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CONCENTRATION OF SALES AND ASSETS: DAIRY CATTLE AND TEA IN MAGUTU, 1964-1971

by

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CONCENTRATION OF SALES AND ASSETS: DAIRY CATTLE AND TEA IN MAGUTU, 1964-1971

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ABSTRACT

Section 2 [pp2-21] shows a reduction in measured inequality of production and the holdings of assets over the period 1964-1971. There is some tendency for the proportionate rate of growth of sales and assets to decline with any given increase in the initial levels of sales and size of assets. The variation in the proportionate rates of growth between size groups of sales and assets is however particularily pronounced for smaller producers. If the source of the reduction in measured inequality is to be found in the increased concentration of production within the middle size group of producers, then the variation in proportionate growth accounts for the relatively worsening position of the smaller 20 to 30% of all producers.

Section 3 [pp22-37] gives a more precise account of the relationship between size and growth of assets.

Section 4 [pp37-55] examines the consequences of the transfer of tea stumps and dairy cattle. Of particular interest is the import, behind the inheritance of stumps and enforced sale of dairy cattle, which transfer gives to the tendencies of proportionate growth as shown in Section 2.

Section 5 [pp 55-62] estimates the proportion of households out of the total population of households, which have entered tea and milk production for sale since 1964. The proportionately large number of entrants, of the exsisting producers in 1964, into production has accelerated the conentration of production around the middle size groups of producers.

Appendix A [pp 67-84] contains an account of the sources of the data used for this analysis and the areas where there is likely to be any bias in the results.

Appendix B [pp 85-88] contains a summary of the distributions of incomes from sales, quantities of sales and holdings of assets.

[1] INTRODUCTION

It would be remarkable were we not to find a relatively high degree of measured inequality in the command over assets and the distribution of income from the production of the major enterprises in the small scale agriculture of the Kenya countryside. Our concern, however, is to give some focus to the mode of inequality -- to delineate the locus and degree in the concentration of production, by sale of output and the distribution of assets, by land, livestock and tea acreages; to establish the presence of any permanence in this concentration, for as different groups of households, by size of assets, show different rates of growth in output, so are there shifts in the locus and degree of concentration over time. Finally we seek some explanation behind the shifts in the concentration. The analysis of sales of tea (green leaf) and milk over the period 1964-1971 shows, contrary to much speculative appraisal, that there has been a fall, a decrease in the measured inequality of tea and milk production. This fall is to be sought in the resilience of the middle peasantry, that large group of households within the middle range of the size distribution by assets, who have entered into tea and milk production for sale since 1964 and who in 1971 accounted for a relatively larger proportion of total output, for both enterprises, than they did in 1964.

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* The sources of data used in this analysis came from the Mathira Dairymens' Cooperative monthly payout vouchers and the Ragati leaf base record of monthly payouts. We are indebited to the Manager of the Dairymens' Cooperative, the Chief Technical Officer, Kenya Tea Development Authority and Leaf Officer, Ragati Leaf base for making the records so readily available.

A detailed note on the sources appears as Appendix A. Here, it is sufficient to mention that the whole population of milk and tea producers, selling milk and tea to 4 buying centers within the two sublocations Gatei and Gaikuyu, formed the basis of analysis. Any variation over time in the degree of concentration of sales within these buying centres cannot, therefore, be ascribed to sampling errors.

