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GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

A Participatory Systems Mapping (PSM) based approach towards analysis of business sustainability of rural Indian milk dairies

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Abstract: Drawing from the theories of Participatory Systems Mapping (PSM) this study presents an approach to analysing the business sustainability of entrepreneurial dairy ventures in India. The article begins with a general introduction to the small and medium scale dairy ventures in rural India, highlighting the prominent issues and challenges faced by the stakeholders. The second part demonstrates the use of the PSM framework in developing the Stock and flow diagram (SFD). Further, data from a local milk dairy is collected, and simulations are carried out between 2017–2025 using Vensim®. The outputs are analysed, and inferences are made. This study is expected to enable the policy makers towards the development of sustainable strategies for dairy businesses in general and enable the entrepreneur to analyse the future trends of the potential strategies under his consideration.

Subjects: Dynamical Systems; Industrial Engineering & Manufacturing; Entrepreneurship and Small Business Management

Keywords: Participatory Systems Mapping; entrepreneurship; milk dairy; system dynamics; simulations

1. Introduction

India is one of the largest producers of milk in the world. This sector has both organised and unorganised players; the latter being more abundant in numbers (Kale, Ponnusamy, Chakravarthy,

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PUBLIC INTEREST STATEMENT

"The dairy sector is one of the top-ranked sectors in India. The sector has players in the formal and informal sector, with the latter in plenty. The study provides a holistic view of the issues faced by the stakeholders, primarily the small and medium scaled dairy farmers. Based on group discussions and field studies, high production costs due to increasing fuel prices, lack of information to start and run the ventures, and low availability of veterinary consultants were the major issues. Also, this study demonstrates the use of System Dynamics simulation in the context of the sustainability of a rural milk dairy. The research provides the reader, an understanding of the practical issues faced by the dairy farmers and develop sustainable strategies to boost the sector. Also, it enables the reader to appreciate the usage of model-based policy support in the entrepreneurial context in general".

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Sendhil, & Mohammad, 2018). The unorganised sector of dairy farming consists of farmers who primarily rely on milch animals to provide an additional source of family income (Sharma, Singh, Staal, & Delgado, 2002). To enable the producers in both sectors, the Government of India has announced many schemes for encouraging dairy farming.[1]

Despite all these provisions, the dairy industry is witnessing many closures as far as the new ventures are concerned, primarily in rural settings. Some of the hedges to this industry are its skyrocketing prices of fuel and supplies, unavailability of fodder, lack of good veterinary consultants, and a dire need for a sound supply chain management system. Further, the lack of semi-skilled/unskilled labour, and associated issues in a labour-intensive industry such as this, has led to the abrupt closure of several ventures. These issues stress the need for a study to answer the following questions:

(a) What are the pressing issues impacting the sustainability of the small and medium scale dairy ventures?

(b) How can these dairy ventures ensure sustainability in the light of some of the strategic decisions taken?

To answer these questions, a literature review for developing a thorough grounding of the status quo of the dairy sector (section 3) was conducted. This section followed the objectives of the study in section 2. The research methodology (section 4) attempts to specify the process deployed in data collection, development of the model and validation of the results. Further, through PSM techniques, stakeholders' views about the sector are presented in section 5.

The second question is answered through the simulation of a real-life case. Section 6 presents a case study of "Fresh and Natural" (name changed), a dairy start-up venture and the dairy farmer's dilemma. To test the strategy portfolio for the future scenarios the SFD is developed, the underlying assumptions are mentioned in section 7.

Section 8 presents the results of the simulation. The discussions and concluding remarks are offered in 9 and 10 respectively. Figure 1 presents the paper structure.

2. Objectives of the study

Through this manuscript, an attempt is made to identify the various issues faced by dairy farmers and other stakeholders in rural India. Using PSM as a foundation, a simulation model encapsulating the significant problems faced by an entrepreneur is developed. Further, an attempt to

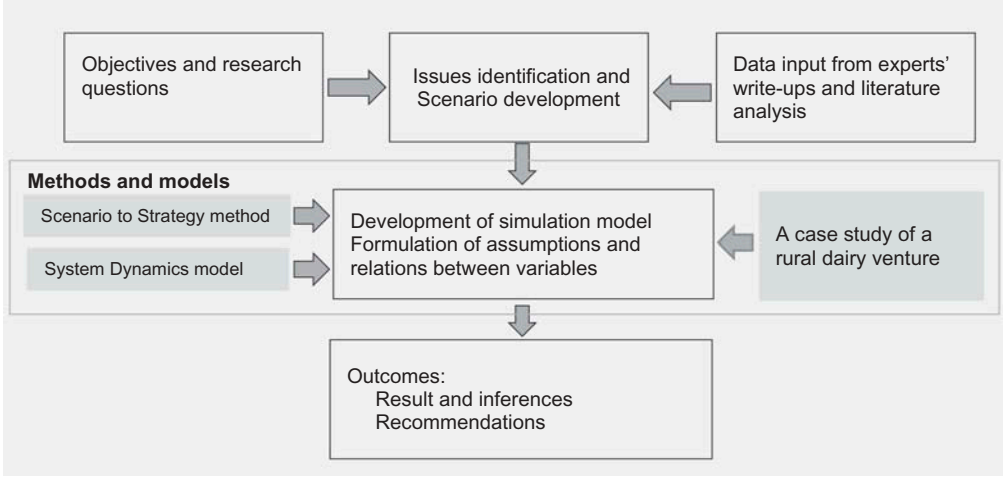

Figure 1. Paper structure.

