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DAIRY PRODUCTION IN TABELAS: SCENARIOS FROM MUMBAI METROPOLITAN REGION (MMR), INDIA

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ABSTRACT
Rapid urbanization in India creates social problems where the role of urban and peri-urban agriculture (UPA) in reducing urban poverty and ensuring environmental sustainability. Mumbai Metropolitan Region (MMR) is a fastest growing region in India with a population of 21 million where high proportion of urban poor along with higher migration to MMR makes the region vulnerable to food crisis. This paper focuses on the current situation of animal production systems (Tabelas) in MMR with special attention towards their contribution towards the local services. An over view about the various concepts of Tabelas were also presented. The question about the various technical and health aspects of these production systems were also mentioned. Based on primary and secondary data, this paper attempts to confirm that urban dairy farming is one of the best options to address increasing urban protein demand and can serve to complement rural supply chains and reduce ecological food prints. These production systems should be better planned and incorporated into the city architecture for ensuring sustainability and employment opportunities in MMR.

Keywords: Gross Domestic Product; Tabelas; Urban and Peri-urban Agriculture; Aaray Milk Colony

INTRODUCTION
Being the largest democratic nation, India occupies 3.3 million sq km^{-1} and a population of 1.2 billion which are administratively divided into 29 states and seven union territories, where one third of the poor still lives below the poverty line of 1 US$ per day (Datt and Ravallion, 2002; Deaton and Dreze, 2002; Census India, 2011). The current growth rate and genie coefficient and multidimensional poverty index of India is 4.0, 36.8 and 0.28 respectively (Krueger, 2008; Panagariya, 2008). In 1950, it was estimated that more than 70% of the total population lives in rural areas and agriculture contributes 56% of the Gross Domestic Product (GDP). India's rate of urbanization is estimated to be about 3.5% per annum. Population explosion and migration of people towards urban area demands more pressure on food, shelter, water and basic necessities (Cohen, 2006).

Agriculture remains a promising sector in Indian economy where agricultural GDP accounts up to 40% of the total GDP. India surpassed the United States milk production becoming the largest single milk producing country in 1998. In 2005 around globe, 14% of the total milk production share comes from India (Babcok Institute, 2007). According to statistics, 70 million households are engaged in milk production with an average heard size of two milking animals (Chandel and Malhotra, 2012; Kurup, 2014). More than half of the total milk production in India comes from buffaloes mainly from the Murrah breed (FAO, 2013; Khamkar, 2014). Manure finds its application as fertilizer and fuel for cooking (Babcok Institute, 2007; Rao *et al.,* 2002). The milk production cost were found to less in compared to United States and Europe due to low labour costs, feed cost, maintenance and inventory costs. The milk price increase in India is comparatively steady when compared to United States (Gokarn, 2011; FAO, 2013).

During the colonial rule, policy interventions were made to regulate the quality of milk as well as allied products and ensure supply in cites and armed forces (Parthasarathy, 2014). Urban livestock keeping provide the needs of urban population which can be accessed fresh due to the short transportation distance. The Aarey Milk Colony was established in year 1951 to relocate the cows and buffaloes as well ensure the supply of dairy products in Mumbai. The annual growth rate in milk production in Mumbai is 1.5% which much less than the state average of 4.61% (Kazade *et al.,* 2002; Misal and Bhise, 2013).