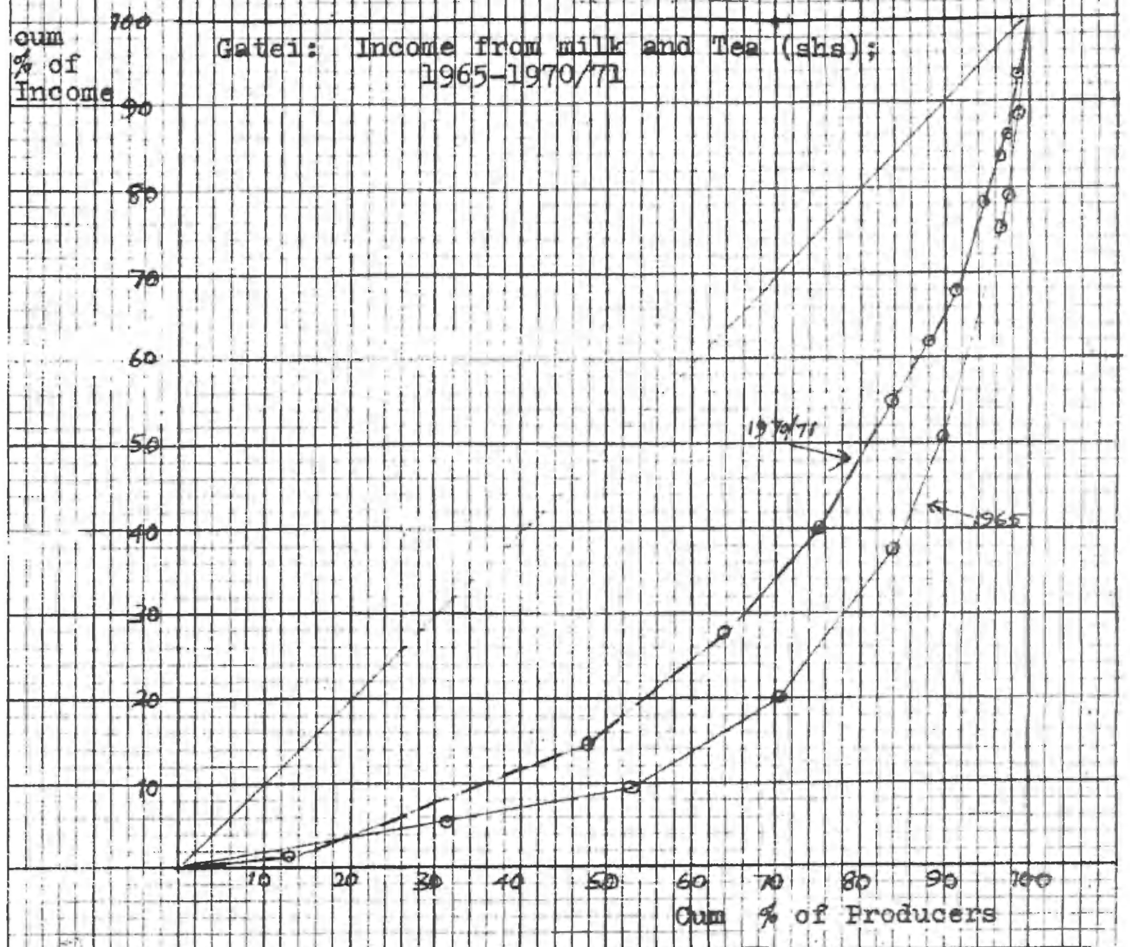
The analysis is severely circumscribed. The sources of the data come from two sublocation of Magutu Location, Nyeri District, an area relatively advanced in the production of tea and milk. Furthermore we are not concerned with minor crops; income from wage labour, government service and self employment; profits from non farm enterprise. Thirdly, the time series start in 1964 (1965 in the case of tea), the first year for which complete, systematic records of green leaf sales, to the KTDA, and milk, to the Mathira Dairymens Cooperative, become available. These restrictions not withstanding, the ability of a mass of households to enter into and expand the production of these dominant enterprises has enabled the survival of the middle peasantry in the face of the accumulation of assets by the larger farmers, whether the sources of that accumulation come from farm or non farm enterprise.