(Source: Authors)

demonstrate the capability of model-based policy support is conducted using a case study of a typical dairy venture. The study is held in the Dakshina Kannada (DK) and Udupi Districts of Karnataka State in South India to enable policymakers to design transformational pathways towards sustainable business opportunities to the dairy businesses in the region.

3. Literature background

3.1. The dairy sector in general

Globally, the dairy sector is facing a lot of uncertainties and challenges. There have been dynamic changes in consumer trends owing to the modernisation of the industry and the integrating of technologies (McMahon, Pieters, Schnuck, & Kroef, 2017). In continuum, this has also provided a plethora of opportunities. Gerosa and Skoet (2012) revealed that over forty years for all countries, the dietary energy intake from dairy products increased from 3.4–4.4 per cent. With an ever increase in population, the consumption rates are growing exponentially. It is estimated that industry is expected to generate revenues worth USD 442.32 billion in 2019 with a Compound Annual Growth Rate (CAGR) of 5 per cent.[2]

The North American dairy industry is dominated by the United States of America with a market revenue at USD 48,506.40 million in 2011,[3] followed by Canada and Mexico. Similarly, Brazil and Argentina were the leading milk procuring countries in the South American continent (Bankuti, Damasceno, Schiavi, Kuwaraha, & Prizon, 2018).

In Asia, India has come a long way to become one of the leading milk producing countries in the world. In its quest for self-reliance, the Indian dairy industry undertook structural changes and milk production increased four-fold over the last four decades.

3.2. The dairy sector in India

The Indian dairy industry has been on a steady path of progression. It has grown from producing 17 million tons of milk in 1951 to 165 million tons in 2016–17[4] with a provisionally recorded gross output of 176.35 million tons for the year 2017–18.[5] The per capita availability of milk has grown from 178 grams per day in 1991–92 to 355 grams per day in 2016–17 which is comparable with the world per capita availability of milk at 289.31 grams per day for 2012 (Ohlan, 2016).

The sector has both organised, as well as unorganised players operating with a large share of milk being produced by smallholders (Kale et al., 2018). The smallholders accounted for 62% of the milk produced which attributed to about 27% to the household income. These are marginal and small farmers (Sharma et al., 2002), and landless laborers (Aneja, 1980) who maintain one to three milch animals (Shukla & Brahmankar, 1999) of low genetic potential, primarily fed on by-products such as crop residues (Saadullah, 1989), reared with the help of under-employed family members (Sharma et al., 2002) and an objective to supplement the farmer's income as well as to generate employment in the rural sector (Krishna Raj, 1980). Studies on the farmer's income have hinted at an increase from 41% to 112% (Kalra, Singh, & Kumar, 2000; Kumar, 2005; Patel, 2003). Besides, the by-products of dairying, such as manure, help to improve the fertility and productivity of landholdings Chantalakhana and Skunmun (2001).

The literature on dairy ventures in India is quite divided. While one strand of the research highlights the factors that hinder the growth of the sector, another highlights the growth opportunities for the industry.

The first strand of literature encourages dairy farming and highlights that the entry timing could not have been any better .[6] Researchers like Rajeshwaran, Naik, and Dhas (2014) have mentioned that India has been experiencing a steady growth in demand for dairy products estimated at 6% to 8% per annum due to increasing demographic projection. Mahmood and Kundu (2008) also studied the demand characteristics of the dairy product and concluded that the increase is attributed to the changing demographic trends. This increasing trend leads to a demand-supply gap as the growth in supply is only 3% to 4% per annum as per the study conducted by (Rajeshwaran et al., 2014). With a positive

demand-supply gap projection for milk and its products, the opportunities become attractive (Bhattacharya, Rao, & Gupta, 2014; Gokarn, 2010). Moreover, the demand for other types of high-added-value dairy products ranging from packaged cheese and yoghurt, baby food supplements, dairy whiteners, ice creams, and probiotic dairy products is growing. These opportunities have led to many youngsters leaving their lucrative corporate careers and taking up dairy farming as a profession.[7]

Another strand of the literature focusses on the challenges of dairy farming. Some of the specific issues that the sector is confronting are such as the high cost of milk production due to the low yield of milk (Hegde, 2001), low return due to improper feed practices (Saadullah, 1989), lack of dairy management practices (Khin Mar Oo, 2005), increase in fuel prices (Rangasamy & Dhaka, 2007a) that leading to increase in transportation and logistics costs (Rangasamy & Dhaka, 2007b), cost of milk reception and procurement (Chauhan, Kalra, Singh, & Raina, 2005; Rangasamy & Dhaka, 2007b), processing and manufacturing cost of dairy products (Ray, 2008), and reduced marketing margins (Yogi, Chauhan, & Sharma, 2007). These aspects pose a profound challenge to the sustainability of the dairy industry in India.

Hegde (2001) suggests that the challenges in the dairy sector can be overcome by working towards reducing the cost of milk handling, clean milk production, active animal husbandry extension. This can happen with even simple, informal collaboration amongst the dairy players. Bulk procurement of fodder, partnership with agriculture farmers for green fodder, pooling of the vehicles used for transportation etc. This, in turn, facilitates a close dialogue with the farmers and such associations should be established and strengthened to acquire new knowledge and technologies and understand milk marketing scenario.

