Food and Agriculture Organization of the United Nations

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Working paper

MILK VALUE CHAIN FOOD LOSS ANALYSIS: CAUSES AND SOLUTIONS

Case studies in the small-scale agriculture and fisheries subsectors

State of Andhra Pradesh – India

Manuscript

Milk value chain
Food loss analysis: causes and solutions

Case studies in the small-scale
agriculture and fisheries subsectors
In the State of Andhra Pradesh, India

Manuscript

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EXECUTIVE SUMMARY

This study covered the milk value chain in Andhra Pradesh and was carried out during April to August, 2016. Milk value chain was selected because of its importance to the food security and economy. Andhra Pradesh holds a strong position in milk production. About 80% of rural population of Andhra Pradesh practices a mixed crop and livestock based farming system. The state ranks fifth in terms of production and has a productivity higher than the national average. Dairy is also a major source of ancillary income contributing USD 15-25 every month (~20% of total monthly income) towards household income.

Case study methodology developed by Save Food was used in the research process, it focuses on identifying the symptoms and causes of food loss and finding relevant solutions, using a phased "4S" approach consisting of Screening (secondary research from documents, reports, and expert consultations), Survey, Sampling, Synthesis (root cause analysis and solution finding). Case study is just a one-moment recording of what is happening in a specific food supply chain in a specific season; next season and in a different location the situation can be very different again. The methodology also takes into account environmental, social and food safety aspects so as to be able to come up with well-rounded solutions. The strategy aims at using the results of the case studies to target opportunities for further detailed studies with wider scope that can lead to concrete investment programs and interventions.

Liquid milk value chain for Krishna and Ananthapur districts were selected for primary survey. Krishna district is the first district to implement operation flood program in Andhra Pradesh with organized cooperative structure, high milk productivity and orderly markets. Ananthapur district is characterized by low milk productivity, low market access and is highly dominated by unorganized market with major incidences of recorded adulteration in milk (Raw milk).

The study covered both formal and informal channels of milk supply chain. Formal trade is channelled through Milk Collection Centers (MCC)/private aggregators where milk is collected from farmers. Milk procured by MCC is further chilled at chilling center. At the processing center, the chilled milk procured from the various MCCs and chilling centers is pasteurized and packed. The packed milk is then marketed through private retailers/milk stations and consumer shops.

The results of the study suggest that losses during the early and middle stages of the food supply chain are higher than later stages. Gaps were observed at the farm level, milk collection center (MCC) and the chilling center leading to losses. Rejection of the milk at MCCs and chilling centers due to non-compliance with quality standards and spillage losses during transportation are major reasons for food loss. The root causes for the deteriorated quality are unhygienic management and milking practices, unethical practices like milk adulteration, lack of price incentives for good quality milk. The losses at the chilling center are also due to the late arrival of the trucks from MCCs, leading to higher microbial load and subsequent rejections. Food Safety is a major concern in this sector. Adulteration of milk, antibiotic residues and presence of aflatoxin M1 are important concerns in this sector. The environmental and social impact of the dairy sector is also briefly covered in the report. The report suggests potential solutions like the introduction of adulteration test kit at milk collection centers and capacity building which would help mitigate the above mentioned losses. These were discussed and validated at the stakeholder consultative workshop. Additional solutions that were suggested during the consultative workshop include milking a cow thrice a day instead of twice (this helps in emptying udder and reducing contamination) and forming village level committees, farmer groups to ensure instil practice of 100% testing.

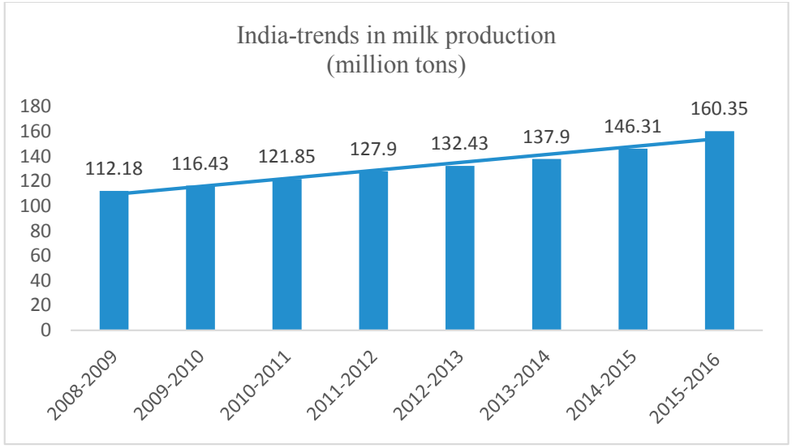
GLOSSARY

AI	Artificial Insemination
ALDA	Area Livestock Development Associations
AP	Andhra Pradesh
APDDCF	Andhra Pradesh Dairy Development Cooperative Federation
APLDA	Andhra Pradesh Livestock Development Agency
BMC	Bulk Milk Chilling centre
CEO	Chief Executive Officer
CLP	Critical loss point
CMP	Chief Minister's Package
CMP	Clean Milk Production
DDGS	Dried Distillers Grains -Soluble
DRDA	District Rural Development Agency
FSC	Food Supply Chain
FSSA	Food Safety and Standards Act
FSSAI	Food Safety and Standards Authority of India
GHG	Greenhouse gas
IDDP	Integrated Dairy Development Program
IDMC	Indian Dairy Machinery Company Ltd.
LLP	Low loss point
LR	Lactometer Reading
MACS	Mutually Aided Cooperative Societies
MCC	Milk Collection Centres
NDDB	National Dairy Development Board
NMPS	National Mission for Protein Supplements
QRs	Quantitative Restrictions
RKVY	Rashtriya Krishi Vikas Yojana
SNF	Solid Non Fat
UNICEF	United Nations International Child Emergency Fund
URAA	Uruguay Round Agreement on Agriculture
USD	United States Dollar
VBMPS	Village Based Milk Procurement System

1. MILK - INTRODUCTION AND BACKGROUND

A. STATUS AND IMPORTANCE OF THE SUBSECTOR; DEVELOPMENTS OVER THE LAST 15 YEARS

India is the largest producer as well as consumer of milk. India ranks first in milk production, accounting for 18.5% of world production, achieving an annual output of 160.35 million tonnes during 2015-16 as compared to 146.31 million tonnes during 2014-15 recording a growth of 9.59%. The per capita availability of milk in India has increased from 176 grams per day in 1990-91 to >300 grams per day in 2013-14. It is more than the world average of 294 grams per day during 2013[1]. This represents a sustained growth in availability of milk and milk products for the growing Indian population. Around 75 million families in rural India are engaged in dairying activities related to milk production constituting about 75 percent of rural households that on average own two to four animals. Therefore, dairying has become an important secondary source of income for millions of rural households engaged in agriculture.



The state of Andhra Pradesh ranks fifth in milk production and it is one of the most agriculturally advanced states in India. In Andhra Pradesh, 73% of milk produced comes from buffaloes, the remaining 27% produce comes from indigenous and crossbred cows. About 80% of rural population of Andhra Pradesh practices a mixed crop and livestock based farming system. Bovines constitute around 41% of the total livestock population and contribute to approximately 52% of the total livestock output. Milk yield in Andhra Pradesh (1206 kg per milch animal per year. Milch animal is one giving or kept for milk) is much higher than the Indian average (1039 kg per milch animal per year) and is increasing at a faster rate due to factors like good breeds, favorable government interventions, progressive farmers. Annual milk production in the state in the year 2014-15 was 9.656 million MT, which is 6.6%[2] of the national production. On average, dairy production adds around USD15-25 every month[3] (~20% of total monthly income) towards household income for households with 1 dairy animal.

[1] Data from Department of Animal Husbandry, Dairying & Fisheries and PIB article and Article at News18
[2] Data from National Dairy Development Board
[3] Income figure is estimated from primary survey and varies depending on many factors like self-consumption, access to fodder etc. Animal maintenance costs have been considered. Accounts for non-milking period of the cow and averages across a 5 year period. Average monthly income ranges from $ 95-115 and it comes from cultivation, livestock (dairy), wages from labor and non-farm business.

Table1: Cattle population census by NDDB 2012

State of Andhra Pradesh	Crossbred Cows Over 2½ years	Indigenous Over 3 years	Total Cows	Female Buffalo Over 3 years	Total Cows & Buffaloes
Population in 000's	1251	2228	3479	5763	9242

Andhra Pradesh's (AP) dairy sector is vibrant and built on experiential knowledge and resilient local cycles of production and consumption. It is categorized into formal and informal market. Even today, dairying in Andhra Pradesh is dominated by the "informal market" which is a market built by the small farmers, milk vendors, and consumers. In this informal marketing channel, the raw milk procured from farmers is distributed to end users by milk agents/vendors. The "formal market" is an organized market built by private dairies and cooperative milk production societies for producing pasteurized milk and other value added milk products.

According to estimates of year 2014-15, the districts of Guntur, Krishna and Prakasam ranked the highest in maximum productivity of milk in Andhra Pradesh. The total milk production from these top 3 districts is approximately 1.2 million MT per year per district and low productivity districts such as Ananthapur, Srikakulam, Vizianagaram and Kadapa account for 0.7 million MT per year per district.

OUTPUT I-1A: NATIONAL PRODUCTION INFORMATION OF THE SUBSECTOR - ACTORS AND PRODUCT FLOW

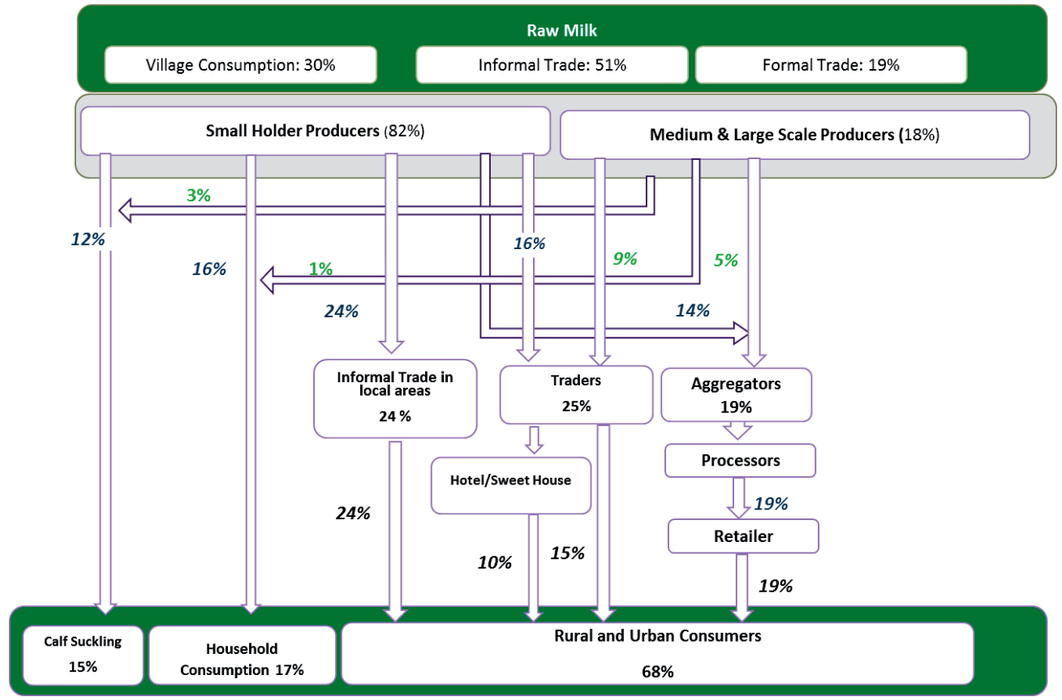
Four main marketing channels were identified in the A.P. dairy sector:

- Government cooperative
- Mutually Aided Cooperative Societies (MACSs)
- Private formal sector and
- Informal sector, including direct marketing (from farmers to consumers, hotels and sweet houses).

In this study, the dairy farmers are segregated into small (with <5 animals), medium (>5-10 animals) and large farmer (>10 animals). Smallholder producers are rural farmers who retain almost 30% of their produce for own consumption. The consumption within the smallholder producer comprises of the milk left for calf in the udder before & after milking and milk distributed directly in their neighborhood. The medium/large farmers do not rear calves and the majority of their livestock holding are heifer animals. The calves are sold in the market after weaning period. The major share of milk is marketed through informal channels. Some of the medium/large milk producers sell their milk directly to consumers in the village and nearby urban areas such as to restaurants, hotels, sweet houses, tea stalls or to a "dudhiya" (small milk trader) who goes to the city to sell fresh milk.

Milk marketed through formal trade is channelled through Milk Collection Centers (MCC)/ Private aggregators where milk is collected and farmers are paid based on fat percentage in the milk brought to the MCC. Milk procured by MCC is then taken to a chilling center where it is cooled to 4 degrees and then the chilled milk is transported to milk processing centers in insulated tankers with a capacity of around 20,000 liters. At the processing center, the chilled milk procured from the various MCCs and chilling centers is pasteurized in boilers. Pasteurized milk is then chilled and sent for packaging. The milk pouches are marketed through private retailers/milk stations and consumer shops.

