

## CHAPTER 4

# ACHIEVING COMPETITIVE ADVANTAGES FOR CO-OPERATIVE DAIRY THROUGH MARKET PLANNING

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The findings of the previous chapter through the House of Quality (HoQ) is being implemented in this chapter. The purpose is to identify the effective advertisement channels for the co-operative dairy. Later a, System Dynamics (SD) model, a conceptual framework is used to comprehend how sales registers growth when the co-operative dairy increases their marketing budget.

### 4.1 Identifying Low-Cost Advertisement Channels

This section elaborates the methodology used to identify the attributes and alternatives used for advertisement channels.

#### *4.1.1 Methodology*

A focus group of six experts were approached to identify possible low-cost advertisement channels and the attributes of selected advertisement channels. The Delphi method-based questionnaires (**Appendix D**) was sent to a panel of experts. The questions were updated to reach consensus and were referred back to the experts. Then, responses were aggregated and shared with the group after each round. The experts were allowed to adjust their answers in subsequent rounds. Since multiple rounds of questions were asked, and the panel was told what the group thinks as a whole, the Delphi method seeks to reach the correct response through consensus.

The Delphi method is a research method based on the results of questionnaires. The steps used in Delphi method are given below:

1. First, the group facilitator selects a group of experts based on the topic being examined.
2. Once all participants are confirmed, each member of the group is sent a questionnaire with the instructions to comment on each topic based on their personal opinion, experience or previous research.
3. The questionnaires are returned to the facilitator who groups the comments and prepares copies of the information.
4. A copy of the compiled comments is sent to each participant, along with the opportunity to comment further.
5. At the end of each comment session, all questionnaires are returned to the facilitator who decides if another round is necessary or if the results are ready for publishing.
6. The questionnaire rounds can be repeated as many times as necessary to achieve a general sense of consensus.

Afterwards, the results from the Delphi were further used in the Analytic Hierarchy Process (AHP) to identify the most effective advertisement channels for the co-operative dairy.

The Analytic Hierarchy Process (AHP) developed by Thomas L. Saaty (1970), is a structured technique for organizing and analysing complex decisions. The method has been used in fields such as government, business, industry, education, and healthcare.

For the pairwise comparison the respondents were asked to compare the factors. The ranking was done as per the scale defined by Saaty (1990) listed in Table 4.1. If a factor F1 is preferred over a factor F2 by a preference score of 3, then the factor F2 is preferred over the factor F1 by a preference score of 1/3.

*Table 4.1: Preference Score for Pairwise Comparison*

<b>Preference score</b>	<b>Definition</b>
1	Equally important or preferred
3	Moderately important or preferred
5	Strongly important or preferred
7	Very strongly important or preferred
9	Extremely important or preferred
2,4,6,8	Intermediate values, when compromise is needed

To check the consistency of the judgment of the experts, a Consistency Ratio (CR) was calculated using following steps:

Step 1: The pairwise comparison matrix [A] was multiplied with the Eigenvector (Priority Vector) [B] to get a resultant vector [C].

Step 2: The elements of matrix [C] were divided by the corresponding elements of the matrix [B] to get a vector [D].

Step 3: The average of the sum of the elements of vector [D] gave a value known as  $\lambda_{max}$ .

Step 4: The consistency index (CI) =  $(\lambda_{max} - n) / (n-1)$  was calculated.

Step 5: A Random Index (RI) was taken from the table, given in next page, for the number of criteria used in decision-making.

<b>n</b>	1	2	3	4	5	6	7	8	9	10
<b>RI</b>	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Step 6: Finally, the consistency ratio (CR) was calculated using following formula,  $CR = CI / RI$ . Usually, a CR of 0.10 (10%) or less is considered acceptable. Next section gives the results using Delphi and analytic hierarchical process (AHP).

#### 4.1.2 The Results of Delphi & Analytic Hierarchy Process (AHP)

Using the Delphi method, the following results were concluded:

1. The attributes of an advertisement channel were Cost, Reach and Effectiveness.

Here, the cost means the cost of advertisement on per day basis. The reach is the number of people get exposed with an identified channel. The effectiveness is a degree to which people will convert it into sales.

2. Seven advertisement channels in the context of the dairy were: Social Media, Advertisement on the back side of auto rickshaw (Auto Back), e-mail, FM Radio, Billboard, Newspaper Inserts and TV.

