 to 92 % during different seasons.

3.1: Soil type, crops grown and livestock population

The soils are hilly, undulating, and shallow to medium in depth in the Eastern part, deep clay in the middle part and alluvium coastal salt affected soil in the Costal area of the district. Around 51% area of the district is under irrigation facility. The main crops grown are paddy, sugarcane, pulses, fruit crops and vegetables.

The livestock population in the district according to 2002 census is as: indigenous milch cattle17078 crossbred milch cattle 30449 and buffaloes 45049 (Anonymous, 2002).

3.2: Sampling procedure

The survey was conducted in five talukas viz. Vansda, Chikhali, Jalalpore, Gandevi, and Navsari. Multistage Random Sampling technique was used to select the respondents. Two villages were selected in each taluka, which were geographically located apart in direction and truly represented the animal husbandry practices of the taluka. In each village, 10 farmers who owned cows producing at least 10 kg or more and buffaloes producing at least 8 kg milk per day were selected. The selected

farmers were interviewed on the basis of questionnaire developed.

Information regarding the amount and types of feeds and fodder being offered to the animals, approximate rate of daily feed intake by individual animal, milk yield and its fat % were collected with the fair degree of precision on a questionnaire from individual farmer, using standard sampling procedure.

3.3: Sample preparation and analytical methods

Samples of green fodder, dry roughage, individual concentrate ingredients, and compound concentrate mixtures (**Plates 3.7 to 3.10**) were collected from all the respondents. The representative samples of feeds/fodder were collected from different farmers and were air dried first and then in a hot air oven at 100 $\pm$ 5 ^{0}C, ground (1 mm) and stored for further analysis. The amount of DM, DCP and TDN available to dairy cows and buffaloes were calculated from the records of intake of feeds and fodder, using digestibility coefficients/nutritive values given by Sen *et al.* (1978), Ranjhan (1991) and ICAR (1998). The average body weight of buffaloes and cows in the district was considered as 450 and 400 kg, respectively. Their requirements for protein and energy (ICAR, 1998), Cu and

Mn (NRC, 2001) and Zn (Arora, 1981) were worked out. The data of milk yield of cows and buffaloes were converted to 4 % FCM (Gaines, 1928) and 6 % FCM (Rice *et al.,* 1970), respectively.

The samples of feeds and fodder were analyzed for proximate constituents by the methods of AOAC (1999). The Ca content was analyzed by the method of Talapatra *et al.* (1940) and the phosphorus content was analyzed colorimetrically by AOAC (1999) method. The contents of Cu, Mn and Zn were analyzed, using Atomic Absorption Spectrophotometer (ECIL, AAS 4141).

IV. RESULTS & DISCUSSION

4.1 : Existing feeding practice in dairy animals of Navsari district.

Most of the dairy animal owners keep the animals stall-fed either at home or at farm within a limited area. They store dry fodder like straws of maize, jowar and paddy. Most of them grow green fodders like jowar, bajari, hybrid napier and lucerne. They also feed local mixed grasses. It was found that the dairy animals are fed roughage two to three times a day.

Among the concentrates, they feed *Sumuldan* (compound cattle feed) manufactured by Surat District Co-operative Milk Producers' Union Limited (Sumul Dairy), maize grain, wheat grain, guar grain, cottonseed cake, etc. This observation is consistence with the reports from Gujarat (Chavda, 2003; Ghogle, 2003; Garg *et al.* 2004), Maharastra (Udar *et al.,* 2003), Haryana State (Mandal *et al.,* 1996; Yadav *et al.,* 1998; Yadav *et al.,* 2002; Maan *et al.,* 2003) and West Bengal (Das *et al.,* 2002; Samanta and Samanta, 2002).

Concentrates were mostly offered twice a day at the time of milking. It also conferred the advantage, in the

event of death of the young calf, when cows/buffaloes were accustomed to let down of milk by offering concentrates, mixed dry/soaked/boiled to a palatable form at the fix time of milking daily.

Most of the farmers reported that availability and animals' appetite were the two criteria taken into account for estimation of roughage requirements of dairy animal. At present majority of the farmers were not following any scientific method of estimation of roughage requirement for their animals. The data on average concentrate and fodder fed to buffaloes and cows (on as such basis) by owners in different talukas surveyed are given in **Tables 4.1** and **4.2**, respectively.

The quantity of concentrate (kg/day) fed to buffaloes in different talukas ranged between 4.83 and 5.21 the maximum being 5.21 in Gandevi taluka. The district average was 4.98 kg/day. The same in cows surveyed in different villages ranged between 4.50 to 7.14 kg/day and in different talukas ranged between 4.79 to 6.96 kg/day. The maximum of 6.96 kg/day was recorded in taluka Chikhli.

The feeding of green fodders to buffaloes in different talukas ranged between 12.60 and 16.83 kg/day. The

district average worked out as 15.42 kg/day. In cows, it ranged between 10.92 and 15.68 kg/day. The district average was 13.15 kg/day. However, the dry roughage feeding to buffaloes ranged between 3.71 and 7.20 kg/day. The district average was 5.52 kg/day. The same in cows surveyed in different villages ranged between 4.00 and 4.39 kg/day. The district average was 4.24 kg/day.

The data on dry matter intake of buffaloes and cows through concentrate and roughages and concentrate to roughage ratio are given in **Tables 4.3** and **4.4**, respectively. The average concentrate to roughage ratio in buffaloes of different talukas ranged between 30.94:69.06 and 35.94:64.06. In cows surveyed the concentrate to roughage ratio ranged between 34.96:65.04 and 47.61:52.39.

The farmers fed the concentrate ingredients separately at the time of milking. These farmers either fed *Sumuldan* alone or a mixture of *Sumuldan* plus one to three kinds of grains/cakes.

It is evident form the above trend that in a bid to balance the supply of nutrients to their animals, the respondents resorted to feeding of several concentrates through separate ingredients. During the study farmers'

response regarding reasons of feeding of combination of concentrates was also elicited. A majority of them felt it necessary for increase recovery of ghee and increase milk yield. The remaining gave variety of reasons viz. increase palatability of feed, animal come in heat regularly, good digestion and availability of nutrients.

The feeding of combination of concentrates was recommended by Lal *et al.* (1995). In an illustration suggested for modification in traditional feeding schedule of buffaloes weighing 500 kg with 10 to 12 kg milk/day with a purpose to not only enhance the nutritional status but also economies feeding. They replaced 5 kg cottonseed cake alone with 7 kg of other cheaper concentrate ingredients costing less than the traditional feed: cottonseed cake, 2 kg; barley/cut wheat/atta, 2 kg; wheat bran/rice polish, 2 kg and guar/gram chuni, 1 kg.

4.2: Chemical composition of feeds and fodder:

The chemical composition of feeds and fodder collected during the survey is given in **Table 4.5**. The data on proximate composition and Ca and P content of the feedstuffs are in agreement with the reports of Anonymous (1983), Desai *et al.* (1984), Desai *et al.* (1985), Garg *et al.*

(1999), Garg *et al.* (2003), Chavda (2003), Ghogle (2003) and Garg *et al.* (2004). However, samples of wheat bran and maize bhardo were found to be adulterated, showing very high crude fibre and silica contents.

4.2.1: Cu content of feedstuffs:

The Cu content seemed to be adequate in most of the feedstuffs collected. The feeds like paddy straw, sugarcane tops dry and mature pasture grass, and green roughage like local mixed grass and sugarcane tops, the quantities were under 7.86 ppm. These findings are in agreement with Garg *et al.* (1999), Chavda (2003) and Ghogle (2003). However, Desai *et al.* (1985) reported slightly higher values of Cu content in these feedstuffs. The grains like maize and wheat contained less than 5.40 ppm Cu. Desai *et al.* (1985) reported much higher values of 8.87 to 12.7 ppm Cu in grains of Banaskantha district. *Sumuldan* contain 25.30 ppm Cu. *Sumuldan*, *Godrejdan, Amuldan* and *Vikasdan* contained 25.30±0.67, 56.35±2.17, 34.44±0.62 and 23.01±0.11 ppm Cu, respectively, which might have been achieved by using mineral mixture as per BIS specifications during manufacture of compound concentrate (IS 1664, 2002).

4.2.2: Mn content of feedstuffs:

Most of the green fodders offered to the animals contained reasonable amount of Mn (31.01± 3.11 and 106.66 ± 8.70 ppm). The values for *jowar* and hybrid napier are in agreement with the report of Chavda (2003) and Ghogale (2003). But, the values for other greens were higher in the present study. The value for Mn content of jowar straws (42.13±11.54) is in agreement with the reports of Desai *et al.* (1984), Ghogale (2003) and Chavda (2003). However, Garg *et al.* (1999) reported much higher values. The Mn content of grains ranged between 19.87 ± 0.62 to 79.87 ± 0.69 ppm. *Sumuldan, Godrejdan*, *Amuldan* and *Vikasdan* contained 195.23±1.40, 127.10±3.09, 155.32±1.66 and 108.65±4.41 ppm Mn, respectively, which is again indicative of the fact that the mineral mixture as per BIS specifications was made use of during manufacture of compound concentrate.

4.2.3: Zn content of feedstuffs:

Zn is one element, which is reported to be most deficient in many geographical zones of the country. As a result, plants do not contain this element in sufficient quantity, so as to meet the requirements. From this study (**Table 4.5**), it was apparent that most of the dry

roughages were low in Zn content. Paddy straw, sugarcane tops, mature pasture grass etc. showed less than 28.06 ppm Zn. This is in agreement with the findings of Garg *et al.* (1999) and Chavda (2003) but higher values of paddy straw were reported by Desai *et al.* (1984) and Ghogale (2003). The Zn content of green roughages ranged between 31.01± 3.11 and 106.66 ± 8.70 ppm. The Zn content of jowar green (36.08±5.49), bajri (39.12±0.40) and lucerne (43.51±4.25) is more than the findings of Desai *et al.* (1984), Chavda (2003) and Garg *et al.* (1999), that of para grass (27.88±0.91) is in agreement with Chavda (2003). The Zn content of grains ranged between 25.56±2.95 and 48.61±8.73 ppm. These values are in agreement with the values reported by Desai *et al.* (1985) and Chavda (2003). *Sumuldan* had 171.28± 0.73 ppm Zn, which might have been achieved by using mineral mixture as per BIS specifications during manufacture of compound concentrate.

The perusal of data on Cu, Mn and Zn content of feedstuffs collected during the survey showed variation when compared with the values obtained in the surveys of feeds and fodders in South Gujarat and other parts of Gujarat. The possible reason for such variations may be

that with the introduction of high yielding crop varieties, intensive crop systems and extensive fertilizer application; the mineral profile in soil, plants or animal feedstuffs are rapidly changing, which in turn affect the mineral status of animals (Miller, 1979; Singh and Sangwan, 1987; Vasudevan, 1987; Underwood and Suttle, 1999).

The list of feedstuffs having below critical level (McDowell, 1985; NRC, 2001) of Cu, Mn and Zn is given in **Table 4.6.** The perusal of data indicates that most of the green and dry roughages contained below critical level of Cu, Mn and Zn with certain exceptions mentioned there in.

The percentage of the feed samples collected during survey and containing Cu, Mn and Zn below critical levels has also been worked out for developing a better understanding on the subject and the data is given in **Table 4.7** and graphically depicted in **fig. 4.1**. The perusal of data brings out the fact that 13.33, 20.00 and 20.00 % of the concentrate samples showed below critical levels of Cu, Mn and Zn, respectively. The green roughage samples showed below critical levels of 37.50, 12.50 and 25.00 % for Cu, Mn and Zn, respectively. The dry roughage samples exhibited below critical levels of Cu, Mn and Zn to the extent of 60.00, 20.00 and 60.00 %, respectively.

4.3: Nutritional Status of Dairy Animals in Surveyed Talukas of Navsari District.

The buffaloes produced daily on an average 8.33 to 9.50 kg whole milk and 9.61 to 11.40 kg 6 % FCM (**Table 4.8**). The average daily milk yield and 6 % FCM yield of buffaloes in taluka like Vansda, Chikhli, Jalalpore, Gandevi and Navsari was 9.25 and 11.11, 8.80 and 10.22, 9.17 and 10.76, 9.43 and 11.10, 8.71 and 10.38 kg, respectively.

The daily milk yield and 4 % FCM yield of cows was ranging from 11.20 to 14.33 and 11.37 to 14.55 kg, respectively. The average daily milk yield and 4 % FCM yield of cows in taluka like Vansda, Chikhli, Jalalpore, Gandevi and Navsari was 12.00 and 12.18, 13.68 and 13.89, 13.68 and 13.89, 12.90 and 13.09, 11.21 and 11.38 kg respectively.

4.3.1: Intake of Nutrients by Dairy Animals.

4.3.1.1: Dry Matter Intake

4.3.1.1.1: Buffalo

The data on DM intake of the buffaloes are given in **Table 4.8** and graphically depicted in **Fig. 4.2 & 4.3**. The

over all average DMI of the buffaloes in Navsari district was 13.67 kg/day. In Vansda taluka, the DMI in villages Chapaldhara and Vandarvela was 14.50 and 14.56 kg/day, respectively and average DMI in taluka was 14.53 kg/day. In taluka Chikhli, the average DMI in villages Kukeri and Sadakpore was 14.22 and 14.18 kg/day, respectively, while average in taluka was 14.20 kg/day. The average DMI in the taluka Jalalpore was 14.06 kg/day with 14.78 and 13.33 kg/day being in villages Sarav and Abrama of the taluka, respectively. In Gandevi taluka the DMI in villages Manekpore and Pathri was 13.50 and 13.43 kg/day, respectively and average DMI in taluka was 13.47 kg/day. In taluka Navsari the average DMI in villages Ashtgam and Kumbharfalia villages was 11.93 and 12.34 kg/day, respectively, while average in taluka was 12.16 kg/day.

Lal *et al.* (1998[b]) reported higher values of 15.75 kg DMI/day by lactating buffaloes yielding 10 to 14 kg milk/day. Similarly, Lal *et al.* (1999) reported DMI of 17.0 kg/day in Murrah buffaloes yielding 16 to 18 kg milk/day and Singh *et al.* (2001) reported 15.33 $\pm$ 0.17 kg DMI/day by Murrah buffaloes yielding 7 to 8 kg milk/day in their native breeding tract. The average DMI of 13.30 and 13.88

kg/day in buffaloes yielding 8 to 10 and 10 to 13 kg milk/day recorded in the entire district is less than the values recorded by these workers but is in agreement with Lal *et al.* (1995) who observed DMI of 14.0±0.5 kg/day in buffaloes yielding 10 to 20 kg milk/day.

4.3.1.1.2 : Cow

The data on DM intake of the cows is given in **Table 4.9** and graphically depicted in **Fig. 4.4**. The overall average DMI of the cows in Navsari district was 12.91 kg/day. In Vansda taluka, the DMI in villages Chapaldhara and Vandarvela was 12.72 and 12.86 kg/day, respectively and average DMI in taluka was 12.78 kg/day. In taluka Chikhli, the average DMI in villages Kukeri and Sadakpore was 13.11 and 13.25 kg/day, respectively and average DMI in taluka was 13.18 kg/day. The average DMI in the taluka Jalalpore was 13.35 kg/day with 13.31 and 13.39 kg/day being in villages Sarav and Abrama of Jalalpore taluka, respectively. In Gandevi taluka, the DMI in villages Manekpore and Pathri was 12.91 and 12.97 kg/day, respectively and average DMI in taluka was 12.94 kg/d. In Navsari taluka, the average DMI in villages Ashtgam and

Kumbharfaliya was 12.40 and 12.19 kg/day respectively, while average in taluka was 12.30 kg/day.

The values recorded in the present investigation are more or less in agreement with the recommended DMI values of the high yielding cows (ICAR, 1998).

4.3.1.2: DCP Intake

4.3.1.2.1 : Buffalo

The data of DCP intake of buffaloes is given in **Table 4.8** and graphically depicted in **Fig. 4.2.** The overall average DCP intake of the buffaloes in Navsari district was 0.79 kg/day. In Vansda taluka, the DCP intake of village Chapaldhara and Vandarvela was 0.89 and 0.81 kg / day, respectively, whereas, average DCP intake of taluka Vansda was 0.85 kg/day. In taluka Chikhli, the DCP intake of village Kukeri and Sadakpore was 0.78 and 0.81 kg/day, respectively and average DCP of taluka Chikhli was 0.79 kg/day. In taluka Jalalpore, DCP intake of villages Sarav and Abrama was 0.77 and 0.78 kg/day respectively, whereas, average DCP intake was 0.77 kg/ day. In taluka Gandevi, the DCP intake of Manekpore and Pathri villages was 0.76 and 0.79 kg/day, respectively, whereas, average DCP intake for that taluka was 0.77

kg/day. In taluka Navsari, the DCP intake of villages Ashtgam and Kumbharfaliya was 0.77 and 0.75 kg/ day, respectively and average DCP of taluka was 0.76 kg/day.

Lal *et al.* (1995) reported 0.975 kg DCP intake against requirement of 1.12 kg DCP/day, by the lactating buffaloes yielding 10 to 20 kg milk/day in Hisar district.

Lal *et al.* (1998[a]) reported 1.282 kg DCP intake/day against requirement of 1.20 kg/day, by lactating buffaloes yielding 10 to 14 kg milk/day.

Lal *et al.* (1999) reported DCPI of 1.25 kg/day in Murrah buffaloes yielding 16 to 18 kg milk/day.

Chavda (2003) reported 1.049 kg DCP intake against requirement of 1.028 kg DCP/day, by the lactating buffaloes in Patan district of North Gujarat.

Ghogale (2003) reported 1.06 kg DCP intake against requirement of 1.05 kg DCP/day, by the lactating buffaloes in Sabarkantha district of North Gujarat.

The average DCPI in Navsari district (0.79 kg/day) was less than the finding of these research workers.

4.3.1.2.2: Cow

The data of DCP intake in cows is given in **Table No.4.9** and graphically depicted in **Fig. 4.4**. The overall

average DCP intake in the cows in Navsari district was 0.87 kg/day. In Vansda taluka, the DCP intake of village Chapaldhara and Vandarvela was 0.82 and 0.84 kg / day, respectively, whereas, average DCP intake of taluka Vansda was 0.83 kg/day. In taluka Chikhli, the DCP intake of villages Kukeri and Sadakpore was 0.92 and 0.90 kg/day, respectively and average DCP of taluka Chikhli was 0.91 kg/day. In Taluka Jalalpore, DCP intake of villages Sarav and Abrama was 0.95 and 1.00 kg/day, respectively, whereas, average DCP intake was 0.98 kg/day. In taluka Gandevi, the DCP intake of villages Manekpore and Pathri was 0.89 and 0.89 kg/day, respectively, whereas, average DCP intake for that taluka was 0.89 kg/day. In taluka Navsari, the DCP intake of villages Ashtgam and Kumbharfaliya was 0.76 and 0.70 kg/ day, respectively and average DCP of taluka was 0.73 kg/day.

The values recorded in the present investigation are more or less in agreement with the recommended DCPI values of the high yielding cows (ICAR, 1998)

Chavda (2003) reported 0.916 kg DCP intake against requirement of 0.836 kg DCP/day, by the lactating cows in Patan district of North Gujarat.

Ghogale (2003) reported 0.96 kg DCP intake against requirement of 0.97 kg DCP/day, by the lactating cows in Sabarkantha district of North Gujarat.

4.3.1.3: TDN Intake

4.3.1.3.1: Buffalo

The data of TDN intake of buffalo are given in **Table No. 4.8** and graphically depicted in **Fig. 4.2**. The overall average TDN intake of the buffaloes in Navsari district was 7.52 kg/day. In Vansda taluka, the TDN intake of villages Chapaldhara and Vandarvela was 8.09 and 7.69 kg / day, respectively, whereas, average TDN intake of taluka Vansda was 7.89 Kg/day. In taluka Chikhli, the TDN intake of villages Kukeri and Sadakpore was 7.48 and 7.53 kg/day, respectively and average TDN of taluka Chikhli was 7.50 kg/day. In taluka Jalalpore, TDN intake of villages Sarav and Abrama was 7.98 and 7.25 kg/day, respectively, whereas, average TDN intake was 7.62 kg/ day. In taluka Gandevi, the TDN intake of villages Manekpore and Pathri was 7.49 and 7.65 kg/day, respectively, whereas, average TDN intake for that taluka was 7.56 kg/day. In taluka Navsari, the TDN intake of

villages Ashtgam and Kumbharfaliya was 7.06 and 6.97 kg/ day respectively and average TDN of taluka was 7.01 kg/day.

Lal *et al.* (1995) reported 7.4 kg TDN intake/day against the requirement of 10.0 kg in buffaloes yielding 10 to 20 kg milk/day. Lal *et al.* (1998[a]) reported 9.81 kg TDN intake against the requirement of 10.50 kg/day by lactating buffaloes yielding 10 to 14 kg milk/day. The average TDN intake (7.52 kg/day) by buffaloes in Navsari district was in agreement with these authors.

Lal *et al.* (1999) reported higher TDN intake of 11.93 kg/day against the calculated requirement of 11.2 kg for buffaloes yielding 16 to 18 kg milk/day.

Chavda (2003) reported higher TDN intake of 10.17 kg against requirement of 8.79 kg TDN/day, by the lactating buffaloes in Patan district of North Gujarat.

Ghogale (2003) reported higher TDN intake of 10.30 kg against requirement of 9.35 kg TDN/day, by the lactating buffaloes in Sabarkantha district of North Gujarat.

4.3.1.3.2: Cow

The data of TDN intake in cows are given in **Table No. 4.9** and graphically depicted in **Fig. 4.4.** The overall average TDN intake in the cows in Navsari district is 7.38 kg/day. In Vansda taluka, the TDN intake of villages Chapaldhara and Vandarvela was 7.47 and 7.27 kg / da,y respectively, whereas, average TDN intake of taluka Vansda was 7.36 kg/day. In taluka Chikhli, the TDN intake of villages Kukeri and Sadakpore was 7.47 and 7.68 kg/day, respectively and average TDN of taluka Chikhli was 7.58 kg/day. In taluka Jalalpore, TDN intake of villages Sarav and Abrama was 7.51 and 7.62 kg/day, respectively, whereas, average TDN intake was 7.56 kg/ day. In taluka Gandevi, the TDN intake of villages Manekpore and Pathri was 7.61 and 7.30 kg/day, respectively, whereas, average TDN intake for that taluka was 7.45 kg/day. In taluka Navsari, the TDN intake of villages Ashtgam and Kumbharfaliya was 6.99 and 6.90 kg/day, respectively and average TDN of taluka was 6.95 kg/day.

The above said values for TDN intake are more or less in agreement with ICAR (1998) values reported for same.

Chavda (2003) reported higher TDN intake of 8.20 kg against requirement of 7.21 kg TDN/day, by the lactating buffaloes in Patan district of North Gujarat.

Ghogale (2003) reported higher TDN intake of 8.36 kg against requirement of 8.03 kg TDN/day, by the lactating buffaloes in Sabarkantha district of North Gujarat.

4.3.2 : Intake of Nutrients by Dairy Animals as % of Requirement.

4.3.2.1 : DCP Intake

4.3.2.1.1 : Buffalo

The data of DCP intake as percent of requirement in buffalo are given in **Table No. 4.8** and graphically depicted in **Fig. 4.3**. The overall average of DCP intake as percent of requirement of the buffaloes in Navsari district was 88.77. In Vansda taluka, the DCP intake as percent of requirement in villages Chapaldhara and Vandarvela was 96.27 and 90.28, respectively, whereas, average DCP intake as percent of requirement of taluka Vansda was 93.62. In taluka Chikhli, the DCP intake as percent of requirement of village Kukeri and Sadakpore was 94.25 and 88.37, respectively and average DCP intake as percent of requirement in taluka Chikhli

was 91.90. In taluka Jalalpore, DCP intake as percent of requirement in villages Sarav and Abrama were 86.06 and 86.50, respectively, whereas, average DCP intake as percent of requirement was 86.28. In taluka Gandevi, the DCP intake as percent of requirement in villages Manekpore and Pathri was 83.80 and 86.24, respectively, whereas, average DCP intake as percent of requirement for that taluka was 84.85. In taluka Navsari, the DCP intake as percent of requirement in villages Ashtgam and Kumbharfaliya was 89.96 and 84.85, respectively and average DCP intake as percent of requirement of taluka was 87.04.

Lal *et al.* (1995) observed the range of percent deviation in supply of DCP as –20 to +20 of the requirement in buffaloes yielding 10 to 20 kg milk/day. Whereas, Lal *et al.* (1998[a]) reported 6.83 % excess DCP intake in lactating buffaloes yielding 10 to 14 kg milk/day. Lal *et al.* (1999) reported excess DCP intake of 49.6 % in buffaloes yielding 16 to 18 kg milk/day.

Other studies aimed for evaluating the nutritional status of dairy animals in India, based on survey of different districts showed variable trends - Most of them showing undersupply of DCP. Sharma and Chander (1968)

reported that during the lean periods, the animals kept under stall-feeding conditions; the DCP intake was 58 and 54 % of the requirement in cows and buffaloes in milk, respectively. Similarly, Sharma and Chander (1971) reported that stall-fed milch animals of Kangra district of Himachal Pradesh were found to be short in DCP to the extent of 28 to 42 percent.

Handa and Gill (1989) reported DCP supply as 89.6 % of requirement in category of farmers keeping up to two lactating animals in Ludhiana district of Punjab. The farmers keeping 5 to 7, 10 to 12 and above 15 lactating animals supplied more DCP (109.9 to 128.3 %). In Gujarat study, Anonymous (1991) inferred that in different seasons on an average about 15 % Mehsani buffaloes were underfed for DCP. Similar trend was observed in Maharashtra wherein Patange *et al.* (2002) reported deficit of DCP in Marathwadi milch buffaloes throughout the year irrespective of category of farmers and Randhe *et al.* (1993) reported less availability of DCP to the extent of 8.9 % in the milch buffaloes of Parbhani district.

In a Bihar study, Badal and Dhaka (1998) reported deficiency of DCP intake as 49.52 % in buffaloes and in U.P.; Singh *et al.* (2003[a]) reported quite substantial

deficiency of DCP in buffaloes (-51.58 to –52.77 %) of Ghazipur and Varanasi district. The extent of deficiency was different in different blocks of the district surveyed.

