Consulting Service for "Benchmark Survey on Quality of Raw and Processed Milk in Nepal"

RFP No: NDDB/C/RFP/2072-73/01

Final Report

2073 Ashadh

Submitted to:

Government of Nepal

Nepal Dairy Development Board (NDDB)

Harihar Bhawan, Lalitpur

Post box: 5901

Tel : 977-1-525400 Fax: 977-1-532096

E-mail:nddb@mos.com.np

Submitted by:

Right to Access Nepal "RAN", Kathmandu, Nepal

Contact: 01-4412240/9841584764

Email: rannepalktm@gmail.com

URL: www.righttoaccessnepal.org.np

Lainchour, Kathmandu
2073-Ashadh-15^h

To:
The Executive Director
National Dairy Development Board (NDDB),
Hariharbhawan, Lalitpur,

Subject: Submission of Draft Report

Dear Sir,

We submit the draft report of consulting service for ***Benchmark Survey on Quality of Raw and Processed Milk in Nepal*** after the completion of major activates related to the service in accordance with service contract between NDDB and Right to Access Nepal (RAN) dated on 10th of Baishakh, 2073. The report contains the detail analysis of Milk's Nutritional, Bacterial, Adulteration, and COP in accordance with the Team of Reference after incorporating the suggestions of the Evaluation Committee of the assignment.

Yours sincerely,

____

Mr. Binod Paudel, Executive Director
Right to Access Nepal "RAN"
Lainchaur, Kathmandu, Nepal
01-4412240/9841584764
rannepalktm@gmail.com

Table of Content

List of Table

List of Figures

Abbreviation

^{0}C	:	Degree Celsius
AI	:	Artificial Insemination
Avg.	:	Average
BMSS	:	Biratnagar Milk Supply Scheme
CFU	:	Colony Forming Unit
COB	:	Clout on Boiling
COP	:	Code of Practice
CR/CDR	:	Central Development Region
DDC	:	Dairy Development Corporation
DENIDA	:	Danish International Development Agency
DLS	:	Department of Livestock
ER/EDR	:	Eastern Development Region
FAO	:	Food and Agriculture Organization
FWR/FWDR	:	Far-Western Development Region
GMP	:	Good Manufacturing Process/Practice
HKH	:	Hindu Kush Himalaya
HMSS	:	Hetaunda Milk Supply Scheme
HTST	:	High Temperature Short Time
KMSS	:	Kathmandu Milk Supply Scheme
LMSS	:	Lumbini Milk Supply Scheme
Max	:	Maximum
Med	:	Median
Min	:	Minimum
MOAD	:	Ministry of Agriculture Development
MPC	:	Multi-Purpose Cooperative
MT	:	Metric Ton
MWR/MWDR	:	Mid-Western Development Region
NBSM	:	Nepal Bureau of Standards and Metrology
NDDB	:	National Dairy Development Board
NS	:	Nepal Standard
Obs.	:	Observation
PBS	:	Phosphate Buffer Solution
PMSS	:	Pokhara Milk Supply Scheme
SD	:	Standard Deviation
SNF	:	Solid Not Fat
SPC	:	Standard Plate Count
TNTC	:	Too Numerous to Count
ToR	:	Term of Reference
TPC	:	Total Plate Count
UHT	:	Ultra High Temperature
UN	:	United Nation
US	:	United State
WHO	:	World Health Organization
WR/WDR	:	Western Development Region

Chapter I
Introduction

1.1 Backgrounds

Dairy is the most important sub sector in Nepalese livestock production, providing almost 2/3rd of the livestock sector GDP and 9% to national GDP. The sub sector provides employment for more than half million farm families in production and further more than 10000 in processing and marketing. The dairy sub sector not only provides employment and income generation opportunities but also ensures flow of money from urban (consumers sites) to rural sector (production sites) that has tremendously helped in livelihood improvement of the rural people as well as development of the rural sector. The dairy animal farming is gradually transforming into commercial system from the subsistence and large dairy animal farms are emerging in the country to meet the unmet demand for milk and milk products in the country. Young, educated and foreign returnees are being attracted in this enterprise recently.

Milk is a rich source of minerals such as calcium, vitamin D and phosphorous which are very important to develop human bones, but a glass of milk contains more other essential nutrients. It contains protein, carbohydrates, vitamins, minerals and fat. Protein is important to fight diseases, renew cells, build muscles and maintain healthy hair and nails. It has substantial amount of carbohydrate in form of lactose which gives energy to the body. A moderated amount of milk fat supplies essential fatty acids which help to keep body cells warm.

Being a nutritious food, milk serves as an ideal medium for the growth of various microorganisms. It is a highly perishable commodity and poor handling can exert both a public health and economic toll, thus requiring hygienic vigilance throughout the production to consumer chain. Although freshly drawn milk from animals may possess temporary 'germicidal' or 'bacteriostatic' properties, growth of microorganisms is inevitable unless it is processed by freezing, heat treatment or irradiation. Microorganism in raw milk can originate from different sources such as air, milking equipment, feed, soil, faeces and grass. The microorganism load and types found in milk shortly after milking are influenced by factors such as animal and equipment cleanness, season, ambient temperature, storage, personnel health, cleanness and animal health. On this basis the daily production and eventual marketing and sale of milk requires special consideration to ensure its delivery to the market in hygienic and acceptable condition.

Antibiotics used on cattle medicine practices in local dairy farmers are unavoidable. These practices allow the antibiotic residues still left on milk. Even the concentrations were low, antibiotic residue consumed can cause health problems such as allergy, intoxication and antibiotic-resistance. Besides that, milk with antibiotic residues cannot be treated with using microorganisms' starter. Antibiotic residues-free milk would increase consumer safety.

Adulteration of milk reduces the quality of milk and can even make it hazardous. Adulterants such as soap, acid, starch, table sugar and chemicals like formalin may be added to the milk. Most of the chemicals used as adulterants are poisonous and cause health hazards. Adulterants are mainly added to increase the shelf life of milk. Some of the preservatives like acid and formalin are added to the milk as adulterants, thereby increasing the storage period of milk. Generally, water is added to the milk to increase the volume content of the milk. Such practices are illegal and should be prohibited, and thus, adulteration free milk is today's deemed voice of government, consumer, and other stakeholders.

The quality is the key for success in today's market. Milk should be free from adulteration, antibiotic residues, and harmful bacteria such as coliform. It should be fresh to drink with incorporating a rich amount or necessary nutrients on it. Therefore, we (the consulting firms) proposed method and strategy to carry out the study of "Benchmark Survey of Raw and Processed Milk in Nepal". The proposed methodology is expected to cover the scope required by the client, thereby, is supposed to help for making a quality milk production and distribution behaviour in Nepal.

1.2 Problem Statement

Food safety is universally recognized as a public health priority. It requires a holistic approach, from production to consumption. All foods have the potential to cause food borne illness, and milk and milk products are no exception. Milk is complete food in itself whereas it also harbors many harmful microorganisms if handled and stored improperly that has human health implication. Dairy animals may carry human pathogens. Such pathogens present in milk may increase the risk of causing food borne illness. Moreover, the milking procedure, subsequent pooling and the storage of milk carry the risks of further contamination from man or the environment or growth of inherent pathogens. Further, the composition of many milk products makes them good media for the outgrowth of pathogenic micro-organisms. Potential also exists for the contamination of milk with residues of veterinary drugs, pesticides and other chemical contaminants. Therefore, implementing the proper hygienic control of milk and milk products throughout the food chain is essential to ensure the safety and suitability of these foods for their intended use.

Milk and dairy products can be important in diversifying the diet. They are nutrient dense and provide high quality protein and micronutrients in an easily absorbed form that can benefit both nutritionally vulnerable people and healthy people when consumed in appropriate amounts. Although dairy foods contribute to saturated fatty acid content of the diet, other components in milk such as calcium and polyunsaturated fatty acids may reduce risk factors for coronary heart disease. There is moderate evidence showing an association between milk and dairy product consumption and lower incidence of Type 2 Diabetes in adults. Some components in milk and dairy products such as calcium, vitamin D (fortified milk) and milk proteins may be protective against cancer. Several studies suggest that milk may offer protection against colorectal cancer. Raw milk and raw milk products can lead to food-borne illness in humans. Given that these products are not pasteurized/ treated, alternative safety controls are required to ensure that they do not pose a public health risk (Source: Food and Agriculture Organization of the United Nations online). In this regard, it is important to recognise a combination of essential nutrients in raw and processed milk necessary for human healthy life of Nepalese market, and thus an important research question raised as: To what extent current nutritional values of raw and pasteurized milk exist in Nepal, and do they fall within the permissible standard such as Nepal Standard (NS), WHO, etc.?

In addition to being a nutritious food for humans, milk provides a favorable environment for the growth of microorganisms. Yeasts, moulds and a broad spectrum of bacteria can grow in milk, particularly at temperatures above 16°C. Raw milk from animal such as healthy cow contains few bacteria, but contamination during handling can rapidly increase bacterial numbers. Milk is an ideal food and many bacteria grow readily in it. Microbes can enter milk via the cow, air, feedstuffs, milk handling equipments and persons, etc. Some bacteria are useful in milk processing, causing milk to sour naturally. Natural souring of milk may be advantageous: for example, in smallholder butter-making. Naturally soured milk is used to make many products, e.g. irgo, yoghurt, sour cream, ripened buttermilk and cheese. These products provide ways of preserving milk and are also pleasant to consume. They are produced by the action of fermentative bacteria on lactose and are more readily digested than fresh milk. However, milk can also carry pathogenic bacteria, such as Salmonella, Tuberculosis *Bovis* and *Brucella*, and can thus transmit disease. Other bacteria can cause spoilage of the milk, and spoilage cause poor yields of products. The *coliform* group of bacteria comprises all aerobic and anaerobic grams which are capable of fermenting lactose with the production of acid and gas in higher temperature in little time. Most coliforms do not cause disease, but a small percentage can cause illness in people, especially young children, the elderly, and those with weakened immune systems. Testing of coliform organisms is used to monitor the hygienic quality of food products. However, pasteurisation is a heat treatment method to reduce bacteria in milk, but pasteurised milk is not sterile. Concerning the specified context, the next important research question is raised as: To what extent the bacterial quality exists in raw and pasteurized milk of Nepal, and does it fall within the permissible standard such as Nepal Standard (NS), WHO, UN Food and Agriculture, etc.?

Dairy cattle that have been treated with antibiotics produce milk containing antibiotic residues for a period of time after treatment. Treated cows are therefore required to be excluded from the milk supply for a specific time period to ensure that antibiotic residues no longer remain in their milk. Antibiotic residues in milk may lead to severe allergic reactions in sensitive consumers, and a change in consumer perception of milk being a pure, unadulterated, natural product. All of these concerns may result in major economic losses to the dairy industry as well as in public health. Meanwhile, the next important research question is raised as: To what extent the level of antibiotic residues contamination exists in raw and pasteurized milk of Nepal?

Quality control tests for milk are very important to assure adulterant free milk for consumption. Milk is most commonly diluted with water, this not only reduces its nutritional value, but contaminated water can also cause additional health problems. Milk shall be injurious when harmful preservative such as formalin is added on it, thereby, causes liver and kidney damage as it is highly toxic. Urea can lead to vomiting, nausea and gastritis. Urea is particularly harmful for the kidneys, and caustic soda can be dangerous for people suffering from hypertension and heart ailments. The health impact of drinking milk adulterated with these chemicals is worse for children. Caustic soda harms the mucosa of the food pipe, especially in kids. The moment demand important research question that need to be addressed as: To what extent the level of adulteration exists in raw and pasteurized milk of Nepal?

In Nepal, Nepal NDDB and Danida Support Project conducted a Benchmark Survey of Quality of Milk and Milk Products, in 2001. The results from the survey showed that many of the products did not meet the compositional standards laid out by the Food Act. The problem was also seen in the microbiological quality of Milk. In order to reduce the contamination of milk and increase the quality, governmental authority such as Nepal Bureau of Standards and Metrology (NBSM) has made benchmarking standard for milk and milk products. But the standard was made in 1977 and nether it is supposed to be reliable to the present contest nor is it consistent with international standard such as WHO, UN Food and Agriculture, etc. In this regard, NBSM must harmonize standards to facilitate provision of safe milk production and consumption practice so that it could improve public health and increase the economic value to the producers. These standards must be followed in each step of milk production chain such as milk at the farm, collection at bulking centres, procurement at factory, market delivery, and purchase by the consumer. Moreover, packaging should be labeled by quoting necessary composition and information on proper handling by the consumer to reduce risks associated with improper handling of milk. Government of Nepal approved Code of Practice (CoP) for Dairy Industries, but the implementation part is still lacking. Furthermore, most of the dairies do not have laboratory manual or company standards of milk and milk products. This has resulted the deterioration of the quality of milk from source (farmer level) due to unhygienic milking practices, adulteration, use of inappropriate and contaminated milk vessels, open transportation, etc. Meanwhile, behaviour such as lack of cleanliness, use of contaminated water, absence of strict quality control system and use of uncertain quality packing materials by the dairy industries, and use of dirty milk crates, inappropriate transportation of processed milk and its disorganized selling (such as in footpaths) by the retail distributor have further deteriorated the milk quality of Nepal. In this regard, important research questions are raised as: What is the benchmark quality of milk in current scenario? To what extent CoP for Dairy Industries has been implemented in different level of milk production chain such as farmer level, collection centres, freezing centres, dairy industries, and retail stores?

In order to solve above research questions, a Bench Mark Survey Study on quality of raw and pasteurized milk across the dairy value chain in the country is necessary, so that, a prompt recommend can be made for production and trading of quality milk and food safety can be made.

1.3 Objectives of the current study

As per the ToR, following are the specific objectives of the assignment:

- Assess the current nutritional and bacterial quality of raw and pasteurized milk in Nepal and benchmark against the Nepal Standard (NS)
- Establish benchmark of raw and pasteurized milk available in the Nepali market
- Recommend appropriate approach to maintain the established benchmark at different level of production and market chain to maintain the NS.
- Assess the adulteration status of raw milk and make doable recommendation to avoid adulteration

1.4 Scope of assignment

As per the ToR, following are the specific Scopes of the assignment:

- Review of the current chemical and bacterial quality of raw and pasteurized milk available in Nepal market
- Assess the implementation level of CoP administered by the government by all concern stakeholders.
- Assess whether the stakeholders in the production and market chain of raw and pasteurized milk adopted the standard spell out by the Food Act of Nepal
- Assess any GMP process of raw and pasteurized milk undertaken by the stakeholders in market chain.
- Assess the adulteration in the milk and recommend method and strategy to control and monitor the type and level of adulteration in raw and pasteurized milk.
- Formulation of New Methods and Strategies of gathering information about raw milk and pasteurized milk and formulation of new, alternative strategies in to be adopted to tackle the various challenges on maintaining minimum standard of raw and pasteurized milk.
- Assess the current practice of dissemination of Knowledge and Learning Knowledge of the new production, processing and marketing methods and practices of raw and pasteurized milk.

- Assess the evaluation of results and feedback information with respect to raw and pasteurized milk quality and tie it up with minimum bench mark.

1.5 Significance of the Study

Milk is a nutritious food that provides a good media for growth of bacteria. Despite the cleanliness of the milking process, freshly produced milk contains numerous bacteria. Most of these bacteria come from the udder of the milk producing animals which are often contaminated with faecal matter on the outer surface. Washing of the udder reduces the contamination load but does not eliminate it. Good hygiene and sanitization methods are required to prevent spoilage of milk; transmission of disease-causing organisms; and other health hazards associated with consumption of unhygienic milk and products.

Various types of bacteria in raw milk cause different effects in milk and human health. Spoilage bacteria only produce quality changes in milk (taste and cuddling); while pathogenic bacteria from infected animals, a filthy udder and equipment may cause disease. Milk may also contain substances that are hazardous to human health such as antibiotics and pesticides from exposed animals for which withdrawal periods after treatment with veterinary drugs and pesticides are not observed. Veterinary drugs may cause allergies and induce resistance to antibiotics; while pesticides may trigger carcinogenic effects.

Often, at home, milk is boiled to destroy bacteria. However, in industry, heat treatment methods such as pasteurization (75oC for 15 sec) and sterilization (130o-150o C for 3-5sec) are used to make milk safe for consumption. Pasteurization reduces the number of spoilage bacteria and destroys pathogens; while sterilization further destroys their spores. Proliferation of microorganisms can be prevented by refrigerated transport and storage.

To reduce contamination of milk at any step of the value chain and ensure effective heat treatments and good hygienic practices are required throughout the food chain (Farm to table). In this regard, Nepal Bureau of Standards (NBSM) expresses its interest to harmonized standards to facilitate provision of safe milk and reduce wastage through spoilage. These standards should be used at every level of the food chain: production of milk at the farm, collection at bulking centers, procurement at factory, market delivery, and purchase by the consumer. Milk packets should be labeled to provide necessary information on proper handling by the consumer to reduce risks associated with improper handling of milk.

Standards provide guidance on the principles for food hygiene and best practices in the dairy industry (use of veterinary drugs, pesticides animal feeds, prevention of aflatoxins). Safe margins are set for parameters on pathogens, aflatoxins, veterinary drugs and pesticide residues. Test methods provide guidance for validating compliance to specified maximum limits in milk and milk products. Food safety through standards development and regular reviews; product certification (standardization mark); import inspection; testing; training and food safety management system certification is essential to maintain quality of raw and pasteurized milk.

In 2001, NDDB and Danida Support Project conducted a Benchmark Survey of Quality of Milk and Milk Products in Nepal. The survey has shown that many of the products did not meet the minimum compositional standards laid out by the Food Act and the major problem was in the microbiological quality. In this new millennium, quality philosophy is considered as password to the market. Quality, as in other products, is considered as an indispensable attributes of the milk and milk products too.

Most of the dairies have neither laboratory manual nor company standards of milk and milk products. Although there is GoN approved Code of Practice (CoP) for Dairy Industries, it has remained unimplemented. Had this CoP been implemented in true spirit, the dairy industries and the quality of milk and milk products they produce would have been of higher quality standard. But, unfortunately, neither the CoP is implemented by the dairy industries nor the Committee constituted for monitoring the implementation status of the CoP is active and functioning. The Committee meeting, which is to be held at least bi-monthly, has not been held since a long time and neither the Committee members nor persons designated by it have regularly visited the dairies to know their working system and supervise their working conditions.

Consequently, the quality of milk starts gradually deteriorating from source (farmer level) due to unhygienic animal keeping and milking practices, adulteration of water and other substances, use of inappropriate and contaminated milk vessels (e.g. black polythene tanks) and open transportation. In addition, lack of cleanliness, use of contaminated water, absence of strict quality control system and use of uncertain quality packing materials in the dairy industries, and use of dirty milk crates, inappropriate transportation of processed milk and its disorganized selling (such as in footpaths) further deteriorate milk quality. Ineffective system to take action against the defaulters is another critical issue in maintaining the quality of milk. As such, quality of milk and milk products is doubtful. Based on the objectives and functions, NDDB intends to commission a Bench Mark Survey Study on quality of raw and pasteurized milk across the dairy value chain in the country in order to recommend reforms needed for production and trading of quality milk in relation to the food safety.

1.6 Organization of the Study

The study report is broadly categorized in five chapters. The first chapter describes about problem statement, study objectives and significant of the study along with background of the study. The second chapter reviews related documents, papers, research articles, past studies, etc. related to the present study. Similarly, the third chapter discusses the methodological design of the study. The results and findings of the study have been presented in chapter four. Finally, the chapter five concludes the findings of the study.

Chapter II
Conceptual Review of Literatures

2.1 Physical Characteristics of Milk

Milk may be defined various ways. Chemically speaking, milk is a complex fluid in which more than 100 separate chemical compounds have been found. Its major components are water, fat, lactose, casein[1], whey proteins, and minerals (or ash) in amounts varying with the milk of various species of animals. However, for any given species, the range of values for the constituents of milk is fairly constant. From a physiological standpoint, milk is the secretion of the normally functioning mammary gland of the females of all mammals, which is produced for some time following parturition for the diet of the young of the species during the initial period of growth. In terms of physical chemistry, milk is an opaque, whitish fluid of multi disperse phases. The true solution contains lactose, vitamins, acids, enzymes, and some inorganic salts. Moreover, Milk is composed of water, milk fat, and SNF. The SNF consists of protein, lactose, and minerals. These solids are also referred to as skim solids, or serum solids. The term total solid refers to the serum solids plus the milk fat. The major components of raw milk are illustrated in Figure 1.

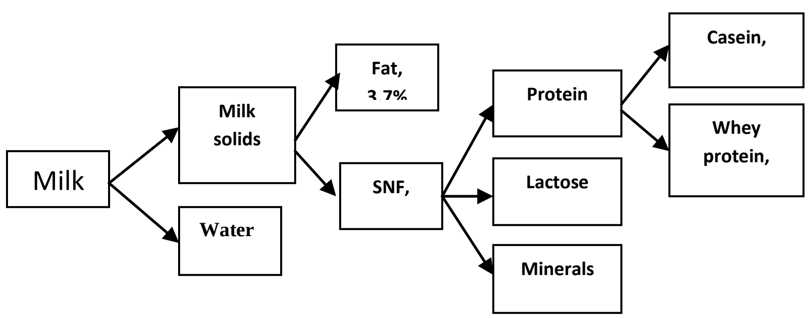


Fig 1: Gross composition of milk, showing major constituents.

The major constituents of milk vary more widely in individual cow’s milk than in pooled market milk. Factors affecting the milk such as breed of cow, intervals of milking, stages of milking, different quarters of udder, lactation period, season, feed, nutritional level, environmental temperature, health status, age, weather, oestrum, gestation period, and exercise are known to cause variations in fat, protein, lactose, and mineral levels in milk derived from individual cows.

[1] the major milk protein

In general, these variations tend to average out but display an interesting seasonal pattern in commercial milk used by food processors, which may have an important impact on properties of the finished products.

2.2 Microbiology of Milk

Initial Micro-flora

Although milk produced from the mammary glands of healthy animals is initially sterile, microorganisms are able to enter the udder through the teat duct opening. Where the mammary tissue becomes infected and inflamed large numbers of microorganisms and somatic cells are usually shed into the milk. Mastitis is a very common disease in dairy cows, and may be present in a subclinical form, which can only be diagnosed by examining the milk for raised somatic cell counts. Although the organisms involved in mastitis are not usually able to grow in refrigerated milk, they are likely to survive, and their presence may be a cause of concern for health. Most common microorganism found in fresh milk form healthy cow are Gram-Positive Cocci, Streptococci, Staphylococci And Micro-Cocci; Lactic Acid Bacteria, Pseudomonas Spp., Yeast, Coryne-Bacteria, etc., whereas most common microorganism found in milk form unhealthy cow are Mycobacterium Bovis, Brucella Abortus, Coxiella Burnetii, Listeria Mono-Cytogenes, Salmonellae, etc. which have a serious health concern for human. The outer surface of the udder is also a major source of microbial contamination in milk. The surface is likely to be contaminated with a variety of materials, including soil, bedding, faeces and residues of silage and other feeds. Many different microorganisms can be introduced by this means, notably Salmonellae, Campylobacter Spp., L. Mono-Cytogenesis, Psychotropic Spore-Formers, Clostridia, and Entero-Bacteriaceae. Good animal husbandry and effective cleaning and disinfection of udders prior to milking are important in minimising contamination.

Other sources of contamination

Milking equipment and storage tanks have been shown to make a significant contribution to the psychrotrophic micro flora of milk if not adequately sanitised. Exposure to inadequately cleaned equipment and contaminated air are also sources of contamination. Milk residues on surfaces and in joints and rubber seals can support the growth of psychrotrophic Gram-negative organisms such as Pseudomonas, Flavobacterium, Enterobacter, Cronobacter, Klebsiella, Acinetobacter, Aeromonas, Achromobacter and Alcaligenes, and Gram-positive organisms such as

Corynebacterium, Microbacterium, Micrococcus and sporeforming Bacillus and Clostridium. These organisms are readily removed by effective cleaning and disinfection, but they may build up in poorly cleaned equipment. Milk-stone, a mineral deposit may also accumulate on inadequately cleaned surfaces, especially in hard water areas. Gram-positive cocci, some lactobacilli, and Bacillus spores can colonise this material and are then protected from cleaning and disinfection. Some of these organisms may survive pasteurisation and eventually cause spoilage. Other, less significant, sources of contamination include farm water supplies, farm workers and airborne microorganisms.

Micro flora during the transportation and storage of milk

Bacterial numbers in the milk may increase during transport, either as a result of contamination from inadequately cleaned tankers or from the growth of Psychrotrophic organisms, particularly Pseudomonas spp. Milk temperature and duration of the transport stage are therefore important factors. On arrival at the processing site, the milk is transferred to bulk storage tanks, or silos, prior to processing. The milk may be stored in the silos for 2 – 3 days, and further growth of Psychrotrophic bacteria is likely during this period. The degree of growth is dependent on the initial microbial load, and the storage time and temperature. The growth of Psychrotrophic bacteria may also be accompanied by the production of heat-stable, extracellular Proteolytic and Lipolytic enzymes. These enzymes are often capable of surviving pasteurisation and, in some cases, ultra high temperature (UHT) processing, and they may subsequently cause spoilage in the processed milk.

Techniques to limit the growth of Psychrotrophs during raw milk storage

Thermisation: The most commonly used technique is to apply a mild heat treatment (thermisation), by heating to around 57 – 68 °C for 15 – 20 seconds and then cooling rapidly to <6 °C. This reduces the Psychrotrophic population significantly and can extend the storage life of the raw milk by several days.

Deep cooling: As the storage temperature is a key factor for the rate of growth of Psychrotrophic spoilage organisms, storing milk at as low temperature as possible can also extend the storage life significantly.

Methods of Treating Milk

Separation: Milk can be separated into skimmed milk, cream and sediment fractions, using centrifugal separators. The agitation involved may also break up clumps of bacteria, potentially producing an apparent increase in the number of colony-forming units. This process also allows the milk to be standardised to a specified fat content by adding back the correct quantity of cream.

Homogenisation: Homogenisation reduces the size of the milk fat globules. The fat globules are then small enough to remain in suspension. Homogenisers used for pasteurised milk may be linked to the pasteuriser, and run at raised temperature in order to minimise possible microbial contamination. UHT processed milks are homogenised in sterile conditions after heat treatment and before aseptic filling.

Pasteurisation: Some form of heat process is commonly applied to milk to ensure microbiological safety, and to extend shelf life; the most commonly used process is pasteurisation. In the most of the case, both low-temperature, long time (63 – 65 °C for 30 minutes), and high-temperature, short time (HTST 71.7 – 75 °C for at least 15 seconds) minimum processes are permitted. However, in practice, the HTST process is now generally used. Higher processes (such as ultra-pasteurisation at 130 to150 °C for at least 2 seconds) may also be applied to products with high fat and solids content. Pasteurisation processes are designed to reduce the numbers of vegetative microbial pathogens to levels that are considered acceptable, although bacterial spores are not destroyed. Most of the potential Psychrotrophic spoilage bacteria are also eliminated. However, certain heat-resistant Mesophilic organisms are able to survive pasteurisation.

UHT or sterilisation processes: Milk may also be subjected to more severe heat processes sufficient to achieve "commercial sterility". This may be done by batch heating in closed containers, or continuously with aseptic filling into sterile containers. Both conventional retort sterilisation and UHT processes must achieve a minimum of 3 minutes to ensure product safety. These processes destroy all vegetative cells in the milk, and the majority of spores, although certain very heat-resistant spores may survive. This results in a long shelf life without the need for refrigeration, but also causes Organoleptic changes in the milk, such as browning. Conventional sterilisation processes involve heating the milk in thick-walled glass bottles, closed with a crimped metal cap, at about 120 °C for approximately 30 minutes. However, modern large-scale production methods often use an initial UHT treatment prior to filling the container, followed by retorting for a reduced time (10 – 12 minutes), and then a rapid cooling process.

2.3 Adulteration in Milk

Table 1:

List of common Milk Adulterants and their harmful effects

Adulterants	Added to	Harmful effects in human health
Water	Increases the volume	Decreases the nutritional value of milk; poses health risk due to addition of contaminated water
Benzoic and Salicylic acid	Increase shelf life for long distance transportation	Increase asthma problem and the level of hyperactivities in children
Detergents	Increases the foaming to give thickness and whiteness	Increases the gastro-intestine and kidney problems
Urea	Provides whiteness; increases the constancy for improving SNF%, imitates natural	Gives overburdens to kidney and may cause kidney failure
Formalin	Increase shelf life for long distance transportation	Causes liver and kidney damage, it is highly toxic
Sugar	Increase the quality and SNF%	Prove fatal for diabetic patient
Carbonates and Bi-Carbonates	Mask the pH and acidity values of badly preserved milk to pass it as fresh milk	Can cause disruption in hormone affecting regular development and reproduction
Ammonium Sulphate	Increases the lactometer reading by increasing the density of milk	Can cause irritation in gastro-intestinal track causing nausea, vomiting, diarrhea, etc. It is neurotoxin and can cause behavioural change

Milk is one of the products which can be adulterated in many ways affecting the quality of further dairy products. Intention behind adding edible or inedible substance in milk is more for economic concerns. But, the root causes can be illustrated as:- demand and supply gap: more acute during some season due to low milk production and increased demand; physical nature of milk: aqueous and opaque nature of milk can accommodate many adulterants in milk; degraded moral society: wrecked moral status coupled with passion for profiteering; spoiled socio-economic structure: persons engaged in the business to increase their income and raise socio-economic status; perishable nature of milk: the unscrupulous producers/traders use preservatives, neutralizers, etc. to prolong the shelf life of sub standard milk; unorganized condition of dairy industry: most of the milk is procured and traded by unorganized dairies; which freely adulterate the milk; low legal standards and their improper enforcement, lack of suitable, rapid and sure tests etc. The table 1 shows the common milk adulterants and their harmful effects.

2.4 Antibiotic Residues in Milk

Antibiotic use plays a major role in the emerging public health crisis of antibiotic resistance. Although the majority of antibiotic use occurs in dairy farms, relatively little attention has been paid to how antibiotic use in dairy animals contributes to the overall problem of antibiotic resistance. The potential threat to human health resulting from inappropriate antibiotic use in dairy animals is significant, as pathogenic-resistant organisms propagated in these livestock are poised to enter the dairy supply and could be widely disseminated in dairy products. Antibiotic residues in milk may lead to severe allergic reactions in sensitive consumers, and cause antibiotic resistance in human body. The table 2 shows the residues warning period of lactating animas.