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Knowledge of dairy production systems in Mumbai Metropolitan Region (MMR) is still scarce. The main objectives of the study were (1) to characterize the different dairy production systems (2) to study their role in local milk supply and employment across MMR.
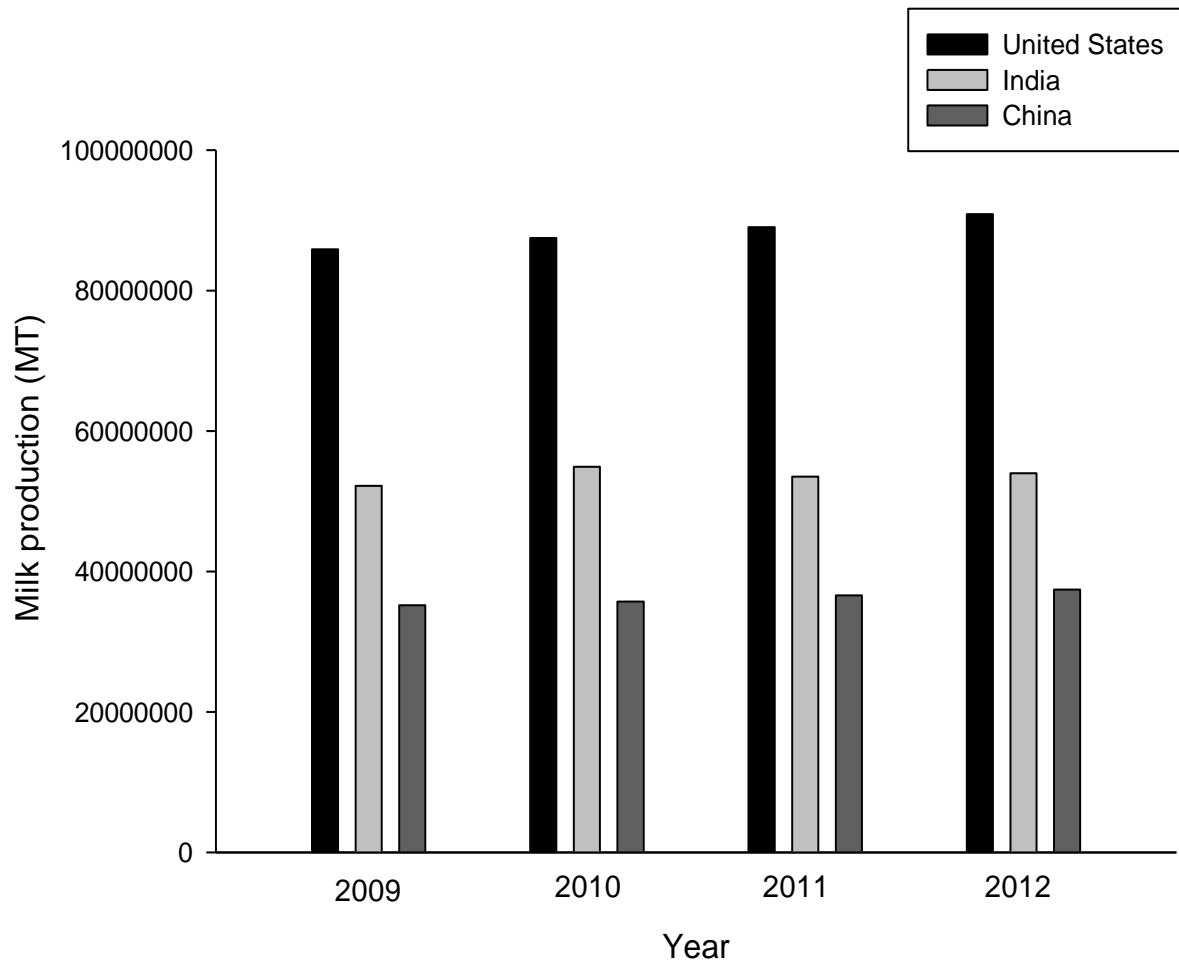

Figure 1: Global annual cow milk production (in metric tons) in three leading countries in different years (FAO Stat, 2014)

MATERIALS AND METHODS
Study Area
Mumbai (18°53' - 19°04' N and 77°48'- 77°53' E), formerly known as Bombay has a population of 21 million in 2009, thus becoming the second largest urban agglomeration in India (Census India, 2011; United Nations, 2012). Mumbai Metropolitan Region (MMR) covers 4,355 km^2 with a population density of 4,065 per km^2. The temperature varies between 22 and 37°C during hot months and from 15 to 22 ^{o}C during cold months (Vazhacharickal, 2014).
Study Approach
The methodology used in this paper was based on primary and secondary data from various sources. Different research articles and books were collected from multiple academic databases. Thus, this paper built partially on own research work as well as based on a literature survey.
Statistical Analysis
The statistics using SPSS 12.0 (SPSS Inc., Chicago, IL, USA) were conducted to summarize the data and graphs were generated using Sigma Plot 7 (Systat Software Inc., Chicago, IL, USA).
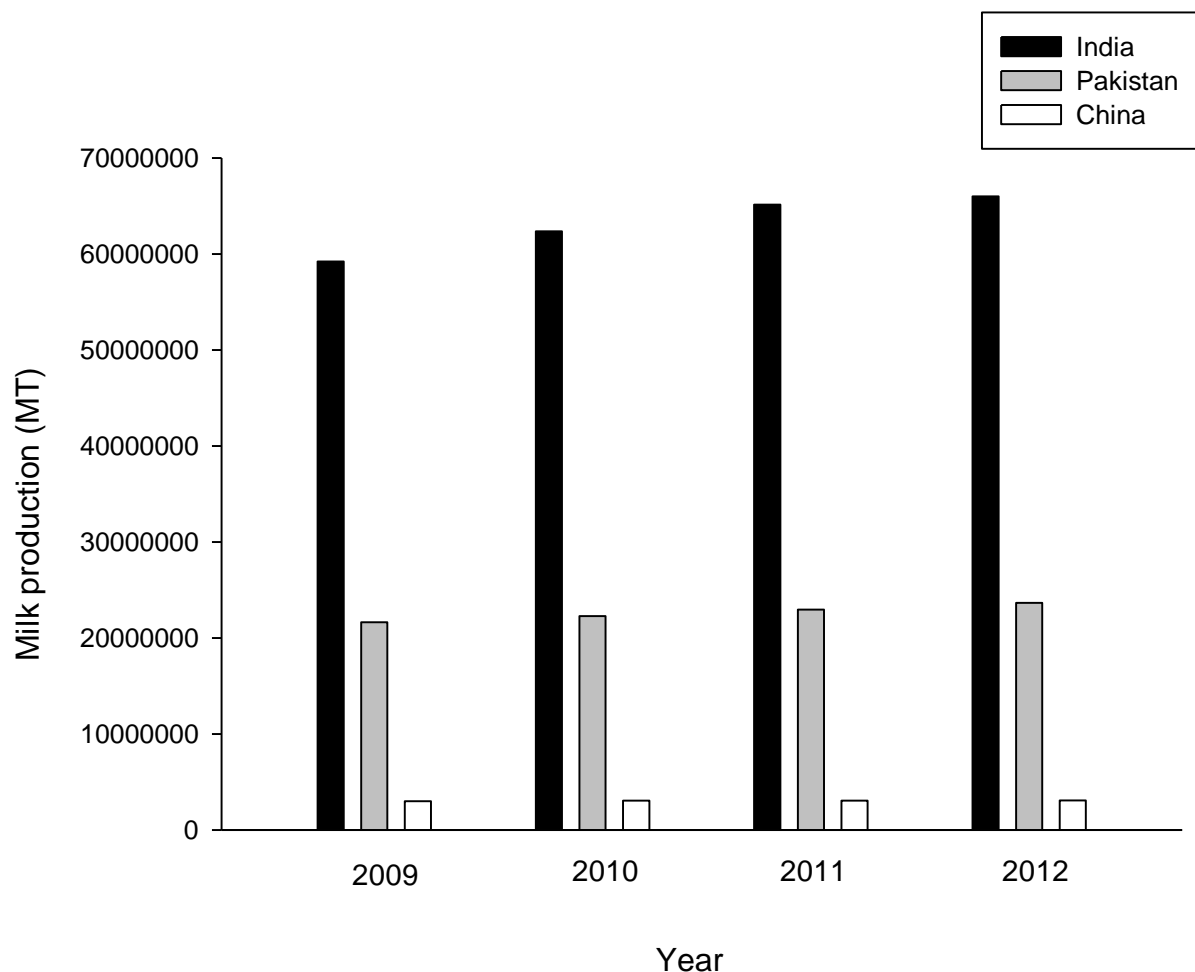
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Figure 2: Global annual buffalo milk production (in metric tons) in three leading countries in different years (FAO Stat, 2014)