##### a. Selection of the Advertisement Channel

In the next page the Figure 4.1 shows a three-level hierarchical structure, with the focus on choice of advertisement channels.

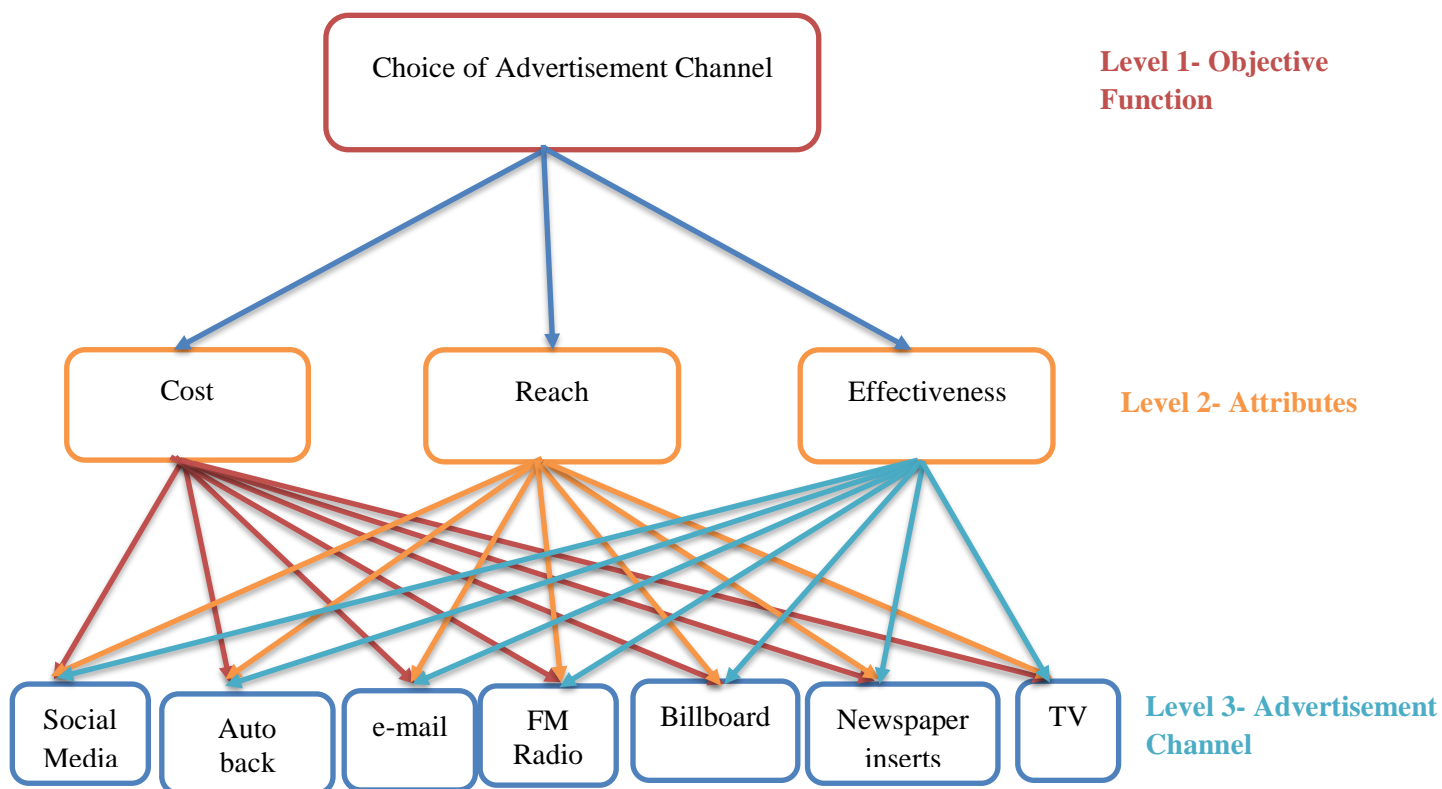


Figure 4.1: Attributes and Alternatives for Advertisement Channels

The next step of the AHP was to prepare a pairwise comparison matrix using the response of the experts.