Table 2:

Effects of common antibiotics used for animals

Antibiotic	Treatment for	Residues warning for milk withdraw
Penicillin	bacterial pneumonia (shipping fever) caused by Pasteurella multocida	48 hours
Flunixin	inflamed tissue, mainly used for pain, soiling, fever, loss of function of certain internal organs, etc.	36 hours
Sulfadimethozine	respiratory, urinary tract, enteric, and soft tissue infections	10 days
Oxytetracyclin	Bacterial pneumonia, caused, inflamed tissue, mainly used for pain, soiling, fever.	21 days
Tetracycline		5 days

Source: US Food and Drug Administration Guideline

2.5 Review Findings

2.5.1. Dairy Animal Population and Distribution in Nepal

Cattle, buffaloes, yak and their crossbred are important dairy animals being reared in the country. The estimated population of cattle, buffaloes and yak/crossbred are 7.2 million, 5.0 million and 63 thousand respectively during the year 2010/11. Of the total cattle population, the distribution in hill agro ecological region was highest (48%) followed by Terai (40%) and least in the mountain agro-ecological region. Similarly, the cattle population was found to be mostly concentrated in the Eastern Development Region (28.8%) followed by Central Development Region (23.6%), Mid Western Development Region (18.0%) and Western Development Region (16.6%). The cattle population was least in the far western development region (13.0%)

Table 3:
Cattle Population by Development and Ecological Region (2010/11)

Ecological Regions	Development Regions					
	EDR	**CDR**	**WDR**	**MWDR**	**FWDR**	**Total**
Mountain	252,649	184,250	11,321	197,051	225,267	870,538 (12%)
Hills	744,597	825,357	773,751	735,714	386,146	3,465,565 (48%)
Terai	1,085,027	693,507	417,976	367,485	325,951	2,889,946 (40%)
Total	**2,082,273 (28.8%)**	**1,703,114 (23.6%)**	**1,203,048 (16.6%)**	**1,300,250 (18.0%)**	**937,364 (13.0%)**	**7,226,049**

Source: (MoAD, 2012)

The distribution of buffaloes was also highest in the hill agro ecological region (52.4%) followed by in Terai (39.0%) and least in mountain region (8.6%). Likewise distribution of buffaloes in CDR, WDR, EDR, MWDR and FWDR were 25.6%, 25.2%, 23.3%, 15.3% and 10.6%, respectively.

Table 4:
Buffalo Population by Development and Ecological Region (2010/11)

Ecological Regions	Development Regions					
	EDR	**CDR**	**WDR**	**MWDR**	**FWDR**	**Total**
Mountain	146,682	148,047	88	34,273	99,185	428,275 (8.6%)
Hills	427,286	644,691	934,358	404,927	205,464	2,616,726 (52.4%)
Terai	587,724	486,383	325,513	324,924	224,104	1,948,648 (39%)
Total	**1,161,692 (23.3%)**	**1,279,121 (25.6%)**	**1,259,959 (25.2%)**	**764,124 (15.3%**	**528,753 (10.6%)**	**4,993,649**

Source: (MOAD, 2012)

The estimated population of yak and crossbred (Chauries) in the country was 63000 during FY 2010/11 and are found in the 28 Northern high hills and mountain district of the country.

Though statistics on population of cattle and buffaloes segregated by breed is not available, it is estimated that around 10-12% of the cattle population and 25-36% of buffalo population are considered to be exotic or crossbred (DLS, 2010).

2.5.2 Annual Milk Production

The estimated annual milk production in the country in the year 2010/11 was 1.56 million MT, a 3.95% higher than that in the year 2009/10 (DLS, 2012). The annual milk production was highest from the hill region (52.5%) followed by Terai (40.5%) and least in the Himalayan region (7.0%).

Table 5:

Annual Milk Production by Ecological Region (2010/11)

Ecological Regions	Cattle			Buffalo			Total Milk (MT)
	Milking animal	Milk Prodn (MT)	Productivity (kg/yr)	Milking animal	Milk Prodn (MT)	Productivity (kg/yr)	
Mountain	113,294	38,466	339.5	98,438	71,009	721.4	109,475
Hills	495,228	220,431	445.1	734,191	596,161	812.0	816,592
Terai	365,600	188,288	515.0	459,015	442,155	963.3	630,443
Total	**974,122**	**447,185**	**459.1**	**1,291,644**	**1,109,325**	**858.8**	**1,556,510**

Source: DLS (2012)

The average milk production per milking cow and buffalo stood at only 459 kg and 859kg respectively. Again the productivity of animals in Terai and Hills were higher as compared to the productivity of animals at Himalayan region mainly due to gradual replacement of indigenous cattle and buffaloes with exotic or crossbred animals particularly in the region where milk collection facilities from organized sector (DDC and private dairies) have been established.

Similarly, the annual milk production in CDR was highest (29.7%) followed by production in EDR (25.5%), WDR (23.2%), MWDR (11.6%) and least in FWDR (10.1%) also coinciding with the milk collection network established in the country. Only recently milk collection and processing facilities have been established in the far western development region.

Table 6:
Annual Milk Production by Development Region (2010/11)

Development Regions	Cattle			Buffalo			Total Milk (MT)
	Milking animal	Milk Prodn (MT)	Productivity (kg/yr)	Milking animal	Milk Prodn (MT)	Productivity (kg/yr)	
EDR	302,767	151,113	499.1	300,644	245,338	816.0	396,451
CDR	238,973	120,941	506.1	347,604	341,970	983.8	462,911
WDR	156,800	72,396	461.7	352,959	288,257	816.7	360,653
MWDR	147,788	53,021	358.8	151,443	126,997	838.6	180,018
FWDR	127,794	49,714	389.0	138,994	106,763	768.1	156,477
Total	**974,122**	**447,185**	**459.1**	**1,291,644**	**1,109,325**	**858.8**	**1,556,510**

The trend analysis of milk production from cattle and buffaloes shows gradual steady increase in both total production and number of milking animals, but the productivity improvement has been marginal both for cattle and buffaloes. Programme for increasing the productivity of dairy animals rather than increasing the absolute number of animals would be quite essential to minimize additional burden on already limited availability of livestock feeding resources.

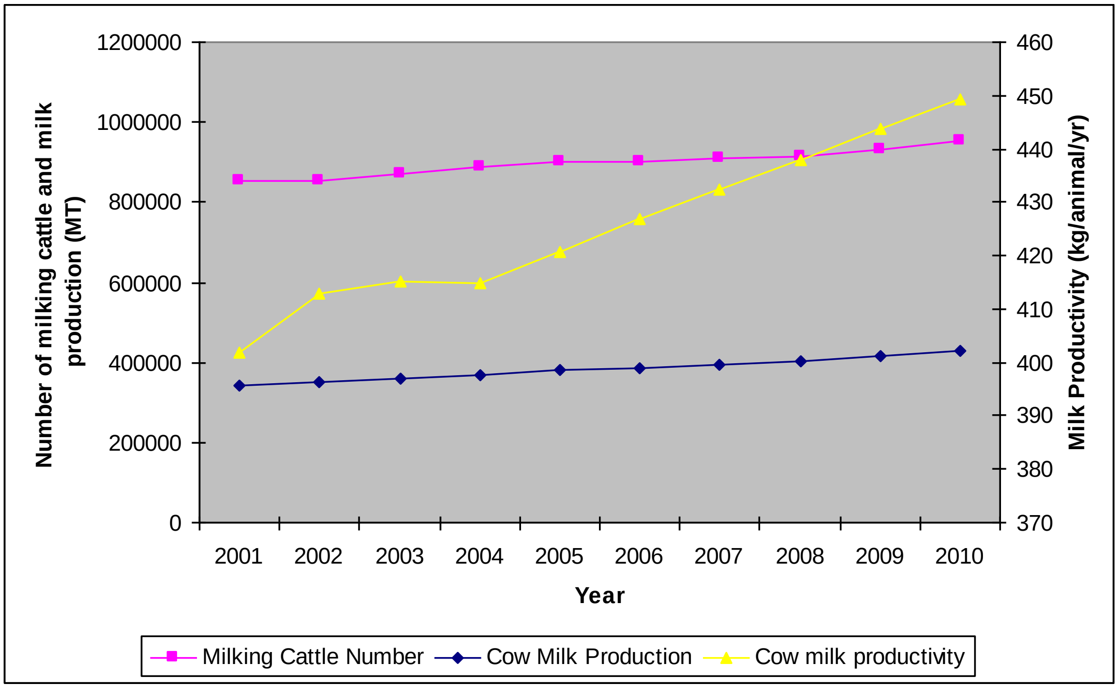


Figure 2: Milking cattle and cow milk production trend in Nepal

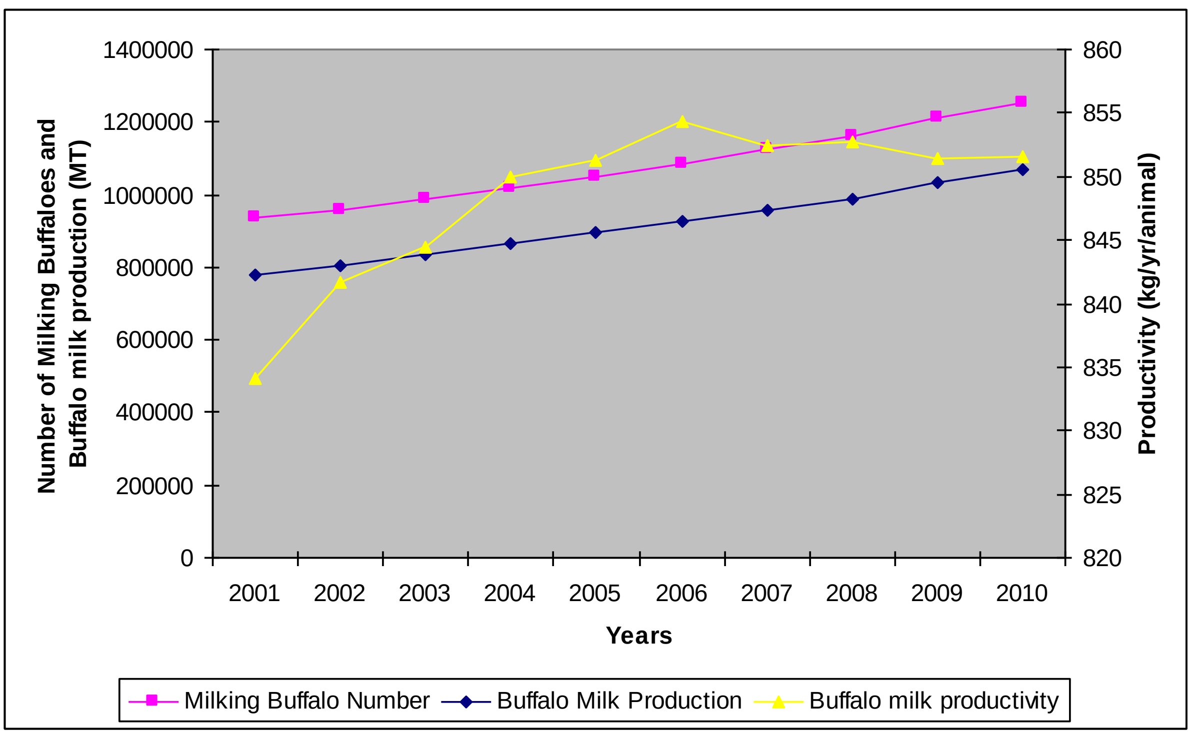


Figure 3: Milking buffalo and buffalo milk production trend in Nepal

2.5.3 Per Capita Milk Availability

Per capita milk availability in Nepal is around 58 kg which is far below the 250g/day (91 kg/annum) recommendation of WHO. The per capita availability of milk in developed world is 222kg. Among the South Asian countries, Pakistan has highest per capita availability (230kg), followed by India (98kg). Per capita availability of milk in Bangladesh (18kg) and Sri Lanka (33kg) is below compared to the figure in Nepal. It has been estimated that annual milk production growth rate of 8-9% is required to meet the WHO/FAO recommended per capita consumption of milk (Table 6). Investment on genetic improvement of dairy cattle for substantial increase in milk production coupled with improvement in feeding and health management would be essential.

Table 7:

Projection on Annual Growth rate required to meet milk consumption recommended by FAO/WHO by 2020.

	2013	2014	2015	2016	2017	2018	2019	2020
Milk Production (MT at current growth)	1665466	1719944	1774421	1828899	1883377	1937855	1992333	2046811
Human Population	27366192	27738883	28111574	28484266	28856957	29229648	29602340	29975031
Per capita availability	60.9	62.0	63.1	64.2	65.3	66.3	67.3	68.3
Milk Production (5% Annual Growth)	1712161	1789987	1867812	1945638	2023463	2101289	2179114	2256940
Per capita availability	62.6	64.5	66.4	68.3	70.1	71.9	73.6	75.3
Milk Production (7% Annual Growth)	1774421	1883377	1992333	2101289	2210244	2319200	2428156	2537111
Per capita availability	64.8	67.9	70.9	73.8	76.6	79.3	82.0	84.6
Milk Production (9% Annual Growth)	1836682	1976768	2116854	2256940	2397025	2537111	2677197	2817283
Per capita availability (kg)	67.1	71.3	75.3	79.2	83.1	86.8	90.4	94.0

2.5.4 Existing Milk Production System in Nepal

Milk production in Nepal broadly can be classified into two systems 1) traditional subsistence milk production system and 2) market linked commercial/ semi commercial milk production system. This market linked system can be further sub divided into

- Smallholder peri-urban production
- Urban Production
- Large Scale commercial production
- Cooperative animal farming and milk production

Rural subsistence production

- Largely in the rural areas
- Mostly animals are indigenous and utilizes natural resources- grazing
- 1-3 milking animals (cattle or buffaloes)
- Predominantly for HH consumption
- Minimal marketing opportunity
- Minimal external inputs- direct cost minimum
- Extra milk sold directly to consumers (if opportunity exists) or converted to ghee and sold in the market

Small holder- peri urban milk production

- Most prevalent in peri urban areas
- 2-10 milking animals (cattle, buffaloes or mixed generally crossbred)
- Generally stall fed
- Milk marketed to organized formal sector
- Farmers mostly involved in MPCs for easy marketing
- Some land holdings for green grass production
- Purchase of compound feeds or ingredients

Urban Production

- Represent small section
- Farmers' keep crossbred animals 1-10
- No green grass production due to high opportunity cost of land
- Depends on purchased feed and dry roughages
- If numbers are few- found roaming around roadside in search of feed
- Opportunity to sell milk directly to consumers with higher price (>Rs 50/lt)

Large Scale Commercial Production

- Gradually emerging in peri urban areas

- More than 20 milking crossbred animals upto 100
- Green forage production - important
- Dairying – not mixed with other agricultural operation
- In Terai and low hills

Cooperative animal farming and milk production

- Emerging – young and educated population
- Medium to large scale commercial production

2.5.5 Smallholder dairying

Smallholder dairy systems are common throughout the developing countries. Market-oriented dairy farming by smallholders practicing a mixed crop-livestock form of farming can be a key to economic development in many areas of the HKH including Nepal. Over the past 10 to 15 years, considerable changes have taken place in the structure and management systems of smallholder dairy farming within the mixed crop-livestock farming systems. In particular, there have been notable changes in the species and breeds of the dairy population, infrastructure, and market developments. Increasing urban markets and improved marketing systems have led to a slow but steady move towards dairy farming as a means of supplementary income generation and even as a commercial venture rather than as part of a subsistence system.

Devendra (2001) categorized smallholder dairy production into three systems:

1. Traditional, usually with ad hoc marketing arrangements such as many peri urban farms
2. Cooperative, formed from natural aggregation and concentration of farms
3. Intensive, where herd sizes become larger

Smallholders manage their herds in order to maintain a steady supply of milk. The number of milch animals that can be reared in a smallholder system has a certain ceiling. The obvious determining factors to this are the size of landholding, the availability of feed and human labour. In the major dairy pocket areas of Nepal, majority of the dairy farmers are smallholders. Out of 880 farms under recording scheme for genetic improvement programme across 14 hill and Terai districts of Nepal, the median herd size was found to be 5 with majority of households (56%) having cattle herd size of 1-5. Very few households were having more than 10 cattle and extremely low had herd size of more than 20 cattle. Some of the smallholder dairy farmers keep the mixed herd of cattle and buffalo, some only buffaloes and rest only cattle with their unique explanation for such practices. Although government programmes have promoted crossbred cows for use as dairy animals, the use of buffalo is becoming popular among small farmers because of their adaptability to local feed resources, high milk fat content, and salvage value in the hills. The milk produced from these smallholder farmers come into formal milk market through organized private and public dairy sector in the country. Some farmers are still opt to supply milk directly to the consumers or to the intermediate processor (hotel and restaurants producing sweets) as they get better price for milk compared to the price when they sell it to the formal milk market.

In Nepal's hills and Terai, areas that are accessible via the road network have experienced significant growth in smallholder dairy farming. The marketing of milk has been facilitated by the establishment of milk collection centers that transport milk to the main chilling canters established by DDC (government), as well as by private dairies in strategic milk collection points.

Private sector involvement in processing milk from smallholdings is increasing. However, the private sector's efforts are also uncoordinated, and quality enforcement is lacking. The private sector also suffers from unfair competition with the subsidized public sector.

In the high hills and mountain areas, *Chauries* (crossbred between yak and hill cattle) are being raised mainly for milk production. The milk is being utilized for Yak cheese production by DDC owned and private cheese factories. Milk production from *Chauries* are seasonal (not milked during winter feed scarce period) and thus the operation of these cheese factories located in the remote high hills of the country are also seasonal.

2.5.6 Periurban milk production

Most of the smallholder dairy production development has been evolved around peri urban areas as there is good road link and good market potential for the milk and products in adjoining city centre. The state owned Dairy Development Corporation (DDC) initiated 5 different milk supply scheme namely Kathmandu Milk Supply Scheme (KMSS), Biratnagar Milk Supply Scheme (BMSS), Hetaunda Milk Supply Scheme (HMSS), Pokhara Milk Supply Scheme (PMSS) and Lumbini Milk Supply Scheme (LMSS) in Kathmandu, Biratnagar, Hetauda, Pokhara and Butwal respectively. Consequently, the smallholder as well as medium to large scale dairy farms emerged in the vicinity of these city centres. The collection and chilling centres were established around these dairy farm settlements. The private dairy sectors also focused their activities on these established centres thus smallholder dairy grew faster in these peri urban areas. However, in the present context of short supply of around 400000 lit of milk daily to the established capacity of small to large dairy industries, the private sectors are expanding their coverage in new peri urban areas as well as in the villages where there is good road linkage. The lower opportunity costs of land and labor in peri urban areas compared to that within the cities have greatly encouraged dairy development in peri urban areas. However, smallholder dairy farming is not uncommon in the city centre itself. Small to medium sized dairy farms are found in major cities like Kathmandu, Pokhara and Biratnagar. The feeding of these dairy animals kept in the city itself however differs from that kept in the peri urban areas. In the city centres, the animals greatly depends on straw and concentrates, whereas there is a practice of cultivating forage grass depending on availability of land in peri urban areas. Green grasses from fallow land and roadside and from fodder tree is also available in the peri urban areas.

2.5.7 Dairying through co-operatives

The fundamentals of the cooperatives is working together to build self reliant communities. Cooperatives are often cited as one of the most effective way of grouping small dairy farmers to deal with the challenges of producing and marketing milk. As a result of the perishable nature of milk and the range of skills involved in its production and marketing, dairying requires a number of services that can best be provided by cooperative action. It is not surprising therefore that the cooperative movement has featured prominently in the development of the dairy industry worldwide.

A dairy cooperative business is owned, operated, and controlled by the dairy farmers who benefit from its services. Members finance the cooperative and share in profits it earns in proportion to the volume of milk they market through the cooperative. Milk producers' cooperatives and association were formed for the first time in 1980 in Nepal to cope with the challenges being faced by smallholder farmers in milk production pockets. At present, there are 1748 Milk Producer's Cooperative Societies (MPCs) functioning in 62 districts in the country (as of Ashad 2068). These primary cooperatives used to have at least 25 member farmers. In the district level, District Milk Producers' Cooperative Unions (DMPCUs) are in function in 38 districts which coordinates and facilitates its member primary cooperatives within the district for dairy operation. Central Dairy Cooperative Association of Nepal (CDCAN) is the national level umbrella for primary cooperatives and union in the country.

The farmers' are paid for milk on basis of fat and SNF content of the milk. However, the primary cooperatives are additionally paid for total solid content of the bulk milk from DDC and dairy industries. This amount helps to run cooperative for its day to day operation. The salary to the personnel involved in the cooperative, transportation cost from collection to chilling centres or dairy industries, and purchase of chemicals and glassware required are also paid from these earnings of the cooperatives.

Farmer-owned dairy cooperatives engage in a variety of activities to provide members an assured market for their milk. Dairy cooperatives range widely in size and function-some solely arrange for the sale of members' milk and provide few services, while others manufacture range of products and may market their products directly to consumers. Most MPCs are engaged in milk collection, quality testing and distribution of milk payments. Some MPCs operate input supply, veterinary services, and consumer goods outlets for members. Feed manufacturing by the cooperatives and selling to the cooperative member is gaining popularity as there is greater quality assurance and payment ease in the process.

2.5.8 Existing Milk and Milk Products Marketing System

The existing milk and milk products marketing channel operating in the country is summarized in the following table and diagram

Table 8: Milk marketing channel and number of intermediaries

Milk Marketing Channels	Number of intermediaries
Producer-consumer	0
Producer-milk hawker-consumer	1
Producer-processor-consumer	1
Producer-processor- retailer-consumer	2
Producer-milk trader—consumer	2
Producer-dairy co-operative –processor- retailer - consumer	3

The number of intermediaries involved will have a bearing on both producer and consumer milk prices. The shorter the channel the more likely that the consumer prices will be low and the producer will get a higher return.

From the consumer point of view, the shorter the marketing chain, the more likely is the retail price going to be low and affordable. But this is only the one side of the coin. Actually the price paid to producer by consumers in direct channel (no middlemen) or short channel (through Hawkers) might have to even pay higher than the processed milk, because of consumers' preference for whole milk rather than reconstituted processed milk. This explains why, following the liberalization of the dairy industry, direct sales of raw milk from producers to consumers (channel 1) or through hawkers (channel 2) has been on the increase despite the public health risks associated with the consumption of untreated milk and milk products. Milk producers may not necessarily benefit from a short marketing chain i.e. milk processors may be paying farmers the same price as hawkers. However, farmers sometimes prefer selling milk to hawkers because other factors such as prompt payments and inaccessibility to formal market outlets such as producer co-operatives or lack of nearby milk processing factory. The biggest disadvantage of direct milk sales to consumers by hawkers is the total lack of quality control and the frequent rate of adulteration of milk with (dirty) water, which is illegal.

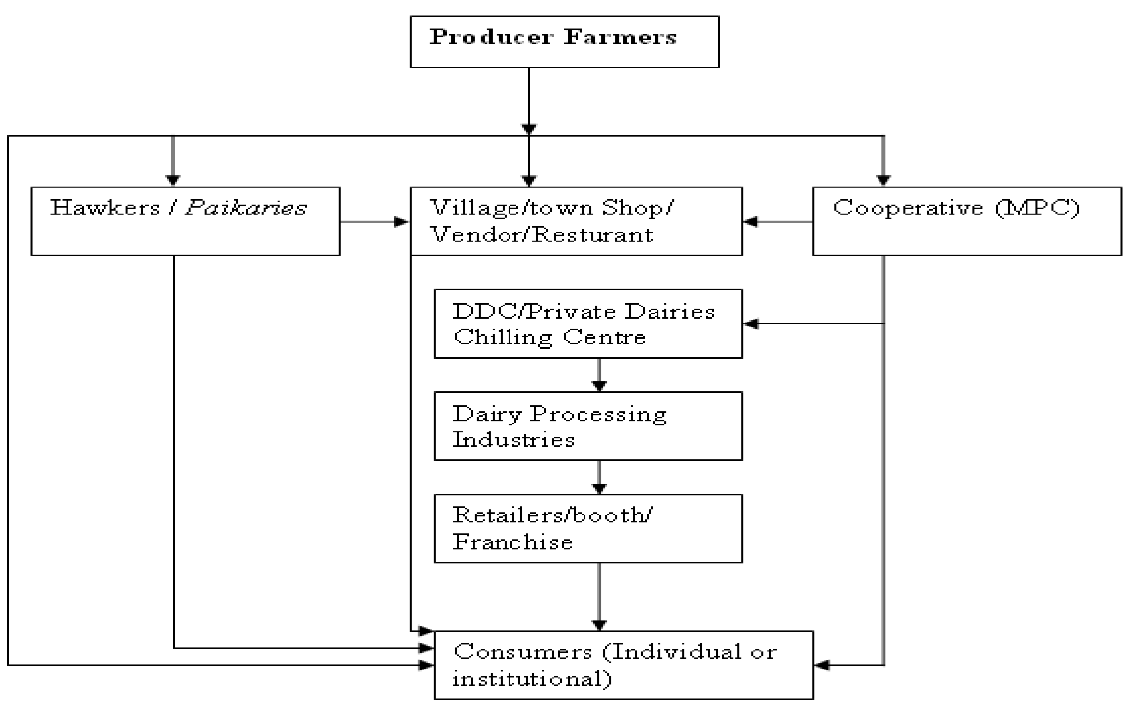


Figure 4: Milk Marketing Channel in Nepal

Table 9:
Advantages and disadvantages of various milking channels

Channel	Strength	Weakness
Cooperative	• Offer an assured permanent market • Offer Services- feed, vaccine etc • No limit to quantity farmers can supply • Quality control- fare trade • Ownership feeling • Investment opportunity-share • Bonus payment • Collection centre not far from producing farm	• Relatively lower price where competition exists • Sometime there might be delay in payment • Farmers end up bearing the cost of mismanagement • Over politicization
Vendors/ Hawkers/ Middlemen	• Pay somewhat higher price where competition exists • Prompt payment • Collects milk from farmers doorstep • Provide market outlet in region not well serviced by formal procurement system	• Chance of disappearance without payment • Not a reliable market • No supply of input or services or no credits on them • Arbitrary change of price without prior knowledge • No quality control on milk
Hotel/ Resturants	• Higher prices than cooperative • Payment can be negotiated • A reliable market • Can not disappear	• No security- business can be closed at any time • No Input and service support • Can't take all milk
Consumers/ neighbors	• Collects from farm/ or delivered • Flexible time • Price is usually higher	• Not a reliable source • Can delay payment
Dairy Industries	• Generally prompt payment • Give price for true weight and content • Relatively better price where competition exists	• Sometimes delayed payment can occur if their products are stored for long time • Tries to control over price paid to producer

The prevailing milk and products marketing channel can be further simplified as:

- Farmers to Consumers- Fluid milk and products such as Curd, Paneer, Khowa, Chhurpi
- Farmers to hotel/Restaurants (Fluid Milk) to consumers- Fluid milk (in tea coffee), *kheer*
- Farmers to Sweet shop (Fluid milk and partially processed products: *Chhena*, *Khowa*) to consumers- various sweets (*Barfi*, *Penda*, *Rasbari*, *Lalmohan* etc)
- Farmers to cooperatives (fluid milk) to consumers- Fluid milk and products (Panner, Ghee, Curd, *Lassi*)

- Farmers to cooperative (fluid milk) to processor (fluid milk) to retailers/vendors (products such as pasteurized milk, yoghurt, cheese, paneer, sweets, ghee etc.) to consumers (the same products)

In a nutshell, while the informal sector scores over the formal sector by virtue of the fact that in many areas it is the only marketing channel open to the rural producer and other factors related to, paying slightly higher prices, offering short term instant cash credit and providing milk collection service at farmer doorstep, the formal sector provides an assured and permanent market as well as a number of other livestock support services.

2.5.8 Dairy Value Chain

The dairy value chain starts with raw milk production at the farmer level and ends with consumers who buy the processed milk and dairy products. There are several players between the start and end of the chain, – namely the feed suppliers, artificial insemination (AI) and health services providers, milk collectors and agents, processing units and distribution networks. At almost each level in the value chain, there is some value added such that the cost of raw milk increases as it passes through the several stages in as illustrated in the following figure:

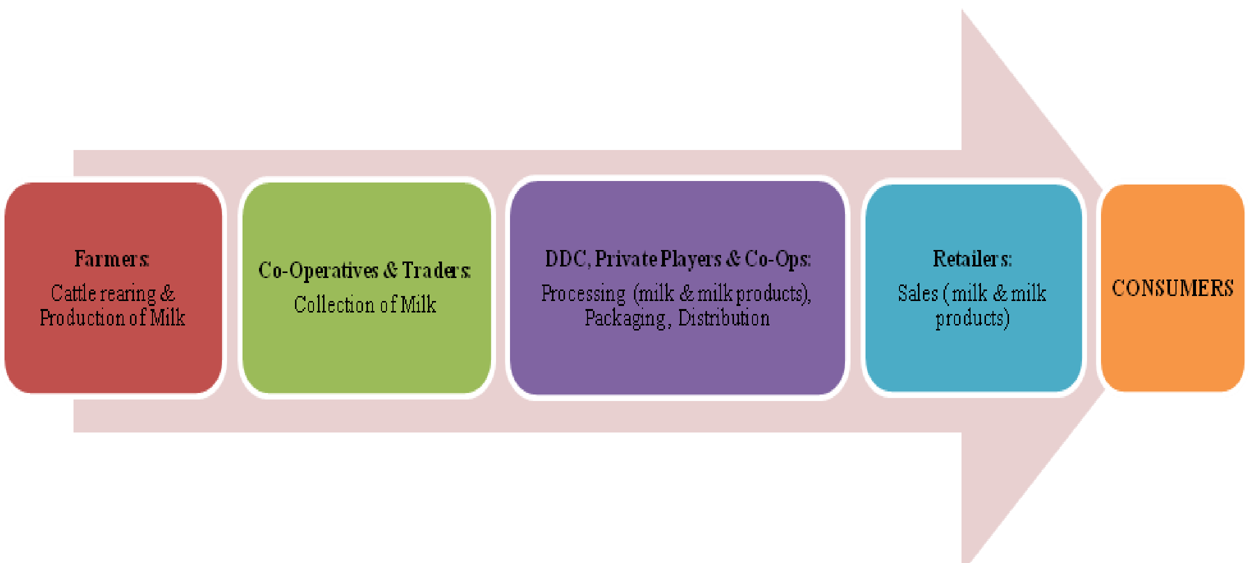


Figure 5: Dairy Value Chain

Production and Collection of Milk

The production of milk takes place in most of the rural households in Nepal, where most farmers are involved in dairy farming too. Milk so produced is collected and factors such as the geography of Nepal, small scattered households with low milk production, spoilage of milk during summer and among other things make milk collection a costly and cumbersome activity. Agents, middlemen and MPCs that collect milk from farmers are the main actors during this stage. Milk collected from the farmers is tested, measured, and stored in the chilling vats. It is then transported, maintaining the cool chain, to the factories to process it into pouch milk and other milk products such as ghee, curd, yoghurt paneer and other diversified products. Collection is normally done only once in the morning, in most parts of Nepal. Besides, maintaining the quality of milk by chilling it and preventing it from spoiling during transit to the factories, no other value addition is made at this stage.

Processing

The highest value addition comes from processing raw milk into packaged milk or milk products such as yoghurt, ghee, cheese, SMP etc. The major actors are the DDC, private dairies (both small and large). 80% of the milk and dairy products produced by DDC are consumed within Kathmandu valley.

Distribution

Once out of the factories, milk and milk products are sent for distribution to consumers through whole-sellers, franchisees, dealers, and retailer outlets. These distributors so to speak are paid on commission basis depending on the volume, value and the type of the products.

Consumption

The dairy value chain ends with the consumers deciding what, when and how much dairy products they want. Actors in the value chain need to pay attention to consumers' taste and perception. Consumers utilize the end products, generating revenue that flows backwards in the value chain and ultimately to the rural farmers. Value chain development is thus a market oriented approach with the ultimate purpose of making consumers happy.

Existing Dairy Processing Industries

The state owned Dairy Development Corporation is a largest dairy industry having daily processing capacity of 225000 lit milk. After economic linearization and rapid urbanization other private diary industries are being established in the various part of the country. There are 3 large private dairy industries having milk processing capacity of more than 50000 lit per day. There are around 10 industries with milk handling capacity of 10000 to 50000 lit, around 30 small industries handling 1000-10000 lit milk per day and around 700 small industries/ vendors handling less than 1000 lit of milk daily.