RESULTS AND DISCUSSION
Buffaloes and cows were kept in closed enclosures called as "Tabelas". These Tabelas are scattered across MMR. Buffaloes are more preferred in Tabelas due to their adaptability, higher milk yield, fat content and more consumer preference. They were very popular among local tea vendors due to creamy nature as well as making more tea (Chai) out of it. Due to the city's rapid expansion, majority of the animal production systems were relocated to Aaray Milk Colony (AMC) which was established by Municipal Corporation of Mumbai. It was estimated that 640 Tabelas operate in MMR with an approximate buffalo population of 50,000 supplying 750,000 liters of fresh milk. The Tabelas were hit seriously during the heavy floods in 2005 where lots of Tabelas were flooded with water.
Buffalo Breeds
The breeds found in MMR were mainly Murrah, Nili Ravi and Jaffarabadi. The varieties are having special distinguishing characteristics and features (Vijh *et al.,* 2008; Kathiravan *et al.,* 2009). Cross breeding (Kumar *et al.,* 2006) also happened which may due to lack of proper pedigree management system, inseminating bulls and keeping records.
History of Aaray Milk Colony (AMC)
The AMC is organized in 30 blocks (each block has 1,000 animals) covering an area of 60.7 ha under the control of Aaray Milk Producers Association which has been processed and distributed inside the Mumbai city.
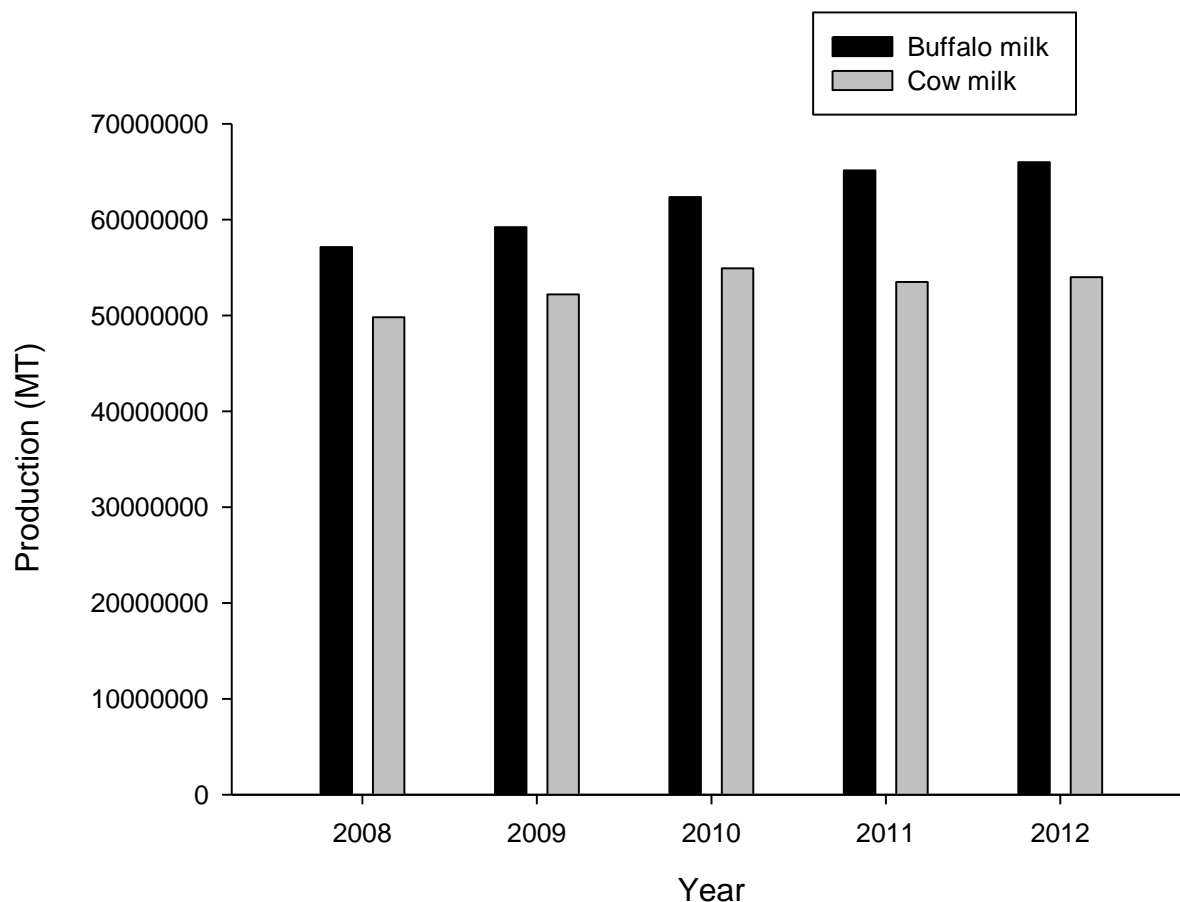
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Figure 3: Annual milk production (in metric tons) in India from different years (FAO Stat, 2014)