3.3. System dynamics and the dairy industry

System Dynamics (SD) is a methodology proposed by Forrester (1961). This can be generally applied to study the dynamic complexity of different systems in a variety of settings (Sterman, 2000). What distinguishes SD from other methods of simulation is its ability to deal with non-linear behaviour of complex dynamic systems (Morecroft, 1988) and to describe any given system mathematically using quantitative or qualitative modes and appreciate the response of a system due to the inherent feedback structures. Modelling in SD consists of the necessary steps viz-a-viz, Problem identification, System Conceptualization, Model formulation, Simulation & validation, and Policy analysis & improvement (Sushil, 1993).

Stanislao, Ford, Tedeschi, and Cannas (2012, 2013); Lie and Rich (2016); Lie, Rich, and Burkart (2017), McRoberts, Nicholson, Blake, Tucker, and Padilla (2010) have worked on the application of SD in dairy farming. The contexts have been varying from the impact of genetics on the effects of marketing on the milk supply chain.

However, it is an exciting observation that no papers are discussing the application of SD in studying the different operational strategies for a dairy, especially in the Indian context. Considering the size of the Indian market, it becomes relevant to position an application-based model which may be used as a teaching case for basic SD. This work aims at developing a model to analyse a practical situation of the future of an unorganised dairy business and propose solutions for its sustenance.

4. Methodology

Post literature review, it can be summarised that the significant works in the field of dairy farming ventures in India are divided into two major strands. The first strand highlights the sector as promising and with very high potential. Whereas, the second strand focuses on the negative aspects of dairying and hints to proceed with caution.

Through this study, an attempt is made to investigate and depict the actual picture at the ground level. This is achieved by conducting qualitative interviews amongst the different stakeholders regarding the underlying issues that affected the day to day functions. These qualitative interviews enabled the identification of significant problems where immediate policy intervention was needed.

Further, the participants were encouraged to provide their views towards the development of a reliable simulation model by which one was able to explore the effects of critical issues influencing Dairy farmers. PSM framework (Wang & Cheong, 2005) was deemed appropriate. This framework was practical (see Figure 2) for building SD models for complex problems as it had an inherent ability to enhance the model's reliability by combining several group process techniques—such as workshops, group discussions, brainstorming, and fieldwork—with SD modelling.

The PSM framework makes full use of group techniques (Andersen, Richardson, & Vennix, 1997; Berard, 2010; Richardson & Andersen, 1995; Vennix, 1996) so that the model can reasonably incorporate a wide variety of knowledge, which includes systems thinking, SD, domain knowledge, and expertise. SD modelling is a rigorous method by which to study and manage complex systems (Sterman, 2000). The PSM framework covers the stages of the model-building process propounded by Sterman (2000) and includes problem articulation, formulating a dynamic hypothesis, formulating a simulation model, testing, and policy design and evaluation.

In the modelling stage, the framework was used to develop a mental representation, identifying a causal loop diagram (CLD) and a stock and flow diagram (SFD) through which a simulation model can be prepared for the venture under consideration. The CLD links variables that have a causal interpretation and the SFD represents the structure of a target system with denotations of rates and accumulations. During this stage, mental representations were formalised using mathematical, logical, and theoretical means. Expert opinions were solicited to justify the model. Further, specific values required for the various stocks, flows and auxiliary variables were collected from a dairy venture belonging to one of the respondents. This was done on a convenience basis as the objective of the study was to demonstrate the capability of model-based policy support for different scenarios instead of arriving at generalisations.

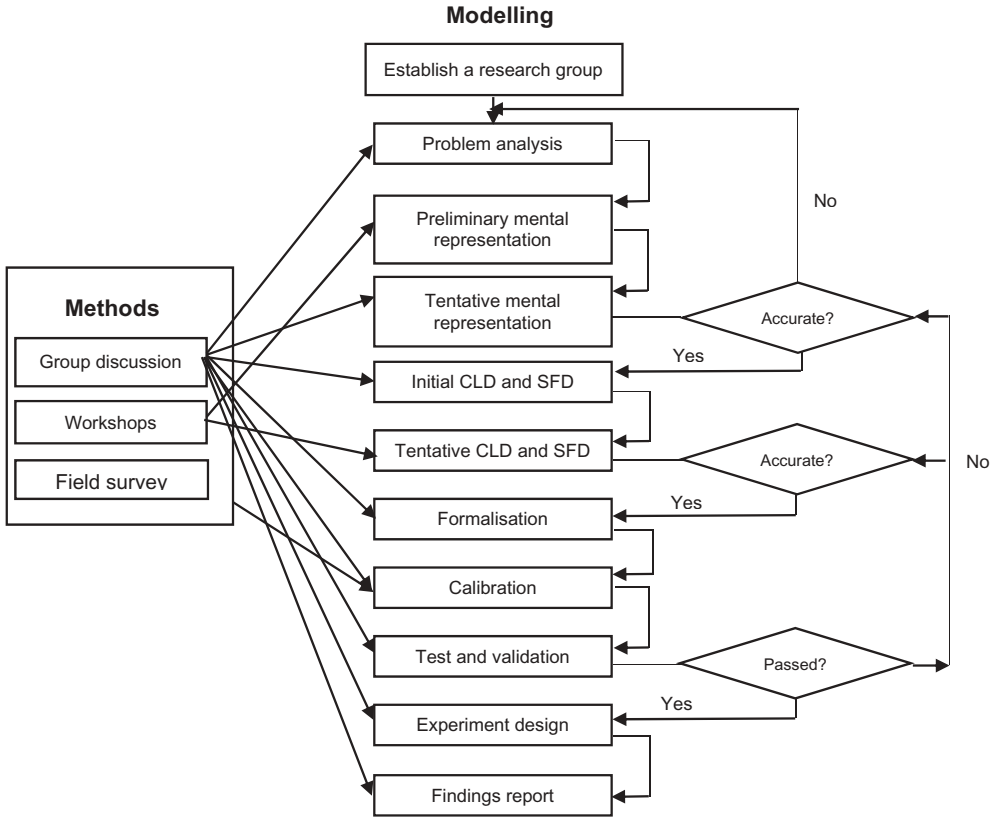

Figure 2. The PSM framework.