The study of milk value chain in Andhra Pradesh estimates that, while 30% of the milk production in Andhra Pradesh is retained in the villages for rural consumption; 51% of the milk produced is still marketed through informal channels. Only 12% of the total milk produced goes through processing at the cooperative level and 7% of total milk produced goes for private sector processing. The milk is then sold majorly as pasteurized, packaged milk and in smaller proportions (around 25% of pasteurized milk); converted to value added products like curd, buttermilk, ghee, paneer and cheese.



OUTPUT I-1B: STATE PRODUCTION INFORMATION OF THE SUBSECTOR:

The most common way to market milk is through agents who deliver milk from door to door (mostly to monthly subscribers); or deliver them to small roadside stalls where milk is sold very early morning to consumers. Milk products are usually distributed through larger "distributors", "depots" or "clearing/forwarding agencies" who deliver milk to small neighbourhood *kirana* stores (grocery stores) and supermarkets, locally or in other states of India. The dairy sector survey findings in Krishna district, Andhra Pradesh is that 19% of milk and milk products are sold through formal channels. Either both agents and distributors can be exclusively or non-exclusively working for the dairy company (Model Dairy, Heritage and Arokya agents work on commission or on a monthly salary. Apart from the usual distribution channels (which they also use extensively), the largest private companies (Model Dairy, Heritage and Arokya) and some of the cooperative sector companies (Krishna milk union), sell their produce from branded milk parlors. However, in general, downstream vertical coordination is not well developed yet. Dairy companies usually outsource the sales of their products and do not have a lot of control/information over where their products are exactly being marketed. Even exports are channelled through distributors, especially by smaller companies, leaving very little specific information within the dairy company.

Average annual growth of milk production over the last 10 years (%)	7.9% for undivided Andhra Pradesh state 2005-2014	
Average cost of milk production (USD / ton)	480 USD/tonne	
Percentage of milk production	On-farm consumption 30%	Marketed 70%
Market product #1 Milk	9.1 million MT/yr.	4.9 billion $/y
Market product #2, Curd, Butter milk, Paneer	0.5 million MT/yr.	0.5 billion $/y
Number, sex of producers	Female 87,000	Male 1.5 million

The average milk yield per day per non – descript (not pure breeds) cow in three seasons was 2 kg, per crossbreed cow 7 kg, per graded Murrah buffaloes it was 6 kg. The above analysis reveals that the average milk yield is high in the case of crossbreed and graded Murrah compared to nondescript cow and buffalo. In the winter season, the highest average milk yield was observed in the case of cross breed cow and in the summer season, the lowest average yield was noticed in the case of graded Murrah buffaloes. In the case of nondescript cows and buffaloes, the average milk yield was same in three seasons.

OUTPUT I-1C: FOOD SAFETY MANAGEMENT MECHANISMS

Adulteration in milk is an important issue not only in the state of Andhra Pradesh but in the entire Indian subcontinent. A 2011 study (National Survey on Milk Adulteration) [4] conducted by Food Safety Standards Authority of India (FSSAI) across 33 states reports that 68.4% of the samples were found to be non-conforming to the standards. The non-conformity was highest with respect to fat % and SNF % suggesting a dilution of milk with water. The other non-conformity parameters include skimmed milk powder, glucose, and detergents. Andhra Pradesh was the state with one of the least non-conformity at 6.7% just behind Goa and Puducherry.

Along the milk FSC, it was observed during our study that various actors such as milk cooperatives at village level indicated that the testing of milk is carried out only at the processing centers and not at the time of procurement. Even at the chilling center, the milk with physiological changes when observed is taken into a testing lab and tests to detect adulterants is conducted only for those samples. The district of Ananthapur has high incidences of adulteration as there is a dearth of cooperatives/ milk collection centers and most of the milk is collected and given to private dairies by milk agents. Hence, in these cases, the testing is carried out only at the time of processing of milk. The milk that gets rejected at the processing and chilling centers is drained. The quality assurance laboratory in dairy firms both cooperative and private maintain records for the incidences of milk rejection due to adulteration. The testing is carried out in cooperatives / private dairy firms through standard testing protocols prescribed by FSSAI for different milk products like skimmed milk, whole milk, buttermilk and curd.

Food Safety and Standards Authority of India (FSSAI): The FSSAI prescribes specific standards for various types of milk. When milk is offered for sale without indication of the class, the standards prescribed for buffalo milk shall apply. The standards stipulate the Fat and (Solid Non-Fat) SNF percentage in the milk and milk products of cow and buffalo. FSSAI also has a stringent set of guidelines for the processing, packaging & labelling of milk, in order to ensure the best quality and safety of this essential food product for the consumers, many of whom are infants and children.

Antibiotics are used for prevention and treatment of diseases (major mastitis), maintenance of stable milk supply and as feed additives. Reasons of the appearance of veterinary drug residues in milk are indiscriminate use, non-adherence to withdrawal period, economic reasons/ignorance and lack off medication records. Antibiotics appear in milk during treatment and after cessation of treatment. Very few published reports are available on incidences of veterinary drug residues in milk and milk products. The majority of the farmers get their animals treated with antibiotics by veterinary surgeons/ stockmen. The common antibiotics used are tetracycline, gentamycin, ampicillin, amoxycillin, oxytetracycline, cloxacillin and penicillin due to the lower costs. Some doctors also use enrofloxacin, lincomycin, streptomycin and chloramphenicol for the treatment of certain diseases. Many dairies or cooperatives do not include testing of milk for antibiotic residues due to non-strict food laws for the same and lack of awareness on detection tests.

FSSAI standards on process hygiene criteria and food safety criteria are covered in their Microbiological Standards for Milk and Milk Products. In Food Safety and Standards (Contaminants, toxins and Residues) Regulations, 2011[5], FSSAI cover regulations regarding metal contaminants, crop contaminants and naturally occurring toxic substances, residues such as insecticides, antibiotic and other pharmacologically active substances. However, FSSAI is yet to notify residue limits for antibiotics & hormones in the milk. Aggregators and processors are the implementing organizations that need to uphold the FSSAI standards. However, there are gaps in reality. The limitations arise due to lack of strict regulation to monitor milk quality, threat of mycotoxins and antibiotic residues going unchecked, inadequate equipment to check milk quality and insufficient incentives to improve milk quality. Recently, FSSAI Testing report for the milk for the period from 1st April'14- 31st Mar'15 reported from Andhra Pradesh that 25 out of 271 samples were found to be adulterated & misbranded, resulting in to 6 criminal and 4 civil cases.

Mycotoxins are toxic substances produced by fungi. Aflatoxins are a type of mycotoxin, they are toxic compounds produced by fungi (Aspergillus flavus and Aspergillus parasiticus) that grow in soil, hay, decaying vegetative matter, crops. Aflatoxin enters food chain either directly through food consumed by humans or indirectly through the feed for animals. In milk supply chain, aflatoxin enters the supply chain through the food on which the cattle feeds. The aflatoxin gets into the milk secreted by the animal. These chemicals are toxic and carcinogenic, have negative impacts on liver and growth. Most countries in the world have limits for permissible levels of aflatoxin. In India, the maximum permissible level of aflatoxin is 30 µg/kg for food (FSSAI), 0.5 µg/kg of aflatoxin M1 for milk (FSSAI) and 20 µg/kg of aflatoxin B1 for feed (BIS) [6].

The testing facilities for aflatoxin is not widely available and is therefore not a common practice in the milk supply chain in Andhra Pradesh. In our field survey too, we were not able to do the test due to logistical constraints in moving sample between field site and testing lab in Hyderabad within the short time window for testing milk. A 2003 ICRISAT report[7] gives a better understanding of the aflatoxin levels by giving a breakdown of sample test results, 53% of buffalo milk samples and 34% of cow milk samples were found to have non-permissible levels of aflatoxin M1.

The commercial value addition in the dairy industry in India is low at present. One of the main reasons contributing to this is the aflatoxin problem. Companies such as Nestle who produce infant foods do not internally source the raw material for the same, instead they import the raw material for the infants products and restrict their processing to mixing and packaging in the country. Recently, new dairy companies are establishing themselves with a focus on milk production and upstream quality control (Milk Mantra in Orissa and Kiaro in Hyderabad are examples). These companies are able to market their products at a premium pricing (almost double the average market value). Further development of milk operations in the country with a higher focus on upstream quality can lead to the development of a dairy industry with better safety standards resulting in higher value added products.

Feed cutting machinery

32 liter vessels used for milk collection

[4] Executive Summary on National Survey on Milk Adulteration 2011 (snap shot survey) that was conducted by the Food Safety and Standards Authority of India

[5] Food safety and standards (contaminats, toxins and residues) regulation, 2011

[6] BIS, IS 2052 (2009): Compounded Feeds for Cattle

[7] Waliyar, F., Reddy, S.V., Subramaniam, K., Reddy, T.Y., Devi, K.R., Craufurd, P.Q., Wheeler, T.R. and Scudamore, K.A., 2003. Importance of mycotoxins in food and feed in India. Aspects of Applied Biology, 68, pp.147-154.

Controller	Control	Actual Situation in the FSC		Responsible agent
Government regulation and requirements	National food safety/ quality standards	Exists and applies to the whole FSC		Food Safety and Standards Authority of India (FSSAI) Quality assurance officers at district level
		Exists but not rigorous	X	
		Doesn't exist		
	Frequency of checking (None, Low, Medium, High)	Harvest	None	FSSAI
		Transport	None	
		Storage	Low	
		Process	Low	
		Market	Low	
	Obligatory registration of the food processing/ preparation unit	Exists	X	Licensing & Registration of Food businesses (FSSAI)
		Doesn't exist		
FSC actors - food safety management system	GHP/ GAP/ HACCP/ voluntary standards	GMP standards at processing; ISO certification standards	High	FSSAI
	Identification of potential hazards	Adulteration tests for Urea, Sweeteners, detergents	Low rigor in execution	FSSAI

B. INVENTORY OF ACTIVITIES AND LESSONS LEARNT FROM PAST AND ONGOING INTERVENTIONS IN SUBSECTOR LOSSES

Milk yields in Andhra Pradesh are higher than the Indian average and are increasing at a faster rate. Milk production in Andhra Pradesh has shown remarkable growth, but the potential role of dairy farming as a tool to increase household incomes, create rural employment and increase the regional competitiveness at producing milk are yet to be realized. For dairy to play such a developmental role there is an urgent need to provide the vast majority of small-scale dairy farmers with quality livestock services packaged in a manner that makes it affordable and has maximum impact on the key production and economic factors.

Keeping in view the immense potential available for encouraging dairy activity, Government of Andhra Pradesh has approved the ***State Milk Mission*** 2011-2015 with an outlay of USD 95.4 million The Mission includes induction of new animals, fodder and feed development, calf rearing, animal health programs, market development and capacity building of producers. The State Milk Mission involves active participation by way of funding from Banks.

Under Rashtriya Krishi Vikas Yojana (RKVY) & National Mission for Protein Supplements (NMPS), the Indian government in year 2014 introduced **Ksheerasagar scheme.** This scheme allots land for fodder development to small farmers and provides for feed supplements, vaccines and health care of pregnant cattle. To promote healthy rearing of calves, ***Sunandini*** program was implemented that includes provision of feed and health care services at subsidized rates to poor and marginal dairy farmers.

Under Chief Minister's Package (CMP) and Integrated Dairy Development Program (IDDP), upgrading of animal production units, strengthening of disease diagnosis equipment, supply of milch animals, fodder seed mini kits, calf-rearing program, strengthening of rural dispensaries and *Pavala Vaddi (interest at 0.25%)* for Milch Animal Rearing are being implemented.

Under a pilot project named INTEGRATED MILK PROJECT- HYDERABAD (Telangana State) AND VIJAYAWADA (Krishna district a milk supply scheme was introduced to organize milk collection from the villages, and process at processing plants in Vijayawada and Hyderabad.

The State government has entered into an agreement with the Milk Mission Project, University of Pennsylvania to enhance the milk production as well as cattle population, in June 2016. As per the agreement, the University experts will impart training to enhance the milk production, livestock population and transfer technology to increase cattle population through artificial insemination and milk production by feeding high quality fodder.

C. THE PROCESS OF POLICY MAKING AND CURRENT POLICY FRAMEWORK/ NATIONAL STRATEGY ON SUBSECTOR LOSSES AND BRIEF DESCRIPTION

The dairy industry is of crucial importance to India since more than 75% of the population is engaged in dairying as part of their livelihood. Dairy products are a major source of economic and nutritious food to millions of people in India and the only acceptable source of animal protein for large vegetarian segment of the Indian population, particularly among the landless, small and marginal farmers[8]. Dairying has been considered as one of the activities aimed at alleviating poverty and unemployment especially in the rural areas in the rain-fed and drought-prone regions. The progress in this sector will result in a more balanced development of the rural economy. Until 1991, the Indian dairy industry was highly regulated and protected through quantitative restrictions (QRs) and stringent licensing provisions for foreign trade.