The production from the AMC fulfils the 20% of the total supply of the milk in the city (Parthasarathy, 2011). The AMC provide space for the farmers to keep their animals with a rent per month. The government also charges for water, electricity charges and plot given cultivation of para grass (*Urochloa mutica*).

Table 1: Characteristics of Tabela and Aaray Milk Colony animal keeping system across the Mumbai Metropolitan Region (modified after Brown, 2012)

| Variable	Tabela	AMC
Ownership	Private	Government
Location	All over MMR	AMC, Goregaon
Right	Proprietor	Leaseholder
Open space for grazing	No (urban area), yes (sub-urban areas)	yes
Milk sale	Private	Processing unit in AMC
Milk price	Association meeting	Fixed price from government
Procurement of feed and other supplies	Self	Provided by government
Government support	No	Yes
Medical facility	Own arrangement	Provided by government

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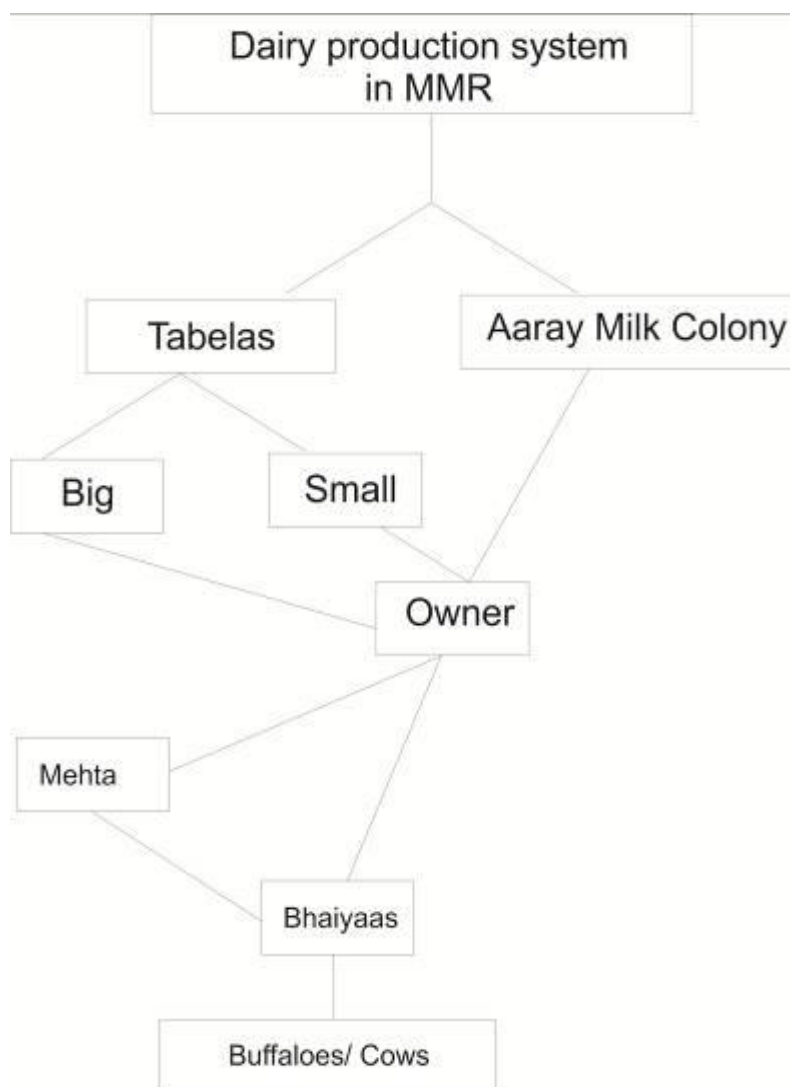
Figure 4: Schematic distribution of organizational set up in Tabelas dairy production system in MMR

