PERFORMANCE OF INDIAN TEA INDUSTRY OVER THE LAST DECADE -- ACTUAL AND PREDICTED.

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ABSTRACT

A System Dynamics (SD) model was developed in the beginning of the eighties to study and analyse the system behaviour and also to suggest policies for future growth of the Indian Tea Industry. The findings from a Delphi study were used in constructing the SD model and in formulating policies for the desired future growth industry. This paper makes an attempt to compare the actual growth pattern of the Indian Tea Industry vis-a-vis the growth of other relevant factors with the predictions made by the Delphii panelists and those generated by the SD model. The reasons for variations in the growth patterns have also been explored.

1. Introduction :

System Dynamics (SD) has emerged as a powerful tool for analysing and studying the behaviour of complex nonlinear dynamic systems by identifying the cause and effect relationships and the feedback control mechanism that creates the dynamics of such systems. The methodology has been successfully applied to numerous problems in different areas with various objectives. One of the pioneering works in the area of SD in India was the SD Modelling of the Indian Tea Industry (Bora, 1981). The uniquness of the model is that it has incorporated the findings from a Delphi study in constructing the model and in formulating policy actions for future growth of the industry. The Delphi study had addressed itself to four issues : normative, narrative, predictive, and suggestive. The model has been used to predict the future behaviour of the industry under two circumstances : (i) continuation of policies existing prior to 1980; (ii) implementation of policies suggested on the basis of the findings of the Delphi study. One decade has passed by since the completion of the study.

This paper makes an attempt to :

A. Compare the findings of the predictive part of the Delphi study with the actual happenings.

B. Compare thee actual behaviour of the Indian Tea Industry with those predicted by the SD model, and to

C. analyse the reasons for variations, if any.

2. The Indian Tea Industry :

The Indian Tea industry plays an important role in Indian economy. The industry provides employment to nearly one million people, of which around 400,000 are women. Besides earning huge amount of foreign exchange, the industry contributes to the national exchequer by way of paying substantial central and state taxes, excise duty, and cess. The tea industry also helps growth of several other industries. India is the largest producer, consumer, and exporter of tea. She has the largest area under tea cultivation and has the distinction of achieving the highest yield per hectare of plantation.

However, the industry has ben facing severe problems of varied nature since long. Short-term and long-term price fluctuation, inadequate fund, heavy tax burden, fall in export quantity, and labor problems have crippled the industry to a great extent. This has led to the hindrances in the growth of the industry.

3. Delphi Study on Future of Indian Tea Industry :

A Delphi study on the future of the Indian Tea Industry was carried out by a team (Bora et al, 1982) at IIT, Kharagpur, towards the fag and of the seventies. Apart from revealing important aspects of the industry, the findings of the study were utilised as input generating devices for an SD model of the industry and in arriving at viable policy decisions. The study was aimed at the following four aspects of the industry :

1) Setting long-term goals and short-term objectives and scoring them for their feasibility ;

2) identifying problems and scoring them for their criticality ;

3) a) forecasting likely and desirable growth of key factors :
       Indian tea production, Indian tea export, average yield/hectare;

   b) listing assumptions related to the forecast and scoring them for their validity,

   c) sugggesting unforeseen developments with their probable year of occurrence and probability of occurrence by 2000 AD, and scoring them for their impact on the growth of the industry, and

4) recommending policy actions and scoring them for their importance.

4. The SD Model for the Indian Tea Industry :

The SD model for the Indian Tea Industry was constructed to :

a. explain past behaviour of the industry, particularly tea price fluctuation and the growth of the industry,

b. project future scenerioes of the industry.

c. recommend viable policies to achieve the preferred future growth.