Since the early 1990s, India embarked upon liberal policy framework, which was reinforced with the signing of Uruguay Round Agreement on Agriculture (URAA) in 1994. Following the success of dairy farming policy, the government has set up a dairy processing policy, reflected in the Milk and Milk Products Order, 1992. In addition, the Government uses a variety of import restrictions to protect its domestic dairy market. The milk processing industry is small compared to the huge amount of milk produced every year. Only 19% of all the milk is delivered to some 400 dairy plants. A specific Indian phenomenon is the unorganized sector of milkmen, vendors who collect the milk from local producers and sell the milk in rural and urban areas, and constitutes 65-70% of the national milk production.

Over the span of three decades, India has transformed from a country with acute milk shortage to the world's leading milk producer, with production exceeding 100 million tonnes in 2006. This phenomenal success is attributed to a Government initiative known as Operation Flood (1970–1996) and its intense focus on dairy development activities.

Operation Flood: Under Operation Flood, rural milk shed areas were linked to urban markets through the development of a network of village cooperatives for procuring and marketing milk. In addition, milk production and productivity were enhanced by ensuring the availability of veterinary services, artificial insemination (AI), and feed and farmer education. The investment paid off, promoting production gains of 4–5 percent per annum. The milk production increased from 23 million tonnes in 1973 to 145.70

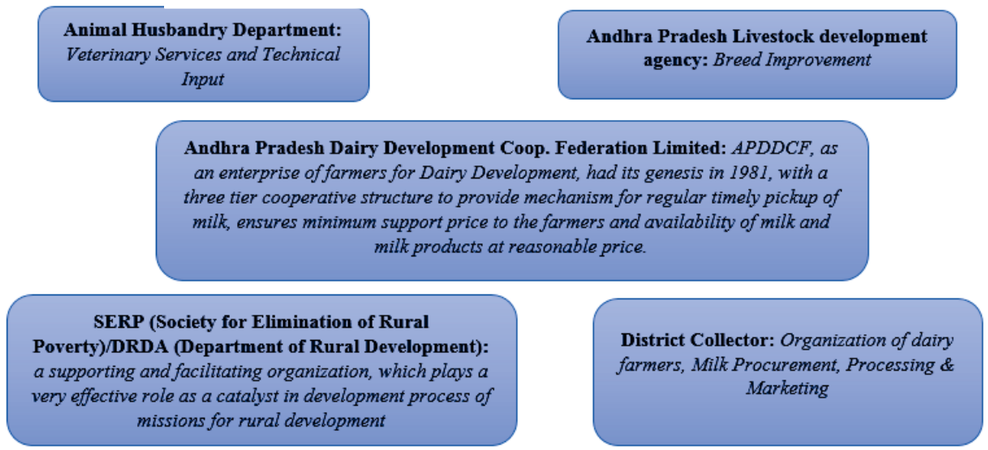
[8] Chapter IV Dairy Processing Industry in India

million tonnes in 2015. Under operation flood program, the government established National Dairy Development Board (NDDB) as a governing body regulating policies and programs and their implementation in the country.

National Dairy Plan: In a bid to boost milk output in the country and increase per-animal production of milk, the National Dairy Development Board (NDDB) announced 42 dairy projects with a financial outlay of 34 million USD in the year 2014[9]. The projects spread across 14 major milk producing states that account for 90% of the nation's milk production —including Andhra Pradesh. The projects were sanctioned under the National Dairy Plan-I, which was launched during March 2012 for implementation during 2011-12 to 2016-17. The newly announced projects cover activities like fodder development, ration balancing (feed management), village-based milk procurement, embryo transfer and import of bulls.

D. RELEVANT INSTITUTIONS AND THEIR ROLE IN TERMS OF POLICY, ORGANIZATIONAL STRUCTURE, MANDATE AND ACTIVITIES IN THE SMALL AND MEDIUM SUBSECTOR

Institutions involved in Dairy Development



Source: http://www.apddcf.gov.in/Links/vijaya%20booklet.pdf

Animal Husbandry Department, State of Andhra Pradesh: Veterinary Health care is provided by 5013 field Veterinary Institutions comprising under department of Animal Husbandry of

- 22 Veterinary Poly Clinics at District level manned by Deputy Directors as referral District hospitals providing specialized services in Gynecology, Surgery and Medicine with X-ray and inpatient facilities,
- 281 Taluka (district level governing body level Veterinary Hospitals manned by Assistant Directors,
- 1794 Veterinary Dispensaries manned by Veterinary Assistant Surgeons and
- 2916 Rural Livestock Units at Village level manned by Para Vets.

There are 22 Animal Disease Diagnostic Laboratories functioning, one each at district headquarters with facilities for disease investigation, quick diagnosis, vaccination and for mapping out diseases to render timely and effective control measures.

[9] Economic times article

National Dairy Development Board (NDDB) is an institution of national importance set up by an Act of Parliament of India. The main office is in Anand, Gujarat with regional offices throughout the country. NDDB's subsidiaries include Indian Dairy Machinery Company Ltd. (IDMC), Anand; Mother Dairy, Delhi; NDDB Dairy Services, Delhi and Indian Immunologicals Ltd, Hyderabad. NDDB promotes, finances and supports producer-owned and controlled organizations. NDDB's programs and activities strengthen farmer cooperatives and support national policies favorable to the growth of such institutions. NDDB has a strong presence and helps Andhra Pradesh develop their cooperative structures by making dairying an attractive source of livelihood for their milk producers through NDDB's "***Clean Milk Production***" (CMP) program implemented under Village Based Milk Procurement System (VBMPS)[10].

Andhra Pradesh Dairy Development Cooperative Federation (APDDCF), an enterprise of farmers for Dairy Development, was established in 1981, with a three tier cooperative structure, provides mechanism for timely pickup of milk and, minimum support price to the farmers, and ensures availability of milk and milk products at reasonable price to consumers.

Andhra Pradesh Livestock Development Agency (APLDA), an agency at state level works through 13 Area Livestock Development Associations (ALDAs) at the district level. ALDAs carry out the Cattle and Buffalo Breeding Operations in the state. ALDAs have promotional and developmental role, arranging services for cattle & buffalo development[11].

E. THE MOST IMPORTANT FSCs IN THE SUBSECTOR, SELECTION OF FSC

Andhra Pradesh is one of the largest milk producing states with high population of milch buffalo and a unique market structure. Buffalo milk being creamier and rich in SNF, minerals like calcium and potassium making it suitable for developing value added products such as cheese. Nearly 25% of the pasteurized milk is used to make value added products. Andhra Pradesh is strategically located in India having an easy access to all parts of the country and to milk deficit countries in South East Asia and Pacific region[12]. Major importers of milk and milk products are Bangladesh, China, Hong Kong, Singapore, Thailand, Malaysia, Philippines, Japan, UAE, Oman, and other Gulf countries with an export value of USD 152,047 million in 2008.

Krishna and Ananthapur districts are the two districts in the state of Andhra Pradesh that were selected for this study to assess the losses along the milk value chain. Krishna district is the first district to have a proper implementation of operation flood program in Andhra Pradesh with a proper cooperative structure and has high milk productivity and also known to have a commercialized and organized market structure. Ananthapur district has low milk productivity, low market access and is highly dominated by unorganized market with major incidences recorded for adulteration in milk.

The products manufactured by Andhra Pradesh dairy companies, can be roughly divided into three categories:

(i) Pasteurized milk (different categories based on fat percentage);

(ii) Short shelf life milk products: curd, cottage cheese (paneer), buttermilk/flavored milk, milk sweets;

(iii) Long shelf life products: ghee, skimmed milk powder (SMP), Ultra High Temperature Processed (UHT) milk.

The consumption pattern of milk and milk products have changed with the increase in the demand for value added milk products in other parts of the world. The most consumed products in this state are milk (75%), curd and buttermilk (15%) and other products like cottage cheese (paneer) and butter constituting 10%.

[10] National Dairy Development Board (NDDB)
[11] Government of Andhra Pradesh, Animal Husbandry Department
[12] Product - Market Identification for Exports of Milk & Milk Products

OUTPUT I-2a. FOOD SUPPLY CHAINS IN THE SUBSECTOR.

FSC #	Geographical area of production	Final product	Volume of final product (tonne/day)	Number, age and gender of smallholder producers	Market of final product, location, buyers	Project support
1	Krishna district	Raw Milk	3198	M-0.225 million F- 11800	Krishna district	NDP, NDDB
	Ananthapur District		1192	M- 9515 F- 1679	Chittoor district	NDP, NDDB
				No. of employees working in processing plants		
2	Krishna District	Pasteurized milk (19% of raw milk goes to processing units)	575.64	M- 7856 F-30	Krishna district	NDP, NDDB
	Ananthapur District		214.6	M- 220 F-60	Chittoor district	NDP, NDDB
3	Krishna district	Curd (20% of pasteurized milk	115.128	M- 40 F-160	Krishna district	NDP, NDDB
	Ananthapur District		42.9	M- 40 F-20	Chittoor district	
4	Krishna district	Butter milk(7% of pasteurized milk)	40.3	M- 40 F-160	Krishna district	NDP, NDDB
	Ananthapur District		15,02	M- 40 F-20	Chittoor district	NDP, NDDB

Table I-2a represents various FSCs in the milk value chain by the selected study regions like Krishna and Ananthapur districts, final products and market for the final product. Similar FSCs for the other districts of the state will make up the entire milk subsector of the state. Number, age and

OUTPUT I-2B. IMPORTANCE OF FOOD SUPPLY CHAINS (FROM I-2A) AT NATIONAL LEVEL

FSC #	Economic Importance	Generation of foreign exchange	Contribution to national food consumption	Contribution to national nutrition	Impacts on environment and climate change
1	3	1	3	3	2
2	3	3	3	3	2
3	2	1	1	1	1
4	2	1	1	1	1

Table I-2b assigns a score of 1 (low), 2 (medium) or 3 (high) to various milk and milk products and importance of the products based on the demand for the produce, consumption levels and economic importance of various milk products. In India, demand for milk and milk products is growing with rising incomes, population growth, urbanization and changes in diets. Shift in total milk production was observed after changes in export laws for various milk products that is clearly defined in the Table I-2b with respect to the generation of foreign exchange and national food consumption. Among the dairy exports, liquid Milk constituted 75% whereas other milk products like curd and buttermilk constituted 7% and 5% respectively. Milk products with well-defined quality characteristics and packaged in attractive containers are being marketed at different places. Most dairy food delicacies are value added products generating high profits.

OUTPUT I-2C. – ECONOMIC IMPORTANCE OF FOOD SUPPLY CHAINS (FROM I-2A) FOR SMALLHOLDER ACTORS –A GENDER ANALYSIS

Most of the farmers practice a mixed cropping system, an agrarian system that comprises both farming and livestock management. The sale of dairy products from this livestock becomes an additional source of income for the farmers. Around 70% of the farmers practice mixed farming in India. The income generated out of this mixed farming pattern is largely used for household expenses.

Dairying activities are distributed among men and women in the household and the roles remain fixed. The men indulge in deworming, grazing, purchase of fodder and medicines, visits to the dispensary and local markets, milking, transportation, marketing, selling and decision making parts of the dairy farming. Whereas women are allotted the jobs of cleaning, washing, feeding and fodder fetching etc. In a mixed farming scenario, the men look after both the cultivation and sale of milk, while women in addition to the household duties lend a supporting hand in both agriculture and dairying. The activities that are assigned to women are restrictive in nature owing to the larger social and cultural barriers and strong patriarchal power structure. Due to lower literacy rates amongst women, the restrictions on mobility and interactions and the historical notion of women's role of the "natural nurturer" makes the efforts income-less and limits the job to that of a supporting nature. The lower skills in technology and lack of access to updated mechanisms add to the non-income participation in chores.

This is not expected to have any impact on losses. However, women's access to income is constrained because of these restrictions. The household livelihood quality may also be constrained owing to a higher probability of money being spent on essentials if women have access to income. Around 20% of milk producers are expected to be women.

