Prospects for the Pakistan Tea Industry

by

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INTRODUCTION

Pakistan's foreign-exchange earnings from tea, which during the period 1951-53 averaged more than 40 million rupees annually, had fallen to an average of 6 million rupees annually during the period 1964-66. This decline in earnings resulted from the diversion of tea from export to domestic markets where higher prices reflected the extent to which the growth of domestic tea consumption had exceeded the growth of production. Recognising that continuation of this trend would lead to Pakistan becoming a net importer of tea with further loss of foreign exchange, the government took steps in the early sixties to encourage expansion of tea production as an alternative to restraining demand through rationing or eventual import controls. In this paper our primary concern is to establish, through analysis and forecast of market forces, the likelihood of Pakistan being able to maintain its self-sufficiency position in tea production up to 1975 without recourse to market controls, and to suggest policy measures that will help in achieving this objective in the longer term. An ancillary purpose is to recommend technical and economic changes that will improve the efficiency of tea production.

Figures 1, 2 and 3, which show consumption, production and prices of tea over time, give some indication of the underlying market situation for the last two decades. The more rapid growth of consumption over production plus the generally upward trend in prices suggest that the market demand curve for tea has been shifting more rapidly to the right than supply. In Sections II and III below, we estimate the rate at which these curves are shifting through time and forecast their relative positions in 1975. The marked year-to-year inverse

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relationship between price and production further indicates that the longer-term pattern has been modified by short-term supply fluctuations, a phenomenon we discuss in detail in Section IV. In the last Section the implications of our forecasts for alternative investments open to tea companies are considered in relation to government policy.

II. TEA PRODUCTION IN 1975

Production of tea is a function of area cropped and yield per acre. By far the greater proportion of tea is obtained from mature bushes which may be defined as plants with more than five years in their permanent site. Total area of mature tea in year t+5 is given by total area of young and mature tea in year t less either abandoned or uprooted sections in the subsequent five years:

$$Mt+5 = At - \sum_{t=1}^{5} Ut$$

where

Mt is area of mature tea in year t

At is total area of tea in year t

Ut is uprooted and abandoned area in year t

Using this identity and the data for total tea area presented in Table I it can be seen that area of mature tea in 1971 will be 93,549—3,000 = 90,549 acres, assuming a uniform rate of uprooting of 600 acres a year. The estimates of mature tea area for 1965 and 1966 calculated by this method compare well with those made by the Pakistan Tea Association which differ by only 77 and 443 acres respectively [8].