4.1 The Model Structure :

Th model has four parts : production, demestic marketing, export, and research and development. Domestic and world tea consumption rates are the only variables that are assumed to be exogenous. Second-order polynomial curves are fitted to their past time series data to define these variables . The DYMOSIM software package (Bora et al, 1982) was used to simulate the SD model. The basic model consists of 20 pure level variables, 16 third-order delays, and 44 first-order smoothing lelvel equations. The detailed structure and description of the model is available elsewhere (Bora, 1981). An eggregate causal loop diagram for the model structure is presented in Fig. 1.
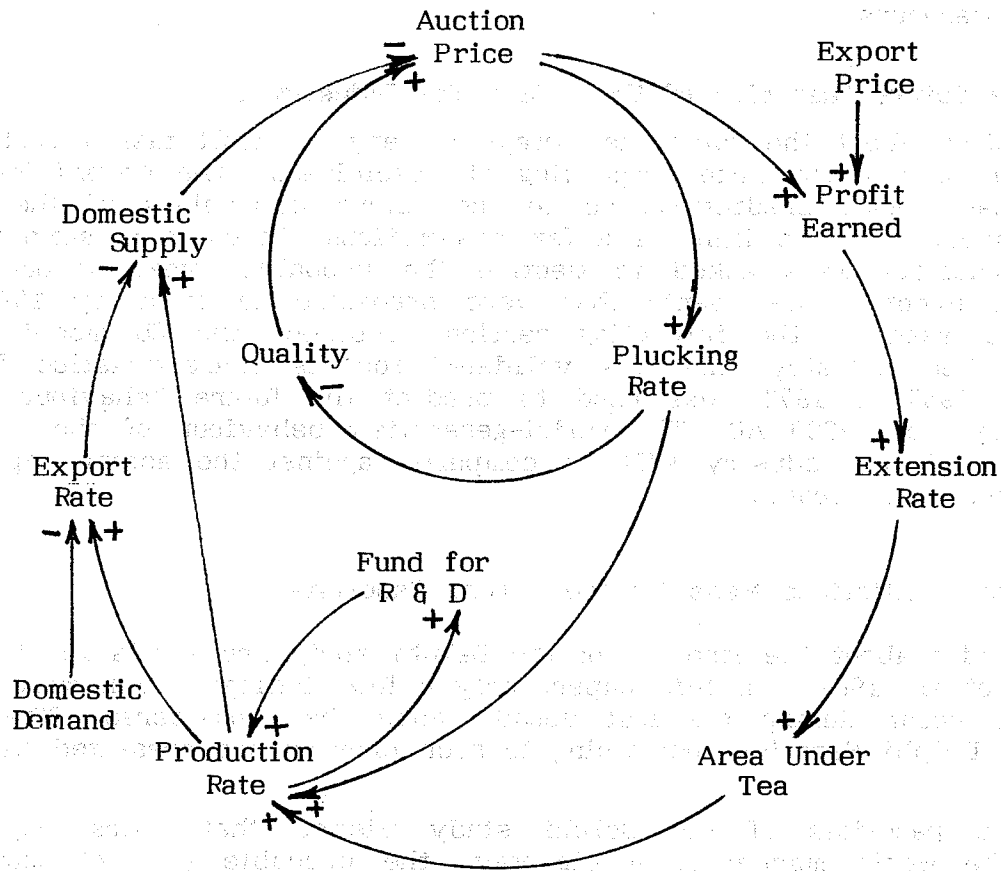

Fig. 1 Aggregate Causal Loops.

4.2 Validation of the Model :

For the purpose of validation, the model was run from 1965 to 1978. The model was subjected to rigorous validation tests that included :

(a)   relevance of model objectives.
(b)   resemblance of the model structure with the real world,
(c)   plausibility of behavioural characteristics of the full model and of each sector of the model under normal and test conditions.

(d)   insensitivity of the model behaviour to changes in parameter values, initial values, shape of table-functions, structural relationships, and computational parameter , and

(e)   verification of the model structure and behaviour by real-world managers.

5. The Future Scenerios of the Indian Tea Industry :

Prediction about the future is always a very difficult task though there is generally little doubt regarding its usefulness. The Delphi Panelists had made some predictions as to the future happenings of the Indian Tea Industry in the light of a few assumptions. In cases of some events, the Panelists were asked to mention the probable year of occurrence of the events. The events that were predicted to occur by 1990 will be discussed in the followiing section. Besides, the SD model of the Indian Tea Industry that was validated for its characteristics for the period 1965 to 1978, was used to predict the future behaviour of the Industry upto 2000 AD. The model-generatted behaviour of the different aspects of the industry will be compared against the actual happenings over the last decade.

5.1 The Predictions Made by the Delphi Panelists ;

Th details about the findings of the Delphi study are available elsewhere (Bora et al, 1982). In this paper, only a few findings which were expected to occur during the last decade would be considered. The views of the Delphi Panelists pertaining to such changes are presented below.

1. The panelists of the Delphi study viewed that China may enter into the world market in a big way, the probable year of occurrence of such an event being 1987.

2. The panelists further viewed that breakthrough in the development of high yielding clones associated with reduced dormant period at the start is likely to be feasible by 1989. Such a development coupled with better agricultural practices would increase the yield of the Indian tea gardens.