The average DCP intake in entire Navsari district ranged between 83.80 and 96.27 % of requirement. In majority of villages the farmers supplied less DCP to their buffaloes.

The percentage of buffaloes underfed, moderately underfed, adequately fed, moderately overfed and overfed on a scale of 90 to 125 (intake as % of requirement) was also worked out (**Table 4.12**). The buffaloes underfed with respect to DCP were 50.00, 40.00, 66.66, 71.43 and 71.43 % in Vansda, Chikhli, Jalalpore, Gandevi and Navsari taluka, respectively. In the following section recommendations have been made for making up these deficits and balance the ration of buffaloes in the areas surveyed.

4.3.2.1.2 : Cow

The data of DCP intake as percent of requirement in cows are given in **Table No. 4.9** and graphically depicted in **Fig. 4.5**. The overall average of DCP intake as percent of requirement of the cows in

Navsari district was 105.96. In Vansda taluka, the DCP intake as percent of requirement in villages Chapaldhara and Vandarvela was 103.03 and 104.55, respectively, whereas, average DCP intake as percent of requirement of taluka Vansda was 103.75. In taluka Chikhli, the DCP intake as percent of requirement of villages Kukeri and Sadakpore was 106.80 and 105.25, respectively and average DCP intake as percent of requirement in taluka Chikhli was 105.98. In taluka Jalalpore, DCP intake as percent of requirement in villages Sarav and Abrama were 115.63 and 116.26, respectively, whereas, average DCP intake as percent of requirement was 115.93. In taluka Gandevi, the DCP intake as percent of requirement in villages Manekpore and Pathri was 105.49 and 108.88, respectively, whereas, average DCP intake as percent of requirement for that taluka was 107.19. In taluka Navsari the DCP intake as percent of requirement in villages Ashtgam and Kumbharfaliya was 100.66 and 92.72, respectively and average DCP intake as percent of requirement of taluka was 96.90.

The average DCP intake in entire Navsari district ranged between 92.72 and 116.26 % of requirement. In

majority of villages, the farmers supplied adequate DCP to their cows.

Sharma and Chander (1968) reported that in cows of Kangra district the DCP intake was 58 % of the requirement. Badal and Dhaka (1998) reported deficiency of DCP intake as 21.91 and 58.72 percent in crossbred cows and local cows, respectively. Singh *et al.* (2003[a]) reported quite substantial deficiency of DCP in cattle (-25.85 to –74.20 %) of Ghazipur and Varanasi districts.

The percentage of cows underfed, moderately underfed, adequately fed, moderately overfed and overfed on a scale of 90 to 125 (intake as % of requirement) was worked out (**Table 4.13**), there were 0.00, 15.79, 10.53, 15.00 and 15.79 percent of cows underfed in Vansda, Chikhli, Jalalpore, Gandevi and Navsari taluka respectively.

4.3.2.2 : TDN Intake

4.3.2.2.1 : Buffalo

The data of TDN intake as percent of requirement of buffalo are given in **Table No.4.8** and graphically depicted in **Fig. 4.3**. The overall average TDN intake as percent of requirement of the buffaloes in Navsari district was 96.43.

In Vansda Taluka, the TDN intake as percent of requirement of village Chapaldhara and Vandarvela was 110.53 and 98.25, respectively, whereas, average TDN intake as percent of requirement of taluka Vansda was 99.39. In taluka Chikhli the TDN intake as percent of requirement of villages Kukeri and Sadakpore was 101.79 and 94.95, respectively and average TDN intake as percent of requirement of taluka Chikhli was 98.85. In taluka Jalalpore, TDN intake as percent of requirement of villages Sarav and Abrama was 102.44 and 92.76, respectively, whereas, average TDN intake as percent of requirement was 97.60. In taluka Gandevi, the TDN intake as percent of requirement of villages Manekpore and Pathri was 94.47 and 96.10, respectively, whereas, average TDN intake as percent of requirement for that Taluka was 95.17. In taluka Navsari, the TDN intake as percent of requirement of villages Ashtgam and Manekpore was 93.53 and 90.14, respectively and average TDN of taluka was 91.59.

Earlier studies indicated a surplus supply of TDN to the buffaloes surveyed, which were very low yielders. For example, Sharma and Chander (1968) observed the TDN supply as 111 % of requirement for buffaloes yielding 1.99 kg milk/day in Kangra district of Himachal Pradesh.

Similarly, Sharma and Chander (1971) reported that milch animals of Kangra district were found to consume surplus in TDN: 20.5 % of animals showed 100 to 125 % supply; 20.4 % of animals showed 125 to 150 % supply; 4.6 % of animals showed 150 to 175 % supply; 9.1 % of animals showed 175 to 200 % supply and 2.3 % of animals showed above 200 % supply when compared to the requirement. In later studies however, a few authors reported surplus TDN supply. Randhe *et al.* (1993) reported that the TDN supply was significantly ($p< 0.05$) surplus by 32.4 percent. Lal *et al.* (1999) reported 6.51 % surplus TDN supply against requirement in buffaloes yielding 16 to 18 kg milk/day. Handa and Gill (1989) reported that the farmers keeping 5 to 7, 10 to 12 and above 15 lactating animals supplied surplus TDN (115.5 to 134.7 %) in Ludhiana district of Punjab. In Maharastra, Patange *et al.* (2002) reported that TDN supply was over and above the recommendations in medium and large farmers. In case of Eastern Plane Zone of U.P., Singh *et al.* (2003[a]) reported that in buffaloes of small and large farmers the consumption of TDN was surplus by about 50 percent.

In majority of recent studies with high yielding buffaloes a trend of deficit supply is indicated. Handa and

Gill (1989) reported TDN supply as 88.3 % of requirement in category of farmers keeping up to two lactating animals in Ludhiana district of Punjab. In Gujarat State, Anonymous (1991) reported that in different seasons on an average about 20 % Mehsani buffaloes were underfed for TDN. Lal *et al.* (1995) reported 24 % short supply of TDN in comparison to their calculated requirements to Murrah buffaloes yielding 10 to 20 liters milk/day. Badal and Dhaka (1998) reported deficiency of TDN supply as 24.16% in buffaloes in Gopalganj district of Bihar. Lal *et al.* (1998[a]) reported 6.5 % short supply of TDN in buffaloes yielding 10 to 14 kg milk/day in Hisar district of Haryana. In Maharastra, Patange *et al.* (2002) reported that TDN supply in Marathwadi buffaloes was significantly ($p \leq 0.05$) short by 8.6 to 23.45 percent in landless, marginal and small farmers. Chavda (2003) reported 16.30% over supply of TDN in comparison to the calculated requirements in buffaloes in Patan district of North Gujarat. Ghogle(2003) reported 9.35% over supply of TDN in comparison to the calculated requirements in buffaloes in Sabarkantha district of North Gujarat.

The average TDN intake in entire Navsari district ranged between 90.14 and 110.53 % of requirement. Thus,

the % deficit ranged between -0.61 and -8.41 (**Table 4.10 and Fig. 4.6**) whereas, in cow there was adequate supply of TDN (**Table 4.11 and Fig. 4.7**). The average value TDN intake for entire district worked out as 96.43 % of requirement. In majority of villages, the farmers supplied low TDN to their buffaloes.

The percentage of buffaloes underfed, moderately underfed, adequately fed, moderately overfed and overfed on a scale of 90 to 125 (intake as % of requirement) was also worked out (**Table 4.12**). The buffaloes underfed with respect to TDN were 0.00, 0.00, 16.66, 0.00 and 42.86 % and moderately underfed with respect to TDN were 50.00, 60.00, 33.33, 85.71 and 42.86 % in Vansda, Chikhli, Jalalpore, Gandevi and Navsari taluka, respectively.

In the following section recommendations for making up these deficits/reducing the surplus in order to balance the ration of buffaloes in the areas surveyed, have been made.

4.3.2.2.2 : Cow

The data on TDN intake as % of requirement in the cows are given in **Table 4.9** and graphically depicted in **Fig. 4.5.** The overall average TDN intake as percent of

requirement of the cows in Navsari district was 106.04. In Vansda Taluka, the TDN intake as percent of requirement of villages Chapaldhara and Vandarvela was 109.87 and 106.02, respectively, whereas, average TDN intake as percent of requirement of taluka Vansda was 108.05. In taluka Chikhli, the TDN intake as percent of requirement of village Kukeri and Sadakpore was 102.78 and 106.09, respectively and average TDN intake as percent of requirement of taluka Chikhli was 104.52. In taluka Jalalpore, TDN intake as percent of requirement of villages Sarav and Abrama was 107.10 and 105.02, respectively, whereas, average TDN intake as percent of requirement was 106.12. In taluka Gandevi, the TDN intake as percent of requirement of villages Manekpore and Pathri was 107.13 and 104.28, respectively, whereas, average TDN intake as percent of requirement for that Taluka was 105.71. In taluka Navsari, the TDN intake as percent of requirement of villages Ashtgam and Manekpore was 106.66 and 104.88, respectively and average TDN intake of Taluka was 105.82.

Sharma and Chander (1968) reported that TDN intake was 147 % of the requirement in cows yielding 1.88 kg milk/day. In Gopalganj district of Bihar, Badal and Dhaka

(1998) reported deficiency of TDN supply as 11.72 and 39.50 % in crossbred cows and local cows, respectively.

When the percentage of cows underfed, moderately underfed, adequately fed, moderately overfed and overfed on a scale of 90 to 125 (intake as % of requirement) was worked out (**Table 4.13**), the cows underfed with respect to TDN were 0.00, 15.79, 26.32, 10.00 and 0.00 %, moderately underfed with respect to TDN were 15.79, 15.79, 5.26, 15.00 and 31.58 %, moderately overfed with respect to TDN were 36.84, 31.58, 31.58, 35.00, 15.79 and overfed with respect to TDN were 36.84, 31.58, 31.58, 35.00, 15.79 in Vansda, Chikhli, Jalalpore, Gandevi and Navsari taluka respectively.

On the basis of this study, it can be concluded that majority of all the milch cows of the areas surveyed in the Navsari district were being adequately fed in terms of energy and proteins. The farmers are using their traditional wisdom in feeding their livestock. In general, the surveys of different districts in different States aimed at evaluating nutritional status of dairy animals and high producing dairy animals in particular have shown a trend of deficit supply of DCP and TDN to the dairy animals. But, the overall supply of DCP and TDN to buffaloes was

88.77 and 96.43 %, respectively in comparison to their calculated requirements. The supply of DCP and TDN to cows was 105.96 and 106.04 % as compared to requirements. Overall the situation with regard to energy and protein supply to cows was very good but in buffaloes it was slightly lower than the requirement in Navsari district. The owners of most of the dairy animals included in this study were the members of Valsad District Co-operative Milk Producers Union Limited (Vasudhara dairy).

4.4 : Suggestions for correcting supply of DCP and/or TDN to dairy animals.

The average DCP intakes of buffaloes in entire Navsari district ranged between 83.80 and 96.27 % of requirement. The buffaloes underfed with respect to DCP were 50.00, 40.00, 66.66, 71.43 and 71.43 % in Vansda, Chikhli, Jalalpore, Gandevi and Navsari talukas, respectively. There were 0.00, 15.79, 10.53, 15.00 and 15.79 percent of cows underfed with respect to DCP in Vansda, Chikhli, Jalalpore, Gandevi and Navsari taluka respectively.

The over all average TDN intakes in the buffaloes in the district ranged between 90.14 to 110.53 % of requirement. The buffaloes underfed with respect to TDN were 0.00, 0.00, 16.66, 0.00 and 42.86 % and moderately

underfed with respect to TDN were 50.00, 60.00, 33.33, 85.71 and 42.86 % in Vansda, Chikhli, Jalalpore, Gandevi and Navsari talukas, respectively. The cows underfed with respect to TDN were 0.00, 15.79, 26.32, 10.00 and 0.00 %, moderately underfed with respect to TDN were 15.79, 15.79, 5.26, 15.00 and 31.58 %, moderately overfed with respect to TDN were 36.84, 31.58, 31.58, 35.00, 15.79 and overfed with respect to TDN were 36.84, 31.58, 31.58, 35.00, 15.79 in Vansda, Chikhli, Jalalpore, Gandevi and Navsari taluka respectively. Wherever necessary, recommendations have been made for balancing the protein and energy supply of dairy animals.

In order to balance the energy and protein supply to the dairy animals, based on the results it is recommended that in case of buffaloes, 650 g, 800g, 900g, 1.1kg and 1.2 kg more compound concentrate mixture prepared as per BIS specification should be fed in Vansda, Chikhji, Jalalpore, Gandevi and Navsari talukas, respectively.

In case of cows, in Navsari taluka, 500g more compound concentrate mixture prepared as per BIS specification should be fed.

4.5 : The average estimated levels of Cu, Mn and Zn supplied to buffaloes.

The data on average estimated levels of Cu, Mn and Zn supplied to buffaloes in comparison to their calculated requirements is presented in **Table 4.14.**

4.5.1 : Intake of Minerals by Dairy Animals.

4.5.1.1 : Copper

4.5.1.1.1 : Buffalo

The data on Cu intake (mg/day) of the buffaloes are given in **Table 4.14** and graphically depicted in **Fig. 4.8.** The overall average Cu intake of the buffaloes in Navsari district was 178.58 mg/day. In Vansda Taluka, the Cu intake in villages Chapaldhara and Vandarvela was 278.82 and 181.74 mg/day, respectively and average Cu intake in taluka was 230.28 mg/day. In taluka Chikhli, the average Cu intake in village Kukeri and Sadakpore was 181.48 and 178.45 mg/day, respectively, while average in taluka was 180.27 mg/day. The average Cu intake in the taluka Jalalpore was 170.81 mg/day, with 167.73 and 173.88 mg/day being in villages Sarav and Abrama, respectively. In Gandevi taluka, the Cu intake in village Manekpore and Pathri was 161.08 and 151.87 mg/day, respectively and

average intake in taluka was 157.13 mg/day. In taluka Navsari, the average Cu intake in villages Ashtgam and Kumbharfaliya was 148.50 and 144.84 mg/day, respectively while average Cu intake in taluka was 146.41 mg/day.

Chavda (2003) reported lower Cu intake of 133.99 mg/day against requirement of 169.37 mg/day, by the lactating buffaloes in Patan district of North Gujarat.

Ghogale (2003) reported lower Cu intake of 138.54 mg/day against requirement of 163.74 mg/day, by the lactating buffaloes in Sabarkantha district of North Gujarat.

4.5.1.1.2 : Cow

The data on Cu intake (mg/day) of the cows are given in **Table 4.15** and the same are graphically depicted in **Fig. 4.10.** The overall average Cu intake of the cows in Navsari district was 179.92 mg/day. In Vansda taluka, the Cu intake in village Chapaldhara and Vandarvela was 230.28 and 176.15 mg/day, respectively and average Cu intake in taluka was 204.64 mg/day. In taluka Chikhli, the average Cu intake in village Kukeri and Sadakpore was

197.23 and 176.26, respectively and average Cu intake in taluka was 186.20 mg/day. The average Cu intake in the taluka Jalalpore was 190.80 mg/day, with 193.18 and 188.16 mg/day being in villagse Sarav and Abrama respectively. In Gandevi taluka, the Cu intake in villages Manekpore and Pathri was 174.81 and 172.05 mg/day, respectively and average intake in taluka was 173.43 mg/day. In taluka Navsari, the average Cu intake in villages Ashtgam and Kumbharfaliya was 164.80 and 122.71 mg/day, respectively, while average in taluka was 144.86 mg/day.

4.5.1.2 : Manganese

4.5.1.2.1 : Buffalo

The data on Mn intake (mg/day) of the buffaloes are given in **Table 4.14** and graphically depicted in **Fig. 4.8.** The overall average Mn intake of the buffaloes in Navsari district was 1871.49 mg/day. In Vansda taluka, the Mn intake in village Chapaldhara and Vandarvela was 1931.80 and 2315.94 mg/day, respectively and average Mn intake in taluka was 2123.87 mg/day. In taluka Chikhli, the average Mn intake in the villages Kukeri and Sadakpore was 2183.33 and 2519.09 mg/day. respectively, while

average Mn intake in taluka was 2317.64 mg/day. The average Mn intake in the taluka Jalalpore was 2027.26 mg/day with 2096.22 and 1958.30 mg/day being in village Sarav and Abrama, respectively. In Gandevi taluka. the Mn intake in the village Manekpore and Pathri was 1711.19 and 1484.66 mg/day, respectively and average intake in taluka was 1614.10 mg/day. In taluka Navsari the average Mn intake in village Ashtgam and Kumbharfaliya was 1207.67 and 1523.71 mg/day respectively while average in taluka was 1388.26 mg/day.

4.5.1.2.2 : Cow

The data on Mn intake (mg/day) of the cows are given in **Table 4.15** and graphically depicted in **Fig. 4.10.** The overall average Mn intake of the cows in Navsari district was 1782.48 mg/day. In Vansda taluka, the Mn intake in village Chapaldhara and Vandarvela was 1682.80 and 2086.33 mg/day, respectively and average Mn intake in taluka was 1873.95 mg/day. In taluka Chikhli, the average Mn intake in the villages Kukeri and Sadakpore was 1840.39 and 2043.84 mg/day respectively, while average Mn intake in taluka was 1947.47 mg/day. The

average Mn intake in the taluka Jalalpore was 1972.34 mg/day with 2033.10 and 1904.82 mg/day being in village Sarav and Abrama, respectively. In Gandevi taluka, the Mn intake in the village Manekpore and Pathri was 1275.65 and 1836.66 mg/day, respectively and average Mn intake of taluka was 1556.16 mg/day. In taluka Navsari, the average Mn intake in village Ashtgam and Kumbharfaliya was 1693.65 and 1441.86 mg/day, respectively while average Mn intake in taluka was 1574.38 mg/day.

4.5.1.3 : Zinc

4.5.1.3.1 : Buffalo

The data on Zn intake (mg/day) of the buffaloes is given in **Table 4.14** and graphically depicted in **Fig. 4.8.** The over all average Zn intake of the buffaloes in Navsari district was 828.12 mg/day. In Vansda taluka, the Zn intake in village Chapaldhara and Vandarvela was 916.58 and 890.65 mg/day, respectively and average Zn intake in taluka was 903.62 mg/day. In taluka Chikhli, the average Zn intake in village Kukeri and Sadakpore was 778.46 and 1021.81 mg/day respectively, while average in taluka was 875.80 mg/day. The average Zn intake in the taluka Jalalpore was 920.47 mg/day with 883.41 and 957.54

mg/day being in village Sarav and Abrama respectively. In Gandevi taluka, the Zn intake in village Manekpore and Pathri was 850.89 and 786.84 mg/day, respectively and average Zn intake in taluka was 815.64 mg/day. In taluka Navsari, the average Zn intake in village Ashtgam and Kumbharfaliya was 679.22 and 612.50 mg/day respectively while average Zn in taluka was 641.09 mg/day.

4.5.1.3.2: Cow :

The data on Zn intake (mg/day) of the cows are given in **Table 4.15** and graphically depicted in **Fig. 4.10.** The overall average Zn intake of the cows in Navsari district was 893.32 mg/day. In Vansda taluka, the Zn intake in village Chapaldhara and Vandarvela was 885.62 and 911.72 mg/day, respectively and average Zn intake in taluka was 897.98 mg/day. In taluka Chikhli, the average Zn intake in villages Kukeri and Sadakpore was 841.48 and 1008.34 mg/day respectively, while average Zn intake in taluka was 929.30 mg/day. The average Zn intake in the taluka Jalalpore was 1060.43 mg/day with 1105.21 and 1010.67 mg/day being in village Sarav and Abrama respectively. In Gandevi taluka, the Zn intake in village

Manekpore and Pathri was 919.13 and 983.39 mg/day, respectively and average Zn intake in taluka was 951.26 mg/day. In taluka Navsari, the average Zn intake in village Ashtgam and Kumbharfaliya was 764.84 and 468.74 mg/day, respectively, while average Zn intake in taluka was 624.58 mg/day.

4.5.2 : Intake of Minerals as % of requirement by Dairy Animals.

4.5.2.1 : Copper

4.4.2.1.1 : Buffalo

The data on Cu intake as % of requirement of the buffaloes are given in **Table 4.14** and graphically depicted in **Fig.4.9.** In Vansda taluka, the Cu intake as % of requirement in village Chapaldhara and Vandarvela was 192.16 and 124.70 %, respectively and average Cu intake as % of requirement of taluka was 158.43 percent. In taluka Chikhli, the average Cu intake as % of requirement in village Kukeri and Sadakpore was 128.72 and 125.76 % respectively, and average was 127.53 percent. The average Cu intake as % of requirement in taluka Jalalpore was 122.37 % with 113.41 and 131.32 % being in village Sarav

and Abrama respectively. In Gandevi taluka, the Cu intake as % of requirement in village Manekpore and Pathri was 119.11 and 113.10 %, respectively and average intake as % of requirement in taluka was 116.53 percent. In taluka Navsari, the average Cu intake in village Ashtgam and Kumbharfaliya was 124.54 and 117.81 % respectively while average in taluka was 120.69 percent. The overall average Cu intake as % of requirement in the buffaloes in Navsari district was 130.30 percent.

Desai *et al.* (1984) observed that Cu was deficient at various levels and recommended that Cu be supplemented in the cattle ration in Panchmahal area of Gujarat State.

Garg *et al.* (1999) reported that milch cows and buffaloes in various talukas of Mehsana district are able to meet their mineral requirements, except Zn and occasionally Cu and Mn, when fed a ration with *Sagardan* and green fodder. However, animals without green fodder are likely to be deficient in Ca, P, Zn and Mn. Quantity of *Sagardan* per day has an important bearing on the quantity of minerals being received by the animals.

Garg (2002[b]), Chavda (2003) and Ghogle (2003) observed that Cu was deficient at various levels and recommended that Cu be supplemented in the cattle ration in Junagadh, Patan and Sabarkantha districts of Gujarat, respectively.

4.4.2.1.2: Cow

The data on Cu intake as % of requirement of the cows are given in **Table 4.15** and graphically depicted in **Fig.4.10 & 11** In Vansda taluka, the Cu intake as % of requirement in village Chapaldhara and Vandarvela was 180.62 and 136.94 %, respectively and average Cu intake as % of requirement of taluka was 159.93 percent. In taluka Chikhli, the average Cu intake as % of requirement in village Kukeri and Sadakpore was 149.72 and 132.72 % respectively, and average intake was 140.77 percent. The average Cu intake as % of requirement in the taluka Jalalpore was 142.99 % with 145.17 and 140.58 % being in village Sarav and Abrama respectively. In Gandevi taluka, the Cu intake as % of requirement in village Manekpore and Pathri was 135.38 and 132.50 %, respectively and average intake as % of requirement in taluka was 133.94 percent. In taluka Navsari, the average

Cu intake in villages Ashtgam and Kumbharfaliya was 132.32 and 100.64 % respectively while average in taluka was 117.31 percent. The overall average Cu intake as % of requirement in the buffaloes in Navsari district was 138.94 percent.

The above data with regard to intake of Cu compared to calculated requirement of both the buffaloes and cows indicate that the dairy animals in Navsari district are in adequate supply. Accordingly, Desai *et al.* (1984), Chavda (2003) and Ghogle (2003) observed that Cu was deficient at various levels and recommended that Cu be supplemented in the cattle ration in Panchmahal, Patan and Sabarkantha district of Gujarat State, respectively. Garg *et al.* (1999) observed that milch cows and buffaloes in various talukas of Mehsana district were able to meet their mineral requirements, except occasionally Cu, when fed a ration with *Sagardan* and green fodder. Quantity of *Sagardan* per day has an important bearing on the quantity of Cu being received by the animals.

4.5.2.2 : Manganese

4.5.2.2.1: Buffalo

The data on Mn intake as % of requirement of the buffaloes are given in **Table 4.14.** In Vansda taluka, the Mn intake in villages Chapaldhara and Vandarvela was 333.04 and 397.64 %, respectively and average Mn intake in taluka was 365.34 percent. In taluka Chikhli, the average Mn intake in villages Kukeri and Sadakpore was 385.55 and 443.91 %, respectively, while average in taluka was 408.89 percent. The average Mn intake in the taluka Jalalpore was 359.92 % with 355.20 and 363.83 % being in villages Sarav and Abrama respectively. In Gandevi taluka, the Mn intake in villages Manekpore and Pathri was 317.38 and 277.55 %, respectively and average intake in taluka was 300.31 percent. In taluka Navsari, the average Mn intake in villages Ashtgam and Kumbharfaliya was 248.84 and 310.79 %, respectively, while average in taluka was 284.24 percent.

The overall average Mn intake as % of requirement in the buffaloes in Navsari district was 339.88 percent.

4.5.2.2.2 : Cow

The data on Mn intake as % of requirement of the cows are given in **Table 4.15.** In Vansda taluka, the Mn intake in villages Chapaldhara and Vandarvela was 331.01 and 405.96 %, respectively and average Mn intake in taluka was 366.51 percent. In taluka Chikhli the average Mn intake in villages Kukeri and Sadakpore was 351.47 and 387.09 %, respectively, while average in taluka was 370.22 percent. The average Mn intake in the taluka Jalalpore was 369.34 % with 381.67 and 355.64 % being in villages Sarav and Abrama, respectively. In Gandevi taluka, the Mn intake in villages Manekpore and Pathri was 246.35 and 354.79 %, respectively and average intake in taluka was 300.57 percent. In taluka Navsari, the average Mn intake in villages Ashtgam and Kumbharfaliya was 340.47 and 296.09 %, respectively while average in taluka was 319.45 percent.

The over all average Mn intake as % of requirement in the cows in Navsari district was 344.75 percent.

The above data with regard to intake of Mn compared to calculated requirement of both the buffaloes and cows indicated that the dairy animals in Navsari district get more than adequate supply. Accordingly, Desai *et al.* (1984) observed that Mn was deficient at various levels

and recommended that Mn be supplemented in the cattle ration in Panchmahal area of Gujarat State. Garg *et al.* (1999) observed that milch cows and buffaloes in various talukas of Mehsana district were able to meet their mineral requirements, except occasionally Mn, when fed a ration with *Sagardan* and green fodder. However, animals without green fodder are likely to be deficient in Mn. Quantity of *Sagardan* per day has an important bearing on the quantity of Mn being received by the animals. Chavda (2003) and Ghogle(2003) observed that milch cows and buffaloes were able to meet their Mn requirements in various talukas of Patan and Sabarkantha district, respectively.

