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Behavioural Inventory Management: A Practical Approach to Mitigate Material Waste in Some FMCG

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ABSTRACT

This paper attempts to examine the behavioural dimension in inventory management practices with the aim of reducing material waste. An effort is made to link the material cost equation established in theoretical stock-induced consumption inventory models to the consumption equation established for a real-life scenario of toothpaste consumption. Overconsumption of toothpaste is considered here as a consumption side stock-induced waste. A stock-induced consumption equation of the linear form is used here to develop simulation programs using MATLAB software to get the results in the shape of indifference curves between two hypothesized behavioural parameters λ and β. Indifference curves obtained are then used to devise a behavioural grid for toothpaste consumption, which is further utilized to classify the consumers and accordingly develop policies and strategies to curb the material waste. The paper has great socio-economic significance and highlights the importance of behavioural inventory management in reducing resource waste.

Keywords: *Behavioural Inventory Management; Indifference Curve; FMCG Tubed and Bottled Products; Stock-induced Toothpaste Waste; Behavioural Grid for Toothpaste Consumption; Simulation.*

1.0 Introduction

The induced consumption because of high levels of stock was considered input-side waste by Sharma & Vrat (2018a) and proved that individual behavioural traits play a very crucial role in making the consumption stock-induced and hence wasteful consumption. Sharma & Vrat (2020a) found that not only the high stock level has an impact on material waste behaviour, but also some visceral factors, for instance,

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individual consumer's habits and attitudes, disciplined consumption, which is inelastic despite high stock availability, may play a much more significant role and advised that they should be addressed properly in stock-induced inventory research. Hence, the concept of "behavioural inventory management" has been originated and was first introduced by Sharma & Vrat (2020a) by extracting it from the stock-induced consumption phenomenon of inventory management practices with an aim to reduce resource wastage. This concept has immense potential for future exploration and may prove to be a very promising field that would enrich the present inventory management practices. The behavioural traits which were identified, have being captured by two behavioural parameters and the impact of these behavioural parameters was studied on water resource wastage. The same methodological approach is adopted here to analyse the impact of these behavioural parameters on resource wastage in the form of overconsumption of some of the FMCG products which are available in tubed or bottled packaging.

Two parameters, namely the scale parameter (α) and the shape parameter (β), are most commonly used to establish the consumption equation in stock-induced consumption inventory models. In these models, various forms of consumption equations, such as linear form $D(t) = \alpha + \beta I(t)$, power form $D(t) = \alpha [I(t)]^{\beta}$ etc., where $\alpha > 0$ and $0< \beta<1$, are being used in model development. Sharma & Vrat (2018a) have recognized that these models have limited real-life applicability because of the difficulty associated with the precise estimation of these parameters as they are invariably behaviour dependent parameters. Sharma & Vrat (2020a) have stated that α is the autonomous consumption triggered by the individual's intrinsic consumption needs, which essentially depend on one's corporeal characteristics and consumption habits, whereas β is the parameter that shows the level of an individual's disciplined and inelastic consumption behaviour despite the presence of a high stock level. To more vividly conceptualize the α parameter, it was hypothesized that autonomous consumption is equal to the product of standard consumption (α'), the consumption that is ideally required, and a behavioural parameter (λ) that could represent the consumer's habits and attitudes. This behavioural parameter was called the habit parameter, and thus the linear consumption equation was established as:

$$D(t) = \lambda\alpha' + \beta I(t) \quad \ldots.(1)$$

For $\lambda=1$ and $\beta=0$; equation (1) gives the standard required consumption. The difference between actual consumption calculated from equation (1) for some real values of λ and β and standard required consumption could provide the amount of stock-induced wasteful consumption. Different values of these parameters would result in an alteration in material consumption and hence different values of material waste, which