3. The panelists opined that greater demand for quality tea would result in the increase of Indian tea export potentiality most probably by 1986. Besides, breakthrough in convenience tea may be possible by 1990 which would push the Indian export further up.

5.2 The Actual Growth of Key Variables :

The values of the variables : Yield Rate of Indian Tea Gardens, World
Market Share for Chinese Tea for the period 1980 through 1988 are
being depicted in Fig.2 .

It is clear from Fig.2 that the world share for Indian Tea is steadily
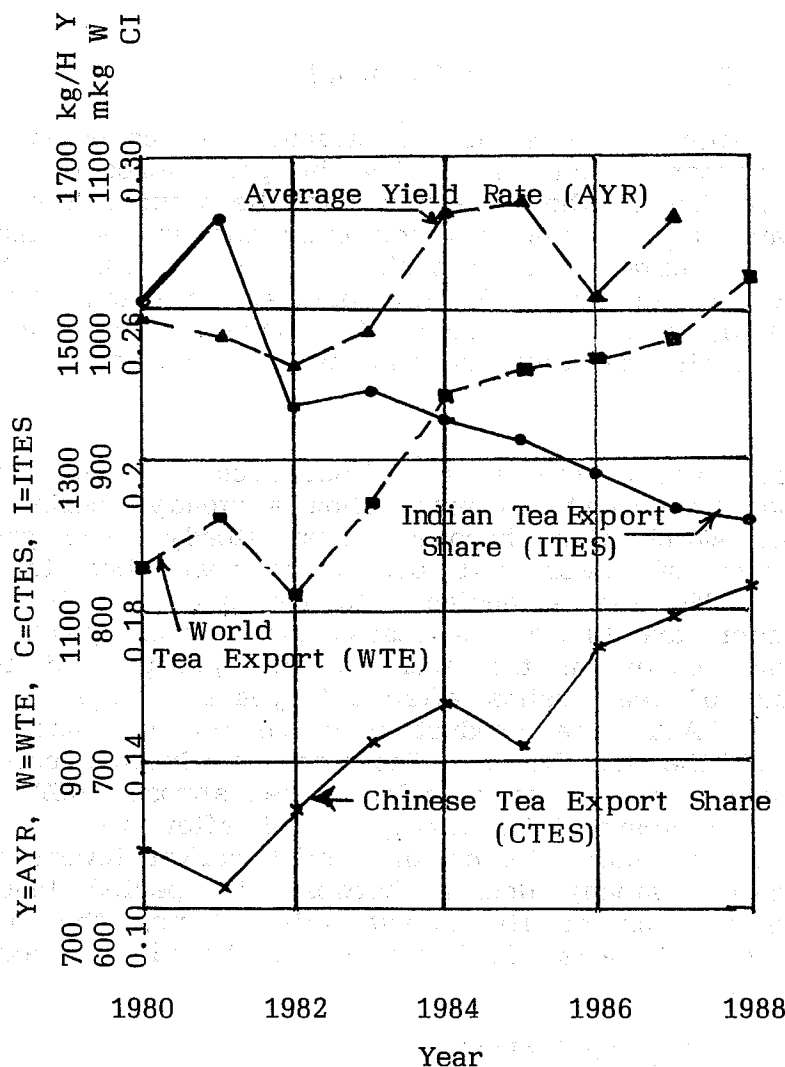decreasing throughout the last decade. It is evident from the fact that

Fig.2   Actual Growth of Key Variables

the export quantity form India is more or less constant at around 210
million kg per year. The world demand for tea is increasing and hence
the share of Indian tea is declining. On the other hand the production
of tea is on the increase. This clearly shows that domestic consumption
of tea in India is on the increase.

It is evident from Fig. 2 that the export share for Chinese tea is increasing noticeably after 1986. This trend boldly establishes the finding of the Delphi study that China would enter into the world market in a big way by the year 1987.

The yield rate of Indian tea is showing a noticeable increase over the last deecade. The drop in yield rate in 1986 is due to the devastating flood in some parts of the country and severe drought in some other parts. The growth in yield rate establishes the authenticity of the Delphi results.

5.3. The Behaviour Generated by the SD Model :

The SD model for depicting the system behaviour was run under the policies prevailing in the seventies and considering the persistence of the environmental forces prevailing in the seventies into the future. The behaviour of a few key variables of the industry over the period January, 1980 to January, 1989, as obtained from such a simulation run of the model, are shown in Fig. 3 (a) and (b). The prices, however, represent the deflated values at price index of 1965. The behaviour of these vaiables can be explained with the help of the causal loop diagram presented in Fig. 1.