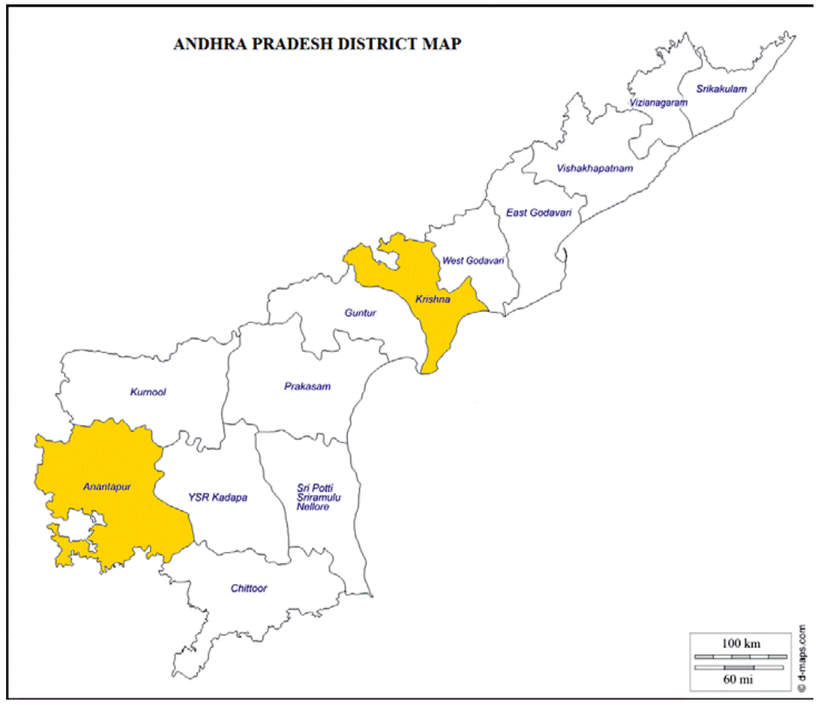
Volume measurement of milk procured

Milk vendor carrying milk cans

2. THE FOOD SUPPLY CHAIN - SITUATION ANALYSIS

A. DESCRIPTION OF THE SELECTED SUBSECTOR SUPPLY CHAIN, ITS LOCATION AND ESTIMATE OF THE QUANTITIES OF PRODUCTS

Krishna district has great potential for milk production with a substantial marketable surplus to tap. 90% of rural households in the district are directly involved in livestock production of which 40% are oriented towards dairy. The district is also a large consumer of milk and dairy products in the state and consumes surplus milk from other coastal districts. The integrated cooperative system is predominantly found in and around the district in the name of The ***Krishna Milk Union*** (a mutually aided cooperative society). In Krishna district, Kowthavaram (located at a distance of 40 km from city) and Nunna village (located at a distance of 10 km from city) have been selected for this study as both these villages have a high number of milk procurement centers, chilling centers along with high informal market presence.



The organized dairying in Krishna district commenced in 1965 by the state government with the assistance of United Nations International Children Emergency Fund (UNICEF). INTEGRATED MILK PROJECT, the milk supply scheme was a great success with its services to the producers and quality supplies to the consumers. The initial procurement network was gradually extended to all over the district within a span of 5 years. The extension of this scheme leads to establishment of APPDDCF that ensured integrated cooperative system exists in Krishna district.

OUTPUT II-3B: DETAILED DESCRIPTION OF THE FOOD SUPPLY CHAIN – BASICS

FSC stage	Geographical Location	Months of the year		Main Products	Quantity (tonne)	By-products	Quantity (tonne)	Duration/ Distance	Services	Food safety and quality controls applied by that part of the chain
		From	To							
Primary Production	Kowthavaram	April	March	Raw Milk	231.6				Feed cutter	N/A
Harvest (Milking)	Kowthavaram	April	March	Raw Milk	231.6			2 hrs.		N/A
Transportation	Kowthavaram	April	March	Raw Milk	185.2			200m-1km	Bicycle / Motor cycle	
Milk collection center	Kowthavaram	April	March	Raw Milk	130			3 hrs.	Cans	Check only for SNF% and fat %
Transportation	Gudlavalleru	April	March	Raw Milk	130			4 km	Truck carrying the 30 liter cans	
Milk chilling center	Gudlavalleru	April	March	Raw Milk	130				Silo; Chilling;	Quality check only if any physiological changes are observed
Storage	Gudlavalleru	April	March	Chilled Milk at 4-5^0 C	130			24 hrs.	Storage tanks at 4-5^0 C	
Transportation	Vijayawada city	April	March	Chilled Milk(4-5^0 C)	130			55 km	Insulated tanker	
Processing plant	Vijayawada city	April	March	Chilled Milk(4-5^0 C)	91	Curd, Buttermilk	39	24 hrs.	Pasteurization, storage, packaging, cold storage	Quality check for adulteration
Retail	Krishna district	April	March	Packed pasteurized milk	91	Curd, Buttermilk	39	24 hrs.	Cold storage 4-5^0 C	

B. DESCRIPTION OF THE EXISTING MARKETING SYSTEMS OF THE SELECTED SUBSECTOR SUPPLY CHAIN, FOR SMALL-SCALE PRODUCERS

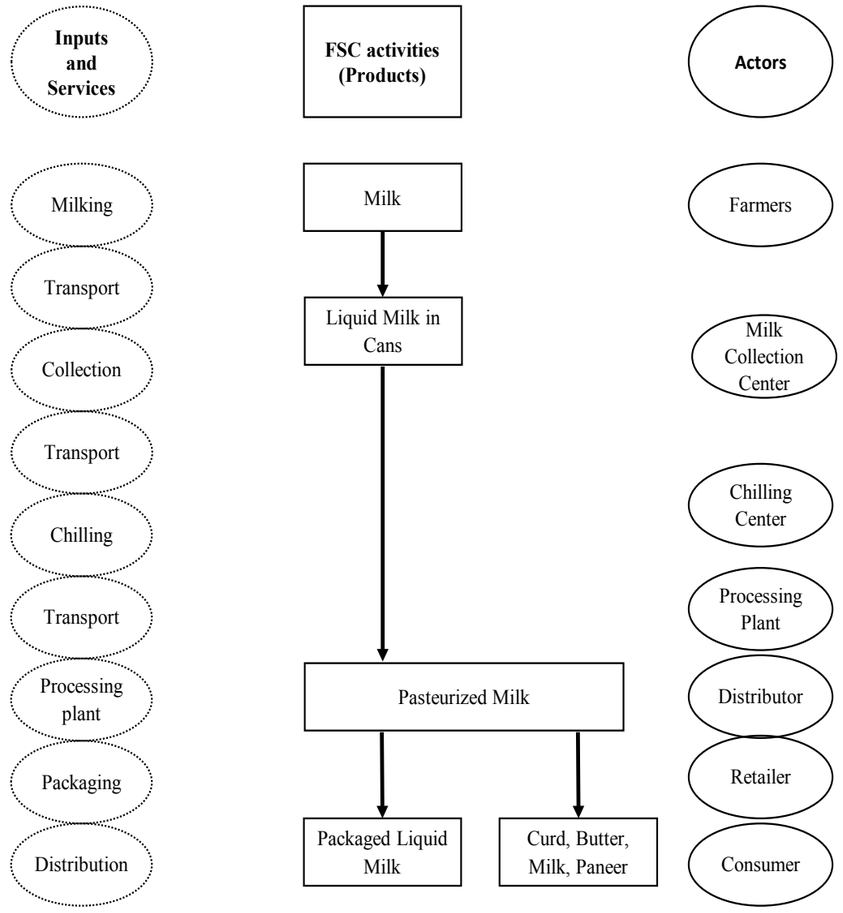
Market access to the small-scale producers has improved tremendously over the past 2 decades across the country. Rising incomes and changing lifestyles have improved the demand for milk and milk products. Four main marketing channels were observed in the Krishna district: the ***government cooperative***, the ***Mutually Aided Cooperative Societies*** (MACSs), the ***private formal sector***, and the ***informal sector***, including direct marketing (from farmers to customers, hotels and sweet houses). In this study, the milk value chain is divided into two markets- ***Formal or the organized*** market and the ***informal or unorganized*** market. Currently, both formal and informal markets operate competitively in the milk FSC. The formal sector is progressing strongly with the improved infrastructure in the form of roads, connectivity, cold chain and power supply.

The formal sector comprises of dairy cooperatives, owned and controlled by dairy farmers, and private aggregators owned and controlled by private companies. Both the cooperatives as well as the aggregators pay the dairy farmer based on the Fat and SNF percentage in the milk. This is calculated by using LACTOMETER READING (LR) machines at the Milk Collection Centers (MCC). Interestingly, the farmer decides whom to sell based not only on the price offered per liter of milk, but also on the trust factor. This is significant because of the perceptions built over the years on the faulty reading of these machines or manipulations by operators in these MCCs. Other factors that drive the decision to join MCC are access to subsidized feed, silage pits, loans, veterinary services at subsidized prices, and bonuses paid. Private aggregators are focusing more on processing and increasing the share of value added products to be able to pay competitive prices to the dairy farmers and retain them. From the MCCs, marketable milk is transported to chilling centers where it is stored under refrigeration at 4 degree centigrade and from there it is transported to processing plants in urban areas by trucks that are also insulated. However, the formal sector processes only up to 30% of the marketable milk.

The informal sector, which accounts for 70% of the marketable milk, is a short value chain of about 3-5 hours where the milk supply takes place from farmer directly to the end consumer within the neighborhoods. In rural neighborhoods, the consumers of milk are increasing faster than the producers. In urban areas, the consumers still prefer 'fresh' milk straight out from the dairy farm in comparison to pasteurized packaged milk thereby increasing the demand for the unpasteurized milk and increase in the milk trade through the vendors or milk agents. Seventy percent of the producers prefer to work with the milk agents rather than the formal sector as this is mainly driven by relationships of several years, convenience, ease of labor (since the vendors do the milking in the producer farm), extending microfinance (vendors provide short-term loans to the dairy producers) and fixed pricing irrespective of the fat and SNF percentage. The increase in the demand for unpasteurized milk in the urban areas is major as it is fresh, creamy, thickness of the curd and also the possibility of price recovery by the consumer if the milk is spoiled after boiling. However, in the informal sector, the chances of adulteration particularly with water are high, as there is no mechanism to check the quality of the milk reaching the consumer.

In the formal sector, the small business owners who trade in milk and milk products and operate from fixed establishments like shops and mandis (local market) from a designated spot or place have to obtain license/registration to carry out their dairy operations in these places, as per FSSAI order. In both the formal and informal trade, milk is collected in both the morning and evening.

OUTPUT I-3a: FLOW DIAGRAM OF THE SELECTED FSC



Manual milking

Milk sold at MCC through direct trade

C. FSC ACTORS' INVOLVEMENT AND THEIR BENEFIT

Case Study (Informal Trade):
Mrs. Lakshmi, an independent woman vendor from Nunna village of Krishna district, Andhra Pradesh starts her operations at 6:00 am each day and collects a total of 32 liters of milk from three dairy farmers of the village who are located at a distance of 2-3 km distance from her house. She has two sons and her husband is a paddy farmer. She represents informal trade of the milk FSC in this study. She carries 32 liters of milk at price of USD 0.54 per liter, selling it at housing complexes and markets at USD 0.62 per liter. Her activity starts in the morning at 6:00 am and ends at 1:00 pm in the afternoon. During interaction with her, it was noted that the amount of milk that is lost in her business is more during transport. This is especially true during summer owing to high temperatures, she loses around 2-3 liters of milk per day by the time she reaches the last consumer. The money earned from selling milk is spent mutually along with her husband on household expenses. When the consumer was asked the reason for opting for informal trade over formal, consumer stated that the milk brought by Lakshmi is fresh and no adulterants are added and there have been no complaints in the past 20 years. Even though she has been doing this informal trade since 20 years, the milk procurement has never exceeded 32 liters per day since she had limited access to the means of transport. Hence, informal trade is a value chain that ends within 3-5 hours after milking without any major food loss due to spillage

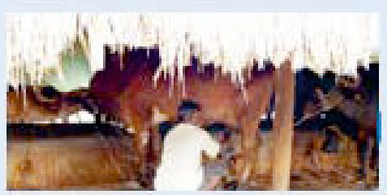
Mrs. Lakshmi milking at farmer's place at 6:30 a.m.

Mrs. Lakshmi carrying 32 liters from farmers' place to the bus stop at Nunna at 9:00 a.m

Mrs. Lakshmi carrying milk and boarding bus to Vijayawada at 10:00 a.m.

Case Study of a small dairy farmer with eight animals in Kowthavaram village, Krishna district:

Mr. Kamaleswar, a small farmer is completely dependent on dairy for his livelihood. He has 4 buffaloes, 1 cow, 2 heifers and 1 calf giving 20 liters per day (buffalo milk – USD 0.8 per liter and cow milk – USD 0.4 per liter), with 3 milking animals. The farmer reduced the number of cows at his farm, as the remuneration rate is low. He has 0.24 Ha of land where he harvests green fodder on his own. The cost of feed and fodder, including dry fodder and concentrates, is USD 415 per month. He gets additional income by selling additional cattle from his farm, up to USD 615 per animal in a year and dung to aqua farms, up to USD 120 per year. He receives 10% more in terms of bonus from the dairy cooperative. At any given point of time, he keeps only 10 animals. He is not happy with veterinary services available, thereby is forced to sell off one of his cattle due to repetitive breeding problems. The dairy cooperative provides emergency services, insurance, feed and nutritional supplements at subsidy. Farmer loses milk due to mastitis, though it is rare at his farm as he observes the animals regularly and takes precautionary measures. He feels that it is a labor-intensive job and he may be the last one of his generation to raise the cattle in his farm. He starts his day at 5 AM, feeds the animals and milks them around 7 AM. Then he takes the milk on his bicycle to the milk collection center in the village before 8 AM. They keep 2 liters of milk at home for self-consumption. He says that he will raise more animals if he gets interest free loans and if the trade is more profitable. He sells in the formal sector, as he trusts the Fat and SNF percentage measurement provided by the MCC, along with the bonus, he gets up to USD 0.07 per liter, paid once in 6 months.