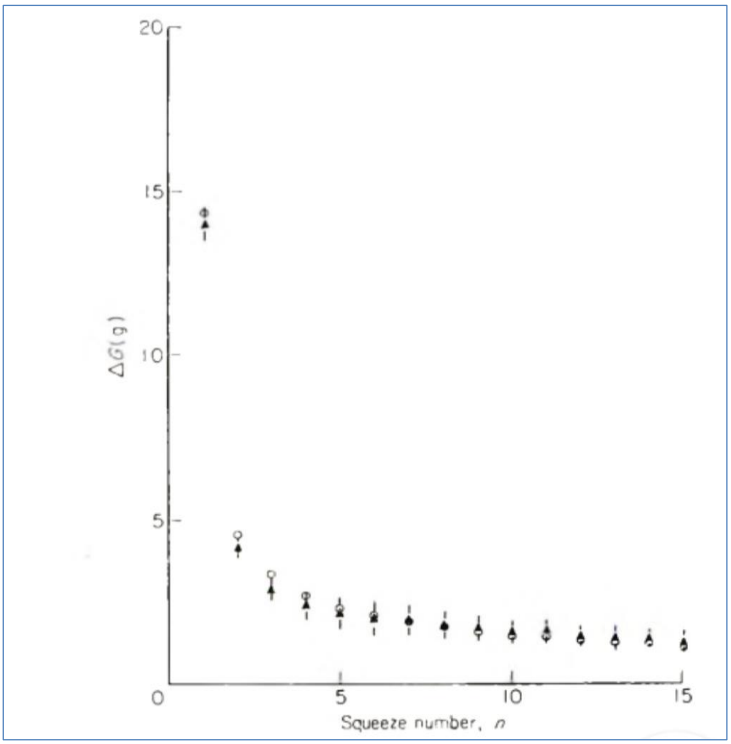
may be captured in indifference curves drawn between the λ and β parameters. Any combination of these two behavioural parameters on an indifference curve would give an equal amount of resource consumption, thus analogous with indifference curves. Moreover, if it is possible to obtain a consumption equation with its specific λ and β values for any particular stock-induced consumption situation, it would be easier to assess the behavioural impact on consumption by varying these behavioural parameters within their realistic stipulated range. Sharma & Vrat (2020b) have discussed such a consumption situation wherein a correlation between the toothpaste consumption rate and the obtainability of toothpaste stock in the tube at that instant was established with a view doing parameter estimation that needs to be known as inputs to a stock-dependent consumption rate inventory model.

1.1 Rationale of the study

A large number of FMCG tubed or bottled products are being used regularly in our daily lives for example, toothpaste, shampoo, hair oil, cosmetic cream and lotion, shaving cream, etc. Whenever a consumer is to use a tubed or bottled product, a certain force is to be applied for a fixed period of time so as to get the squeeze output. The applied force as well as the time interval for which the force is applied essentially depend on the individual's habits and behavioural instinct and also guided by the shape, size, and degree of filling of the tube or bottle (Norén, 1976). Consumer action is regulated by many such factors and is an utterly complicated behavioural phenomenon. It would not be an exaggeration to say that, to a large extent, the stock-induced consumption phenomenon itself is behavioural induced phenomenon. The degree of filling means stock availability for consumption. Sometimes, like in the case of the toothpaste tube, it becomes difficult to put back the extra toothpaste that we get from squeezing, and no other alternative left before us except consuming it; consequently, the consumption becomes stock-induced.

Figure 1 shows the output (ΔG) for 15 consecutive squeezes from a toothpaste tube. It is obvious that the output is much higher when the tube is full, which decreases subsequently. This may be due to the fact that when the tube is full, the contents have no space to redistribute within the tube but instead come out through the orifice. But, for a lesser-filled tube, there is a possibility for redistribution and consequently, the output decreases. This could be easily experienced in practice with full and partially-full tubes. One can easily get more output from the full tube than from the partially full one. Not only the degree of filling (squeeze number) but also both the squeeze time and squeeze force have an influence on the output.

Figure 1: Toothpaste Output (ΔG) from 160gm Tube at 15 Consecutive Squeezes, Squeeze Force 62 n and Squeeze Time 0.5 s