Table 4.2: Pairwise Comparison Matrix [A] of Paired Comparisons

Decimal Equivalent						
Criteria	Cost	Reach	Effectiveness	Cost	Reach	Effectiveness
Cost	1	1	2	1.0	1.0	2.0
Reach	1	1	2	1.0	1.0	2.0
Effectiveness	1/2	1/2	1	0.5	0.5	1.0
				$\Sigma = 2.5$	2.5	2.5

After obtaining the pairwise judgments as seen in Table 4.2 calculation of priority vector or weights of attributes were carried out. Each item in the column is divided with column sum to get the normalised matrix. Then the row-wise average, as shown in Table 4.3, was calculated to obtain the priority weight. This calculation is done by the summation of row and then divided it by that sum.

*Table 4.3: Normalised Matrix [B] of Paired Comparisons and Calculations of Priority Weights*

Criteria	Cost	Reach	Effectiveness	Row $\Sigma$	Average $=\Sigma/3$
<b>Cost</b>	0.4	0.4	0.4	1.2	0.4
<b>Reach</b>	0.4	0.4	0.4	1.2	0.4
<b>Effectiveness</b>	0.2	0.2	0.2	0.6	0.2
$\Sigma$	1	1	1		1.0

The results are that the attributes have the following approximately priority weights:

- a) Cost = 0.4
- b) Reach = 0.4
- c) Effectiveness = 0.2

The summation of priority weights for each attribute should be 1.0. The pairwise comparison matrix [A] was multiplied by Priority weight matrix [B] to get a new vector matrix [C].

$$\begin{bmatrix} 1.0 & 1.0 & 2.0 \\ 1.0 & 1.0 & 2.0 \\ 0.5 & 0.5 & 1.0 \end{bmatrix} [A] \times \begin{bmatrix} 0.4 \\ 0.4 \\ 0.2 \end{bmatrix} [B] = \begin{bmatrix} 1.2 \\ 1.2 \\ 0.6 \end{bmatrix} [C]$$

Then each element in matrix [C] was divided by corresponding elements in matrix [B] to get a new vector matrix [D].

$$[D] = \begin{bmatrix} \frac{1.2}{0.4} & \frac{1.2}{0.4} & \frac{0.6}{0.2} \end{bmatrix}$$

$$= [3 \quad 3 \quad 3]$$

The average of the sum of the elements of the vector [D] gives a value known as  $\lambda_{max}$ .

$$\lambda_{max} = \frac{3+3+3}{3} = 3$$

The value of the Consistency Index (CI) can be calculated as:

$$\text{Consistency Index (CI)} = \frac{\lambda_{max} - n}{n - 1} \quad \dots \text{Equation 4.1}$$

Where,

n = number of attributes or size of the matrix

Therefore, from equation 5.1 the value obtained is:

$$(CI) = (\lambda_{max} - n) / (n-1) = (3-3)/3-1=0$$

The Random Index (RI) for the matrix of the size three is 0.58. The Consistency Ratio (CR), can now be calculated using the relationship given below:

$$CR = \frac{CI}{RI} \quad \dots \text{Equation 4.2}$$

For the calculated CR from equation 4.2, the value is less than 0.1, which is acceptable.

In the next step is a determination of comparison matrices at level three, which is for the advertisement alternatives. These comparison matrices at this level three are made for each alternative, concerning each attribute. Table 4.4 gives the overall calculated value of all paired

comparisons and results in weights for alternatives regarding each attribute. It lists the result of pairwise comparison of marketing channels for cost, reach and effectiveness.

Again, each element in the column was divided by the column sum to get the normalised matrix. The average of the value in each row gives the priority weight for each attribute with respect to each alternative. Once, the priority weight for each attribute is calculated, the next step is the calculation of consistency of the decision using consistency ratio.

From Table 4.4, given in next page, the consistency ratio for the pairwise comparison for cost was found at 1.5% which is less than 10%, and hence acceptable. Similarly, the priority weight for the reach was calculated and the consistency ratio for the pairwise comparison for reach was found to be 3.8 % which is less than 10% hence acceptable. Finally, the pairwise comparison for the effectiveness was done and the priority weight was calculated. The consistency ratio for pairwise comparison of alternatives for effectiveness was found to be 8.3% which is also acceptable.

Further, the alternative weighted evaluation was calculated through which the overall score for each alternative can be identified. Table 4.5 shows the summery of priority weights as attribute weights, evaluation ratings, and weighted evaluations.