4.5.2.3 : Zinc

4.5.2.3.1 : Buffalo

The data on Zn intake as % of requirement of the buffaloes are given in **Table 4.14.** In Vansda taluka, the Zn intake in villages Chapaldhara and Vandarvela was 78.98 and 76.44 %, respectively and average Zn intake in taluka was 77.71 percent. In taluka Chikhli, the average Zn intake in villages Kukeri and Sadakpore was 68.07 and 89.98% respectively, while average intake in taluka was

76.83 percent. The average Zn intake in the taluka Jalalpore was 82.27 % with 74.66 and 89.88 % being in villages Sarav and Abrama respectively. In Gandevi taluka, the Zn intake in villages Manekpore and Pathri was 78.60 and 71.78 %, respectively and average intake in taluka was 75.68 percent. In taluka Navsari, the average Zn intake in villages Ashtgam and Kumbharfaliya was 70.54 and 62.76 % respectively while average in taluka was 66.10 percent.

The over all average Zn intake as % of requirement in the buffaloes in Navsari district was 75.51 percent.

4.5.2.3.1: Cow :

The data on Zn intake as % of requirement of the cows is given in **Table 4.15.** In Vansda taluka, the Zn intake in villages Chapaldhara and Vandarvela was 86.94 and 88.42 %, respectively and average Zn intake in taluka was 87.64 percent. In taluka Chikhli, the average Zn intake in villages Kukeri and Sadakpore was 80.40 and 94.82%, respectively, while average of taluka was 87.99 percent. The average Zn intake in the taluka Jalalpore was 99.04 % with 103.69 and 93.87 % being in villages Sarav and Abrama, respectively. In Gandevi taluka, the Zn

intake in villages Manekpore and Pathri was 88.72 and 94.64 %, respectively and average intake in taluka was 91.68 percent. In taluka Navsari, the average Zn intake in villages Ashtgam and Kumbharfaliya was 76.67 and 48.04 %, respectively, while average in taluka was 63.11 percent.

The overall average Zn intake as % of requirement in the buffaloes in Navsari district was 85.95 percent.

The above data with regard to intake of Zn compared to calculated requirement of both the buffaloes and cows indicated that the dairy animals in Navsari district are in too short supply. Accordingly, Desai *et al.* (1984) observed that Zn was deficient at various levels and recommended that Zn be supplemented in the cattle ration in Panchmahal area of Gujarat State. Desai *et al.* (1985) suggested that most of the fodders and feeds of Banaskantha district in Gujarat State were deficient in Zn and there was a need to supplement zinc or zinc rich fodders such as oil cakes, deoiled rice bran or mineral mixture, while using deficient feedstuffs alone. Straw when mixed with *gotar* had better composition than straw alone. Therefore, straw should be fed after mixing with *gotar*. Garg *et al.* (1999) reported that milch cows and buffaloes in various talukas of Mehsana district were able

to meet their mineral requirements, except Zn, when fed a ration with *Sagardan* and green fodder. However, animals without green fodder are likely to be deficient in Zn. Quantity of *Sagardan* per day has an important bearing on the quantity of Zn being received by the animal. Chavda (2003) and Ghogle (2003) reported that milch cows and buffaloes in various talukas of Patan and Sabarkantha districts, respectively were in too short supply and recommended that Zn be supplemented in the cattle ration in that area of Gujarat State.

In order to develop a better understanding regarding Cu, Mn and Zn availability to dairy animals in the district, the information was derived on percentage **(Tables 4.16 and 4.17)** of deficit (-) /surplus (+) both in buffaloes and cows.

The data on percent deficit (-)/surplus (+) of Cu, Mn and Zn in buffaloes indicate that there was no deficit of Cu and Mn in all the villages and talukas in the district. The percent deficit of Zn in Vansda, Chikhli, Jalalpore, Gandevi and Navsari taluka was 22.29, 23.17, 17.73, 24.32 and 33.90, respectively while average in taluka was 24.49 percent in buffaloes. The cows in all the talukas showed deficit of Zn. Accordingly the deficit in Vansda,

Chikhli, Jalalpore, Gandevi and Navsari taluka was 12.36, 12.01, 0.96, 8.32 and 36.89 %, respectively. The average deficit for the district was 14.05 percent in cows.

The percent deficit (-)/surplus (+) of Cu, Mn and Zn in buffaloes of different talukas of Navsari district is graphically depicted in **Figure 4.12**.

4.5.3. Availability and requirement of minerals in Navsari district

4.5.3.1 Buffaloes

The buffaloes producing 8-10 kg 6%FCM in Navsari district were in adequate supply of Cu (170.18mg/day) and Mn (1839.25mg/day), against daily requirement of Cu (132.96 mg/day) and Mn (531.83mg/day). The buffaloes producing 10-13 kg 6%FCM in Navsari district were also in adequate supply of Cu (183.38 mg/day) and Mn (1889.92mg/day), against daily requirement of Cu (138.81 mg/day) and Mn (555.24mg/day).But, the buffaloes in the district were found deficit in supply of Zn (739.04mg/day) and (879.02mg/day) against daily requirement of Zn (1063.67 mg/day) and (1110.48mg/day), producing 8-10 kg and 10-12 kg 6%FCM, respectively (**Table4.18 and 4.19**).

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4.5.3.2: Cows

The cows producing 10-12 kg 4%FCM in Navsari district are in adequate supply of Cu (166.44mg/day) and Mn (1770.40mg/day), against daily requirement of Cu (126.71 mg/day) and Mn (506.86mg/day). The cows producing 12-16 kg 4%FCM in Navsari district are also in adequate supply of Cu (194.14 mg/day) and Mn (1743.69mg/day), against daily requirement of Cu (130.86 mg/day) and Mn (523.44mg/day).But, the cows in the district are found deficit in supply of Zn (823.56mg/day) and (918.55mg/day) against daily requirement of Zn (1013.71 mg/day) and (1046.88mg/day), producing 10-12 kg and 12-16 kg 4%FCM, respectively (**Table 4.20 and 4.21**).

4.6: Suggested supplementation of Zn to obviate deficiency.

The dairy animals in the district were in short supply of Zn, which needs to be made up.

Since majority of the feedstuffs including most of the green and dry roughages were showing below critical levels (**Table 4.7**) of Zn, approach could be to supply mineral mixture prepared according to latest BIS specifications.

The quantity (g/day) of mineral mixture to be supplemented (**Table 4.22**) in buffalo diets worked out as 35.0 g Vansda taluka; 35.0 g in Chikhli taluka; 25.0 g in Jalalpore taluka; 35.0 g in Gandevi taluka and 45.0 g in Navsari taluka.

The quantity (g/day) of mineral mixture to be supplemented (**Table 4.22**) in cow diets worked out as 15.0, 15.0, 15.0 and 45.0 g in Vansda, Chikhli, Gandevi and Navsari taluka, respectively.

In order to provide required quantity of Zn to dairy animals in villages of Navsari district as above, it is recommended to mix the appropriate quantities of Mineral Mixture as per latest BIS specifications, in the ration of animals on daily basis.

In situations, where some of the feeds in the area are rich in minerals in that animal show short supply, an alternative, cost effective approach is to supplement such feeds in the diets to improve animal productivity. In this regard Desai *et al.* (1985) after survey of the cattle feeds and feeding practices in Banaskantha district (North Gujarat) suggested supplementation of Zn rich feeds such as oil cakes, deoiled rice bran etc. while using deficient feedstuffs alone. Straw mixed with *gotar* has better micro-

mineral composition than straw alone. Similarly Gowda *et al.* (2001) suggested feeding of green fodders and top feeds which were very good source of Zn, in costal zone of Karnataka for obviating mineral deficiency. Gowda *et al.* (2002) for central dry zones of Karnataka recommended strategic supplementation of green fodders, legumes, tree leaves/top feeds in addition to concentrate ingredients like cakes and brans could overcome the deficiency of minerals and could be cost effective. Further, they suggested the use of local feed resources like groundnut haulms; horse gram pods and gram husk could be advantageous in supplementing some of the minerals.

V. SUMMARY AND CONCLUSIONS

Conventional feeding practices followed by the farmers are based on available homegrown concentrates/compound feed and available green and dry fodders. Over feeding, under feeding and imbalanced diets lead to nutritional and reproductive disorders. Therefore, it is essential to conduct survey to find out the plane of nutrition and to advocate standard feeding practices within the available resources and supplement.

The under-supply of minerals in livestock rations is the most common feature. Especially, marginal deficiencies are expressed as unthriftiness or sub-normal growth, fertility or production that are difficult to diagnose and cause significant economic losses. The deficiency of certain minerals may not affect crops yields but their availability from such forages may be inadequate for requirement of livestock. It is therefore necessary to generate information on mineral status, zone-wise, so as to identify deficiencies or toxicities. Regional mapping of elements in feed and fodder is relatively a rapid, reliable and cost effective method of providing baseline data on the levels of macro and microelements. There is an urgent

need to formulate special mineral mixtures for livestock based on these baseline data. There is a need for effective mineral supplementation through specifically tailored, high quality, economically feasible mineral supplements that contain only required minerals for correction of disorders.

A survey of Navsari district was conducted during February-March 2005 to: i) record feeding practices followed by dairy farmers and samples of feeds and fodder, ii) estimate proximate constituents and contents of certain minerals in feeds and fodder in order to assess feeding practices and generate information on mineral status of dairy animals and iii) suggest corrections in the feeding practices within available resources and pronounce appropriate mineral mixtures for supplementing dairy animal diets.

The survey was conducted in five talukas viz. Vansda, Chikhli, Jalalpore, Gandevi and Navsari. Multistage Random Sampling technique was used to select the respondents. Two villages were selected in each taluka, which were geographically located apart in direction and truly represented the animal husbandry practices of the taluka.

In each village, 10 farmers who owned cows producing at least 10 kg or more and buffaloes at least 8 kg milk per day were selected. The selected farmers were interviewed on the basis of questionnaire developed.

Most of the dairy animal owners keep the animals stall-fed either at home or at farm within a limited area. They store dry fodder like straws of maize, *jowar, bajari*, paddy and groundnut haulms. Most of them grow *jowar*, hybrid napier and lucerne. They also feed local mixed grass and sugarcane tops. It was found that the dairy animals were fed roughage two times a day.

Amongst the concentrate they feed *Sumuldan* (compound cattle feed) manufactured by Surat District Co-operative Milk Producer Limited (Sumul Dairy), maize, wheat, guar, tur chuni etc. The use of common salt and mineral mixture supplementation was not a common practice.

The quantity of concentrate fed (kg/day) to buffaloes in different talukas ranged between 4.83 and 5.21 and the maximum being 5.21 in Gandevi taluka. The district average was 4.98 kg/day. The same in cows surveyed in different talukas ranged between 4.79 to 6.96 kg/day. The

maximum of 6.96 kg/day was recorded in taluka Chikhli. The district average was 6.17 kg/day.

A majority of farmers mix *Sumuldan* (compound cattle feed) with one grain, one cake or a mixture of grains and cakes and some of them fed *Sumuldan* alone, at the time of milking. The farmers' response regarding reasons of feeding of combination of concentrates was also elicited. A majority of them felt it necessary for increase recovery of ghee and increase milk yield. The remaining gave variety of reasons viz. increase palatability of feed, animal come in heat regularly, good digestion and availability.

The proximate composition and the content of Ca and P were within the normal range. However, samples of wheat bran and maize bharda were found to be adulterated, showing very high crude fiber and silica contents.

The buffaloes surveyed produced daily on an average 8.33 to 9.50 kg whole milk and 9.61 to 11.40 kg 6 % FCM. The cows surveyed produced 11.20 to 14.33 kg whole milk and 11.37 to 14.55 kg 4 %FCM daily. The percentage of buffaloes surveyed underfed, moderately underfed, adequately fed, moderately overfed and overfed on a scale of 90 to 125 (intake as % of requirement) was calculated.

In order to generate information on Cu, Mn and Zn status of dairy animals, intake of respective minerals as % of requirement was worked out. Following broad conclusions could be drawn from the results of the current study.

1. The average DCP intake of buffaloes surveyed in entire Navsari district ranged between 83.80 and 96.27 % of requirement. The buffaloes underfed with respect to DCP were 50.00, 40.00, 66.66, 71.43 and 71.43 %, and moderately underfed were 12.50, 60.00, 16.66, 28.57 and 28.57; and the cows surveyed underfed with respected to DCP were 0.00, 15.79, 10.53, 15.00 and 15.79 % and moderately underfed were 36.84, 26.32, 21.05, 20.00 and 31.58 in Vansda, Chikhli, Jalalpore, Gandevi and Navsari talukas, respectively.

2. The over all average TDN intakes in the buffaloes surveyed in the district ranged between 90.14 to 110.53 % of requirement. The buffaloes with respect to TDN were 0.00, 0.00, 16.66, 0.00 and 42.86 % underfed; 50.00, 60.00, 33.33, 85.71 and 42.86 % moderately underfed and 50.00, 40.00, 50.00, 14.29 and 14.29 % adequately fed in Vansda, Chikhli, Jalalpore, Gandevi and Navsari talukas,

respectively. The cows surveyed with respect to TDN were 0.0, 15.79, 26.32, 10.00 and 0.0 % underfed; 15.79, 15.79, 5.26, 15.00 and 31.58 % moderately underfed and 0.0, 5.26, 5.79, 5.00 and 5.26 % overfed in Vansda, Chikhli, Jalalpore, Gandevi and Navsari talukas, respectively. Wherever necessary, recommendations have been made for balancing the protein and energy supply of dairy animals.

3. In order to balance the energy and protein supply to the dairy animals; based on the results it is recommended that in case of buffaloes, in Vansda taluka, 650g compound concentrate mixture prepared as per BIS specifications should be fed more. Similarly, in Chikhli, Jalalpore, Gandevi and Navsari taluka 800g, 900g, 1.1kg and 1.2kg compound concentrate mixture (BIS standard) should be fed more. In case of cows, adequate supplies of DCP and TDN were found in most of the talukas except in taluka Navsari, therefore, supply of 500g more compound concentrate mixture (BIS standard) in the ration of the cows of that area would meet their requirement.

4. The dry and green roughages contained reasonable amount of Cu (5.55±0.18 - 21.03±2.35). *Sumuldan* contained 25.30ppm Cu. Most of the green fodders contained reasonable amount of Mn (31.0±13.11-106.66±8.70 ppm), grains 19.87±0.62 to 79.87±0.69, and *Sumuldan* contained 195.23±1.40 ppm Mn. Most of the dry roughages contained less than 24.86 ppm Zn. The Zn content of green roughages ranged between 26.14 and 74.32, of grains 18.65 and 46.27, and that of *Sumuldan* 171.28±0.73 ppm. Among the feeding stuffs, 13.33, 20.00, and 20.0 % of concentrates, 37.50, 25.00 and 12.50 % of the green roughages and 60.0, 60.0 and 20.0 % of the dry roughages had below critical levels of Cu, Mn and Zn, respectively.

5. The overall average Cu, Mn and Zn intake as % of requirement in the buffaloes in Navsari district was 130.30, 339.88 and 75.51, respectively. In buffaloes, the intake was 158.43, 127.53, 122.37, 116.53 and 120 % for Cu; 365.34, 408.89, 359.92, 300.31 and 284.24% for Mn and 77.71, 76.83, 82.27, 75.68 and 66.10 % for Zn in Vansda, Chikhli, Jalalpore, Gandevi and Navsari talukas, respectively. In cows, the intake was 159.93, 140.77,

142.99, 133.94 and 117.31 % for Cu; 366.51, 370.22, 369.34, 300.57 and 319.45 % for Mn and 87.64, 87.99, 99.04, 91.68 and 63.11 % for Zn in Vansda, Chikhli, Jalalpore, Gandevi and Navsari talukas, respectively. The intake of Cu and Mn compared to calculated requirement of both the buffaloes and cows indicateD that the dairy animals in Navsari district get more than adequate supply.

6. The cows and buffaloes of all the talukas and villages showed deficit Zn intake. However, the trend was reverse with respect to Cu and Mn.

7. In order to balance the supply of Zn to dairy animals of the district, it is recommended to supply mineral mixture prepared according to latest BIS specifications (BIS 2002). The quantity of mineral mixture to be supplemented (rounded off to the nearest five) in buffalo diets worked out as 35 g/day in Vansda, Chikhli and Gandevi taluka; 25 and 45 g/day in Jalalpore and Navsari taluka, respectively.

The quantity of mineral mixture to be supplemented in cow diets worked out as 15 g/day in Vansda, Chikhli and Gandevi taluka; and 45 g/day in Navsari taluka respectively.

REFERENCES

Aggett P.J.; Mills C.F.; Plant J.A.; Simpson P.R.; Stevenson A. and Holliday C.F. (1988). A study on environmental geochemistry and health in northeast Scotland, in geochemistry and health. Proceedings of the Second International Symposium (ed I Thornton) pp 81-91, science review Ltd. Northwood England.

Ahlawat , M.R.; Pal, R.N. and Laller, A.N. (1960). A study of the practices in the feeding of buffaloes in four towns of Punjab. *Indian Journal of Dairy Sciences* **13:** 126-135.

Anonymous (1983). Final Report of the I.C.A.R. scheme (From February 1952 to June 1973), Western Regional Animal Nutrition Station, Gujarat Agricultural University, Anand Campus, Anand-388 110.

Anonymous (1985-86). Annual Progress Report of Western Regional Animal Nutrition Research Station. Animal Nutrition Research Department, Gujarat Agricultural University, Anand.

Anonymous (1986-87). Annual Progress Report of Western Regional Animal Nutrition Research Station. Animal Nutrition Research Department, Gujarat Agricultural University, Anand.

Anonymous (1991). Final Report (1.8.1989 to 31.7.1991) of ICAR Ad Hoc Scheme on *Nutritional Status of Mehsani Buffaloes - A field study*. Department of Animal Nutrition and Dairy Science, College of Veterinary Science and Animal Husbandry, Gujarat Agricultural University, Sardarkrushinagar, Dist.: Banaskantha, India.

Anonymous (1998-99). Bulletin of Animal Husbandry and Dairying Statistics, Statistical Cell, Directorate of Animal Husbandry, Gujarat State, Ahmedabad.

Anonymous (2000). Annual Progress Report of Western Regional Animal Nutrition Research Station. Animal Nutrition Research Department, Gujarat Agricultural University, Anand.

Anonymous (2002). 18th Survey Report on Estimation of Major Livestock Products, Gujarat State 2000-2001. Directorate of Animal Husbandry, 45 Krishibhavan, Sector 10 A, Gandhinagar.

AOAC (1999). *Official Method of Analysis,* 18th ed., Association of Official analytical Chemists, Washington, DC.

Arora, S.P. (1981). Zinc and Vitamin A relationship in metabolism. In Gawthorne, J.M. *et. al.* (Ed), TEMA4 (pp 572). Perth, Australia: Springer-Verlag, Berlin, New York.

Arora, S.P. (1997). *Feeding of Dairy Cattle and Buffaloes,* Published by Directorate of Information and Publications on Agriculture, ICAR, New Delhi.

Badal, P.S. and Dhaka, J.P. (1998). An analysis of feeding pattern and cost of milk production in Gopalganj district of Bihar. *Indian Journal of Dairy Sciences* **51** (2): 121-126.

Bhuvnesh Kumar; Pachauri S.P. and Narendra Kumar (2002). Evaluation of trace elements status of dairy cattle, feed, fodder and soil at medium elevation in hills to establish soil- plant- animal relationship. *Indian Journal of Animal Sciences,* **72** (4): 332-336.

Biswas R. and Samanta G. (2002). Mineral status of cattle and goats in relation to feeds and fodders of old alluvial zone of West Bengal. *Indian Journal of Animal Sciences* **72** (1): 104-106.

Chaudhary, A.B. and Gupta B.N. (1983). Trace element status of the naturally available fodders in the hilly tracts of Darjeeling District of West Bengal. *Indian Journal of Dairy Sciences* **36:** 110-113.

Chavda, M.R. (2003). *Assessment of Feeding Practices and Status of Certain Minerals in Dairy Animals of Patan District of North Gujarat.* M.V.Sc. Thesis, Gujarat Agricultural University, Sardarkrushinagar, Gujarat.

Chawla, M.S. and Negi, S.S. (1968). Nutritive inadequacy of Palampur hay for sheep rearing. *Journal of Research Punjab Agricultural University* **5** (3, Suppl.): 103-07.

CLFMA (1994). Compound Livestock Feed Manufacturers' Association. News Bulletin, Vol. XVII No. 4 Jan, 94.

Dandopath S.K.; Ghosh T.K. and Biswas S. (2002). Trace and macro element status of cattle in red laterite zone of West Bengal. *Indian Journal of Animal Sciences,* **72** (9): 817-819.

Das A.; Biswas P. and Rajendran D. (2003). Micronutrient profile of feeds fodders and animals in hill zone of West Bengal. *Animal Nutrition and Feed Technology* **3:**9-16.

Das P.; Biswas S.; Ghosh T.K. and Haldar S. (2002[a]). Micronutrient status of dairy cattle in new alluvial zone of West Bengal. *Indian Journal Animal Sciences,* **72** (2): 171-173.

Das P.; Biswas S.; Ghosh T.K. and Haldar S. (2002[b]). Micronutrient status of dairy cattle maintained by farmers in the New Alluvial Zone of West Bengal. *Animal Nutrition and Feed Technology* **2:** 19-26.

Desai H.B.; Desai M.C.; Purohit L.P.; Patel Z.N. and Shukla P.C. (1984). A note on trace element content in cattle feeds of Panchmahals. *GAU Research Journal* **9** (2): 75-81.

Desai H.B.; Desai M.C.; Purohit L.P.; Patel Z.N. and Shukla P.C. (1985). Survey of cattle feeds and feeding practices in Banaskantha District. *GAU Research Journal* **11**(1) 35-43.

Gaines, W.L. (1928). The energy basis of measuring milk yield in dairy cows, *University of Illinois Agricultural Experimental Station Bulletin* 308.

Garg M.R.; Arora S.P. Bhanderi B.M.; Sherasia P.L. and Singh D.K. (2000). Mineral status of feeds and fodders in Kaira district of Gujarat. *Indian Journal of Dairy Science, 53* :291-297.

Garg M. R.; Bhanderi B.M.; Sherasia P.L. and Singh D.K. (1999). Mapping of certain feeds and fodders in the Mehsana district of Gujarat State. *Indian Journal of Dairy Science* **52** (2): 69-77.

Garg M.R.; Bhanderi B.M. and Sherasia P.L. (2002[a]). Mineral content of feeds and fodders in Junagadh district of Gujarat. *Indian Journal of Animal Nutrition,* **19** (1) 57-62.

Garg M.R.; Bhanderi B.M. and Sherasia P.L. (2002[b]). Trace mineral status of feeds and fodders in Junagadh district of Gujarat. *Indian Journal of Dairy Science,* **55** (3) 154-158.

Garg M.R.; Bhanderi B.M. and Sherasia P.L. (2003). Macro Mineral status of feeds and fodders in Kutch district of Gujarat. A*nimal Nutrition and Feed Technology* **3**:179-188.

Garg, M.R., Bhanderi, B.M. and Sherasia, P.L. (2004). Status of certain trace mineral in feeds and fodder in Kutch district of Gujarat. *Indian Journal of Animal Nutrition*, **21** (1): 8-12.

Ghogale, P.P. (2003). *Assessment of Feeding Practices and Status of Certain Minerals in Dairy Animals of Sabarkantha District of North Gujarat.* M.V.Sc. Thesis, Gujarat Agricultural University, Sardarkrushinagar, Gujarat.

Gill, R.S.; Sharma, D.D.; Gupta, S.C.; Chander, S. and Negi, S.S. (1970). Vagaries in the feeding of cattle and buffaloes in Kangra District. A survey report. *Journal of Research, Punjab Agricultural University* **7**: 80-85.

Gowda N.K.S.; Prasad C.S.; Ramana J.V. and Skivaramaiah (2001). Mineral status of soils, feeds, fodders and animals in Coastal Agro–Eco Zone of Karnataka. *Animal Nutrition and Feed Technology* **1:** 97-104.

Gowda N.K.S.; Prasad C.S.; Ramana J.V. and Shivaramaiah (2002). Assessment of mineral status in hilly and dry zones of Karnataka and ways to supplement them. *Indian Journal of Animal Sciences* **72** (2): 165-170.

Handa, M.C. and Gill, R.S. (1989). Nutritional status of dairy animals kept by different categories of farmers in Punjab State. *Indian Journal of Animal Nutrition,* **6** (1): 38-43.

Hinders, R. (1999). Research needed to determine correct trace mineral levels. *Feedstuffs,* **71:** 10

ICAR (1985) *Nutrient Requirement of Livestock and Poultry*. Indian Council of Agricultural Research, Krishi Bhawan, New Delhi, India.

ICAR (1998). *Nutrient Requirement of Livestock and Poultry*. Indian Council of Agricultural Research, New Delhi, India.

IS 1664 (2002).Mineral mixture for supplementing cattle feeds. Bureau of Indian Standard, Manak Bhavan; 9. Bahadur Shah Zafar Marg, New Delhi-110 002.

Jackson M.J., (1993). Zinc deficiency and Human Health. Environmental Geochemistry and Health in developing countries. The geological society, Burlington House, Piccadilly, London, WIV OJU.

Khan S.A.; Bedi S.P.S.; Sawhney P.C. and Ranjhan S.K. (1979). Copper status of soil, plants and animals in Tarai areas. *Indian Journal of Dairy Science* **32** (3) :290-296.

Lal, D.; Dixit, V.B.; Arora, U. and Chauhan, T.R. (1999). Nutritional status of high yielding buffaloes - A case study. *Indian journal of Animal Production and Management.,* **15** (1): 39-41.