Tabelas
The Tabelas were organized in a hierarchical manner where one person runs the business and workers are being hired for milking, feeding, washing, cleaning and sale of milk. Shift system also operates in some big Tableas in morning and evening basis. In big Tableas, Mehta (worker head) co-ordinate 6-8 Bhaiyaa (worker) where one worker is responsible for looking up to 10-20 animals. The buffaloes are kept for 10 months in Tabelas and if there production falls below 5 liters of milk per day, then sold to slaughter house or transported to neighboring states especially Gujarat. These animals were later bought back by the Tabelas owners.
Most of the Tablas were located in Western lines after Andheri till Virar (suburbs of Mumbai). The construction were made of wooden structure, where separate high roof structures present for keeping registers, medicine and office space for the owners. The roofs are made of steel roofs with wooden rails interconnected. The sides were kept open for good ventilation, light and easy movement of the animals while talking out. Zero grazing system is followed all Tabelas were animals are provided food and fodder. The feds include roughage, concentrates as well as organic cakes. Seasonal availability of feed stuff also play role in the selection. Separate storage houses for keeping feed mixtures while straw is kept in the

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courtyard after rainy season. The watering and bathing of buffalos take place in the courtyards as groups for two times after milking in common shared pools from neighboring Tabelas also.

Table 2: Composition of the diets in the Tabelas (modified after; Brown, 2012)

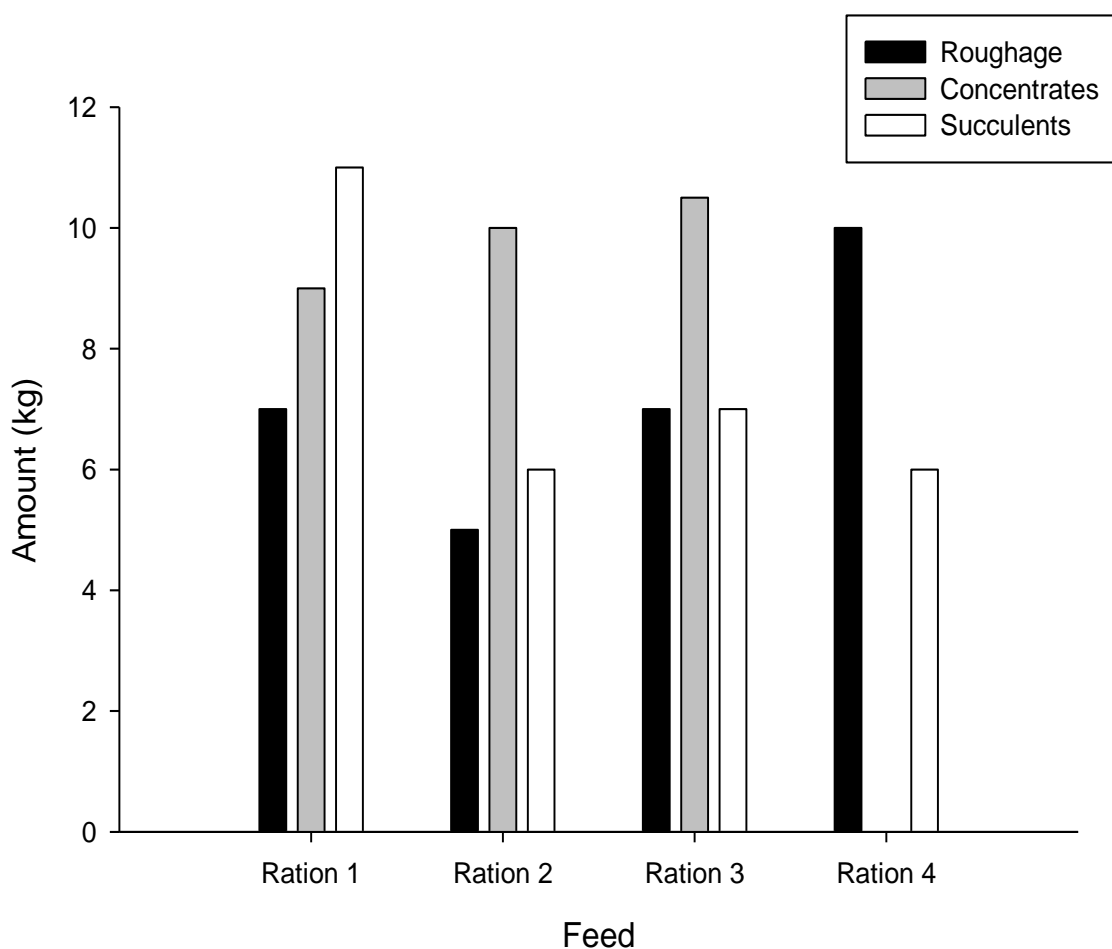| Classification	Material
Roughage	Rice straw
	Para grass
	Rice hulls
Concentrates	
Energy rich	Maize
	Paddy
	Wheat
Protein rich	Chick peas
	Coconut cake
Succulents	Market residues
	Green forage, grass
Others	Mustard expellers
	Cane sugar
	Corn pulp