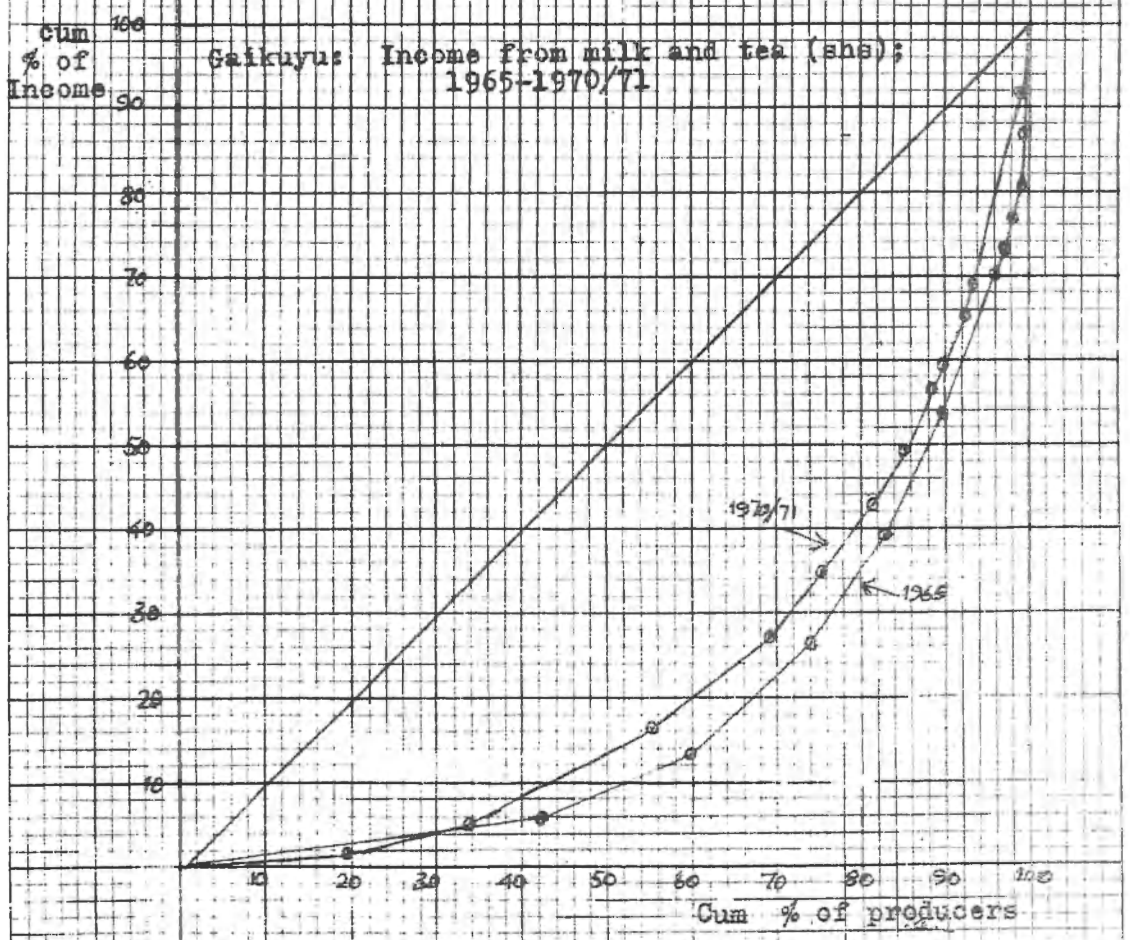
The significance of this survival is to be seen in the demonstration that whilst the relative position of the bottom 20% to 30% of the households has worsened over the period, the position of the top 10% of households has not improved. The fetter upon the expansion of the largest farms and the concentration of milk and tea production comes from the improved position of the middle peasantry.

[2] The Description of Measured Inequality, 1964-1971.

We employ two measures of inequality, the Gini coefficient and the Lorenz curve. Gini, as a concentration ratio, gives an index for the joint distribution of total income, from output sales, and the producers. In the range from 0.0 [total equality of income for all producers] to 1.0 [total inequality], the ratio measures the difference between the proportions of income received by the proportionate number of producers at different income levels. As an overall ratio, the coefficient cannot give the locus, the location of inequality within the income range. It cannot show whether the larger farmers, as opposed to the middle group of households, are increasing their share of output; whether the distribution is becoming more unequal for the smaller group of households.