Lal, D.; Dixit, V.B.; Chauhan, T.R. and Solanki, V.S. (1998[a]). A critical analysis of the feeding system of lactating buffaloes in Hisar. *Indian Journal of Animal Production and Management,* **14** (3): 164-166.

Lal, D.; Gupta, R.; Dixit, V.B. and Sethi, R.K. (1995). Nutritional status of lactating buffaloes in Hisar - A random survey analysis. *Indian Journal of Dairy Sciences,* **48** (5): 378-381.

Lal, S.N.; Verma, D.N. and Singh, S.P. (1998[b]). Nutritional status of lactating Murrah buffaloes kept by different categories of farmers in Eastern Uttar Pradesh. *Indian Journal of Animal Nutrition* **15** (1): 44-47.

Maan N.S.; Mandal A.B.; Yadav P.S.; Lall D.L. and Gupta P.C. (2003). Mineral status of feeds and fodders in Rohtak District of Haryana State. *Animal Nutrition and Feed Technology* **3**: 1-7.

Mandal, A.B.; Yadav, P.S.; Sunaria, K.R.; Kapoor, V. and Maan, N.S. (1996). Mineral status of buffaloes in Mahindergarh district of Haryana. *Indian Journal of Animal Sciences* **66:** 849-851.

McDowell, L.R. (1985). *Nutrition of Grazing Ruminants in Warm Climates.* Academic Press, New York.

McDowell L.R.; Conard J.H. ;Ellis G.L. and Loosli J.K. (1983). *Minerals for grazing ruminants in tropical regions*. Animal Science Department, Centre for tropical agriculture, University of Florida, Florida p.89.

Miller, W.J. (1979). *Dairy Cattle Feeding and Nutrition,* Academic Press, New York.

Morrison, F.B. (1956). *Feeds and Feeding*. Morrison Publishing Co. Ithaca, New York.

Mtimuni J.P.; Conard J.H.; Mc Dowell L.R. and Martin F.G. (1990). Effect of seasons on mineral concentration of soil, plant and animal tissues. *International Journal Animal sciences* **57** :1145-47.

National Research Council (1996). Committee on Animal Nutrition, *Nutrient Requirement of Cattle.* National Academy of Science, Washington D.C.

NRC (1971) National Research Council (4th Edition) National Academy of Science, Washington, D.C.

NRC (1989). *Nutrient Requirement of Dairy Cattle*. 6th rev. ed. National Academy of Science, National Research Council, Washington, D.C.

NRC (2001). *Nutrient Requirements of Dairy Cattle,* 7th revised ed. National Academy of Sciences, Washington, DC.

Pande M. B. and Gupta, R. S. (2001). Availability and utilization of livestock feed resources in different agro-climatic zones of Gujarat. Rev. Paper presented in Proc. X Animal Nutrition Conference (November 9-11, 2001), National Dairy Research Institute, Karnal (Haryana).

Parnerkar, S., Vahora, S.G., Pandya, P.R., Patil, Y.J. and Shaikh, M.A. (2006). Prioritization of limiting nutrients in dairy animals of Surendranagar district. Proc. VI Biennial Conference of ANA (September 15-17, 2006), Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu.

Patange, D.D.; Kulkarni, A.N.; Gujar, B.V. and Kalyanrkar, S.D. (2002) Nutrient availability to milch Marathwadi buffaloes in their home tract. *Indian Journal of Animal Nutrition* **19** (1): 41-46.

Pathak, N.N. and Verma, D.N. (1993). *Nutrient requirements for Buffaloes*. International Book Distributing Co. Lucknow, India.

Pradhan K. (1981a). Feeding strategy for Indian dairy animals under feed resource constraints. Paper presented at the XVII Dairy Industry Conference held at Ahmedabad, February 19-21, 1981.

Pradhan, K. (1981b). Feeding strategy for Indian Dairy Animals under feed Resource constrains. *Indian Dairyman* **33** (4): 255-262.

Ramana J.V.; Prasad C.S. and Gowda S.K. (2000). Mineral profile of soil, feeds fodders and blood plasma in southern transition zone of Karnataka. *Indian Journal of Animal Nutrition,* **17** (3), 179-183.

Ramana J.V.; Prasad C.V.; Gowda N.K.S. and Ramachandra K.S. (2001). Levels of micronutrients in soil, feed, fodder and animals of north east transition zone of Karnataka. *Indian Journal of Animal Nutrition,* **18** (3):235-242.

Randhawa C.S; Randhawa S.S. and Sood N.K. (2002). Effect of molybdenum induced copper deficiency on peripheral blood cells and bone marrow in buffalo calves. *Asian Australian Journal of Animal Sciences,* **15** :509-515.

Randhe, S.R.; Gaffar, M.A.; Auradkar, S.K. and Deshmukh, S.V. (1993). Nutritional status of buffaloes in rural areas of Parbhani district of Maharashtra State. *Indian Journal of Animal Nutrition* **10** (2): 127-131.

Ranjhan, S.K. (1991). *Chemical Composition of Indian Feeds and Feeding of Farm Animals.* 6th new edition ICAR, New Delhi.

Rice, V.A.; Andrew, F.N.; Warnick, E.J. and Legates, J.E. (1970). *Breeding and Improvement of Farm Animals*, 6th edn. Bombay, India : Tata MC Graw Hill Publishing Company Ltd.

Samanta A. and Samanta G. (2002). Mineral profile of different feed and fodders and their effect on plasma profile in ruminants of West Bengal. *Indian Journal of Animal Nutrition* **19** (3):278-281.

Sen, K.C.; Ray, S.N. and Ranjan, S.K. (1978). *Nutritive value of Indian feeds and fodders.* Pub. No. 25, Indian Council of Agricultural Research, New Delhi.

Sharma, D.D. and Chander, S. (1968). Nutritional status of cattle in the temperate region of Kangra district. *Journal of Research Punjab Agricultural University* **5** (3, Suppl.): 7-13.

Sharma, D.D. and Chander, S. (1971). Nutritional status of animal in the Kangra district. *Journal of Research Punjab Agricultural University* **8**: 136-142.

Sharma, D.D. and Gill, R.S. (1968). Nutritional value of Palampur hay Evaluation a sole feed and in inter combination with *Peuraria thumbergiana* (Kudzu). *Journal of Research Punjab Agricultural University.* **5** (3, Suppl.): 98-102.

Sharma, D.D.; Gill, R.S. and Negi, S.S. (1967). Effect of maturity on chemical composition of some summer pasture grasses in the mountainous region of Kangra District. *Journal of Research Punjab Agricultural University* **4**: 420-26.

Sharma, D.D.; Negi, S.S. and Sidhu, G.S. (1966). Nutritive evaluation vis-à-vis improvement of intermountain range grasses. *Journal of Research Punjab Agricultural University* **3** : 313-20.

Singh, A.K.; Vidyarthi, V.K.; Verma, D.N. and Lal, S.N. (1998). Nutritional status of buffaloes in rural areas of Azamgarh district of Uttar Pradesh. *Indian Journal of Animal Nutrition.* **15** (2): 126-128.

Singh, C.B.; Pramanik, P.S. and Mishra S. (2003[a]). Availability of nutrients from prevailing feeds and fodders to dairy animals in eastern plain zone of Uttar Pradesh. *Indian Veterinary Medical Journal,* **27** (1):53-54.

Singh, J.; Yada, K.K. and Mandal, A.B. (2001). Feeding plane of milch Murrah buffaloes in its native breeding tract. *Buffalo Journal* **1**:1-12.

Singh, K. and Sangwan, B.S. (1987). Zinc status in Haryana soils and factors affecting its availability. In: Proc. Symp. *Recent Advances in Mineral Nutrition* (Ed. V.M. Mandokhot), Haryana Agricultural University, Hisar, India, pp. 193-197.

Singh, R.; Randhawa, S.S. and Randhawa, C.S. (2003[b]). Trace element status of cross bred cattle from sub-mountainous belt of Punjab in relation to soil and fodder. *Indian Journal of Animal Sciences,* **73** (9): 1072-1076.

Talapatra S.K.;Ray S.C. and Sen K.C. (1940). Estimation of phosphorus, Chloride, Calcium, Sodium and Potassium in food stuffs. *Indian Journal of Veterinary Science and Animal Husbandry.* **10**: 243-246.

Tiffany M.E.; McDowell L.R.; Martin F.G.; Wilkilson N.S.; Cordoso E.C. and Rabiansky P.A.(2000). Effects of pasture applied biosolids on performance and mineral status of grazing beef heifers. *Journal of Animal Science* **78** 1331.

Tripathi M.K.; Mishra A.S.; Misra S.K.; Verma D.L.; Karim S.A. and Jakhmola (2002). Macro and micro mineral status of grazing livestock on community rangeland of semiarid Rajasthan. *Indian Journal of Animal Sciences* **72** (12): 1182-1184.

Udar S.A.; Chopde S. and Dhore R.N. (2003). Mineral profile of soil feeds and fodders and buffaloes in western agro-climatic zone of Vidarbha. *Animal Nutrition and Feed Technology* **3** : 165-172.

Underwood E.J. (1981). *The mineral Nutrition of livestock*. Commonwealth Agriculture Bureax, London.

Underwood, E.J. and Suttle, N. F. (1999) *The Mineral Nutrition of Livestock,* 3rd ed. CAB International Publishing.

Vasudevan, B. (1987). Mineral deficiency syndrome among dairy cattle, sheep and goats in India. In: Proc. Symp. *Recent Advances in Mineral Nutrition* (Ed. V.M. Mandokhot), Haryana Agricultural University, Hisar, India, pp. 45-49.

Yadav P.S.; Mandal A.B.and Dahiya D.V. (2002) Feeding pattern and mineral status of Buffaloes in Panipat District of Haryana State. *Animal Nutrition and Feed Technology* **2:** 127-138.

Yadav, P.S.; Mandal, A.B.; Kapoor, V., Sunaria, K.R. and Maan, N.S. (1998) Mineral status of cows and buffaloes in Rewari district of Haryana. *Indian Journal of Animal Sciences,* **68:** 1059-1061.

Table 4.5: Chemical composition of feeds and fodder.

Feeds	**CP**	**EE**	**CF**	**NFE**	**Ash**	**Silica**	**Ca**	**P**	**Cu**	**Zn**	**Mn**
Concentrate											
Tur chuni (4)	18.76 ±0.59	4.19 ±0.19	15.29 ±1.57	55.63 ±1.36	6.13 ±0.48	1.46 ±0.40	0.36 ± 0.05	0.25 ± 0.02	14.91 ± 1.43	33.77 ± 0.19	23.27 ± 3.06
Wheat bran (4)	4.73 ±0.47	3.40 ±0.36	37.43 ±1.81	37.23 ±1.94	17.21 ±0.40	5.29 ±0.19	0.15 ± 0.01	0.64 ± 0.03	13.07 ± 0.04	55.09 ± 0.37	100.10 ± 0.67
Wheat *bharda* (6)	12.33 ±0.74	2.28 ±0.15	2.48 ±0.37	80.42 ±0.51	2.48 ±0.25	0.24 ±0.04	0.13 ± 0.01	0.51 ± 0.01	3.71 ± 0.01	29.38 ± 0.10	27.24 ± 0.24
Maize *bharda* (7)	3.75 ±0.16	3.81 ±0.14	7.09 ±0.66	29.03 ±1.51	56.32 ±0.92	12.23 ±0.24	2.06 ± 0.03	0.18 ± 0.01	3.89 ± 0.09	19.06 ± 0.40	79.87 ± 0.69
Cotton seed (4)	24.84 ±0.12	21.12 ±0.20	13.40 ±0.15	35.72 ±0.23	4.93 ±0.04	0.40 ±0.01	0.41 ± 0.01	0.81 ± 0.04	16.50 ± 0.17	76.40 ± 0.47	40.44 ± 1.66
Guar *bharda* (9)	42.41 ±0.68	4.32 ±0.08	9.57 ±1.09	37.83 ±1.16	5.87 ±0.20	0.65 ±0.14	0.40 ± 0.02	0.74 ± 0.02	11.08 ± 0.58	46.27 ± 2.22	40.09 ± 8.70
Cotton seed cake (11)	25.47 ±0.75	10.21 ±0.17	21.44 ±0.73	36.23 ±1.43	6.65 ±0.15	0.91 ±0.04	0.35 ± 0.02	0.58 ± 0.08	15.41 ± 0.74	47.08 ± 2.51	49.77 ± 6.15
Rice polish (15)	10.21 ±0.51	11.90 ±0.61	4.99 ±0.39	65.06 ±2.05	7.84 ±1.25	2.89 ±0.79	0.13 ± 0.01	2.12 ± 0.04	10.86 ± 0.89	46.62 ± 2.23	150.29 ± 4.09
Sumul dan (9)	18.39 ±0.28	3.03 ±0.17	7.90 ±0.21	55.31 ±0.46	15.37 ±0.51	3.77 ±0.09	2.06 ± 0.05	1.78 ± 0.05	25.30 ± 0.67	171.28 ± 0.73	195.23 ± 1.40
Godrej dan (5)	18.51 ±0.55	3.01 ±0.24	11.26 ±0.44	53.74 ±0.69	13.48 ±0.31	4.75 ±0.26	1.27 ± 0.01	1.15 ± 0.04	56.35 ± 2.17	128.52 ± 3.12	127.10 ± 3.09

Table 4.5: Continue.

Uttam dan (4)	20.80 ±1.30	3.02 ±0.21	10.91 ±0.22	48.95 ±2.02	16.32 ±0.56	3.32 ±0.04	1.01 ± 0.04	0.74 ± 0.02	14.47 ± 0.31	79.92 ± 0.48	66.06 ± 0.37
Bajri (4)	15.45 ±0.05	2.35 ±0.05	21.96 ±0.51	49.70 ±0.53	12.55 ±0.11	6.16 ±0.04	0.12 ± 0.04	0.41 ± 0.05	8.62 ± 0.01	18.65 ± 0.40	19.87 ± 0.62
Vikas dan (6)	20.66 ±0.58	2.89 ±0.23	11.76 ±0.17	49.29 ±1.44	15.40 ±0.78	5.23 ±0.19	1.21 ± 0.03	1.87 ± 0.02	23.01 ± 0.11	141.36 ± 4.21	108.65 ± 4.41
Super mix (5)	10.46 ±2.45	2.37 ±0.05	16.46 ±0.71	54.80 ±3.59	15.91 ±1.63	11.55 ±1.70	1.75 ± 0.04	0.56 ± 0.01	14.53 ± 0.63	58.22 ± 1.23	107.06 ± 0.99
Amul dan (4)	16.29 ±0.14	4.08 ±0.05	8.55 ±0.20	53.99 ±1.65	17.09 ±1.34	4.72 ±0.21	1.81 ± 0.09	1.46 ± 0.02	34.44 ± 0.62	136.84 ± 2.28	155.32 ± 1.66
Green fodders											
Shedha grass (6)	6.30 ±1.06	1.35 ±0.23	37.61 ±2.60	42.18 ±3.96	12.56 ±1.85	6.52 ±1.89	0.43 ± 0.08	0.33 ± 0.06	7.65 ± 0.99	36.18 ± 5.49	93.8 ±46.69
Jowar green (8)	6.33 ±0.62	2.76 ±0.20	29.56 ±1.44	50.01 ±2.74	11.33 ±1.67	6.09 ±1.61	0.45 ± 0.02	0.26 ± 0.02	7.80 ± 0.97	36.08 ± 3.77	31.01 ± 3.11
Hybrid napier (8)	11.46 ±1.13	1.88 ±0.16	30.67 ±1.35	41.98 ±2.48	14.01 ±0.97	5.63 ±0.58	0.43 ± 0.04	0.22 ± 0.03	8.98 ± 1.21	30.79 ± 2.92	41.07 ± 5.51
Lucerne (4)	22.77 ±3.58	3.50 ±0.17	24.85 ±2.87	42.73 ±1.84	6.15 ±2.95	0.80 ±0.41	1.79 ± 0.30	0.41 ± 0.04	21.03 ± 2.35	43.51 ± 4.25	54.74 ± 9.18
Para grass (4)	8.20 ±0.14	1.57 ±0.09	26.77 ±0.79	46.07 ±0.40	17.39 ±1.4	6.94 ±0.39	0.39 ± 0.01	0.20 ± 0.02	12.09 ± 0.86	27.88 ± 0.91	106.66 ± 8.70
Green sugar cane top (5)	3.97 ±0.13	2.57 ±0.12	32.66 ±1.22	52.16 ±1.58	8.63 ±0.76	3.80 ±0.10	0.28 ± 0.01	0.21 ± 0.01	5.55 ± 0.18	26.14 ± 0.87	42.40 ± 0.18

Table 4.5: Continue..

Bajri green (5)	2.34 ±0.12	2.09 ±0.09	29.30 ±0.46	56.44 ±0.68	9.83 ±0.54	4.44 ±0.09	0.59 ± 0.02	0.22 ± 0.03	8.34 ± 0.06	39.12 ± 0.40	44.65 ± 0.47
Sudan grass (4)	11.54 ±0.12	2.30 ±0.07	2.32 ±0.02	72.92 ±0.18	10.91 ±0.11	4.99 ±0.16	0.54 ± 0.02	0.42 ± 0.03	14.55 ± 0.12	74.32 ± 0.42	59.16 ± 0.28
Dry fodder											
Paddy straw (10)	4.42 ±0.24	1.22 ±0.13	30.40 ±1.06	47.22 ±0.96	16.74 ±0.52	17.98 ±5.66	0.29 ± 0.03	0.12 ± 0.01	6.75 ± 0.79	28.03 ± 2.70	218.18 ± 39.29
Dry sugar cane top (4)	3.91 ±0.38	2.31 ±0.13	29.33 ±0.47	56.03 ±1.02	8.42 ±0.41	4.00 ±0.11	0.35 ± 0.01	0.13 ± 0.03	4.23 ± 0.50	27.62 ± 1.67	35.09 ± 1.66
Mature pasture grass (6)	2.97 ±0.13	1.56 ±0.11	41.69 ±1.24	43.65 ±1.52	10.14 ±0.49	6.50 ±0.57	0.47 ± 0.06	0.14 ± 0.04	4.64 ± 0.80	27.93 ± 2.39	56.22 ± 3.76
Bajri straw (4)	3.67 ±0.07	1.26 ±0.07	13.35 ±0.42	56.04 ±0.68	9.36 ±0.19	3.60 ±0.07	0.57 ± 0.01	0.54 ± 0.02	16.45 ± 0.17	45.50 ± 0.29	98.66 ± 0.35
Jowar straw (4)	4.40 ±0.94	2.77 ±0.26	38.05 ±3.33	42.71 ±4.66	12.07 ±0.39	4.69 ±0.08	0.48 ± 0.05	0.36 ± 0.09	9.26 ± 1.93	43.54 ± 9.84	42.13 ± 11.54
Figures in the parentheses indicate number of samples analyzed.											

Table 4.6: Feedstuffs having below critical levels of macro and micro minerals

Feedstuff	Ca	P	Cu	Zn	Mn
	%		ppm		
	<0.30	**<0.25**	**<8**	**<30**	**<40**
Concentrate	Wheat bran, Wheat bhardo, Rice polish, *Bajri*	Maize *bharda*	Maize *bharda*, Wheat *bharda*	Maize *bharda*, Wheat *bharda*, *Bajri*	*Tur* chuni, Wheat *bharda*, *Bajri*
Green Roughage	Sugarcane tops	Hybrid napier, Para grass, Sugarcane tops, *Bajri*	Shedha grass, *Jowar*, Suga cane tops	Para grass, Sugarcane tops	*Jowar*
Dry Roughage	Paddy straw	Paddy straw, Sugarcane tops	Paddy straw, Sugarcane tops, Dry grass	Paddy straw, Sugarcane tops, Dry grass	Sugarcane tops

Table 4.2: Average concentrate and fodder fed to cows by farmers on as such basis (kg/day).

Taluka	Village	As such (kg/d)			
		Concentrate	**Green**	**Dry**	**Total**
Vansda	Chapaldhara	6.50	14.20	3.25	23.95
	Vandervella	6.44	7.28	5.67	19.39
	Average	**6.47**	**10.92**	**4.39**	**21.79**
Chikhli	Kukeri	7.14	7.11	5.11	19.36
	Sadakpore	6.80	15.70	3.40	25.83
	Average	**6.96**	**11.63**	**4.22**	**22.81**
Jalalpore	Sarav	6.30	14.10	4.40	24.80
	Abrama	6.44	14.89	4.22	25.55
	Average	**6.37**	**14.47**	**4.32**	**25.16**
Gandevi	Manekpore	6.70	13.60	3.30	23.60
	Pathri	5.80	12.45	4.70	22.95
	Average	**6.25**	**13.03**	**4.00**	**23.28**
Navsari	Ashtgam	5.05	14.50	4.50	24.05
	Kumbharfalia	4.50	17.00	4.11	25.61
	Average	**4.79**	**15.68**	**4.32**	**24.79**
Dist. Average		**6.17**	**13.15**	**4.24**	**23.56**

Table 4.1: Average concentrate and fodder fed to buffaloes by farmers on as such basis (kg/day).

Taluka	Village	As such (kg/d)			
		Concentrate	**Green**	**Dry**	**Total**
Vansda	Chapaldhara	5.88	15.25	5.50	26.63
	Vandervella	4.25	14.75	7.25	26.25
	Average	**5.06**	**15.00**	**6.38**	**26.44**
Chikhli	Kukeri	4.50	12.00	7.67	24.17
	Sadakpore	5.50	13.50	6.50	25.50
	Average	**4.90**	**12.60**	**7.20**	**24.70**
Jalalpore	Sarav	5.00	17.67	6.00	28.67
	Abrama	4.67	16.00	5.33	26.00
	Average	**4.83**	**16.83**	**5.67**	**27.33**
Gandevi	Manekpore	5.38	15.75	5.00	26.13
	Pathri	5.00	15.33	5.00	25.33
	Average	**5.21**	**15.57**	**5.00**	**25.79**
Navsari	Ashtgam	4.83	16.67	3.33	24.83
	Kumbharfalia	4.88	16.50	4.00	25.38
	Average	**4.86**	**16.57**	**3.71**	**25.14**
Dist. Average		**4.98**	**15.42**	**5.52**	**25.92**

Table 4.4: Concentrate to roughage ratio in cows.

Taluka	Village	DM	Concentrate	Roughage	Concentrate: Roughage Ratio
		kg/day			
Vansda	Chapaldhara	12.72	5.85	6.87	45.99:54.01
	Vandervella	12.68	5.80	7.06	45.10:54.90
	Average	**12.78**	**5.83**	**6.97**	**45.55:54.45**
Chikhli	Kukeri	13.11	6.43	6.68	49.05:50.95
	Sadakpore	13.25	6.12	7.13	46.19:53.81
	Average	**13.18**	**6.28**	**6.91**	**47.61:52.39**
Jalalpore	Sarav	13.31	5.67	7.64	42.60:57.40
	Abrama	13.39	5.80	7.59	43.32:56.68
	Average	**13.35**	**5.74**	**7.62**	**43.00:57.00**
Gandevi	Manekpore	12.91	6.03	6.88	46.71:53.29
	Pathri	12.97	5.22	7.75	40.25:59.75
	Average	**12.94**	**5.63**	**7.32**	**43.47:56.53**
Navsari	Ashtgam	12.40	4.55	7.85	36.69:63.31
	Kumbharfalia	12.19	4.05	8.14	33.22:66.78
	Average	**12.30**	**4.30**	**8.00**	**34.96:65.04**
Dist. Average		**12.91**	**5.56**	**7.35**	**43.07:56.93**

Table 4.3: Concentrate to roughage ratio in buffaloes.

Taluka	Village	DM	Concentrate	Roughage	Concentrate: Roughage Ratio
		kg/day			
Vansda	Chapaldhara	14.50	5.29	9.21	36.48:63.52
	Vandervella	14.56	3.83	10.74	26.25:73.75
	Average	**14.53**	**4.56**	**9.98**	**31.38:68.65**
Chikhli	Kukeri	14.22	4.05	10.17	28.48:71.52
	Sadakpore	14.18	4.95	9.23	34.91:65.09
	Average	**14.20**	**4.41**	**9.79**	**31.06:68.94**
Jalalpore	Sarav	14.78	4.50	10.28	30.45:69.55
	Abrama	13.33	4.20	9.13	31.51:68.49
	Average	**14.06**	**4.35**	**9.71**	**30.94:69.06**
Gandevi	Manekpore	13.50	4.84	8.66	35.85:64.15
	Pathri	13.43	4.50	8.93	33.51:66.49
	Average	**14.47**	**4.69**	**8.78**	**34.82:65.18**
Navsari	Ashtgam	11.93	4.35	7.58	36.46:63.54
	Kumbharfalia	12.34	4.39	7.95	35.58:64.42
	Average	**12.16**	**4.37**	**7.79**	**35.94:64.06**
Dist. Average		**13.67**	**4.49**	**9.18**	**32.85:67.15**

Table 4.7: Percentage of feed samples containing Cu, Zn and Mn below the critical levels.

Feedstuff category	Cu	Zn	Mn
Concentrates	13.33	20.00	20.00
Green roughages	37.50	25.00	12.50
Dry roughages	60.00	60.00	20.00

Table 4.8: Average estimated levels of nutrients supplied to buffaloes in comparison to their calculated requirements.