Note: CLD = causal loop diagram; SFD = stock and flow diagram

(Source: Wang & Cheong, 2005)

The robustness of the model developed was then tested for its causality using an approach followed by Roy and Mohapatra (2000), and robustness as suggested by Barlas (1994) for variations in the input parameters. The simulated behaviour of the model was studied and analysed. In this process, every variable was tested for dimensional consistency. The model was tested for extreme conditions (i.e., those that would never be observed in the real world).

5. Issues with the dairy industry in DK and Udupi district

To identify the major issues, the driving factors, and the associated challenges in the dairy sector, stakeholder interviews primarily through the participatory methods were conducted. Further, the outputs were triangulated with the available literature (both scientific and the company reports). The participants in the interviews included academicians, policy makers, entrepreneurs, employees, veterinary consultants, and customers (Table 1).

The interviews aimed to identify the areas of concern which potentially impact the sustainability of the ventures. The stakeholders identified various issues which were broadly grouped under the four crucial areas viz-a-viz, Government policies and awareness, Entrepreneurial issues, Workers and employment issues and Veterinary consultant issues. The stakeholders were further interviewed for their views.

5.1. Issues put forward by the academicians/policy makers

The policymakers were positive about the potential of the Government schemes to promote dairy ventures.[8] They also mentioned that adequate information is provided in the Krishi Vigyana Kendra (KVK)[9] (Centre for Agriculture and Horticulture set up by the Government for farmers and entrepreneurs in every district). However, they mentioned that people very rarely making use of the facilities provided. The views of the participants (A2) are discussed below.

> ***Translated from local language**: At KVK, we have maintained around 50 acres of farmland at Brahmavara, we have developed models of dairy and other animal husbandry units with an intent to provide an insight into aspects of dairying like basic requirements, animal housing, calf rearing, dung and urine management and others. We also conduct special workshops (free of cost) on topics like the selection of cows, transport of animals, daily care, feeding, healthcare, diseases, reproductive management etc. However, we have observed that the response is low. We wish that the people of the region make use of the state-of-the-art facilities that are provided here.*

Similarly, the academician (A1) mentioned:

Table 1. Interviewee profiles

ID	Profile of the participants
Academicians/Experts	
A1	Professor in Entrepreneurship
A2	Policymaker in dairy farming
Entrepreneurs	
E1	Dairy farmer (1st generation) from DK District
E2	Dairy farmer (2nd generation) from Udupi District
E3	Technologist turned Dairy farmer (1st generation) from Udupi District
E4	A former Dairy farmer who closed his business unit
Employees	
EM1	Daily wage worker based from Udupi District
EM2	A migrant worker from a neighbouring state on a fixed salary
Veterinary Consultants	
V1	Veterinary consultant
V2	Private Veterinary pharmacist

Many promoters of small-scale dairies do not conduct the feasibility study well. With limited knowledge about the pros and cons of the venture, the promoters avail loan from co-operative banks and money lenders at high-interest rates. The improper planning often leads to failure of the enterprise.

5.2. Issues related to the farmers

The farmers highlighted the issues that impacted them on a routine basis. The foremost was the rise in the fuel prices leading to increased costs of transportation, maintenance, and procurements. They perceived that they are unable to get the right price for the milk due to reasons related to increased rates of the fodder. Also, the imbalance in the ratio between the veterinary consultants/institutions to the number of cows was a vexing issue. Regarding the presence of facilities at the KVK, the farmers quoted inaccessibility due to the location as a constraint. The following are the view of participants E1, E2, and E3 respectively. One participant (E4) spoke about his story but refused to allow us to publish it in our manuscript due to social stigma. Prima-facie, it appeared to be a case of mismanagement of the venture due to lack of information and domain expertise.

***Translated from local language**: I started this venture with great hope. However, the last few years have been very turbulent. The prices of fuel have skyrocketed in the previous few years. This has, in turn, increased transportation costs leading to increased operational expenditure. Also, the fodder availability is another concern, we usually stockpile the dry fodder (paddy grass) during the season and use it throughout the year, but then we do not get the green feed for our cattle (E1).*

The veterinary consultants are very few. It is difficult to schedule an appointment with them as they must cater to many clients. We wish the Government takes proper steps to increase the ratio of veterinary consultants and the animals (E2).

I did not get the opportunity to go to KVK and see the facilities. It is in Brahmavara—Hebri road, which is very far from the place where I live. A single visit would consume at least half of my day. I do not understand why it was set-up at such a distant location (E3).

5.3. Issues related to the workers

The local worker availability has always been an issue to the dairy farms in DK and Udupi districts. The two regions boast of a high average per-capita income in comparison to the others in the state.[10] Hence the wages are highly competitive. As a result, it becomes challenging to hire local workers considering excess operational costs.