Table 4.4: Summary of All Paired Comparisons and Results Weights for Alternatives with Respect to Each Attribute

<i>With Respect to</i>	<i>Advertisement</i>	<i>A: Social Media</i>	<i>B: Auto Back</i>	<i>C: e-mail</i>	<i>D: FM Radio</i>	<i>E: Billboard</i>	<i>F: Newspaper inserts</i>	<i>G: Tv</i>	<i>Priority Weights</i>	<i>Consistency Ratio</i>
<i>Cost</i>	<i>A</i>	1.00	2.00	3.00	5.00	6.00	3.00	8.00	0.362	<i>0.015</i>
	<i>B</i>	0.50	1.00	2.00	2.00	3.00	2.00	5.00	0.198	
	<i>C</i>	0.33	0.50	1.00	2.00	3.00	0.50	4.00	0.126	
	<i>D</i>	0.20	0.50	0.50	1.00	2.00	0.50	2.00	0.080	
	<i>E</i>	0.17	0.33	0.33	0.20	1.00	0.33	2.00	0.051	
	<i>F</i>	0.33	0.50	2.00	2.00	3.00	1.00	3.00	0.145	
	<i>G</i>	0.13	0.20	0.25	0.50	0.50	0.33	1.00	0.038	
<i>Reach</i>	<i>A</i>	1.00	3.00	2.00	6.00	3.00	2.00	3.00	0.28	<i>0.038</i>
	<i>B</i>	0.33	1.00	0.25	2.00	0.50	0.33	0.33	0.06	
	<i>C</i>	0.50	4.00	1.00	8.00	3.00	2.00	7.00	0.28	
	<i>D</i>	0.17	0.50	0.13	1.00	0.33	0.25	0.33	0.03	
	<i>E</i>	0.33	2.00	0.33	3.00	1.00	0.50	1.00	0.09	
	<i>F</i>	0.50	3.00	0.50	4.00	2.00	1.00	3.00	0.16	
	<i>G</i>	0.33	3.00	0.33	0.33	1.00	0.33	1.00	0.08	
<i>Effectiveness</i>	<i>A</i>	1.00	3.00	0.50	4.00	3.00	2.00	3.00	0.21	<i>0.083</i>
	<i>B</i>	0.33	1.00	0.20	3.00	0.50	0.33	0.25	0.06	
	<i>C</i>	2.00	5.00	1.00	7.00	4.00	3.00	2.00	0.32	
	<i>D</i>	0.25	0.33	0.14	1.00	0.33	0.25	0.33	0.04	
	<i>E</i>	0.50	3.00	0.33	4.00	1.00	1.00	2.00	0.13	
	<i>F</i>	0.50	3.00	0.33	4.00	0.50	1.00	2.00	0.13	
	<i>G</i>	0.33	4.00	0.50	3.00	1.00	0.50	1.00	0.12	

For alternative weighted evaluation the value is calculated with the relationship given below:

$$\text{Alternative Weighted Evaluation} = \sum (\text{Attribute Weight} \times \text{Evaluation Rating})$$

For the alternative SMS advertisement, the value is calculated as:

$$= 0.4 \times 0.362 + 0.4 \times 0.28 + 0.2 \times 0.21 = 0.2988$$

Likewise, all the calculations are done for the other alternatives to get the weighted evaluation or weighted score.

*Table 4.5: Summary of Priority Weights as Attribute Weights, Evaluation Ratings and Weighted Evaluations*

	Attributes			Alternative Weighted Evaluation
	Cost	Reach	Effectiveness	
Attributes Weights Alternatives	0.4	0.4	0.2	
Social Media	0.362	0.28	0.21	0.30
Auto Back	0.198	0.06	0.06	0.11
e-mail	0.126	0.28	0.32	0.23
FM Radio	0.080	0.03	0.04	0.05
Billboard	0.051	0.09	0.13	0.08
Newspaper inserts	0.145	0.16	0.13	0.15
Tv	0.038	0.08	0.12	0.08
				$\Sigma = 1.00$

It is distinct from the above Table 4.5 that social media is the best alternative followed by e-mail and newspaper inserts. We can say that the alternative of social media is 1.32 times preferable to the alternative of e-mail and two times preferable to the alternative of newspaper inserts. Finally, the order of the alternatives with respect to the decreasing order of weighted evaluations or scores are social media, auto back, e-mail, FM radio, billboard, newspaper inserts and TV.