TABLE I

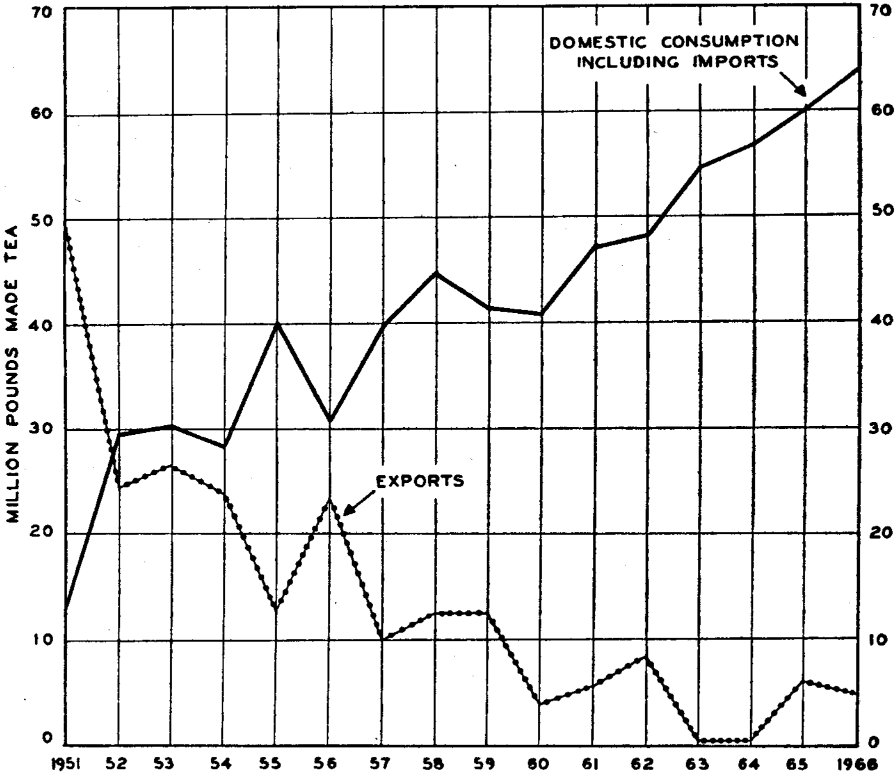
TOTAL TEA AREA, UPROOTING AND PROJECTED MATURE TEA AREA

Year	Total tea area (*acres*)	Estimated uprooting (*acres*)	Projected area mature tea	
			Year	Acres
1960	77,553	600*	1965	74,527
1961	78,303	600*	1966	75,364
1962	79,868	600*	1967	77,105
1963	82,763	731	1968	79,806
1964	86,495	495	1969	83,600
1965	90,155	552	1970	87,155
1966	93,549	387	1971	90,549
1970	103,730**	—	1975	100,730**

Source: Area and uprootings from [8] for the year 1967

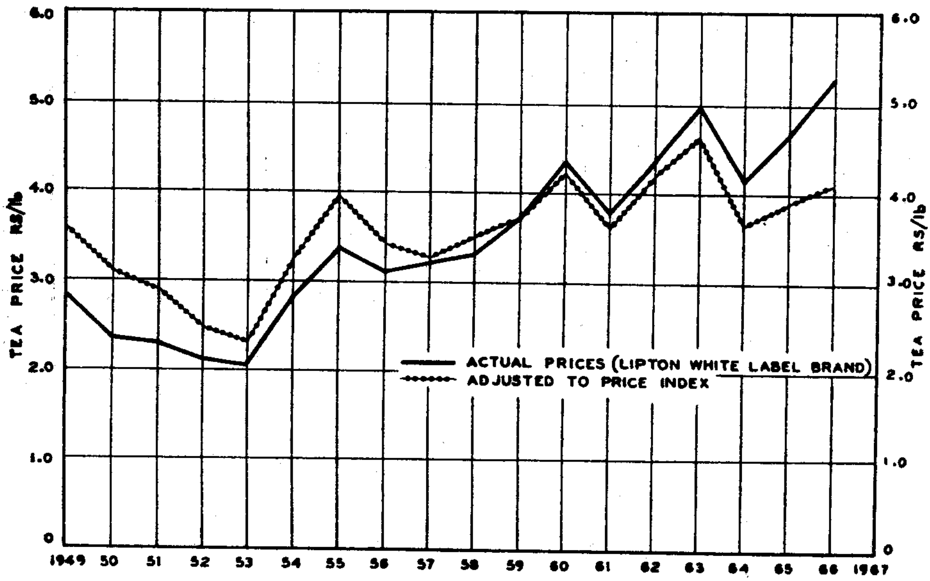
*National only.

**Linear extrapolation of trend in Column (2), 1960-66.



Source: International Tea Committee, *Annual Bulletin of Statistics, 1967.*

Figure 1. Domestic Tea Consumption and Exports



Source: Lipton Pakistan Ltd.

Figure 2. Wholesale Price Changes, 1949-1967

Our estimate of mature tea area in 1975 of 100,730 acres, listed in Table I, was obtained by extrapolating from the 1971 forecast of mature tea area of 90,549 acres by the rate of increase in plantings, net of uprootings, between 1960 and 1966 *viz.* 2.7 per cent per annum. It may be noted that our acreage estimates are much lower than those made by both the Pakistan Tea Board and the Pakistan Tea Association. While we estimate total tea area in 1970 to be 103,730 acres, the Pakistan Tea Board's estimate is 120,000 acres and that of the Pakistan Tea Association 108,607 acres [9]. Planting rates in the remaining years of the Third Five-Year Plan will have to be at an unprecedented level if these more optimistic forecasts are to be achieved.

The other variable determining tea production is yield per acre and in Table II the average yields of mature tea for the years 1960 through 1966 are listed. These estimates are higher than other published estimates because seed trees, nursery and areas below five years of age have been excluded from area estimates. This method leads to a slight upward bias in yield per acre as small quantities of tea are harvested from immature areas but nevertheless this estimate is closer to true yield than total production divided by total area under all tea.