Figure 5: Examples of various feed ration formulations of Tabelas in Mumbai Metropolitan Region (MMR) showing the different components (modified after; Brown, 2012)
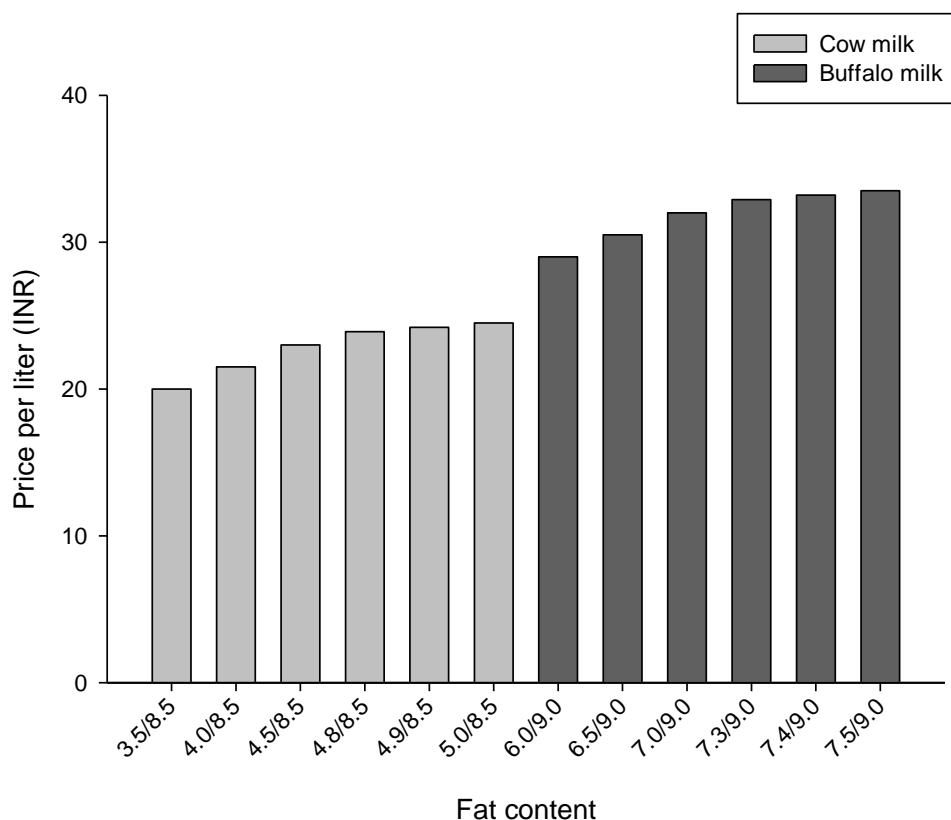
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Figure 6: Price for procurement of cow and buffalo milk depending on the fat in MMR by government (AMC, 2014)
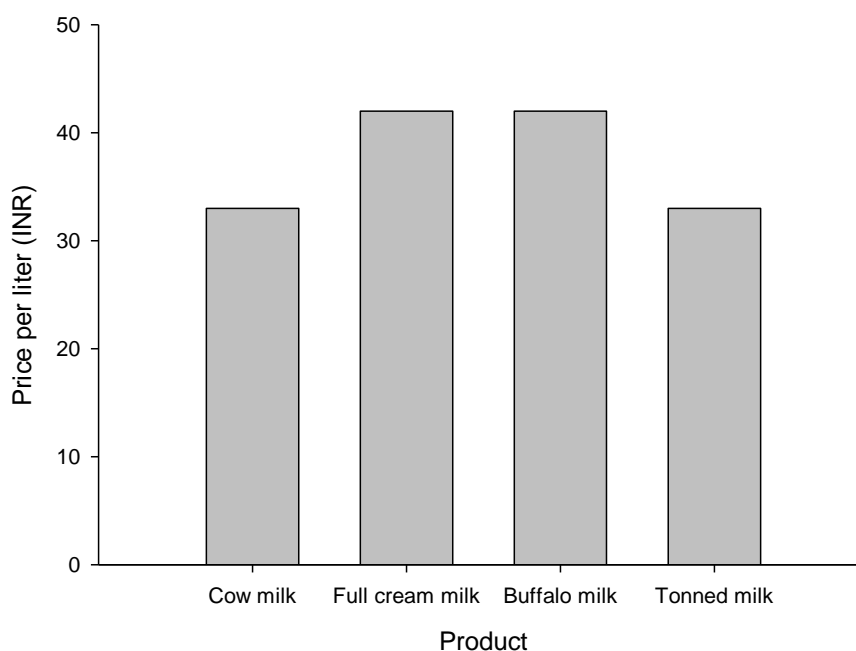