## **4.2 Integrated View of Production-Inventory Model for Co-operative Dairy**

Marketing is a very complex activity. As a primary function, it interacts with production to determine product availability and quality. In addition to this, it is affected by the pricing policies and profitability of the organisation.

Market interaction is intricate and cannot be intuitively appreciated. To appreciate the impact of marketing; at conceptual level, a feedback structure model offers a suitable explanation. For understanding the complexity of marketing, the feedback structure captures some of the essential dynamic modes that exist in the real market scenario. Furthermore, with the help of system dynamics the dairy production inventory model is elaborated on in the next section.

### ***4.2.1 Methodology***

System dynamics use feedback control system principles to analyse different problems that an organisation needs to study. For management practice, system dynamics promotes to integrate some functional areas of an organisation into a conceptual framework, to provide a quantitative foundation to examine more effective organisation policy.

The three advantages of system dynamics approach as suggested by the J.W. Forrester are (Forrester, 1968):

1. Advances in feedback system design and analysis
2. Progress in computer simulation technique
3. Increasing experience in the modelling of decision-making processes

A system is nothing but a structure of interacting functions. Both the separate functions and the interrelationships as defined by the structure contribute to the system behaviour.

Therefore, to explain a system, one should describe the separate functions as well as the methods of interactions of these functions. To identify the structure of a system, it is important to comprehend the primary nature of the structure common to all dynamic systems.

A dynamic system is one that changes with the time. Each part interacts with each other's to create a progression of system conditions. The basic structure of such systems is common, whether in engineering, management or in any purposeful relationship of components. The steps involved in the theory of system structure are as follows (Roberts, 1981):

Closed boundary

Feedback loops

Levels

Rates

Goals

Observed condition

Discrepancy

Desired action

#### ***4.2.2 Results of System Dynamics Modelling***

The Causal loops for the model are shown in Figure 4.2. Where, Loop 1 and loop 2 are goal seeking negative loops while loop 3 is growth seeking positive loop. The complete interaction is shown in the flow diagram.

A flow diagram of a production system model as shown in Figure 4.3 captures production-distribution and the essence of marketing. The factory order rate for milk

(FORM) increases the order back log for milk (OBLM) that is reduced by the production start rate for milk (PSRM). The production start rate for milk (PSRM) depends on the indicated production level (IPL) which is a function of the order back log for milk (OBLM) and the required back log for milk (RBLM). The equation for the indicated production level for milk (IPLM) can be written as:

$$IPLM = OBLM - RBLM$$

Where,

IPLM= Indicated Production Level for Milk (units)

OBLM= Order Back Log for Milk (units)

RBLM= Required Back Log for Milk (units)