TABLE II

TEA AREA, PRODUCTION AND YIELDS PER ACRE: 1960-1966

Year	Area mature tea (*acres*)	Production (*million lb. made tea*)	Yield per acre (*pounds made tea*)
1960	71,777*	41.822	583**
1961	72,052*	59.041	819
1962	72,939*	51.630	708**
1963	73,672*	55.023	747
1964	74,178*	63.095	850
1965	74,528	59.678	801
1966	75,364	62.328	827

*Estimated, using registered acreage, in year t. *See* Thomas and Ahmad for discussion of validity of registered area [13].

**Drought year.

Over the years 1966 through 1975 a small rise in mean yield may be expected because the proportion of young but mature tea will increase as the plantings of the 1960-70 extension programme reach maturity. However, the extension programme has been forced at a pace exceeding the capacity of the industry to produce high quality planting stock and in consequence the inherent genetic capacity of much of the planting material used in the extension acreage is not high enough to produce dramatic increases in average yield. This dearth of high quality planting stock must be considered a serious limitation of 'crash' extension programmes; all the more so because the crop, once established, is cultivated for at least 40 years.

Many factors affect yield per acre but the most important is plant population. Plant population is closely related to age of the plantation and in 1966 58 per cent of Pakistan tea was over 40 years old [9]. It is not possible to satisfactorily rejuvenate old plantations by managerial practices such as infilling, pruning or manurial programmes and in consequence high average yields will only be achieved with accelerated replanting programmes. As will be demonstrated in Section III, this replanting is unlikely to occur in the short-term because of the current greater profitability of other forms of investment in tea production.

In summary, we consider that only moderate increases of the order of 10 per cent above the 1960-66 level are to be expected by 1975, giving an estimated production of 84.41 million pounds of made tea (100,730 mature acres × 838 lbs/acre). If subsidies were given for replanting then higher average yields would be obtained but there would be a temporary reduced area of mature tea and production would fall below 84 million pounds in 1975. Using the optimistic area projections of the Pakistan Tea Board and Pakistan Tea Association with our yield estimates given production for 1975 as 101 million and 91 million pounds of made tea respectively.

III. PREDICTING TEA CONSUMPTION

The main purpose of our econometric investigation of tea consumption was to identify the major factors shifting the demand curve, but we also hoped to obtain an estimate of price elasticity that would allow prediction of the magnitude as well as the direction of price changes. The basic hypothesis that we sought to test through multiple linear regression was that aggregate tea consumption is a function of price, per capita income and 'urbanisation'. It was expected that income elasticity of demand would be relatively high since for low-income consumers tea represents something of a luxury[1], yet the effect of this high-income elasticity on price elasticity would be modified by a relatively low substitution elasticity, there being no good substitutes for tea. With a fall in price of tea, the positive effect on quantity demanded resulting from an increase in real income would only be slightly augmented by a switch of purchasing power from commodities which are but poor substitutes for tea. Coffee and fresh milk, which are both substitutes in consumption for tea, are not widely consumed in urban areas as yet for they are relatively expensive.

[1]Sengupta [12], in an unpublished study, obtained estimates of income elasticities of demand for tea in the range 0.7 — 0.9, using household budget data from North India.

The inclusion of "urbanisation", measured as percentage of population living in urban areas, is in recognition of the fact that the social habit of tea drinking in Pakistan has been closely associated with the urban way of life. However, with the recent advent of the transistor radio the social importance of the village tea shop has risen and tea consumption in rural areas is increasing.

Three linear functions expressing the basic hypothesis were tested by single equation least squares procedures:

(1) $C_t = a + b_1P_t + b_2Y + b_3U_t$

(2) $C_t - C_{t-1} = a + b_1(P_t - P_{t-1}) + b_2(Y_t - Y_{t-1}) + b_3(U_t - U_{t-1})$

(3) $C_t = a + b_1P_t + b_2Y_t + b_3t$

where

C_t is aggregate absorption of tea in year t (production + imports — exports) [8, report for 1967]

P_t is average wholesale price of Liptons "White Label" tea in rupees/pound deflated by C.S.O. cost of living index 1959/60 = 100 (Liptons Pakistan Ltd., private communication)

Y_t is national income per head in year t expressed in 1959/60 prices [6].

U_t is proportion of total population living in urban areas in year t[7].

t runs from 1949/50 to 1966/67

It is considered that aggregate consumption is a more appropriate choice for dependent variable than aggregate consumption divided by population but expression of consumption in this way does not eliminate the normal aggregation problems associated with this sort of data nor does it hide the fact that we have no knowledge of yearly change in stocks.