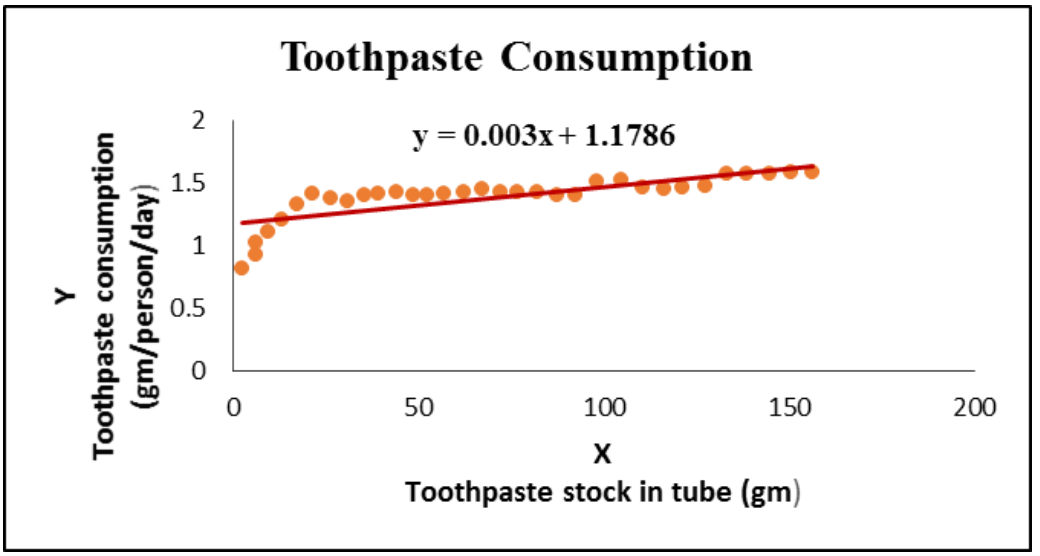


Source: Norén (1976)

Sharma & Vrat (2020b) have drawn the stock-induced consumption curve for toothpaste consumption by an individual, and the equation of this curve gives information about the α and β for the same. Data points for average toothpaste consumed per person per day for a family were obtained by daily weighing a 150 gm toothpaste tube after its consumption to plot the curve as shown in Figure 2. From the figure, it is evident that in the beginning, the consumption rate is high as the tube is full, but the consumption rate starts decreasing with the successive decrescent in the contents inside the tube.

It is also evident from the curve that towards the finishing end, the consumption is slightly below the genuinely required standard consumption (approx. 1 gm per person per day). The stock-dependent consumption phenomenon is very clearly apparent from this graph. Initial consumption could be termed as stock-induced when the stock level is high; afterwards, when it is low, the consumption could be termed as stock-dependent.

Figure 2: Stock-level Dependent Toothpaste Consumption



Source: Sharma & Vrat (2020b)

Linear curve fitting gives the stock-dependent consumption equation as:

$$Y = 1.17 + 0.003\ X \qquad \ldots.(2)$$

Where,

Y = Toothpaste consumption (gm/person/day) and

X = Weight of the tube (gm)

Comparing equation number (2) with equation number (1), the value of $\lambda\alpha'$ comes out to be 1.17, and the value of β comes out to be 0.003. Expression $\lambda\alpha'$ refers to the consumption level that is intrinsically required by an individual and is independent of toothpaste stock availability inside the tube, whereas parameter β refers to the coefficient of elasticity of consumption due to squeeze number. The values of λ and β may be different for different individuals, as these parameters depend on an individual's behaviour. Hence, it is evident that both λ and β used in consumption equation (1) are more or less behavioural induced parameters and may be estimated within a definite range. Moreover, to estimate about α', the opinion of a number of dentists may be cited in this regard, as they say that actually the toothbrush, not the toothpaste, cleans the teeth (Chamberlin, 2013). A pea-size amount of toothpaste, which may be equivalent to 0.25 gm, is considered sufficient for maintaining effective mouth hygiene (Creeth *et al.*, 2013), but 1 gm of toothpaste is considered here as standard required amount of

toothpaste (α') per brushing, as it is opined that this much amount is required to maintain the appropriate concentration of fluoride (Stark, 2012). This gives the benchmark value of toothpaste consumption by an individual, which could be compared to some actual consumption value and the difference could be attributed to the sock-induced wasteful consumption, which in turn, could be attributed to individual behavioural traits.

The difference between the actual toothpaste consumption by the family given by equation (2) and the genuinely required standard quantity of toothpaste for consumption was attributed to stock-induced toothpaste waste, and the indifference curves were obtained for the above-mentioned case of toothpaste consumption and toothpaste waste. The findings emphasise the need to work on these behavioural traits represented by the λ and β parameters to get a reduction in stock-induced toothpaste waste that is taking place in a regular manner, thus advocating the need to incorporate the idea of behavioural inventory management in this scenario. To regulate this behavioural inventory, a behavioural toothpaste consumption grid was conceived to evaluate, direct, and motivate individuals to improve their consumption habits for better resource utilization and to support sustainability. An efficient management of these parameters may prove to be a proactive approach curbing the resource waste. This study would be beneficial for professionals and future researchers in that it states that efforts must be better placed to institute more conservative toothpaste consumption habits.

The rest of this article is organized as follows. Section two, reviews literature and research background. Section three, discusses the objectives of the study. Section four, discusses the methodology adopted. Section five, provides the results in the form of indifference curves and derives a behavioural toothpaste consumption grid. Section six, provides the suggestions and finally section seven, provides the conclusions and future extensions.