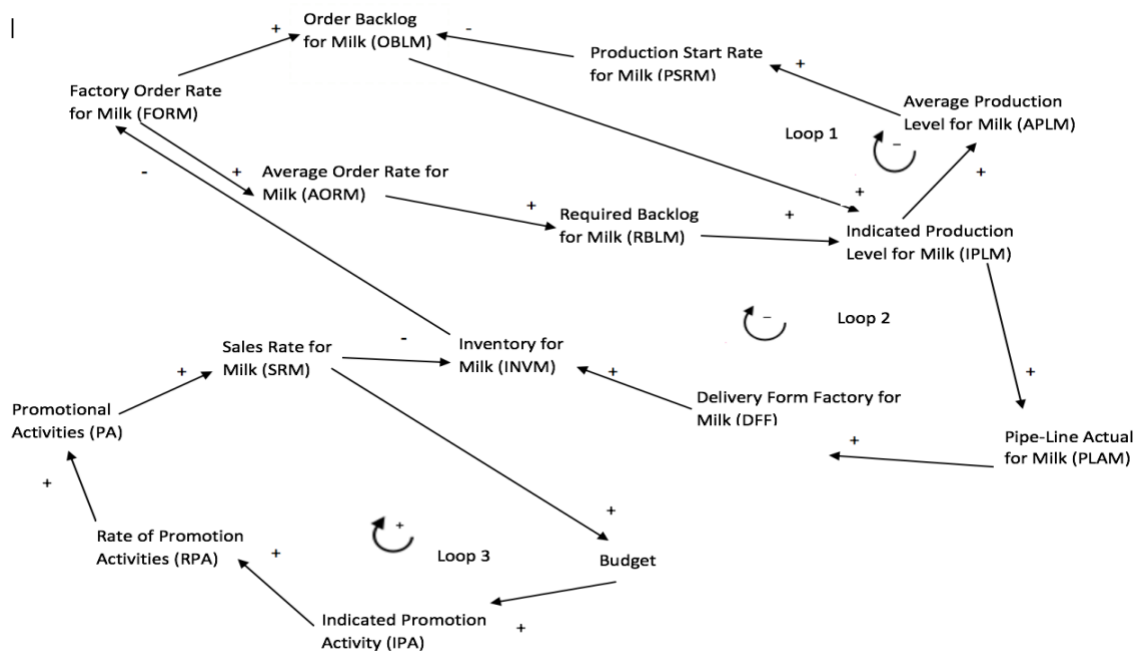


Figure 4.2: Simplified Causal Loop Diagram



A flow chart of a conceptual structure of dairy production inventory model is shown in the Figure 4.3. Figure 4.4 shows the set of equations used for the simulation model, where other parameters can also be seen.

Variable	Equation	Initial Value
AORM	SMTH1(FORM, 4)	
APLM	SMTH1(IPLM, 3)	
ASRM	SMTH1(SRM, 3)	
B	ASRM*RS	
DFF	DELAY1(PLAM, 2)	
DINVM	WINVDM*ASRM	
FPSRM	APLM	
FORM	ASRM+(DINVM-INVM)/TAIM	
INVM(t)	INVM (t - dt) + (DFF - SRM) * dt	
INIT INVM	WINVDM*ASRM	
INIT OBLM		60000
IPA	B/PAEX	
IPLM	(OBLM-RBLM)/TABLM	
OBLM(t)	OBLM (t - dt) + (FORM - PSRM) * dt	
PSRM	APLM	
PA(t)	PA (t - dt) + (RPA) * dt	
PLAM(t)	PLAM (t - dt) + (FPSRM - DFF) * dt	
PAAT		20
PAEX		300
PEFF	GRAPH(TIME) (1.0, 1.0000), (112.0, 1.0526), (223.0, 1.1053), (334.0, 1.1338), (445.0, 1.1601), (556.0, 1.1842), (667.0, 1.1908), (778.0, 1.1952), (889.0, 1.1996), (1000.0, 1.2018)	
RBLM	GRAPH(AORM) (50.0, 400.0), (75.0, 525.0), (100.0, 600.0), (125.0, 650.0), (150.0, 675.0)	
RS		2
RPA	(10000+PA) * PEFF	
TABLM		4
TAIM		12
WINVDM		6

*Figure 4.4: Set of Equations and Initial Values for the Production-Inventory Model*

The bottom part of the conceptual framework model shows the physical flow of inventory. The PSRM represented as FPSRM (for some computational convenience) feeds into a pipe-line actual for milk (PLAM) inventory and reduced by delivering from the factory for milk (DFFM), which is modelled as first order delay.

DFFM flows into inventory of milk (INVM) which is reduced by the sales rate for milk (SRM). The FORM depends on the average sales rate (ASR) and the inventory discrepancy.

$$\text{Inventory Discrepancy} = \text{Desired Inventory} - \text{Actual Inventory}$$

This discrepancy is modelled using multiplicative inventory function (PMI), which is connected to the production start rate for milk (PSRM).

In fact, the equation of PSRM is:

$$\text{PSRM} = \text{APRM}$$

Where,

PSRM= Production Start Rate for Milk

APRM= Average Production Rate for Milk

This model is a modified model suggested by Sharma and Mohapatra (unpublished thesis). The model has been tested. The behaviour of inventory and order backlog was stabilised and did not show any explosive or unpredictable behaviour. Here, FORM is modelled as:



$$\text{FORM} = \text{ASRM} + \frac{\text{DINVM} - \text{INVM}}{\text{TAIM}}$$

Where,

ASRM = Average Sales Rates for Milk

DINVM = Desired Inventory for Milk

INVM = Inventory for Milk

TAIM = Time to Adjust Milk discrepancies

Here, TAIM is the most sensitive variable because model will behave explosively if TAIM is less than 8 days (Mohapatra, Sharma 1986).

This positive loop 3 gives the market growth tendency with increase in budget B, a high fraction of revenue devoted to sales budget. The rate of promotional activities (RPA) increases and, therefore, the promotional activities (PA) increases. The promotional activities (PA) increase the sales rate for milk (SRM). Such a positive loop has a growth characteristic. The growth rate in this loop depends on the delays around this loop. The promotional activity adjustment time (PAAT) represents the delays in budgeting and delays in finding the channels and training the salesman. The value of 20 days is shorter than most of the actual system.