A full interpretation of the results of the regression analysis and a discussion of the methodological problems encountered is given in Appendix A. It may be noted here that the strong association between time and the independent variables precluded satisfactory estimation of the desired elasticities. However, the high coefficients of determination obtained for equations in which urbanization or time appeared as explanatory variables permitted the use of these equations for prediction purposes. Assuming a level of urbanization of 18.55 per cent by 1975, obtained by extrapolating the trend in Planning Commission urbanization estimates, predicted tea consumption in 1975 is 84.40 million pounds. Using the simple regression of consumption on time given an estimate of 80.78 million pounds of made tea with 90 per cent confidence limits of 90.68 and 70.88 million pounds. The estimate by linear extrapolation does not differ significantly from another made by fitting the Gompertz curve. This function is given by:

$$\log C_t = a - br^t$$

where a, b and r are constants and it is assumed that errors are proportional to consumption, *i.e.*, variation of log Y is constant, gives an estimate of tea consumption in 1975 of 83.65 million pounds with a coefficient of determination of .902. FAO [2] estimate aggregate consumption of tea in 1975 to be 81.8 million pounds under their low G.D.P. assumption and 92.5 million pounds under their high-income assumption.

TABLE III

COMPARISONS OF PREDICTED TEA CONSUMPTION

Method	R^2	Estimated tea consumption in 1975 (*million lbs.*)
(i) Linear extrapolation	.887	80.78 ± 9.90
(ii) Gompertz curve	.902	83.65
(iii) FAO income elasticity	—	81.8 — 92.5
(iv) Urbanization projection	.891	84.4

In exercising judgment as to which of these estimates is likely to be closest to actual consumption in 1975, it is pertinent to mention *i*) because of the high correlation between time and urbanization we have only circumstantial evidence to support our hypothesis that tea consumption is causally affected by urbanization, and *ii*) as stated at the beginning of this Section, there is a trend to higher consumption in rural areas and because this is a relatively recent development the long-term impact on growth of consumption is not taken care of by linear extrapolation.

Our supply forecasts for 1975 indicated that production will be of the order of 84.41 million pounds, an estimate which is considerably lower than those based on the acreage estimates of the Pakistan Tea Board and Pakistan Tea Association. If our forecasts are correct, domestic tea prices are likely to remain at their current high level through time while exports of tea remain low or become non-existent.

Before turning to the implications of these forecasts for government policy it is appropriate to consider what is behind the short-term supply fluctuations that characterise tea production, and in particular to note whether economic efficiency would be better served by control of these factors than by present costly stock operation.

IV. SHORT-TERM PRODUCTION FLUCTUATIONS

Producers, processors and blenders of tea in Pakistan require for efficient utilisation of plant and stores a regular and assured flow of tea through time. Variations in output can to some extent be avoided by stock operation but this is expensive. We consider in this Section three aspects of fluctuation: annual variation illustrated in Figure 3; seasonal variation illustrated in Figure 4, and variation between individual months of different years, shown in Figure 5 by the coefficient of variation 1952-60.

Thomas and Ahmad [13], in their statistical analysis of factors influencing tea production, conclude that fluctuations in total production between years cannot be explained by either changes in acreage or prices. They seek to explain this fluctuation and the fluctuation between months over the year by a consideration of environmental factors. They conclude that although variation in annual production cannot be explained by total annual rainfall or a rainfall-temperature index (Lang's factor), it can be explained by considering factors affecting monthly output. Between December and February they consider low temperatures to be an overriding growth constraint but place emphasis on water availability for the remainder of the year. They found a strong statistical correlation between rainy days over a two-month period and the subsequent month's tea production and concluded that irrigation would be beneficial even during the monsoon. In this paper we argue that although their analysis is statistically significant and therefore useful for forecasting, their basic hypothesis is based upon inadequate biological foundation The stand taken in this study is that the growth of the tea plant is determined by a complex of environmental factors that include solar energy or light intensity and day length, as well as soil moisture availability and temperature.