1.2 Objectives of the Study

This paper attempts to achieve the following objectives:

1. To study the behavioural impact on stock-induced toothpaste waste by drawing and analysing indifference curves.
2. To classify the consumers by framing a behavioural grid for toothpaste consumption.
3. To recommend strategies for behavioural inventory management.

2.0 Literature Review

A plethora of stock-induced consumption inventory control models give richness to the subject. Some of the milestone models are Gupta & Vrat (1986), Baker & Urban

(1988), Datta & Pal (1990), Padmanabhan & Vrat (1990, 1995), Roy & Maiti (1998), Wang & Gerchak (2000), etc. Hou *et al.,* (2011) have developed a model for deteriorating items with a linear stock-dependent selling rate under inflation and the time value of money over a finite planning horizon.

Ouyang *et al.,* (2003) developed a stock-dependent demand model incorporating the effects of inflation and time value of money, considering a linear stock-dependent demand equation. A model for seasonal products was formulated by Roy *et al.,* (2009), considering linearly displayed stock-dependent demand, which was made in an imprecise environment under inflation and the time value of money. Power form stock-dependent demand models were developed by Baker & Urban (1988), Datta & Pal (1990), Datta & Paul (2001), Giri *et al.,* (1996), Giri & Chaudhuri (1998), Pal *et al.,* (1993), Ray & Chaudhuri (1997), Ray *et al.*, (1998) and Urban (1992). A single-period model was developed by Urban & Baker (1997) for deterministic demand of a product, which is a multivariate function of time, price and level of inventory.

Hwang & Hahn (2000) have developed a model for power form stock-dependent demand rate for fixed lifetime products. Teng & Chang (2005) have formulated an EOQ model considering the demand rate as the power function of the instantaneous inventory level until down to a certain level of stock, after which the demand rate becomes a constant. Pal & Ghosh (2007a) developed a model considering the general rate of deterioration. Pal & Ghosh (2006, 2007b) also derived models for permissible delay in payment, which were quantity-dependent. Soni & Shah (2008) derived a trade credit model in which payments may be made progressively and retailers are offered two credit periods to settle their account.

Tripathi *et al.,* (2018), Jaggi *et al.,* (2019), and Cárdenas-Barrón *et al.,* (2020) have improved the earlier developed trade credit stock-dependent demand inventory models by considering different realistic situations. Recently, advanced optimization techniques such as genetic algorithms were used by Singh & Singh (2012), Agarwal *et al.,* (2018) and Bhunia *et al.*, (2017) in model development, while an artificial neural network model considering stock-dependent demand was developed by Šustrová (2016). Sharma & Vrat (2018a) have identified the need to link these extensively available inventory models to real-life scenarios where stock-induced consumption is taking place. Moreover, Sharma & Vrat (2021) have given an entirely new criterion for inventory classification, i.e. the stock-induced consumption index, for effective inventory management.

3.0 Research Methodology

To draw the indifference curves, the material cost per cycle equation given by Padmanabhan and Vrat (1995) was taken, which is rewritten here by replacing α with λα' as:

$$\text{Material cost per cycle} = \lambda\alpha'/\beta + \theta * \{e^{\beta T} - 1\} * C \quad \ldots.(3)$$

Where θ is a constant rate of deterioration, T is cycle time, and C is the unit cost of the item. Only material cost is considered here, ignoring all other inventory costs, because the objective of this study is to analyse and model the impact of an individual's behavioural traits on stock-induced toothpaste consumption.

Now, MATLAB (R2020b) simulation programmes were developed to obtain the indifference curves for toothpaste consumption cost, toothpaste waste, and toothpaste waste cost per person per month by varying λ and β behavioural parameters within their stipulated ranges shown in Table 1. Equation (3) gives the toothpaste consumption cost per person, while toothpaste waste is estimated as the difference between the actual toothpaste consumed per person and the standard required toothpaste consumption (α'). Table 1 shows the values of various parameters used in simulation runs.

Table 1: Values of Parameters Used in Simulation

Parameters	α (gm/yr)	α' (gm/yr)	λ_{act}	β_{act}	Θ	T (month)	C (Rs./gm)	Range for λ	Range for β
Values	424.3	360	1.17	0.003	0.001	1	0.6	0.6 – 1.33	0 – 1

Here, the actual autonomous toothpaste consumed by an average adult (α) has a value of 424.3 gm/year as obtained from equation (2). It comprises the standard required toothpaste consumed (α') and the actual habit parameter (λ_{act}) as elaborated in the above section. Standard required toothpaste consumption per day is the measure for optimum consumption, which is sufficient to clean an average adult's teeth. For an individual it is taken as 1gm/person/day (Stark, 2012). Cycle time is taken as 1 month, as it is assumed that it takes approximately 1 month to finish a 120 gm toothpaste for a four-member family. By using the relation $\alpha = \alpha' \lambda_{act}$, the value of λ_{act} comes out to be 1.17.