Most of the dairy ventures are forced to employ migrant workers from neighbouring states. This is accomplished through a local agent, who coordinates the labour supply for such enterprises. This has its limitations as the employees tend to be loosely controlled.

***Translated from local language**: The wage that I get by working in the dairy venture is very less. A construction worker earns more than what I get. I am old now to engage myself in construction labour, and my children are earning, we are financially stable now, that is why I am willing to continue here (EM1).*

I am a resident of Uttar Pradesh. My family lives there. I get a decent salary here which is good enough to sustain both myself and my family back home. However, I don't like this place. The cultures are different. I am facing challenges in getting accustomed to the local culture. Someday, I would want to go back and set-up my venture back at my home town (EM2).

5.4. Issues related to veterinary consultants

The veterinary consultants highlighted the need for a higher number of medical practitioners to ensure that adequate service is being provided to the clients. They mentioned that most of the small-scale ventures buy animals from other enterprises at lower costs. These are the cows which are typically beyond their prime. Further, excessive cross-breeding has resulted in a decline in the quality of the milk. They also mentioned that the conditions in which the cattle are kept need to be improved.

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> ***Translated from local language**: We find it very challenging to meet our clients' needs. The dairies are in different places and most of our time is spent in travelling. We wish if there were more consultants nominated by the government, it would be easy to manage. Regarding low profits, it is to be understood that the milk price is based on the fat content in the milk. Typically, the small-scale farmers buy cattle which would be beyond their prime from other dairies. The direct effect is a low yield of milk. Further, excessive cross-breeding results in the decline of the fat content in the milk produced. This is a vicious cycle the farmers get trapped into (V1).*

Finally, the stakeholders were asked to identify the three major issues which needed intervention at the policy level. The stakeholders predominantly defined the following matters.

(a) High production costs due to increasing fuel prices.

(b) Lack of information to start and run the ventures.

(c) Low availability of veterinary consultants.

6. Case study: fresh and natural

As a part of model building and simulation, a dairy farmer (E1) based out of Puttur, DK district was approached in March 2017 (Figure 3). The venture was selected based on convenience. During the interaction, the dairy farmer appraised us about the challenges faced in sustaining the dairy business. The business started three years ago and had not achieved break-even. The dairy farmer's dilemma was to choose one amongst the two potential strategies in addition to continuing as it is (mentioned at the end of the section).

Started in February 2014 with 10 Jersey cows in a traditional setting, the dairy farmer realised the potential in the dairy industry and built a state-of-the-art milk dairy in the locality which infrastructure for housing around 20 animals. He obtained a loan of INR 10 lakhs

Figure 3. The pictures from the rural dairy farm a) Picture of the rural entrepreneur's dairy with dry feed (hay stack) arranged at the entrance; b) cow shed to house pregnant cows; c) Milch cows inside the cowshed; d) concentrate feed provided by the milk producers union.

(Source: Authors)

The first batch of cows was bought from a local breeder hailing from neighbouring district Hassan, Karnataka at INR 35,000 which gave a yield of 18–20 litres of milk per day respectively (mean 18.24, SD 5.76). A portion of the milk (approximately 20%) was internally used for suckling by the calves, and the rest was sold to an agent who procured at INR 24 a litre.

The cow dung was sold to an arecanut farmer who paid INR 8000 per tractor load (capacity 4 Tons). The male calves were sold to agents at an average price of INR 5000 while the cows after their prime milch life (9 years) were given to the temple *goshalas* (cow care sheds) or tertiary farmers. The cows were vaccinated frequently and inseminated with quality semen at their prime time. A typical insemination process cost INR 200 for a local bull and costs up to INR 1500 for an imported bull with excellent lineage. The dairy farmer claimed that the probability of conception was around 75% (based on the history of the venture).

As with all other new ventures, this business too was facing workforce issues. The dairy farmer had hired labourers from Uttar Pradesh, a state in North India and was given free accommodation and food, plus a monthly salary of INR 10,000. A labourer was able to handle up to 15 cattle. He also mentioned that he incurred a net loss of 6.32 lakh INR in the first year. This was primarily due to the one-time overhead cost of infrastructure and procurement of the cows.

The cattle are fed processed green fodder and dry fodder daily. Besides, concentrate feed is provided once a week. Table 2 displays the cattle feed schedule and details are as per the chart is given below.

The dairy farmer summarised that he was looking at the following options for sustaining the business before taking the harsh decision of closing it down.

6.1. Business as usual: continue as it is and play the waiting game

The present number of cattle remain untouched and wait for some more time, hoping for the things to get stabilised.

6.2. Scenario 1: rear high yielding cows, produce and sell organic compost and sell

Holstein Friesians are known for their excellent milk yielding capacity. It was suggested that cows from a distinguished lineage fed on a daily concentrate feed supply would boost milk production at the dairy. The suggestion here is to bring in 5HF cows to the farm.

Also, it was suggested to convert the manure into organic compost and market it. It was also observed that there exists a big market for organic vegetables where compost manure can be sold at INR 30/kg. The materials required for preparing compost manure were neither significantly complicated nor expensive

6.3. Scenario 2: rebrand the product as organic milk and supply at a premium and produce and market organic compost

The dairy farmer also identified that there existed a good market for organic milk in the neighbouring city of Mangalore. Owing to a new health consciousness drive, the emphasis on consumption of organic dairy had increased significantly. Further, people perceive buying organic products as a symbol of a quality lifestyle.