FIG 1: LORENZ CURVES FOR INCOME FROM TEA AND MILK





To show the locus of inequality we use the Lorenz curve, a connection of observations plotted from the cumulative percentage of producers and the cumulative percentage of income received.[1] The larger the area between the curve and the main diagonal, the line of 45^{o} passing through the two intercises /the line of perfect equality/, the more unequal the distribution of income.

Table 1 gives the change in the Gini coefficients for the total income from the sale of milk and tea; Figure 1 shows the change in the Lorenz curves 1965 and 1971.[2]

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1. The method for estimating the Gini coefficient was derived from M. Bronfenbrenner's 'simple method! See M. Bronfenbrenner, Income Distribution Theory, London, 1i71, p. 50.

2. Bronfenbrenner points out that estimates of the coefficient are biased by virtue of the bunching of observations along the Lorenz curve. Particularily, observations bunched towards the top end of the curve will tend to understimate the value of the coefficient. The results shown here give declines in the value of the coefficient, i.e. reduced inequality in the concentration of production between 1964 and 1971. In the case of tea, observations are less bunched at the top end of the distribution (for producers with sales of more than 3600 lbs. over the year) in 1970/71 than 1965. The decline in measured inequality for each of the 4 buying centers and all centres tends to be understated. However, in the case of milk there is no change in the bunching of observations at the top end of the distribution. For one centre, Gaikuyu, where there was the only instance of an increase in inequality, there is more bunching in 1970/71 than in 1964 which understates the increase in measured inequality. For two centres, Gatei (Kagochi) and Kaibei bias is adverse in that the decline in measured inequality is overstated.

TABLE 1. TOTAL INCOME FROM MILK AND TEA

Sub-Location	Mean Sized Holding (1970) (Acres)	Gini Coefficient 1965 1970	Avereage Annual Change in Gini Coefficient	Average Annual rate of growth in Total income
Gatei	3.8 (420 persons p. Sq. km)	0.62 0.50	-11.6%	19.7%
Gaikuyu	6.5 (370 persons p. Sq. km)	0.62 0.56	- 0.7%	18.5%

Gatei, the sublocation characterized by a higher man /land ratio, a lower mean size of holding, a lower proportion of holdings more than twice the mean size of holding/ lower than Gaikuyu Gatei /shows not only a slightly higher average annual rate of growth in total income than Gakuyu but a far higher average annual decrease in measured inequality. Moreover, the decrease in the measured inequality is more pronounced in Gatei, for the households occupying the middle range of deciles, than in Gaikuyu. Indeed, the relative position of the poorest group of households has worsened in both centres whereas the rise in inequality at the bottom end of the distribution embraces 20% of the purchasers in Gatei, 30% of the producers in Gaikuyu are so affected. Correspondingly at the top end of the distribution, the group occupying the highest decile has not been able to maintain it's relative position to the same extent in Gatei as in Gaikuyu.

The third measure we use is the transition matrix.[3] The matrix shows the relative mobility of groups of households over the relevant period, by the way they change their position within the size distribution of income. For instance, from Table 2(a) for Gatei sublocation whilst 13% of households in the lowest income group (less than Shs 250) remained within the same size group, 30% moved up 1 group (to double their mean income), 18% moved up 2 groups (to quadruple their

3. The use of transition matrics overcomes the weakness of the Gini Coefficient -- Lorenz curve measures in permitting the precise location of the changes in measured inequality within the size distribution between 1965 and 1970/71. We have depended upon the method developed by A. Singh and G. Whittington in Growth, Profitability and Valuation, Cambridge, 1968.