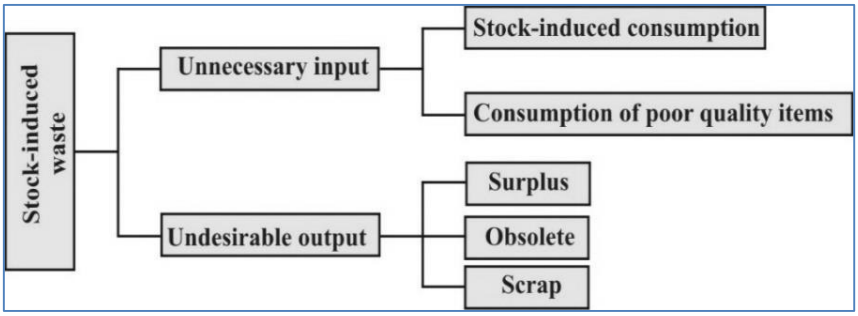
Moreover, equation (2) gives the value of the actual shape parameter (β_{act}) equal to 0.003. Since toothpaste deteriorates at a very slow rate during its cycle time, therefore, θ is taken too small here, say 0.001. The cost of toothpaste is taken as Rs. 0.6/gm as the price of 120 gm toothpaste used is Rs.72. To determine the range of λ values, it is considered that the proportion of best to worst consumption habits, excluding anomalies,

is always 2:1 (Barnes, 1980; Padhi & Vrat, 2011). Hence, range of λ values should be taken here in a proportion of 1:2 in reference to the standard autonomous consumption, ranging from $\lambda_{min} = 0.6$ to $\lambda_{max} = 1.33$. More often, the parameter β varies from 0 to 1, which signifies completely plastic and completely elastic stock-induced consumption, respectively. The simulation experiment was executed by concurrently changing the λ and β parameters within their stipulated range.

3.1 Rationale of the study

Both input and output side wastage, which are defined by Sushil & Vrat (1988) have been associated with the phenomenon and are shown in Figure 3.

Figure 3: Input and Output Side Stock-induced Waste



Source: Sharma & Vrat (2018a)

Initiating the research in this direction, Sharma & Vrat (2016, 2018b) identified a latent behavioural dimension in stock-induced resource wastage and concluded that a better understanding of the scale and shape parameters used in stock-induced consumption equations may lead to solving some socio-economic issues that may have originated due to high stock availability for consumption, such as material consumption in some FMCG products like toothpaste.

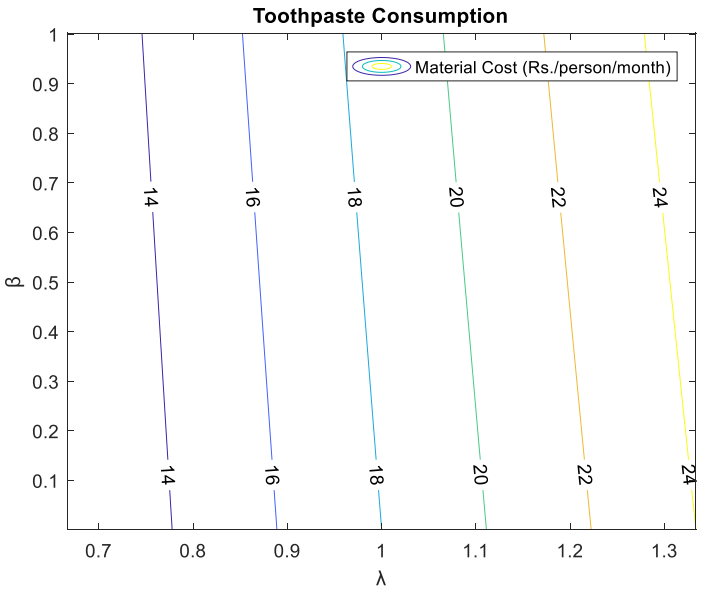
4.0 Analysis and Dicussion

Simulation runs give the results in the form of right downward sloping indifference curves. Figure 4 shows the indifference curves obtained for toothpaste consumption cost; Figure 5 shows the indifference curves obtained for stock-induced toothpaste waste; and Figure 6 shows the indifference curves obtained for toothpaste

waste cost. These indifference curves represent the different conflations of behavioural traits represented by the λ and β parameters, which could give an equal level of toothpaste consumption cost, toothpaste waste and toothpaste waste cost. The curve passing through λ=1 is the standard toothpaste cost curve, which gives zero waste. The costs acquired right of this curve augment the toothpaste waste costs, and the costs acquired left of this curve augment the toothpaste cost savings.