Water is essential for plant growth for the part it plays in a number of physiological functions. Water deficits interfere with plant growth and, if severe, cause the death of the plant. However, the water requirements of plants are limited and providing there is a regular supply of soil moisture sufficient to meet potential evapotranspiration then optimum water requirements for growth are met and production cannot suffer on account of water shortage. Irrigation or precipitation in excess of potential evapotranspiration will not aid growth and may cause harmful effects by leaching nutrients from the soils or by causing drainage problems in low-lying lands. It can be seen from the data in Table IV that in East Pakistan, from May to August, rainfall greatly exceeds potential evapotranspiration, the maximum amount of water required for optimum growth. While rainfall is not a daily occurrence, water storage in most tea

Source: Pakistan Tea Association

Figure 3. Fluctuations in Production, 1947-1966

TABLE IV

POTENTIAL EVAPOTRANSPIRATION AND AVERAGE RAINFALL SRIMANGAL

Month	Potential evapotranspiration (*inches*)[1]	Average rainfall Sylhet District (52-60) (*inches*)[2]
May	7.12	22.9
June	5.62	28.2
July	4.96	21.8
August	5.35	18.1
September	5.76	18.5

[1]Hunting Technical Services Ltd. [4].
[2]Ahmad and Thomas, Table B-2 [13].

TABLE V

TEMPERATURE AND GROWING SEASON OF SAMPLE LOCATIONS

Sample location	Mean temperature coldest month (0°F)	Growing season (months)	Latitude
Poti, USSR	44	6	42°N
Hankow, China	40	6—7	31°N
Tocklai, Assam, India	60	8—9	27°N
Srimangal, East Pakistan	63	9	24°N
Cholo, Malawi	62	12*	16°S
Nuwara Eliya, Ceylon	57	12	7°N
Kericho, Kenya	62	12	0°

*Two months near dormancy. *Source:* except Srimangal: Harler [3].

soils is 7 inches in the root zone and more than half of this may be removed by the plant before growth is affected. There is no likelihood of this soil moisture deficit occurring between May and August except in Chittagong during May in the 1 in 10 driest year and therefore some other explanation must be found for fluctuating yields during the monsoon season.

A recent study has shown that in the post-monsoon period soil moisture supplies from soil-water storage and occasional rainfall are adequate for mature tea until the end of January and irrigation at this time does not stimulate growth [4]. Ahmad and Thomas suggest that temperatures are too low but as was shown by Harler with the data reproduced in Table V tea grows elsewhere throughout the year although lower temperatures occur.

In most years by February water stored in the soil since the previous monsoon plus the small spasmodic post-monsoon precipitation is depleted by evapotranspiration and soil-water stress occurs that is sufficient to depress growth. It has been shown that in many cases this deficit can be economically met by irrigation commencing at the beginning of February and ending in April in the north and May in the south [4].

It has been established that between May and August there is a satisfactory soil moisture environment for growth and also that thermal conditions are not limiting. However, as a result of monsoon cloud cover light intensity is low which reduces photosynthesis and hence sugar formation and growth. Shade trees that are necessary to protect bushes from radiation in the hot months, from March to May, are in full leaf from May onwards further cutting down light intensity[2]. From August to October soil moisture, temperatures and light intensity are good and, therefore, high yields are obtained.

We postulate that it is significant that Cholo, Nuwara Eliya and Kericho, which have a lower mean temperature in the coldest month but a longer growing season than East Pakistan, all lie within the tropics. It suggests that the winter dormancy in East Pakistan and other tea growing areas outside the tropics is affected by day-length, induced either by short winter days or possibly long summer days or by a joint photo-thermal effect. Such day-length control of growth is common to many plants particularly those that originated outside the tropics. Harler notes that flowering (another process often day-length controlled) is mainly from September to November in the northern hemisphere, February to April in the southern hemisphere but equally in each month near the equator. This day-length explanation of winter dormancy must remain a hypothesis until empirical studies have been made but it would seem a promising subject for research. If it is short winter days rather than long summer days that cause dormancy it may be possible to arrange a night break to stimulate growth (*i.e.*, a searchlight mounted on a lorry moving round the estate might break dormancy—surely no more difficult to arrange than sprinkler irrigation).

It is further suggested that our hypothesis gives a sound explanation of the variation that occurs between production in the same month of different years shown by the coefficient of variation of monthly output in Figure 4. The highest variation occurs in February, March, April and May when rainfall is the main factor influencing yield. In June and July, variation is low but still

[2]Lopping of shade trees in June might have beneficial effects but labour is scarce at this time.