Table 2: Transition Matrices, 1965-1970/71, for Income from Milk and Tea (Green Leaf) Sales

The number within each cell gives the proportion (%) households out of the total for each income group in 1965 (on the vertical column) which moved into income groups in 1970/71 (on the horizontal row). Entrants are those households without income from milk and tea in 1965: Deaths are those households with income in 1965 but not in 1970/71:

(a). GATEI INCOME FROM MILK AND TEA SALES

1965 (shs)	1970/71 (shs) Deaths	<250	251-500	501-1000	1001-2000	2001-4000	4001-8000	>8001	No. of H/hds
Entrants		33.3	22.2	16.6	22.2	5.6			36
<250	1.6	13.1	29.5	18.0	29.5	8.2			61
251-500	5.0		5.0	25.0	35.0	25.0	5.0		20
501-1000				18.8	25.0	56.3			16
1001-2000					27.3	45.5	27.3		11
2001-4000						57.1	42.9		7
4001-8000								100.0	1
>8001									0
Number of Households	2	20	27	25	40	30	7	1	152

Proportionate Growth in Income

Income in 1970/71 Income in 1965:	1	2	4	8	16,	Entrants	Deaths	
Number of Households	19	36	30	23	6	36	2	152
% of Households (less entrants and deaths)	16.7	31.6	26.3	20.2	5.3			114

(b). GAIKUYU:		INCOME FROM MILK AND TEA SALES								
		1970/71 (Shs)								
		Deaths	<250	251-500	501-1000	1001-2000	2001-4000	4001-8000	>8001	No. of H/hds
	Entrants		38.9	24.4	22.2	12.2	2.2			90
1965 (shs)	<250	3.6	14.6	14.6	23.6	27.3	14.6	1.8		55
	251-500			4.3	30.4	34.8	30.4			23
	501-1000				31.6	26.3	31.6	10.5		19
	1001-2000				5.3	21.0	36.8	36.8		19
	2001-4000					10.0		90.0		10
	4001-8000							50.0	50.0	2
	>8001								100.0	1
Number of Households		2	43	31	47	44	30	20	2	219

Proportionate Growth in Income.

Income in 1970/71/Income in 1965

	½	1	2	4	8	16*	Entrants	Deaths	
No. of holds	2	21	37	34	24	9	90	2	219
% of households (less entrants and and deaths)	1.6	16.5	29.1	26.8	18.9	7.1			127

* includes one household with growth ratio of 32.

income), 30% moved up 3 groups and 8% moved up 4 groups. Note that the upper limit of each size group is double that of the preceeding size group so that for any randomly chosen household within a given group, moving up one group means a doubling of income, moving up two groups means a quadrupling of income, falling by one group means a halving of income.

If we divide the income groups in 1970/71 by those of 1965, then we give the proportionate change of groups over the period. For instance, from the table under the table under the transition matrix for Gatei sublocation, 17% of Households, from all groups in 1965, remained within the same group, 32% of households doubled their income, 26% of households quadrupled their income and so on. Now, while between the two sublocations we found different rates of decline in measured inequality, the proportionate change in income looks remarkably similar for both sublocations. The only appreciable difference is that a proportionately greater number of households in Gaikuyu showed a growth of more than 8 times their 1965 income level and that growth came from the lowest size group (< Shs. 250). The differences in the changes in measured inequality do not come, therefore, from the overall rates of mobility ; they come rather from (i) differences in relative mobility and (ii) differences in the number of entrants between the two sublocations.

(i) The differences in relative mobility arise out late at which a given household from any size group will reach or overtake any household from the next size group over the relevant period. Were all households to show the same rate of proportionate change [i.e. the same proportion of households from lower size groups double or quadruple their income as do households from middle and higher size groups] then no one household can reach or overtake any other. The similarity in overall proportionate change disguises the differences between rates of mobility for the same size class but for different sublocations. In Gatei, the sublocation with the higher man land ratio, there is some tendency for an increase in the proportion of households remaining within the same size group, or rising up by one size group as the size group of income increases. In Gaikuyu, however, at a lower man/land ratio with more land to be brought into cultivation, the middle size groups show a higher rate of movement into higher size groups than in Gatei: there is no discernable monotonicity between the proportions of households remaining in the same size group and the increase in the size group of income. If a relatively high proportion of households from lower size groups are rising into middle size groups, then so there is some movement from middle into higher size groups. Where the measure of relative mobility is the probability of the intially smaller household (of size x) catching up with, or overtaking the income level of the initiallylarger household (of size 2x), then the ratio between the 'actual number of catchings up' and the 'maximum possible number of catchings up' is 0.302 for Gatei, 0.452 for Gaikuyu.[4] That fewer households can catch up with others in Gatei, than in Gaikuyu, means that under these particular conditions, a greater proportion of households get stuck within the middle range of the distribution, by size group of income, in Gatei than Gaikuyu. This makes the measured inequality of income in Gatei less unequal than in Gaikuyu.