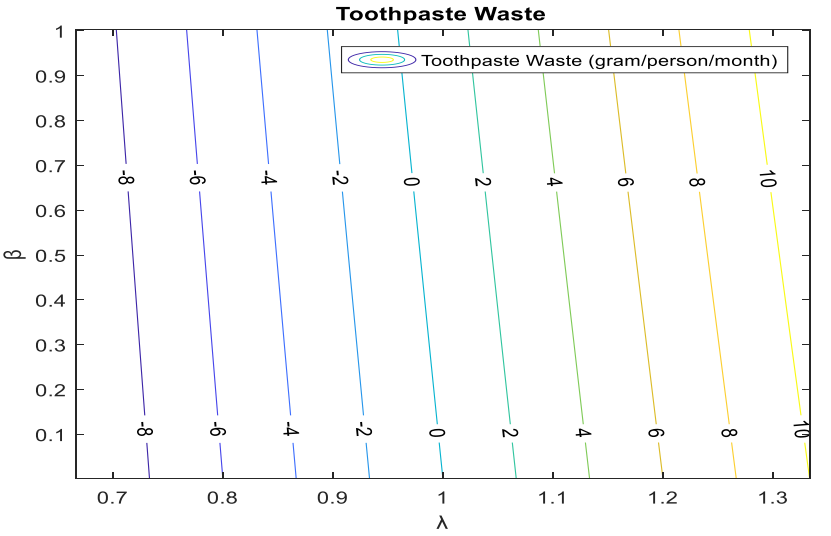
The indifference curves obtained in this case reveal that the actual toothpaste consumption (shown by equation (2)) cost happens to be approximately Rs. 21 per person per month. With the increase or decrease of λ and β parameters we may get toothpaste cost as small as Rs. 14 per person per month or as big as Rs. 24 per person per month. The person whose consumption is represented by the given regression line wastes approximately 5 gm toothpaste per month as shown in Figure 5, which in monetary terms equals approximately Rs. 3 in a month as shown in Figure 6. With the best possible use the person can save up to approximately 8 gm and with the worst possible use, the person can waste up to approximately 10 gm per month. In this way a person can save up to approximately Rs. 4 and can waste up to approximately Rs. 6 in a month, as shown in Figure 6**.** Though this monetary waste may seem negligible but cumulatively it becomes huge.