Figure 7: Price for the sale of different types of cow and buffalo milk in MMR by the government (AMC, 2014)
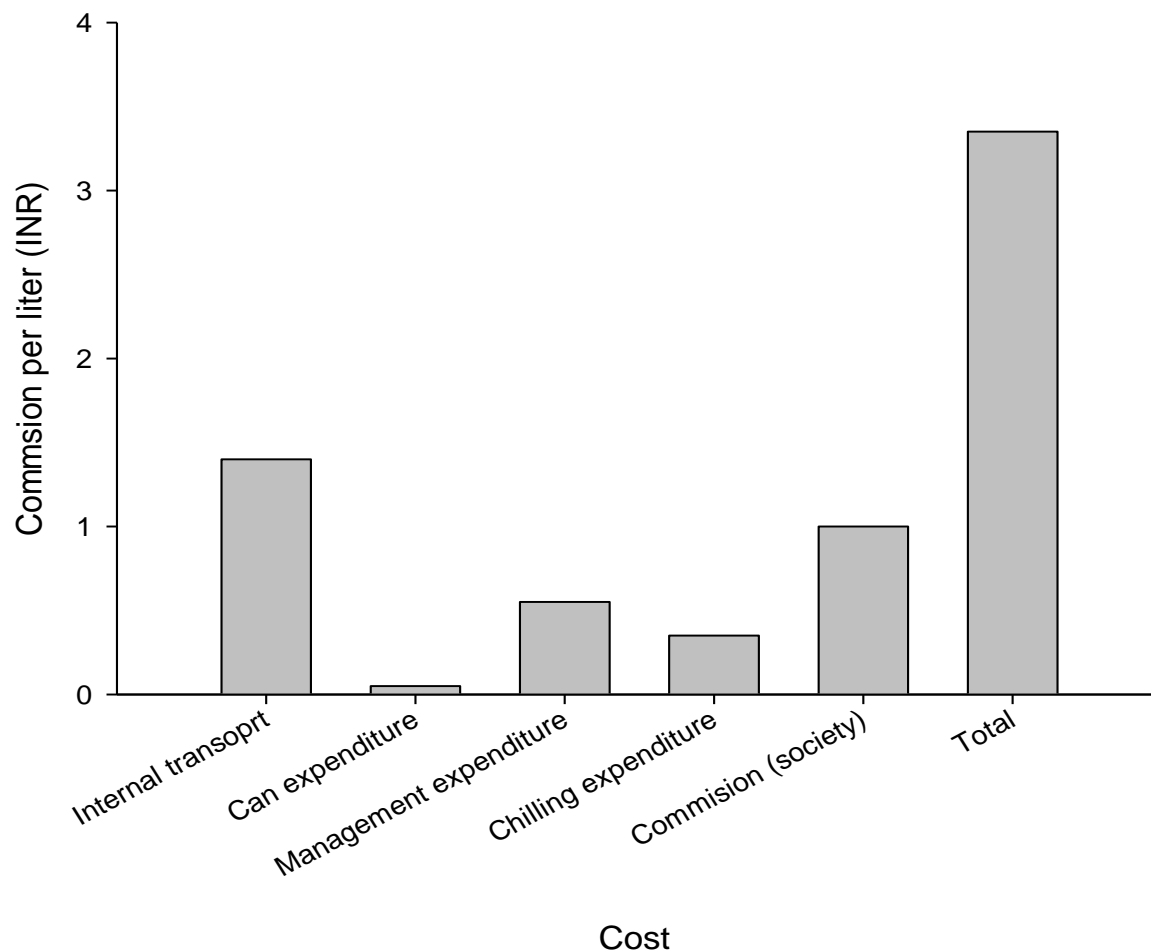
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Figure 8: Various cost associated with the procurement milk in MMR by the government (AMC, 2014)

Table 3: Distributor commission and milk transportation cost across the Mumbai Metropolitan Region (AMC, 2014)

Milk sale (Ltr)	Distributor commission per Ltr (INR)	Transport cost per Ltr (INR)	Total cost per Ltr (INR)
1 - 50	1.40	0.75	2.15
50 - 100	1.65	0.75	2.40
100 - 200	1.90	0.75	2.90
200 - 300	2.15	0.75	2.90
Above 300	2.40	0.75	3.15