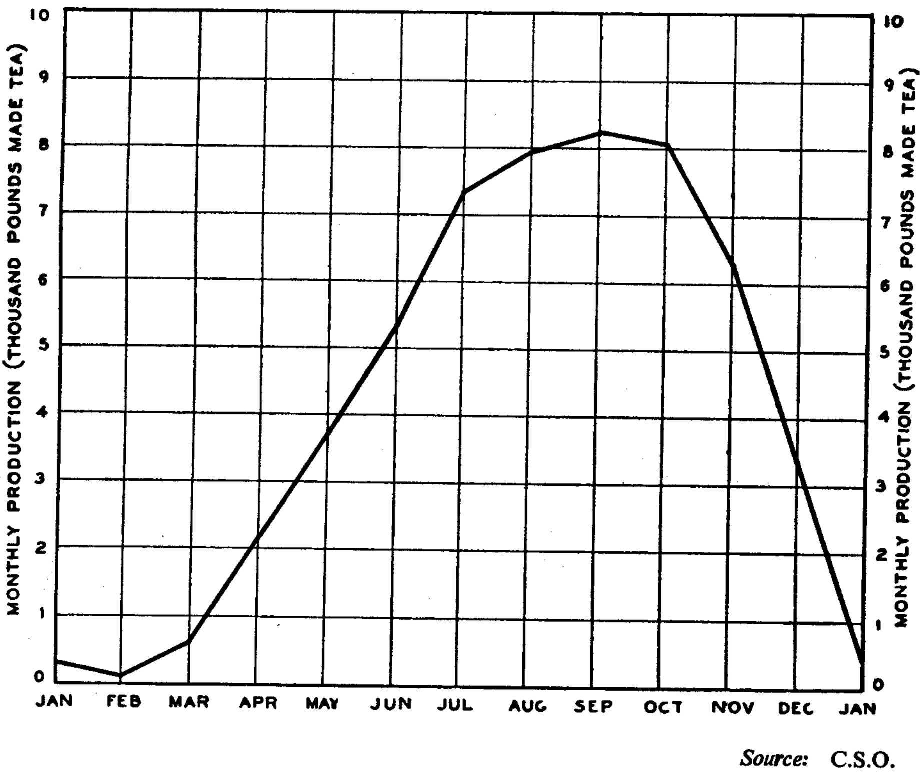
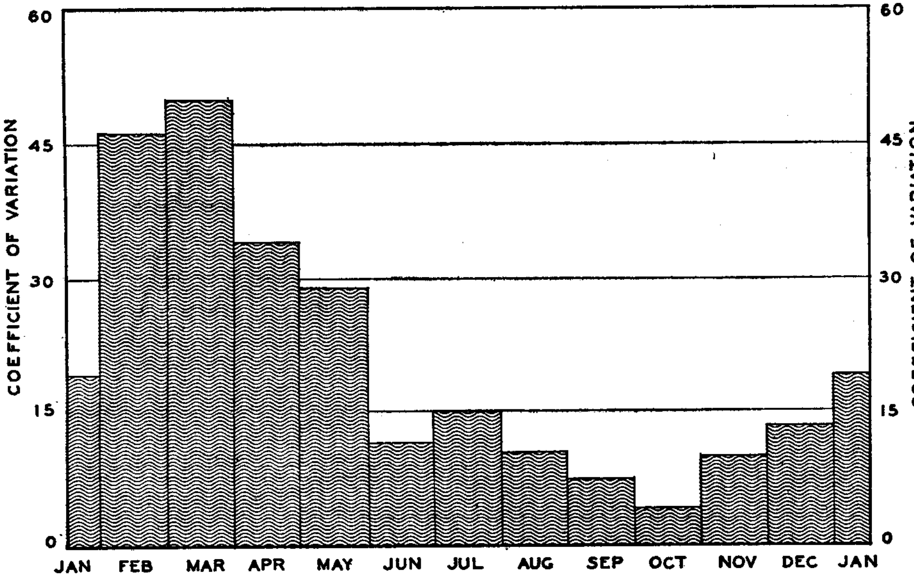


Figure 4. Mean Monthly Productions, 1952-1960



Source: C.S.O.

Figure 5. Coefficient of Variation: Mean Monthly Productions, 1952-1960

higher than August to November when near-optimum conditions for growth occur regularly. The comparatively high figure for January is probably explained by small total and occasional holding over of December crop.

The important economic conclusion is that variation from year to year and month to month is caused by climatic factors that cannot be effectively controlled at present. One exception to this is water supply between February and May but with high capital costs, low returns in certain circumstances and technical problems associated with large-scale irrigation it is suggested that an important part of yield variation due to drought must be accepted for the near future. In view of this efficient stock operation to eliminate some of this production variation is essential.