The Promotional Activities Expenditure (PAEX) is assumed to be 300 per day.

$$B = \text{ASRM} \times \text{RS}$$

Where,

B = Budget for sales activity (INR/day)

ASRM = Average Sales Rate for Milk (units/day)

RS = Revenue to Sales, which is INR 2 per unit

$$IPA = B / PAEX$$

Where,

IPA = Indicated Promotional Activities

PAEX = Promotional Activities Expenditure, which is INR 300 per day

As the time passes, promotional activities increase. The promotional effectiveness increases from 1 to 1.2 in thousands of days. Therefore, Figure 4.5 shows a graphical representation of the Inventory for Milk (INVM), Order Backlog for Milk (OBLM) and Pipe-Line Actual for Milk (PLAM).

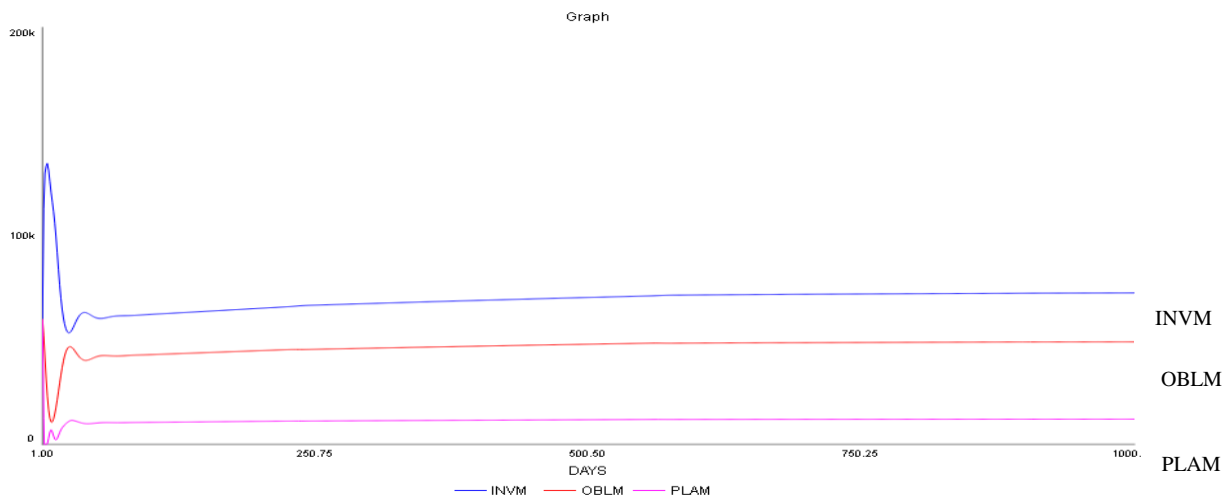


Figure 4.5: Graphical Representation of Inventory for Milk (INVM), Order Backlog for Milk (OBLM) and Pipeline Actual for Milk (PLAM)

The Figure 4.6 shows the Sales Rate for Milk (SRM) grows from 10k to 12.5 k in 1000 days, this means a growth rate of 21% in 1000 days or 7.66% per year.