D. CREATION AND INCOME GENERATION; ECONOMIC DATA OF THE FSC; ENVIRONMENT-RELATED INPUTS AND FACTORS OF THE FSC

OUTPUT II-4: DETAILED DESCRIPTION OF THE FSC – SOCIAL STRUCTURES

During the study, it was observed that women are mainly involved in cleaning, feed making and manure preparation. Whereas, men are involved in tasks such as land preparation, feeding, farming practices and animal health. Women participation is constrained by lack of skill set for quicker milking (it is also physically harder) and cultural barriers like limited education and responsibility of managing household chores. Most of the farmers practice manual feeding and milking instead of using feed cutting machinery and mechanical milking machines. At the MCCs, even though women procure milk and deliver at MCCs, the cash for the milk is collected by men of the household and only their name is registered at MCCs. Women are restricted for community participation activities at MCCs and men of the household take financial decisions as the society in these districts is still a male dominated and does not allow women to participate in MCC activities. There have been few cases where the financial decisions are taken mutually.

FSC STEPS	Involvement of Women		Involvement of Men		Who is mainly involved: women, men, children	Organization level of FSC actors[13]	Gender / social patterns Observations and remarks that explain the chosen qualifiers and/or give additional information
	Girls	Adult	Boys	Adult			
	Qualifier[14]						
Primary Production		2		4	Men	Household	Men are in charge of land preparation, feeding, farming practices and animal health. Women are involved in feed making, cleaning of animals and manure preparation. Limited technology access is the reason for less participation of women. Manual feeding practices instead of cutters and millers in progressive/ large farms.
Harvest (Milking)		1		4	Men	Individual	Cultural barriers like restrictions on women participation and travel to MCCs and lack of milking skill are limitations for women's participation.
Transportation		1		4	Men	Individual	Cultural barriers and lack of means of transport for women
Milk collection centre		1		4	Men	Cooperative	Cultural barriers, lack of means of transport with the women and willingness to participate in collection due to household works.
Transportation				4	Men	Cooperative	Male dominated stage because of the limited involvement of women in loading/ offloading
Milk chilling centre				4	Men	Cooperative	When technology is available, men are more often involved. Women are involved more in the cleaning and maintenance roles.
Processing plant		3		3	Women and Men	Cooperative	Women are involved in cleaning, packing, administrative and long duration works. Men are involved in machine operation, maintenance and managerial works.
Wholesale				3	Men	Cooperative	Dominated by men who deal with buyers at this level
Retail		2		2	Women and men	Individual	Traditionally dominated by women in local markets. Markets outside the community are led by men. Women are also involved as employees

[13] Individual/Household level/Cooperative

[14] (Qualify the equipment, conditions), not clear access to services and training, 4: excellent, 3: good, 2: moderately good, 1: bad.

OUTPUT II-5: DETAILED DESCRIPTION OF THE FSC – ECONOMICS.

Dairying is a labor-intensive activity. In a highly commercial district like Krishna, the labor costs for green fodder cutting and milking are high and the cost of production is much higher in Krishna when compared to other districts owing to lack of labor and high labor wages. The following input cost are taken from farmer to MCC, then MCC costs to the processing and manufacturing costs and these inputs are provided by Krishna Milk Union.

FSC stage	Main Products	Types of operations	Cost USD/kiloliter final product	Cumulative Cost USD/kiloliter	Value USD/kiloliter final product	Value-added / Margins USD/kiloliter	Remarks
Primary Production	Milk	Feed costs+ maintenance costs	420	420			
Harvest (Milking)	Milk	Manual – No cost		420			Marginal farmer does the milking on his own; no labor involved
Transportation	Milk			420	520	100	Transportation by walk or bicycle; no costs involved Sells at 520USD/kiloliter to MCC
Milk collection center	Milk	From farmer	520	520			
Milk collection and chilling	Milk	Manpower cost + Electricity	35	555			430 liters per day; 3USD electricity charge; 12 USD per day of manpower costs
Transportation	Milk	Fuel+Manpower	10	565			
Storage	Chilled milk	Electricity	0.7	565.7			
Processing plant	Packaged milk	Processing + Packaging + Manpower + Electricity + Maintenance	16	581.7			
Retail	Packaged milk	Transport + Maintenance	8.3	590	630	40	

OUTPUT II-6A: DETAILED DESCRIPTION OF THE FSC – ENVIRONMENT

PRODUCTION		**Quantity**	**Unit**
Tools/ Equipment	Manual Feed cutting is more prevalent Feed cutting machine (large farmers use this)	3 hours per day	200 units of Electricity per year[15]
Materials, Chemicals	Dry fodder	2.81	tonnes per year per animal
	Cereal Fodder	12	Tonnes per animal per year
	Feed supplements Cattle feed pellet. Rice DDGS (Dried Distillers Grains -Soluble)	50	kg per month per 10 animals
Energy	Electricity to run the Manual feed cutting machines and running the motor for water	24 hours	500 units of electricity
Water (cleaning and maintaining the cow)	Underground water/ Krishna River	15	liters per day
Land	Government land for fodder cultivation	1	acre of land per 2-3 animals per year
STORAGE		**Quantity**	**Unit**
Tools, Equipment, Facilities	Chill storages –electricity	24 hours	1800 units/year of electricity
	Insulated tankers	20,000	Liters capacity. 3 insulated tankers per chilling center
Materials, Chemicals	Hydrogen fluoride (cleaning of tanker)	300-400	ml per tanker
TRANSPORTATION		**Quantity**	**Unit**
Tools, Equipment, Facilities	Insulated cans Tankers	30 20,000	liters liters capacity
PROCESSING		**Quantity**	**Unit**
Tools, Equipment, facilities	Boilers, freezers	24 hours	25000 units/yr of electricity
	Manufacturing machine, conveyor belts, powder plant	24 hours	500 units/yr of electricity
Materials Chemicals	Water (cleaning) Nitrogen, hydrogen fluoride (cleaning of tanker)	1000 300-400	liters per day ml per tanker
Water	River water (maintenance of the plant)	1000 liters per day	
WHOLESALE, RETAIL		**Quantity**	**Unit**
Tools, Equipment, Facilities	Chilling storage facility	24 hours	50 units of electricity per year

[15] Source of electricity is government power supply. Most of the government supply is produced from thermal power plants. Around 15% is from renewable sources.

OUTPUT II-6B: FACTORS FOR THE ENVIRONMENTAL ASSESSMENT

The environmental, social and health impacts of livestock production in India have more positive implications than negative ones as the production system is still largely dominated by a rural-based crop livestock integrated smallholder mixed farming system. Methane gas emission is one of the major negative impact of cattle rearing due to enteric fermentation in bovines. Enteric fermentation is a digestive process by which carbohydrates are broken down by microorganisms into simple molecules for absorption into the bloodstream of the ruminant. A cow, on average releases between 70 and 120 kg of methane per year[16]. Methane is a greenhouse gas like carbon dioxide (CO_2). Therefore, the release of about 100 kg Methane per year for each cow is equivalent to about 2300 kg CO_2 per year. However, the contribution of methane from cattle have not been measured in this survey.

Factors	Description	Details
Type of production system	Mixed farming is a system of farming which involves the growing of crops as well as the raising of livestock.	Mixed farming systems in which dairy animals are fed on grass, crop residues and cultivated fodder and supplementary feeding is practised only when feasible. The wastes from animals are used as manure for crops.
Land degradation	Livestock depends on the green fodder as a major source of nutrition. Green fodder cultivation is labour intensive and fertilizers like urea are used to maximise the yield and this degrades the land	Degradation of common land is a concern due to low productivity
Sources of GHG emissions	Methane gas emission because of enteric fermentation of the cattle. Energy used for feed manufacturing and fodder cutting, transport, processing, storage, cold chain	Interventions in technology and awareness of balanced nutrition can reduce the production of GHG gases. Usage of solar energy in processing, storage and cold chain can significantly impact the production of GHG gases
Climatic factors	Fodder scarcity during summers and drought is the major constraint for livestock productivity	Water and fodder scarcity during summers and drought has driven small and marginal dairy farmers to distress sale of livestock
Consumption of water and energy	Water and energy consumption – a significant factor in milk and milk product processing The fodder development in India is mostly dependent on green water, as agriculture is mostly rain fed in India. The energy is derived from fossil fuels like coal and natural gas	Efficient processing technology and usage of solar power in chilling centres and processing plants can reduce the consumption of energy Currently the lack of infrastructure, technology, scale of operations hinder the viability and sustainability of these alternate power sources set up

[16] Abstract of Cattle And Global Warming, Adel A. Abdel-Ghani, Dept. of Anim. Prod., Minia Univ., Egypt

3. THE FOOD LOSSES - STUDY FINDINGS AND RESULTS

A. DESCRIPTION OF THE FSC: RISK FACTORS

In Andhra Pradesh, milk is an important and most consumed livestock product. It is a cost-efficient and nutritious source of protein, minerals and vitamins. The adulteration of milk has become a concern in last few years. Some producers add skimmed milk powder or sweeteners to increase the quantity and maintain the Fat and SNF percentage[17]. Moreover, there are several kinds of other pollutants such as industrial waste, vehicle discharge and heavy metals in the field resulting in accumulation of pollutants in soil, plant and animal systems, ultimately reaching the food chain, and affect human health. Table below proposes some of the risk factors that may contribute to the losses in milk supply chain.

OUTPUT II-7: FOOD LOSS RISK FACTORS. (FORMAL SECTOR)

Variable	Unit	Parameter: Relation to food losses	Value of variable
Veterinary Services	L/M/H	High – Veterinary service available; Medium – Para veterinary service available Low – none available full time Higher the service available, lower the loss due to mastitis and other animal diseases.	Medium
Production supply/ demand ratio	Ratio	If the production crosses demand, there are instances of milk holiday being declared in Andhra Pradesh during which milk is not procured from farmers and leads to increased losses.	< 1
Packaging materials and facilities	L/M/H	Low implying inefficient machinery can cause leaky pouches. Medium and Higher level machinery can function efficiently	High
Transport duration	L/M/H	Low is 2hr. Medium is 3-4hr; High is beyond 4hr.	High
Price incentive for quality and quality monitoring mechanisms	Y/N	If there are strict mechanisms to check adulteration and substandard milk and simultaneously price encouragement for good quality milk, then the losses will be low	N
Knowledge of FSC actors	L/M/H	Medium (higher awareness will reduce losses)	Medium

B. CRITICAL LOSS POINTS: TYPE AND LEVEL OF FOOD LOSSES IN THE SELECTED SUBSECTOR CHAINS, INCLUDING BOTH QUANTITATIVE AND QUALITATIVE LOSSES

Milk loss at the producer level is mainly due to the discarding of infected milk resulting from mastitis and other infections, however, this is not considered as food loss since it results in lower milk production and not technically a food loss. Spoiled and adulterated milk led to rejection of the milk at MCCs and chilling centers and this is considered as a food loss. It was observed that the major milk rejections occur during summer due to increased microbial content in milk owing to high temperature, which is compounded by time gap between milking and delivery at the chilling center. The sour milk thus gets rejected at the chilling centers after the acidity and pH test. Total quantitative loss in the milk supply chain is 5.8%. The critical points in the supply chain where improvements will contribute to reduced loss and improvement in milk quality are at: farm level, milk collection centre and the chilling centre.

[17] Milk Quality Testing at Rajasthan University of Veterinary and Animal Sciences, Bikaner

FSC # 1, Krishna, Liquid Milk			
Step in the FSC	**Expected Loss Points**		**Comments/Remarks**
	Quantitative	Qualitative	
Milk collection center to chilling center(CLP)	3%	N/A	Milk not reaching the chilling center in defined time due to inclement weather, early milking, mostly in summer; and mixing of sour milk, adulterated milk
Processing center (LLP)	1.3%	N/A	Flushing, acidity or adulterated milk, leaky pouches
Retail (LLP)	1.5%	N/A	Leaky pouches, discarded milk, unused milk, returned milk, consumer discarding before consumption

OUTPUT III-8A: QUALITY SCORING OF FOOD PRODUCTS

FSSAI standards for different classes and designations of milk in India: Ministry of Health and Family welfare (Food Safety and Standards Authority of India) Notification Dated 1st August, 2011 mentions below standards.

Class of Milk	Designation (Types)	Fat %	SNF %
Buffalo milk	Raw, pasteurized, boiled, flavoured, sterilized	5.0	9.0
Cow milk	Raw, pasteurized, boiled, flavoured, sterilized	3.5	8.5

III-8B: QUALITY ANALYSIS OF SAMPLED UNITS.

Unit evaluated	Type of damage (deterioration) if any	Potential cause and symptoms
Buffalo milk	NA	The Fat % of Buffalo milk measured at MCC and Bulk Milk Chilling center (BMC)is 6.8% and SNF % is 8.9%

III-9: PRESENTATION OF LOAD TRACKING AND SAMPLING RESULTS

Load tracking was carried out in Kowthavaram village situated 40 km from Vijayawada. Load tracking was done for the entire value chain of cooperative society model. Krishna Milk Union MCC at Kowthavaram village was taken as the beginning of the procurement with 5 liters of milk taken from a small farmer at 6:30 AM. The farmer took the milk to the MCC where these 5 liters of milk was tested for fat and SNF percentage. The fat was 6.8% and SNF was 8.9%. The 5 liters of milk was mixed with the milk procured from other farmers from the same and surrounding villages and the can (30 L) was thus sent to chilling center by 9:55 AM in insulated tankers/ aluminum cans. At the chilling center, the milk can with a capacity with 30 liters of milk was tested for Fat and SNF percentage. The fat was 5.7 % and SNF was 7.9%. From chilling center, the chilled milk is carried to processing center at 12:00 noon in insulated tankers (2000 L). At the processing center, the milk is tested for fat and SNF percentage, adulterants, toxins and acidity. The approved milk is taken in for processing where milk is pasteurized, then 75% of the milk is goes into the manufacturing unit for packaging of pasteurized milk, and the rest of 25% of the milk goes into processing for value added products. The product was tracked along the distribution pathway from procession unit booths, retailers and hotels.