2.6 Importance of milk hygiene

Milk becomes sour when stored for long periods at high ambient temperatures prevalent in tropical and subtropical countries. This is because the inherent lactic acid bacteria and contaminating microorganisms from storage vessels or the environment break down the lactose in milk into lactic acid. When sufficient lactic acid has accumulated, the milk becomes sour and coagulates. Raw milk that contains too much lactic acid, even if it does not appear to be curdled, will coagulate when heated. This acidity is known as "developed acidity" and such milk is not acceptable for sale to consumers or milk processors.

The number of spoilage bacteria in raw milk depends on the level of hygiene during milking and the cleanliness of the vessels used for storing and transporting the milk. During the first 2–3 hours after milking, raw milk is protected from spoilage by inherent natural antibacterial substances that inhibit the growth of spoilage bacteria. However, if the milk is not cooled, these antibacterial substances break down causing bacteria to multiply rapidly. Cooling milk to less than 10°C may prevent spoilage for up to three days. High storage temperatures result in faster microbial growth and hence faster milk spoilage.

Raw milk is also known to be associated with pathogenic bacteria which cause milk-borne diseases such as tuberculosis, brucellosis or typhoid fever, among others. Hygienic milk production, proper handling and storage of milk, and appropriate heat treatment can reduce or eliminate pathogens in milk. In many countries, milk processing factories are required by law to pasteurise milk before selling it to the public. Many consumers also routinely boil milk before drinking it to protect themselves from milk-borne diseases. Processed milk must be handled hygienically to avoid post-processing contamination.

So, whether one is selling milk directly to consumers or to a processing factory, it must be handled hygienically so that it remains fresh and capable of being heated without curdling. Hygienic milk handling includes using clean equipment, maintaining a clean milking environment, observing good personal hygiene and preserving the quality of milk during storage and transportation to the consumer or processing plant.

2.6.1 Clean Milk Production on the Farm

Good hygienic practice is very important in the production of clean milk. Clean milk has the following characteristics:

- Low bacterial count
- Pleasant creamy smell and colour
- No obnoxious odors
- No dirt and extraneous matter
- No residues of antibiotics, sanitizers or pesticides

2.6.2 Sources of Milk contamination

Raw milk may be contaminated by bacteria from several sources. These include:

- Udder and udder flanks
- Milker
- Milking environment
- Milking equipment
- Vessels used for milk storage and transportation

2.6.3 Conditions for Clean Milk Production

Some important points to observe in order to produce clean milk:

- Milking should be carried out in a well-ventilated barn with adequate lighting.
- The floor of the milk barn must be durable and easy to clean, preferably made of concrete.
- After use, milking vessels and equipment must be cleaned with potable water, sanitized and dried in the sun on a drying rack. Suitable disinfectants, such as hypochlorite solution, should be used at the recommended concentrations.
- Milkers must be healthy and not suffering from contagious diseases or ulcers.
- Only healthy cows should be milked. Cows suffering from mastitis should be milked last and their milk discarded. Milk from cows on antibiotic treatment should not be sold until the specified withdrawal period (usually 72 hours or more) has elapsed.
- Colostrum (the milk produced in the first five days after calving) should not be mixed with normal milk. Calves must be allowed to suckle their dams and excess colostrum may be given to other calves.
- During milking, the first strips of milk (fore milk) should be milked into a separate, black-coated cup (strip cup) to check for mastitis. The fore milk should then be discarded.
- Where possible, raw milk should be cooled using simple methods such as immersing milk cans in a trough of running cool water or evaporative cooling

2.6.4 Milk preservation on the farm

While most smallholder farmers do not have cooling facilities, it is important to cool milk and store it at as low a temperature as is practically possible if it cannot be delivered within 2–3 hours after milking. This is particularly important for evening milk or where morning milk cannot be transported to the milk collection point within 2–3 hours. Simple means of cooling, such as immersing milk cans in ice blocks or cold water in a trough, are better than leaving the milk uncooled. Where available, domestic refrigerators may be used but avoid freezing milk as this destabilizes the fat.

2.6.4 Good Milking Procedure

It is important to follow proper milking procedures in order to obtain milk of good and consistent quality. A properly executed routine milking procedure is part and parcel of clean milk production.

The following steps should be followed:

Milk at the same time every day ensures consistent butterfat content. Usually, the longer the milking interval the higher the butterfat content and volume of milk. The reverse is true for shorter intervals. There are no economic benefits of milking more than twice a day unless one has very high yielding cows (>40 litres/day). For most smallholder producers, a twice-a-day milking routine is adequate.

- Wash the udder with a clean towel Stimulates milk let-down and release of the hormone oxytocin which acts on the milk secretory (alveolar) cells, causing release of milk.
- Remove the fore milk into a strip cup Helps to check for abnormal colour or presence of blood clots. This may indicate infections like mastitis. The fore milk should be discarded.
- Complete milking within 4–5 minutes After 5 minutes, the stimulation effect of release of oxytocin wanes away.
- Dip teats in a post teat dip disinfectant (iodophor or hypochlorite) Prevents infection of the udder.
- Test cows regularly using the California mastitis test (CMT) or the Whiteside test, both of which are simple to use. Enables early detection and treatment of mastitis
- Use of appropriate equipment: One of the major sources of contamination of milk is the use of equipment and storage vessels which cannot be easily cleaned and sanitized. These

include jerry cans and buckets made of non-food grade plastic. Metal containers such as aluminum and stainless steel cans are recommended under the code of hygienic practices.

2.7 Fundamentals of CoP

Dairy farmers are in the business of producing food. They aim to ensure that the safety and quality of their raw milk will satisfy the highest expectations of the food industry and consumers. On-farm practices should also ensure that milk is produced by healthy animals under acceptable conditions for the animals and in balance with the local environment.

The overarching principles applying to the production, processing and handling of all milk and milk products are:

- From raw material production to the point of consumption, all dairy products should be subject to a combination of control measures. Together, these measures (good agricultural practice - GAP and good manufacturing practice - GMP) should meet the appropriate level of public health protection.
- Good hygienic practices should be applied throughout the production and processing chain so that milk and milk products are safe and suitable for their intended use.
- Wherever appropriate, hygienic practices for milk and milk products should be implemented.
- GAP/GMP together should be effective.

All dairy farmers, suppliers to dairy farmers, milk carriers and haulers, dairy product and food manufacturers, distributors and retailers should be part of an integrated food safety and quality assurance management system. Good farming practices underpin the marketing of safe, quality-assured milk-based products.

The role of dairy farmers is to ensure that good agricultural, hygienic and animal husbandry practices are employed at the farm level. The focus should be on preventing a problem (including animal diseases) rather than solving it after it has occurred.

Good dairy farming practices should contribute to ensuring milk and milk products are safe and suitable for their intended use.

2.7.1 Quality Assurance during production of milk

The guiding objective for good dairy farming practice is that milk should be produced on-farm from healthy animals under generally accepted conditions. To achieve this, dairy farmers need to apply GAP in the following areas:

- animal health;

- milking hygiene;
- animal feeding and water;
- animal welfare; and
- environment.

For some of these areas, there are control points that must be managed to achieve defined outcomes. The guide contains guidelines specific to the five areas listed above but is not meant as a substitute for national legislation.

GAP also means that dairy farmers should ensure that appropriate records are kept, especially those that enable adequate traceability of:

- the use of agricultural and veterinary chemicals;
- the purchase and use of animal feed and
- the unique identification of individual animals.

Records should also be kept of:

- milk storage temperatures (when available)
- veterinary or medication treatments of individual animals.

The owner of a dairy farm should also ensure that people undertaking and supervising the milking operations and management of the dairy farm are skilled in:

- animal husbandry;
- the hygienic milking of animals;
- the administration of veterinary drugs;
- the activities undertaken on the dairy farm in relation to food safety and food hygiene; and
- health and safety practices relating to dairy farm operators.

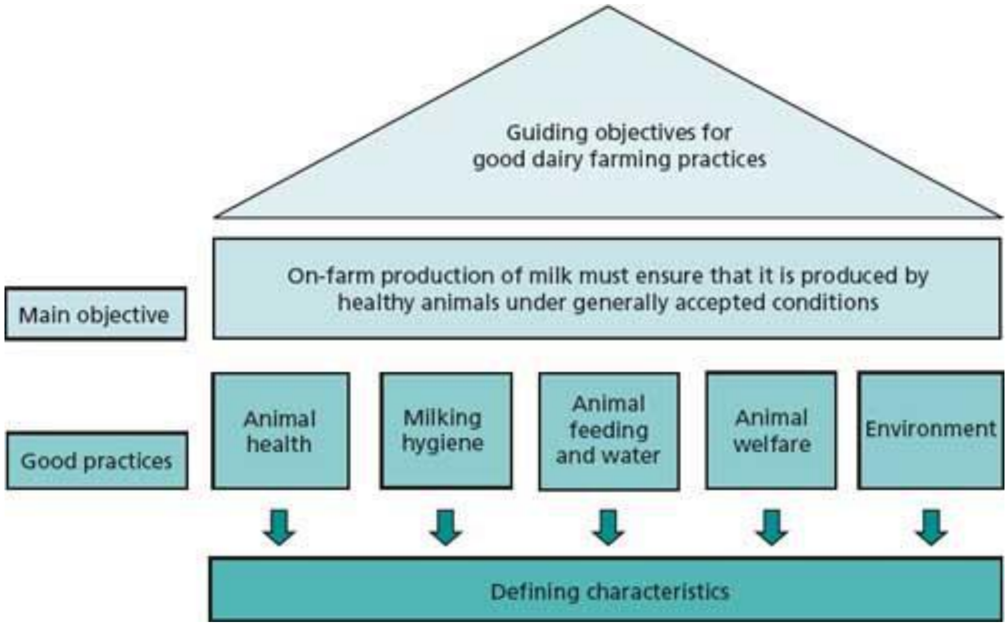


Figure 6: Quality assurance during transportation of milk

Vessels used to transport milk must meet the specifications in the code of hygienic practices. Vessels made of copper or copper alloys should not be used for milk as copper oxidises butterfat, resulting in off-flavours. Aluminium and stainless steel containers are ideal. Non-food grade plastic cans, buckets and jerry cans must not be used[1]. In addition to milk vessels being made of the right material they should:

- Have smooth finishes free from open seams, cracks and rust
- Have wide openings such that every surface that comes into contact with milk can be accessed easily for cleaning and sanitation. In this regard, both metal and plastic containers with dead ends should not be used for handling and storage of milk.
- Be used only for handling and storing milk

2.7.2 Quality assurance at milk collection centres

Farmer groups and operators of milk collection points and centres need systems of quality control for the milk they receive from individual farmers. This enables segregation of poor quality milk at collection centres. Several simple tests, if carried out judiciously and consistently, will enable the milk collection centre to ensure that only good quality milk is accepted for onward transportation to milk processing factories, milk bars or retailers of raw milk in urban centres.

It is necessary to provide a facility for cleaning of milk cans and other vessels used in bringing the milk to the milk cooling centre. A wash trough with cold running water will enable milk cans to be rinsed free of milk immediately they are emptied. Soap for cleaning milk cans should be made available by the farmer group. Milk cans should be well rinsed after cleaning to avoid tainting the milk with soap residues.

Farmers should be advised to thoroughly clean their milk cans with soap and tepid water immediately upon returning to the farm. A final rinse with hot water will kill most bacteria. The cans should then be dried on a drying rack in the sun; sunlight helps

2.7.3 Quality Assurance at Processing Industry

The raw and chilled milk received at processing industry first need to be stored in the appropriate tank maintaining the appropriate temperature. The milk is then pasteurized at appropriate Temp for appropriate time to insure all harmful organisms are killed. Personal hygiene of factory operator, cleanliness of working area, appropriate machinery installed, appropriate management of effluent are basic requirements for assuring the quality of finished products from the factory to be supplied to the consumers.

2.7.4 Good Husbandry Practices

Animal health

Animals that produce milk need to be healthy and an effective health care programme should be in place.

Good agricultural practice (GAP)	Examples of suggested measures to achieve GAP	Objective/Control measure
1.1 Prevent entry of disease onto the farm	1.1.1 Only buy animals of known disease status and control their introduction onto the farm 1.1.2 Ensure cattle transport on and off the farm does not introduce disease 1.1.3 Have secure boundaries/fencing 1.1.4 If possible, limit access of people and wildlife to the farm 1.1.5 Have a vermin control programme in place 1.1.6 Only use clean equipment from a known source	- Keep animals healthy - Comply with national/regional animal movement and disease controls
1.2 Have an effective herd health management programme in place	1.2.1 Use an identification system that allows all animals to be identified individually from birth to death 1.2.2 Develop an effective herd health management programme focused on prevention that meets the farm's needs as well as regional and national requirements 1.2.3 Regularly check animals for signs of	- Detect animal diseases early - Prevent spread of disease among animals - Prevent transmission of zoonoses - Ensure traceability

	disease 1.2.4 Sick animals should be attended to quickly and in an appropriate way 1.2.5 Keep sick animals isolated and separate milk from sick animals and animals under treatment 1.2.6 Keep written records of all treatments and identify treated animals appropriately 1.2.7 Manage animal diseases that can affect public health (zoonoses)	
1.3 Use all chemicals and veterinary medicines as prescribed	1.3.1 Use chemicals according to directions, calculate dosages carefully and observe appropriate withholding periods 1.3.2 Only use veterinary medicines as prescribed by veterinarians and observe specified withholding periods 1.3.3 Store chemicals and veterinary medicines securely and dispose of them responsibly	- Prevent occurrence of chemical residues in milk
1.4 Train people appropriately	1.4.1 Have procedures in place for detecting and handling sick animals and veterinary chemicals 1.4.2 Make sure all people are sufficiently trained to carry out their tasks 1.4.3 Choose competent sources for advice and interventions	- Follow correct procedures

Milking hygiene

Milk should be harvested and stored under hygienic conditions. Equipment used to harvest and store milk should be suitable and well maintained.

Good agricultural practice (GAP)	Examples of suggested measures to achieve GAP	Objectives/Control measures
2.1 Ensure milking routines do not injure cows or introduce contamination to milk	2.1.1 Uniquely identify individual animals 2.1.2 Ensure appropriate udder preparation for milking 2.1.3 Ensure consistent milking techniques 2.1.4 Separate milk from sick or treated animals 2.1.5 Ensure milking equipment is correctly installed and maintained 2.1.6 Ensure a sufficient supply of clean water	- Use suitable and well maintained equipment for milking and milk storage

2.2 Ensure milking is carried out under hygienic conditions	2.2.1 Ensure housing environment is clean at all times 2.2.2 Ensure milking area is kept clean 2.2.3 Ensure the milkers follow basic hygiene rules	- Harvest milk under hygienic conditions
2.3 Ensure milk is handled properly after milking	2.3.1 Ensure milk is cooled in the specified time 2.3.2 Ensure milk storage area is clean and tidy 2.3.3 Ensure milk storage equipment is adequate to hold milk at the specified temperature 2.3.4 Ensure unobstructed access for bulk milk collection	- Refrigerate and store milk under hygienic conditions

Animal feeding and water

Animals need to be fed and watered with products of suitable quality and safety.

Good agricultural practice (GAP)	**Examples of suggested measures to achieve GAP**	**Objectives/Control measures**
3.1. Ensure animal feed and water are of adequate quality	3.1.1 Ensure the nutritional needs of animals are met 3.1.2 Ensure good quality water supplies are provided, regularly checked and maintained 3.1.3 Use different equipment for handling chemicals and feed stuffs 3.1.4 Ensure chemicals are used appropriately on pastures and forage crops 3.1.5 Only use approved chemicals for treatment of animal feeds or components of animal feeds and observe withholding periods	- Keeping animals healthy with good quality feed - Preserve water supplies and animal feed materials from chemical contamination - Avoid chemical contamination due to farming practices
3.2. Control storage conditions of feed	3.2.1 Separate feeds intended for different species 3.2.2 Ensure appropriate storage conditions to avoid feed contamination 3.2.3 Reject mouldy feed	- No microbiological or toxin contamination or unintended use of prohibited feed ingredients or veterinary preparations - Keeping animals healthy with good quality feed
3.3. Ensure the traceability of feedstuffs bought off	3.3.1 All suppliers of animal feeds should have an approved quality	- Quality assurance programme of feed supplier

the farm	assurance programme in place 3.3.2 Maintain records of all feed or feed ingredients received on the farm (specified bills or delivery notes on order)	

Animal welfare

Animals should be kept according to the following principles:

- Freedom from thirst, hunger and malnutrition
- Freedom from discomfort
- Freedom from pain, injury and disease
- Freedom from fear
- Freedom to engage in relatively normal patterns of animal behaviour

Good agricultural practice (GAP)	**Examples of suggested measures to achieve GAP**	**Objectives/Control measures**
4.1 Ensure animals are free from thirst, hunger and malnutrition	4.1.1 Provide sufficient feed (forage and/or fodder) and water every day 4.1.2 Adjust stocking rates and/or supplementary feeding to ensure adequate water, feed and fodder supply 4.1.3 Protect animals from toxic plants and other harmful substances 4.1.4 Provide water supplies of good quality that are regularly checked and maintained	- Healthy, productive animals - Appropriate feeding and watering of animals
4.2 Ensure animals are free from discomfort	4.2.1 Design and construct buildings to be free of obstructions and hazards 4.2.2 Where relevant, provide adequate space allowances and clean bedding 4.2.3 Protect animals from adverse weather conditions and the consequences thereof 4.2.4 Provide housed animals with adequate ventilation 4.2.5 Provide non-slippery floors	- Protection of animals against extreme climate conditions - Provide a safe environment
4.3 Ensure animals are free from pain, injury and disease	4.3.1 Have an effective herd health management programme in place and inspect animals regularly 4.3.2 Protect against lameness 4.3.3 Lactating animals should be milked regularly 4.3.4 Do not use procedures and	- Justified and humane actions - Good sanitary conditions

	practices that cause unnecessary pain 4.3.5 Follow appropriate calving and weaning practices 4.3.6 Have appropriate procedures for marketing calves 4.3.7 When animals have to be killed on-farm, avoid unnecessary pain 4.3.8 Avoid poor milking routines as they may injure cattle	
4.4 Ensure animals are free from fear	4.4.1 Provide competent animal husbandry skills and appropriate training	- Absence of ill-treatment - Security of animals and farmer
4.5 Ensure animals can engage in relatively normal patterns of animal behaviour	4.5.1 Have herd management and husbandry procedures that do not unnecessarily compromise social activity	- Freedom of movement - Preserve gregarious behaviour and other behaviours, such as preferred sleeping position

Environment

Milk production should be managed in balance with the local environment surrounding the farm.

Good agricultural practice (GAP)	**Examples of suggested measures to achieve GAP**	**Objectives/Control Measures**
5.1 Have an appropriate waste management system.	5.1.1 Ensure wastes are stored to minimize the risk of environmental pollution 5.1.2 Manage pastures to avoid effluent runoff by spreading farm manures in accordance with local condition	- Limit the potential impact of dairy farming practices on the environment.
5.2 Ensure dairy farming practices do not have an adverse impact on the local environment	5.2.1 Contain dairy runoff on-farm 5.2.2 Use chemicals (fertilizers, agricultural and veterinary chemicals, pesticides, etc) appropriately to avoid contamination of the local environment 5.2.3 Ensure overall appearance of the dairying operation is appropriate for a facility in which high quality food is harvested	- Presenting a positive image of milk production practices.
5.1 Have an appropriate waste management system.	5.1.1 Ensure wastes are stored to minimize the risk of environmental pollution 5.1.2 Manage pastures to avoid effluent runoff by spreading farm manures in accordance with local conditions	- Limit the potential impact of dairy farming practices on the environment.

Chapter III

Research Methodology

3.1 Population

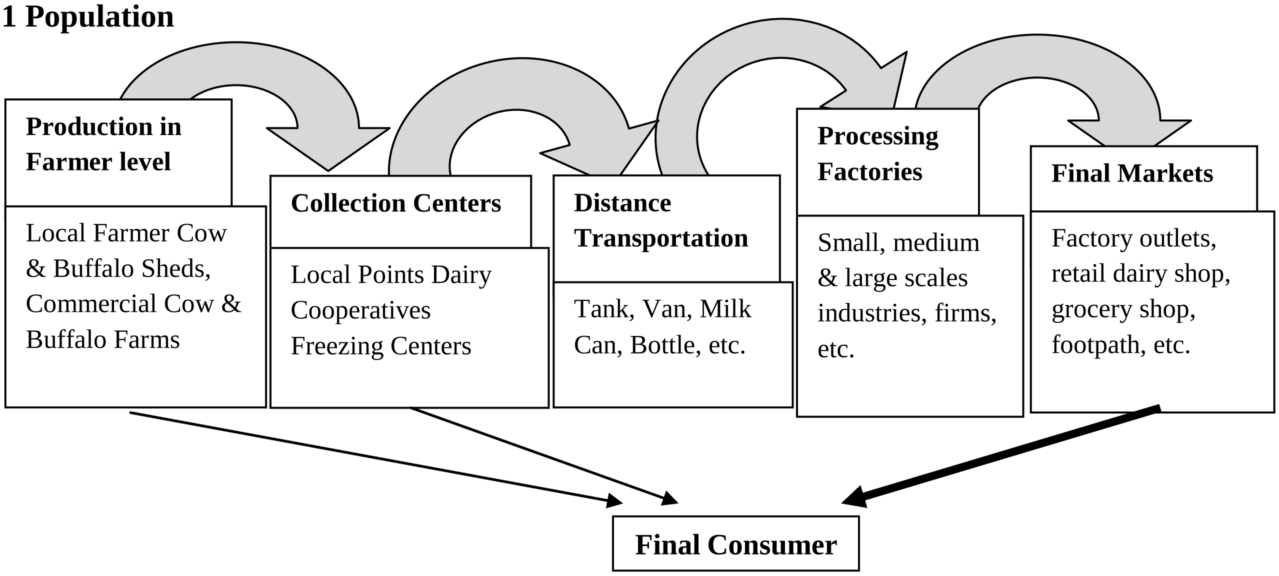


Fig 7: Milk Production and Distribution channels in Nepal

Table 10: Tentative size of Milk and milk production

Particulars	Unit	2008/9	2009/10	2010/11	2011/12
Animal Population					
i) Cattles	No	7090714	7175198	7226050	7244944
ii) Buffalos	No	4680486	4836984	4993650	5133139
Milk Production					
i) Cow	Mt	413919	429030	447185	468913
ii) Buffalos	Mt	1031500	1066867	1109325	1153838
Dairy Cooperatives	No	1674 (i.e. of 2015/16 data from Coop. Division)			

Source: Statistics of Agriculture Activities, Ministry of Agriculture

Nepalese milk production and distribution channels are comprised with multiple layers. We can broadly categorize the channels in to five layers as in figure 7. Mainly, milks are collected in local collection centers from either by local non-professional farmers or by commercial farm houses. Sometime consumers visit local farm sheds or local collection centers to collect fresh and raw milk directly. Collected milks from local collection centers and dairy cooperatives are further collected to nearby freezing centers. After cooling the milk into the desired temperature, a distance transport to processing industry is done by milk tanks, vans, etc. Those milks are processed in processing centers, and thereby, distributed to final consumers through factory outlets, dairy realtors, glossary shop, footpath, etc. The tentative size of milk and milk producing animals of Nepal are given in the table 10.

3.2 Sampling

Sampling Point:

Number of Development Regions: 5 (1. Eastern, 2. Central, 3. Western, 4. Mid-Western, 5. Far-Western)

Number of target Ecological Regions: 2 (Hill, Tarai)

Number of Production Channel: 5 (as per figure 1)

Total Number of Sampling Point = (Number of Development Region × Number of target Ecological Regions × Number of Production Channel

= 5 × 2 × 5 = 50 Points

Sampling Frame and Actual Sample Size:

Sample collection districts and sites from each sampling point are finalized and presented in the table below after the discussion with the technical team of NDDB.

Table 11: Sampling Frame of the Study

Devlmt. Regions	**Eastern**		**Central**		**Western**		**Mid-Western**		**Far-Western**	
Geography	Hilly	Tarai	Hilly	Tarai	Hilly	Tarai	Hilly	Tarai	Hilly	Tarai
District	Ilam	Sunsari	Kavre	Chitwan	Kaski	Nawal parasi	Surkhet	Banke	Dadel dhura	Kailali
Farmer Level	15	15	15	15	15	15	5	5	5	5

Collection Centers	3	3	3	3	3	3	1	1	1	2
Distance Transportation	3	3	3	3	3	3	1	1	1	1
Processing Factories	-	2	3	2	3	3	3	2	-	3
Final Consumer	5	5	5	5	5	5	5	5	5	5
Total	26	28	29	28	29	29	15	14	12	16

	Farmer Level	Collection Centers	Distance Transportation	Processing Factories	Final Consumer	Total
Kathmandu Valley	15	3	3	24	21	66

Total targeted sample size: 292 observations

3.5 Assignments:

3.5.1 COP and GMP Assessment

Government of Nepal approved Code of Practice (CoP) for Dairy Industries for good manufacturing process/practice (GMP) in each level of milk value chain. The first assignment of the project is to access the implementation status of the COP and GMP in dairy value chain of Nepal. Using the structured checklist, the assessment of COP/GMP shall be taken out through the field survey of each observation of the sampling frame. The structured questionnaire is prepared in Nepali language and presented in Annex I.

3.5.2 Nutritional Quality Examination

It is important to recognize a combination of essential nutrients in raw and processed milk which is necessary for human health. Therefore, the next assignment of the project is to examine the nutritional quality of the raw and processed milk of Nepal. The milk sample will be first sensory evaluated for presence or absence of visible dirt, acceptable or unacceptable odor and normal or abnormal color. The nutritional quality or the nutrient content of milk will be analyzed by using Lactoscan at the milk collection center brought by individual farmers. The table 12 shows the list of the physical and nutritional components that shall be tested in existing milk value chain of Nepal.

Table 12: Physiology and Nutritional testing list of Milk

Components	**Methodology**	**Detail**
Sensory evaluation	Appearance, flavor	Visible dirt- Present or absent Odor- Acceptable or not acceptable Color- normal or abnormal
COB	-	Milk sample will be boiled in test tube and any clot observed
Fat content SNF Protein Added Water Conductivity pH Temperature	Lactoscan milk analizer	If Lactoscan machine is not available, then fat will be determined by Gerber’s Centrifuge method, SNF by Butyrometer, pH by pH meter and temperature by thermometer.

3.5.3 Adulteration Examination

Milk is one of the products which can be adulterated in many ways affecting the quality of further dairy products. The next assignment of the project is to examine the adulteration status of the milk in the market. The adulteration examination is done using "kit for detection of adulterations in milk" developed by National Dairy Development Board, Anand-388001, Gujarat, India. The detail of the examination process is presented in the table 13.

Table 13: Adulteration Test of Milk

Components	**Methodological Steps**
Urea Detection	1. Take 2 ml milk. 2. Add 2 ml Urea Reagent and mix well 3. Distinct Yellow Colour-Urea has been added to milk
Starch and Cereal Flours Detection	1. Boil 5 ml milk and cool it. 2. Add a few drops of starch reagent. 3. Blue Color-Starch and Cereal Flours have been added to milk.
Sugar/Sucrose	1. Take 1 ml milk. 2. Add 1 ml. Sugar Reagent.

Detection	3. Place in boiling water for 3-5 minutes. 4. Red Colour-Sugar has been added to milk.
Salt Detection	1. Add 5 ml Salt Reagent-I 2. Add a few drops of Salt Reagent-II 3. Add 1 ml. milk and mix well. 4. Yellow Colour- Salt has been added to milk
Neutralizers Detection	1. Take 2 ml milk. 2. Add 2 ml. Neutralizer Reagent and mix well. 3. Rose Red/Pink Colour- Neutralizers have added to milk.

3.5.4 Microbiological Test

To determine harmful bacteria present in the pasteurized and unpasteurized milk samples, two tests were carried out.

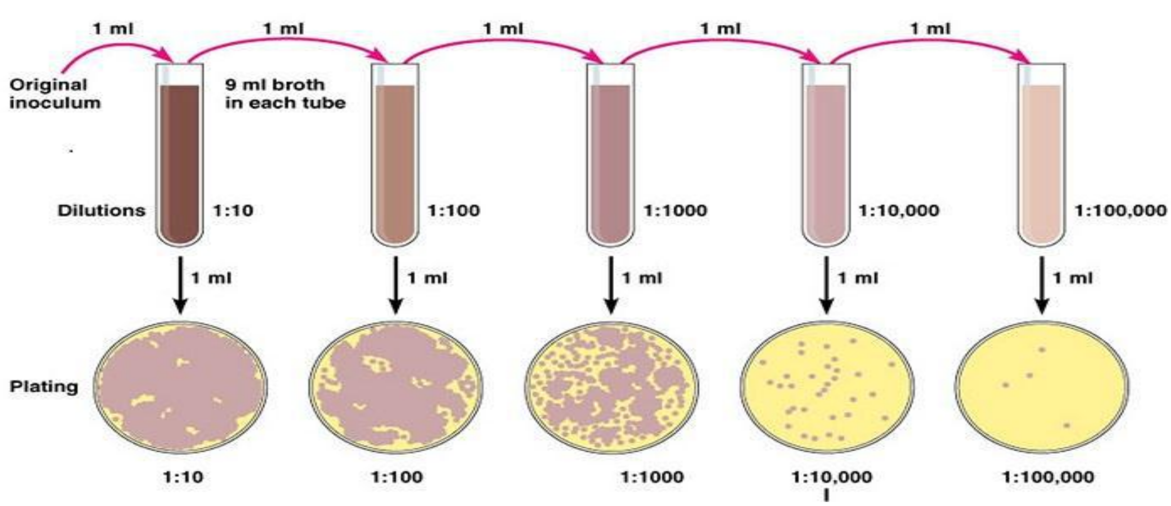
Total Plate Count / Standard Plate Count

The Standard Plate Count (SPC) is used extensively in both regulatory and premium testing programs. In addition to the SPC, raw milk can be subjected to a number of other bacteriological tests that are used as indicators of how that milk was produced. The SPC gives an estimated count of the total bacteria in a sample

The Standard Plate Count (SPC) of raw milk gives an indication of the total number of aerobic bacteria present in the milk at the time of pickup. Milk samples are plated in a semi-solid nutrient media and then incubated for 48 hrs at 32°C (90°F) to encourage bacterial growth. Single bacteria (or clusters) grow to become visible colonies that are then counted. All plate counts are expressed as the number of colony forming units per milliliter (cfu/ml) of milk. Newer films based tests have allowed for automation of this procedure. The nutrient agar system remains the gold standard. Aseptically collected milk from clean, healthy cows generally has an SPC less than 1,000 cfu/ml. Higher counts suggest bacteria are entering the milk from a variety of possible sources. Though it is impossible to eliminate all sources of contamination, counts of less than 5,000 cfu/ml are possible, while counts of 10,000 cfu/ml should be achievable by most farms. The most frequent cause of a high SPC is poor cleaning of the milking system. Milk residues on equipment surfaces provide nutrients for growth and multiplication of bacteria that contaminate the milk at subsequent milk times. Other procedures that can elevate bulk-tank SPC are milking dirty udders, maintaining an unclean milking and housing environment, and failing to rapidly cool milk to less than 40°F. On rare occasions, cows with mastitis can shed infectious bacteria into the milk can also cause a high SPC. In these circumstances, a concurrent elevation in SCC should be evident.