Figure 4: Toothpaste Cost Indifference Curves



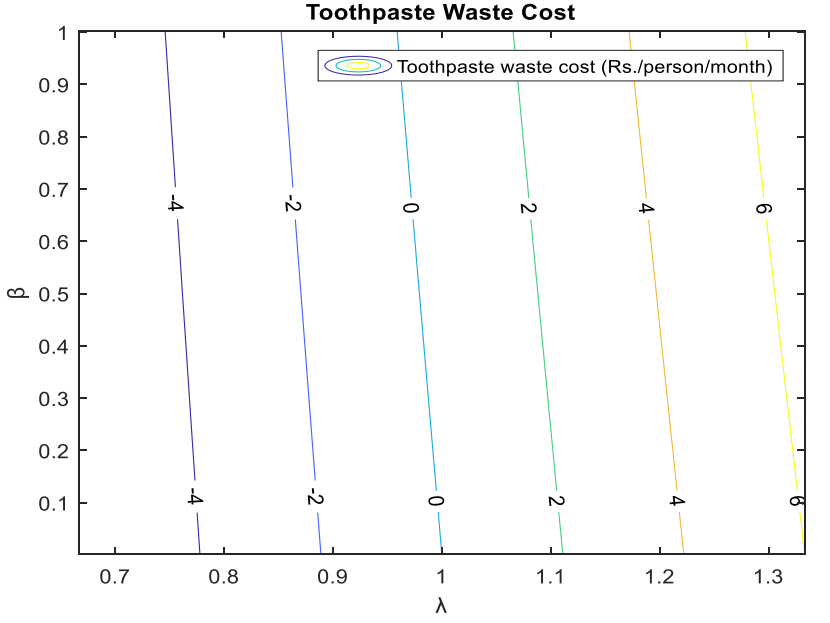
Sourece: Present Study

Figure 5: Toothpaste Waste Indifference Curves



Sourece: Present Study

Figure 6: Toothpaste Waste Cost Indifference Curves

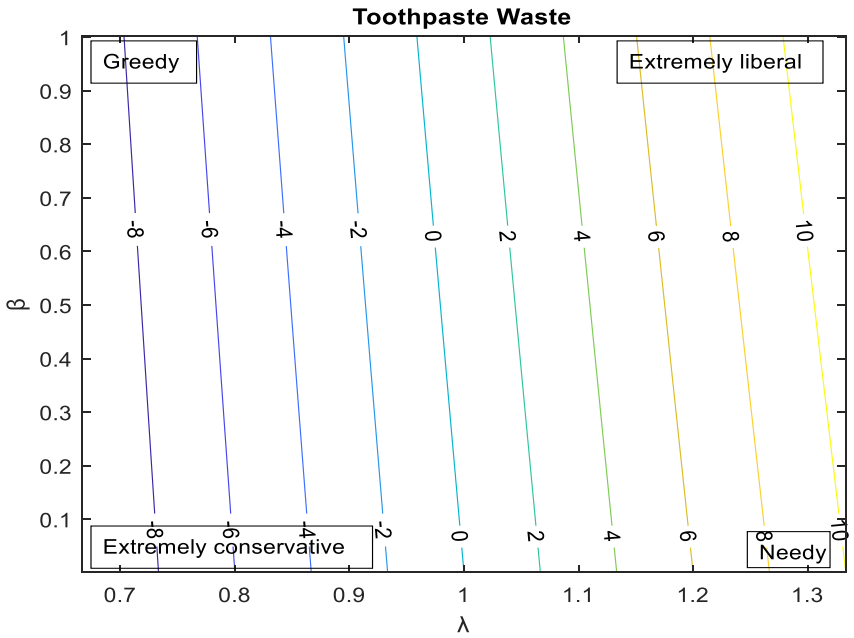


Sourece: Present Study

The indifference curves obtained here are almost in the form of straight lines, which signify that the λ and β parameters can be perfectly substituted for each other. In other words, one can infer that people who are conservative and less wasteful in their consumption habits remain indifferent to the high stock availability, while for those who are liberal in their consumption habits, a small increase in stock-level will add to their wasteful consumption. The degree of convexity of these indifference curves is affected by the rate of decrease in the marginal rate of substitution of λ for β.

Moreover, the indifference curves obtained as a result of simulation runs could provide a basis to classify the toothpaste consumers and to derive a Behavioural Grid for Toothpaste Consumption, which is shown in Figure 7.

Figure 7: Behavioural Grid for Toothpaste Consumption



Sourece: Present study

And the resulting toothpaste consumption patterns are:

a) **Extremely conservative**: with low values of λ and β. These consumers are extremely conservative and good in their consumption habits, being least affected by the toothpaste stock served. They do not contribute to the wasteful toothpaste consumption.

b) **Greedy**: with a low value of λ but a high value of β. These consumers are good enough in their consumption habits, but they tend to over consume just because of availability of toothpaste stock inside the tube for consumption.
c) **Needy**: with a high value of λ but a low value of β. These consumers have their intrinsic consumption habits so developed and nurtured that they end up consuming more despite being least affected by the toothpaste stock availability.
d) **Moderate**: with moderate values of λ and β. These consumers are moderately influenced by their consumption habits as well as toothpaste stock levels.
e) **Extremely liberal**: with high values of λ as well as β. These consumers are highly influenced by habits and stock levels and are responsible for huge toothpaste waste.

This classification of consumers would provide a basis to formulate policies and strategies to achieve moderate or extremely conservative way of toothpaste consumption behaviour. From this analysis, it is obvious that the α and β parameters applied in stock-dependent demand inventory models need to be precisely assessed for an individual or group, and accordingly, behavioural intervention strategies need to be implemented, which are discussed in the next section.