A	Product	Buffalo Milk			
B	Event	Procurement (MCC to chilling centre)			
C	Duration of the event	2-3 hours			
D	Location	Kowthavaram MCC, Krishna district			
	Before the event	Experimental Unit	Volume of unit	No of units	Total volume
E	Load	Aluminium can	30 litres	3	72.7 litres of buffalo milk Fat % - 6.8%
		Value (score / %)	Observations / Causes		
H	Sample size	72.7 litres	No rejection of the from dairy farmer; the milk was observed for SNF and fat percentage and basic physical changes were observed		
I	Average quality score (0–10)	NA			
J	%age unfit (< 2)	0	NA		
K	%age low quality (2-6)	0	NA		
	After the event	Experimental Unit	Volume of unit	No of units	Total Volume
L	Load				72.2 litres
		Value (score / %)	Observations / Causes		
O	Sample size	72.7 litres	There was no spillage and no rejection of milk due to increase in microbial load or physiological/ physical changes in the odour, texture and colour of the collected milk Milk is subjected to organoleptic tests for any contamination/ adulteration; Fat and SNF % was also tested		
P	Average quality score (0–10)	NA			
Q	%age unfit (< 2)	0	NA		
R	%age low quality (2-6)	0	NA		
	Quantity loss	Value (%)	Observations / Causes		
S	%age lost (E-L)/E	0	On the day of load tracking, there was no milk rejection at the MCC or chilling centre. In 3B, the CLP was based on the observation and recordings provided by the MCCs and chilling centres during the year.		
	Quality loss	Value (%)	Observations / Causes		
T	%age lost (Q-J)	0			
U	%age quality reduction (R-K)	0			

NOTE: ***In case of suspicion arising out of organoleptic test, milk is subjected to acidity tests. The milk with high microbial load will be rejected and drained. The losses due to high microbial load are more in summer season due to high temperatures.***

SUMMARY

The major causes of milk losses are unhygienic management and milking practices, unethical practices like milk adulteration, lack of price incentives from government for efforts to improve quality, inappropriate equipment at the collection center to check the quality of milk. Farmers discard the milk from mastitis-infected quarter of the udder on the first day. The agent at MCC relies only on his ability to detect the adulteration or infection in the milk by checking the odor, color, fat and SNF percentage in the milk brought by the farmer. The adulterants used to increase the fat and SNF percentage are urea, ammonia fertilizers, starch and cereal flours, sucrose, glucose, salt, neutralizers and hydrogen peroxide. The incidence of clinical mastitis (the cow displays definitive symptoms of the disease like mild to severe inflammation of the udder and visible changes in the milk, such as small clots) is up to 10%, whereas subclinical mastitis (more likely to be caused by contagious pathogens[18]) can range up to 50% in cows and 20% in buffaloes, in India. The survey indicated that only 1% of the Kowthavaram village cattle population is affected with mastitis.

Farmers incur losses because of milk rejections at the collection centers due to microbial load and mastitis infection in cattle. The delays in delivery of milk to collection centers is also a critical cause of the high microbial load. This occurs during summer season, when the keeping quality of milk deteriorates faster. It is also noted to occur when the farmers combine leftover milk from the previous evening to fresh milk from the morning to avoid losses. Milk with odor from unclean vessels with contaminants/flavors is also rejected at MCC. At the chilling center, however, there are equipment to check the acidity and adulteration. In this case, suspected milk, after undergoing organoleptic tests, is subjected to acidity and adulteration analysis. The losses at the chilling center are also due to late arrival of the trucks from MCCs, leading to higher microbial load and subsequent rejections. However, this happens rarely, due to inclement weather, traffic jams or road blockages in monsoons.

Milk is received on the basis of volume at MCCs. The price is however determined by the fat and SNF % measured by LR machine. There is a potential economic loss for farmers if the Fat and SNF measurement is fraudulent due to manipulation of the machines. This warrants periodic checks and strict control measures by state regulatory authorities. Even though women farmers get the milk to the MCC, money is generally collected by their spouses once every 15 days. In some cases, women farmers also mentioned that the pricing is not equal and women farmers are paid less when compared with men who deliver milk at the MCCs.

In the informal sector, however, the losses are mainly qualitative due to adulteration with water by the milk vendors who supply to the consumer. The vendor adulterates the milk with water for purely commercial purposes. The consumer pays the vendor based on his perception of quality of milk supplied and also based on taste and yoghurt formation (Indian households mostly prepare yoghurt at home by fermenting milk). The farmers keep some milk for self-consumption and sell the surplus. If the consumer finds the milk curdled, then the farmer or the agent incurs losses. This occurs because of infected milk or delay in supply of milk due to inclement weather or transportation issues as the milk does not undergo chilling or processing in the informal sector. However, the practice in the Indian households is to boil the milk immediately after receiving from the milk vendor. This prevents the milk from spoilage. There is no formal mechanism to check the quality of milk in informal trade. However, stringent quality measures combined with sustainable livelihood mitigation measures can be introduced to prevent vendor level adulteration of milk.

The supply chain in informal trade is very short, where the vendors deliver milk collected from producers within 3-4 hours from milking. Women participation in milk trade is minimal whereas they are more involved in pre-production aspects of the value chain. The unique case study of the women vendor indicated in the report shows that her limitation to enlarge her business was due to lack of access to transportation.

In both the sectors, though microbial load is taken care of to a major extent by either processing or boiling, the threat of mycotoxins and antibiotic residues goes unchecked.

[18] Mastitis information on Animal Husbandry website of UK

Case study of Milk Agent at Dharmavarm, Ananthapur district

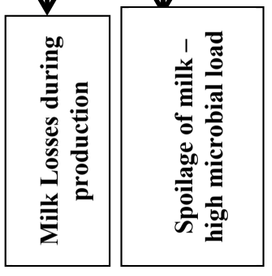
Ananthapur, being one of the low milk production district of Andhra Pradesh is also dominated by informal sector. Under informal market study, Mr. Narendra is a milk agent who collects the milk from the villagers and sells it to private dairy. He also works as the Gopala Mitra (private AI workers) appointed by the government. He stated that progressive/marginal farmers would adulterate around 30% of the procured milk and this leads to milk loss and the adulterated milk is drained. This adulteration would be identified by tracking down the milk can that is being spoiled repeatedly, the continuous adulterated milk is rejected, and farmer doing the activity will be subjected to punishment. The adulterants include toxins, fat mixers; and some instances Fevicol (glue) mixed with milk to increase the thickness of the milk According to milk trader, the productivity of animals in Ananthapur is low because of the lack of knowledge about AI and other veterinary services. Hence, Ananthapur needs ways to create access to AI technology to small/marginal farmers

C. THE CAUSES OF THESE LOSSES AND IDENTIFIED (POTENTIAL) LOSS REDUCTION MEASURES

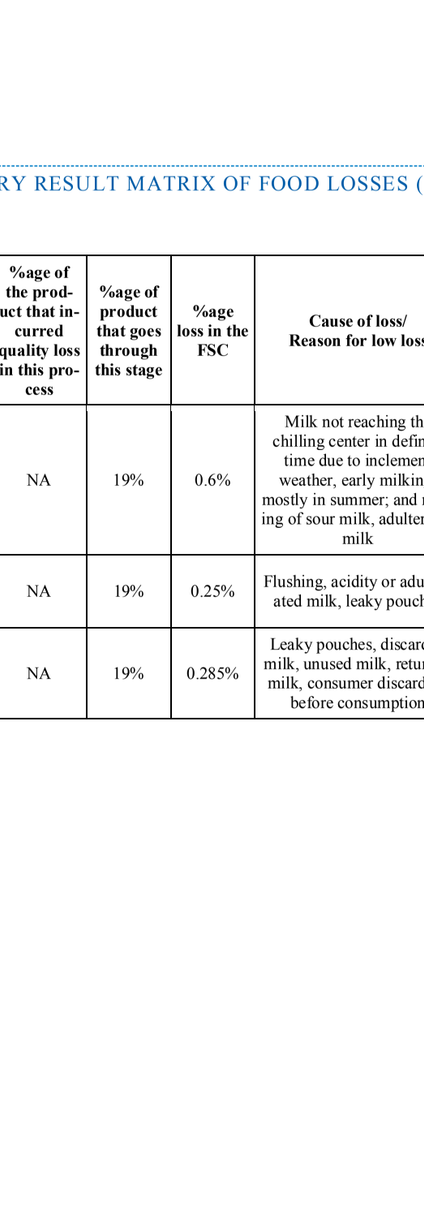
OUTPUT IV-1: CAUSE FINDING DIAGRAM.DATA FROM PRIMARY SURVEY

In the below diagrams, blue font indicates the selected feature.

1. Food loss assessment methods have revealed a batch of food products containing *losses or product of low quality*.



2. Identify and describe the *symptoms* that lead to this quantitative/quality loss.

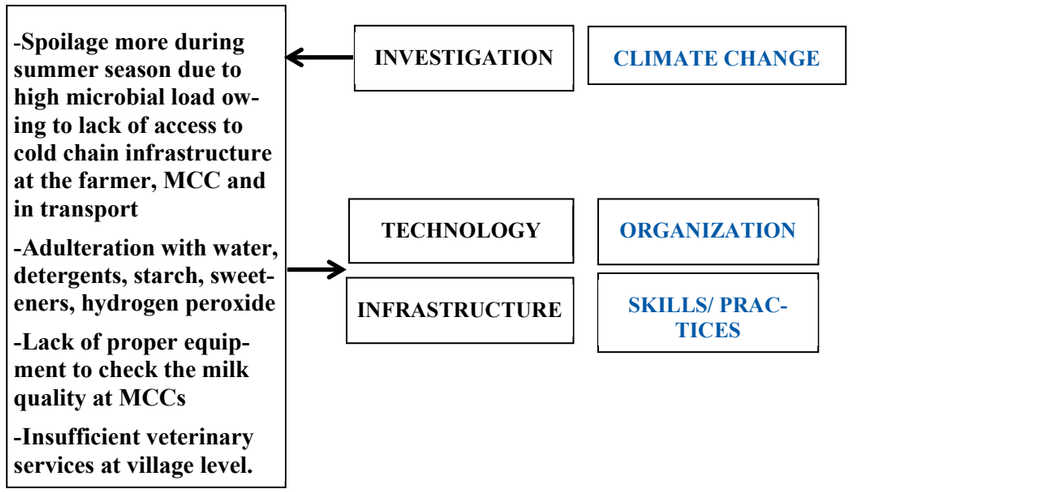


3. Verify the possible *causes* by consultation of experts and literature, and by on-site investigation.

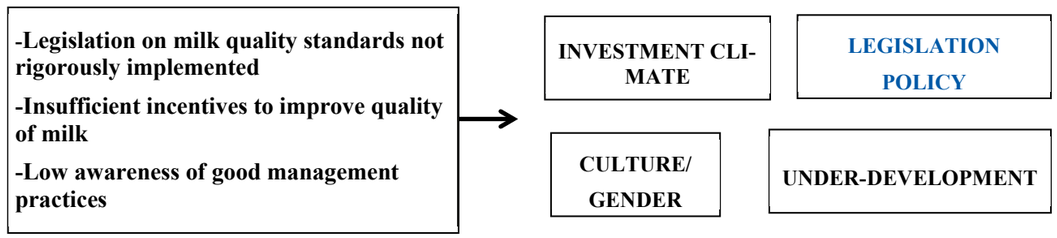
OUTPUT III-10: SUMMARY RESULT MATRIX OF FOOD LOSSES (FOR KRISHNA DISTRICT)

FSC stage/ process	Type of loss Qn./Ql.	%age lost in this process Quant	%age of the product that incurred quality loss in this process	%age of product that goes through this stage	%age loss in the FSC	Cause of loss/ Reason for low loss	Reduced market value	CLP / LLP	Destination of food loss	Impacts on the environment/climate change/natural resources	Impact/ FSC actors affected (men / women)	Loss perception of FSC actors (men / women)	Suggested solutions
Milk chilling/ collection centers	Qn	3.5%	NA	19%	0.6%	Milk not reaching the chilling center in defined time due to inclement weather, early milking, mostly in summer; and mixing of sour milk, adulterated milk	NA	CLP	Discarded or self-consumption	Food losses in milk will further put additional burden on the precious resources like water, energy and land (fodder)	Collection/ chilling centers	High	Adulterant test kits, capacity building
Processing center	Qn	1.3%	NA	19%	0.25%	Flushing, acidity or adulterated milk, leaky pouches	NA	LLP	Discarded		Processing center	Negligible	
Retail	Qn	1.5%	NA	19%	0.285%	Leaky pouches, discarded milk, unused milk, returned milk, consumer discarding before consumption	NA	LLP	Discarded		Retailers/ Consumers	Negligible	

4. Identify the *real cause* of the low quality and subsequent food loss.



5. Find the underlying *reason* for the cause, why the problem hasn't been solved yet.



D. LOW LOSS POINTS, AND GOOD PRACTICES LEADING TO LOW FOOD LOSSES

The farmer to MCC linkage has improved over the years to become a LLP due to increased market and logistics access. Similarly, at the retail end also there used to be damages and leakages. But over the years, it has become LLP due to improved logistics, retail point chillers.