The plate count method relies on bacteria growing a colony on a nutrient medium. The colony becomes visible to the naked eye and the number of colonies on a plate can be counted. For effective plate count method one should do serial dilution of the original sample. Our objective is to grow on average between 30 and 300 colonies of the target. Fewer than 30 colonies makes the interpretation statistically unstable and greater than 300 colonies often results in overlapping colonies and imprecision in the count. To ensure that an appropriate number of colonies will be generated several dilutions are normally cultured. Even though cell count method is more time consuming, but provides statistically accurate and repeatable results.

Like stated earlier, for effective plate count, serial dilution must be done. Serial dilution is any dilution where the concentration decreases by the same quantity in each successive step. Serial dilutions are multiplicative. If a solution has a 1/10 dilution the number represents 1 part of the patient sample added to 9 parts of diluents. So the volumes used would be 10-1= 9. This represents 1 part patient sample added to 9 parts of diluents.



We have also used serial dilution method in our experiment. The original sample was serially diluted, plated by swabbing and counting of live bacteria to determine the number of bacteria in a given population. Swabbing the suspension allows us to evenly distribute samples on the plate. To this end we will make serial dilutions of a solution containing an unknown number of bacteria, plate these bacteria and determine the total number of bacteria in the original solution by counting the number of colony forming units and comparing them to the dilution factor. Each colony forming unit represents a bacterium that was present in the diluted sample. The numbers of colony forming units (CFU's) are divided by the product of the dilution factor and the volume of the plated diluted suspension to determine the number of bacteria per ml that were present in the original solution.

For each dilution, the numbers of colony forming units on the plates were counted. If the number of CFUs on the plate was greater than 1000, it was recorded as TNTC (too numerous to count). Alternatively, if the numbers are greater than 1000 and if the diluted bacterial suspension was evenly distributed the on the surface of the plate then the plate was divided into 4 sectors, the number of bacteria in one sector was counted and multiplied by four. If the number of CFUs on the plate was below 10, the number of CFUs was recorded, but it was not used in calculations.

Materials Required

- Distilled Water
- Phosphate Buffer Saline
- MacConkey Agar
- Nutrient Agar
- Petri Dishes
- Test tube
- Micro Pippette and Tips

Procedure:

1. Firstly, the bacterial source was serially diluted. 10 small sterile test tubes were taken and each tube was marked starting from 10^{-1} to 10^{-10}.
2. 4.5 ml of Phosphate Buffer Solution (PBS) was added to each tube.
3. 0.5 ml of milk sample was added in the first dilution tube. This bacterial suspension was mixed thoroughly using the vortex shaker on each dilution before preceding the next dilution.

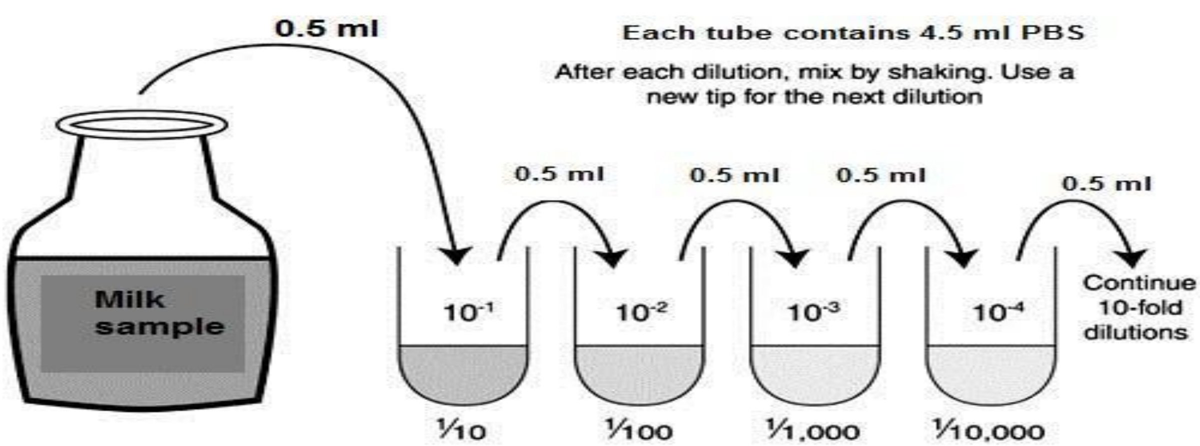
4. 0.1 ml of each diluted suspension was added to respective Nutrient agar and Mc Conkey agar plate. (Nutrient Agar is used for total bacterial count and Mc Conkey agar used for Coliform count)
5. The bacterial suspension was evenly distributed by swabbing.
6. The plates were then placed in incubator at 37°C overnight.
7. After incubation, the plates were taken out and bacteria were counted under electric colony counter.

Calculating the number of bacteria per ml of serially diluted bacteria:

To calculate the number of bacteria per ml of diluted sample one should use the following equation:

$$\frac{\text{Number of CFU}}{\text{Volume plated (ml) x total dilution used}} \longrightarrow \frac{\text{Number of CFU}}{\text{ml}}$$

For example, if for the 1x 10^{-8} dilution plate you plated 0.1 ml of the diluted cell suspension and counted 200 bacteria, then the calculation would be: **200/0.1 ml x 10^{-8} or 200/10^{-9} or 2.0 x 10^{11} bacteria per ml.**



Coliform Count

Coliforms detected from pasteurized products can often suggest improper pasteurization or post pasteurization contamination. Coliform tests are conducted following pasteurization primarily to detect bacterial recontamination of the milk. Retail milk products must have a coliform count less than 10/ml or gram

The Coliform Count (Coli Count) procedure selects for bacteria that are most commonly associated with manure or environmental contamination. Milk samples are plated on a selective nutrient media that encourages the growth of coliform bacteria, while preventing the growth of others. Although coliform are often used as indicators of fecal contamination, there are strains that commonly exist in the environment. Coliform may enter the milk supply as a consequence of milking dirty cows or the claw becoming soiled with manure during milking. Generally, counts greater than 100 cfu/ml would indicate poor milking hygiene or other sources of contamination. Higher coliform counts more often result from dirty equipment and in rare cases result from milking cows with environmental coliform mastitis.

Enumeration of total coliform bacteria: Total coliform was determined by the same method used in the enumeration of total viable bacteria. The medium used for coliform was MacConkey agar. Inoculated plates were incubated at 37°C for 24 hours. After incubation, typical pinkish and centrally red colonies were counted by using colony counter and total coliform was calculated.

3.6 Study Approach:

Desk Study

A review of literatures related to the assignments such as books, working papers, journal articles, proceedings, research papers, university theses, related laws: food act, COP, etc.; standards, etc. shall be done. The past study conducted by NDDB and other related stakeholders of Nepal has reviewed rigorously.

Field Survey

During the field survey, samplers have done two tasks: filling up questionnaire/checklist for CoP and Food Act implementation assessment and collection of Milk samples for field test. Moreover, the collected from Kathmandu Valley and Kavre District have transfored to the lab in Kathmandu. Field Samplers have done three tasks: collecting sample milk, field testing of them, and filling up of questionnaire from each observation.

Field Test

The testings of the nutritional quality and food adulteration status of the milk have done in field immediately during the sampling time point using reagents and milk analyzer. The methodology and protocol of such reagents/analyzers given by the manufacturers are presented on preceeding section i.e. section 3. For the validation purpose, witness signature: most probably the milk sample owner; is made compulsory for the field testing results. Testing record form is presented in annex 2.

Lab Test

The lab testing of bacterial quality –TPC and Coliform- has done using the appropriate lab methodology as shown in the assignments. Due to the time requiring factor for distance transportation that results spoilage of milk, only the samples from the Kathmandu Valley and Kavre District have tested in lab.

Technical Analysis

The lab has provided the report of tested results. This includes the chemical, physical and microbiological analysis of milk.

Data Analysis: Descriptive analysis such as mean, median, standard deviation and their t-scores shall be generated for field survey and Lab results data. Moreover, frequency count, ratio, percent, etc are also very important tools for qualitative analysis. District wise analysis of descriptive statistics has done to seek the inferential and generalizing quality of the drawn sampless.

3.5 Sampling Guidelines

- Sampling equipment shall be clean and dry.
- Samples for bacteriological examination shall be collected by a person trained in the technique of sampling for bacteriological work. For bacteriological purposes, all equipment including plungers, sample bottles, stoppers, shall be sterile and the samples shall be collected under aseptic conditions.
- Equipment shall be sterilized by one of the following methods:

a) Heating in a hot air oven for not less than 2 hours at 160°C, or

b) Autoclaving for not less than 15 minutes at 120°C.

NOTE - Under field conditions, equipment may be sterilized by immersion for at least 5 minutes in boiling water. Equipment treated by this method shall be used immediately.

- Sampling Bottles. - The sampling bottles shall be made of good quality glass, suitable for sterilization. The sample bottle shall be wide mouthed, round with sloping sides on the pattern of the milk bottles. Bottles used for collecting samples for chemical analysis shall be provided with well-fitting caps, or bark corks. Bottles for collecting samples for bacteriological examination shall be glass stoppered. The capacity of the sample bottle shall be 100, 150 or 250 ml. The size of the sample bottle selected for taking a sample shall be such that after containing the quantity of milk required for analysis; only a small space would be left for efficient mixing of the sample as a larger space would allow the rat to churn during transit. When samples are collected for bacteriological examination, it shall be seen that air-space is avoided by filling the bottles to the top, leaving however, and sufficient space to allow for expansion of the rubber stopper. Bark corks shall not be used for closing milk sample bottles for bacteriological examination.

NOTE - Alternatively, for collecting samples for chemical analysis suitable plastic bottles of above capacities may also be used.

- Label of Samples: Each sample container shall be sealed air-tight after filling and marked with particulars regarding the, purpose of sampling, the name of the supplier or other particulars of the stock, the date and time of sampling, the nature of preservatives, if any, added and any other relevant information. Samples for bacteriological examination shall be marked distinctively.

- Transport of Samples: Milk samples which are to be examined for flavor shall be protected from light and shall not be exposed to odours, which may be absorbed during transport.

a) Samples for Chemical Examination-s- It is desirable that samples of milk for chemical examination are delivered for testing on the same day they are taken. The samples shall be stored in a refrigerator at a temperature of 0 to 5°C. Where this is not possible, adequate precautions shall be taken to prevent deterioration and exposure to high temperature and light during transit, In some cases, formaldehyde may be added as a preservative to prevent deterioration, provided it does not interfere with the subsequent analysis. When formaldehyde has been added, this fact and the quantity added shall be indicated on the label,

NOTE - If any sample is to be used for cryoscopic examination, mercuric chloride shall be permissible as a preservative, provided the bottle is properly labeled as ' POISON '.

b) If the tests are to determine the bacteriological quality of the milk, samples shall be chilled immediately and maintained at a temperature not exceeding 4^oC.

Chapter IV
Analysis and Presentation

4.1 The nutrient content in Milk

Milk is an important source of nutrient required for growth in infants and children and for maintenance of health in adults. Milk is a perfect food, readily digested and absorbed. It is a sole natural food for infants and children. It is chiefly a valuable source of good quality protein, fat, carbohydrates, vitamins and minerals. Protein in diet supply the amino acids required for growth of infants and children. It is also required for maintenance of tissues in adults.

Milk contains fat, protein, lactose, minerals and vitamins in addition to major component water ranging from 83-87% depending on species and stages of lactation, season etc. The protein content is more or less stable but the fat content varies greatly with species, breed, stage of lactation, feeding management and health condition.

Table:14

Descriptive Statistics of Milk's Physiological and Nutritional Quality (Sunsari District)

Level		Temp.	FAT	SNF	Density	Added Water	Level	Temp.	FAT	SNF	Density	Added Water
Overall	Avg.	30.71	4.27	8.35	27.05	11.3	Farmer	30.87	4.84	8.52	27.19	9.164
	Max.	34	8.4	10	35.5	62.3		32	8.4	9.2	32.5	16.1
	Min.	25	1	3.6	10	0		29	1.5	7.8	23.6	1.37
	Range	9	7.4	6.4	25.5	62.3		3	6.9	1.4	8.9	14.73
	SD	1.46	1.8	1.13	4.57	11.49		0.74	1.85	0.42	2.75	4.24
	CV	0.048	0.42	0.14	0.17	1.01		0.024	0.38	0.05	0.10	0.46
	Med	31	4.05	8.4	27.25	10		31	4.3	8.4	27.1	10
	No of Obs.	28	28	28	28	28		15	15	15	15	15
CC	Avg.	31.67	3.93	8.47	28	9.36	Trans.	31.67	2.73	8.17	27.67	13.06
	Max.	32	4.1	8.7	28.8	12.1		34	4.9	9.5	33.7	25
	Min.	31	3.7	8.2	26.7	7.02		30	1	7	24.2	0
	Range	1	0.4	0.5	2.1	5.08		4	3.9	2.5	9.5	25
	SD	0.58	0.21	0.25	1.14	2.56		2.08	1.99	1.26	5.24	12.54
	CV	0.018	0.05	0.03	0.04	0.27		0.066	0.73	0.15	0.19	0.96
	Med	32	4	8.5	28.5	8.96		31	2.3	8	25.1	14.2
	No of Obs.	3	3	3	3	3		3	3	3	3	3
Factory	Avg.	28.67	4.6	8.17	26.07	12.43	Outlet	32.5	3.95	8.05	26.25	13.6
	Max.	31	5.5	8.5	27.8	17.1		34	4.9	8.1	27.4	14.2
	Min.	25	4.1	7.7	23.3	9.09		31	3	8	25.1	13
	Range	6	1.4	0.8	4.5	8.01		3	1.9	0.1	2.3	1.2
	SD	3.21	0.78	0.42	2.4	4.16		2.12	1.34	0.07	1.65	0.85
	CV	0.11	0.17	0.05	0.01	0.33		0.065	0.34	0.01	0.069	0.06
	Med	30	4.2	8.3	27.1	11.1		32.5	3.95	8.05	26.25	13.6
	No of Obs.	2	2	2	2	2		5	5	5	5	5

COB=Clout on Boiling; Temp=Temperature; Sen=Sensory Evaluation; SNF=Solid Not Fat; 1=(+)ve; 2=(-)ve;

The Food Act of Nepal has defined Standard Pasteurized milk should have at least 3% fat content and 8% Solid Not Fat (SNF). The act is silent about the protein content of milk. The Act also emphasizes 0 level of coliform (harmful bacteria) in processed milk and less than 1000 total plate count/ml.

The price of raw milk paid to the farmers in Nepal at present is determined by the fat and solid not fat content. However, in developed countries, protein is also important criteria for fixing the price of milk.

Table 15:
Descriptive Statistics of Physiological and Nutritional Test of Milk (Ilam District)

	Temp.	pH	FAT	SNF	Den.	Added Water	Temp.	pH	FAT	SNF	Den.	Added Water
Overall							Farmer					
Avg.	21.77	7.15	2.35	7.11	24.14	23.77	21.8	7.14	2.27	7.04	23.7	24.47
Max.	22.5	7.31	5.4	8.59	29.9	43.5	22.5	7.31	5.4	8.32	28.9	42.1
Min.	21	7.01	0.89	5.37	17.7	8.43	21	7.01	0.89	5.43	17.7	10.6
Range	1.5	0.3	4.51	3.22	12.2	35.07	1.5	0.3	4.51	2.89	11.2	31.5
SD	0.45	0.09	0.99	0.89	3.45	9.78	0.46	0.11	1.03	0.92	3.4	10.08
CV	0.02	0.01	0.42	0.13	0.14	0.41	0.02	0.01	0.45	0.13	0.14	0.41
Med	22	7.13	2.16	7.2	24.1	22.55	22	7.12	2.1	7.1	23.9	23.7
No of Obs.	26	26	26	26	26	26	15	15	15	15	15	15
CC							Trans.					
Avg.	21.67	7.16	2.08	7.14	26.27	23.27	21. 7	7.14	2.6	7.3	24.47	21.47
Max.	22	7.2	2.6	7.45	29.9	25.2	22	7.21	2.8	7.5	25.2	22.6
Min.	21	7.13	1.73	6.98	23.3	20	21	7.09	2.3	7.2	23.9	19.3
Range	1	0.07	0.87	0.47	6.6	5.2	1	0.13	0.5	0.3	1.3	3.3
SD	0.58	0.04	0.46	0.27	3.35	2.8	0.58	0.07	0.26	0.17	0.67	1.88
CV	0.03	0.01	0.22	0.04	0.13	0.12	0.03	0.01	0.1	0.02	0.03	0.09
Med	22	7.15	1.92	7	25.6	24.6	22	7.11	2.7	7.2	24.3	22.5
No of Obs.	3	3	3	3	3	3	3	3	3	3	3	3
Outlet												
Avg.	21.8	7.2	2.56	7.17	24	23.366						
Max.	22	7.3	4.94	8.59	27.7	43.5						
Min.	21	7.09	1	5.37	18.1	8.43						
Range	1	0.21	3.94	3.22	9.6	35.07						
SD	0.45	0.1	1.45	1.39	4.65	15.18						
CV	0.02	0.01	0.56	0.19	0.194	0.65						
Med	22	7.24	2.3	7.91	27.2	15						
No of Obs.	5	5	5	5	5	5						

The collected samples were tested immediately after bringing them to the laboratory for fat content, protein content, solid not fat (SNF) content and lactose content. Lactoscan machine was used to determine these nutrients content. A 20 ml sample after shaking the content was used to determine the nutrients content of pasteurized and raw milk. After each 5 sample, the machine was washed with the distilled water and at the end of the test, this was washed by alkaline detergent solution prescribed by the manufacturer.

The discriptive statistics of milk content of pasteurized milk sample is given in the tables presented on this section.

Table 16:
Descriptive Statistics of Physiological and Nutritional Test of Milk (Chitwan District)

	Temp.	pH	FAT	SNF	Den.	Added Water	Temp.	pH	FAT	SNF	Den.	Added Water
Overall							Farmer					
Avg.	31.25	7.13	3.8	7.9	24.35	11.92	31.2	7.1	4.31	8.4	23.43	10.31
Max.	32	7.31	8.78	9.01	32.1	70	32	7.31	8.78	9.01	28.9	17.3
Min.	30	7.01	1.5	2.5	17	0	30	7.01	2.62	7.68	17	6.91
Range	2	0.3	7.28	6.51	15.1	70	2	0.3	6.16	1.33	11.9	10.39
SD	0.59	0.11	1.51	1.4	3.97	14.9	0.68	0.11	1.72	0.31	3.8	2.82
CV	0.019	0.01	0.4	0.18	0.16	1.25	0.02	0.02	0.4	0.04	0.16	0.27
Med	31	7.12	3.77	8.34	24.2	8.835	31	7.03	3.94	8.39	23.9	10.2
No of Obs.	28	28	28	28	28	28	15	15	15	15	15	15
CC							Transp.					
Avg.	31.3	7.17	4.13	8.29	26.27	11.21	31	7.13	3.06	7.96	24.47	4.34
Max.	32	7.31	4.38	8.44	29.9	12.4	31	7.15	3.1	8.79	25.2	5.81
Min.	31	7.01	3.98	8.17	23.3	9.64	31	7.11	3	7.4	23.9	1.6
Range	1	0.3	0.4	0.27	6.6	2.76	0	0.04	0.1	1.39	1.3	4.21
SD	0.58	0.15	0.22	0.14	3.35	1.42	0	0.11	1.71	1.97	3.8	28.8
CV	0.02	0.02	0.05	0.02	0.12	0.127	0	0.01	0.56	0.25	0.16	6.6
Med	31	7.2	4.04	8.25	25.6	11.6	31	7.13	3.08	7.7	24.3	5.6
No of Obs.	3	3	3	3	3	3	3	3	3	3	3	3
Factory							Outlet					
Avg.	31.5	7.13	3.35	7.45	24.98	4.55	31.4	7.19	2.7	6.3	25.64	24.7
Max.	32	7.15	3.9	7.7	25.01	7	32	7.29	4.8	8.9	32.1	70
Min.	31	7.11	2.8	7.2	24.95	2.1	31	7.09	1.5	2.5	18.1	0
Range	1	0.04	1.1	0.5	0.06	4.9	1	0.2	3.3	6.4	14	70
SD	0.71	0.02	0.78	0.35	0.04	3.47	0.55	0.08	1.37	2.87	6.4	34.2
CV	0.02	0	0.23	0.05	0.0017	0.76	0.02	0.01	0.51	0.46	0.25	1.39
Med	31.5	7.13	3.35	7.45	24.98	4.55	31	7.21	2.6	7.6	27.2	0.3
No of Obs.	2	2	2	2	2	2	5	5	5	5	5	5

Table: 17
Descriptive Statistics of Milk's Physiological and Nutritional Quality (Kavre District)

Level		Temp.	FAT	SNF	Density	Added Water	Level	Temp.	FAT	SNF	Density	Added Water
Overall	Avg.	19.57	4.74	8.40	25.94	9.51	Farmer	22.0	4.84	8.52	27.19	9.164
	Max.	26.30	7.60	9.10	30.90	42.80		26.2	8.4	9.2	32.5	16.1
	Min.	5.40	2.70	1.32	15.30	0.00		11.4	1.5	7.8	23.6	1.37
	Range	20.90	4.90	7.78	15.60	42.80		14.8	6.9	1.4	8.9	14.73
	SD	6.20	1.22	1.72	3.54	10.07		4.3	1.85	0.42	2.75	4.24
	CV	0.32	0.26	0.23	0.14	1.06		0.2	0.38	0.05	0.10	0.46
	Med	21.50	4.80	7.90	26.30	6.65		22.5	4.3	8.4	27.1	10
	No of Obs.	29	29	29	29	29		15	15	15	15	15
CC	Avg.	18.67	3.93	8.47	28	9.36	Trans.	17.67	2.73	8.17	27.67	13.06
	Max.	32	4.1	8.7	28.8	12.1		34	4.9	9.5	33.7	25
	Min.	31	3.7	8.2	26.7	7.02		30	1	7	24.2	0
	Range	1	0.4	0.5	2.1	5.08		4	3.9	2.5	9.5	25
	SD	0.58	0.21	0.25	1.14	2.56		2.08	1.99	1.26	5.24	12.54
	CV	0.018	0.05	0.03	0.04	0.27		0.066	0.73	0.15	0.19	0.96
	Med	32	4	8.5	28.5	8.96		31	2.3	8	25.1	14.2
	No of Obs.	3	3	3	3	3		3	3	3	3	3
Factory	Avg.	18.67	4.6	8.17	26.07	12.43	Outlet	22.5	3.95	8.05	26.25	13.6
	Max.	31	5.5	8.5	27.8	17.1		34	4.9	8.1	27.4	14.2
	Min.	25	4.1	7.7	23.3	9.09		31	3	8	25.1	13
	Range	6	1.4	0.8	4.5	8.01		3	1.9	0.1	2.3	1.2
	SD	3.21	0.78	0.42	2.4	4.16		2.12	1.34	0.07	1.65	0.85
	CV	0.11	0.17	0.05	0.01	0.33		0.065	0.34	0.01	0.069	0.06
	Med	30	4.2	8.3	27.1	11.1		32.5	3.95	8.05	26.25	13.6
	No of Obs.	3	3	3	3	3		5	5	2	5	5

COB=Clout on Boiling; Temp=Temperature; Sen=Sensory Evaluation; SNF=Solid Not Fat; 1=(+)ve; 2=(-)ve;

Table 18:

Descriptive Statistics of Physiological and Nutritional Test of Milk (Nawalparasi District)

	Temp.	pH	FAT	SNF	Den.	Added Water	Temp.	pH	FAT	SNF	Den.	Added Water
Overall							Farmer					
Avg.	31.49	6.94	3.88	8.07	28.01	23.77	21.8	7.14	2.27	7.04	23.7	24.47
Max.	41.00	7.3	7.20	8.90	35.50	43.5	22.5	7.31	5.4	8.32	28.9	42.1
Min.	25.00	6.5	1.00	7.14	23.30	8.43	21	7.01	0.89	5.43	17.7	10.6
Range	16.00	0.8	6.20	1.76	12.20	35.07	1.5	0.3	4.51	2.89	11.2	31.5
SD	4.68	0.21	1.37	0.45	3.38	9.78	0.46	0.11	1.03	0.92	3.49	10.08
CV	0.15	0.03	0.35	0.06	0.12	0.41	0.02	0.01	0.45	0.13	0.149	0.41
Med	30.00	6.95	3.97	8.20	27.80	22.55	22	7.12	2.1	7.1	23.9	23.7
No of Obs.	29	29	29	29	29	29	15	15	15	15	15	15
CC							Trans.					
Avg.	21.67	7.16	2.08	7.14	26.27	23.27	21. 7	7.14	2.6	7.3	24.47	21.47
Max.	22	7.2	2.6	7.45	29.9	25.2	22	7.21	2.8	7.5	25.2	22.6
Min.	21	7.13	1.73	6.98	23.3	20	21	7.09	2.3	7.2	23.9	19.3
Range	1	0.07	0.87	0.47	6.6	5.2	2	0.13	0.5	0.3	1.3	3.3
SD	0.58	0.04	0.46	0.27	3.35	2.8	0.58	0.07	0.26	0.17	0.67	1.88
CV	0.03	0.01	0.22	0.04	0.13	0.12	0.03	0.01	0.1	0.02	0.03	0.09
Med	22	7.15	1.92	7	25.6	24.6	22	7.11	2.7	7.2	24.3	22.5
No of Obs.	3	3	3	3	3	3	3	3	3	3	3	3
Outlet							Factory					
Avg.	21.8	7.2	2.56	7.17	24	23.36	21.8	7.16	2.6	7.04	23.7	23.77
Max.	22	7.3	4.94	8.59	27.7	43.5	22	7.2	2.8	8.32	28.9	43.5
Min.	21	7.09	1	5.37	18.1	8.43	21	7.13	2.3	5.43	17.7	8.43
Range	1	0.21	3.94	3.22	9.6	35.07	1	0.07	0.5	2.89	11.2	35.07
SD	0.45	0.1	1.45	1.39	4.65	15.18	0.45	0.04	0.26	0.92	3.49	9.78
CV	0.02	0.01	0.56	0.19	0.194	0.65	0.02	0.01	0.1	0.13	0.15	0.41
Med	22	7.24	2.3	7.91	27.2	15	22	7.15	2.7	7.1	23.9	22.5
No of Obs.	5	5	5	5	5	5	3	3	3	3	3	3

The average fat content of the pasteurized milk is 4.72% in milk sample of Chitwan distric. Though, the fat of the milk is varied by seasonal, and other feeding materials, the allmost sample were in the range as prescribed by Food Act for standard pasteurized milk.

The solid not fat (SNF) content of milk comprises of lactose, protein and minerals. The SNF of the standard milk according to food acts of Nepal should be not less than 8. In the most of the milk sample from various level, the average SNF content was found to be nearto or equal to or higher than ot that, which is acceptable as per the standard.

The other nutritional quality and physiological quality range or standard of the milk such as protien, added water, tempreture at the time of collection of the sample, density, pH, etc are not defined by the food act. The details of those are presented on the table in this scetion. Those statistics are slidely varried in different district of Nepal. Therefore, it can be concluded that the physiological and neutritional quality of milk are uniform in entire the country.