The auction price follows the yearly fluctuation pattern. The auction price in India and the export tea price show a steady decline after 1980 through 1984 after which they become almost steady. The profit is on the increase because of lower unit production cost. Due to the lower profit earned till 1980 the extension rate remains at a low level and the total area under tea (TAUT) decreases after 1981. TAUT, however, represents the tea bushes in the economic age group, and the model considers uprooting of tea bushes after 100 years of age. Inspite of declining values of TAUT, the production is on the increase because of high yield rate of the tea bushes. Increased production rate leads to higher export rate and thus average sales of tea abroad (ASTA) increases steadily between the years 1981 through 1986 after which it becomes steady. More supply of Indian tea to the world market lowers the export pricee which shows a steady decline between the period 1980 to 1983. The export price remains at its lowest value during the period 1983 to 1987. Decline in ASTA after 1987 results in the rise of export price during 1988.

5.4. Actual Growth of Key Variables :

Th actual values as obtained from Tea Statistics (Tea Board, 1986, 1987, 1988) of a few key variables over the period 1980 through 1988 are shown in Fig. 4. The variations in the values of the key variables : Average Export Price (AEP), Average Auction Price (AAP), Average Tea Production Rate (ATPR), Average Sales of Tea Abroad (ASTA), and Total Area Under Tea (TAUT) can be explained from the causal mechanism on the basis of which the SD model was constructed.
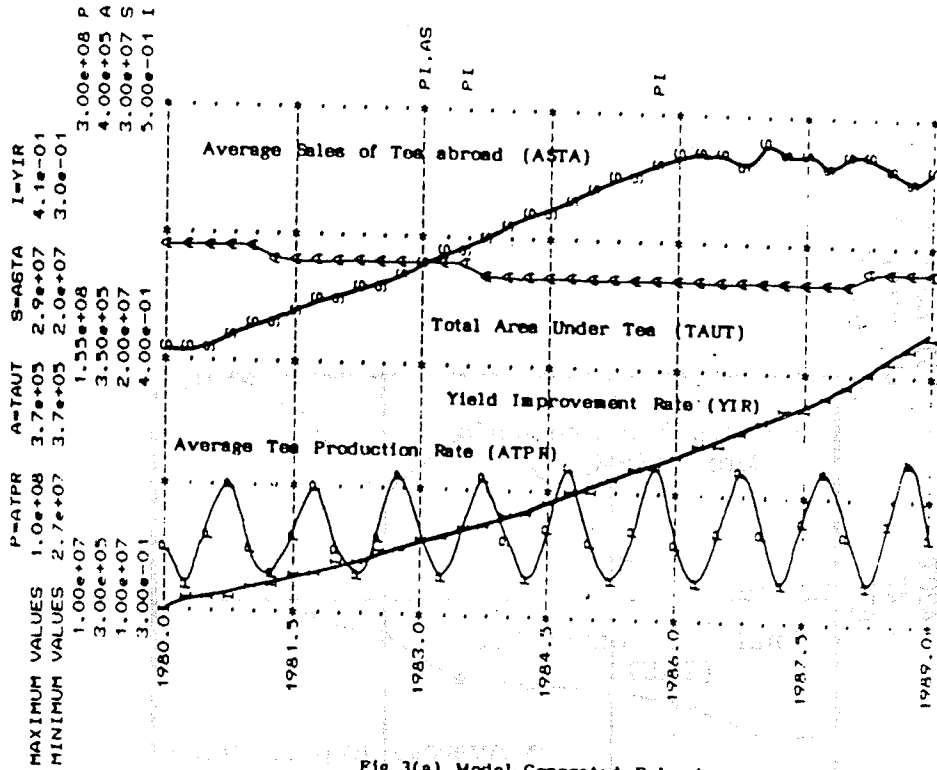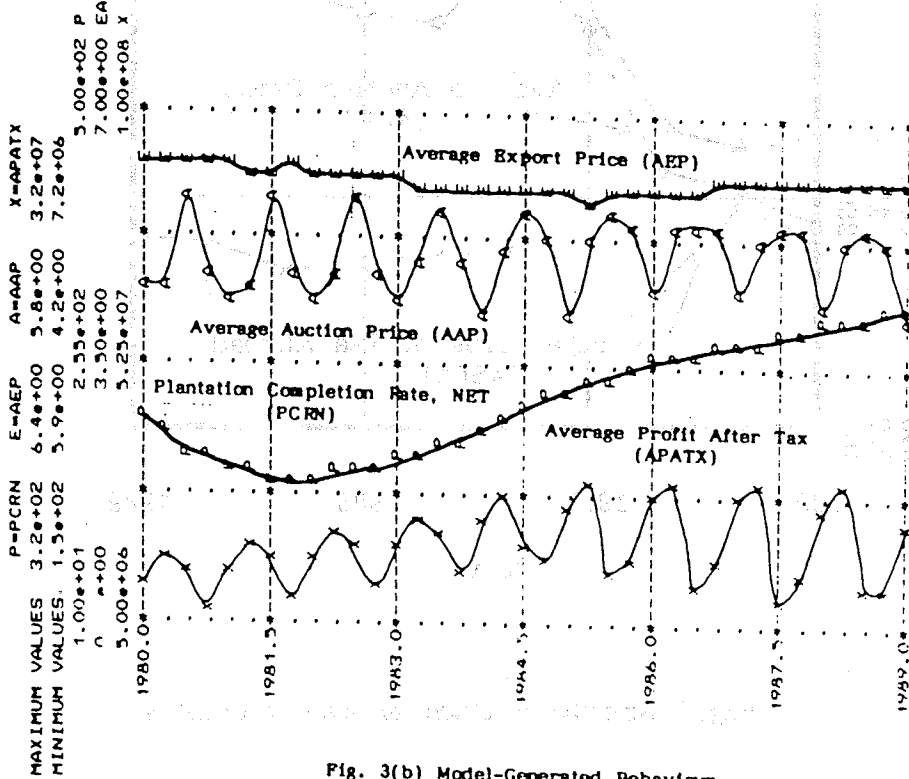
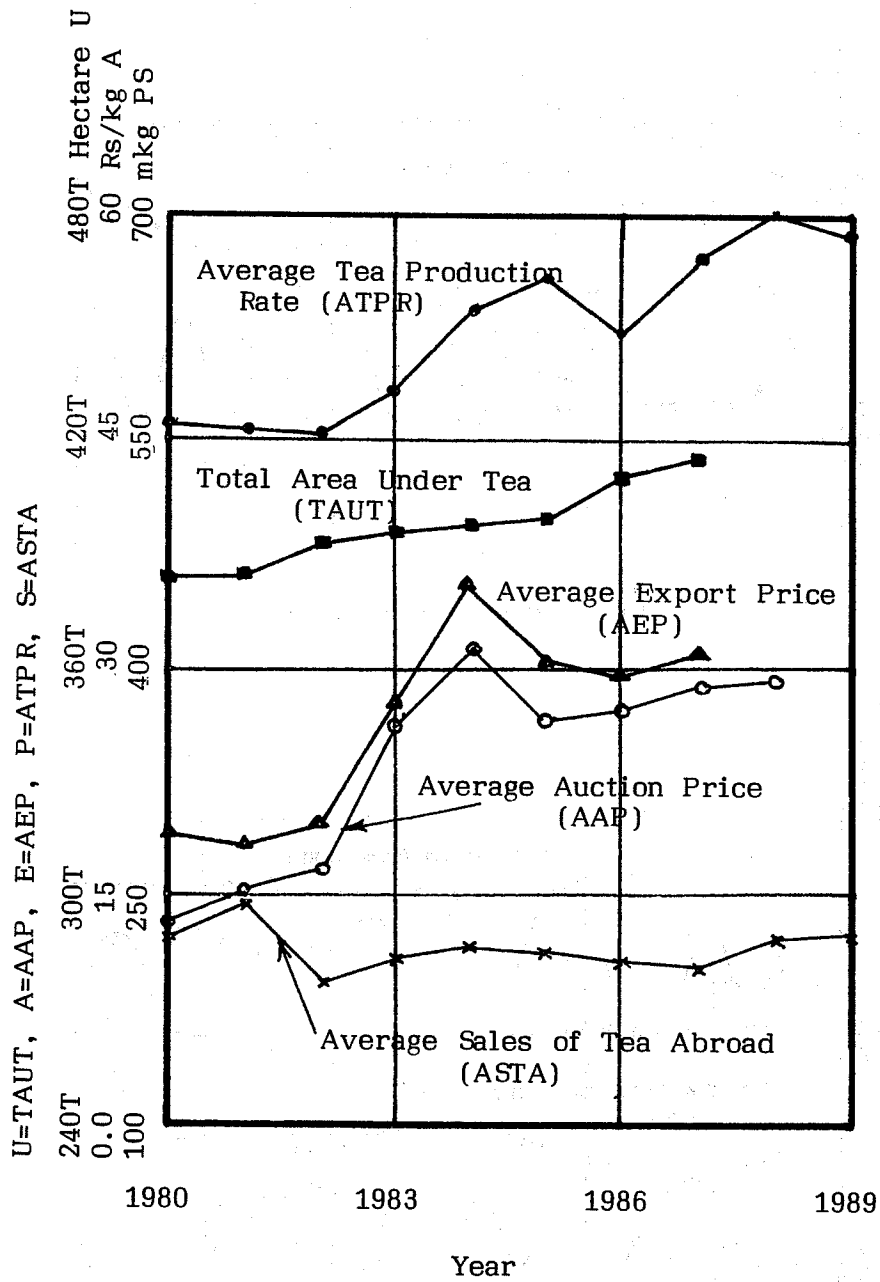Fig.3(a) Model-Generated Behaviour .