V. INVESTMENT IN TEA PRODUCITON IN RELATION TO GOVERNMENT POLICY

The forecasts made in Sections II and III of this paper indicated that tea prices, at least until 1975, are likely to continue at their current high level providing continued incentives for private enterprise to expand production through new investment. In Section II, we mentioned that tea companies seem more willing to expand production through bringing new land into production than uprooting and replanting with higher yielding varieties. In this Section we probe more deeply into the reasons for this preference and consider the implications in terms of government objectives.

Although rates of return to investment vary widely from estate to estate depending upon costs of development, production costs and product quality achieved, returns to established tea enterprises are generally high as can be judged from profits earned recently by the major tea companies. Capital costs of new investment are determined by the location, topography and vegetation of the area to be developed, and the extent to which new processing capacity has to be created. While many companies have excess capacity or can create extra capacity at little cost, land suitable for tea production is relatively scarce although some of the highest yields and best quality tea is grown on steep 'tilahs' (sandstone ridges) which have been recently planted and were previously considered unsuitable. Costs of bringing undulating land with light scrub into cultivation where such exists or replanting existing tea areas average about 3,000 rupees per acre, but are appreciably higher for rougher terrain. It is estimated that on the majority of estates marginal costs of production lie between 1.25 rupees and 2.00 rupees per pound including taxation. (Tea Association estimate 2.00 rupees per pound [9]). Low cost of production is almost universally associated with high average yields because this enables a spread of the high fixed cost element.

In Tables VI and VII a range of assumptions regarding the expected yields, capital costs and forecast profits (on the basis of current prices) from

TABLE VI

YIELDS PER ACRE ON NEW TEA PLANTATIONS

Year	Yield (*pound made tea/acre*)	
	High	Moderate
0	0	0
1	0	0
2	0	0
3	0	0
4	240	100
5	560	300
6	800	500
7	900	700
8	1,000	800
9-40	1,200	800

Note: Old tea due for replacement yields 400 pounds per acre.

TABLE VII

ASSUMED RANGE IN CAPITAL COSTS AND PROFITS ON NEW TEA PLANTATIONS

Range	Capital cost (*Rs./acre*)	Profit (*Rs./pound made tea*)
High	5,500	2.00
Medium	3,500	1.50
Low	2,500	—

investment are presented. This information is difficult to obtain and a number of sources have been used [9 ; 10 ; 11].

The attractiveness of investment in the tea industry has been tested using this data by the discounted cash flow technique of analysis which measures the marginal internal annual rate of return that can be expected given the forecast cost and benefit streams [5]. Results of this analysis are presented in Table VIII.

TABLE VIII

ANNUAL RATE OF RETURN TO INVESTMENT IN AREA EXTENSIONS AND REPLANTING (%)

Capital costs	High yields				Moderate yields			
	New extension		Replanting		New extension		Replanting	
	High prof.	Low prof.	High prof.	Low prof.	High prof.	Low prof.	High prof.	Low prof.
High	18.6	14.6	10.9	9.4	14.5	12.0	5.8	4.6
Medium	22.3	19.2	13.4	11.9	18.7	16.0	7.5	6.3
Low	28.7	23.2	15.2	13.8	22.6	19.4	8.7	7.6

Tea companies can expect high rates of return of between 12 and 25 per cent per year from increased acreage but the returns to replanting are relatively low at 5-15 per cent. This is because low but consistent tea yields are foregone immediately an old section is uprooted and the higher yields of the new crops are delayed for five years, but for extension of area in most cases there is little or no income foregone as it is currently under jungle or bamboo scurb. The area of waste land suitable for tea is however limited and on many estates all potential tea soils have already been developed. As there are severe technical constraints preventing dramatic yield improvement to existing plantations it is evident that replanting with high yielding varieties must play an increasing role in meeting the steadily increasing demand for tea. In general the best land was the first to be developed and this now has some of the oldest and poorest stands of tea. Replanting of these areas will yield between 10-15 per cent per year depending upon capital costs and profit per pound. Development costs and cost of production on this land are low as it is generally fairly level and closest to the factory and, therefore, it is to be expected that this land will be replanted by tea companies as soon as land for extension of area is either exhausted or cost of its development rise above cost of replanting. The major part of the land carrying old tea has a moderate yield potential and rates of return to replanting under all cost assumptions are less than 10 per cent which is insufficient to mobilize private capital. However, if a social benefit-cost calculation is carried out with all taxation included as a benefit and not as a cost, rates of return to replanting would be sufficiently high to justify investment[3]. It is evident that unless the old tea area is replanted with high yielding young stock, Pakistan will have an age distribution of tea that is ill-suited to satisfying