Taluka	Village	MY	6 % FCM	DMI	Available Nutrients (kg/day)		Required Nutrients (kg/day)		Available Nutrients (% of requirement)	
		kg/day			DCP	TDN	DCP	TDN	DCP	TDN
Vansda	Chapaldhara	9.50	11.40	14.50	0.89	8.09	0.93	8.07	96.27	110.53
	Vandervella	9.00	10.82	14.56	0.81	7.69	0.90	7.84	90.98	98.25
	Average	**9.25**	**11.11**	**14.53**	**0.85**	**7.89**	**0.91**	**7.95**	**93.62**	**99.39**
Chikhli	Kukeri	8.33	9.61	14.22	0.78	7.48	0.83	7.34	94.25	101.79
	Sadakpore	9.50	11.15	14.18	0.81	7.53	0.92	7.97	88.37	94.95
	Average	**8.80**	**10.22**	**14.20**	**0.79**	**7.50**	**0.86**	**7.59**	**91.90**	**98.85**
Jalalpore	Sarav	9.00	10.71	14.78	0.77	7.98	0.89	7.79	86.06	102.44
	Abrama	9.33	10.81	13.33	0.78	7.25	0.90	7.83	86.50	92.76
	Average	**9.17**	**10.76**	**14.06**	**0.77**	**7.62**	**0.89**	**7.81**	**86.28**	**97.60**
Gandevi	Manekpore	9.50	11.05	13.50	0.76	7.49	0.91	7.93	83.80	94.47
	Pathri	9.33	11.15	13.43	0.79	7.65	0.92	7.97	86.24	96.10
	Average	**9.43**	**11.10**	**13.47**	**0.77**	**7.56**	**0.91**	**7.95**	**84.85**	**95.17**
Navsari	Ashtgam	8.33	10.12	11.93	0.77	7.06	0.86	7.55	89.96	93.53
	Kumbharfalia	9.00	10.57	12.34	0.75	6.97	0.88	7.73	84.85	90.14
	Average	**8.71**	**10.38**	**12.16**	**0.76**	**7.01**	**0.87**	**7.65**	**87.04**	**91.59**
Dist. Average		**9.09**	**10.75**	**13.67**	**0.79**	**7.52**	**0.89**	**7.81**	**88.77**	**96.43**

Table 4.9: Average estimated levels of nutrients supplied to cows in comparison to their calculated requirement.

Taluka	Village	MY	4 % FCM	DMI	Available Nutrients (kg/day)		Required Nutrients (kg/day)		Available Nutrients (% of requirement)	
		kg/day			DCP	TDN	DCP	TDN	DCP	TDN
Vansda	Chapaldhara	11.90	12.08	12.72	0.82	7.47	0.79	6.80	103.03	109.87
	Vandervella	12.11	12.29	12.86	0.84	7.27	0.80	6.87	104.55	106.02
	Average	**12.00**	**12.18**	**12.78**	**0.83**	**7.36**	**0.80**	**6.84**	**103.75**	**108.05**
Chikhli	Kukeri	13.78	13.98	13.11	0.92	7.47	0.88	7.41	106.80	102.78
	Sadakpore	13.60	13.80	13.25	0.90	7.68	0.87	7.35	105.25	106.09
	Average	**13.68**	**13.89**	**13.18**	**0.91**	**7.58**	**0.88**	**7.38**	**105.98**	**104.52**
Jalalpore	Sarav	13.10	13.30	13.31	0.95	7.51	0.85	7.19	115.63	107.10
	Abrama	14.33	14.55	13.39	1.00	7.62	0.90	7.58	116.26	105.02
	Average	**13.68**	**13.89**	**13.35**	**0.98**	**7.56**	**0.88**	**7.38**	**115.93**	**106.12**
Gandevi	Manekpore	13.20	13.40	12.91	0.89	7.61	0.85	7.22	105.49	107.13
	Pathri	12.60	12.79	12.97	0.89	7.30	0.83	7.03	108.88	104.28
	Average	**12.90**	**13.09**	**12.94**	**0.89**	**7.45**	**0.84**	**7.12**	**107.19**	**105.71**
Navsari	Ashtgam	11.20	11.37	12.40	0.76	6.99	0.76	6.58	100.66	106.66
	Kumbharfalia	11.22	11.39	12.19	0.70	6.90	0.76	6.59	92.72	104.88
	Average	**11.21**	**11.38**	**12.30**	**0.73**	**6.95**	**0.76**	**6.58**	**96.90**	**105.82**
Dist. Average		**12.70**	**12.89**	**12.91**	**0.87**	**7.38**	**0.83**	**7.06**	**105.96**	**106.04**

Table 4.10: Percent deficit (-)/surplus (+) of nutrients in buffaloes surveyed.

Taluka	Village	Percent deficit/excess in buffaloes	
		DCP	**TDN**
Vansda	Chapaldhara	-3.23	0.53
	Vandervella	-9.02	-1.75
	Average	**-6.38**	**-0.61**
Chikhli	Kukeri	-5.75	1.79
	Sadakpore	-11.63	-5.55
	Average	**-8.10**	**-1.15**
Jalalpore	Sarav	-13.94	2.44
	Abrama	-13.50	-7.24
	Average	**-13.72**	**-2.40**
Gandevi	Manekpore	-16.20	-5.53
	Pathri	-13.76	-3.90
	Average	**-15.15**	**-4.83**
Navsari	Ashtgam	-10.04	-6.47
	Kumbharfalia	-15.15	-9.86
	Average	**-13.96**	**-8.41**
Dist. Average		**-11.23**	**-3.57**

Table 4.11: Percent deficit (-)/surplus (+) of nutrients in cows surveyed.

Taluka	Village	Percent deficit/excess in cows	
		DCP	**TDN**
Vansda	Chapaldhara	3.03	9.87
	Vandervella	4.55	6.02
	Average	**3.75**	**8.05**
Chikhli	Kukeri	6.80	2.78
	Sadakpore	5.25	6.09
	Average	**5.98**	**1.22**
Jalalpore	Sarav	15.63	7.10
	Abrama	16.26	5.02
	Average	**15.93**	**6.12**
Gandevi	Manekpore	5.49	7.13
	Pathri	8.88	4.28
	Average	**7.19**	**5.71**
Navsari	Ashtgam	0.66	6.66
	Kumbharfalia	-7.28	4.88
	Average	**-3.10**	**5.82**
Dist. Average		**5.96**	**6.04**

Table 4.12: Percentage of buffaloes underfed, moderately underfed, adequately fed, moderately overfed and overfed out of those surveyed.

Taluka	DCP					TDN				
	U	MU	A	MO	O	U	MU	A	MO	O
Vansda	50.00	12.50	25.00	12.50	0.00	0.00	50.00	50.00	0.00	0.00
Chikhli	40.00	60.00	0.00	0.00	0.00	0.00	60.00	40.00	0.00	0.00
Jalalpore	66.66	16.66	16.66	0.00	0.00	16.66	33.33	50.00	0.00	0.00
Gandevi	71.43	28.57	0.00	0.00	0.00	0.00	85.71	14.29	0.00	0.00
Navsari	71.43	28.57	0.00	0.00	0.00	42.86	42.86	14.29	0.00	0.00
Dist.	60.60	27.27	9.09	3.03	0.00	12.12	54.54	33.33	0.00	0.00

U-Underfed (< 90 % of requirement), MU-Moderately Underfed (>90 to < 100 % of requirement), Adequately fed (>100 to<110 % of requirement), MO – Moderately overfed (>110 to < 125 % of requirement), O – Overfed- (>125% of requirement)

Table 4.13: Percentage of cows underfed, moderately underfed, adequately fed, moderately overfed and overfed out of those surveyed.

Taluka	DCP					TDN				
	U	MU	A	MO	O	U	MU	A	MO	O
Vansda	0.00	36.84	42.11	21.05	0.00	0.00	15.79	47.37	36.84	0.00
Chikhli	15.79	26.32	26.32	21.05	10.53	15.79	15.79	31.58	31.58	5.26
Jalalpore	10.53	21.05	5.26	36.84	26.32	26.32	5.26	21.05	31.58	15.79
Gandevi	15.00	20.00	20.00	35.00	10.00	10.00	15.00	35.00	35.00	5.00
Navsari	15.79	31.58	42.11	10.53	0.00	0.00	31.58	47.37	15.79	5.26
Dist.	11.46	27.08	27.08	25.00	9.38	10.42	16.67	36.46	30.21	6.25

U-Underfed (< 90 % of requirement), MU-Moderately Underfed (>90 to < 100 % of requirement), Adequately fed (>100 to<110 % of requirement), MO – Moderately overfed (>110 to < 125 % of requirement), O – Overfed- (>125% of requirement)

Table 4.14: Average estimated levels of Cu, Zn, and Mn supplied to lactating buffaloes in Navsari district in comparison to their calculated requirements.

Taluka	MY (kg/d)	Fat (%)	DMI (kg/d)	Mineral intake (mg/day)			Mineral requirement (mg/day)			Mineral intake (% of requirement)		
				Cu	Zn	Mn	Cu	Zn	Mn	Cu	Zn	Mn
Vansda	9.25 ±0.37	7.76 ± 0.11	14.53 ±0.10	230.28 ±23.42	903.62 ±35.25	2123.87 ±84.80	145.31 ±1.00	1162.50 ±7.96	581.25 ±3.98	158.43 ±15.99	77.71 ±2.92	365.34 ±14.22
Chikhli	8.80 ±0.37	7.38 ±0.26	14.20 ±0.33	180.27 ±8.68	875.80 ±79.64	2317.64 ±127.75	142.00 ±3.25	1136.00 ±26.02	568.00 ±13.01	127.53 ±8.33	76.83 ±6.19	408.89 ±23.56
Jalalpore	9.17 ±0.48	7.53 ±0.15	14.06 ±0.54	170.81 ±4.56	920.47 ±45.42	2027.26 ±148.12	140.58 ±5.37	1124.67 ±42.94	562.33 ±21.47	122.37 ±5.53	82.27 ±4.37	359.92 ±19.80
Gandevi	9.43 ±0.48	7.54 ±0.10	13.47 ±0.16	157.13 ±4.72	815.64 ±54.68	1614.10 ±109.21	134.71 ±1.60	1077.71 ±12.76	538.86 ±6.38	116.53 ±2.41	75.68 ±4.87	300.31 ±21.98
Navsari	8.71 ±0.36	7.67 ±0.11	12.16 ±0.42	146.41 ±8.55	641.09 ±52.02	1388.26 ±146.14	121.64 ±4.22	973.14 ±33.76	486.57 ±16.88	120.69 ±6.95	66.10 ±5.44	284.24 ±26.68
District	9.09 ±0.18	7.60 ±0.06	13.67 ±0.20	178.58 ±8.09	828.12 ±28.40	1871.49 ±78.66	136.68 ±2.05	1093.45 ±16.38	546.73 ±8.16	130.30 ±5.11	75.51 ±2.18	339.88 ±12.04

Table 4.15: Average estimated levels of Cu, Zn, and Mn supplied to lactating cows in Navsari district in comparison to their calculated requirements.

Taluka	MY (kg/d)	Fat (%)	DMI (kg/d)	Mineral intake (mg/day)			Mineral requirement (mg/day)			Mineral intake (% of requirement)		
				Cu	Zn	Mn	Cu	Zn	Mn	Cu	Zn	Mn
Vansda	12.00 ± 0.45	4.36 ± 0.06	12.78 ± 0.13	204.64 ± 13.48	897.98 ± 32.35	1873.95 ± 6.37	127.84 ± 1.31	1022.74 ± 10.44	511.37 ± 5.22	159.93 ± 10.20	87.64 ± 2.76	366.51 ± 11.26
Chikhli	13.68 ± 0.94	4.31 ± 0.07	13.18 ± 0.15	186.20 ± 11.12	929.30 ± 36.63	1947.47 ± 73.55	131.80 ± 1.53	1054.40 ± 12.25	527.20 ± 6.13	140.77 ± 7.59	87.99 ± 2.99	370.22 ± 14.47
Jalalpore	13.68 ± 1.18	4.37 ± 0.10	13.35 ± 0.17	190.80 ± 6.19	1060.43 ± 49.06	1972.34 ± 8282	133.50 ± 1.69	1068.00 ± 13.50	534.00 ± 6.75	142.99 ± 4.46	99.04 ± 4.13	369.34 ± 14.59
Gandevi	12.90 ± 0.62	4.06 ± 0.12	12.94 ± 0.11	173.43 ± 3.49	951.26 ± 31.57	1556.16 ± 101.66	129.40 ± 1.12	1035.20 ± 8.96	517.60 ± 4.48	133.94 ± 2.22	91.68 ± 2.70	300.57 ± 19.63
Navsari	11.21 ± 0.25	4.07 ± 0.12	12.30 ± 0.17	144.86 ± 8.74	624.58 ± 1.49	1574.38 ± 79.24	123.00 ± 1.74	984.00 ± 13.91	492.00 ± 6.95	117.31 ± 6.30	63.11 ± 4.84	319.45 ± 14.94
District	12.70 ± 0.35	4.23 ± 0.05	12.91 ± 0.07	179.92 ± 4.53	893.32 ± 23.24	1782.48 ± 40.18	129.11 ± 0.75	1032.89 ± 5.99	516.45 ± 3.00	138.94 ± 3.24	85.95 ± 1.99	344.75 ± 7.36

Table 4.16: Percent deficit (-)/surplus (+) of Cu, Zn and Mn in buffaloes surveyed

Taluka	Village	Cu	Zn	Mn
Vansda	Chapaldhara	92.46	-21.02	233.04
	Vandervella	24.70	-23.56	297.64
	Average	**58.43**	**-22.29**	**265.34**
Chikhli	Kukeri	28.72	-31.93	285.55
	Sadakpore	25.76	-10.02	343.91
	Average	**27.53**	**-23.17**	**308.89**
Jalalpore	Sarav	13.41	-25.34	255.20
	Abrama	31.32	-10.12	263.83
	Average	**22.37**	**-17.73**	**259.52**
Gandevi	Manekpore	19.11	-21.40	217.38
	Pathri	13.10	-28.22	177.85
	Average	**16.53**	**-24.32**	**200.31**
Navsari	Ashtgam	24.54	-29.46	148.84
	Kumbharfalia	17.81	-37.24	210.29
	Average	**20.69**	**-33.90**	**184.24**
Dist. Average		**30.30**	**-24.49**	**239.88**

Table 4.17: Percent deficit (-)/surplus (+) of Cu, Zn and Mn in cows surveyed

Taluka	Village	Cu	Zn	Mn
Vansda	Chapaldhara	80.62	-13.06	231.01
	Vandervella	36.94	-11.58	305.96
	Average	**59.93**	**-12.36**	**266.51**
Chikhli	Kukeri	49.72	-19.60	251.47
	Sadakpore	32.72	-5.18	287.09
	Average	**40.77**	**-12.01**	**270.22**
Jalalpore	Sarav	45.17	3.69	281.67
	Abrama	40.58	-6.13	255.64
	Average	**42.99**	**-0.96**	**269.34**
Gandevi	Manekpore	35.38	-11.28	146.35
	Pathri	32.50	-5.36	254.79
	Average	**33.94**	**-8.32**	**200.57**
Navsari	Ashtgam	32.32	-23.33	240.47
	Kumbharfalia	0.64	-51.96	196.09
	Average	**17.31**	**-36.89**	**219.45**
Dist. Average		**38.94**	**-14.05**	**244.75**

Table 4.20: Availability and requirement of Ca, P, Cu, Zn, and Mn for a milch cows (400kg) producing 10-12 kg 4% FCM per day in Navsari district.

Feedstuffs	DMI (kg/d)	Daily intake				
		Ca (g)	P (g)	Cu (mg)	Zn (mg)	Mn (mg)
Concentrates	4.97	68.78	71.82	107.97	579.02	709.85
Green fodder	3.75	17.83	10.40	31.84	132.97	216.78
Dry fodder	3.95	11.67	4.92	26.81	111.58	843.77
Daily intake	12.67	98.28	87.14	166.44	823.56	1770.40
Daily requirement	-	51.01	32.60	126.71	1013.71	506.86
Intake as % of requirement	-	193.07	268.60	131.11	80.71	349.14

Table 4.18: Availability and requirement of Ca, P, Cu, Zn, and Mn for a milch buffaloes (450kg) producing 8-10 kg 6% FCM per day in Navsari district.

Feedstuffs	**DMI (kg/d)**	**Daily intake**				
		Ca (g)	**P (g)**	**Cu (mg)**	**Zn (mg)**	**Mn (mg)**
Concentrates	3.90	53.47	50.18	92.69	444.95	513.17
Green fodder	4.22	26.60	11.75	42.73	149.04	209.46
Dry fodder	5.18	15.14	6.23	34.77	145.05	1116.62
Daily intake	13.30	95.21	68.16	170.18	739.04	1839.25
Daily requirement	-	62.53	40.58	132.96	1063.67	531.83
Intake as % of requirement	-	151.93	168.06	127.15	69.16	342.51

Table 4.21: Availability and requirement of Ca, P, Cu, Zn, and Mn for a milch cows (400kg) producing 12-16 kg 4% FCM per day in Navsari district.

Feedstuffs	**DMI (kg/d)**	**Daily intake**				
		Ca (g)	**P (g)**	**Cu (mg)**	**Zn (mg)**	**Mn (mg)**
Concentrate	5.87	78.36	85.49	138.73	689.94	828.08
Green fodder	3.46	15.96	8.86	29.45	120.23	170.70
Dry fodder	3.76	11.69	5.18	25.96	108.38	744.91
Daily intake	13.09	106.02	99.54	194.14	918.55	1743.69
Daily requirement	-	60.13	38.22	130.86	1046.88	523.44
Intake as % of requirement	-	176.74	259.51	148.17	87.43	332.02

Table4.19: Availability and requirement of Ca, P, Cu, Zn, and Mn for a milch buffaloes (450kg) producing 10-13 kg 6% FCM per day in Navsari district.

Feedstuffs	**DMI (kg/d)**	**Daily intake**				
		Ca (g)	**P (g)**	**Cu (mg)**	**Zn (mg)**	**Mn (mg)**
Concentrate	4.82	67.98	68.74	11.43	580.71	656.24
Green fodder	4.22	21.71	12.42	38.33	159.61	254.53
Dry fodder	4.84	15.14	6.60	33.63	138.71	979.15
Daily intake	13.88	104.82	87.76	183.38	879.02	1889.92
Daily requirement	-	71.12	45.90	138.81	1110.48	555.24
Intake as % of requirement	-	147.24	191.90	132.10	79.10	338.39

Table 4.22: Suggested supplementation of Zn to obviate deficiency in cows.

Taluka	**Mineral mixture as per BIS specification (g/d)**	
	Buffalo	**Cow**
Vansda	35	15
Chikhli	35	15
Jalalpore	25	Adequate
Gandevi	35	15
Navsari	45	45
District	35	20

Table 2.1: Average percentage DCP (%) and TDN (%) intake by buffaloes, taluka wise in Mehsana district during different seasons (Anonymous, 1991).

Season	Taluka	DCP (%)			TDN (%)		
		U	A	O	U	A	O
Summer	Vijapur	15.00	20.00	65.00	40.00	30.00	30.00
	Mehsana	10.56	47.22	47.22	36.11	36.66	27.22
	Kadi	5.00	42.22	52.77	10.00	78.88	11.11
	Kheralu	10.56	68.33	21.11	5.00	95.00	-
	Patan	10.00	50.00	40.00	10.00	70.00	20.00
	Average	**10.00±1.42**	**45.55±6.94**	**45.22±6.51**	**20.22±6.58**	**62.11±11.14**	**17.67±4.91**
Monsoon	Vijapur	5.56	72.21	22.22	11.11	66.67	22.22
	Mehsana	34.28	43.57	27.14	29.23	48.57	22.14
	Kadi	22.22	72.22	5.56	11.11	55.55	33.33
	Kheralu	25.00	50.55	25.00	25.00	55.00	20.00
	Patan	35.00	60.00	5.00	20.00	35.00	45.00
	Average	**24.41±4.77**	**59.60±5.17**	**16.98±4.33**	**19.30±3.27**	**52.16±4.64**	**28.54±4.23**
Winter	Vijapur	15.00	55.00	30.00	40.00	50.00	10.00
	Mehsana	-	33.63	66.36	4.54	66.82	28.63
	Kadi	-	70.00	30.00	50.00	45.00	5.00
	Kheralu	10.00	30.00	60.00	50.00	50.00	-
	Patan	10.00	11.11	68.89	30.56	41.66	27.77
	Average	**7.00±2.68**	**39.95±9.16**	**51.05±7.79**	**35.02±7.54**	**50.70±3.87**	**14.28±5.28**

U = Under feeding, A = Adequate feeding, O = Over feeding

Table 2.8 : Feeding plane of buffaloes in Sabarkantha district of North Gujarat(Ghogale, 2003)

Taluka	Village	MY	6 % FCM	DMI	Available Nutrients (kg/day)		Require Nutrients (kg/day)		Available Nutrients (% of requirement)	
		kg/day			DCP	TDN	DCP	TDN	DCP	TDN
Khedbrahma	Matoda	10.84	11.54	16.19	0.98	10.31	1.06	9.35	95.50	108.93
	Morad	10.63	11.07	16.05	1.14	10.02	1.03	9.16	108.96	109.17
	Average	**10.73**	**11.31**	**16.12**	**1.06**	**10.17**	**1.04**	**9.25**	**102.23**	**109.05[b]**
Idar	Phinchod	10.40	11.26	14.55	1.11	9.31	1.02	9.24	109.21	100.90
	Kapoda	11.44	12.78	16.57	1.08	10.62	1.11	9.89	99.98	109.10
	Average	**10.92**	**12.02**	**15.56**	**1.09**	**9.97**	**1.07**	**9.57**	**104.60**	**105.00[a]**
Bhiloda	Rajendranagar	10.15	10.95	16.06	0.99	10.20	1.02	9.11	97.54	112.56
	Ramnagar	10.73	11.83	16.95	1.11	10.63	1.06	9.37	104.59	113.47
	Average	**10.44**	**11.39**	**16.51**	**1.05**	**10.42**	**1.04**	**9.24**	**101.06**	**113.02[a]**
Bayad	Demai	11.00	11.99	16.30	1.01	10.49	1.09	9.56	83.99	110.04
	Ubharan	10.00	11.50	16.45	1.03	10.46	1.05	9.35	98.35	111.73
	Average	**10.50**	**11.74**	**16.38**	**1.02**	**10.48**	**1.07**	**9.45**	**91.17**	**110.88[a]**
Modasa	Dugarwada	10.09	11.45	16.77	1.20	11.11	1.05	9.33	99.34	105.44
	Medhasan	10.18	10.68	15.44	1.00	10.02	1.00	9.00	100.17	111.67
	Average	**10.14**	**11.07**	**16.11**	**1.10**	**10.57**	**1.03**	**9.16**	**99.76**	**108.58**
Dist. Average		**10.58**	**11.54**	**16.14**	**1.06**	**10.30**	**1.05**	**9.35**	**99.76**	**109.35**

Means bearing different superscripts within column differ significantly (P< 0.05)

Table 2.10 : Percent deficiency / excess of nutrients in buffaloes in Sabarkantha district of North Gujarat (Ghogale, 2003)

Taluka	Village	Percent deficit/ excess in buffaloes	
		DCP	TDN
Khedbrahma	Matoda	- 4.50	8.93
	Morad	8.96	9.17
	Average	**2.23**	**9.05**
Idar	Phinchod	9.21	0.90
	Kapoda	-0.02	9.10
	Average	**4.60**	**5.00**
Bhiloda	Rajendranagar	-2.46	12.56
	Ramnagar	4.59	13.47
	Average	**1.06**	**13.02**
Bayad	Demai	-16.01	10.04
	Ubharan	-1.65	11.73
	Average	**-8.83**	**10.88**
Modasa	Dugarwada	- 0.66	5.44
	Medhasan	0.17	11.67
	Average	**- 0.24**	**8.55**
Dist. Average		**-0.24**	**9.55**

Table 2.9 : Feeding plane of cows in Sabarkantha district of North Gujarat (Ghogale, 2003)

Taluka	Village	MY	4 % FCM	DMI	Available Nutrients (kg/day)		Require Nutrients (kg/day)		Available Nutrients (% of requirement)	
		kg/day			DCP	TDN	DCP	TDN	DCP	TDN
Khedbrahma	**Matoda**	11.06	11.16	12.70	0.84	8.19	0.83	7.18	101.84	114.49
	Morad	12.42	12.08	12.84	0.92	8.27	0.89	7.44	103.37	112.19
	Average	**11.74** [a]	**11.62** [a]	**12.77**	**0.93**	**8.23**	**0.86**	**7.31**	**102.64**	**113.34**
Idar	**Phinchod**	14.78	14.41	12.65	1.08	8.55	1.02	8.31	108.05	103.80
	Average	**14.78** [b]	**14.41** [b]	**12.65**	**1.08**	**8.55**	**1.02**	**8.31**	**108.05**	**103.80**
Bhiloda	**Rajendranagar**	12.57	13.43	11.61	0.91	8.21	0.95	7.92	95.90	104.95
	Ramnagar	12.60	13.43	12.05	0.98	7.92	0.95	7.92	104.77	100.94
	Average	**12.59** [a]	**13.43** [b]	**11.83**	**0.95**	**8.07**	**0.95**	**7.92**	**100.34**	**102.94**
Bayad	**Demai**	14.00	14.40	11.53	0.83	7.97	1.01	8.23	84.79	98.10
	Ubharan	14.91	15.05	12.86	0.93	8.80	1.05	8.48	92.60	104.23
	Average	**14.45** [b]	**14.73** [b]	**12.20**	**0.88**	**8.38**	**1.03**	**8.36**	**88.70**	**101.17**
Modasa	**Dugarwada**	12.67	13.69	12.77	0.99	8.62	0.93	8.08	107.03	107.67
	Medhasan	14.00	13.40	13.19	0.92	8.51	0.96	8.01	99.77	111.51
	Average	**13.33** [b]	**13.55** [b]	**12.98**	**0.95**	**8.56**	**0.95**	**8.05**	**103.40**	**109.59**
Dist. Average		**13.45**	**13.66**	**12.45**	**0.96**	**8.36**	**0.97**	**8.03**	**101.53**	**105.71**

Means bearing different superscripts within column differ significantly (P< 0.05)

Table 2.11 : Percent deficiency / excess of nutrients in cows in Sabarkantha district of North Gujarat (Ghogale, 2003).