Milk losses in the supply chain have come down significantly in Andhra Pradesh due to improved market access through integrated cooperative society model to the small and marginal dairy farmer. The increasing demand for milk and milk products ensured that there is healthy competition for procurement of milk among dairy cooperatives and private aggregators. This leads to improved infrastructure facilities like MCCs and chilling centers even at remote rural locations. Improved rural connectivity with better roads and transport facilities also ensured that the milk reaches in time to the chilling centers in the formal sector and consumers in informal sector.

Liberalization of the economy in the 1990s and improved ease in licensing of dairy industry lead to increased investments by private players and dairy cooperatives in the formal sector, thereby improving the efficiency of the processing technology and improved cold chains during distribution and better storage facilities at the retailer points. However, there is still room for improvement.

Dairy cooperatives in the formal sector are also providing veterinary services, extension activities and subsidized feed and fodder to their member farmers. This has reduced the food losses to a significant extent at the production level, though it has to reach all producers.

Case study of MCC at Kowthavaram, Krishna district that procures milk for a Dairy cooperative

MCCs Secretary and his assistant manage the Kowthavaram MCC. The MCC also has two directors who are selected on a rotational basis from the active dairy farmer members. The MCC has 210 members out of which only 50 are active (who deliver milk at least 180 days and 180 litres in a year). However, 200 farmers, including members and non-members, deliver milk at MCC. The farmers belong to cross section of castes and classes in the village. Overall, there are 800 cattle in the village, with 400 currently in milking.

The MCC procured 231644 litres in 2015-16, up by 7% from previous year, attributed to better conception in cattle and better rainfall providing access to more green fodder. The amount disbursed to the farmers is USD 121,793. MCC also claims that the procurement of milk increased at their society mainly because of increased trust after setting up of SNF percentage and Fat percentage testing equipment. MCC estimates that more than 500 litres every day is still sold in informal sector from the village through milk vendors due to distance, convenience – as the vendor himself milks the animal in the farm, relationships developed, fixed rate irrespective of Fat percentage and microfinancing facility offered. MCC operates on a cooperative model, where they have disbursed up to USD 0.077 per litre of milk as bonus to the members, from the profit generated. MCC also provides feed, feed supplements and insurance on subsidy to the farmer members.

September to March is the flush period and March to August is the lean period wherein the production levels vary up to 50% of the flush season. Overall, on an average 30% of the milk procured is sold at the MCC itself to the buyers within the village. Some of the buyers are dairy farmers who used to rear cattle before but sold off due to non-availability of labour and improper veterinary services.

The farmer is given voucher upon receipt of milk, stating Fat and SNF percentage and volume of milk. The Fat is measured using Gerber test by **Butyrometer**. SNF is measured using a centrifuge and the level of sedimentation in the centrifuge tube. Based on experience and fat percentage reading, milk will be rejected if found to be deviant in colour or odor. The rejection at this MCC is mainly due to smell or addition of stored milk. Milk procured is transported in cans to Gudlavalleru chilling centre, which is 9 km away, by 9 AM. Sometimes, if the van does not reach the dock in time or milk becomes sour by the time it reaches the chilling centre, there will be rejection at the chilling centre. Overall, the losses at this MCC were up to 1-1.5%.

4. THE FOOD LOSS REDUCTION STRATEGY-CONCLUSIONS AND RECOMMENDATIONS

A. IMPACT OF FOOD LOSSES IN THE SELECTED FSC.

The following are the observations and conclusions made after surveying various stakeholders in milk value chain:

OBSERVATIONS:

1. Quantitative losses at the production level affect the socio-economic lifestyle of the small and marginal dairy farmers. There are losses in production that go unrecorded due to inadequate nutrition and poor conception rates leading to non-realization of the genetic potential of the dairy cattle. The small farmer doesn't perceive these losses due to lack of awareness. On the other hand, lack of timely veterinary services and improper management practices lead to milk losses due to mastitis and other reproductive problems. Low productivity and high input costs including labor are driving many dairy farmers away from the industry. This may have a long-term negative impact on country's milk production. These losses technically do not form part of milk supply chain food losses since they are factors before the milking. Adoption of portable milking machines and capacity building measures for the farmers may help in reducing these losses.
2. Rejections at the MCCs and chilling centers due to spoilage of milk in case of high microbial load affect the dairy farmer as well as village cooperative society on the economic front. Lack of awareness and unhygienic milking and cleaning practices lead to high microbial load in the milk. Unviable MCCs may lead to closure of the unit, which will deprive the small dairy farmers of proper market access.
3. Faulty or manipulated LR machines, used for measuring fat and SNF in the MCCs, result in loss of trust in the formal sector forcing the farmers towards the informal trade, where they are subject to the pressures by the middle man. It is observed that the farmers in the lower strata and women feel that they are the ones who are subjected to this discrimination more.
4. The labor intensive dairy industry, including milking, fodder cutting and transporting, keeps the woman restricted to cleaning and supporting roles in the back yard dairy farming. Even the woman labor involved in medium and large dairy farms are recruited to mainly undertake the cleaning and farm maintenance roles. Lack of awareness with regard to nutrition and management practices also is a challenge for the woman dairy farmers.
5. Due to high input costs, labor intensive work and losses in milk supply chain, the dairy farmer is also not able to grow socially in the hierarchy. The profession is not looked up as a decent, respectable one in the rural community. Adoption of modern technology in milking and management may alleviate this problem.
6. Adulteration of milk, when detected at the MCCs and chilling centers leads to rejection of the lot resulting in quantitative and economic losses. In the case of the informal sector, it leads to qualitative losses in the nutrition of the milk to the consumer. This is mainly a result of unethical practices for illegal profiteering motives. Lack of strict monitoring and punishment allow these practices to continue unabated. However, left unchecked this has potential health hazards to the huge milk consuming population of India, particularly to children. Further, the high prevalence of adulteration also potentially prevents the milk from entering higher value processing chains. Adulteration in some cases happens with the connivance of the people in charge of MCCs. Constant monitoring of the testing equipment by the Dairy cooperatives has reduced these practices in the FSC, though not completely eliminated. This is substantiated by the increasing procurement volumes in the formal sector in Krishna district over the last 3-5 years, which is attributed to the increasing trust in the system.
7. Losses in the milk supply chain also may lead to a more skewed demand to supply ratio, thereby forcing the country to import milk to meet the increasing demand for milk and milk products. Even the negative perception about quality of milk available, may also lead to consumers opting for other protein and nutrition sources.
8. A large number of rural families depend on the dairy industry, both for self-sustenance wherein milk produced in the backyard farm is used for consumption and as an assured source of income to support the income from agriculture farming or manual labor. Losses in the milk supply chain will not only lead to malnutrition at the producer family level but also deter the socio-economic growth of a large number of marginal dairy farmers.
9. Inadequate milk procurement due to losses in supply chain may also affect the sustainability of dairy cooperatives and private dairies. This can have a potential impact on the future investments by private industry and other large players in infrastructure and processing.
10. Environment aspect: All sites visited had operations based on (fossil fuel-based) grid connected generators. Renewable energy such as solar power is not deployed anywhere and energy efficiency measures were also not in place. However, most actors expressed that they would consider solar power as a potential energy source for the future, on the condition of government subsidies. Biogas plants have also been implemented at household level in the region but have been a failure to a large extent. The main reason was reported to be maintenance constraints and operational limitations, such as insufficient manure. As for technology needs, especially cold storage, no one reported a need for improved cold chains to increase efficiency or reduce milk losses in the value chain.

B.FOOD LOSS REDUCTION STRATEGY

FOOD LOSS REDUCTION MEASURES

PORTABLE ADULTERANT TESTING KIT:

1. ***Formal Sector:*** Cooperatives supported by the government should provide adulterant testing kit at every MCC to ensure milk quality assurance. These societies will also be responsible for creating awareness among the farmers regarding the milking time, which will, in turn, reduce the spoilage of the milk by the time, it reaches the chilling center. Training the district's dairy industry players like cooperatives and private dairies on hygienic milk handling and quality testing including the use of standardized equipment and reagents. Enhanced industry regulation to carry out quality surveillance of milk for increased compliance to standards through training of dairy inspectors, procuring of inspection tools and setting up a regulatory laboratory will improve the quality and quantity of the produce and reduce the losses.
2. ***Informal Sector:*** Establish adulterant testing centers in 10 villages where trained women can carry out the quality check for the milk that goes through informal sector. Para-veterinarians / technicians can train the women on the protocol of adulterant testing in milk. Self-help groups and Panchayat (village council) activities supported by government will manage these centers and reduce the losses in their area of operation.
3. International Crops Research Institute for the Semi-Arid Tropics(ICRISAT) have devised a fast, simple and affordable test kit for detection of aflatoxin that uses a competitive enzyme-linked immunosorbent assay (cELISA) to rapidly detect the presence of aflatoxin. The new detection kit claims to cut the cost of testing to $1 per sample. The suitability for milk and widespread practical application of this in milk chilling centers need to be studied.
4. Other important measures in the right direction that are already in Andhra Pradesh Government's plan[5] are to strengthen the food quality testing laboratories with high precision instruments to not only test for aflatoxin but other toxic contaminants; promote IPM to reduce high pesticide levels; and promote soil test-based fertilizer management to reduce nitrate levels and improve plant nutrient contents. The introduction of a quality certificate to certify the product to be aflatoxin free would help in promoting knowledge among consumers and supply chain actors; help farmers to

get a better market price for better quality product; and promote value added products in the dairy supply chain.

In addition to above adulterant test kits, continuous capacity building of all actors in the milk supply will help in reduction of losses across the supply chain. The capacity building should target all aspects of milk production from knowledge of good animal feeding, animal health maintenance and healthcare services (esp. treating and managing mastitis), time required between calving and sale of milk, milking and handling practices.

COST-BENEFIT ANALYSIS OF THE FOOD LOSS REDUCTION MEASURES

OUTPUT IV-2A: BUDGET CALCULATION FOR FOOD LOSS REDUCTION THROUGH ADULTERANT TEST KIT

	ITEM	VALUE	UNIT
a	Annual milk production in Kowathavarm villages	414,144	L
b	Total milk production of 10 villages	3,106	MT/yr.
c	Product value	538	$/MT
d	Total product value	1,671,028	for 10 villages
e	Loss rate	3	%
f	Anticipated loss reduction	1	%
g	Cost of intervention	4,620	Adulterant test kits in 10 villages @1 per village @$462/kit
h	Depreciation	10	years
i	Yearly costs of investment	462	$/yr….. (g/h)
j	Yearly costs of operation	1,000	$/yr.
k	Total yearly costs of solution	1,462	$/yr…. (i+j)
l	Client costs per ton product	0.47	$/MT/yr…. (k/b)
m	Food loss	93	MT/yr…. (b*e)
n	Economic loss	50,034	$/yr…. (c*m)
o	Loss reduction	31	MT/yr….(b*f)
p	Loss reduction savings	16,678	$/yr….(o*c)
q	Total Client costs	1,462	$/yr….(k)
r	Profitability of solution	15,216	$/yr…..(p-q)

This intervention is planned for implementation in 10 villages where government supported women cooperative society checks milk samples. Post testing, certified milk will reach either consumer or processing units. This will ensure loss reduction and quality assurance as well.

ADDITIONAL RECOMMENDATIONS:

Usage of Solar technology at chilling centers to reduce the input costs: Use of solar energy has great commercial scope in the dairy processing operations. Solar based refrigeration system for milk cooling at village level society, solar based vapor absorption system for milk and milk related cooling operations, room conditioning for cold stores and packaging rooms for milk and milk products, will reduce peak load requirements. Solar-based refrigeration can be implemented in cooperative society for nine chilling centers of Krishna milk union in Krishna district.