Table 19:
Descriptive Statistics of Physiological and Nutritional Test of Milk (Kaski District)

	Temp.	pH	FAT	SNF	Den.	Added Water	Temp.	pH	FAT	SNF	Den.	Added Water
Overall							Farmer					
Avg.	31.25	7.13	4.03	7.33	23.10	17.01	31.2	7.1	4.31	8.4	23.43	10.31
Max.	32	7.31	5.74	9.00	28.50	33.00	32	7.31	8.78	9.01	28.9	17.3
Min.	30	7.01	3.00	4.50	5.00	14.00	30	7.01	2.62	7.68	17	6.91
Range	2	0.3	2.74	4.50	23.50	19.00	2	0.3	6.16	1.33	11.9	10.39
SD	0.59	0.11	0.67	1.05	5.13	5.84	0.68	0.11	1.72	0.31	3.8	2.82
CV	0.019	0.01	0.17	0.14	0.22	0.34	0.02	0.02	0.4	0.04	0.16	0.27
Med	31	7.12	4.10	7.50	23.00	23.00	31	7.03	3.94	8.39	23.9	10.2
No of Obs.	29	29	29	29	29	29	15	15	15	15	15	15
CC							Transp.					
Avg.	31.3	7.17	4.13	8.29	26.27	11.21	31	7.13	3.06	7.96	24.47	4.34
Max.	32	7.31	4.38	8.44	29.9	12.4	31	7.15	3.1	8.79	25.2	5.81
Min.	31	7.01	3.98	8.17	23.3	9.64	31	7.11	3	7.4	23.9	1.6
Range	1	0.3	0.4	0.27	6.6	2.76	0	0.04	0.1	1.39	1.3	4.21
SD	0.58	0.15	0.22	0.14	3.35	1.42	0	0.11	1.71	1.97	3.8	28.8
CV	0.02	0.02	0.05	0.02	0.12	0.127	0	0.01	0.56	0.25	0.16	6.6
Med	31	7.2	4.04	8.25	25.6	11.6	31	7.13	3.08	7.7	24.3	5.6
No of Obs.	3	3	3	3	3	3	3	3	3	3	3	3
Factory							Market					
Avg.	31.5	7.13	3.35	7.45	24.98	4.55	31.4	7.19	2.7	6.3	25.64	24.7
Max.	32	7.15	3.9	7.7	25.01	7	32	7.29	4.8	8.9	32.1	70
Min.	31	7.11	2.8	7.2	24.95	2.1	31	7.09	1.5	2.5	18.1	0
Range	1	0.04	1.1	0.5	0.06	4.9	1	0.2	3.3	6.4	14	70
SD	0.71	0.02	0.78	0.35	0.04	3.47	0.55	0.08	1.37	2.87	6.4	34.2
CV	0.02	0	0.23	0.05	0.0017	0.76	0.02	0.01	0.51	0.46	0.25	1.39
Med	31.5	7.13	3.35	7.45	24.98	4.55	31	7.21	2.6	7.6	27.2	0.3
No of Obs.	3	3	3	3	3	2	5	5	5	5	5	5

Table: 20
Descriptive Statistics of Milk's Physiological and Nutritional Quality (Dadeldhura District)

Overall	Temp.	FAT	SNF	Density		Temp.	FAT	SNF	Density	Added Water
Avg.	30.19	4.25	6.96	15.8492	Farmer	30.66	3.34	6.75	5.91	13.23
Max.	39	7.2	8.4	27		35.3	3.99	7.5	19.8	33.65
Min.	19.8	2.57	4.5	2.3		29	2.57	5.63	2.3	7.52
Range	19.2	4.63	3.9	24.7		6.3	1.42	1.87	17.5	26.13
SD	4.705	1.46	1.09	10.2655		2.642	0.55	0.71	7.79	11.43
CV	0.156	0.34	0.16	0.6477		0.086	0.16	0.11	1.32	0.863
Med	29.1	3.56	7.03	21.22		30	3.5	6.99	2.4	8
No of Obs.	12	12	12	12		5	5	5	5	5

COB=Clout on Boiling; Temp=Temperature; Sen=Sensory Evaluation; SNF=Solid Not Fat; 1=(+)ve; 2=(-)ve;

Table 21:
Descriptive Statistics of Physiological and Nutritional Test of Milk (Surkhet)

	Temp.	FAT	SNF	Density	Added Water	Temp.	FAT	SNF	Density	Added Water
Overall						Outlet				
Avg.	26.95	4.79	7.88	25.55	9.78	21.8	2.27	7.04	23.7	24.47
Max.	34.8	7.20	8.92	31.00	48.00	22.5	5.4	8.32	28.9	42.1
Min.	19.8	1.94	4.50	15.00	0.00	21	0.89	5.43	17.7	10.6
Range	15	5.26	4.42	16.00	48.00	1.5	4.51	2.89	11.2	31.5
SD	4.47	1.38	1.13	3.85	12.77	0.46	1.03	0.92	3.48671	10.08
CV	0.17	0.29	0.14	0.15	1.31	0.02	0.45	0.13	0.14712	0.41
Med	28.45	4.85	8.27	26.00	5.87	22	2.1	7.1	23.9	23.7
No of Obs.	14	14	14	14	14	5	5	5	5	5

Table 22:

Descriptive Statistics of Physiological and Nutritional Test of Milk (Kailali District)

	Temp.	FAT	SNF	Density	Added Water	Temp.	FAT	SNF	Density	Added Water
Overall						Farmer				
Avg.	29.31	4.89	9.37	24.9	8.90	34	5.02	8.24	22.54	11.42
Max.	36	6.9	27.5	29.6	17.1	36	6.9	8.7	26.9	17.1
Min.	22	3	7.4	11.1	1.37	27	3.4	7.7	11.1	6.5
Range	14	3.9	20.1	18.5	15.73	9	3.5	1	15.8	10.6
SD	4.67	1.05	4.86	3.94	5.28	3.94	1.38	0.43	6.47	4.67
CV	0.16	0.22	0.52	0.16	0.59	0.12	0.27	0.05	0.29	0.41
Med	28.5	4.55	8.14	25.55	7.585	36	4.5	8.3	25.1	11.1
No of Obs.	16	16	16	16	16	5	5	5	5	5

Table:23

Descriptive Statistics of Milk's Physiological and Nutritional Quality (Kathmandu Valley)

	Temp.	pH	FAT	SNF	Den.	Added Water	Temp.	pH	FAT	SNF	Density	Added Water
Overall							Farmer					
Avg.	18.29	6.773	4.37	7.61	25.96	4.45	16.5	6.66	4.17	8.01	26.82	2.72
Max.	30.3	7.52	8	10.1	35.7	23.6	27	7.13	7.4	10	35.4	13.8
Min.	10	5.3	1.8	5.05	3.4	0	10	6.1	1.8	6.87	3.4	0
Range	20.3	2.22	6.2	5.09	32.3	23.6	17	1.03	5.6	3.14	32	13.8
SD	6.58	0.39	1.43	1.18	5.32	6.763	6.752	0.319	1.48	0.94	7.14775	5.22
CV	0.36	0.058	0.33	0.16	0.20	1.52	0.41	0.048	0.36	0.12	0.27	1.92
Med	15.6	6.8	4.1	7.45	26.3	0	12.8	6.6	4	7.51	26.6	0
No of Obs.	66	66	66	66	66	66	15	15	15	15	15	15
Factory							Outlet					
Avg.	19.7	6.979	4.38	7.37	24.2	5.87	17.97	6.7	4.46	7.74	27.51	2.77
Max.	28	7.22	8	10.1	35.7	23.6	30.3	7.52	8	10.1	35.7	13
Min.	12	6.55	2.4	5.06	13.1	0	10.3	5.3	2.8	5.81	20.5	0
Range	16	0.67	5.6	5.08	22.6	23.6	20	2.22	5.2	4.33	15.2	13
SD	5.439	0.19	1.22	1.37	5.53	8.209	7.656	0.51	1.71	1	3.54	4.79
CV	0.276	0.03	0.28	0.19	0.23	1.41	0.426	0.076	0.38	0.13	0.128	1.73
Med	20	7.026	4.4	7.31	24	0.96	13	6.7	3.6	7.43	26.7	0
No of Obs.	24	24	24	24	24	24	21	21	21	21	21	21

COB=Clout on Boiling; Temp=Temperature; Sen=Sensory Evaluation; SNF=Solid Not Fat; 1=(+)ve; 2=(-)ve;

Table:24

Descriptive Statistics of Milk's Physiological and Nutritional Quality (Banke District)

Level		Temp.	FAT	SNF	Density	Added Water	Level	Temp.	FAT	SNF	Density	Added Water
Overall	Avg.	25.2	3.8	8.1	24.1	9.3	Farmer	24.87	3.84	7.52	23.19	8.164
	Max.	34	8.9	8.9	28.5	23.7		32	8.4	9.2	32.5	16.1
	Min.	15.3	1.5	6.6	19.0	0.0		29	1.5	7.8	23.6	1.37
	Range	18.7	2.7	2.3	9.5	23.7		3	6.9	1.4	8.9	14.73
	SD	6.60	0.8	0.8	2.5	8.5		0.74	1.85	0.42	2.75	4.24
	CV	0.26	0.2	0.1	0.1	0.9		0.024	0.38	0.05	0.10	0.46
	Med	22	3.7	8.5	24.6	9.9		31	4.3	8.4	27.1	10
	No of Obs.	15	15	15	15	15		5	5	5	5	5
Factory	Avg.	27.67	4.6	8.17	26.07	12.43	Outlet	25.3	3.82	7.42	23.10	5.164
	Max.	31	5.2	8.5	27.8	17.1		32	8.4	9.2	32.5	16.1
	Min.	25	1.5	7.7	23.3	9.09		18	1.5	7.8	23.6	1.37
	Range	6	1.4	0.8	4.5	8.01		3	6.9	1.4	8.9	14.73
	SD	3.21	0.78	0.42	2.4	4.16		0.74	1.85	0.42	2.75	4.24
	CV	0.11	0.17	0.05	0.01	0.33		0.024	0.38	0.05	0.10	0.46
	Med	30	4.2	8.3	27.1	11.1		31	4.3	8.4	27.1	10
	No of Obs.	3	3	3	3	3		5	5	5	5	5

COB=Clout on Boiling; Temp=Temperature; Sen=Sensory Evaluation; SNF=Solid Not Fat; 1=(+)ve; 2=(-)ve;

4.2 The Adulteration Test in Milk

Adulterants are the substances that are added in the product for making more profit or to extend the shelf life of highly perishable goods. The adulterants are mostly harmful for the human health and thus should be avoided such unethical practices by the actors in dairy value chain. The sampled milk samples from farm level to consumer level were tested for adulteration of starch, sugar, neutralizer, Urea, salt and starch as per the standard protocol described in the label of the reagents used.

Table 25:
Descriptive Statistics of Adulteration Test of Milk (Sunsari District)

	Sen	Urea	Neu	Salt	COB	Starch	Sugar		Sen.	Urea	Neu	Salt	COB	Starch	Sugar
Overall								Farmer							
Freq.	28	0	0	4	0	0	0		15	0	0	1	0	0	0
Percent	100	0	0	14.3	0	0	0		100	0	0	6.67	0	0	0
No of Obs.	28	28	28	28	28	28	28		15	15	15	15	15	15	15
CC								Trans.							
Freq.	3	0	0	1	0	0	0		3	0	0	1	0	0	0
Percent	100	0	0	33.3	0	0	0		100	0	0	33.3	0	0	0
No of Obs.	3	3	3	3	3	3	3		3	3	3	3	3	3	3
Factory								Outlet							
Freq.	3	0	0	1	0	0	0		2	0	0	1	0	0	0
Percent	100	0	0	33.3	0	0	0		100	0	0	50	0	0	0
No of Obs.	3	3	3	3	3	3	3		2	2	2	2	2	2	2

Freq.=No of +ve Count; No of Obs.=Number of Observation; CC=Collection Center; Trans.=Transportation; Sen= Sensory Evaluation; Neu=Neutralizer

Table 26:
Descriptive Statistics of Adulteration Test of Milk (Ilam District)

	Sen	Urea	Neut.	Salt	COB	Starch	Sugar	Sen	Urea	Neut.	Salt	COB	Starch	Sugar
Overall								Farmer						
Freq	26	0	0	26	0	0	0	15	0	0	15	0	0	0
%	100	0	0	100	0	0	0	100	0	0	100	0	0	0
No of Obs.	26	26	26	26	26	26	26	15	15	15	15	15	15	15
CC								Trans.						
Freq	3	0	0	3	0	0	0	3	0	0	3	0	0	0
%	100	0	0	100	0	0	0	100	0	0	100	0	0	0
No of Obs.	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Outlet														
Freq	5	0	0	5	0	0	0							
%	100	0	0	100	0	0	0							
No of Obs.	5	5	5	5	5	5	5							

Freq.=No of +ve Count; No of Obs.=Number of Observation; CC=Collection Center; Trans.=Transportation; Sen= Sensory Evaluation; Neu=Neutralizer

Food adulteration is an act of intentionally debasing the quality of food offered for sale either by the admixture or substitution of inferior substances or by the removal of some valuable ingredients. Food adulteration takes into account not only the intentional addition or substitution or abstraction which adversely affects nature, substances and quality of foods, but also their incidental contamination during the period of growth , harvesting, storage, processing, transport and distribution.

Table 27:
Descriptive Statistics of Adulteration Test of Milk (Chitwan District)

	Sen	Urea	Neut	Salt	COB	Starch	Sugar	Sen	Urea	Neut	Salt	COB	Starch	Sugar
Overall								Farmer						
Freq.	28	0	0	28	0	0	0	15	0	0	15	0	0	0
Percent	100	0	0	100	0	0	0	100	0	0	100	0	0	0
No of Obs.	28	28	28	28	28	28	28	15	15	15	15	15	15	15
CC								Transp.						
Freq.	3	0	0	3	0	0	0	3	0	0	3	0	0	0
Percent	100	0	0	100	0	0	0	100	0	0	100	0	0	0
No of Obs.	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Factory								Market						
Freq.	0	0	0	0	2	0	0	0	0	0	0	5	0	0
Percent	0	0	0	0	100	0	0	0	0	0	0	100	0	0
No of Obs.	2	2	2	2	2	2	2	5	5	5	5	5	5	5

Freq.=No of +ve Count; No of Obs.=Number of Observation; CC=Collection Center; Trans.=Transportation; Sen= Sensory Evaluation; Neu=Neutralizer

Table 28:
Descriptive Statistics of Adulteration Test of Milk (Kavre District)

	Sen	Urea	Neu	Salt	COB	Starch	Sugar	Sunsari	Sen.	Urea	Neu	Salt	COB	Starch	Sugar
Overall															
Freq.	30	0	0	7	4	0	0	Farmer	15	0	0	1	0	0	0
Percent	100	0	0	23.3	13.3	0	0		100	0	0	6.67	0	0	0
No of Obs.	30	30	30	30	30	30	30		15	15	15	15	15	15	15
CC															
Freq.	3	0	0	1	0	0	0	Trans.	3	0	0	1	0	0	0
Percent	100	0	0	33.3	0	0	0		100	0	0	25	0	0	0
No of Obs.	3	3	3	3	3	3	3		4	4	4	4	4	4	4
Factory															
Freq.	3	0	0	1	0	0	0	Outlet	5	0	0	2	0	0	0
Percent	100	0	0	33.3	0	0	0		100	0	0	40	0	0	0
No of Obs.	3	3	3	3	3	3	3		5	5	5	5	5	5	5

Freq.=No of +ve Count; No of Obs.=Number of Observation; CC=Collection Center; Trans.=Transportation; Sen= Sensory Evaluation; Neu=Neutralizer

Adulteration means any materials which is or could be employed for making the food unsafe or sub standard or misbranded or containing extraneous matter. The adulterants/preservatives assume the proportion of health hazards for end consumers, particularly infants (Tipu et al., 2007). Suppliers of milk appear to have found three ways to increase their margin from the sale of milk: (i) dilution (ii) extraction of valuable components, i.e. milk fat removed as cream, and (iii) a combination of (i) and (ii) with the addition of cheap (and sometimes potentially harmful) bulking additives, such as low quality flour, to bring the total solids to a level which is acceptable to consumers. Some of the chemicals, adulterants and malpractices results in public health concern and malnutrition. Normally, the adulteration in food is done either for financial gain or lack of proper hygienic conditions of processing, storing, transportation and marketing. This ultimately leads to the stage that the consumer is either cheated or often becomes victim of diseases. Such types of adulteration are quite common in developing countries. It is equally important for the consumer to know the common adulterants and their effects on health.

Table 29:

Descriptive Statistics of Adulteration Test of Milk (Nawalparasi District)

	Sen	Urea	Neut.	Salt	COB	Starch	Sugar
Overall							
Freq	26	0	0	0	0	0	0
%	100	0	0	0	0	0	0
No of Obs.	29	29	29	29	29	29	29

Freq.=No of +ve Count; No of Obs.=Number of Observation; CC=Collection Center; Trans.=Transportation; Sen= Sensory Evaluation; Neu=Neutralizer

Quality control tests for milk are very important to assure adulterant free milk for consumption. Adulteration of milk reduces the quality of milk and can even make it hazardous. Adulterants such as salt, urea, starch, table sugar and chemicals such as costic soda may be added to the milk. Most of the chemicals used as adulterants are poisonous and cause health hazards. Adulterants are mainly added to increase the shelf life of milk. Some of the preservatives like acid and formalin is added to the milk as adulterants, thereby increasing the storage period of milk. Generally, water is added to the milk to increase the volume content of the milk. Some of the common adulterants found in milk and their detection are presented on the tables of this section.

Table 30:

Descriptive Statistics of Adulteration Test of Milk (Kaski District)

	Sen	Urea	Neut	Salt	COB	Starch	Sugar
Overall							
Freq.	28	0	0	0	0	0	0
Percent	100	0	0	0	0	0	0
No of Obs.	28	28	28	28	28	28	28

Freq.=No of +ve Count; No of Obs.=Number of Observation; CC=Collection Center; Trans.=Transportation; Sen= Sensory Evaluation; Neu=Neutralizer

Table 31:

Descriptive Statistics of Adulteration Test of Milk (Banke District)

	Sen	Urea	Neu	Salt	COB	Starch	Sugar		Sen.	Urea	Neu	Salt	COB	Starch	Sugar
Overll															
Freq.	15	0	0	3	0	0	0	Farmer	15	0	0	1	0	0	0
Percent	100	0	0	20	0	0	0		100	0	0	20	0	0	0
No of Obs.	15	15	15	15	15	15	15		5	5	5	5	5	5	5
Factory															
Freq.	3	0	0	1	0	0	0	Outlet	2	0	0	1	0	0	0
Percent	100	0	0	20	0	0	0		100	0	0	20	0	0	0
No of Obs.	3	3	3	3	3	3	3		5	5	5	5	5	5	5

Freq.=No of +ve Count; No of Obs.=Number of Observation; CC=Collection Center; Trans.=Transportation; Sen= Sensory Evaluation; Neu=Neutralizer

During our testing of the adulteration in milk, we found a significant amount of salt added to the milk. In Kathmandu Valley, three samples were found to be Urea adulterated out of 66 samples. Similerly, sixteen samples of milk were found to be Salt adulterated. Neither of the sample tested for the COB, is found to be positive. For the detail result, the statistics are presented in the table.

Table 32:
Descriptive Statistics of Adulteration Test of Milk (Surkhet/Kailali/Dadeldhura District)

	Sen	Urea	Neut.	Salt	COB	Starch	Sugar
Overall							
Freq	14/16/15	0	0	0	0	0	0
%	100	0	0	0	0	0	0
No of Obs.	14/16/15	14/16/15	14/16/15	14/16/15	14/16/15	14/16/15	14/16/15

Freq.=No of +ve Count; No of Obs.=Number of Observation; CC=Collection Center; Trans.=Transportation; Sen= Sensory Evaluation; Neu=Neutralizer

Table 33:
Descriptive Statistics of Adulteration Test of Milk (Kathmandu Valley)

	Sen	Urea	Neu	Salt	COB	Starch	Sugar		Sen.	Urea	Neu	Salt	COB	Starch	Sugar
Overall															
Freq.	67	3	0	16	0	0	0	Farmer	15	0	0	1	0	0	0
Percent	100	4.5	0	23.9	0	0	0		100	0	0	6.7	0	0	0
No of Obs.	66	66	66	66	66	66	66		15	15	15	15	15	15	15
Factory															
Freq.	24	3	0	14	0	0	0	Outlet	21	0	0	0	0	0	0
Percent	100	12.5	0	58.3	0	0	0		100	0	0	0	0	0	0
No of Obs.	24	24	24	24	24	24	24		21	21	21	21	21	21	21

Freq.=No of +ve Count; No of Obs.=Number of Observation; CC=Collection Center; Trans.=Transportation; Sen= Sensory Evaluation; Neu=Neutralizer

4.3 The CoP Test in Milk

The descriptive statistics of the CoP assessment of the milk are presented in the annex III. Here, we have presented the some meaningful discussion ponitwise.

4.3.1 Dairy animal farms and farmers

Most of the farmers visited were found to be aware about the hygienic condition required for production of clean milk, however, most of them were also found to be negligent in this aspect. Some of them were lacking on the knowledge on Good Husbandry Practices (GHP). In general following observations regarding the status of CoP/ GHP implementation in the observed farms:

- The cleanliness of the dairy animal farms was not upto the level required from bird eye observation. Some of the observed farms (25%) were in very bad condition, around 60% were in the medium level and only 15% farms were found to be very neat and clean. The lack of cleanliness in the farms was more due to ignorance rather than lack of resources. Regular cleaning of the animal shed was lacking. Some of the farmers stated that inadequate water availability was the major reason for poor cleanliness of the farm.

- In 90% of the farms, the manure pit was just next to the shed. Appropriate disposal of manure was lacking.
- The outlooks of the farm workers were not very pleasing. There were no provision for working dress and boots in most of the farms. The personnel hygiene of the farm workers were also found to be grossly compromised. This again was the shear negligence rather than lack of knowledge.
- There was no provision of milking parlour except in one large farm. Animals were milked in the same place where they are being kept.
- Regular vaccinations against prevailing diseases were common in almost all farms. Drenching against internal parasites is practiced when found infected after faecal examination as well as a regular practice of twice drenching in a year.
- Post milking teat dipping practices to control mastitis was minimal but most of the farmers reported dry cow therapy for mastitis control.
- There was lack of isolation shed for sick animals.
- In most of the farms milking cans were either aluminum or stainless steel. None of the farms were found to be using plastic can for milking animals
- Some farmers were found to be using plastic buckets to carry milk to the collection centre, which need to be discouraged.
- The vessel used for milking and carrying milk seems to be cleaned regularly
- Farm bio security seems to be grossly overlooked. Farmers were also unaware about the importance and fundamental of farm bio security.
- Though most of the farmers reported that they do not sell milk from the animals during antibiotic medication period, but reliability of the statement is questionable.
- Almost all farm visited were located near the milk collection centre, thus there was no time lag between production and delivery of milk to the collection centre.

4.3.2 Collection Centre/ Chilling Centres and transportation

Implementation status of code of practices at collection centre/ chilling centre of both private sector and DDC were not satisfactory. Partially, some of the setting and practices were found to be complying with CoP while most of the others were not. Following observations were made in collection centre/ chilling centre

- Some of the collection centre/ chilling centre were found to be located side by the road. The dust contamination arising from road and vehicle was prominent.
- There was generally lack of proper cleanliness in the collection premises and surroundings.
- The floor in the collection centre/ chilling centre was not properly level (wear and tear) making floor cleaning difficult.
- The wash basins were not in the proper place in most of the collection centre.
- In the collection centre run by cooperatives of private dairy industries, the primary lab to test the milk quality was in the same milk receiving area which is not a good practice.
- The wall and floor of some of the collection centre were found to be not properly cleaned
- It was observed that there was no provision for refresher training to the staff working in the collection centre that motivate them to comply with CoP and maintain personal hygiene.
- The collection centres were found to be accepting milk carried out in plastic can/ tank even without proper closing the lid/cover exposing contamination during the transport.
- Some milk carrying can were even found to be temporarily repaired with soap to close the small opening,
- In some of the collection centre, the personnel involved in handling of milk were found to be even not wearing apron, gloves and boots.
- In some of the collection centre, the cleanliness of milk receiving tank was not acceptable.
- The chilling cost of milk has been increasing due to increasing load shedding.
- The proper effluent management systems were missing in most of the collection centre. Spill over milk and milk containing utensil washing water was found to be let in front of the collection centre.

4.3.3 Dairy industries

Dairy industries of different capacity were observed. In general, the dairy industries were found to be struggling for adopting and fully complying with the CoP. The general conditions of the factory premises, surroundings, equipments and workers are found to be improving gradually, but still lots have to be done to fully comply with the CoP. The following observations were made in the different dairy industries

- Dairy industries were found to be gradually moving towards modernization, efficient management and maintaining surrounding cleanliness, but still lot improvement in the installed equipment and premises are required.
- The existing pipelines and valve need to regularly checked, some of them were found to be rusted, leaking and should be maintained properly.
- The industries were accepting the unsold milk from the market and reusing in the next batch which has been one of the reason for deteriorating quality of marketed milk.
- Though most of the industrialists were aware of HACCP, GMP and FSMS, the implementation is not to a full standard and thus need their appropriate implementation.
- The old machinery used for several years, need tested for their efficiency and updated as per required.
- The processing cost is increasing due to increasing load shedding.
- In some industries, trained dairy technicians were lacking.
- Training and motivation of the factory workers for maintaining personal hygiene and maintaining quality products through popper industry operating producers was found to be necessary.
- The basic amenities for the factory workers were available in most of the industries
- Most of the factory lack effluent treatment plant and management of factory effluent seems to a major problem.
- Most of the factory had no laboratory or functional laboratory for micro biological test. The microbiological quality of the products must be stringently monitored and consumers should be assured of quality and hygienic milk and milk products particularly the absence of coliform bacteria in the pasteurized milk.
- Regular quality testing procedures should be adopted in the industries
- The pset control system inside the factory premises was lacking which need to be in place.
- In most of the factory, water treatment plant/ facility was lacking.
- In most of the industries, the process flow charts were not in place.

- Regulation for visitors were not stringent in most of the factories
- The storage of packing materials should also be managed properly to avoid post processing contamination.

4.4 Micro-Biological Testing of the Milk

As milk is complete food for human it is also highly perishable and also a good source of nutrient for microbial growth which has human health implication. Therefore the processed milk supplied to the consumers should content the prescribed nutrients in it and should be free from any visual dirt and free from harmful microbial contamination. For this careful and hygienic handling of milk both in production and processing places as well as proper storage at outlets are also mandatory. Milk quickly becomes sour when it is stored for long periods at high ambient temperatures prevalent in tropical and subtropical countries. This is because the inherent lactic acid bacteria and contaminating microorganisms from storage vessels or the environment break down the lactose in milk into lactic acid. When sufficient lactic acid has accumulated, the milk becomes sour and coagulates. Raw milk that contains too much lactic acid, even if it does not appear to be curdled, will coagulate when heated. This acidity is known as "developed acidity" and such milk is not acceptable for sale to consumers or milk processors.

The number of spoilage bacteria in raw milk depends on the level of hygiene during milking and the cleanliness of the vessels used for storing and transporting the milk. During the first 2–3 hours after milking, raw milk is protected from spoilage by inherent natural antibacterial substances that inhibit the growth of spoilage bacteria. However, if the milk is not cooled, these antibacterial substances break down causing bacteria to multiply rapidly. Cooling milk to less than 10°C may prevent spoilage for up to three days. High storage temperatures result in faster microbial growth and hence faster milk spoilage.

Raw milk is also known to be associated with pathogenic bacteria which cause milk-borne diseases such as tuberculosis, brucellosis or typhoid fever, among others. Hygienic milk production, proper handling and storage of milk, and appropriate heat treatment can reduce or eliminate pathogens in milk. In many countries, milk processing factories are required by law to pasteurize milk before selling it to the public. Many consumers also routinely boil milk before drinking it to protect themselves from milk-borne diseases. Processed milk must be handled hygienically to avoid post-processing contamination. So whether one is selling milk directly to consumers or to a processing factory, it must be handled hygienically so that it remains fresh and capable of being heated without curdling. Hygienic milk handling includes using clean equipment, maintaining a clean milking environment, observing good personal hygiene and preserving the quality of milk during storage and transportation to the consumer or processing plant.

Bacterial contamination of raw milk can generally occur from three main sources; within the udder, outside the udder, and from the surface of equipment used for milk handling and storage. The bacteriological tests used most often are the Standard Plate Count (SPC), the Preliminary Incubation Count (PI), the Lab Pasteurization Count (LPC) and the Coliform Count. Ideally, bacteria levels within the udder are low and additional bacterial contamination is minimized. When bacteria counts are elevated above acceptable levels, both quantitative and qualitative analyses can help pinpoint the causes.

Raw milk as it leaves the udder of healthy cows normally contains very low numbers of microorganisms and generally will contain less than 1000 colony-forming units of total bacteria per milliliter (cfu/ml). In healthy cows, bacterial colonization within the teat cistern, teat canal, and on healthy teat skin does not significantly contribute total numbers of bacterial neither in bulk milk, nor to the potential increase in bacterial numbers during refrigerated storage. This natural flora of the cow generally will not influence the SPC, PI, LPC, or Coliform counts.

While the healthy udder should contribute very little to the total bacteria count of bulk milk, a cow with mastitis has the potential to shed large numbers of microorganisms into her milk. The influence of mastitis on the total bacteria count of bulk milk depends on type of bacteria, the stage of infection and the percent of the herd infected. Quarters from infected cows have the potential to shed in excess of 10,000,000 bacterial cfu/ml of milk produced. Mastitis organisms found to most often influence the total bulk milk bacteria counts are Streptococci (primarily Strep agalactiae and Strep uberis) although other mastitis pathogens have the potential to influence the bulk tank count as well. Staphylococcus aureus is not thought to be a frequent contributor to total bulk tank counts although counts as high as 60,000/ml have been documented. While Staph aureus and Strep ag are rarely found outside of the mammary gland, environmental mastitis pathogens (Strep uberis and coliforms) can occur in milk as a result of other contributing factors such as dirty cows, poor equipment cleaning and/or poor cooling. Increases in SCC can sometimes serve as supportive evidence that mastitis bacteria may have caused increases in the bulk tank counts. This correlation seems to apply more for Streptococci than for Staph aureus. Correlations between increases in somatic cell counts and other environmental mastitis organisms, including coliform bacteria, and coagulase-negative Staphylococci, were found to be poor as well. Staph aureus and Strep ag do not grow significantly on soiled milking equipment or under conditions of marginal or poor milk cooling. In general, mastitis organisms will not influence PI or LPC though in some cases of coliform mastitis, Coli counts may be elevated.

The exterior of the cows' udder and teats can contribute microorganisms that are naturally associated with the skin of the animal as well as microorganisms that are derived from the environment in which the cow is housed and milked. In general, the direct influence of natural inhabitants as contaminants in the total bulk milk count is considered to be small and most of these organisms do not grow competitively in milk. Of more importance is the contribution of microorganisms from teats soiled with manure, mud, feeds or bedding. Teats and udders of cows inevitably become contaminated while they are lying in stalls or when allowed in dirty lots. Used organic bedding has been shown to harbor large numbers of microorganisms often exceed 100,000,000 to 10,000,000,000 per gram of bedding. Organisms associated with bedding materials that contaminate the surface of teats and udders include streptococci, staphylococci, spore-formers, coliforms and other Gram-negative bacteria. Both thermoduric and psychrotrophic strains of bacteria are commonly found on teat surfaces indicating that contamination on the outside of the udder can influence PI, LPC, and Coli counts. The influence of dirty cows on total bacteria counts depends on the extent of soiling of the teat surface and the udder prep procedures employed. Milking heavily soiled cows could potentially result in bulk milk counts exceeding 10,000 cfu/ml. Several studies have investigated pre-milking udder hygiene techniques in relation to the bacteria count of milk. Generally, thorough cleaning of the teat with a sanitizing solution (predip) followed by thorough drying with a clean towel is effective in reducing the numbers of bacteria in milk contributed from soiled teats.

The degree of cleanliness of the milking system probably influences the total bulk milk bacteria count as much, if not more, than any other factor. Milk residue left on equipment contact surfaces supports the growth of a variety of microorganisms. Organisms considered to be natural inhabitants of the teat canal and teat skin are not thought to grow significantly on soiled milk contact surfaces or during refrigerated storage of milk. This generally holds true for organisms associated with contagious mastitis (Staph aureus and Strep ag) though it is possible that certain bacteria associated with environmental mastitis (coliforms) may be able to grow significantly. In general, bacteria from environmental contamination (bedding or manure) are more likely to grow on soiled equipment surfaces. Water used on the farm might also be a source of bacteria, especially psychrotrophs, which could seed soiled equipment. Cleaning and sanitizing procedures can influence the degree and type of bacterial growth on milk contact surfaces by leaving behind milk residues that support growth, as well as by setting up conditions that might select for specific microbial groups. Even though equipment surfaces may be considered efficiently cleaned with hot water, more resistant bacteria (thermodurics) may endure in low numbers. If milk residue is left behind (milk stone) growth of these types of organisms, although slow, may persist. Old cracked rubber parts are also associated with higher levels of thermoduric bacteria. Significant build-up of these organisms to a point where they influence the total bulk tank count may take several days to weeks though increases would be detected in the LPC. Less efficient cleaning, using lower temperatures and/or the absence of sanitizers tends to select for the faster growing, less resistant organisms (psychrotrophs), principally Gram-negative rods (coliforms and Pseudomonas) and some Streptococci. This will result in a high PI and in some case an elevated LPC. Effective use of chlorine or iodine sanitizers has been associated with reduced levels of psychrotrophic bacteria that cause high PI counts. Psychrotrophic bacteria tend to be present in higher bacteria count milk and are often associated with neglect of proper cleaning or sanitizing procedures and/or poorly cleaned refrigerated bulk tanks.

Refrigeration of raw milk, while preventing the growth of non-psychrotrophic bacteria, will select for psychrotrophic microorganisms that enter the milk from soiled cows, dirty equipment and the environment. Minimizing the level of contamination from these sources will help prevent psychrotrophs from growing to significant levels in the bulk tank during the on-farm storage period or at the processing plant. In general these organisms are not thermoduric and will not survive pasteurization. The longer raw milk is held before processing (legally up to 5 days), the greater the chance that psychrotrophs will increase in numbers. Holding milk near the PMO legal limit of 45°F allows much quicker growth than milk held below 40°F. Although milk produced under ideal conditions may have an initial psychrotrophic population of less than 10% of the total bulk tank count, psychrotrophic bacteria can become the dominant bacteria after 2 to 3 days at 40°F, resulting in a significant influence on PI counts. Colder temperatures 34-36°F will delay this shift, though not indefinitely.

Under conditions of poor cooling with temperatures greater than 45°F, bacteria other than psychrotrophs are able to grow rapidly and can become predominant in raw milk Streptococci have historically been associated with poor cooling of milk. These bacteria will increase the acidity of milk. Certain bacteria are also responsible for a "malty defect" that is easily detected by its distinct odor. Storage temperatures greater than 60°F tend to select for these types of contaminants. The types of bacteria that grow and become significant will depend on the initial contamination of the milk. Once milk leaves the farm, raw milk handling as well as the sub-sample collected by the milk hauler is beholden to the same sets of rules. If the raw milk or the samples used to run the regulatory tests are maintained at the proper temperature, bacterial counts can be significantly altered. Since most bulk tank milk is commingled in an over-the-road milk truck, the only way to determine each producer's contribution to the commingled milk is the sub-sample collected at pickup. Sample integrity must be maintained from the original bulk tank of milk, through hauling to the milk processor, and eventually through the end of the diagnostic procedures. As more milk processors are using bacteria counts within their premium programs, competent subsample handling is essential. In addition, much like SCC, one or two samples within a 30-day span are inadequate to provide a proper measure of a farm's management practices.