Table 2. Feeding chart for the animals

Feed	Cost/kg (INR)	Qty.	Total	Frequency
Dry feed	4	5.5	22	Daily
Green feed	2	15	30	Daily
Concentrate feed	28	3.5	98	Weekly

7. Application of system dynamics

Based on the case-facts, a stock and flow diagram (Annexure 1) was developed using the conventions propounded by (Lane, 2000), and simulations were carried out until 2025 to study the effect of the three scenarios on the break-even time of the business. Some of the underlying assumptions were:

- The average costs incurred were expected to remain uniform over time.
- The cost of rearing calves is not considered as their sale value will nullify it.
- At any point in time only 70% of the cow's lactate.
- The cows were free from illnesses, and the effect of local conditions on hybrid cows was insignificant.

Three runs were simulated based on the options mentioned and analysed. The values of the critical variables and constants used are specified in the following table (Table 3):

8. Results of the simulation

The output of the three scenarios is demonstrated as shown below. The scenario wise results are mentioned below (Figures 3, 4, and 5).

8.1. Milk production capacity

Business as usual: The milk production capacity trends are highlighted in Figure 4. It can be observed that under the BAU scenario, the yield of milk reduces from the current production levels of 28,475 Litres per year to around 25,000 Litres per year in 2018. This can be owed to the ageing of the cattle which are present in the dairy. Further, the production capacity increases to a maximum of 30,000 Litres per year in 2021 before dropping down to 22,704 Litres per year in 2024. This peaks up again in 2025 to a capacity 24,567 Litres per year.

Scenario 1: In the first scenario, the milk yield is significantly higher than the previous case. It follows the same trend as the former curve. However, the highest value achieved is 34,360 Litres per year in 2021. Further, it drops to 26,000 Litres per year in 2024 and peaks up again to 28,497 Litres per year in 2025.

Scenario 2: The second scenario closely follows the BAU scenario with an average decrease of 2–3% in terms of YoY values.

8.2. Number of customers served

Business as usual: The trends pertaining to the number of customers served are displayed in Figure 5. The customers for the business as usual scenario also closely follows the trends of the milk production capacity of the venture. It can be observed that the venture started with 20 customers in 2016. Further, the numbers decrease corresponding to milk production capacity until 2018. Further, the number of customers served increases to 33 in 2021, before falling to 14 in 2024 and increasing to 23 in 2025.

Table 3. Different variables and constants

Variable	Value	Units
Cost per shed	200,000	INR
Conception probability	0.65	Dmnl
Gender probability	0.5	Dmnl
Utility Costs	5000	INR/month
Veterinary costs	5000	INR/month
Theoretical milk production	700	Litres/month

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Figure 4. Milk produced per year.

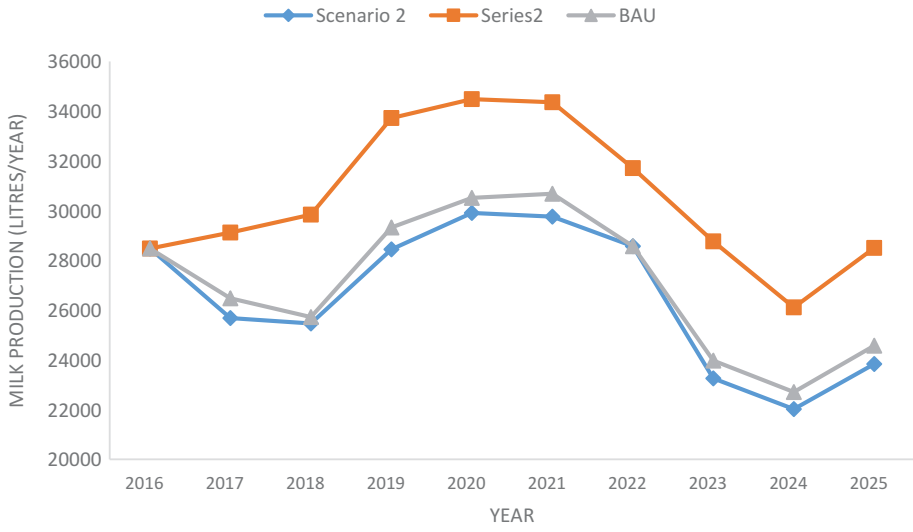
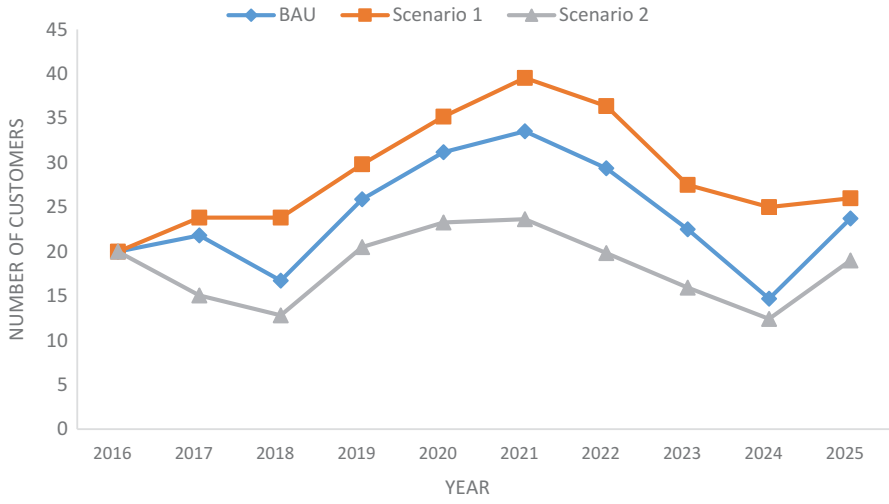


Figure 5. Total customers served over time.