4.1 Behavioural intervention strategies to reduce material waste in FMCG tubed or bottled products

"4 E's" model for behavioural change is recommended here with the aim of affecting individual consumers' toothpaste consumption, which could be extended to the consumption of any tubed or bottled FMCG product. Four behavioural intervention strategies could be enlisted for this purpose: Enable, Encourage, Engage, and Exemplify. A single strategy or a mix of strategies as per the type of consumer classified through the grid may enable favourable behavioural change. These strategies are:

- *Enable:* provide people with the required support, such as by removing barriers and providing pertinent information to enable them to make responsible choices. The proposed enabler strategies to help people exhibit extremely conservative consumption traits are:

i. Small orifice size - It is advisable to downsize the orifice regardless of the size of the tube or bottle; alternatively, a dispenser mechanism should be incorporated to regulate the opening as per the user's requirements. This could enable an individual to reduce wasteful consumption by providing enforced control.
ii. Appropriate level of viscosity- It has been observed that products with lower viscosity exhibit a greater propensity for stock-induced consumption, as one can easily get more volumetric output from a squeeze. Therefore, it is recommended that

policies should be made to standardize the product viscosity to enable an individual to show conservative product consumption behavior.

iii. Ethical design practices – The ethical consciousness of marketing people and the manufacturer is even more crucial to minimizing waste. Manufacturers should relocate their focus from profit-making to the environmental and sustainability obligations of society. They should not always follow the marketing strategy to sell jumbo-sized products at a reduced per-unit cost, which may result in stock-induced wasteful product consumption.

- *Encourage*: Offer people the right signals to change such as giving them rewards for a favourable behaviour or penalize them for unfavourable ones. Proposed strategies to encourage consumers to effectively use FMCG products are:
- Policies to monitor and control not only the upper limit of orifice size but also the product viscosity should be formulated by government agencies like the Beuro of Indian Standards (BIS), and manufacturers who do not comply with these policies should be heavily penalized.
- Manufacturers need to obtain necessary permits from BIS.
- Periodic inspections would be carried out to ensure the rules are not flouted. In cases of violations, manufacturers would be required to pay hefty fines.
- A random complaint-based inspection would be carried out while making note of the violations.
- Product and package design must ensure meeting pollution rules and not to contribute degrading the environment in any way.
- *Engage*: Help people understand their responsibilities, both individually and community as a whole, and take action. Role models could play a crucial role.
- By sensitizing people towards waste – material wastage from tubed and bottled products should be perceived as a socio-economic waste, and to curtail this, social consciousness needs to be raised through education and awareness campaigns.
- Both print and electronic media need to proactively highlight the need for sustainable consumption.
- Social media can be effectively utilized to communicate with people in the awareness generation process.
- It would be a good idea to write a message on the toothpaste tube mentioning “less quantity is sufficient for you” or “Squeeze sincerely”. Even a polite request not to waste toothpaste may be imprinted on the packaging.
- The government can launch a number of campaigns, and youth can be involved to make them effective.

- Children must be earmarked to impart knowledge. Parents, elderly people of the family and educational institutes can help develop the habit of sustainable consumption.
- Educating people about wasteful consumption and its adverse effects to the environment.
- *Exemplify:* Be the change you want in others and lead by epitomizing the same behaviour through learning and continual improvement.

A careful mix of these strategies may prove to be more effective in influencing the toothpaste consumption behaviour and the consumption of similar other FMCG products.

5.0 Conclusions

This research shows that the resource consumption habits and unaltered relatively inelastic consumption behaviour may prove to be game changer in containing the overconsumption and hence stock-induced material waste in case of some FMCG products which are available in tubed or bottled packaging. Behavioural toothpaste consumption grid, derived from the results obtained, may be effectively used as a framework to categorize the consumers as an individual or group, and accordingly to formulate single or a mix of aforesaid strategies, leading towards the least material waste behaviours. In the generic way; the current research advocates the necessity to proactively bring about a change in behavioural inventory both in the corporate world as well as in the individualistic world of consumerism. Real-life applicability of stock-induced consumption inventory models by addressing consumption side waste could be utilized to guide practitioners and aid in future endeavours to lessen every kind of resource wastage.

The stock-induced wasteful material consumption mainly triggered by consumption behavioural traits may be prominently addressed to recommend strategic interventions and policy formulations to combat most of the socio-economic issues associated with the wastage of critical resources that are oblivious to our society. In reality, stock-induced inventory models may be used to assess the savings as a result of waste prevention, which is essentially caused by enhancing consumption traits and behaviours. In this way, implementing a stock-induced inventory model furnishes a reactive approach towards inventory control where acceptance is given to the prevailing individual consumption behaviour, which is apparently expressed in these models. On the other hand, behavioural inventory management is a new and proactive strategy where

individuals and groups are trained to exhibit consumption behaviour that is independent of stock availability. Moreover, the scope of the behavioural impact on stock-induced consumption should be appropriately incorporated into stock-dependent demand inventory research. However, this research can be expanded to incorporate many other parameters such as class, culture, geography, gender, age, etc., to more vividly analyse the behavioural effects on stock-induced toothpaste consumption and toothpaste waste.

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