Microbiological analysis of milk is carried out to determine the degree of bacterial contamination in milk and to understand the chemical changes brought in milk as a result of microbial action. Pasteurization is done to destroy such harmful bacteria. If pasteurization of milk is not carried out properly there will be presence of larger count of bacteria in the milk. Methylene blue Reduction test is used to detect the presence of bacteria in milk. This test works on the principle that the methylene blue indicator is present in an oxidized form, but in the presence of bacteria, leads to the reduction of this indicator in a comparatively short span of time. The blue color developed on addition of the indicator to the milk will change to white color within a short period indicates the presence of bacteria in the milk and thus denotes improper pasteurization.

4.4.1 Total plate count

The total number of bacterial count in pasteurized milk sample is presented in the Annex IV. The average number of bacteria per ml of pasteurized milk was 16600 leaving two samples which had too many numbers of bacteria to be counted. TPC ranged from 9000 to as high as 35000 with two samples innumerable, but not a single pasteurized milk sample were free from bacteria.

4.4.2 Coliform count

Coliform is a harmful bacteria mostly arising from faecal origin. Coliform were detected both in pasteurized and loose milk marketed in Kathmandu valley which need to be addressed with proper hygienic measures to be taken both at production and processing unit as well as post processing handling. The coliform counts in sampled milk samples are presented in annex IV.

4.5 Discussion

4.5.1 The nutrient contents

The fat and solid not fat content of the milk (standard pasteurized) were within the range as prescribed by Food Act of Nepal. The Food Act of Nepal states that the standard pasteurized milk should contain at least 3% fat and 8% SNF. The average fat content of pasteurized milk marketed in different brand name in Kathmandu valley was found to be 2.98% ranging from 2.7 to 3.2%. No consistently low or high fat content in pasteurized milk were obtained indicating reliability of adjustment of fat content during the processing. Similarly the SNF content was 7.95% ranging from 7.7 to 8.13%.

In the loose milk marketed, the average fat content of cow milk and buffalo milk were 4.04 and 6.3% respectively while that of SNF content were 7.98 and 9.2% respectively for cow and buffalo milk. The protein and lactose content were not considered independently for determining price of milk in Nepal but is collectively appears in SNF content is determines the price of milk.

The nutrient content of milk is determined by the genetics and environment in which the animals are raised. Milk composition varies considerably among breeds of dairy cattle: Jersey and Guernsey breeds give milk of higher fat and protein content than Shorthorns and Friesians. Zebu cows can give milk containing up to 7% fat. Similarly, there is difference in the milk constituents between different species. The milk constituents in cow milk are given the Table. The cow milk contains 85.5-89.5% water and rest 10.5 to 14.5 solids. The solid parts of milk constitute fat, protein, lactose and minerals. The fat content varies from 2.5 to 6.0%; protein content varies from 2.9-5.0%; lactose 3.6 to 5.5% and minerals from 0.6 to 0.9%.

Table 34 *Composition of cow milk*

Main constituent	Range (%)	Mean (%)
Water	85.5 – 89.5	87.0
Total solids	10.5 – 14.5	13.0
Fat	2.5 – 6.0	4.0
Proteins	2.9 – 5.0	3.4
Lactose	3.6 – 5.5	4.8
Minerals	0.6 – 0.9	0.8

The potential fat content of milk from an individual cow is determined genetically, as are protein and lactose levels. Thus, selective breeding can be used to upgrade milk quality. Heredity also determines the potential milk production of the animal. However, environment and various physiological factors greatly influence the amount and composition of milk that is actually produced. Herd recording of total milk yields and fat and SNF percentages will indicate the most productive cows, and replacement stock should be bred from these.

The milk constituents are also influenced by the environment. The fat content of milk varies considerably between the morning and evening milking because there is usually a much shorter interval between the morning and evening milking than between the evening and morning milking. If cows were milked at 12-hour intervals the variation in fat content between milkings would be negligible, but this is not practicable on most farms. Normally, SNF content varies little even if the intervals between milkings vary.

The fat, lactose and protein contents of milk vary according to stage of lactation. Solids-not-fat content is usually highest during the first 2 to 3 weeks, after which it decreases slightly. Fat content is high immediately after calving but soon begins to fall, and continues to do so for 10 to 12 weeks, after which it tends to rise again until the end of the lactation. The variation in milk constituents throughout lactation is shown in the following Figure.

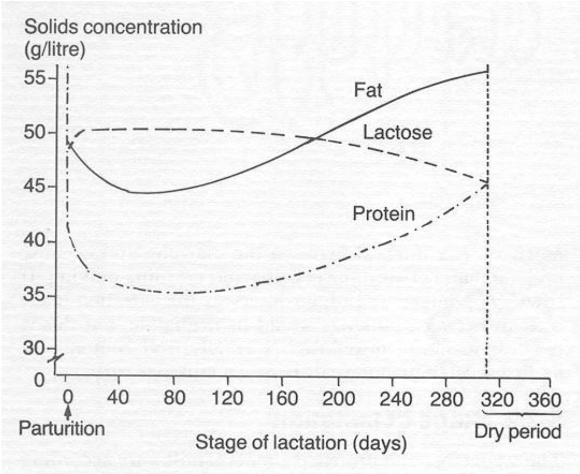


Figure 11. *Changes in the concentrations of fat, protein and lactose over a lactation of a cow*

As cows grow older, the fat content of their milk decreases by about 0.02 percentage units per lactation. The fall in SNF content is much greater.

Underfeeding reduces both the fat and the SNF content of milk produced, although SNF content is more sensitive to feeding level than fat content. Fat content and fat composition are influenced more by roughage (fibre) intake.

The SNF content can fall if the cow is fed a low-energy diet, but is not greatly influenced by protein deficiency, unless the deficiency is acute.

The first milk drawn from the udder is low in fat while the last milk (or strippings) is always quite high in fat. Thus it is essential to mix thoroughly all the milk removed, before taking a sample for analysis. The fat left in the udder at the end of a milking is usually picked up during subsequent milkings, so there is no net loss of fat.

Both fat and SNF contents can be reduced by disease, particularly mastitis.

Milk fat

If milk is left to stand, a layer of cream forms on the surface. The cream differs considerably in appearance from the lower layer of skim milk.

Under the microscope cream can be seen to consist of a large number of spheres of varying sizes floating in the milk. Each sphere is surrounded by a thin skin—the fat globule membrane—which acts as the emulsifying agent for the fat suspended in milk (Figure).The membrane protects the fat from enzymes and prevents the globules coalescing into butter grains. The fat is present as an oil-in-water emulsion: this emulsion can be broken by mechanical action such as shaking.

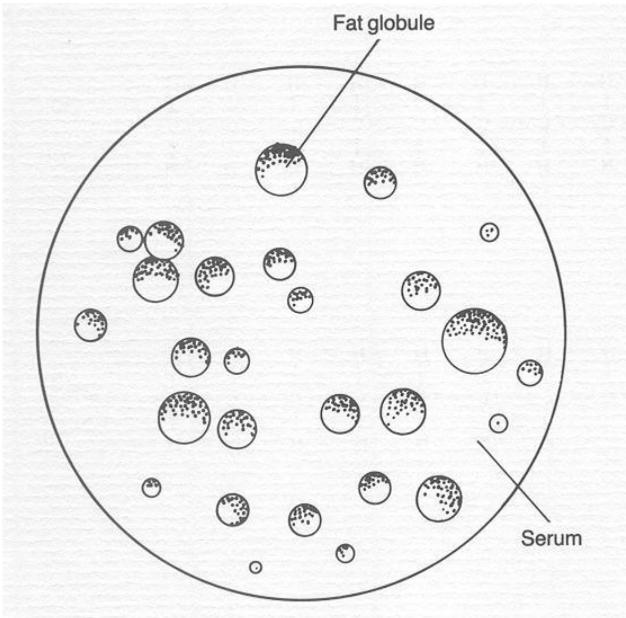


Figure 12 *Fat globules in milk.*

Fats are partly solid at room temperature. The term oil is reserved for fats that are completely liquid at room temperature. Fats and oils are soluble in non-polar solvents, e.g. ether.

About 98% of milk fat is a mixture of triacyl glycerides. There are also neutral lipids, fat-soluble vitamins and pigments (e.g. carotene, which gives butter its yellow colour), sterols and waxes. Fats supply the body with a concentrated source of energy: oxidation of fat in the body yields 9 calories/g. Milk fat acts as a solvent for the fat-soluble vitamins A, D, E and K and also supplies essential fatty acids (linoleic, linolenic and arachidonic).

Milk proteins

Proteins are an extremely important class of naturally occurring compounds that are essential to all life processes. They perform a variety of functions in living organisms ranging from providing structure to reproduction. Milk proteins represent one of the greatest contributions of milk to human nutrition. Proteins are polymers of amino acids. Only 20 different amino acids occur, regularly in proteins. They have the general structure:

Some proteins contain substances other than amino acids, e.g. lipoproteins contain fat and protein. Such proteins are called conjugated proteins:

One of the major milk protein is casein Casein was first separated from milk in 1830, by adding acid to milk, thus establishing its existence as a distinct protein. In 1895 the whey proteins were separated into globulin and albumin fractions. It was subsequently shown that casein is made up of a number of fractions and is therefore heterogeneous. The whey proteins are also made up of a number of distinct proteins.

Casein is easily separated from milk, either by acid precipitation or by adding rennin. In cheese-making most of the casein is recovered with the milk fat. Casein can also be recovered from skim milk as a separate product. Casein is dispersed in milk in the form of micelles. The micelles are stabilised by the K-casein. Caseins are hydrophobic but K-casein contains a hydrophilic portion known as the glycomacropeptide and it is this that stabilises the micelles.

After the fat and casein have been removed from milk, one is left with whey, which contains the soluble milk salts, milk sugar and the remainder of the milk proteins (whey protein). Like the proteins in eggs, whey proteins can be coagulated by heat. When coagulated, they can be recovered with caseins in the manufacture of acid-type cheeses. The whey proteins are made up of a number of distinct proteins, the most important of which are lactoglobulin and lactoglobulin. Lactoglobulin accounts for about 50% of the whey proteins, and has a high content of essential amino acids. It forms a complex with K-casein when milk is heated to more than 75°C, and this complex affects the functional properties of milk. Denaturation of -lactoglobulin causes the cooked flavor of heated milk.

In addition to the major protein fractions outlined, milk contains a number of enzymes. The main enzymes present are lipases, which cause rancidity, particularly in homogenised milk, and phosphatase enzymes, which catalyse the hydrolysis of organic phosphates. Measuring the inactivation of alkaline phosphatase is a method of testing the effectiveness of pasteurisation of milk.

Peroxidase enzymes, which catalyse the breakdown of hydrogen peroxide to water and oxygen, are also present. Lactoperoxidase can be activated and use is made of this for milk preservation.

Milk also contains protease enzymes, which catalyse the hydrolysis of proteins, and lactalbumin, bovine serum albumin, the immune globulins and lactoferrin, which protect the young calf against infection.

Milk carbohydrates

Lactose is the major carbohydrate fraction in milk. It is made up of two sugars, glucose and galactose. The average lactose content of milk varies between 4.7 and 4.9%, though milk from individual cows may vary more. Mastitis reduces lactose secretion.

Lactose is a source of energy for the young calf, and provides 4 calories/g of lactose metabolised. It is less soluble in water than sucrose and is also less sweet. It can be broken down to glucose and galactose by bacteria that have the enzyme -galactosidase. The glucose and galactose can then be fermented to lactic acid. This occurs when milk goes sour. Under controlled conditions they can also be fermented to other acids to give a desired flavour, such as propionic acid fermentation in Swiss-cheese manufacture.

Lactose is present in milk in molecular solution. In cheese-making lactose remains in the whey fraction. It has been recovered from whey for use in the pharmaceutical industry, where its low solubility in water makes it suitable for coating tablets. It is used to fortify baby-food formula. Lactose can be sprayed on silage to increase the rate of acid development in silage fermentation. It can be converted into ethanol using certain strains of yeast, and the yeast biomass recovered and used as animal feed. However, these processes are expensive and a large throughput is necessary for them to be profitable. For smallholders, whey is best used as a food without any further processing.

Heating milk to above 100oC causes lactose to combine irreversibly with the milk proteins. This reduces the nutritional value of the milk and also turns it brown.

Because lactose is not as soluble in water as sucrose, adding sucrose to milk forces lactose out of solution and it crystallizes. This causes sandiness in such products as ice cream. Special processing is required to crystallize lactose when manufacturing products such as instant skim milk powders.

Some people are unable to metabolize lactose and suffer from an allergy as a result. Pre-treatment of milk with lactase enzyme breaks down the lactose and helps overcome this difficulty. In addition to lactose, milk contains traces of glucose and galactose. Carbohydrates are also present in association with protein. K-casein, which stabilizes the casein system, is a carbohydrate-containing protein.

Milk salts

Milk salts are mainly chlorides, phosphates and citrates of sodium, calcium and magnesium. Although salts comprise less than 1 % of the milk they influence its rate of coagulation and other functional properties. Some salts are present in true solution. The physical state of other salts is not fully understood. Calcium, magnesium, phosphorous and citrate are distributed between the soluble and colloidal phases (Table 16). Their equilibria are altered by heating, cooling and by a change in pH.

Table 35. *Distribution of milk salts between the soluble and colloidal phases.*

	Total	Dissolved	Colloidal
	(mg/100 ml of milk)		
Calcium	1320.1	51.8	80.3
Magnesium	10.8	7.9	2.9
Total phosphorus	95.8	36.3	59.6
Citrate	156.6	141.6	15.0

In addition to the major salts, milk also contains trace elements. Some elements come to the milk from feeds, but milking utensils and equipment are important sources of such elements as copper, iron, nickel and zinc.

Milk vitamins

Milk contains the fat-soluble vitamins A, D, E and K in association with the fat fraction and water-soluble vitamins B complex and C in association with the water phase. Vitamins are unstable and processing can therefore reduce the effective vitamin content of milk.

4.5.2 Milk Adulteration

Adulteration was not the major problem detected in pasteurized milk. None of the milk samples were found to be adulterated with table sugar and formalin either to enrich SNF content or to increase the shelf life. Since the pasteurized milk is the bulk of milk collected from different collection centre for processing, the adulteration in processed milk might be attributable to adulteration at production and collection level. However, some of the pasteurized milk samples were found to be positive for adulteration with starch and caustic soda. However, the adulteration was not consistent meaning that some branded pasteurized milk is not always found to be adulterated with these substances.

However, the adulteration of starch and soda was more prominent with the milk sold loose in the market. This has been mainly due to extend shelf life of milk and increasing SNF content of milk as milk is paid on the basis of fat and SNF content by the milk vendors to the producers.

The removal of fat, addition of water to increase volume, addition of sugar, starch to increase SNF content, addition of soda, formalin to increase shelf life, addition of urea, ammonium sulphate are some forms of adulteration in milk.

In a study carried out in Pakistan to evaluate level of adulteration of milk vended at educational canteen, results of adulterants showed that 97% and 93% of the milk samples collected from canteens of educational institutes and public places showed water addition in them. Urea adulteration was present in 63% and 87% samples; Formalin adulteration was present in 23% and 27% samples while 87% and 97% samples showed cane sugar adulteration from various canteens of educational institutes and public places, respectively. While hydrogen peroxide adulteration was found in 3% milk samples from various canteens of public places. No sample was found to be adulterated with starch, detergent and oil from canteens of both the places. Similar results have been also reported by Haasnoot et al. (2001), Cataldi et al. (2003), Mabrook and Petty (2003), Jha and Matsuoka (2004), Renny et al. (2005), Borin et al (2006), Luykx et al. (2007), Sengar (2007) and Lateef et al. (2009). It is also concluded that milk sold at various canteens of educational institutes and public places were extensively put to malpractices such as skimming and adulteration with water (Khan et al. 1991, Mustafa et al. 1991, Khan et al. 1999 and Lateef et al. 2009). Different adulterants present in the milk like water, urea, formalin, hydrogen peroxide and cane sugar threatened the wholesomeness of milk. It is very unfortunate that the students in educational institutes and public at public places especially passengers are enforced to consume that milky coloured fluid which is extensively put to adulteration. It did not meet the legal standard and requirements.

Adulteration of Milk Samples Collected from Canteens of Various Educational Institutes and Public Places:

Adulterants	Milk Samples from Canteens of Educational Institutes		Milk Samples from Canteens of Public Places	
	Absent	Present	Absent	Present
Water	3%	97%	7%	93%
Starch	100%	0%	100%	0%
Urea	37%	63%	13%	87%
Formalin	77%	23%	73%	27%
H2O2	100%	0%	97%	3%
Detergents	100%	0%	100%	0%
Oil	100%	0%	100%	0%
Cane Sugar	13%	87%	3%	97%

Source: Faraz et al. (2013)

4.5.3 Microbiological quality of milk

Both pasteurized and loose milk sold in Kathmandu valley were found to be unsafe from microbiological quality standard for human consumption. The total plate count as well as coliform count per ml of milk in loose sold unpasteurized milk was significantly higher compared to the pasteurized milk. However, even the pasteurized milk was unsafe. The milk from DDC had somewhat lower coliform count (400-600 CFU/ml) compared to the pasteurized milk of other brands. The coliform contamination of milk sold marketed loose are attributable to lower hygienic standard at production level (animal farms) and handling during transportation and selling, but the coliform count even in the pasteurized milk revealed that either the milk is not properly pasteurized (problem in pasteurization unit- time and temperature combination) or there is post pasteurization contamination such as the contaminated filling pouch, contaminated water used for washing the unit, lack of cleanliness in the milk handler at processing etc.

Coliform are considered as indicator organisms because their presence in food indicates some form of contamination. Poor hygiene, contaminated water, unsanitary milking practices, and improperly washed and maintained equipment can lead to higher coliform counts in raw milk. Pasteurized milk shouldn't contain any coliform bacteria as though coliform bacteria can't survive the pasteurization temperature but the presence of TCC (Total coliform count)of the pasteurized milk samples indicates either defect in pasteurization process or post pasteurization contamination which includes contamination in packaging materials, defects in pipe lines.

Bacterial growth in milk

Bacterial growth refers to an increase in cell numbers rather than an increase in cell size. The process by which bacterial cells divide to reproduce themselves is known as binary transverse fission. The time taken from cell formation to cell division is called the generation time. The generation time can therefore be defined as the time taken for the cell count to double.

The curve shown in the Figure below shows the phases of bacterial growth following inoculation of bacteria into a new growth medium. The following phases can be identified:

1. *Lag phase:* There is usually some delay in growth following inoculation of bacteria into a new medium, during which time the bacteria adapt to the medium and synthesise the enzymes needed to break down the substances in the growth medium.

2. *Log phase:* Once the bacteria have adapted to the new medium they start to reproduce quickly and their numbers multiply evenly for each increment of time. A plot of the log number of cells against time gives a linear relationship: this is therefore called the log phase. The cells are at their greatest activity in this phase. Transferring cultures to a fresh medium at regular intervals can maintain the cells in an active state. An active culture can rapidly dominate any new environment.
3. *Stationary phase:* As the bacteria dominate the growth medium, they deplete the available nutrients or toxic waste products accumulate, slowing the rate of reproduction. At the same time, cells are dying off: A state of equilibrium is reached between the death of old cells and formation of new cells, resulting in no net change in cell numbers. This phase is called the stationary phase.
4. *Death phase:* In the next phase the formation of new cells ceases and the existing cells gradually die off: This is called the death phase.
5. The log phase can be prolonged by removing toxic waste, by adding more nutrients or both.

The log phase can be prolonged by removing toxic waste, by adding more nutrients or both.

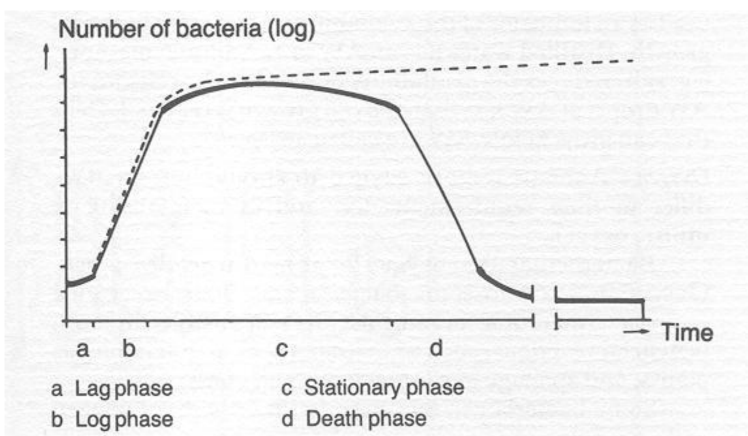


Figure 13 *The four phases of bacterial growth*.

Factors affecting bacterial growth

Bacterial growth is affected by (1) temperature, (2) nutrient availability, (3) water supply, (4) oxygen supply, and (5) acidity of the medium.

Temperature*:* Theoretically, bacteria can grow at all temperatures between the freezing point of water and the temperature at which protein or protoplasm coagulates. Somewhere between these maximum and minimum points lies the optimum temperature at which the bacteria grow best.

Temperatures below the minimum stop bacterial growth but do not kill the organism. However, if the temperature is raised above the maximum, bacteria are soon killed. Most cells die after exposure to heat treatments in the order of 70°C for 15 seconds, although spore-forming organisms require more severe heat treatment, e.g. live steam at 120°C for 30 minutes.

Bacteria can be classified according to temperature preference: *Psycrophilic* bacteria grow at temperatures below 16°C, *mesophilic* bacteria grow best at temperatures between 16 and 40°C, and *thermophilic* bacteria grow best at temperatures above 40°C.

Nutrients: Bacteria need nutrients for their growth and some need more nutrients than others. Lactobacilli live in milk and have lost their ability to synthesise many compounds, while *Pseudomonas* can synthesise nutrients from very basic ingredients.

Bacteria normally feed on organic matter; as well as material for cell formation organic matter also contains the necessary energy. Such matter must be soluble in water and of low molecular weight to be able to pass through the cell membrane. Bacteria therefore need water to transport nutrients into the cell.

If the nutrient material is not sufficiently broken down, the micro-organism can produce exo-enzymes which split the nutrients into smaller, simpler components so they can enter the cell. Inside the cell the nutrients are broken down further by other enzymes, releasing energy which is used by the cell.

Water: Bacteria cannot grow without water. Many bacteria are quickly killed by dry conditions whereas others can tolerate dry conditions for months; bacterial spores can survive dry conditions for years. Water activity (AW) is used as an indicator of the availability of water for bacterial growth. Distilled water has an AW of 1. Addition of solute, e.g. salt, reduces the availability of water to the cell and the AW drops; at AW less than 0.8 cell growth is reduced. Cells that can grow at low AW are called *osmophiles.*

Oxygen: Animals require oxygen to survive but bacteria differ in their requirements for, and in their ability to utilise, oxygen.

Bacteria that need oxygen for growth are called *aerobic*. Oxygen is toxic to some bacteria and these are called *anaerobic*. Anaerobic organisms are responsible for both beneficial reactions, such as methane production in biogas plants, and spoilage in canned foods and cheeses.

Some bacteria can live either with or without oxygen and are known as *faculative anaerobic* bacteria.

Acidity**:** The acidity of a nutrient substrate is most simply expressed as its pH value. Sensitivity to pH varies from one species of bacteria to another. The terms pH optimum and pH maximum are used. Most bacteria prefer a growth environment with a pH of about 7, i.e. neutrality.

Bacteria that can tolerate low pH are called *aciduric.* Lactic acid bacteria in milk produce acid and continue to do so until the pH of the milk falls to below 4.6, at which point they gradually die off. In canning citrus fruits, mild heat treatments are sufficient because the low pH of the fruit inhibits the growth of most bacteria.

Bacteria in milk

Milk fresh from a healthy cow contains few bacteria, but contamination during handling can rapidly increase bacterial numbers. Milk is an ideal food and many bacteria grow readily in it.

Some bacteria are useful in milk processing, causing milk to sour naturally, leading to products such as *irgo.* However, milk can also carry pathogenic bacteria, such as *Salmonella, Tuberculosis bovis* and *Brucella,* and can thus transmit disease. Other bacteria can cause spoilage of the milk, and spoilage and poor yields of products.

Bacterial contamination of raw milk can generally occur from three main sources; within the udder, outside the udder, and from the surface of equipment used for milk handling and storage. The bacteriological tests used most often are the Standard Plate Count (SPC), the Preliminary Incubation Count (PI), the Lab Pasteurization Count (LPC) and the Coliform Count.

Sources of bacteria in raw milk

Milk is synthesized by cells within the mammary gland and is virtually sterile when secreted into the alveoli of the udder. Beyond this stage of milk production, bacterial contamination can generally occur from three main sources; within the udder, outside the udder, and from the surface of equipment used for milk handling and storage. Cow health, environment, milking procedures and equipment sanitation can influence the level of microbial contamination of raw milk. Equally important is the milk holding temperature and length of time milk is stored before testing and processing that allow bacterial contaminants to multiply. All these factors will influence the total bacteria count (SPC) and the types of bacteria present in raw bulk tank milk.

Microbial contamination from within the udder: Raw milk as it leaves the udder of healthy cows normally contains very low numbers of microorganisms and generally will contain less than 1000 colony-forming units of total bacteria per milliliter (cfu/ml). In healthy cows, bacterial colonization within the teat cistern, teat canal, and on healthy teat skin does not significantly contribute total numbers of bacterial neither in bulk milk, nor to the potential increase in bacterial numbers during refrigerated storage. This natural flora of the cow generally will not influence the SPC, PI, LPC, or Coliform counts. While the healthy udder should contribute very little to the total bacteria count of bulk milk, a cow with mastitis has the potential to shed large numbers of microorganisms into her milk. The influence of mastitis on the total bacteria count of bulk milk depends on type of bacteria, the stage of infection and the percent of the herd infected. Quarters from infected cows have the potential to shed in excess of 10,000,000 bacterial cfu/ml of milk produced. Mastitis organisms found to most often influence the total bulk milk bacteria counts are *Streptococci* (primarily *Strep agalactiae* and *Strep uberis*) although other mastitis pathogens have the potential to influence the bulk tank count as well. *Staphylococcus aureus* is not thought to be a frequent contributor to total bulk tank counts although counts as high as 60,000/ml have been documented. While *Staph aureus* and *Strep ag* are rarely found outside of the mammary gland, environmental mastitis pathogens (*Strep uberis* and coliforms) can occur in milk as a result of other contributing factors such as dirty cows, poor equipment cleaning and/or poor cooling. Increases in SCC can sometimes serve as supportive evidence that mastitis bacteria may have caused increases in the bulk tank counts. This correlation seems to apply more for *Streptococci* than for *Staph aureus*. Correlations between increases in somatic cell counts and other environmental mastitis organisms, including coliform bacteria, and coagulase-negative

Staphylococci, were found to be poor as well. *Staph aureus* and *Strep ag* do not grow significantly on soiled milking equipment or under conditions of marginal or poor milk cooling. In general, mastitis organisms will not influence PI or LPC though in some cases of coliform mastitis, Coli counts may be elevated.

Microbial contamination from outside the udder: The exterior of the cows' udder and teats can contribute microorganisms that are naturally associated with the skin of the animal as well as microorganisms that are derived from the environment in which the cow is housed and milked. In general, the direct influence of natural inhabitants as contaminants in the total bulk milk count is considered to be small and most of these organisms do not grow competitively in milk. Of more importance is the contribution of microorganisms from teats soiled with manure, mud, feeds or bedding. Teats and udders of cows inevitably become contaminated while they are lying in stalls or when allowed in dirty lots. Used organic bedding has been shown to harbor large numbers of microorganisms often exceed 100,000,000 to 10,000,000,000 per gram of bedding. Organisms associated with bedding materials that contaminate the surface of teats and udders include streptococci, staphylococci, spore-formers, coliforms and other Gram-negative bacteria. Both thermoduric and psychrotrophic strains of bacteria are commonly found on teat surfaces indicating that contamination on the outside of the udder can influence PI, LPC, and Coli counts. The influence of dirty cows on total bacteria counts depends on the extent of soiling of the teat surface and the udder prep procedures employed. Milking heavily soiled cows could potentially result in bulk milk counts exceeding 10,000 cfu/ml. Several studies have investigated premilking udder hygiene techniques in relation to the bacteria count of milk. Generally, thorough cleaning of the teat with a sanitizing solution (predip) followed by thorough drying with a clean towel is effective in reducing the numbers of bacteria in milk.

Microbial contamination from equipment cleaning and sanitizing: The degree of cleanliness of the milking system probably influences the total bulk milk bacteria count as much, if not more, than any other factor. Milk residue left on equipment contact surfaces supports the growth of a variety of microorganisms. Organisms considered to be natural inhabitants of the teat canal and teat skin are not thought to grow significantly on soiled milk contact surfaces or during refrigerated storage of milk. This generally holds true for organisms associated with contagious mastitis (*Staph aureus* and *Strep ag)* though it is possible that certain bacteria associated with environmental mastitis (coliforms) may be able to grow significantly. In general, bacteria from environmental contamination (bedding or manure) are more likely to grow on soiled equipment surfaces. Water used on the farm might also be a source of bacteria, especially psychrotrophs, which could seed soiled equipment. Cleaning and sanitizing procedures can influence the degree and type of bacterial growth on milk contact surfaces by leaving behind milk residues that support growth, as well as by setting up conditions that might select for specific microbial groups. Even though equipment surfaces may be considered efficiently cleaned with hot water, more resistant bacteria (thermodurics) may endure in low numbers. If milk residue is left behind (milk stone) growth of these types of organisms, although slow, may persist. Old cracked rubber parts are also associated with higher levels of thermoduric bacteria. Significant build-up of these organisms to a point where they influence the total bulk tank count may take several days to weeks though increases would be detected in the LPC. Less efficient cleaning, using lower temperatures and/or the absence of sanitizers tends to select for the faster growing, less resistant organisms (psychrotrophs), principally Gram-negative rods (coliforms and *Pseudomonas*) and some *Streptococci*. This will result in a high PI and in some case an elevated LPC. Effective use of chlorine or iodine sanitizers has been associated with reduced levels of psychrotrophic bacteria that cause high PI counts. Psychrotrophic bacteria tend to be present in higher bacteria count milk and are often associated with neglect of proper cleaning or sanitizing procedures and/or poorly cleaned refrigerated bulk tanks.

Milk storage temperature and time: Refrigeration of raw milk, while preventing the growth of non-psychrotrophic bacteria, will select for psychrotrophic microorganisms that enter the milk from soiled cows, dirty equipment and the environment. Minimizing the level of contamination from these sources will help prevent psychrotrophs from growing to significant levels in the bulk tank during the on-farm storage period or at the processing plant. In general these organisms are not thermoduric and will not survive pasteurization. The longer raw milk is held before processing (legally up to 5 days), the greater the chance that psychrotrophs will increase in numbers. Although milk produced under ideal conditions may have an initial psychrotrophic population of less than 10% of the total bulk tank count, psychrotrophic bacteria can become the dominant bacteria after 2 to 3 days at 40°F, resulting in a significant influence on PI counts.