Scenario 1: In the first scenario, the milk yield is significantly higher than the previous case. It follows the same trend as the former curve. However, the highest value achieved is 40 customers in 2021. Further, it drops to 25 customers in 2024 and increases to 26 years in 2025.

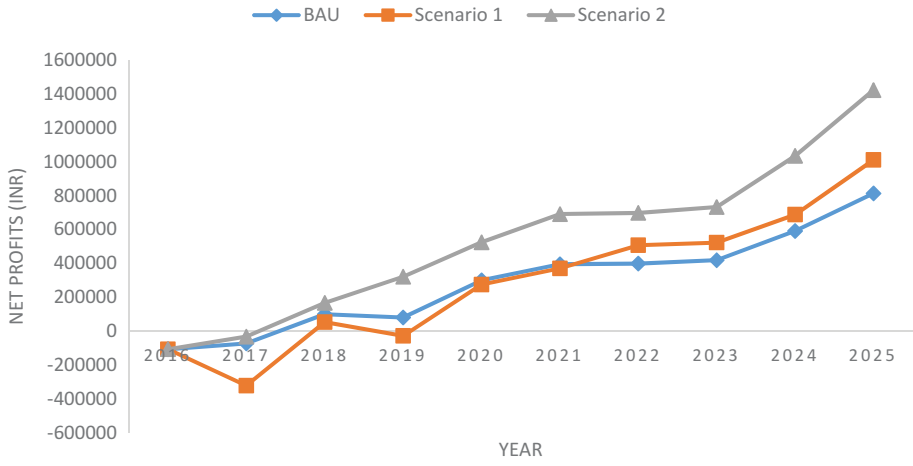
Scenario 2: The second scenario follows the BAU scenario. However, in this case, the number of customers served will be lesser than BAU. One can observe that the total customers will reduce to 13 in 2018. Later, it increases to 23 in 2021, before falling to 12.5 in 2024 and again rising to 19 in 2025.

It is to be noted that the organic milk does not get diluted like the regular milk; hence, the output quantity will be lesser than that of the regular variety after suckling.

8.3. Total profits earned

Business as usual: The trends pertaining to the total profits earned over time are presented in Figure 6. In the business as usual scenario, it is observed that starting from loss levels of INR 1,01,072 the profit grows uniformly over the years. The break-even will be achieved in mid-2017. Further, the profit curve will steadily increase to INR 8,13,708 by 2025.

Figure 6. Net profit patterns between 2017–2025.



Scenario 1: In the first scenario, with an investment on the cattle, the profit further plummets to INR 3,22,256. It hovers around the break-even and till 2019. This is since the cattle population crosses 20 and hence there will be a need to construct another cowshed. Finally, the profits continue to grow to INR 10,11,392.

Scenario 2: In the second scenario, with an increased profit margin for organic milk, it can be observed that the profits continuously increase to INR 14,23,989 by 2025. Hence it can be seen that this is an excellent strategy to continue. It is also to observed that under this scenario, the breakeven is reached faster.

9. Discussions

9.1. Summary of results

The present study aimed at answering two research questions. The first research question was to identify the pressing issues impacting the sustainability of small and medium scale enterprises. Through PSM, the key issues that hampered the dairying sector were identified. The ones that featured most prominently were: High production costs due to increasing fuel prices, Lack of information to start and run the ventures, and Low availability of veterinary consultants. However, the stakeholders identified other issues such as shortage of labour, the distance of the KVK from the city, low-fat content in the milk, lack of knowledge before starting the ventures, and many others.

The second research question was, how can these dairy ventures ensure sustainable growth in the light of some of the strategic decisions taken by such enterprises. To answer this, the PSM sessions formalised the SFD and using data from the interviews and secondary literature, and simulations were conducted for a time-zone between 2017 and 2025 for a typical rural venture. The results demonstrate, currently, the business as usual scenario is not going to be beneficial for him in the long run. Further, given the financial constraints, it is not wise on the part of the dairy farmer to also invest in increasing the capacity of the dairy. The results enable us to suggest that he should focus mainly on rebranding the milk as organic milk and selling it to the market. This works in the current context as there is an increasing demand for organic milk (DuPuis, 2000). The encouraging factor is that the modifications can be done without a significant change in the current infrastructure and the labour requirements in comparison to the other options.

9.2. Implications

The research work opens many implications to the dairy farmer under consideration as well as to the academicians who would want to use SD in MSME domain. For the dairy farmer, it gives a clear insight into the implications of the scenarios. System's perspective enables him to foresee the consequences of his decisions. It can be observed that, contrary to the belief of procuring high milk yielding cattle for making profits, the simulation shows that, a much-subdued approach of rebranding as an organic milk producer represents policy levers and fetch the benefits with least investment and with a new breakeven for the dairy farmer.

From the academic perspective, this research provides an example of how SD models can be developed using PSM in an entrepreneurial setting. The model developed serves as a base for any researcher working on dairy management domain and entrepreneurial strategising using SD as a tool.

9.3. Limitations

This approach of simulating strategies using SD has its limitations. Though the SFD was developed based on the inputs of different stakeholders, the values for simulation were based on a single venture which was selected based on convenience. Hence, the outputs derived holds good only in the context of the enterprise under consideration and cannot be generalised. Further, the model may be enhanced by considering, the influential factors like price change of commodities over time, the lactating cycle of the cows and so on.