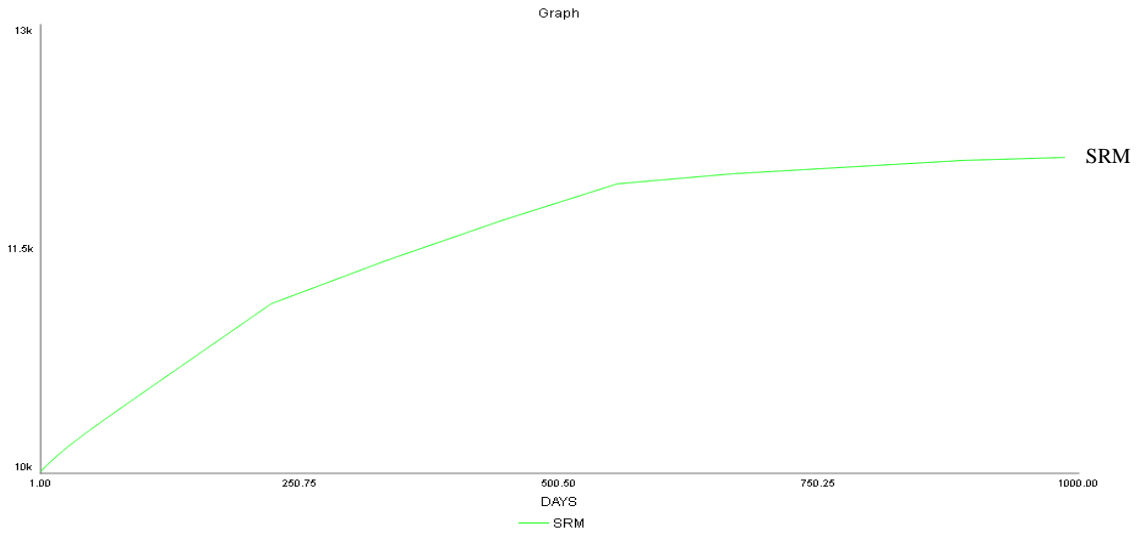


Figure 4.6: Graphical Representation of Sales Rates for Milk (SRM)

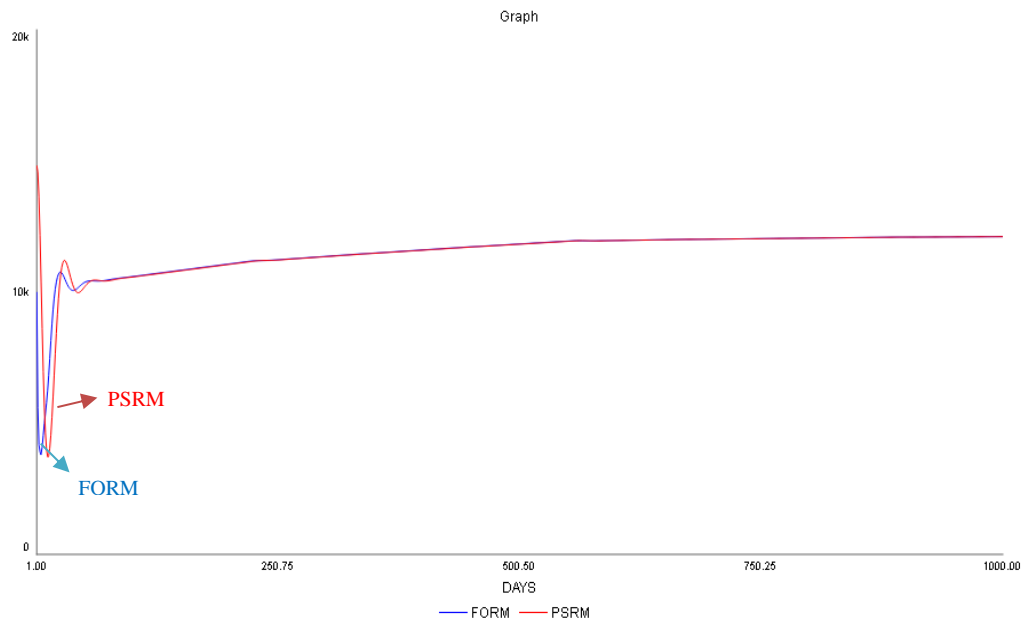


Figure 4.7: Graphical Representation of Factory Order Rate for Milk (FORM) and Production Start Rate for Milk (PSRM)

The Figure 4.7 shows a graphical representation of Factory Order Rate for Milk (FORM) and Production Start Rate for Milk (PSRM).

The conceptual model shows that the integrated view of dairy through a production inventory model behaves nicely with an increasing trend of SR obtained through the increased allocation of budget and learning curve effect. It can also to be seen that the model does not behave abruptly.

### **4.3 Conclusions**

Using the Delphi approach three attributes identified for the study were cost, reach and effectiveness. The result for the multi attributes decision study using Analytical Hierarchical Process (AHP) shows that top three low-cost advertisement channeles, which are best for the co-operative dairy. The three marketing channeles having highest priority weights were Social Media, e-mail and Newspaper Insert were selected for the low-cost marketing.

The conceptual production-inventory model has two negative feedback loops, and the model does not show any abnormal behaviour. The conceptual framework supports the idea that an increase in budget supports a growth in sales, and hence increases the profit of the co-operative dairy.