[3]Assuming no taxation and a marginal profit of 3.00 rupees per pound, rates of return would range from 17 to 30 per cent.

home demand at reasonable prices, let alone to provide surplus for export. Our analysis suggests, therefore, that there is a strong case for uprooting and replanting subsidies such as are presently operated in Ceylon where up to 2,500 rupees per acre are granted over a three-year period [1].

In East Pakistan capital grants of say 1,500 rupees per acre would increase the rate of return to the tea company from 5-15 per cent to 7-25 per cent. It should be appreciated, however, that although large-scale uprooting and replanting would ensure meeting of target production in the fifth and subsequent plan periods a temporary shortfall would occur that might require short-term imports such as were obtained from Indonesia in 1967. Alternatively government could depress consumption by allowing internal prices to rise and regulate profits to the tea companies by taxation adjustments. Taxation, a powerful weapon of government for the incidence of taxation, on the tea producer is between 1.00 rupee and 1.33 rupees per pound or approximately 25 per cent of retail prices.

Two further issues should be mentioned in this policy context. First, prospects for world tea prices are not overly good, and Pakistan needs to consider, both as an exporter of the past and a potential importer, whether costly import-substitution policy merits the saving in foreign exchange. Secondly, because of the threat to world tea prices, pressures are mounting for an International Tea Agreement that would in all probability allocate quotas to exporting countries on the basis of acreage under tea. If Pakistan were to enter the next decade as a net exporter of tea then current emphasis upon development by extension of area, even at the expense of replanting, would enhance Pakistan's chances of sizeable export markets.

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Appendix A

The Appendix Table A-1 shows the results of the regression analysis, used for predicting tea consumption in 1975, referred to in Section III. Consideration of the results of the first equation explains why two further models were tested. It may be noted that while the coefficients of determination for equation (1) are relatively high and many of the coefficients achieve statistical significance, it is only the urbanisation variable whose coefficient remains highly stable and is significant in all the equations in which it appears. The income variable only achieves significance in equations 1(d) and 1(f) where it appears without the urbanisation variable, while little meaning can be attached to the coefficients of the price variable. The nature of these results together with examination of the original data suggested that time might be a factor inhibiting estimation of true causal relationships. We, therefore, modified the form of the regression equation and tested equations (2) and (3) in an attempt to determine how time was affecting the results. Expressing all variables as first differences gave poor statistical results (see equation (2a) in Appendix Table A-1) but this negative performance suggested that serial correlation was less of a problem than multicollinearity. This suspicion was confirmed on examination of the correlation matrix for equation (3) (in which time was substituted for urbanization) which showed high correlations between time and all explanatory variables. An attempt was made to obtain an estimate of price elasticity of demand by the method of conditional regression using a FAO estimate of income elasticity of demand of 0.8 [1] but the results were inconclusive, and without cross-section data there was little we could do to obtain improved estimates of the causal relationships involved.

APPENDIX TABLE A-1

AGGREGATE TEA CONSUMPTION: 1950-1966
REGRESSION RESULTS

Regression equation	Constant term	Independent variables*				R^2	No. of observations
		Y_t	P_t	U_t	t		
1(a)	—50.833			7.286 (.636)		.891	18
(b)	—50.889		.086 (7.266)	7.266 (.884)		.891	18
(c)	—52.933	.012 (.109)	.175 (2.764)	7.118 (1.673)		.891	18
(d)	—112.080	.492 (.087)				.667	18
(f)	—109.731	.402 (.088)	7.262 (3.226)			.751	18
(g)	—52.461	.010 (.100)		7.181 (1.290)		.891	18
2(a)**	.792	.020 (.247)	.719 (4.619)	4.907 (28.430)		.008	17
3(a)	17.677				2.330 (.208)	.887	18
(b)	18.293		—.218 (2.631)		2.346 (.293)	.887	18
(c)	—3.064	.072 (.098)	.279 (2.760)		2.063 (.485)	.891	18

*Figures in parentheses are standard errors.

**All variables are first differences.