Taluka	Village	Percent deficit/ excess in cows	
		DCP	TDN
Khedbrahma	Matoda	1.84	14.49
	Morad	17.07	12.19
	Average	**9.45**	**13.34**
Idar	Phinchod	8.05	3.80
	Average	**8.05**	**3.80**
Bhiloda	Rajendranagar	-4.10	4.95
	Ramnagar	4.77	0.94
	Average	**0.34**	**2.94**
Bayad	Demai	-15.21	-1.90
	Ubharan	-7.40	4.23
	Average	**-11.30**	**1.17**
Modasa	Dugarwada	7.03	7.67
	Medhasan	-0.23	11.51
	Average	**3.40**	**9.59**
Dist. Average		**1.53**	**5.71**

Table 2.2 : Feeding plane of buffaloes in Patan district of North Gujarat (Chavda, 2003)

Taluka	Village	MY	6 % FCM	DMI	Nutrient Intake (kg/d)		Nutrients Requirement (kg/d)		Nutrient Intake (% of Requirement)	
		(kg/d)			DCP	TDN	DCP	TDN	DCP	TDN
Siddhpur	Methan	12.33	14.40	16.20	1.248	9.50	1.122	9.46	110.72	100.33
	Nagwasan	11.77	13.33	15.47	1.031	9.51	1.061	9.03	97.34	105.26
	Average	**12.05**	**13.87**	**15.83**	**1.140**	**9.51**	**1.091**	**9.24**	**104.03**	**102.79**
Patan	Balisana	11.69	13.53	16.15	1.009	9.56	1.072	9.11	94.30	105.05
	Anavada	10.67	11.25	17.88	0.929	10.17	0.942	8.17	98.37	124.56
	Average	**11.18**	**12.39**	**17.02**	**0.969**	**9.86**	**1.007**	**8.64**	**96.33**	**114.80**
Chanasma	Mithi Ghariyal	12.76	14.82	17.35	1.130	10.92	1.146	9.64	98.99	113.86
	Islampura	11.00	12.72	16.57	1.117	9.72	1.026	8.77	108.37	110.75
	Average	**11.88**	**13.77**	**16.96**	**1.124**	**10.32**	**1.086**	**9.20**	**103.68**	**112.31**
Harij	Dunavada	10.32	11.27	16.41	1.071	9.93	0.943	8.18	113.69	121.39
	Boratvada	10.71	12.05	18.05	0.923	10.81	0.988	8.50	93.66	127.71
	Average	**10.52**	**11.66**	**17.23**	**0.997**	**10.37**	**0.966**	**8.34**	**103.68**	**124.55**
Sami	Mujpur	10.75	12.21	17.26	1.128	10.49	0.997	8.57	113.63	122.99
	Rafu	10.43	11.99	18.07	0.900	11.05	0.985	8.48	92.10	131.14
	Average	**10.59**	**12.10**	**17.66**	**1.014**	**10.77**	**0.991**	**8.52**	**102.86**	**127.06**
District	Average	**11.24**	**12.76**	**16.94**	**1.049**	**10.17**	**1.028**	**8.79**	**102.12**	**116.30**

Table 2.4: Percent deficit (-)/surplus (+) of nutrients in buffaloes surveyed in Patan district of North Gujarat (Chavda, 2003).

Taluka	Village	Nutrients	
		DCP	**TDN**
Siddhpur	Methan	+10.72	+0.33
	Nagvasana	-2.66	+5.26
	Average	**+4.03**	**+2.79**
Patan	Balisana	-5.70	+5.05
	Anaavada	-1.63	+24.56
	Average	**-3.67**	**+14.80**
Chansma	Mithighariyal	+1.01	+13.86
	Islampura	+8.37	+10.75
	Average	**+3.68**	**+24.55**
Harij	Dunavada	+13.69	+21.39
	Boratvada	-6.34	+27.71
	Average	**+3.68**	**+24.55**
Sami	Mujpur	+13.63	+22.99
	Rafu	-7.90	+31.14
	Average	**+2.86**	**+27.06**
District	**Average**	**+2.12**	**+16.30**

Table 2.3 : Feeding plane of cows in Patan district of North Gujarat(Chavda, 2003)

Village	MY	4 % FCM	DMI	Nutrient Intake (kg/d)		Nutrients Requirement (kg/d)		Nutrients Intake (% of Requirement)	
	(kg/d)			DCP	TDN	DCP	TDN	DCP	TDN
Methan	15.45	16.66	15.04	1.270	8.70	1.129	9.00	112.57	98.34
Nagwasan	17.78	18.73	14.27	1.044	9.07	1.243	9.74	83.76	93.55
Balisana	10.71	11.20	12.80	0.853	7.59	0.832	7.19	102.89	105.64
Mujpur	10.83	11.26	13.70	0.916	8.20	0.836	7.21	110.04	113.87

Table 2.12 : Percent of buffaloes underfed, moderately underfed, adequately fed, moderately overfed and overfed out those surveyed in Sabarkantha district of North Gujarat(Ghogle, 2003).

Taluka	DCP					TDN				
	U	MU	A	MO	O	U	MU	A	MO	O
Khedbrahma	42.10	14.28	28.57	15.06	0	5	15.36	57.87	21.77	5
Idar	24.24	18.18	6.06	39.39	12.12	12.12	27.27	30.30	21.21	9.09
Bhiloda	25.00	17.85	28.57	17.85	10.71	3.57	-	39.28	46.42	10.71
Bayad	50.00	5.00	25.00	15.00	5.00	5	15	30	40	10
Modasa	22.72	31.81	-	18.18	27.27	-	2	6	11	3

Table 2.13 : Percent of cows underfed, moderately underfed, adequately fed, moderately overfed and overfed out those surveyed in Sabarkantha district of North Gujarat (Ghogle, 2003)

Taluka	DCP					TDN				
	U	MU	A	MO	O	U	MU	A	MO	O
Khedbrahma	24.13	25.86	3.44	32.75	15.51	3.00	4.00	14.00	27.00	10.00
Idar	22.22	11.11	22.22	11.11	33.33	-	66.66	-	33.33	-
Bhiloda	41.17	11.76	11.76	17.64	17.64	17.64	52.94	11.76	58.82	11.76
Bayad	48.00	20.00	24.00	8.00	-	20.00	28.00	24.00	28.00	-
Modasa	30.00	10.00	30.00	10.00	20.00	10.00	20.00	10.00	40.00	20.00

U-Underfed (<90 % of requirement), MU-Moderately Underfed (>90 to <100 % of requirement), A-Adequately fed (>100 to <110 % of requirement), MO – Moderately overfed (>110 to < 125 % of requirement), O – Overfed-(>125% of requirement)

Table 2.6: Percent of buffaloes underfed, moderately underfed, adequately fed, moderately overfed and overfed out those surveyed in Patan district of North Gujarat (Chavda, 2003)..

Taluka	DCP					TDN				
	U	MU	A	MO	O	U	MU	A	MO	O
Sidhpur	6.98	39.53	34.88	11.63	6.98	-	23.25	44.19	32.56	-
Patan	32.14	35.17	14.29	14.29	3.57	-	7.14	39.29	25.00	28.57
Chanasma	22.58	12.90	19.35	38.17	8.46	-	3.23	29.03	58.06	9.68
Harij	23.26	16.28	30.23	18.60	11.63	-	-	9.30	51.16	39.54
Sami	31.28	27.27	13.64	18.18	9.09	-	9.09	9.09	13.64	68.18

Table 2.7: Percent of cows underfed, moderately underfed, adequately fed, moderately overfed and overfed out those surveyed in Patan district of North Gujarat (Chavda, 2003).

Taluka	DCP					TDN				
	U	MU	A	MO	O	U	MU	A	MO	O
Methan	27.27	18.18	9.09	9.09	36.37	27.27	27.27	27.27	9.09	9.09
Nagvasana	77.77	16.67	5.56	-	-	27.77	61.11	5.56	5.56	-
Balisana	-	28.57	57.14	14.29	-	-	-	100.00	-	-
Mujpur	-	16.67	16.67	66.66	-	-	-	16.67	83.33	-

U-Underfed (<90 % of requirement), MU-Moderately Underfed (>90 to <100 % of requirement), A-Adequately fed (>100 to <110 % of requirement), MO – Moderately overfed (>110 to < 125 % of requirement), O – Overfed-(>125% of requirement)

Table 2.14: Nutritional status of animals in Surendranagar district (Parnerkar *et al.* 2006)

Particulars	DCP			TDN		
	Winter	**Summer**	**Monsoon**	**Winter**	**Summer**	**Monsoon**
Cows						
Under fed	73	66	61	12	52	36
Adequately fed	17	25	27	57	30	49
Over fed	10	09	12	31	18	15
Buffaloes						
Under fed	58	56	40	18	38	30
Adequately fed	23	33	48	47	33	45
Over fed	19	11	12	35	29	25

Table 2.15: Average estimated level of nutrient supplied to buffaloes in comparison to their calculated requirements (Lal *et al.*, 1995).

	DM (kg)	**DCP (%) (g)**	**TDN (%) (kg)**
Category I			
Estimated requirement	11.5±0.3 (10-12)	600 (382-900)	5.6±0.40 (4-6)
Actually supplied	8.35±1.2 (7-12)	402 (280-800)	4.0±0.56 (3.0-5.8)
Percent deviation	-28 (10-40)	-33 (8-50)	-29 (12-50)
Category II			
Estimated requirement	14.2±0.2 (12-15)	1120 (1000-1500)	10.0 (8.0-12.8)
Actually supplied	14.0±0.5 (12-15)	975 (780-1500)	7.4 (6.6-8.4)
Percent deviation	Nil	-12 (-20 to +20)	-24 (18 to 40)

( ): Figures given in parentheses indicates range.

Table 2.35 : Average estimated levels of Cu, Mn and Zn supplied to cows in comparison to their calculated requirements in Patan district of Gujarat (Chavda, 2003).

Village	Mineral Intake (mg/d)			Mineral Requirement (mg/d)			Mineral Intake (% of Requirement)		
	Zn	Cu	Mn	Zn	Cu	Mn	Zn	Cu	Mn
Methan	987.08	150.36	925.98	1203.42	150.43	601.71	81.71	99.44	153.63
Nagwasan	1030.29	173.84	839.06	1141.82	142.73	570.91	90.22	122.08	147.93
Balisana	774.33	97.19	820.97	1023.77	127.97	511.89	75.90	76.03	160.68
Mujpur	570.65	156.45	712.43	1095.73	136.97	547.87	52.05	114.21	130.03

Table 2.36 : Percent deficit (-)/surplus (+)of Cu, Mn and Zn in cows surveyed in Patan district of Gujarat (Chavda, 2003).

Village	Cu	Mn	Zn
Methan	-0.56	+53.63	-18.29
Nagvasana	+22.08	+47.93	-9.78
Balisana	-23.97	+60.68	-24.10
Mujpur	+14.21	+30.03	-47.95

Table 2.37 : Percent deficit (-)/surplus (+) of Cu, Mn and Zn in buffaloes surveyed in Patan district of Gujarat (Chavda, 2003).

Taluka	Village	Cu	Mn	Zn
Siddhpur	Methan	-6.95	+31.27	-30.03
	Nagvasana	-0.42	+25.65	-26.90
	Average	**-3.69**	**+28.46**	**-28.46**
Patan	Balisana	-4.94	+47.42	-37.38
	Anaavada	-48.40	+12.98	-44.48
	Average	**-26.33**	**+30.20**	**-40.93**
Chansma	Mithighariyal	-37.08	+32.00	-52.88
	Islampura	-22.21	+48.37	-42.04
	Average	**-29.64**	**+40.19**	**-47.46**
Harij	Dunavada	-20.16	+26.22	-39.16
	Boratvada	-34.41	+9.10	-57.18
	Average	**-27.28**	**+17.66**	**-48.17**
Sami	Mujpur	-3.99	+12.15	-64.68
	Rafu	-22.03	+19.49	-68.96
	Average	**-13.01**	**+15.82**	**-66.82**
District	**Average**	**-20.06**	**+26.47**	**46.37**

Table 2.16 : Nutrients supply to milch buffaloes under different categories (Lal *et al.*, 1998[a]).

Category	Nutrients (kg)			
		DM (kg)	**DCP (%)**	**TDN (%)**
I	Supplied	-	-	-
	Required	8.8	0.525	5.0
II	Supplied	11.6	0.775	6.62
	Required	11.5	0.820	7.30
	% Short	-	5.5	9.31
III	Supplied	15.75	1.282	9.81
	Required	14.00	1.200	10.50
	% Short	-	-	6.5

Table 2.17 : Nutritional status of high yielding Murrah buffalo (Lal *et al.*, 1999).

Season	Nutrients (kg)			
		DM (kg)	**DCP (%)**	**TDN (%)**
Winter	Supplied	17.40	1.907	12.08
	Required	17.18	1.500	12.50
	Excess (+)/deficit (-)	+ 0.22	+ 0.407	- 0.42
Summer	Supplied	17.0	1.870	11.93
	Required	17.0	1.250	11.20
	Excess (+)/deficit (-)	0.0	+ 0.620	+ 0.73

Table 2.18 : Feeding plane of milch buffaloes with different levels of milk production (Singh *et al.*, 2001).

Milk Yield (kg)	TDN (%) (kg)			CP (kg)		
	Required	Supplied	% Excess	Required	Supplied	% Excess
8.81±0.43 (5.5-10.0)	7.17^{b}±0.06 (5.64-8.86)	7.64^{a}±0.07 (5.30-10.68)	6.42	1.300^{y}±0.01 (0.933-1.637)	1.471^{x}±0.09 (0.470-2.500)	13.15
12.60±0.17 (11-18)	9.25^{b}±0.08 (8.08-11.87)	9.77^{a}±0.13 (6.70-11.93)	5.56	1.780^{y}±0.02 (1.543-2.418)	2.054^{x}±0.04 (1.175-2.584)	15.52

( ) :Figures given in parentheses indicates range.

Table 2.19 : Average DM (KG), DCP (%) and TDN (%) supplied to the animal round the year (kg/h/d) (Lal *et al.*, 1998[b]).

Season	Category of farmers					Average
	Landless	Marginal	Small	Medium	Large	
Dry Matter						
Rainy	$10.97^{a}\pm0.16$	$10.04^{b}\pm0.18$	$12.32^{b}\pm0.17$	$12.16^{b}\pm0.22$	$11.96^{b}\pm0.19$	11.89 ± 0.1
Winter	13.03 ± 0.24	12.63 ± 0.20	12.71 ± 0.18	12.97 ± 0.19	12.87 ± 0.16	12.84 ± 0.21
Summer	$10.72^{a}\pm0.13$	$11.97^{b}\pm0.20$	$12.20^{a}\pm0.23$	$12.00^{bc}\pm0.22$	$11.68^{bc}\pm0.25$	11.71 ± 0.24
DCP (%)						
Rainy	$0.45^{a}\pm0.02$	$0.52^{b}\pm0.07$	$0.62^{c}\pm0.04$	$0.64^{c}\pm0.04$	$0.59^{c}\pm0.05$	0.58 ± 0.04
Winter	$0.40^{a}\pm0.01$	$0.56^{b}\pm0.02$	$0.74^{c}\pm0.02$	$0.79^{c}\pm0.02$	$0.78^{c}\pm0.02$	0.65 ± 0.02
Summer	$0.39^{a}\pm0.01$	$0.50^{b}\pm0.01$	$0.55^{c}\pm0.01$	$0.58^{c}\pm0.01$	$0.54^{c}\pm0.02$	0.51 ± 0.02
TDN (%)						
Rainy	$5.89^{a}\pm0.19$	$6.32^{b}\pm0.08$	$6.51^{b}\pm0.21$	$6.87^{c}\pm0.12$	$6.76^{c}\pm0.16$	6.47 ± 0.22
Winter	$6.28^{a}\pm0.13$	$6.42^{ab}\pm0.09$	$6.72^{b}\pm0.09$	$7.09^{c}\pm0.11$	$70.8^{c}\pm0.11$	$6.72^{c}\pm0.12$
Summer	$5.61^{a}\pm0.07$	$6.29^{b}\pm0.10$	$6.37^{b}\pm0.13$	$6.37^{b}\pm0.14$	$6.17^{b}\pm0.14$	6.16 ± 0.14

a,b,c Figure bearing different superscripts in a row differ significantly ($P<0.01$).

Table 2.20 : Intake of DM (KG), DCP (%) and TDN (%) (kg/d) in buffaloes maintained by different groups of farmers(Singh *et al.*, 1998).

Particular		Groups of farmers			
		I	II	III	IV
DM (KG)	**Calves**	$2.33^{a}\pm0.16$	$2.44^{a}\pm0.13$	$1.19^{b}\pm0.18$	$2.50^{a}\pm0.26$
	Non-milch	$4.77^{a}\pm0.50$	$5.87^{a}\pm0.56$	$6.23^{b}\pm0.46$	$5.19^{c}\pm0.46$
	Milch	9.18 ± 0.15	9.64 ± 0.23	9.93 ± 0.20	9.50 ± 0.22
DCP (%)	**Calves**	$0.03^{a}\pm0.01$	$0.04^{a}\pm0.02$	$0.07^{b}\pm0.02$	$0.08^{b}\pm0.01$
	Non-milch	0.05 ± 0.01	0.09 ± 0.02	0.11 ± 0.02	0.08 ± 0.01
	Milch	0.31 ± 0.02	0.33 ± 0.02	0.36 ± 0.01	0.37 ± 0.02
TDN (%)	**Calves**	$0.98^{a}\pm0.07$	$1.09^{b}\pm0.07$	0.86 ± 0.09	$1.08^{b}\pm0.11$
	Non-milch	2.13 ± 0.27	2.70 ± 0.28	2.70 ± 0.25	2.28 ± 0.29
	Milch	4.24 ± 0.10	4.40 ± 0.12	4.58 ± 0.13	4.44 ± 0.13

a,b,c Figure bearing different superscripts in a row for a category differ significantly ($P<0.05$).

Table 2.21 : Average quantity of nutrients offered to and required by the different categories of animals with the mean values of offered/required ratio (Sharma and Chander, 1968).

Nutrients	Categories of Animals			
	Cows in milk (kg)	**Buffaloes in milk (kg)**	**Cows dry (kg)**	**Buffaloes dry (kg)**
Dry Matter				
Offered	7.44	9.98	6.26	10.25
Required	4.81	9.30	4.90	9.75
Mean value of offered/required ratio	1.55±0.13	1.09±0.08	1.28±0.09	0.97± 0.08
DCP (%)				
Offered	0.118	0.207	0.112	0.119
Required	0.225	0.397	0.204	0.297
Mean value of offered/required ratio	0.58± 0.15	0.54± 0.06	0.57± 0.13	0.42± 0.12
TDN (%)				
Offered	3.31	4.60	2.98	4.39
Required	2.29	4.15	2.32	3.51
Mean value of offered/required ratio	1.47± 0.14	1.11± 0.07	1.45± 0.13	1.30± 0.14

Table 2.22 : Average quantity of nutrients offered and nutrients available to the stall-fed animals in comparison with their requirements (Sharma and Chander, 1971).

Nutrients	Categories of Animals			
	Cows in milk (kg)	Cows dry (kg)	Buffaloes in milk (kg)	Buffaloes dry (kg)
Dry Matter				
Required	5.59	4.68	10.50	9.82
Offered	6.32	4.18	10.13	9.36
Available	4.95	4.00	8.68	7.82
Mean of ratios of available/required quantities	0.97	0.85	0.83	0.79
DCP (%)				
Required	0.264	0.217	0.332	0.327
Offered	0.141	0.073	0.236	0.058
Available	0.141	0.073	0.236	0.058
Mean of ratios of available/required quantities	0.58	0.29	0.72	0.24
TDN (%)				
Required	2.59	2.44	3.70	3.73
Offered	3.55	2.24	5.06	4.58
Available	2.95	2.11	4.34	3.85
Mean of ratios of available/required quantities	1.14	0.95	1.16	1.07

Table 2.23 : Intake of DM (kg), DCP (%) and TDN (%) in buffaloes maintained by different land holding groups (Randhe *et al.*, 1993).

Nutrient Intake	Buffaloes	Land holding groups of farmers						
		I	II	III	IV	V	VI	VII
DM (kg)	Dry	4.61±0.15	4.78±0.26	3.89±0.20	4.99±0.16	5.54±0.09	5.44±0.14	5.40±0.18
	Milch	5.57±0.16	5.51±0.13	5.69±0.16	5.64±0.14	5.68±0.15	5.76±0.14	6.31±0.13
DCP (kg)	Dry	0.192± 36.61	0.209± 40.34	0.224± 37.56	0.237± 30.62	0.285± 34.16	0.267± 49.10	0.291± 60.01
	Milch	0.421± 24.03	0.422± 25.89	0.414± 26.16	0.413± 22.81	0.455± 27.70	0.514± 23.20	535.47± 21.89
TDN (kg)	Dry	5.34±0.24	5.38±0.24	4.85±0.37	5.52±0.17	5.72±0.23	5.46±0.30	5.91±0.23
	Milch	5.19±0.11	6.02±0.12	5.95±0.20	6.06±0.18	6.38±0.16	6.23±0.14	6.60±0.14

Table 2.24 : Deficit (-)/Surplus (+) of nutrient in buffaloes maintained by different landholding groups (Randhe *et al.*, 1993).

Nutrient Intake	Buffaloes	Land holding groups of farmers						
		I	II	III	IV	V	VI	VII
DM (kg)	Dry	-0.64* (12.19)	-0.47 (8.95)	-0.86 (16.38)	-0.26 (4.95)	+0.29* (5.52)	+0.19 (3.61)	+0.15 (2.85)
	Milch	-2.43* (30.37)	-2.49* (31.13)	-3.31* (28.87)	-2.36 (29.5)	-2.32* (29.0)	-2.24* (28.0)	-1.69* (21.12)
DCP (%)	Dry	+5.14 (2.74)	+22.63 (12.10)	+37.88 (20.25)	+50.25 (26.87)	+98.20* (52.51)	+80.83 (43.22)	+104.75* (56.01)
	Milch	-43.49 (9.35)	-28.92 (6.40)	-86.37* (17.60)	-68.83* (14.28)	-49.14 (9.73)	-8.18 (1.56)	-24.47 (4.37)
TDN (%)	Dry	+3.07* (135.24)	+3.11* (137.00)	+2.58* (113.65)	+3.25* (143.17)	+3.45* (151.98)	+3.19* (140.52)	+3.64* (160.35)
	Milch	+1.47* (33.10)	+1.68* (38.70)	+1.34* (29.06)	+1.51* (38.18)	+1.66* (35.16)	+1.39* (28.71)	+1.50* (29.41)

* = $P<0.05$

Table 2.25 : Season wise DM (KG)I (kg/d) of milch Marathwadi buffaloes (Patange *et al.*, 2002).

Season	Category					Average
	I	II	III	IV	V	
Monsoon	$6.32^{a}\pm0.19$	$6.45^{a}\pm0.19$	$6.64^{a}\pm0.16$	$6.87^{a}\pm0.25$	$8.34^{b}\pm0.13$	7.11 ± 0.15
Winter	$7.03^{a}\pm0.10$	$7.73^{b}\pm0.10$	$7.92^{b}\pm0.13$	$8.81^{c}\pm0.20$	$8.98^{c}\pm0.13$	8.22 ± 0.10
Summer	$5.30^{a}\pm0.17$	$9.53^{b}\pm0.13$	$8.45^{c}\pm0.16$	$10.65^{c}\pm0.25$	$9.68^{d}\pm0.13$	8.39 ± 0.14
Average	$6.18^{a}\pm0.10$	$6.86^{b}\pm0.17$	$7.65^{c}\pm0.14$	$8.80^{d}\pm0.11$	$9.10^{c}\pm0.11$	7.61 ± 0.13

a,b,c,d Figure bearing different superscripts in a row differ significantly (P<0.05).

Table 2.26 : Daily DCP (%) and TDN (%) (kg) supplied to milch Marathwadi buffaloes in different season (kg ± S.E.) (Patange *et al.*, 2002).

Season	Nutrient		Category					Average
			I	II	III	IV	V	
Monsoon	**DCP (%)**	Supplied	0.420^{b}±0.006	0.338^{a}±0.005	0.346^{a}±0.007	0.464^{c}±0.007	0.523^{d}±0.005	0.422±0.002
		% Deficit (+) Surplus	±0.71	-42.80	-42.77	-7.54	±2.86	-15.16
	TDN (%)	Supplied	3.70^{a}±0.07	3.78^{a}±0.03	3.94^{b}±0.09	4.13^{c}±0.04	4.98^{d}±0.05	4.23±0.12
		% Deficit (+) Surplus	-14.05	-25.69	-21.06	-16.46	+2.00	-11.58
Winter	**DCP (%)**	Supplied	0.455^{b}±0.008	0.386^{a}±0.010	0.440^{b}±0.008	0.539^{c}±0.011	0.468^{b}±0.004	0.458±0.003
		% Deficit (+) Surplus	-8.13	-40.67	-20.22	-0.55	-18.16	-16.81
	TDN (%)	Supplied	4.23^{a}±0.10	4.49^{a}±0.07	4.65^{b}±0.05	5.32^{c}±0.04	5.18^{c}±0.03	4.83±0.04
		% Deficit (+) Surplus	-12.52	-14.25	-8.17	+3.75	-0.38	-4.96
Summer	**DCP (%)**	Supplied	0.365^{a}±0.00	0.418^{b}±0.004	0.520^{c}±0.010	0.613^{d}±0.012	0.436^{b}±0.009	0.471±0.002
		% Deficit (+) Surplus	-20.2	-25.83	+0.73	+16.43	-13.9	-5.94
	TDN (%)	Supplied	3.18^{a}±0.03	3.81±0.03	5.04^{c}±0.04	6.02±0.05	6.26^{c}±0.04	5.10±0.09
		% Deficit (+) Surplus	-37.73	-31.23	+2.77	18.43	+23.48	+5.68
Average	**DCP (%)**	Supplied	0.418^{b}±0.004	0.393^{a}±0.002	0.452^{c}±0.006	0.551^{e}±0.006	0.500^{d}±0.003	0.460±0.003
		% Deficit (+) Surplus	-11.96	-33.07	-13.71	+5.08	-5.2	-10.86
	TDN (%)	Supplied	3.71^{a}±0.05	4.05^{b}±0.04	4.53^{c}±0.03	5.17^{d}±0.03	5.35^{e}±0.02	4.65±0.02
		% Deficit (+) Surplus	-23.45	-22.96	-8.6	+3.67	+6.35	-5.80

a,b,c,d,e Figure bearing different superscripts in a row differ significantly (P<0.05).

Table 2.27 : Daily DCP (%) and TDN (%) (Kg) supplied to milch Marathwadi buffaloes in different season (kg ± S.E.) (Handa and Gill, 1989).