(ii) In 1970/71, 40% of households in Gaikuyu had entered tea and milk production since 1965; only 25% of the households in Gatei were entrants. As the entrants are concentrated in the lower size groups of the 1970/71 distribution, and are more so concentrated in Gaikuyu than Gatei, the effect of a larger number of new producers is to reduce any tendency towards less inequality within the distribution of income from the production of the two enterprises.

Over 1965 to 1970/71, the effect of price changes upon the growth of income was slight. The net payout, including the second payment, for green leaf tea dropped slightly from an average of 0/36 cents per lb. in 1965 to an average of 0/34 cents per lb. for 1970/71; the payout

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4. The inability measure is derived from Singh and Whittington, Growth, Proftitability and Valuation, pp. 99, 304.

price for milk rose from an average of 1/92 per gallon in 1965 to 2/35 per gallon in 1970/71.[5] Price fluctuations within the year, in the case of milk, were greater than fluctuations between years. The dominant component in the growth in income was out of the growth in output and we now consider the effects of this growth upon the concentration of production, treating milk and tea as separate analytical categories.

The Concentration Of Milk and Tea Sales, 1964-1970/71.

Similar measures are employed to show changes in the degree of concentration of sales as were used for the description of the measured inequality of income. The difference is that we consider the collection of green leaf and milk from 4 buying centres, rather than the two centres of

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5.	MILK Average net Payout price per gallon in cents	GREEN LEAF TEA Net Payout Price per lb. in cents
1964	216	37
1965	192	36
1966	224	37
1967	224	37
1968	208	27
1969	208	30
1970	205	30
1971	245	41
Annual Average change	0%	- 0.4%

1. Source: Mathira Dairymens' Cooperative Annual Accounts an and Payout vouchers, 1964-1971. Monthly Payout Prices by the Cooperative are averaged to give the annual average.

2. Source: Kenya Tea Development Authority Annual Reports, 1964/5 - 1971/2 Net Payout Price = [1st Payment + 2nd Payment] - [Revenue less + Capital cess]. The 2nd payment is based upon the bonus given to growers in Mathira Division from financial surpluses earned at the Ragati Tea Factory. Payments and cesses are set annually by the financial year, July-June.

Gatei and Gaikuyu; we also use a normative transition probability matrix to give some 'as if' equilibrium of the distribution of outputs, under different assumptions regarding the proportions of entrants into and out of the distribution. The normative transition probabilities are merely of heuristic value but they enable an evaluation of the effects of entry and death upon the distributions of sales.

TABLE 3:		TOTAL SALES FROM MILK AND TEA					
		MILK, 1964-1970/71			TEA, 1965-1970/1		
Buying Center	Mean size of holding (acres)	Average annual rate of growth in sales	Change in Gini coefficient	Relative mobility index	Average Annual rate of growth in sales	Change in Gini Coefficient	Relative Mobility Index
Kaibei	3.8[1]	+19.9%	-1.9%	.348%	+19.9%	-2.5%	.387%
Gatei (Kagochi)	3.8	+17.7%	-2.1%	.419	+16.9%	-2.0%	.401
Gaikuyu	6.5	+17.2%	+2.2%	.379	+13.7%	-1.3%	.401
Gitunduti	6.5[2]	+13.4%	-3.6%	.405	+14.3%	-1.3%	.425
All Centres		+16.6%	-1.0%	.384	+16.6%	-2.0%	.407