Colder temperatures 34-36°F will delay this shift, though not indefinitely. Under conditions of poor cooling with temperatures greater than 45°F, bacteria other than psychrotrophs are able to grow rapidly and can become predominant in raw milk. *Streptococci* have historically been associated with poor cooling of milk. These bacteria will increase the acidity of milk. Certain bacteria are also responsible for a "malty defect" that is easily detected by its distinct odor. Storage temperatures greater than 60°F tend to select for these types of contaminants. The types of bacteria that grow and become significant will depend on the initial contamination of the milk. Once milk leaves the farm, raw milk handling as well as the sub-sample collected by the milk hauler is beholden to the same sets of rules. If the raw milk or the sample used to run the regulatory tests is maintained at the proper temperature, bacterial counts can be significantly altered. Since most bulk tank milk is commingled in an over-the-road milk truck, the only way to determine each producer's contribution to the commingled milk is the sub-sample collected at pickup. Sample integrity must be maintained from the original bulk tank of milk, through hauling to the milk processor, and eventually through the end of the diagnostic procedures. As more milk processors are using bacteria counts within their premium programs, competent subsample handling is essential. In addition, much like SCC, one or two samples within a 30-day span are inadequate to provide a proper measure of a farm's management practices.

Chapter V
Conclusion and Recomendation

5.1 Conclusion

Both pasteurized and loose milk are sold in Nepal. There are various brand names of pasteurized milk from different dairy industries sold from the various outlets located throughout the valley. Similarly, loose milk collected by the vendor from various producer farmers in the city outskirt or collected from middlemen is directly sold to the consumers in city without processing, but with removal of certain level of fat content in the milk. Collected milk is kept in the deep freeze before and are sold to the consumers. Farmers are either paid on the basis of fat content or based both on fat and SNF content.

The quality of processed (pasteurized) milk sold in the various brand names in Nepal mostly comply with the legal standard set forth by Nepal Food Act in terms of fat and SNF content. The fat content and SNF content didn't vary significantly from the set standard of 3 and 8% respectively. The detectable adulteration in pasteurized milk was also minimal. Whereas though fat and SNF content of the loose milk sold are slightly higher than that of the pasteurized milk, the adulteration level was more in loose sold milk. Starch and soda adulteration was more common in loose sold milk while adulteration of sugar, formalin are nor prevalent.

The quality of milk sold in Kathmandu valley from the micro biological aspect was more critical and do not comply at all with the set forth standard of nil coliform count in pasteurized milk. The bacterial contamination (TPC and coliform) was more in the milk sold loose compared to the pasteurized milk. Stringent hygienic measures both at production and processing unit thus is warranted. Farmers need to be encouraged to comply with good husbandry practice an processing industry should strictly follow the COP developed for dairy sector.

5.2 Recommendation

Based on the current study, the following recommendations have been made for availing the wholesome and quality milk to the consumers of Kathmandu valley in general and throughout the country in particular**:**

- Milk producer farmers need to be motivated for production of hygienic milk following good husbandry practices. The government should encourages through various means for production of hygienic milk
- Farmers should be trained for adopting GHP
- The milk pricing system should also be based on the microbiological quality of the supplied milk
- The processing industries should strictly follow Code of Practice developed for dairy sector. NDDB in collaboration of DLS should have authority to implement COP and facilitate industries to comply with the COP.
- The factory workers should be motivated in personal hygiene.
- Loose vending of raw milk in the city should be discouraged, if still to be continued, strict regulation on quality aspect should be emphasized.
- Milk pricing system should also depend on the protein content of the milk.

Annexes

Annex I: Field Questioners

<u>दुग्ध उद्योग संबन्धि प्रश्नावली</u>

नमस्कार ! म नेपालमा दुधको गुणस्तर कस्तो छ भनि अध्ययनको लागि सर्भेक्ष्यणमा आएको हुँ । यो अध्ययन राष्ट्रिय दुग्ध विकास बोर्डको सहयोगमा अधिकारका लागि पहुँच नेपाल भन्ने संस्थाले गर्न लागि रहेको छ । यस अध्ययनबाट हाल नेपालमा प्रचलित कच्चा तथा प्रशोधित दुधको प्रयोग, प्रसारण, गुणस्तर आदिको अवस्था थाहा भई दुधको गुणस्तर वृद्धि गर्न सहयोग पुग्दछ । अब म केहि प्रश्नहरु तपाईहरुसँग सोध्न गई राखेको छु । यसबाट प्राप्त सुचना अध्ययनको नतिजा हाँसिल गर्न मात्र प्रयोग हुनेछ । तपाईहरुले दिनुभएको सुचनाको प्रसारण हामी गर्ने छैनौं । तसर्थ, सहि जवाफ दिएर अध्ययनलाई सफल पारिदिनुहोला ।

स्थान____________________ समय________________नमूना (sample) कोड नं ________________

सर्भेक्षणकर्ताको नाम______________________________________

१. उद्योग तथा उद्योगीको नाम:____

२. उद्योग रहेको स्थल:____________________ ३. उद्योग स्थापना साल: ____________________

४. उद्योगको प्रकार: दूध प्रसोधन मात्र ☐ दुग्ध जन्य पदार्थमात्र ☐ दूध तथा दुग्ध पदार्थ दुवै ☐

५. दैनिक दुध प्रशोधन क्षमता: स्थापित .... संचालित ....

६ कार्यरत जनशक्ति संख्या : प्राविधिक .... प्रशासन ....

७। ISO Certification प्राप्त ☐ गरेको ☐ नगरेको

८. उद्योग अन्तर्गत संचालिन चिस्यान केन्द्र संख्या:

आफु मातहतको ......

सहकारीको चिस्यान संख्या............

९. उद्योगले चर्चेको जग्गाको क्षेत्रफल: .... प्रशोधन कक्षको क्षेत्रफल :..............

१०. उद्योग निर्माणस्थल: ☐ वस्तीको विचमा ☐ वस्तीवाट वाहिर

११. उद्योग वरिपरिको वातावरण: ☐ स्वच्छ, सफा ☐ फोहोरमैला तथा धुलोयुक्त ☐ गाईवस्तु गोठ नजिक

१२. उद्योगस्थल वाढि पहिरोवाट मुक्त ☐ छ ☐ छैन

१३. उद्योगस्थलसम्म

वाटोको व्यवस्था: ☐ छ ☐ छैन

विजुलीको व्यवस्था: ☐ छ ☐ छैन

पावर व्याकअप: ☐ छ ☐ छैन

ढल निकास: ☐ छ ☐ छैन

१४. उद्योग भवनको छत: ☐ ढलान ☐ जस्तापाता ☐ अन्य

१५. भवनको भुई तातोपानी, एसिड, अल्काली आदिले: ☐ विग्रिने ☐ नविग्रिने

हालको अवस्था कस्तो छ ....

१६. भवनको भुइ सफा गर्न : ☐ सजिलो ☐ असजिलो

१७. भवनभित्र किरा, फट्यांग्रा प्रवेश गर्न : ☐ सक्ने ☐ नसक्ने

१८. भवनभित्र छुट्टाछुट्टै

प्रसोधनकक्ष: ☐ छ ☐ छैन हालको अवस्था......................................

भण्डारणकक्ष: ☐ छ ☐ छैन हालको अवस्था......................................

व्वाईलरकोठा: ☐ छ ☐ छैन हालको अवस्था......................................

प्रयोगशाला: ☐ छ ☐ छैन हालको अवस्था......................................

ड्रेसिङ्ग रुम: ☐ छ ☐ छैन हालको अवस्था......................................

सौचालय तथा वेसिन: ☐ छ ☐ छैन हालको अवस्था......................................

१९. कारखानको दुध भर्ने । वितरण गर्ने स्थलको उचाई : .... फिट

२०. भवनको नियमित मर्मत संभार भएको : ☐ छ ☐ छैन

२१. प्रशोधन कक्षको वनावट : ☐ पक्की ☐ कच्ची

२२. प्रशोधन कक्षमा प्राकृतिक प्रकाशको उचित व्यवस्था: ☐ छ ☐ छैन

२३. प्रशोधन कक्षभित्र उचित स्थानमा आवश्यकता अनुरुप विजुलीवत्तीको व्यवस्था : ☐ छ ☐ छैन

थप प्रकाशको आवश्यकता पर्छ पर्दैन रु..

२४. प्रशोधन कक्षको भुंई एसिड, अल्काली आदिले : ☐ विग्रिने ☐ नविग्रिने हालको अवस्था...................

२५. प्रशोधन कक्षको भुंई : ☐ टायल लगाईएको ☐ टायल नलगाईएको

२६. प्रशोधन कक्षको भुंईमा पानी नजम्ने व्यवस्था : ☐ छ ☐ छैन

भुई हल्का भिरालो ☐ छ ☐ छैन

२७. प्रशोधनकक्षको भित्ता कम्तीमा १.५ मि उचाई सम्म टाईल लगाईएको : छ ☐ छैन ☐

२८. प्रशोधन कक्षभित्र मेशिन तथा सरसमानका् जडान, मर्मत संभार, निरिक्षण तथा स्वच्छ उत्पादनको लागी उपयुक्त

हुने किसिमले राखिएको : ☐ छ ☐ छैन

२९. प्रशोधन कक्षमा उचित भेन्टिलेशनको व्यवस्था : ☐ छ ☐ छैन

३०. प्रशोधन कक्षभित्र किरा फट्यांग्रा नछिर्ने व्यवस्था गरिएको : ☐ छ ☐ छैन

३१. कारखानाको भुंई तथा भित्ताहरु नियमित सरसफाई तथा निसंकमण गर्ने गरिएको : ☐ छ ☐ छैन

३२. प्रशोधन कक्षको समय समयमा Sterility हेर्ने व्यवस्था : ☐ छ ☐ छैन

३३. दुध प्रशोधनको लागी आवश्यक मात्रामा खान योग्य पानीको व्यवस्था : ☐ छ ☐ छैन

पानीको श्रोत : ☐ डिप वोरिङ्ग ☐ खानेपानी कार्यालय वितरित ☐ ट्यांकरवाट किनेको ☐ अन्य

पानी प्रशोधनको व्यवस्था : ☐ छ ☐ छैन

पानी प्रशोधन प्लान्टको नियमित सरसफाई : ☐ छ ☐ छैन

३४. दुध प्रशोधनसंग प्रत्यक्ष्य सम्पर्कमा नआउने जस्तै वाफ उत्पादन, अग्नी नियन्त्रण, रेफ्रिजरेशन आदिको लागी चाहिने पानीको उचित प्रवन्ध : ☐ छ ☐ छैन

३५. कारखाना सरसफाई गर्न आवश्यक तातो चिसो पानीको व्यवस्था : ☐ छ ☐ छैन

३६. प्रशोधन तथा सरसफाईको लागी प्रयोग हुने पानीको सुक्ष्म जैविक तथा रासायनिक परिक्षण गरि रेकर्ड

राख्ने गरेको : ☐ छ ☐ छैन

सुक्ष्म जैविक (कोलिफर्म लगायत) परिक्षणको अन्तराल: ....

रासायनिक परिक्षणको अन्तराल :...................

३७. उद्योगबाट निस्कने फोहोर पानी तथा अन्य सामाग्रीको उचित व्यवस्थापन गर्ने गरिएको : ☐ छ ☐ छैन

कसरी गर्ने गरिएको छ ?

Effluent Treatment Plant को व्यवस्था : ☐ छ ☐ छैन

३८. कामदारहरु कारखाना पस्नु अघि सरसफाई गरि

एप्रोन लगाउने गरिएको : ☐ छ ☐ छैन

वुट लगाउने गरिएको : ☐ छ ☐ छैन

क्याप, लगाउने गरिएको : ☐ छ ☐ छैन

फेस मास्क लगाउने गरिएको : ☐ छ ☐ छैन

ग्लोव लगाउने गरिएको : ☐ छ ☐ छैन

३९. यि सामग्रीहरुको नियमित सरसफाई : ☐ गर्छ ☐ गर्दैन

४०. प्रशोधन कक्ष पस्न अघि फुटवाथ तथा हातको Sanitization को व्यवस्था गरिएको : ☐ छ ☐ छैन

४१. कारखाना परिसरभित्रका सौचालयहरुको सरसफाई व्यवस्थित : ☐ छ ☐ छैन

४२. कामदारले सौचालय प्रयोग गर्दा छुट्टै चप्पलको प्रयोग गर्ने गरिएको : ☐ छ ☐ छैन

४३. कामदारहरुको लागी कपडा फेर्नका् लागी छुट्टै कोठाको व्यवस्था : ☐ छ ☐ छैन

४४. दुध संकलन, प्रशोधन, विकी वितरणमा संलग्न व्यक्ति व्यक्तिगत सरसफाईमा ध्यान दिने : ☐ गर्छ ☐ गर्दैन

४५. दुध संकलन, प्रशोधन, विकी वितरणमा संलग्न व्यक्तिको नियमित स्वास्थ्य परिक्षण गरि रेकर्ड राख्ने गरिएको

☐ छ ☐ छैन

नियमित परिक्षण अवधि...........

४६. कारखाना परिसरभित्र प्रवेश गर्ने वाहिरका व्यक्तिहरुलाई सफा कपडा, एप्रोन आवश्यकता अनुसार वुट, पंजा, क्याप आदिको प्रयोग गर्ने गरिएको : ☐ छ ☐ छैन

४७. प्रशोधनसंग प्रत्यक्ष संलग्न व्यक्तिले हरेक पटक काम शुरु गर्नु अघि, सौचालय प्रयोग पछि तथा सडेगलेका कच्चा दुध छोएपछि सावुन पानीले राम्रो संग हात खुट्टा सफागर्ने गरेको : ☐ छ ☐ छैन

४८. प्रशोधन कक्षमा जथाभावी थुक्ने, खानेकुरा खाने, चुरोट सुर्ति खान निषेध गाएिको : ☐ छ ☐ छैन

Solid Waste Management को व्यवस्था :..

४९. प्रशोधनसंग प्रत्यक्ष संलग्न व्यक्तिले गहना, घडि, टिका लगाउने तथा नंग पाल्ने गरेको ☐ छ ☐ छैन

५०. प्रयोगशालाको व्यवस्था

माईक्रोवायोलोजिकल ल्याव: ☐ छ ☐ छैन

केमिकल ल्याव : ☐ छ ☐ छैन

५१. नियमित रुपमा कच्चा दुधको परिक्षण गर्ने गरिएको : ☐ छ ☐ छैन

इन्द्रियानुभ परिक्षण : ☐ दैनिक ☐ साप्ताहिक ☐ पाक्षिक ☐ मासिक ☐ अन्य

क्लट अन वोइलिङ्ग परिक्षण: ☐ दैनिक ☐ साप्ताहिक ☐ पाक्षिक ☐ मासिक ☐ अन्य

अल्कोहल परिक्षण : ☐ दैनिक ☐ साप्ताहिक ☐ पाक्षिक ☐ मासिक ☐ अन्य

फ्याट परिक्षण : ▭ दैनिक ▭ साप्ताहिक ▭ पाक्षिक ▭ मासिक ▭ अन्य

एस.एन.एफ. परिक्षण : ▭ दैनिक ▭ साप्ताहिक ▭ पाक्षिक ▭ मासिक ▭ अन्य

मिसावट परिक्षण: : ▭ दैनिक ▭ साप्ताहिक ▭ पाक्षिक ▭ मासिक ▭ अन्य

५२. मापदण्ड पुरा नभएको दुधलाई : ▭ फिर्ता पठाईन्छ ▭ मुल्य घटाएर लिईन्छ ▭ त्यतिकै लिईन्छ

५३. प्रशोधित दुधको परिक्षण गर्ने गरिएको : ▭ छ ▭ छैन

इन्द्रियानुभ परिक्षण : ▭ दैनिक ▭ साप्ताहिक ▭ पाक्षिक ▭ मासिक ▭ अन्य

फ्याट परिक्षण : ▭ दैनिक ▭ साप्ताहिक ▭ पाक्षिक ▭ मासिक ▭ अन्य

एस.एफ.एन परिक्षण : ▭ दैनिक ▭ साप्ताहिक ▭ पाक्षिक ▭ मासिक ▭ अन्य

मिसावट परिक्षण: ▭ दैनिक ▭ साप्ताहिक ▭ पाक्षिक ▭ मासिक ▭ अन्य

कोलिफर्म परिक्षण : ▭ दैनिक ▭ साप्ताहिक ▭ पाक्षिक ▭ मासिक ▭ अन्य

फोस्फटेज परिक्षण : ▭ दैनिक ▭ साप्ताहिक ▭ पाक्षिक ▭ मासिक ▭ अन्य

सम्पुर्ण सुक्ष्मजीवाणु गणना : ▭ दैनिक ▭ साप्ताहिक ▭ पाक्षिक ▭ मासिक ▭ अन्य

५४. प्रशोधन विधि: ▭ व्याच पाश्चुराईजेशन ▭ HTST पाश्चुराईजेशन ▭ अन्य

५५. व्याच पाश्चुराईजेशनको तापक्रम तथा समय : ...., ...

५६. ज्त्क्त पाश्चुराईजेशनको तापक्रम तथा समय : ...., ...

५७. दुग्ध उद्योगमा प्रयोग हुने र दुध र दुग्ध पदार्थ संग संसर्ग हुने पाईप, भल्भ, क्यान, स्टोरेज ट्यांक आदिको निर्माण

स्टेनलेस स्टिल (SS 304) ▭ पोलिथिन ▭ अन्य ▭

५८. दुध प्रशोधन गर्नु अघि र पछि उपकरण, स्टोरेज ट्यांक, ढुवानीको साधन, पाईप लाईन, फिलिङ्ग उपकरणहरु राम्रो संग सफा तथा निर्मलीकरण गर्ने गरिएको : ▭ छ ▭ छैन

५९. प्रशोधन पश्चात Commercial Food Grade को उचित स्तरको (Proper Strength) को अल्काली तथा

एसिड तथा तातो पानीले सफा गर्ने गरेको : ▭ छ ▭ छैन

६०. प्रशोधित दुध तथा कच्चा दुध एकै ठाउंमा राख्ने गरिएको : ▭ छ ▭ छैन

६१. मेशिनरी औजारहरुको नियमित परिक्षण : ▭ गरिन्छ ▭ गरिदैन

६२. प्रशोधन कक्षको झ्याल ढोका खुला राख्ने गरिएको : ▭ छ ▭ छैन

६३. प्रशोधन कक्ष अन्य प्रयोजनको लागी प्रयोग गर्ने गरिएको : ☐ छ ☐ छैन

६४. प्रयोग गरिने पाउडर दुधको गुणस्तर नेपाल सरकारले तोकेको मापदण्ड अनुसार : ☐ छ ☐ छैन

पाउडर दुधको मापदण्ड:

पाउडर दुधका श्रोत :

६५. केट, ट्रली तथा अन्य सामाग्रीहरुको सरसफाई : ☐ राम्रो छ ☐ राम्रो छैन

६६. परिक्षणमा प्रयोग हुने केमिकलहरुको भण्डारण :☐ ठिक छ ☐ ठिक छैन

६७. केमिकलसंग कःए तथा प्याकेजि सामान संगै भण्डारण गरिएको :☐ छ ☐छैन

भण्डारणको अवस्था कस्तो छ?...

६८. प्रशोधित दुधको प्याकेटमा ऐन नियम अनुसारको लेवल लगाईएको : ☐ छ ☐ छैन

६९. प्रशोधन विधि उल्लेख गर्ने गरिएको : ☐ छ ☐ छैन

७०. उत्पादन मिति तथा व्याच नं, उपभोग गरिसक्नु पर्ने मिति उल्लेख ☐ छ ☐ छैन

७१. विकि वितरणमा जानु अघि स्टोरेजमा राखीएको तापक्रम :..........

७२. विक्री वितरणमा प्रयोग गरिने भ्यानको अवस्था ☐ राम्रो☐ नराम्रो

७३. फिर्ता आएको दुध लाई : ☐ अन्य ताजा दुधमा मिसाईन्छ☐ दुग्ध पदार्थ उत्पादन गरिन्छ☐ फालिन्छ

७४. विभिन्न तहमा आवश्यक पर्ने विभिन्न तालिम पाएको :☐ छ☐ छैन

तालिम प्रदान गर्ने संस्था । कार्यालय : ....

गुणस्तरको दूध उत्पादन तर्फ उत्प्रेरणा जगाउने संस्था : ....

७४. स्वच्छ तथा स्वस्थ्यकर दूध उत्पादन तथा वितरणको लागी तालिमको आवश्यकता ☐ छ☐ छैन

७५. आन्तरिक निरिक्षणको व्यवस्था: ☐ छ ☐ छैन

७६. HACCP. ISO प्रमाणिकरण तर्फ व्यवस्थापन लागेको :☐ छ ☐ छैन

दूध संकलन केन्द्र संबन्धि प्रश्नावली

नमस्कार ! म नेपालमा दुधको गुणस्तर कस्तो छ भनि अध्ययनको लागि सर्भेक्ष्यणमा आएको हुँ । यो अध्ययन राष्ट्रिय दुग्ध विकास बोर्डको सहयोगमा अधिकारका लागि पहुँच नेपाल भन्ने संस्थाले गर्न लागि रहेको छ । यस अध्ययनबाट हाल नेपालमा प्रचलित कच्चा तथा प्रशोधित दुधको प्रयोग, प्रसारण, गुणस्तर आदिको अवस्था थाहा भई दुधको गुणस्तर वृद्धि गर्न सहयोग पुग्दछ । अब म केहि प्रश्नहरु तपाईहरुसँग सोध्न गई राखेको छु । यसबाट प्राप्त सुचना अध्ययनको नतिजा हाँसिल गर्न मात्र प्रयोग हुनेछ । तपाईहरुले दिनुभएको सुचनाको प्रसारण हामी गर्ने छैनौं । तसर्थ, सहि जवाफ दिएर अध्ययनलाई सफल पारिदिनुहोला ।

स्थान____________________ समय________________नमूना (sample) कोड नं ________________

सर्भेक्षणकर्ताको नाम______________________

संकलन केन्द्रको नाम: ______________________________संकलन केन्द्रको ठेगाना: ______________________

केन्द्र ईन्चार्ज: ______________________ सालाखाला दैनिक दूध संकलन: .... लि

संकलन केन्द्रमा चिलिङ्गको सुविधा : ☐ छ ☐ छैन

भएमा, चिस्यान क्षमता: ....लि भण्डारण क्षमता : ....लि

संकलन केन्द्रको किसिम : : ☐ डि.डि.सी. ☐ प्राईभेट डेरी ☐ सहकारी ☐ अन्य

संकलित दुध कंहा पठाईन्छ : ☐ डि.डि.सी. ☐ प्राईभेट डेरी ☐ अन्य ☐

पावर Backup को व्यवस्था : ☐ छ ☐ छैन

---

१. दुध संकलन केन्द्र । चिस्यान केन्द्र को परिशरको वातावरण : ☐ स्वच्छ छ ☐ फोहोर छ

२. दुध संकलन केन्द्र । चिस्यान केन्द्र धेरै कृषक । संस्थाहरुलाई : ☐ पायक पर्ने ☐ अपायक पर्ने

३. दूध संकलन विहान वेलुका दुवै पटक : ☐ हुन्छ ☐ हुदैन

४. दुध संकलन केन्द्रमा आवश्यक पानीको आपुर्ती : ☐ पर्याप्त छ ☐ अपार्यप्त छ

पानीको श्रोत :...................... पानी निर्मलीकरणको व्यवस्था: ....

५. संकलन केन्द्रमा सरसफाईवाट आएका फोहोर पानीको व्यवस्थापन : ☐ ठिक छ ☐ ठिक छैन

६. दुध संकलन तथा स्टोर गर्ने भांडा : ☐ स्टेनलेस स्टिल ☐ आलमुनियम ☐ अन्य

७. दुध ढुवानी गरिने भांडा : ☐ स्टेनलेस स्टिल ☐ आलमुनियम ☐ अन्य

८. दुध ढुवानी गरिने भांडाको मुख ☐ भित्र सफा गर्न सकिने खालको छ ☐ सानो सफागर्न गारो पर्नेखालको छ

९. दूध वुझाउन ल्याउनेले दूधको भाडा सफा गर्ने गरेको : ☐ छ ☐ छैन

१०. दूध संकलनमा प्रत्यक्ष संलग्न व्यक्तिको व्यक्तिगत सरसफाई : ☐ राम्रो छ ☐ राम्रो छैन

११. सौचालय प्रयोग पछि हात खुट्टा राम्रो संग सावुन पानीले धुने व्यवस्था : ☐ छ ☐ छैन

१२. टयांकर क्यान भाडाहरु सफाईको सुविधा : ☐ छ ☐ छैन

१३. ट्यांकर, स्टोरेज ट्यांक, भाडावर्तनहरुको सरसफाईको वर्तमान अवस्था : ☐ राम्रो छ ☐ राम्रो छैन

१४. चिस्यान केन्द्रमा दुधलाई राखिने तापकम :............

१५. संकलन भएको सवै दुधलाई चिस्याउने क्षमता ☐ छ ☐ छैन

१६. सामान्यतया संकलन कार्यको कति घण्टा पछि प्रशोधन स्थलमा दुध पठाउने गरिएको : ....

१७. संकलन । चिस्यान केन्द्रवाट प्रशोधन स्थलसम्म ढुवानी गर्न प्रयोग हुने भांडा । ट्यांकर: ☐

स्टेनलेस स्टिल ☐ एलमुनियम ☐ अन्य

१८. दूध ढुवानी गरिने ट्यांकर इन्सुलेटेड : ☐ छ ☐ छैन

१९. संकलन केन्द्रमा प्रयोगशालाको व्यवस्था : ☐ छ ☐ छैन

२०. केमिकलहरु उचित ढंगवाट भण्डारण गरिएको : ☐ छ ☐ छैन

२१. नियमित रुपमा कच्चा दुधको परिक्षण गर्ने गरिएको : ☐ छ ☐ छैन

इन्द्रियानुभ परिक्षण : ☐ दैनिक ☐ साप्ताहिक ☐ पाक्षिक ☐ मासिक ☐ अन्य

क्लट अन वोइलिङ्ग परिक्षण: ☐ दैनिक ☐ साप्ताहिक ☐ पाक्षिक ☐ मासिक ☐ अन्य

अल्कोहल परिक्षण : ☐ दैनिक ☐ साप्ताहिक ☐ पाक्षिक ☐ मासिक ☐ अन्य

फ्याट परिक्षण : ☐ दैनिक ☐ साप्ताहिक ☐ पाक्षिक ☐ मासिक ☐ अन्य

एस.एन.एफ. परिक्षण : ☐ दैनिक ☐ साप्ताहिक ☐ पाक्षिक ☐ मासिक ☐ अन्य

मिसावट परिक्षण: : ☐ दैनिक ☐ साप्ताहिक ☐ पाक्षिक ☐ मासिक ☐ अन्य

२२. गुणस्तरहिन दूध लिने गर्नु भएको : ☐ छ ☐ छैन

२३. राम्रो गुणस्तरको दुधलाई प्रिमियम मुल्यको व्यवस्था : ☐ छ ☐ छैन

२४. कृषकहरुलाई सफा तथा स्वच्छ दूध उत्पादन तथा आपूर्ति गर्न उत्प्रेरणा दिने गर्नुभएको ☐ छ ☐ छैन

२५. कुनै प्रकारको तालिमको आवश्यकता : ☐ छ ☐ छैन

भएमा, कस्तो तालिम:..

कति समयको: ....

२६. संकलन केन्द्रको आकस्मिक । नियमित निरिक्षण : ☐ हुने गरेको ☐ हुने नगरेको

२७. समय समयमा दुध उत्पादनस्थनको निरिक्षण ? ☐ गर्ने गरेको ☐ गर्ने नगरेको

उत्पादनस्थल (कृषकस्तरमा)संबन्धि प्रश्नावली

नमस्कार ! म नेपालमा दुधको गुणस्तर कस्तो छ भनि अध्ययनको लागि सर्भेक्ष्यणमा आएको हुँ । यो अध्ययन राष्ट्रिय दुग्ध विकास बोर्डको सहयोगमा अधिकारका लागि पहुँच नेपाल भन्ने संस्थाले गर्न लागि रहेको छ । यस अध्ययनबाट हाल नेपालमा प्रचलित कच्चा तथा प्रशोधित दुधको प्रयोग, प्रसारण, गुणस्तर आदिको अवस्था थाहा भई दुधको गुणस्तर वृद्धि गर्न सहयोग पुग्दछ । अब म केहि प्रश्नहरु तपाईहरुसँग सोधन गई राखेको छु । यसबाट प्राप्त सुचना अध्ययनको नतिजा हाँसिल गर्न मात्र प्रयोग हुनेछ । तपाईहरुले दिनुभएको सुचनाको प्रसारण हामी गर्ने छैनौं । तसर्थ, सहि जवाफ दिएर अध्ययनलाई सफल पारिदिनुहोला ।

स्थान____________________ समय________________नमूना (sample) कोड नं ________________

सर्भेक्षणकर्ताको नाम______________________

कृषकको नाम: ______________________ कृषकको ठेगाना:______________________

दूधाल गाईको संख्या: .... दधालु भैसीको संख्या: ...... जम्मा गाई भैंसी संख्या: ....

पालिएका गाईका जातहरु:..

पालिएका भैंसीका जातहरु:..

आहारा व्यवस्थापन : ☐ घांसमा आधारित ☐ पराल, चोकर दानामा आधारित ☐ अन्य

सरदर दैनिक दूधको उत्पादन:

वढि हुने सिजनमा: ....लि

कम हुने सिजनमा: ....लि

दूध विकि गरिने संकलन केन्द्र: ______________________

संकलन केन्द्र सम्मको दुरी: ______________________

दूध संकलन केन्द्रमा लगिने : ☐ विहान मात्र ☐ वेलुका मात्र ☐ विहान वेलुका दैनिक दुई पटक

औषत प्राप्त हुने दूधको मूल्य :

गाईको : रु .... प्रति लि.

भैंसीको : रु .... प्रति लि.

---

१. गाई भैंसी पालिएको ठांउको वातावरण: ☐ राम्रो ☐ नराम्रो

२. गोवर तथा मुत्र व्यवस्थापन : ☐ राम्रो ☐ नराम्रो

३. गाईवस्तु पालीएको गोठको सरसफाई : ☐ राम्रो ☐ नराम्रो

४. पानी आपूर्तिको अवस्था : ☐ पर्याप्त ☐ अपर्याप्त

पानीको श्रोत :____________________ पानीको स्वच्छता (वाह्य निरिक्षण):____________________

५. दुधालु गाई भैंसीको स्वास्थ्य अवस्था : ☐ स्वस्थ ☐ अस्वस्थ

६. अस्वस्थ्य पशुवस्तूको व्यवस्थापन:..