Table 4: Vale addition of the milk and milk products and their sale rate in Mumbai Metropolitan region (AMC, 2014)

Product	Name of product	Consumer price (INR)
Refreshing drink	Energee	20
Ready to drink milk	Long life cow milk	20
Masala milk	Masala milk	24
Lassi	Lassi	17
Dahi	N.A*	N.A*
Ghee	N.A*	400

*N.A: Not available

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Milk Distribution System

Milk distribution in Tabelas were organized and highly complex with a network marketing chains and regular consumers. Tabela owners are united and jointed under Mumbai Milk Producers Association (MMPA) which takes care of the milk price and other facilities and issues. In some Tabelas in sub-urban areas the milk is transported to the city center and later redistributed. Most of the Tabelas are also involved in selling milk to the local people through direct as well by distributors. In the case of farmers in AMC, the milk is procured by the processing plant, packed and later distributed inside and city as well making other dairy products. The milk and milk products were sold through Aarey Sarita (milk booth). The milk is distributed mainly through Kurla Dairy, Worli Dairy and Aarey Dairy 25,000, 32,000 and 21,000 liters per day respectively.

SWOT Analysis

Strength, weakness, opportunities and threat (SWOT) analysis summaries the dairy production in MMR.

Strength

- Co-operative membership help marketing and create a sustainable market
- Milk processing through co-operatives works efficiently with less wastage, high quality milk products and innovative marketing
- The presence of co-operatives helped farmers to extent the dairy production
- Committed members with organizing vision and voluntary action

Weakness

- Shortage of professional man power
- Low price of the milk when compared to independent farmer
- Lack of training and other extended services
- Interference of some members in co-operatives

Opportunities

- Costumers get the desired quality and quantity of the products
- Reliable and continuous supply of the products
- Affordable prices and door step delivery
- Provision of infrastructures especially processing machines, chilling centers and feed supply

Threats

- Challenge to waste disposal and neighbor complaints
- Health and hygienic condition of the animals
- Use of hormones and antibiotics
- Lack of appropriate policy favoring dairy sector
- Pressure from real-estate mafia to shift the Tabelas and acquire the high valuable land
- Supply of milk and milk products from other states

Actors Involved

The major actors involved in dairy farming actives were Tabela owners, workers usually migrants from UP, MP and Bihar, government, associations, co-operative societies, milk procurement societies, dairy processors, milk sale booth and vendors who sale milk. In addition the role of technical persons especially form veterinary fields also a part in this network.

Disadvantages

The major disadvantages were technical constraints, lack of space for the animals, hygienic management practices, use of medications and hormones, neighbor complaints as well as forced relocation from the governments. Since majority of the Tabelas occupy the prime land in the city, a lot of interest among builders to convert these lands to residential complexes and shift Tabelas to the outskirts of the city.

Policy Making

Urban dairy farming should be incorporated as an integral component in sustainable city development. These can strengthen the urban resilience and reduce the vulnerability for poor people and create opportunities.

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Figure 9: Satellite map of Mumbai Metropolitan Region (MMR) showing major urban hubs

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Figure 10: Dairy farming in Mumbai Metropolitan Region (MMR): (top left), Tabela; (top right), newly born calf in pen; (middle left), storage of animal feeds; (middle right), Dairy cows involved in Tabelas; (bottom left), rice straw; (bottom right), worker bathing buffaloes

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Figure 11: Animal feeds used in the dairy production system in Mumbai Metropolitan Region (MMR): (top left), peanut cake; (top right), rice husk; (middle left), maize stem; (middle right), rice straw; (bottom left), para grass; (bottom right), groundnut oil

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Figure 12: Dairy production system in Mumbai Metropolitan Region (MMR): (top left), Tabelas with cows in open area; (top right), buffaloes crossing the railway track; (middle left), milk collection cans; (middle right), transportation of milk to the processing unit (bottom left), dunk cakes made for cooking purpose; (bottom right), various milk products from Aaraey Milk Colony

These dairy contributions in the urban and peri-urban area can surely reduce environmental foot prints especially energy, CO_2, water and nutrients and enhancing resilience against climate change (De Zeeuw *et al.,* 2011). The development of 'recreational dairy production systems and demonstration dairy farms where sustainable milk production coupled with recreational services to urban citizens including school children. Planners and policy makers can explore non-conventional approach of implementing sustainable dairy production systems with hygienic and well being of the animals. High technology intensive based dairy production systems with special focus on hygienic milk handling and processing units can be also implemented especially in the case of MMR.

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Conclusion
The affordability and availably of proteins plays a major role in sustainable developing process which improves nutritional balances and macroeconomic stability. In order to achieve this, a well managed 'White revolution' should be brought into MMR ensuring protein security for urban people as well as profitability to producers. These production systems could contribute additional contribution for urban food production which even used for demonstration as well as learning for school children.

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