Fig. 3(b) Model-Generated Behaviour.

Fig.4 Growth Pattern of Key Variables

The value of TAUT shows a very slow but steady increase over the past decade. In fact, the value of TAUT increased from 381086 Hectares in 1980 to 414232 Hectares in 1987, registering a growth rate of around 1% per year. It can be considered as normal natural growth. The industry could not take up extension planting at a higher rate. Increase in the value of TAUT coupled with high yielding clones and good agricultural practices has caused an increase in ATPR. On the price front, however, the cyclical pattern still prevails. In 1984 there was a price boom again. This price boom is attributed to the factors such as : strong demand pressure from producing countries , low stock in both producing and consuming countries, increase in tea consumption in Middle East, and steady prices of sugar (Tea Statistics, 1983-84 Issue). In India the production levels were almost stagnant at 560 million kg till 1982, which resulted in errosion of stock. Because of the increasing domestic tea consumption rate the export went down and the AAP went up. The effect of world tea price was felt in Indian Auction too. AAP shot up in 1983 and continued till 1984. Rise in AAP and AEP during 1981 to 1984 resulted in the increase of TAUT after 1985. Higher price realisation led to the production of low quality tea, more production, and overstock-ing of tea during 1984. Such acts resulted in the decline of tea prices in India and abroad after 1984.

The model generated behaviour and the actual behaviour of a few variables over the past decade show some differences. The first differencee is noticed in the gowth pattern of TAUT. While the model generated behavi-our shows a steady decline, the actual growth pattern shows a steady growth of around 1% per year. The model considers the uprooting of old tea bushes after 100 years of age, whereas in actual practice tea bushes are not being uprooted at that rate. The new plantation rates in both the cases are almost the same. Another difference is noticed in the behaviour of ASTA. This had so happened because of the fact that there is a huge and exportable surplus caused by increased production and low growth rate of domestic tea consumption rate. The model does not (can not) take into consideration the effects of flood, drought, local agitation, etc. Such factors had affected the actual production. Domestic tea consumption, which has been considered exogenous and is being gene-rated using a second order polynomial against time, is actually dependent on many other factors such as availabiliy of sugar and milk, price of coffee, etc. The model does not take into account these factors. The model-generated behaviour does not predict the tea price boom in 1984. However, it shows a rise in auction price in India during 1980-1982.. The long-term (6 to 9 years) price fluctuations are truely generated by the model.

While it is possible to build up other causal mechanisms into the SD model , it is not possible to incorporate factors such as government policies, natural calamities, etc. into the model. Since the commodity production and price depend largely on such factors, it may not be possible to generate through an SD model the exact behaviour pattern of all the variables. Nevertheless, the overall characteristics of the Indian Tea Industry as generated by the model resemble to a great extent with those that had actually happened.

6. Conclussion :

Systems Dynamics is a powerful methodology for analysing System behaviour and for designing policies for feasible and desireable growth pattern. Delphi study could be of enormous help in the problem identification and system study phase of modelling. Such a marriage between the two methodologies was tried in studying the Indian Tea Industry stystem. The Delphi study was conducted for predicting the growth of certain key variables. The SD model was developed to predict the overall behaviour of the system under study and to formulate suitable policies for the objectives set by the Delphi Panelists. In this paper, an attempt was made to compare between the actual happennings of the industry and the predictions made by the Delphi study as well as by the System Dynamics study. Though there are some variations in the actual growth compared to the predicted growth patterns, the overall behaviour patterns are similar in both the cases. The important aspect of the study is that it has been possible to explain the actual growth patterns with the help of the causal mechanism incorporated in constructing the SD model.

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