Nutrients	Category				Cluster		Ludhiana district
	I	II	III	IV	Doraha	Jagraon	
Supplied (kg/h/d)							
DM (Kg)	8.95±0.56	11.85±0.32	10.89±0.39	12.69±0.20	11.54±0.27	10.65±0.38	11.10±0.24
DCP (%)	0.40±0.01	0.82±0.05	0.67±0.07	0.68±0.06	0.65±0.05	0.68±0.14	0.67±0.07
TDN (%)	4.12±0.19	7.399±0.23	6.51±0.26	7.91±0.16	6.47±0.27	6.46±0.25	6.46±0.18
% of Requirement							
DCP (%)	89.6	128.3	118.5	112.3	109.9	118.3	114.9
TDN (%)	88.3	134.7	120.1	138.7	115.5	119.1	117.1

Table 2.28 : Average nutrient intake per milch animal (Badal and Dhaka, 1998).

	Per milch animal per day (kg)		
	Buffalo	**Crossbred cow**	**Local cow**
Total intake			
TDN (%)	3.557	4.158	2.529
DCP (%)	0.208	0.328	0.135
Recommended intake (ICAR, 1985)			
TDN (%)	4.690	4.710	4.180
DCP (%)	0.412	0.420	0.327
Requirement deficient (%)			
TDN (%)	24.16	11.72	39.50
DCP (%)	49.52	21.91	58.72

Table 2.29 : The trace element content (ppm) of feed and fodder samples collected during different seasons from Panchmahal district of Gujarat. (Desai *et al.*, 1984)

Type	Feedstuffs	Cu (ppm)	Mn (ppm)	Zn (ppm)
Seeds and grains	Cotton	10.13	14.97	28.67
	Dhandhan	18.34	75	34.4
	Gram	7.78	45	23.22
	Kodra	8.33	57.5	20.64
	Maize	4.06	11.06	23.62
	Milo	3.88	15	12..47
	Paddy	4.79	18.99	18..73
	Paddy (black)	5.1	57.94	24.57
	Puvad	7.62	25.25	36.77
	Sheria	15..36	30.83	59.24
	Tulsa	13.06	60	26.32
	Udid	6.11	25	25.37
	Wal	8.06	31.25	20.62
Oil cakes	Groundnut	16.85	58.82	39.42
	Mahuda(expeller)	4.92	13.59	24.03
	Mahuda	4.79	9.5	23.74
	Til	27.41	33.91	90..81
Chunies	Gram	7.41	90.56	32.24
	Guar	13.33	27.5	24.51
	Tuar	12.11	59.15	32.6
	Udid	15.11	112.14	34.06
Bhardo	Barley	2.66	14.24	38.59
	Guar	8.36	22.2	31.24
	Kulti	no	63.3	24.4
	Vari	9.05	28.49	37.36
	Wheat	7.13	47.57	43.53

Table 2.29 : Continued...

Type	Feedstuffs	Cu (ppm)	Mn (ppm)	Zn (ppm)
Polish, kuski, brans	Rice polish	7.78	142.5	26.66
	Rice kuski	7.18	143.37	30.98
	Rice bran(parboiled)	10	103.75	21.72
	Vari bran	4.79	121.85	31.78
	Wheat bran	8.69	135.3	81.63
	Wheat flour	3.2	41.15	33.48
Hulls, chhalla	Bajri	8.61	61.25	22.79
	Rajgira	14.44	112.5	27.52
	Tur	7.5	21.25	17.85
CM	Comp.CM(A)	22.12	91.18	36.81
	Comp.CM(N)	15.57	177.44	47.11
	Comp.CM(R)	20.77	126.6	31.78
HM CM	CM (puvad)	7.78	100.28	25.51
	CM(puvad bafnu)	6.04	60.14	32.73
	CM(boiled puvad bafnu)	6.38	76.25	21.72
	CM	8.84	76.59	27..87
	Bhardo mix.	3.2	83.34	32
	CM(Poultry feed)	13.33	117.5	29.24

Table 2.29 : Continued...

Type	Feedstuffs	Cu (ppm)	Mn (ppm)	Zn (ppm)
Green fodder	Arotaro	5.51	43.78	29.89
	Akalu baklu	6.95	206.31	38.59
	Anghido	6.39	66.47	31.78
	Athimadhi	7.99	15.54	34.05
	Bhatadi	3.73	54.21	28.4
	Chil	13.33	147.5	92.02
	Dharo	9.73	57.52	32.9
	Gamthio	10.65	85.46	44.28
	Gharko	5.33	194.65	28.37
	Gugari	3.73	58.55	30.65
	Kagada	7.99	71.21	22.7
	Kanajaro	1.19	126.66	35.33
	Karkario	3.73	68.06	31.78
	Koobabul	7.46	39.56	22.7
	Kutri	8.58	90.2	34.62
	Leparvy	13.85	74.38	30..08
	Samo	7.12	140.85	31.78
	Sheran	2.4	41.79	21.85
	Sukali	4	64.1	22.43
	Sukari	6.39	82.09	31.21
	Tandaljo	8.89	67.5	156.62
	Vakumbo	10.56	15	32.25
	wild chikory	13.89	51.25	27.31
	Zari	5.89	83	30.75
	Zinzvo	5.96	70.98	34.51
	Mixed green grass	9	92.37	28.29

Table 2.29 : Continued...

Type	Feedstuffs	Cu (ppm)	Mn (ppm)	Zn (ppm)
Cultivated green fodder	Bajri	5	35	11.61
	Jowar	7.22	40	13.09
	Lucerne	11.85	45.83	20.5
	Maize	4.96	24.5	23.56
	Mustard plant	8.33	65	27.95
	Rajgira plant	3.88	30	16.34
	Sugarcane tops	3.33	55	10.75
	Wall plant	5.56	42.5	14.32
Dry fodder	Bhatadi	4.17	62.19	12.68
	Forest grass	1.38	44.38	15.05
	Roza	5.56	100	22.79
	Sukali	3.88	40	8.6
	Mixed grass	6.67	55	17.2
Straws	Bajri	4.33	29.51	15.48
	Bant	4.07	49.83	12.47
	Bavto	2.78	20	21.26
	Jowar	4.55	37.5	26.43
	Kodra	6.67	132.5	20.64
	Maize	3.88	35.94	16.22
	Paddy	4.74	400.14	21.95
	Wheat	4.53	55.83	9.39

Table 2.29 : Continued...

Type	Feedstuffs	Cu (ppm)	Mn (ppm)	Zn (ppm)
Gotars	Gram	8.89	85.83	12.47
	Groundnut plant	8.33	100	12.04
	Groundnut	8.43	132.92	15.74
	Groundnut stem	5.56	79.58	12.4
	Pea	6.67	47.5	18.06
	Tuar	8.33	75.83	15.27
	Udid	7.22	52.5	18.91
	Wal pod covers	12.78	75	12.9
Tree leaves and creepers	Castor	12.78	315	13.1
	Dhamas	14.44	140	13.52
	Dharido	12.78	60	37.41
	Dhahardi	13.33	145	32.25
	Gansayadi	18.89	115	26.23
	Khakhar	5.37	97.33	6.59
	Neem	4.44	30	13.3
	Pipal	7.78	20	22.08
	Sag	7.22	61.5	15..91
	Wav creeper	12.78	30	15.91
Miscellaneous	Acacia pods	6.11	20	19.78
	Cotton boll	5.86	44.31	154.36
	Cotton ball cover	5.14	21.25	10.32
	Groundnut shell	7.78	35	9.03
	Mahuda flower	2.51	14.05	14.43
	Mahuda flower(extracted)	9.59	50.54	32.35
	Maize cob cover	4.31	15	17.53
	Prosophis pods	9.44	15	19.78
	Sheria boll(green seeds)	5	52.5	20.21

Table 2.30 : Trace minearl content of feeds and fodder samples collected from Banaskantha district of Gujarat (Desai *et al.*, 1985).

Type	Feedstuffs	Ca%	P (ppm)	Cu (ppm)	Mn (ppm)	Zn (ppm)
Green fodders	Dhaman	0.78	0.21	14.2	75.75	12.81
	Jermado	-	-	16.49	71.98	14.4
	Kuri	0.4	0.41	13.36	70.07	31..52
	Tarado	-	-	19	119.3	23.04
	Mixed green	0.6	0.21	11.79	100.37	14.96
Cultivated green fodders	Bajri	1.21	0.11	7.31	55.52	11.4
	Rajka bajri	0.68	0.39	13.22	62.32	18.94
	Jowar	1.42	0.19	10.03	79.81	17.63
	Kubabul	1.94	0.25	10.86	39.77	13.9
	Lucerne	1.76	0.3	14.96	48.53	17.48
	Sarson	-	-	17.12	76.34	31.81
Tree leaves and creepers	Khakhar	2.98	0.14	10.72	77.5	48.91
	Wev creeper	1.49	0.5	19.63	91.09	27
Dry fodders	Bajri	0.63	0.15	7.32	32.26	10.6
	Jowar	0.4	0.12	6.86	33.52	13.63
	Wheat	0.36	0.04	5.67	43.81	6.35
	Mixed straw	0.53	0.1	5.57	48	9.81
	Mixed straws + Gotar	1.89	0.1	3.34	65.93	10.73
	Guar gotar	1.14	0.09	9.19	28.92	7.8
	Guar stems	0.45	0.06	7.72	26.03	5.4
	Mung gotar	2.93	0.18	8.35	87.91	11.72
	Mung stems	1.04	0.12	7.52	30.65	10.32
	Tur gotar	1.31	0.1	9.33	69.4	15.45
	Mixed gotar	2.15	0.08	10.16	94.27	13.4

Table 2.31 : The mineral status of feeds and fodders in Mehsana district of Gujarat (Garg *et al.*, 1999)

Feedstuffs	Ca (%)	P(%)	Cu (ppm)	Mn (ppm)	Zn (ppm)
Bajra grain	0.03	0.3	8.11	20.4	37.14
Bajra husk	0.14	0.14	7.08	32.37	13.25
Bajra straw	0.41	0.14	1096	51.03	16.93
Cotton seed cake	0.3	0.58	23	46.66	49.44
chikodi	1.6	0.44	34.78	143.55	43.52
Sorghum green	0.2	0.23	9.39	37.19	25.91
Sorghum straw	0.38	0.14	3.53	64.82	14.69
Sagardan	1.08	0.93	36.46	97.71	58.27
Hybrid napier	0.64	0.29	16.23	111.2	21.81
Local grass	0.44	0.19	7.78	58.1	16.79
Lucern green	1.74	0.33	28.57	84.09	35.55
Oat green	0.6	0.44	26	170.9	21.33
Isabgul husk	0.24	0.33	8.4	13.77	26.72
Wheat grain	0.05	0.3	8.73	40.85	32.13
Wheat straw	0.19	0.07	3.48	42.48	5.99

Table 2.32 : Mineral content of feedstuffs (% of DM (kg)) from different villages of Junagadh district of Gujarat (Garg *et al.*, 2002).

Type	Feedstuffs	Ca (%)	P (%)
Straw	Bajra	0.54	0.08
	Groundnut	1.78	0.12
	Sorghum	0.59	0.12
	Maize	0.68	0.12
	Wheat	0.46	0.03
Concentrate	Cottonseed cake	0.23	0.59
	Groundnut cake	0.31	0.53
	Bajra grain	0.05	0.35
	Sorghum grain	0.04	0.26
	Maize grain	0.03	0.26
	Wheat grain	0.07	0.31
	Wheat bran	0.1	0.72
	Dudhdhara dan	0.85	0.34
	Dudhganga dan	5.97	0.16
	Sardar dan	1.89	0.56
Fodder and grass	Bajra green	0.52	0.23
	Sorghum green	0.54	0.22
	Hybrid napier	0.69	0.24
	Local grass	0.67	0.12
Miscellaneous feed	Banyan leaves	1.95	0.12
	Garlic leaves	3.18	0.1
	Neem leaves	1.64	0.14
	PJ pods	0.44	0.16
	Sugarcane tops	0.44	0.13
	Urd pods	2	0.1

Table 2.33 : Trace mineral status of feeds and fodders in Junagadh district of Gujarat (Garg *et al.*, 2002).

Type	Feedstuffs	Cu (ppm)	Zn (ppm)	Mn (ppm)
Straw	Bajra	8.15	14.42	51.84
	Groundnut	7.17	22.07	58.20
	Sorghum	5.71	23.91	49.58
	Maize	6.76	23.95	67.10
	Wheat	4.03	15.53	76.30
Concentrate	Cottonseed cake	11.44	43.01	22.71
	Groundnut cake	19.30	55.35	37.20
	Bajra grain	6.19	40.13	19.33
	Sorghum grain	6.72	39.90	16.40
	Maize grain	2.89	22.40	8.44
	Wheat grain	6.31	31.95	41.75
	Wheat bran	12.36	76.04	107.30
	Dudhdhara dan	16.35	48.55	116.00
	Dudhganga dan	19.90	35.10	138.00
	Sardar dan	14.30	29.00	105.00
Fodder and grass	Bajra green	8.21	31.50	71.53
	Sorghum green	5.27	24.84	48.57
	Hybrid napier	4.30	30.10	37.30
	Local grass	3.82	20.54	122.85
Miscellaneous feed	Banyan leaves	5.26	17.10	22.10
	Garlic leaves	29.30	28.30	14.80
	Neem leaves	6.38	23.60	55.30
	PJ pods	6.88	11.70	18.30
	Sugarcane tops	3.06	24.84	48.24
	Urd pods	6.28	17.30	74.20

Table 2.38 : The macronutrient content of feeds and fodders of Kutch district of Gujarat (Garg *et al.*, 2003)

Feedstuffs	**Ca (%)**	**P (%)**
Bajra green	0.38	0.29
Bajra husk	0.23	1.14
Bajra straw	0.31	0.24
Cowpea green	1.87	0.25
Groundnut straw	2.22	0.17
Guar green	1.89	0.24
Hybrid Napier	0.36	0.12
Local grasses	0.66	0.19
Lucerne green	1.68	0.31
Maize green	0.36	0.23
Maize straw	0.46	0.26
Sorghum green	0.36	0.23
Sorghum straw	0.4	0.14
Sweet potato creepers	1.8	0.28
Wheat straw	0.47	0.1
Bajra grain	0.044	0.36
Barley grain	0.074	0.6
Coconut cake	0.087	0.54
Cottonseed cake	0.23	0.49
Guar grain	0.35	0.35
Maize grain	0.013	0.86
Wheat bran	0.15	0.34
Wheat grain	0.053	0.26
Critical level	< 0.30	< 0.25

Table 2.44 : The trace minerals content of feeds and fodders of Kutch district of Gujarat (Garg *et al.*, 2004)

Feedstuffs	Cu (ppm)	Zn (ppm)	Mn (ppm)
Bajra green	11.86	44.45	61.9
Bajra husk	11.30	54.30	73.95
Bajra straw	5.41	38.83	41.76
Cowpea green	11.58	43.17	79.77
Groundnut straw	7.16	24.76	69.85
Guar green	14.49	42.70	54.03
Hybrid Napier	13.53	42.00	78.35
Local grasses	7.73	41.61	84.76
Lucerne green	11.38	27.39	59.90
Maize green	4.64	34.25	48.60
Maize straw	6.29	29.04	76.82
Sorghum green	6.72	33.95	59.31
Sorghum straw	6.82	34.70	74.00
Sweet potato creepers	11.09	22.65	50.40
Wheat straw	4.98	24.07	56.35
Bajra grain	24.90	34.60	61.10
Barley grain	7.27	35.00	21.50
Coconut cake	31.73	48.30	61.00
Cottonseed cake	19.50	44.38	45.15
Guar grain	35.15	72.30	45.22
Maize grain	4.30	31.83	7.20
Wheat bran	18.47	84.29	124.78
Wheat grain	9.67	29.96	74.43
Critical level	< 8.0	< 30.0	< 40.0

Table 2.34: The macro and trace element content of feed and fodder samples collected from Patan district of Gujarat State (Chavda, 2003)

Feedstuffs	Ca (%)	P (%)	Cu (ppm)	Mn (ppm)	Zn (ppm)
Jowar	0.07	0.42	1.68	15.19	34.50
Bajri	0.07	0.36	2.93	13.85	27.98
Wheat	0.08	0.38	3.35	34.16	21.21
Barley	0.17	0.45	3.68	42.53	27.67
Cottonseed cake	0.28	0.54	8.55	31.02	37.09
Sagar dan	1.36	1.01	18.20	83.50	108.47
Green Jowar	0.35	0.19	3.73	40.38	25.74
Lucerne	1.60	0.25	6.75	28.72	21.99
Rajka Bajri	0.51	0.21	5.71	58.40	40.59
Hybrid Napier	0.54	0.23	4.23	42.97	24.45
Para Grass	0.30	0.19	6.34	52.18	26.76
Local Mixed Grass	0.46	0.16	4.71	51.05	26.27
Jowar straw	0.49	0.13	2.90	37.99	14.69
Bajri straw	0.41	0.13	2.90	35.65	10.00
Wheat straw	0.33	0.06	2.30	32.20	6.64
Paddy straw	0.43	0.10	2.11	94.70	26.32
Wheat bhusa	0.31	0.04	1.14	39.65	6.69

Table 2.39: The macro and trace element content of feed and fodder samples collected from Sabarkantha district of Gujarat State (Ghogale, 2003).

Feeds	Ca (%)	P (%)	Mn (ppm)	Zn (ppm)	Cu (ppm)
Sabar dan	1.10	0.43	71.89	107.54	16.89
Guar bhardo	0.59	0.23	17.34	48.61	9.49
Maize bhardo	0.24	0.29	71.56	25.56	5.40
Wheat Bhardo	0.28	0.30	21.21	35.16	3.35
Cotton seed cake	0.69	0.22	19.11	27.38	12.25
Pioneer jowar	0.51	0.52	30.03	25.53	7.57
Rajka bajri (multicut)	0.58	0.42	74.62	26.64	7.86
Green jowar	0.56	0.26	37.66	30.61	6.28
Dharo	0.37	0.26	51.72	25.44	3.97
Pioneer jowar	0.51	0.52	30.03	25.53	7.57
Wheat bhusa	0.32	0.11	44.81	11.13	3.15
Jowar straw	0.43	0.28	39.66	21.54	6.83
Udad bhusa	0.37	0.30	46.83	17.30	4.47
Maize straw	0.41	0.19	43.98	17.92	7.69
Groundnut haulms	0.51	0.28	48.20	17.03	5.32
Maize cobs	0.37	0.20	14.44	18.58	2.33
Paddy straw	0.46	0.19	47.29	24.68	2.03
Bajra straw	0.36	0.11	78.93	14.67	8.92

Table 2.40 : Percentage of feed samples containing Cu, Mn and Zn below critical levels in Sabarkantha district of Gujarat (Ghogale, 2003).

	Cu	**Mn**	**Zn**
Concentrates (%)	22.22	12.5	25
Green roughages (%)	83.33	33.33	83.33
Dry roughages (%)	40	90	100

Table 2.41: Cu, Mn and Zn status of buffaloes in Sabarkantha district of Gujarat (Ghogale, 2003).

Taluka	Village	Mineral intake (mg/day)			Mineral requirement (mg/day)			Mineral intake (% of requirement)		
		Cu	Mn	**Zn**	**Cu**	**Mn**	**Zn**	**Cu**	**Mn**	**Zn**
Khedbrahma	**Matoda**	129.09	1021.69	775.45	174.30	697.20	1394.40	74.14	146.78	55.51
	Morad	208.88	1008.22	750.28	179.02	716.08	1432.15	117.00	141.77	52.27
	Average	**168.94**	**1014.96**	**762.57**	**176.66**	**706.64**	**1413.28**	**95.57**	**144.28**	**53.89** [b]
Idar	**Phinchod**	159.96	820.72	651.56	145.54	582.16	1164.32	110.46	141.63	56.06
	Kapoda	150.51	859.78	621.60	165.74	662.98	1325.96	91.16	130.21	46.91
	Average	**155.23**	**840.25**	**636.58** [b]	**155.64**	**622.57**	**1245.14**	**100.81**	**135.92**	**51.48** [b]
Bhiloda	**Rajendranagar**	120.78	644.64	569.54	160.62	642.49	1284.98	75.46	100.33	44.26
	Ramnagar	111.38	676.37	561.46	169.54	678.16	1356.32	65.58	99.78	41.36
	Average	**116.08**	**660.51**	**565.50** [b]	**165.08**	**660.33**	**1320.65**	**70.52**	**100.06**	**42.81** [a]
Bayad	**Demai**	119.98	748.42	514.59	163.03	652.12	1304.24	74.04	115.18	39.70
	Ubharan	136.64	1098.07	549.78	164.49	657.96	1315.92	82.66	166.78	41.64
	Average	**128.31**	**923.24**	**532.18** [a]	**163.76**	**655.04**	**1310.08**	**78.35**	**140.98**	**40.67** [a]
Modasa	**Dugarwada**	119.50	847.91	516.56	167.75	670.98	1341.96	71.78	127.52	38.80
	Medhasan	122.41	824.91	496.00	154.45	617.78	1235.56	79.05	133.43	40.05
	Average	**120.41**	**824.91**	**506.28**	**161.10**	**644.38**	**1288.76**	**75.41**	**130.48**	**39.42**[a]
Dist. Average		**138.54**	**843.17**	**588.20**	**163.74**	**654.98**	**1309.95**	**75.41**	**129.17**	**44.95**

Means bearing different superscripts within column differ significantly (P< 0.05)

Table 2.42: Percent deficit / excess of minerals in buffaloes in Sabarkantha district of Gujarat (Ghogale, 2003)

Taluka	Percent deficit / excess		
	Cu	Mn	Zn
Khedbrahma	**-4.43**	**44.25**	**-46.11**
Idar	**0.81**	**35.92**	**-48.52**
Bhiloda	**-29.48**	**0.06**	**-57.19**
Bayad	**-21.65**	**40.98**	**-59.33**
Modasa	**-24.59**	**30.48**	**-60.58**
Dist. Average	**-15.15**	**29.17**	**-55.05**

Table 2.45: Distribution Cu, Mn (ppm) and Zn (ppm) in fodders (on dry matter basis) in Darjeeling district of West Bengal (Chaudhary and Gupta, 1983).

Feedstuffs	Cu (ppm)	Mn (ppm)	Zn (ppm)
Tree leaves	18.4(7.47-21.37)	263.87(15.08-1423.69)	42.49(14.60-84.95)
Grasses	10.2(3.33-16.09)	276.48(80.42-1281.96)	37.57(18.24-68.77)
Shrubs	18.96(18.91-19.01)	330.34(117.14-483.54)	78.78(49.09-108.47)
Creepers	18.16(10.95-22.21)	326.48(195.68-416.04)	36.93(12.74-54.78)

( ): Figures given in parentheses indicates range.

Table 2.46 : Mineral status of common roughages tree leaves in old alluvial zone of West Bengal (Biswas and Samanta, 2002).

Type	Feedstuffs	Ca (%)	P (%)	Cu (ppm)	Mn (ppm)	Zn (ppm)
Roughages	Paddy straw	0.17	0.04	9.63	22.76	32.04
	Pasture grass	0.53	0.27	60.03	61.67	29.65
Tree leaves	Jack fruit	0.35	0.14	74.8	21.98	130.29
	Banyan	0.88	0.23	26.62	46.82	41.27
	Guava	1.85	0.47	166.76	100.12	138.42
	Mango	1.87	0.16	97.37	77.58	67.89
	Bamboo	0.87	0.35	32.54	87.89	89.43
Concentrates	Mustard oil cake	0.84	1.43	62.16	98.18	35.46
	Rice bran	0.38	1.43	25.6	230.26	89.21
	Gram chuni	0.18	0.17	19.14	109.38	13.34
	Compounded feed	1.95	1.78	20.62	134.7	35.43

Table 2.47 : The profile of Ca (%), P, and Zn in feeds and fodders of new alluvial zone of West Bengal (Das *et al.*, 2002).

Feedstuffs	**Ca (%)**	**P(%)**	**Cu (ppm)**	**Zn (ppm)**
Rice bran	0.33(0.30-0.36)	1.55(1.48-1.68)	25.6(24.9-27.1)	101.3(99.1-102.3)
Wheat bran	0.12(0.09-0.15)	0.75(0.67-0.84)	13.4(12.9-15.3)	63.5(62.2-65.6)
Mustard cake	0.81(0.74-0.88)	1.65(1.55-1.74)	66.7(45.4-82.6)	45.9(34.5-57.5)
Mung chuni	0.31(0.25-0.34)	0.31(0.35-0.18)	18.9(17.5-20.4)	48.3(45.7-50.9)
Gram chuni	0.18(0.13-0.24	0.21(0.15-0.25)	19.8(18.1-21.4)	14.8(12.4-16.8)
Paddy straw	0.15(0.07-0.17)	0.05(0.01-0.07)	10.0(7.1-11.2)	30.5(24.7-43.5)
Doob grass	0.45(0.31-0.58)	0.35(0.10-0.41)	59.3(43.7-70.1)	37.2(23.2-45.7)
Hybrid napier	0.5(0.41-0.53)	0.35(0.30-0.39)	2.85(2.7-3.00)	69.3(68.3-70.2)
Para grass	0.25(0.22-0.28)	0.12(0.09-0.15)	19.45(19.4-19.5)	21.0(20.0-23.0)
Critical level	**0.3**	**0.35**	**8**	**30**

( ) :Figures given in parentheses indicates range.

Table 2.48 : The composition of Ca, P, Fe, Cu and Mn in different feed and fodders (Samanta and Samanta, 2002).

Type	Feedstuffs	Ca (%)	P (%)	Cu (ppm)	Mn (ppm)	Zn (ppm)
Tree leaves	Bamboo	0.79	0.3	29.48	52.62	85.5
	Ficus bengalensis	0.77	0.25	26.29	42.42	39.52
	Ficus religiosa	1.27	0.4	28	39.44	41.1
	Jack fruit	0.32	0.12	85.74	27.04	130.3
	Mangifera indica	1.69	0.12	85.48	65.6	61.48
Fodders	Doob grass	0.65	0.13	53.46	39.23	35.55
	Cyperus rotumdus	0.59	0.13	11.66	28.16	31
	Mikania scandens	0.63	0.22	91.02	48.9	27.4
	Enhydra fluctans	0.32	0.25	10.12	48.89	27.4
	Oldenlantia berzii	0.31	0.18	7.97	42.2	24.9
	Compound feed	1.98	1.82	9.54	146.47	36.64
	Rice bran	0.38	1.45	19.12	240.98	95.1
	Rice straw	0.15	0.06	9.4	289.1	32.9

Table 2.49 : Trace and macro element status of the feedstuffs in Red Laterite zone of West Bengal (Dandopath *et al.*, 2002).