BUDGET CALCULATION FOR SOLAR IMPLANTS (INTERVENTION #2)

	ITEM	VALUE	UNIT
a	Milk production	45,625,000	liters/ year in cooperative society
		45,625	tonnes/ year
b	Value	24,546,250	$/year (at $538/t)
c	Chilling plants	9	
d	Cost of electricity used to run all chilling centers	80,000	$/year
e	Cost of intervention	9,230	$
f	Total cost for all chilling centers	83,070	$
g	Operational cost	3,000	$/year
h	Depreciation cost	8,307	$/year (f/10 years)
i	Total cost	11,307	$/year
j	Saving	68,693	$/year

Quality check for milk from MCC at chilling center

SNF and fat % testing at MCC

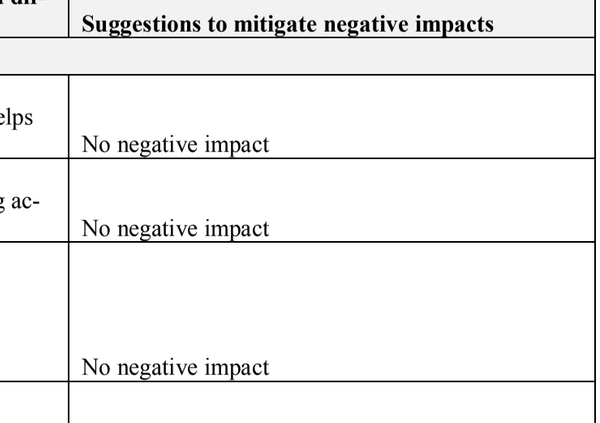
OUTPUT IV-2B: ASSESSING SOCIAL IMPLICATIONS OF SPECIFIC FOOD LOSS SOLUTION SUGGESTIONS.

(How) Does the suggested solution intervention…	Description of the potential impact	Gender dimension of the impact (how women and men may be affected differently)	Suggestions to mitigate negative impacts
Intervention #1: Adulterant test kit			
…impact the employment situation of FSC actors?	the test kit will provide more employment for technicians	No impact. Focus on women technicians helps empowerment	No negative impact
… increase or reduce the workload of FSC actors?	It will increase the workload on the supply chain but with benefits	No impact on existing actors	No negative impact
…raise or increase the need for training to apply solutions?	Technicians will need training. Farmers will need sensitization. There will be a need for monitoring also for farmers and technicians.	No impact	No negative impact
…distribute benefits to the FSC actors? (income access and control)	It will positively impact the chilling center	No impact	No negative impact
…require a degree of organization of the FSC actors (membership in producer organizations/cooperatives etc.)?	Awareness of members through aggregators needed;	No impact	No negative impact
…coincide with cultural and social norms and will be culturally and socially acceptable?	Women will be given charge to do the testing.	Woman technicians may find it culturally challenging to reject milk from male farmers. Over time this will become acceptable	Sensitization and acceptability of female technicians
…impact dynamics of power in the FSC? (WHO has ownership of solutions?)	Women technicians will have responsibility	More women awareness and involvement	No negative impact
Intervention #2: Solar plants			
…distribute benefits to the FSC actors? (income access and control)	Electricity reduction and therefore income increase for collection centres	No impact	No negative impact

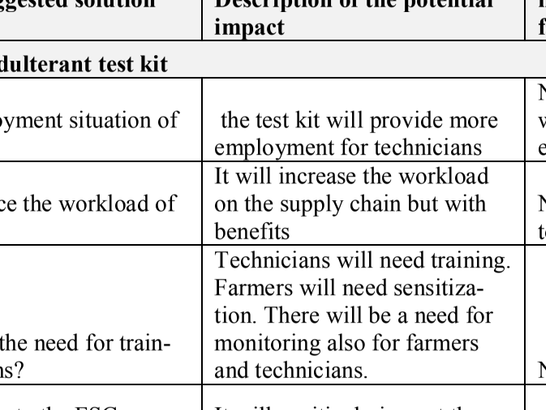
OUTPUT IV-3: SUMMARY TABLE OF FOOD LOSSES, CAUSES AND SOLUTIONS

Critical Loss Points	Magnitude of losses in the FSC		Cause of loss	Intervention to reduce losses	Loss reduction		Cost of Intervention (adulteration kit) (USD)	Implications			
	%	(ton/yr)	USD/year		%	USD		Economic	Social	Food security	Environmental and climate change	Policy
Milk collection / chilling centre	3%	~100MT/y r.	~ 50,000	High microbial load & adulteration	Check adulteration with kits at MCC level	1%	~17,000	Self-sustaining in the long run;	Employment generation, gender equity	Clean, safe, high quality milk to the consumer; better nutrition to the producer family	Reduced adulteration in milk leads to lesser losses and therefore more efficient utilization of resources	Policy interventions on mandatory quality checks and subsidy for the milk testing machine may be the way forward

Insulated milk tanker at processing center



Pasteurization machinery- boilers



C. FOOD LOSS REDUCTION PLAN, STRATEGY, INVESTMENT REQUIREMENTS

To deal with milk losses arising out of microbial load, water adulteration and inaccurate measurement of Fat and SNF, a number of critical areas need to be addressed to reduce milk losses along the milk supply chain, promoting collective milk marketing and raising awareness on ethical practices. The following strategic measures may be considered for introduction by the stakeholders:

- Promotion and advancement of a quality-based milk payment system.
- Training farmers on farm management practices that also improve efficiency of milk production and handling
- Training dairy industry players on hygienic milk handling and quality testing including the use of standardized equipment and reagents.
- Enhance industry regulation to carry out quality surveillance of milk for increased compliance to standards through training of dairy inspectors, procuring of inspection tools and setting up a regulatory laboratory. This training should be in particular to enhance the quality and safety of milk on the farm and at the early stage of the production.
- Promotion of cold chain throughout the supply chains.
- Promote and improve production and commercialization of traditional and value-added dairy products.
- Rigorous implementation of the FSSAI act to prevent milk adulteration and to ensure the maintenance of milk quantity and quality measurement standards using accurate equipment. Regional quality control and measurement labs will also go a long away in assuring the consumers about the quality and safety of milk.

The food loss reduction measures and strategies as suggested earlier were discussed during the stakeholder consultative workshop. Some of the additional points that came up are listed below:

- Milking practices is a factor that influences production and contamination. The animal should be milked thrice a day instead of two times that is being followed widely now. This increases the production of the animal by 5%. It further reduces contamination of the milk as the udder gets emptied completely resulting in quality milk
- Formation of Farmer Producer Organizations/ cooperative societies/ village level committees to facilitate and promote adulterant testing and to ensure 100% testing
- Capacity building and awareness creation on clean milk, clean udder, testing, adulterants, value added products need to be promoted
- Cold chain facilities to be promoted such as the installation of bulk milk chillers. This will contribute to increase the quality of milk and reduce spoilage in summer season

D. FOLLOW-UP ACTION PLAN/ CONCEPT NOTE

Poor awareness of management practices leads to low productivity of the dairy cattle reared by small and marginal dairy farmers. Milk rejection due to high microbial load and adulteration cause major quantitative economic losses for the dairy farmer and qualitative nutrition losses or health safety issues for the consumers.

To address these issues that arose during the screening and field survey studies, we propose an action plan in the targeted FSC.

The intervention of adulterant test kit could be implemented with CSIR's newly developed technology solution – Ksheer Scanner. Government could step in to provide the scanners at a subsidized rate to the various collection centers. The intervention can be pilot tested in 10 MCCs where currently the rejections are the highest. The government could consider allowing a marginal increase in the price of milk to accommodate the costs for testing and promote vendors to certify themselves.

Case Study (women farmer):

Mrs. Kalyani lives in Nunna village of Krishna district and has been involved in farming activities since childhood. She has 5 acre of land where she has been rearing three buffaloes in 0.25 acre of land and earns livelihood by marketing the milk. Initially she has reared two cows and three buffaloes, but due to the increase in the demand for buffalo milk and pricing based on higher fat percentage in buffalo milk, she sold the cows in auction during festivals and has been rearing buffaloes since last 5 years. She gets a profit of USD 46.15 per month by selling the buffalo milk. She stated that due to political issues and caste system at the milk collection center, she has shifted to informal trade (trade through vendors) from an organized market. According to her, the pricing mechanism is not appropriate in the district because of political influence on milk pricings.

Mrs. Kalyani interviewed by Sathguru employee

Women working at packaging section

BIBLIOGRAPHY/ REFERENCES

Foot-note	Description	Link verified as on 9th Nov 2016
1	Department of Animal Husbandry, Dairying & Fisheries	http://dahd.nic.in/about-us/divisions/cattle-and-dairy-development
1	Article at News18 website	http://www.news18.com/news/business/economic-survey-2015-16-india-ranks-first-in-milk-production-accounting-for-18-5-per-cent-of-world-production-1208209.html
1	Press Information Bureau	http://pib.nic.in/newsite/PrintRelease.aspx?relid=145394
2, 10	National Dairy Development Board	http://www.nddb.org/ and the production data is at: http://www.nddb.org/information/stats/milkprodstate
4	Executive Summary on National Survey on Milk Adulteration 2011 by the Food Safety and Standards Authority of India	http://admin.indiaenvironmentportal.org.in/files/file/sample_analysed(02-01-2012).pdf
5	Food safety and standards (contaminats, toxins and residues) regulation, 2011	http://www.old.fssai.gov.in/Portals/0/Pdf/Food safety and standards (contaminats, toxins and residues) regulation, 2011.pdf
6	BIS, IS 2052 (2009): Compounded Feeds for Cattle	https://law.resource.org/pub/in/bis/S06/is.2052.2009.pdf
7	Waliyar, F., Reddy, S.V., Subramaniam, K., Reddy, T.Y., Devi, K.R., Craufurd, P.Q., Wheeler, T.R. and Scudamore, K.A., 2003. Importance of mycotoxins in food and feed in India. Aspects of Applied Biology, 68, pp.147-154.	https://www.researchgate.net/publication/261720899_Importance_of_mycotoxins_in_food_and_feed_in_India
8	Chapter IV Dairy Processing Industry in India	http://shodhganga.inflibnet.ac.in/bitstream/10603/9835/12/12_chapter 4.pdf
9	Article at Economic Times website	http://articles.economictimes.indiatimes.com/2014-11-21/news/56339569_1_ndp-i-milk-production-rural-milk-producers
11	Government of Andhra Pradesh, Animal Husbandry department	http://apahd.gov.in/premier/aplda.html
12	Report on dairy exports	http://agritrade.iift.ac.in/html/Training/Product%20study/Dairy.pdf
16	Abstract of Cattle And Global Warming, Adel A. Abdel-Ghani, Dept. of Anim. Prod., Minia Univ., Egypt	http://research.iugaza.edu.ps/files/7355.PDF
17	Rajasthan University of Veterinary and Animal Sciences, Bikaner	http://rajuvas.org/milk-quality-testing/
18	Mastitis information on Animal Husbandry website of UK	http://dairy.ahdb.org.uk/technical-information/animal-health-welfare/mastitis/symptoms-of-mastitis/sub-clinical-mastitis/#.V44PyPl97IU
Other	FSSAI manual of methods of analysis of foods	http://www.fssai.gov.in/Portals/0/Pdf/Draft_Manuals/MILK_AND_MILK_PRODUCTS.pdf
Other	NDRI report on antibiotic residues in milk	http://www.cseindia.org/userfiles/antibiotic_milk_chand%20ram.pdf
Other	Government of Andhra Pradesh Primary Sector Development: Status, Strategy and Action Plan	http://niti.gov.in/writereaddata/files/AndhraPradesh_Report_2.pdf
Other	Kalla, A., et al. (2015) Isolation and Identification of Specific Pathogens, Presence of Antibiotics, Aflatoxins, Pesticide Residues and Industrial Contaminants in Supply Chain of Milk in Selected Coastal Districts of Andhra Pradesh. Advances in Bioscience and Biotechnology, 6, 330-344	http://file.scirp.org/pdf/ABB_2015042916571000.pdf
Other	FSSAI microbiological standards for milk and milk products	http://www.fssai.gov.in/Portals/0/Pdf/Draft_Regulation_on_Microbiological_standards_milk_and_milk_products_31_08_2015.pdf
Other	A document on dairy processing in India	http://shodhganga.inflibnet.ac.in/bitstream/10603/9835/12/12_chapter%204.pdf

ITINERARY

Date	Itinerary	Address
Preliminary Visit to Vijaywada		
17th - 19th May 2016	Visit to Dairy farmers	Purushothapatnam Village
	Vendor Interaction and visit to local aggregator	Vijaywada
Visit to Vijaywada		
5th - 10th June 2016	Nunna village vendor supply channel - dairy farmer and vendor interaction & Veterinarian interview	Nunna village
	Organised sector - Cooperative - Milk collection center (MCC) study and dairy farmer interaction at the production site (farm)	Kowthavaram village
	Dairy Cooperative - Vijaya - Krishna Milk Union - Board member interaction	Kowthavaram
	Travel	Kowthavaram to Vijayawada
	Meeting with Joint Director, Animal Husbandry Department, Krishna District	Vijayawada
	Meeting with Private Dairy - Head Operations and visit to the processing plant	Vijayawada
	Milk collection center observation	Nunna village
	Follow the Milk from MCC to Bulk Milk cooling center to Processing plant - Load tracking	
	Visit to Milk processing plant	
	Distribution and retail point visit	Vijayawada
Visit to Ananthapur		
28th - 29th June 2016	Interaction with dairy farmers,local vendors and aggregators	Dharmavarm
	Interaction with Local Dairy	Ananthapur

SAVE FOOD
Global Initiative on Food Loss and Waste Reduction
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