10. Conclusions

This paper presented a mixed methods approach to the study of milk dairy practices in rural India, specifically in the context of DK and Udupi districts in Karnataka. The stakeholders were identified and using PSM, the underlying issues and stakeholder perspectives were identified. Further, an SFD was developed, and for simulation, a case of a dairy venture was considered. Three scenarios were simulated for the dairy venture under consideration. The business as usual situation showed meagre returns over the time considered and was deemed inappropriate in the current context. The second scenario involved the purchase of high yield cows like Jersey and Holstein Friesian to boost milk production and subsequent sales. This is a general strategy sought by most of the dairy farmers as they are facing a crisis. Investment on these cattle is more taxing for the farmers as these breeds require more feed and care since they are not native animals. It is also noteworthy that the feed costs have been growing over 30–50 per cent in the last decade.

The third scenario was to rebrand the product as organic milk and serve to a mass market nearby. In the current context, this looked like a feasible option as it didn't have any considerable cost associated with implementation and the product fetched a premium in the market.

As far as the best option is concerned, it is still too early to tell whether one of these approaches will lead to a new direction in the improvisation of the profitability for the venture under consideration due to the complex business dynamics involved. However, this study makes a significant contribution to the literature in terms of building robust models in SD using PSM and to any researcher willing to apply PSM and SD in a related context.

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Notes

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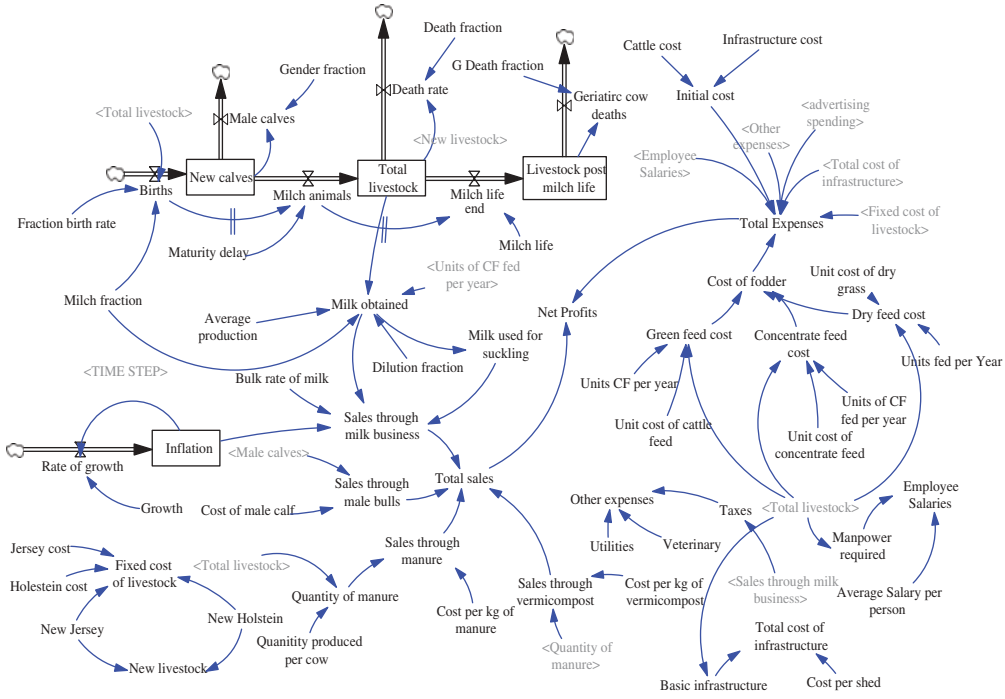
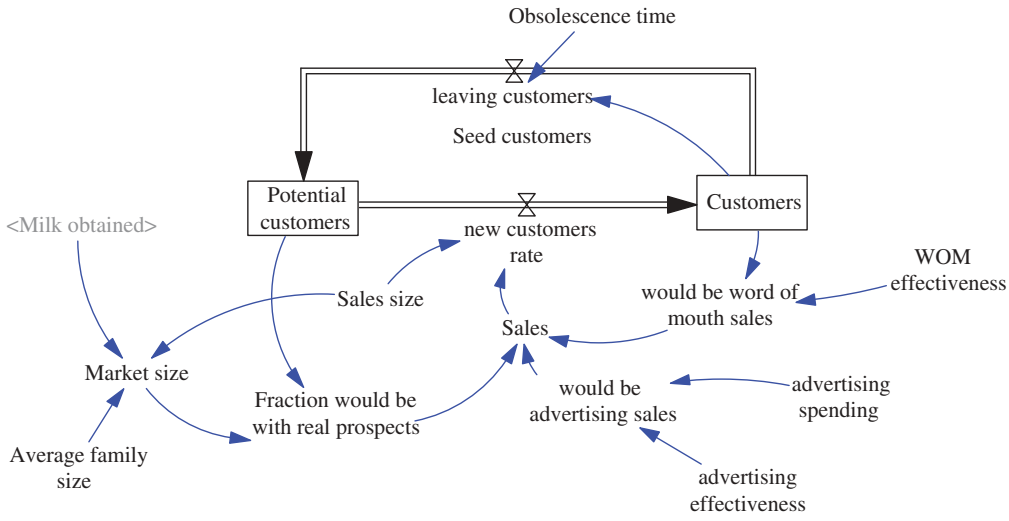
Annexure 1. The stock and flow diagram





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