Feedstuffs	Ca (%)	P (%)	Cu (ppm)	Mn (ppm)	Zn (ppm)
Pasture grass-1	0.54-0.58	0.27-0.31	40.5-42.7	49.35-51.05	31.75-33.15
Pasture grass-2	0.72-0.76	0.34-0.36	42.65-42.70	54.40-57.25	26.30-28.65
Paddy straw-1	0.32-0.34	0.10-0.11	9.05-10.65	190-198..5	25.35-28
Paddy straw-2	0.21-0.23	0.09-0.11	7.50-8.25	240..240-252..5	28.25-29.40
Compound feed-1	1.82-2.15	0.98-1.12	26.15-27..85	74.25-79	26.35-27.10
Compound feed-2	1.12-1.26	0.78-0.92	38.10-39..20	92.60-94.55	22.50-23.40
Rice bran-1	0.28-0.31	0.28-0.31	32.05-34.10	80.55-83.75	28.10-30..25
Rice bran-2	0.38-0.42	0.38-0.43	29.35-30.05	91.45-101.6	29.65-30.30

Table 2.50 : The micronutrient status of feeds and fodders / tree leaves in Hill zone of West Bengal (Das *et al.*, 2003).

Type	Feedstuffs	Ca (%)	P (%)	Cu (ppm)	Mn (ppm)	Zn (ppm)
Forages	Paddy straw	0.29	0.11	8.43	25.19	40.75
	Hybrid Napier	0.5	0.2	7.06	62.99	56.05
Tree leaves	Amlisho	0.29	0.16	21.8	82.72	42.72
	Chilaune	0.26	0.16	23.13	68.77	47.22
	Dhougree	0.19	0.17	36.94	106.21	38.76
	Kans	0.27	0.1	32.21	62.09	28.06
	Piple	0.77	0.16	29.33	66.3	31.66
	Phurke	0.28	0.27	17.97	62.02	57.35
	Phutta	0.72	0.2	23.47	72.22	72.23
	Ratnaula	0.18	0.14	38.73	50.99	31.91
	Titapat	0.89	0.16	28.44	60.86	28.92
Concentrate	Maize	0.27	0.33	5.94	21.74	37377
	Rice bran	0.35	1.41	25.38	103.76	100.65
	HM Compound feed	0.97	1.41	31.11	111.3	38.15
	Critical level	< 0.3	<0.25	<8.0	<40.0	<30.0

Table 2.51 : Mineral status of soil, feeds and fodders and buffaloes in western agro climatic zone of Vidharbha region (Udar *et al.*, 2003).

Feedstuffs	Ca (%)	P (%)	Cu (ppm)	Mn (ppm)	Zn (ppm)
Chaffed sorghum straw	0.39(0.32-0.44)	0.17(0.11-0.22)	38.37(33.0-58.0)	52.88(45.5-60.16)	24.12(15.00-30.5)
Wheat straw	0.19(0.17-0.20)	0.12(0.07-0.13)	34.5(25.62-57.0)	42.16(39.37-48.0)	22.33(10.25-27.2
Arhar straw	0.64(0.43-0.82)	0.09(0.07-0.12)	40.46(26.25-63.0)	54.68(50.62-57.0)	15.78(5.00-26)
Gram straw	0.68(0.43-0.96)	0.14(0.12-0.16)	33.39(23.12-81.2)	48.21(48.5-60.16)	15.53(3.75-25)
Soyabean straw	0.56(0.52-0.58)	0.10(0.11-0.13)	29.42(24.16-35.0)	32.92(31.0-34.16)	20.23(15.00-27.5)
Pasture grass	0.58(0.42-0.77)	0.26(0.15-0.43)	33.75(25.62-47.5)	68.03(64.16-72.5)	20.71(16.25-28.33)
Cotton seed cake	0.23(0.14-0.30)	0.67(0.55-0.78)	37.5(25.62-47.5)	48.34(44.0-51.5)	22.75(17.0-26.5)
Cotton seed	0.18(0.18-0.19)	0.69(0.61-0.74)	34.77(30.0-51.25)	47.86(39.5-66.0)	27.04(24.16-32.5)
Cotton tree leaves	0.55(0.49-0.58)	0.20(0.2-0.21)	35.19(28.33-58.3)	38.80(36.16-41.8)	26.34(21.66-32.5)

( ) :Figures given in parentheses indicates range.

Table 2.52 : The micronutrient content of feeds and fodders in southern transition zone of Karnataka (Ramana *et al.*, 2000).

Feedstuffs	Ca (%)	P (%)	Cu (ppm)	Zn (ppm)
Paddy straw	0.36	0.08	6	5
Ragi straw	0.72	0.25	9	11
Maize	0.31	0.18	10	6
Jowar	0.3	0.41	16	14
Hybrid Napier	0.51	0.22	8	14
Maize	0.31	0.34	20	9
Farm grass	0.36	0.5	9	10
Hariali grass	0.57	0.47	13	17
Local weed grass	1.43	0.7	40	74
Dolichos lablab	0.98	0.53	28	35
Fence creeper leave	0.92	0.35	26	161
Ganike leaves	1.12	0.63	40	32
Haluvana leaves	0.91	0.52	27	28
Compound feed	1.21	1.26	11	35
Ground nut cake	0.36	1.15	20	43
Wheat bran	0.41	1.43	18	64
Rice bran	0.39	2.25	10	60
Gram husk	0.71	0.1	12	14
Horse gram pod	1.18	0.17	16	17
Groundnut haulms	1.11	0.14	1	11

Table 2.53 : Micronutrient content of feeds and fodders in coastal zone of Karnataka (Gowda *et al.*, 2001)

Type	Feedstuffs	Ca (%)	P (%)	Cu (ppm)	Zn (ppm)
Straw	Paddy straw	0.49(0.2-0.7)	0.10(0.1-0.11)	3.45(2.7-4.3)	34.50(28-41)
Green fodders	Hybrid napier	0.6(0.5-0.7)	0.58(0.5-0.6)	33.47(9.6-46.0)	74.33(57-84)
	Para grass	0.66(0.3-1.0)	0.60(0.4-0.7)	51.06(31-64)	129(67-180)
	NB 21	0.72(0.5-1.0)	0.63(0.6-0.7)	33.03(15.2-42.8)	94(85-100)
	Mixed local grasses	0.74(0.5-1.1)	0.58(0.5-0.7)	36.83(15.6-45.6)	85.33(58-120)
Tree leaves/top feeds	Banana leaves	0.79	0.4	33	99
	Bamboo leaves	0.73	0.24	7.53	36
	Local creeper	1	0.51	31.7	77
	Banana flowers	0.78	0.6	59.5	43
	Areca leaves	0.5	0.17	85.8	100
	Banana stem	1.1	0.32	27.5	180
	Erythrine leaves	1.7	0.56	31.5	110
	Glyricidia leaves	1.1	0.42	30	82
Concentrates	Yellow maize	0.08	0.36	4.51	36
	Ragi grain	0.46	0.47	5.65	46
	Jowar	0.14	0.39	4.13	50
	Broken rice	0.23	0.43	14	25
	Wheat bran	0.2	1.5	8.31	46
	Rice polish	0.25	2.05	9.22	230
	Groundnut cake	0.43	0.81	23.9	110
	Soyabean cake	0.36	1	17.8	77
	Cottonseed cake	0.74	1.32	31.4	120
	Commercial feeds	1.75(1.4-2.4)	1.63(1.5-1.8)	10.06(8.4-13.7)	69.5(49-97)
	Home made min mix	11	6.19	23.3	120
	Commercial min. mix.	25	9.53	130	3500mg/kgDM (KG)

Table 2.53 : Continued...

Type	Feedstuffs	Ca (%)	P (%)	Cu (ppm)	Zn (ppm)
Straw/ kadbis	Paddy straw	0.32	0.2	1.25	55
	Jowar Kadbi	0.4	0.22	2.5	74
Green fodder	Cu (ppm)ltivated green fodder	0.46	0.82	12.3	60
	Green gram fodder	2.6	0.34	8.05	93
	Para grass	0.57	0.58	4.93	47
	Mixed local grasses	0.68	0.57	3.4	65
	Mixed weed grass	1.43	0.64	9.74	99
Tree leaves/ top feeds	Subabul fodder	2	0.38	10.5	84
	Glyricidia leaves	3.1	0.35	6.6	77
	Neem leaves	0.75	0.25	5.5	110
	Drumstick leaves	1.4	0.58	10.5	51
	Tree pods	0.86	0.38	8.06	63
Concentrates	Jowar grain	0.32	0.41	2.48	100
	Bajara grain	0.06	0.5	12.7	60
	Rice bran	0.76	1.83	4.6	60
	Bajra+rice bran	0.21	0.64	2.19	34
	J+M+B+horse gram powder	0.79	0.56	9.48	55
	Rice bran + Rice Husk	0.19	0.98	2.74	75
Miscellaneous	Groundnut Haulms	1.75	0.33	5.9	95

Table 2.54 : Micronutrients in soil feed, fodder and animals of north east transition and dry zones of Karnataka. (Ramana *et al.,* 2001)

Type	Feedstuffs	Ca (%)	P (%)	Cu (ppm)	Zn (ppm)
Straw/kadbis	Paddy straw	0.19	0.19	5.77	27
	Wheat straw	0.36	0.21	6.46	28
	Jowar kadbi	0.57	0.11	17.7	120
Green fodder	Maize green	0.58	0.46	22	103
	Jowar	0.83	0.48	32.28	143
	Hybrid Napier fodder	0.71	0.47	23.3	83
	Black gram green fodder	2	0.48	26.2	80
	Soyabean green fodder	1.9	0.65	76.8	490
	Guinea grass	0.7	0.55	21.7	80
	Para grass	0.71	0.4	24.3	66
	Mixed local grass	0.97	0.48	63.05	88
Tree leaves/ top feeds	Subabul fodder	1.3	0.47	27.8	73
	Glyricidia leaves	2.1	0.41	28.4	120
	Neem leaves	2.6	0.25	25	70
	Karanj leaves	1.5	0.35	29	67
	Sugarcane tops	0.99	0.43	16	47
Concentrate feeds	Wheat grain mixture	0.13	0.51	6.19	46
	Bajra +jowar grain mix.	0.11	0.6	8.51	40
	Black gram powder	0.43	0.39	18.4	99
	Rice bran	0.36	0.71	15	47
	Rice bran+Rice husk	0.21	0.67	29.6	38
	GNC	0.25	0.94	28.1	91
Miscellaneous	Sugarcane Bagasse	0.15	0.13	10.8	19
	Gram husk mixture	0.69	0.28	12.52	45
	Tur dal husk	0.53	0.28	18.8	73
	Masur dal husk	0.45	0.37	17.9	67

Table 2.55 : Mineral status of feeds and fodders in hilly zone and central dry zone (Gowda *et al.*, 2002)

Name of feedstuff	Ca (%)	P (%)	Cu (ppm)	Zn (ppm)
Paddy straw	8.9	8.9	0.4	0.12
Ragi straw	4.58	4.55	5.35	213
Hybrid napier	0.5	0.33	19	26.8
Maize	0.31	0.34	0.29	9.18
Mixed local grass	1.11	0.44	18.15	36.7
Banana leaves	1.09	0.56	46.2	38.8
Haluvana leaves	0.79	0.75	30.31	45.5
Coffee leaves	0.93	0.44	25.2	26.1
Compound feed	0.98	1.51	12.56	39.4
Groundnut cake	0.37	1.08	22.3	37.4
Wheat bran	0.24	1.5	20	58.6
Rice bran	0.17	2.57	10	57
Broken rice	0.05	0.19	1.8	37
Coconut cake	0.81	2.96	19	48
Gram husk	0.75	0.1	15.9	13.6
Coffee seed	0.25	0.34	35	16.6
Fence creeper leaves	1.56	0.31	29.8	18.6

Table 2.55 : Continued...

Feedstuffs	Ca (%)	P (%)	Cu (ppm)	Zn (ppm)
Ragi straw	1.11	0.18	11.46	20.14
Paddy straw	0.39	0.17	11.63	14.45
Jowar kadbi	0.65	0.23	15	48
Maize kadbi	0.46	0.14	24.36	22.95
Bajra straw	0.59	0.32	16.26	36.1
Maize	0.75	0.48	37.54	36.2
Hybrid napier	1	0.48	45.3	41.02
CO I	0.57	0.36	26.8	76
CO II	0.61	0.35	50.13	68
Lablab legume	1.85	0.33	54.22	95.5
Cow pea	2.37	0.56	35.7	43.9
Soyabean fodder	1.88	0.46	63.11	284
Mixed grass	0.8	0.54	21.48	14
Weed grass	1.6	0.43	38.53	60
Local grass	0.88	0.46	23.4	19.6
Glyricidia	2.02	0.41	40.81	24
Neem	2.32	0.32	22.87	23
Black gram	1.97	0.46	34.54	33
Drum stick	3.03	0.47	25.51	28
Banana	1.75	0.39	48.12	21
Mulberry	2.8	0.49	44	31
Sugarcane top	0.6	0.36	10.84	32
Subabul	2.48	0.36	73.3	181
Compound feed	1.1	1.6	17.06	45.25

Table 2.56 : The mineral content (ppm) of mixed pasture from various regions of semiarid Rajasthan (Tripathi *et al.*, 2002).

Regions	Feedstuffs	Cu (ppm)	Mn (ppm)	Zn (ppm)
Malpura	Mixed pasture (fresh)	31.35	30.01	143.62
Niwai		30.21	31.69	107.99
Lamba		26.98	42.26	109.43
Toda		27.71	38.97	123.49
Deoli		41.52	34.06	108.4
Dhouli		14.95	37.67	125.68
Range		19.41-41.52	23.57-42.87	86.25-150.03
Malpura	Mixed pasture (washed)	19.41	36.37	133.8
Niwai		15.46	34.19	146.22
Lamba		16.54	34.21	134.86
Toda		15.93	39.03	123.13
Deoli		22.6	27.04	116.32
Dhouli		12.53	29.11	119.54
Range		12.53-22.61	26.12-42.56	112.56-152.36

Table 2.57 : The copper status (ppm) of plants in Tarai area of Uttar Pradesh (Khan *et al.*, 1979).

Feedstuffs	**Cu (ppm)**	**Feedstuffs**	**Cu (ppm)**
Paddy straw	4.32(1.13-9.58)	Berseem	13.33(6.05-21.52)
Wheat straw	3.48(1.3-6.69)	Black gram	7.64(3.38-11.89)
Chari	5.87(3.73-10.96)	Lucern	10.88
Maize	6.19(2.08-12.08)	Soyabean straw	6.6(5.30-8.46)
Sugarcane top	5.31(2.03-8.08)	Cow pea	13(12.80-13.32)
Pearl millet	10.66(6.47-14.85)	Arhar straw	6.07
Oat	6.25(4.07-9.19)		

Table 2.58 : The mineral composition of feeds and fodders of Panipat district of Haryana State (Yadav *et al.*, 2002).

Feedstuffs	Ca (%)	P (%)	Cu (ppm)	Mn (ppm)	Zn (ppm)
Wheat straw	0.38(0.13-0.67)	0.11(0.5-.02)	17.67(4.00-51.00)	30.58(21.00-47.00)	14.58(10.00-40.00)
Paddy straw	0.40(0.19-0.63)	0.09(0.06-0.14)	13.08(7.00-28.00)	37.67(15.00-58.00)	21.25(15.00-40..00)
Gram straw	0.53	0.6	9	27	40
Berseem	1.29(0.38-2.60)	0.33(0.20-0.60)	21.53(4.00-50.00)	69.30(21.00-137.00)	37(10-80)
Oat	0.64(0.40-1.09)	0.33(0.20-0.37)	15.33(11.00-20.00)	33.00(13.00-46.00)	30(20-40)
Gulidanda	0.33(0.20-0.46)	0.26(0.21-0.30)	29.67(14.00-45.00)	31.67(22.00-41.00)	25.00(20-35)
Mustard cake	0.56(0.36-0.96)	1.02(0.46-1.34)	20.68(11.00-58.00)	53.32(26.00-61.00)	36.95(10-75)
Cotton seed cake	0.32(0.13-0.75)	0.76(0.31-1.16)	23.70(9.00-74.00)	43.20(11.00-110.00)	39.00(25-65)
Gram chuni	0.58(0.40-0.95)	0.48(0.21-0.90)	31.57(16.00-49.00)	48.14(22.00-68.00)	42.14(20-70)
Wheat flour	0.24(0.14-0.52)	0.48(0.42-0.57)	12.33(6.00-25.00)	55.67(49.00-63.00)	22.50(15-50)

Table 2.59 : The mineral composition of roughages and concentrates in Rohtak district of Haryana (Mann *et al.*, 2003).

Type	Feedstuffs	Ca (%)	P (%)	Cu (ppm)	Mn (ppm)	Zn (ppm)
Roughages	Wheat straw	0.19(0.11-0.34)	0.09(0.035-0.18)	2.3(0.00-9.38)	27.7(6.7-60.60)	22.6(6.8-39.70)
	Berseem	1.19(0.65-1.82)	0.29(0.13-0.50)	7.2(0.0-12.50)	49.1(10.1-77.40)	23.1(6.3-52.30)
	Green oats	0.34(0.28-0.39)	0.16(0.15-0.18)	5.63(3.13-9.38)	54.45(40.4-70.70)	22.87(12.60-32.95)
	Guli danda	0.45(0.34-0.60)	0.22(0.09-0.36)	2.8(0.0-6.3)	51.3(24.1-74.10)	8.6(2.7-12.7)
Concentrates	Cottonseed	0.41(0.29-0.67)	0.90(0.43-1.65)	12.7(6.3-18.80)	44.6(16.2-76.50)	42.83(12.6-70.00)
	Cottonseed cake	0.51(0.30-0.78)	0.87(0.52-1.65)	14.9(6.3-25.00)	35.0(10.1-71.70)	51.1(21.8-82.60)
	Mustard cake	1.14(0.74-0.98)	1.29(0.78-1.65)	13.8(6.3-31.30)	29.8(33.0-60..80)	50.3(25.1-88.00)
	Wheat flour	0.25(0.14-0.38)	0.50(0.21-0.78)	11.1(6.3-18.80)	33.0(14.6-56.20)	37.9(12.6-68.30)
	Pelleted feeds	1.05(0.72-1.60)	1.16(0.79-1.40)	14.8(12.5-18.80)	43.7(17.5-81.00)	54.6(30.5-80.80)

( ): Figures given in parentheses indicates range.

Table 2.60 : The Mineral concentration in fodder of sub- mountains belt of Punjab (Singh *et al.*, 2003[b])

District	Feedstuffs	Cu (ppm)	Mn (ppm)	Zn (ppm)
Ropar	Maize	4.31	40.28	24.55
	Sorghum	5.27	66.06	26.42
	Bajra	5.45	57.38	31.81
Hoshiarpur	Berseem	10.05	81.93	37.3
Gurdaspur	Berseem	9.25	60.83	32.37

Table 2.5: Percent deficit (-)/surplus (+) of nutrients in cows surveyed in Patan district of North Gujarat (Chavda, 2003).

Village	Nutrients	
	DCP	**TDN**
Methan	+12.57	-1.66
Nagvasana	-16.24	-6.45
Balisana	+2.89	+5.64
Mujpur	+10.04	+13.87

Table 2.43 : Percent deficit / excess of minerals in cows in Sabarkantha district of Gujarat (Ghogale, 2003).

Village	Cu	Mn	Zn
Khedbrahma	**9.21**	**57.66**	**-38.11**
Idar	**26.97**	**52.75**	**-37.15**
Bhiloda	**-9.96**	**17.19**	**-45.34**
Bayad	**-23.88**	**44.98**	**-52.91**
Modasa	**-12.85**	**46.58**	**-55.42**
Dist. Average	**-3.341**	**41.62**	**-47.06**

Survey of Navsari district

Plate 3.1: Chapaldhara village dairy co-operative society

Plate 3.2: Kumbharfaliya village dairy co-operative society

Plate 3.3: Collection and sampling of milk

Plate 3.4: Estimation of SNF in milk

Plate 3.5: Storage of dry roughages in village Vandarvella

Plate 3.6: Storage of dry roughages in village Manekpore

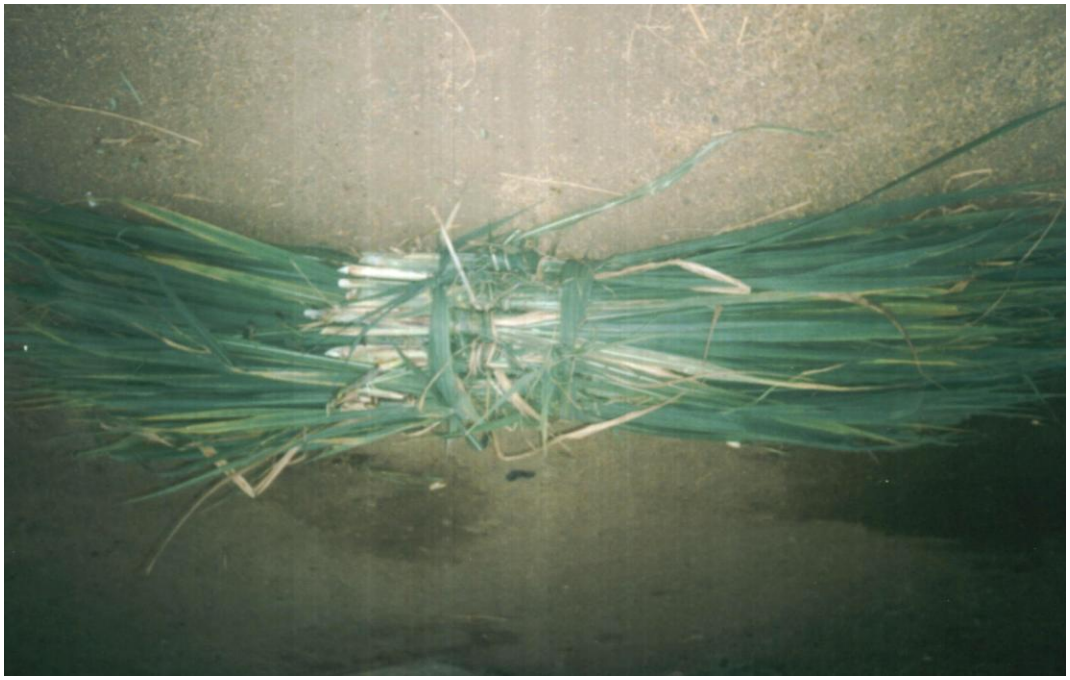

Plate 3.7: Sugarcane tops in village Abrama

Plate 3.8: Sugarcane tops in village Sarav

Plate 3.9: Rice Kuski in village Pathri

Plate 3.10: Compound concentrates mixture (*Sumuldan*)

Plate 3.11: Cooking of *bajri* grains

Plate 3.12: Water soaked cottonseed cake

Plate 3.13: Buffaloes feeding on sugarcane tops in village Chapaldhara

Plate3.14: Herd of crossbred cows in village Chapaldhara

Fig. 3.1: Map of Gujarat State

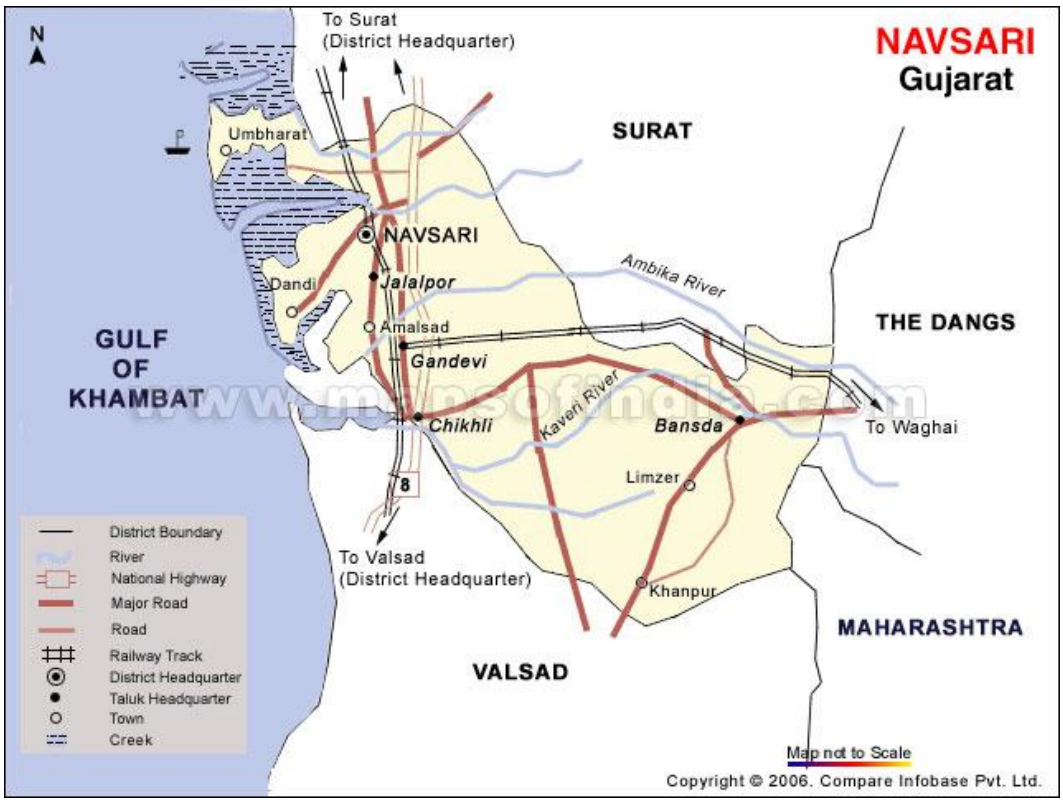

Fig. 3.2: Map of Navsari district