७. भ्याक्सीनेसन गर्ने गरिएको

एफ.एम.डि विरुद्ध: ☐ छ ☐ छैन

HS तथा BQ विरुद्ध: ☐ छ ☐ छैन

अन्य रोग विरुद्ध: ☐ छ ☐ छैन

८. थुनेलो रोग रोकथामको व्यवस्था गरिएको : ☐ छ ☐ छैन

९. दुध दुहुने व्यक्तिको स्वास्थ्य अवस्था : ☐ स्वस्थ ☐ अस्वस्थ

१०. दुध दुहुने व्यक्तिको व्यक्तिगत सरसफाई: ☐ राम्रो ☐ नराम्रो

११. सौचालय प्रयोग पछि सावुन पानीले हात खुट्टा राम्रो संग धुने: ☐ गरेको ☐ नगरेको

१२. दुध दुहुनु पूर्व गाईभैंसीको सफाई तथा थुन तथा कल्चौडोको सरसफाई : ☐ राम्रो ☐ नराम्रो

१३. दुध दुहुने भांडो : ☐ स्टेनलेस स्टिल ☐ एलमुनियम ☐ अन्य

१४. दुध दुहुने भांडाको सरसफाई : ☐ राम्रोसंग गर्ने गरिएको ☐ झारा टार्ने किसिमवाट गर्ने गरिएको

१५. दूध ढुवानी गरिने भांडाको सरसफाई : ☐ राम्रो ☐ नराम्रो

१६. दुध दुहिसके पछि चिस्यान केन्द्र । संकलन केन्द्र सम्म पुराईसक्ने समय : ....घण्टा

१७. एन्टिवायोटिक तथा अन्य औषधि प्रयोग गरिएका गाईभैंसीवाट उत्पादित दुध विक्री ☐ गरिन्छ ☐ गरिदैन

१८. स्वच्छ दुध उत्पादनको लागी उत्प्रेरणा : ☐ मिलेको छ ☐ मिलेको छैन

१९. स्वच्छ तथा गुणस्तरको दूध आपुर्ति गर्दा प्रिमियम मुल्य पाउने गरेको : ☐ छ ☐ छैन

२०. स्वच्छ दुध उत्पादनको लागी तालिम लिनु भएको : ☐ छ ☐ छैन

२१. थप तालिमको आवश्यकता : ☐ छ ☐ छैन

भएमा, कस्तो किसिमको तथा कति दिनको रु ....

२२. पशु व्यवस्थापन एवं उपचार सम्वन्धि परामर्श पाउने गर्नुभएको : ☐ छ ☐ छैन

परामर्शको श्रोत :..

प्रशोधित दुध वितरण सम्बन्धि प्रश्नावलीहरु

१. दुध राख्ने प्लास्टिकको केट सफा छ ☐ छैन ☐

२. डेलिभरी भ्यान खुल्ला छ ☐ छैन ☐

३. डेलिभरी भ्यान सफा छ ☐ छैन ☐

४. दुध बिकी गर्ने स्थान/पसल सफा छ ☐ छैन ☐

५. दुध बिकि गर्ने स्थान/पसल प्रत्यक्ष घाम पर्ने खालको ☐ छ ☐ छैन

६. दुध बेच्ने स्थान फूटपाथ/फोहोरी वातावरण /जथाभावि ☐ छ ☐ छैन

७. प्रशोधित दुधको लेबल छ ☐ छैन ☐

८. प्रशोधित दुधको प्याकेटमा तपशिल मध्ये के लेखिएको छ

क. निरोगन प्रक्रिया (पाश्चराइड) ☐

ख. जिवाणु हनन (स्टेरीलाईजड) ☐

ग. उच्च तापक्रममा उपचार (UHT Treated) ☐

९.प्याकेटमा पोषक तत्वहरुको विवरण छ ☐ छैन ☐

१०. प्याकेटमा उद्योगको पुरा नाम/ठेगाना छ ☐ छैन ☐

११. उपभोग गरिसक्नु पर्ने मिति छ ☐ छैन ☐

१२. प्याकिङ प्लास्टिक प्रयोग गरिसकेपछि पुन प्रयोगका लागि जम्मा गरी बिक्रि गर्नु पर्ने भनि उपभोक्तामा जनचेतना जगाउने शब्द छ ☐ छैन ☐

Annex II: Milk Testing Forms

Description of Sampling Point (Institution, Farmer etc.):				
Name of Sampler:				
Sample Code:				
Date/Time:		**Place:**		**District**
S.N.	**Parameters**	**Test Method**	**Observed Value**	
			Unit	**Value**
1	Temperature	Thermometer	C^o	
2	Sensory evaluation	**Appearance:** appearance-no forgien matter, no cream layer **Flavor:** salty, sour, rancid	Good or Bad	
3	pH	pH meter	pH Scale	
4	Urea	Kit Reagent	+ive / -ive	
5	Neutralizer	Kit Reagent	+ive / -ive	
6	Salt	Kit Reagent	+ive / -ive	
7	COB	Boiling	+ive / -ive	
8	Starch	Kit Reagent	+ive / -ive	
9	Sugar	Kit Reagent	+ive / -ive	
;				
10	FAT	Lacto-scan Milk Analyzer	%	
11	SNF	Lacto-scan Milk Analyzer	%	
12	Density	Lacto-scan Milk Analyzer	%	
13	Addition Water	Lacto-scan Milk Analyzer	%	
14	Protein	Lacto-scan Milk Analyzer	%	

Name and Signature of Witness

	Name	**Affiliation**	**Position**	**Signature**
1				
2				

Annex III: Descriptive Statistics of COP Test of Milk Value Chain

Annex III.1: Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Farmer Level (Sunsari)

	Q1	Q2	Q3	Q4	Q5	FMD	HS/BQ	Other	Q8	Q9	Q10	Q11	Q12	Steel	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22
Freq.	15	15	14	15	15	12	10	0	4	15	15	15	15	6	14	15	1	0	10	0	1	15	6
%	100	100	93.3	100	100	80	66.7	0	26. 7	100	100	100	100	40	93.3	100	6. 7	0	66. 7	0	6.67	100	40
No of Obs.	15	15	15	15	15	15	15	15	15	15	15	15	15	6	15	15	15	15	15	15	15	15	15

	No of Cow	No of Buff	Total	Max	Min	Distance CC	Cow	Buff.
Avg.	1.99	1.75	2.27	14	6.7	13.3	51	61.25
Max.	2	1.5	2	10	4	5	50	62.5
Min.	4	3	6	40	28	45	55	65
Range	1	1	1	5	2	0.5	43	55
SD	3	2	5	35	26	44.5	12	10
CV	1	0.95	1.54	11.13	8.16	15.53	4.45	4.79
Med	0.52	0.55	0.68	0.87	1.28	1.17	0.09	0.087
No of Obs.	14	4	15	15	15	15	13	4

Annex III.2: Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Collection Center (Sunsari District)

	Avg Collection (ltr)	Cooling (ltr)	Storage (ltr)
Avg.	130	250	250
Max.	200	500	500
Min.	50	50	50
Range	150	450	450
SD	75.5	229.13	229.12
CV	0.58	0.92	0.92
Med	140	200	200
No of Obs.	3	3	3

	Q1a	Q1a	Q1d	Q1c	Q1d	QN2	QN3	QN4	QN5	QN8	QN9	QN10	QN11	QN12	QN13
Freq.	2	1	1	2	0	2	1	3	3	2	3	1	1	3	3
%	100	100	100	100	0	66.7	33.3	100	100	66.67	100	100	100	100	100
No of Obs.	2	1	1	2	3	3	3	3	3	3	3	1	1	3	3

	QN14	QN15	QN16	QN17	QN18	QN19	QN21	Alc.	Fat	SNF	QN22	QN23	QN24	QN25	QN26	QN27
Freq.	0	3	0	1	1	0	1	0	0	0	0	0	0	2	1	1
%	0	100	0	100	33.3	0	33.3	0	0	0	0	0	0	66.67	33.33	33.33
No of Obs.	2	3	1	1	3	3	3	1	1	1	3	3	3	3	3	3

Annex III.3: Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Farmer Level (Ilam District)

	Grass	Stra and Palate	QN1	QN2	QN3	QN4	QN5	FMD	HS/BQ	Other	QN8	QN9	QN10	QN11	QN12	Steel	Alm.	QN14	QN15	QN16	QN17	QN18	QN19	QN20	QN21	QN22
Freq.	15	6	15	13	12	6	15	6	3	9	9	15	15	15	15	6	10	15	15	0	13	4	12	1	15	0
%	100	40	100	86.7	80	40	100	40	20	60	60	100	100	100	100	40	66.7	100	100	0	86.7	26.7	80	6.7	100	0
No of Obs.	15	6	15	15	15	15	15	15	15	15	15	15	15	15	15	6	10	15	15	15	15	15	15	15	15	15

	No of Cow	No of Buff	Total	Max	Min	Dist. CC	Cow
Avg.	2.6	0	2.4	11.7	3.07	55.2	37.87
Max.	5	0	5	18	6	500	48
Min.	1	0	1	7	2	1	30
Range	4	0	4	11	4	499	18
SD	1.64	0	1.64	3.26	1.39	132.7	5.42
CV	0.6	0	0.68	0.27	0.45	2.40	0.14
Med	2	0	2	11	2	10	35
No of Obs.	15	15	15	15	15	15	15

Annex III.4: Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Collection Center (Ilam District)

	QN1	QN2	QN3	QN4	QN5	QN8	QN9	QN10	QN11	QN12	QN13	Other	QN19	QN20	QN21	QN22	QN23	QN24	QN25	QN26	QN27
Freq.	3	3	0	2	3	3	3	3	3	3	3	3	3	3	3	0	3	3	3	3	3
%	100	100	0	66.67	100	100	100	100	100	100	100	100	100	100	100	0	100	100	100	100	100
No of Obs.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Annex III.5: Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Farmer Level (Chitwan District)

	No of Cow	No of Buff	Total		Grass	Stra and Palate	Both	QN1	QN2	QN3	QN4	Water	QN5	FMD	HS/BQ	Other	QN8	QN9
Avg.	2.46	2	2.73	Freq.	10	15	15	15	12	11	15	1	14	15	15	5	11	15
Max.	4	2	4	Percent	66.67	100	100	100	80	73.33	100	6.7	93.33	100	100	33.33	73.33	100
Min.	1	2	1	No of Obs.	10	15	15	15	14	14	15	8	14	15	15	15	15	15
Range	3	0	3															
SD	0.88	0	0.80	Freq.	QN10	QN11	QN12	Steel	Alm	QN14	QN15	QN16	QN17	QN18	QN19	QN20	QN21	QN22
CV	0.36	0	0.29	Percent	14	15	14	6	8	15	14	0	10	6	9	1	13	1
Med	3	2	3	No of Obs.	93.33	100	93.33	40	53.33	100	93.33	0	66.66	40	60	6.67	86.67	6.67
No of Obs.	13	2	15		14	15	14	6	9	15	14	0	15	15	15	15	15	15

Annex III.6: Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Collection Center (Chitwan District)

	Avg Col(ltr)	Cooling (ltr)	Storage(ltr)	Time		Pvt. Dairy	Others	Back up	QN1	QN2	QN3	QN4	PM	QN5	QN8	QN9	QN10	QN11	QN12
Avg.	1633.33	1333.3	1166.66667	5.5	Freq.	3	1	0	3	2	1	3	0	3	2	3	1	1	3
Max.	2000	2000	2000	7	%	100	100	0	100	66.66667	33.33333	100	0	100	66.66667	100	100	100	100
Min.	1400	1000	500	2.5	No of Obs.	3	1	3	3	3	3	3	3	3	3	3	1	1	3
Range	600	1000	1500	4.5															
SD	321.4	577.3	763.762616			QN13	QN14	QN15	Others	QN18	QN19	QN20	QN21	QN22	QN23	QN24	QN25	QN26	QN27
CV	0.196	0.433	0.654		Freq.	3	0	3	1	1	0	0	1	0	0	0	2	1	1
Med	1500	1000	1000	7	%	100	0	100	100	33.33333	0	0	33.33333	0	0	0	66.66666667	33.33333	33.33333
No of Obs.	3	3	3	3	No of Obs.	3	2	3	1	3	3	2	3	3	3	3	3	3	3

Annex III.7: Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Farmer Level (Kavre)

	Q1	Q2	Q3	Q4	Q5	FMD	HS/BQ	Other	Q8	Q9	Q10	Q11	Q12	Steel	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22
Freq.	15	15	14	14	15	12	5	0	10	15	15	15	15	6	14	15	1	0	10	0	1	15	6
%	100	100	93.3	93.3	100	80	33.3	0	66.67	100	100	100	100	40	93.3	100	6. 7	0	66.7	0	6.67	100	40
No of Obs.	15	15	15	15	15	15	15	15	15	15	15	15	15	6	15	15	15	15	15	15	15	15	15

	No of Cow	No of Buff	Total	Max	Min	Distance CC	Cow	Buff.
Avg.	3.1	1.75	2.27	14	6.7	13.3	51	61.25
Min.	2	2	2	10	4	5	50	62
Max.	4	3	6	40	28	45	55	65
Range	2	1	4	30	24	40	5	3
SD	3	2	5	35	26	44.5	12	10
CV	1	0.95	1.54	11.13	8.16	15.53	4.45	4.79
Med	3.52	0.55	0.68	0.87	1.28	1.17	0.09	0.087
No of Obs.	14	4	15	15	15	15	13	4

Annex III.8: Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Collection Center (Kavre District)

	Avg Collection (ltr)	Cooling (ltr)	Storage (ltr)
Avg.	130	250	250
Max.	200	500	500
Min.	50	50	50
Range	150	450	450
SD	75.5	229.13	229.12
CV	0.58	0.92	0.92
Med	140	200	200
No of Obs.	3	3	3

	Q1a	Q1a	Q1d	Q1c	Q1d	QN2	QN3	QN4	QN5	QN8	QN9	QN10	QN11	QN12	QN13
Freq.	2	1	1	2	0	2	1	3	3	2	3	1	1	3	3
%	100	100	100	100	0	66.7	33.3	100	100	66.67	100	100	100	100	100
No of Obs.	2	1	1	2	3	3	3	3	3	3	3	1	1	3	3

	QN14	QN15	QN16	QN17	QN18	QN19	QN21	Alc.	Fat	SNF	QN22	QN23	QN24	QN25	QN26	QN27
Freq.	0	3	0	1	1	0	1	0	0	0	0	0	0	2	1	1
%	0	100	0	100	33.3	0	33.3	0	0	0	0	0	0	66.67	33.33	33.33
No of Obs.	2	3	1	1	3	3	3	1	1	1	3	3	3	3	3	3

Annex III.9: Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Farmer Level (Nawalparsi District)

	Grass	Straw and Palate	QN1	QN2	QN3	QN4	QN5	FMD	HS/BQ	Other	QN8	QN9	QN10	QN11	QN12	Steel	Alm.	QN14	QN15	QN16	QN17	QN18	QN19	QN20	QN21	QN22
Freq.	15	6	15	13	12	6	15	6	3	9	9	15	15	15	15	6	10	15	15	0	13	4	12	1	15	0
%	100	40	100	86.7	80	40	100	40	20	60	60	100	100	100	100	40	66.7	100	100	0	86.7	26.7	80	6.7	100	0
No of Obs.	15	6	15	15	15	15	15	15	15	15	15	15	15	15	15	6	10	15	15	15	15	15	15	15	15	15

	No of Cow	No of Buff	Total	Max	Min	Dist. CC	Cow
Avg.	5	3.45	8.13	46.93	30.4	12.87	48.13
Max.	13	10	17	170	164	45	55
Min.	2	1	2	9	3	1	44
Range	11	9	15	161	161	44	11
SD	3.32	2.88	5.49	44.94	43.55	12.13	4.09
CV	0.66	0.83	0.67	0.96	1.43	0.94	0.08
Med	4	2	5	30	15	10	46
No of Obs.	15	11	15	15	15	15	15

Annex III.10: Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Collection Center (Nawalparasi District)

	QN1	QN2	QN3	QN4	QN5	QN8	QN9	QN10	QN11	QN12	QN13	Other	QN19	QN20	QN21	QN22	QN23	QN24	QN25	QN26	QN27
Freq.	2	2	2	3	3	2	3	1	1	3	3	0	3	0	3	0	0	0	2	1	1
%	66.7	66. 7	66. 7	100	100	66. 7	100	100	100	100	100	0	100	0	100	0	0	0	66.7	33. 3	33.3
No of Obs.	3	3	3	3	3	3	3	1	1	3	3	3	3	1	3	3	3	3	3	3	3

Annex III.11: Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Farmer Level (Kaski District)

	No of Cow	No of Buff	Total		Grass	Stra and Palate	Both	QN1	QN2	QN3	QN4	Water	QN5	FMD	HS/BQ	Other	QN8	QN9
Avg.	3.85	1.53	4.87	Freq.	10	15	15	15	12	11	15	1	14	15	15	5	11	15
Max.	28	19	28	Percent	66.67	100	100	100	80	73.33	100	6.7	93.33	100	100	33.33	73.33	100
Min.	0	0	1	No of Obs.	10	15	15	15	14	14	15	8	14	15	15	15	15	15
Range	28	19	27															
SD	7.46	4.87	9.01		QN10	QN11	QN12	Steel	Alm	QN14	QN15	QN16	QN17	QN18	QN19	QN20	QN21	QN22
CV	1.94	3.17	1.85	Freq.	14	15	14	6	8	15	14	0	10	6	9	1	13	1
Med	1	0	1	Percent	93.33	100	93.33	40	53.33	100	93.33	0	66.66	40	60	6.67	86.67	6.67
No of Obs.	13	15	15	No of Obs.	14	15	14	6	9	15	14	0	15	15	15	15	15	15

Annex III.12: Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Collection Center (Kaski District)

	Avg Col(ltr)	Cooling (ltr)	Storage(ltr)		Pvt. Dairy	Other s	Backu p	QN1	QN2	QN3	QN4	PM	QN5	QN8	QN9	QN1 0	QN1 1	QN1 2
Avg.	533.33	633.33	633.33	Freq.	3	1	0	3	2	1	3	0	3	2	3	1	1	3
Max.	700	1000	1000	%	100	100	0	100	66. 7	33.3	100	0	100	66. 7	100	100	100	100
Min.	200	200	200	No of Obs.	3	1	3	3	3	3	3	3	3	3	3	1	1	3
Range	500	800	800															
SD	288.68	404.15	404.15		QN13	QN14	QN15	Other s	QN1 8	QN1 9	QN2 0	QN2 1	QN2 2	QN2 3	QN2 4	QN2 5	QN2 6	QN2 7
CV	0.54	0.64	0.64	Freq.	3	0	3	1	1	0	0	1	0	3	3	3	3	3
Med	700	700	700	%	100	0	100	100	33.3	0	0	33.3	0	100	100	100	100	100
No of Obs.	3	3	3	No of Obs.	3	2	3	1	3	3	2	3	3	3	3	3	3	3

Annex III.13: Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Farmer Level

	Q1	Q2	Q3	Q4	Q5	FMD	HS/BQ	Other	Q8	Q9	Q10	Q11	Q12	Steel	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22
Freq.	5	5	4	5	5	2	3	0	4	5	5	5	5	6	4	5	1	0	1	0	1	5	3
%	100	100	80	100	100	40	60	0	26. 7	100	100	100	100	40	80	100	20	0	60	0	20	100	40
No of Obs.	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

	No of Cow	No of Buff	Total	Max	Min	Distance CC	Cow	Buff.
Avg.	2.4	2	3.6	21.8	12.6	22	52.5	63.33
Max.	4	3	6	40	28	40	55	65
Min.	1	1	2	9	2	10	50	60
Range	3	2	4	31	26	30	5	5
SD	1.1	1.0	1.8	16.6	12.78	12.55	2.89	2.89
CV	0.5	0.5	0.5	0.76	1.01	0.57	0.05	0.05
Med	2	2	3	10	5	15	52.5	65
No of Obs.	5	3	5	5	5	5	4	3

Annex III.14: Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Farmer Level (Surkhet District)

	Grass	Stra and Palate	QN1	QN2	QN3	QN4	QN5	FMD	HS/BQ	Other	QN8	QN9	QN10	QN11	QN12	Steel	Alm.	QN14	QN15	QN16	QN17	QN18	QN19	QN20	QN21	QN22
Freq.	5	3	5	3	2	6	5	6	3	9	9	5	5	5	5	6	2	5	5	0	3	4	2	1	5	0
%	100	60	100	60	80	40	100	40	20	60	60	100	100	100	100	40	66.7	100	100	0	60	80	80	6.7	100	0
No of Obs.	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	6	3	5	5	5	5	5	5	5	5	5

	No of Cow	No of Buff	Total	Max	Min
Avg.	2	5.75	4.71	22.1	10.3
Max.	7	19	26	100	50
Min.	0	1	1	4	2
Range	7	18	25	96	48
SD	2.83	8.85	9.39	34.84	17.58
CV	1.41	1.54	1.99	1.57	1.71
Med	1	1.5	1	8	4
No of Obs.	5	4	5	5	5

Annex III.15: Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Farmer Level (Kailali District)

	No of Cow	No of Buff	Total		Grass	Stra and Palate	Both	QN1	QN2	QN3	QN4	Water	QN5	FMD	HS/BQ	Other	QN8	QN9
Avg.	1	1.5	1.57	Freq.	1	5	5	5	2	1	5	1	1	5	5	5	3	5
Max.	1	2	3	Percent	20	100	100	100	40	20	100	6.7	20	100	100	100	60	100
Min.	1	1	1	No of Obs.	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Range	0	1	2															
SD	0	0.57	0.78	Freq.	QN10	QN11	QN12	Steel	Alm	QN14	QN15	QN16	QN17	QN18	QN19	QN20	QN21	QN22
CV	0	0.38	0.50	Percent	4	5	4	3	2	5	4	0	1	1	1	1	1	1
Med	1	1.5	1	No of Obs.	80	100	80	60	40	100	80	0	20	20	20	20	20	20
No of Obs.	5	4	5		5	5	5	5	5	5	5	5	5	5	5	5	5	5

Annex III.16:

Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Market (Dadeldhura District)

	QN1	QN2	QN3	QN4	QN5	QN6	QN7
Yes Count	0	0	0	5	4	0	0
Percentage	0	0	0	100	80	0	0
Count	5	5	5	5	5	5	5

Annex III.17:

Descriptive Statistics of Questionnaire Survey for CoP of Milk in Outlet (Kailali District)

	QN1	QN2	QN3	QN4	QN5	QN6	QN7	Pasteurized	Sterilized	UHT	QN9	QN10	QN11	QN12
Freq.	5	0	5	5	2	3	3	5	0	0	5	5	5	0
Percent	100	0	100	100	40	60	60	100	0	0	100	100	100	0
No of obs.	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Annex III.18:

Descriptive Statistics of Questionnaire Survey for CoP of Milk in Market (Surkhet District)

	QN1	QN2	QN3	QN4	QN5	QN6	QN7
Yes Count	0	0	0	5	4	0	0
Percentage	0	0	0	100	80	0	0
Count	5	5	5	5	5	5	5

Annex III.19: Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Market (Banke)

	QN1	QN2	QN3	QN4	QN5	QN6	QN7
Yes Count	3	1	3	2	4	2	0
Percentage	60	20	60	40	80	40	0
Total Count	5	5	5	5	5	5	5

Annex III.20: Descriptive Statistics of Questionnaire Survey for CoP of Milk in Outlet (Kaski District)

	QN1	QN2	QN3	QN4	QN5	QN6	QN7
Yes Count	4	0	3	4	4	2	0
Percentage	80	0	60	80	80	40	0
Couunt	5	5	5	5	5	5	5

Annex III.21: Descriptive Statistics of Questionnaire Survey for CoP of Milk in Market (Nawalparsdi District)

	QN1	QN2	QN3	QN4	QN5	QN6	QN7
Yes Count	4	1	3	4	4	2	0
Percentage	80	20	60	80	80	40	0
Couunt	5	5	5	5	5	5	5

Annex III.22: Descriptive Statistics of Questionnaire Survey for CoP of Milk in Market (Kavre)

	QN1	QN2	QN3	QN4	QN5	QN6	QN7
Yes Count	3	1	3	4	4	2	0
Percentage	60	20	60	80	80	40	0
Count	5	5	5	5	5	5	5

Annex III.23: Descriptive Statistics of Questionnaire Survey for CoP of Milk in Outlet (Chitwan District)

	QN1	QN2	QN3	QN4	QN5	QN6	QN7
Yes Count	3	2	2	3	4	1	2
Percentage	60	40	40	60	80	20	40
Couunt	5	5	5	5	5	5	5

Annex III.24: Descriptive Statistics of Questionnaire Survey for CoP of Milk in Market (Ilam District)

	QN1	QN2	QN3	QN4	QN5	QN6	QN7
Yes Count	5	2	5	5	3	0	0
Percentage	100	40	100	100	60	0	0
Couunt	5	5	5	5	5	5	4

Annex III.25: Descriptive Statistics of Questionnaire Survey for CoP of Milk Production in Market (Sunsari District)

	QN1	QN2	QN3	QN4	QN5	QN6	QN7
Yes Count	3	1	3	4	4	2	0
Percentage	60	20	60	80	80	40	0
Count	5	5	5	5	5	5	5

Annex IV: Lab Result for Microbiological Test

S.No.	Lab Code	Unit	Observed values		Sampling point
			Coliform /100ml	TPC/100ml	
1	M_{76}	counts/100 ml	>2400	TNTC	Kathmandu District
2	M_{77}	counts/100 ml	>2400	TNTC	
3	M_{78}	counts/100 ml	>2400	TNTC	
4	M_{79}	counts/100 ml	>2400	$28X10^6$	
5	M_{80}	counts/100 ml	>2400	TNTC	
6	M_{81}	counts/100 ml	>2400	$44X10^6$	Bhaktapur
7	M_{82}	counts/100 ml	>2400	$44X10^5$	
8	M_{83}	counts/100 ml	>2400	$28X10^6$	
9	M_{84}	counts/100 ml	>2400	$6X10^6$	Kathmandu
10	M_{85}	counts/100 ml	240	TNTC	
11	M_{86}	counts/100 ml	>2400	TNTC	
12	M_{87}	counts/100 ml	23	TNTC	Bhaktapur
13	M_{88}	counts/100 ml	>2400	TNTC	
14	M_{89}	counts/100 ml	>2400	TNTC	Kathmandu
15	M_{90}	counts/100 ml	>2400	TNTC	Lalitpur
16	M_{91}	counts/100 ml	>2400	$256X10^6$	
17	M_{92}	counts/100 ml	>2400	TNTC	Bhaktapur
18	M_{93}	counts/100 ml	>2400	TNTC	
19	M_{94}	counts/100 ml	>2400	TNTC	Kathmandu
20	M_{95}	counts/100 ml	>2400	TNTC	
21	M_{96}	counts/100 ml	>2400	TNTC	
22	M_{61}	counts/100 ml	>2400	$72X10^6$	Kathmandu District
23	M_{62}	counts/100 ml	>2400	$37X10^6$	
24	M_{63}	counts/100 ml	>2400	$88X10^6$	
25	M_{64}	counts/100 ml	23	$37X10^6$	
26	M_{65}	counts/100 ml	>2400	$132X10^6$	
27	M_{66}	counts/100 ml	>2400	$83X10^6$	
28	M_{67}	counts/100 ml	>2400	$41X10^6$	
29	M_{68}	counts/100 ml	23	$16X10^6$	Lalitpur
30	M_{72}	counts/100 ml	>2400	$12X10^6$	
31	M_{73}	counts/100 ml	>2400	$150X10^6$	
32	M_{74}	counts/100 ml	>2400	TNTC	
33	M_{75}	counts/100 ml	>2400	$87X10^6$	
34	M_{69}	counts/100 ml	>2400	TNTC	Bhaktapur
35	M_{70}	counts/100 ml	>2400	$204X10^6$	
36	M_{71}	counts/100 ml	>2400	$5X10^6$	
37	M_{36}	counts/100 ml	>2400	TNTC	Bhaktapur District
38	M_{40}	counts/100 ml	>2400	TNTC	
39	M_{41}	counts/100 ml	>2400	TNTC	
40	M_{42}	counts/100 ml	>2400	TNTC	
41	M_{43}	counts/100 ml	>2400	TNTC	
42	M_{44}	counts/100 ml	>2400	$254X10^6$	
43	M_{35}	counts/100 ml	>2400	TNTC	

44	M_{39}	counts/100 ml	>2400	TNTC	
45	M_{49}	counts/100 ml	>2400	$38X10^6$	
46	M_{50}	counts/100 ml	240	$7X10^6$	
47	M_{56}	counts/100 ml	>2400	$132X10^6$	
48	M_{57}	counts/100 ml	23	$53X10^6$	
49	M_{59}	counts/100 ml	>2400	TNTC	Lalitpur
50	M_{60}	counts/100 ml	>2400	TNTC	
51	M_{58}	counts/100 ml	>2400	TNTC	
52	M_{55}	counts/100 ml	>2400	TNTC	Kathmandu
53	M_{45}	counts/100 ml	>2400	$290X10^6$	Kavre
54	M_{47}	counts/100 ml	>2400	$108X10^6$	
55	M_{48}	counts/100 ml	>2400	$6X10^6$	
56	M_{37}	counts/100 ml	>2400	$268X10^6$	
57	M_{38}	counts/100 ml	>2400	TNTC	
58	M_{46}	counts/100 ml	>2400	$290X10^5$	
59	M_{51}	counts/100 ml	240	$12X10^5$	
60	M_{53}	counts/100 ml	23	$8X10^6$	
61	M_{54}	counts/100 ml	>2400	TNTC	
62	M_{52}	counts/100 ml	>2400	$70X10^6$	Kathmandu district
63	M_{22}	counts/100 ml	>2400	$68 X10^6$	
64	M_{23}	counts/100 ml	>2400	$19X10^6$	
65	M_{24}	counts/100 ml	>2400	$6X10^6$	
66	M_{25}	counts/100 ml	>2400	$14X10^6$	
67	M_{26}	counts/100 ml	>2400	$36X10^6$	
68	M_{27}	counts/100 ml	>2400	$204X10^6$	
69	M_{28}	counts/100 ml	>2400	$134X10^6$	Lalitpur District
70	M_{29}	counts/100 ml	>2400	$64X10^6$	
71	M_{30}	counts/100 ml	>2400	$43X10^6$	
72	M_{31}	counts/100 ml	>2400	TNTC	
73	M_{32}	counts/100 ml	>2400	$77X10^6$	
74	M_{33}	counts/100 ml	>2400	$43X10^6$	
75	M_{34}	counts/100 ml	>2400	$28X10^6$	
76	M_{3}	counts/100 ml	>2400	$106 X10^6$	Kathmandu
77	M_{4}	counts/100 ml	>2400	$122X10^6$	
78	M_{6}	counts/100 ml	>2400	$139X10^6$	
79	M_{1}	counts/100 ml	>2400	$608X10^6$	
80	M_{11}	counts/100 ml	>2400	TNTC	
81	M_{13}	counts/100 ml	>2400	$380X10^6$	
82	M_{2}	counts/100 ml	>2400	$130X10^6$	
83	M_{5}	counts/100 ml	>2400	$176X10^6$	
84	M_{7}	counts/100 ml	>2400	$12X10^6$	
85	M_{8}	counts/100 ml	>2400	$144X10^6$	
86	M_{9}	counts/100 ml	>2400	$328X10^6$	
87	M_{10}	counts/100 ml	>2400	$330X10^6$	
88	M_{12}	counts/100 ml	>2400	$208X10^6$	
89	M_{14}	counts/100 ml	>2400	$316X10^6$	
90	M_{15}	counts/100 ml	>2400	$340X10^6$	

91	M_{16}	counts/100 ml	>2400	TNTC	
92	M_{17}	counts/100 ml	>2400	TNTC	
93	M_{18}	counts/100 ml	>2400	$85X10^{6}$	
94	M_{19}	counts/100 ml	>2400	TNTC	
95	M_{20}	counts/100 ml	>2400	$384X10^{6}$	
96	M_{21}	counts/100 ml	>2400	$640X10^{6}$	