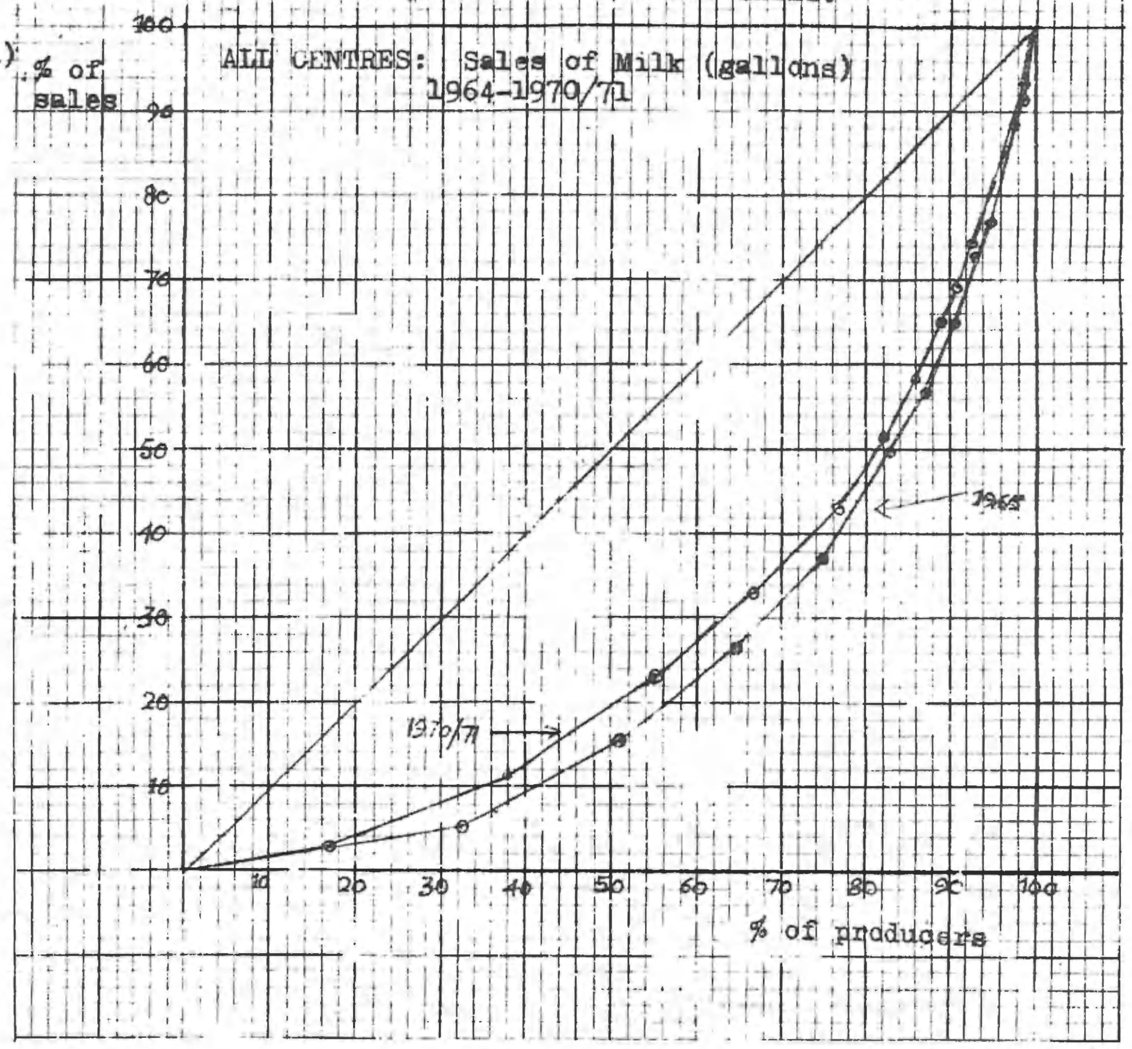
1. Holdings in Kaibei are slightly smaller than in Gatei but the enumerated size of holding is taken from the mean size for Gatei sublocation.

2. Holdings in Gituduti are larger than in Gaikuyu but the enumerated size of holding is taken from the mean size for Gaikuyu sublocation.

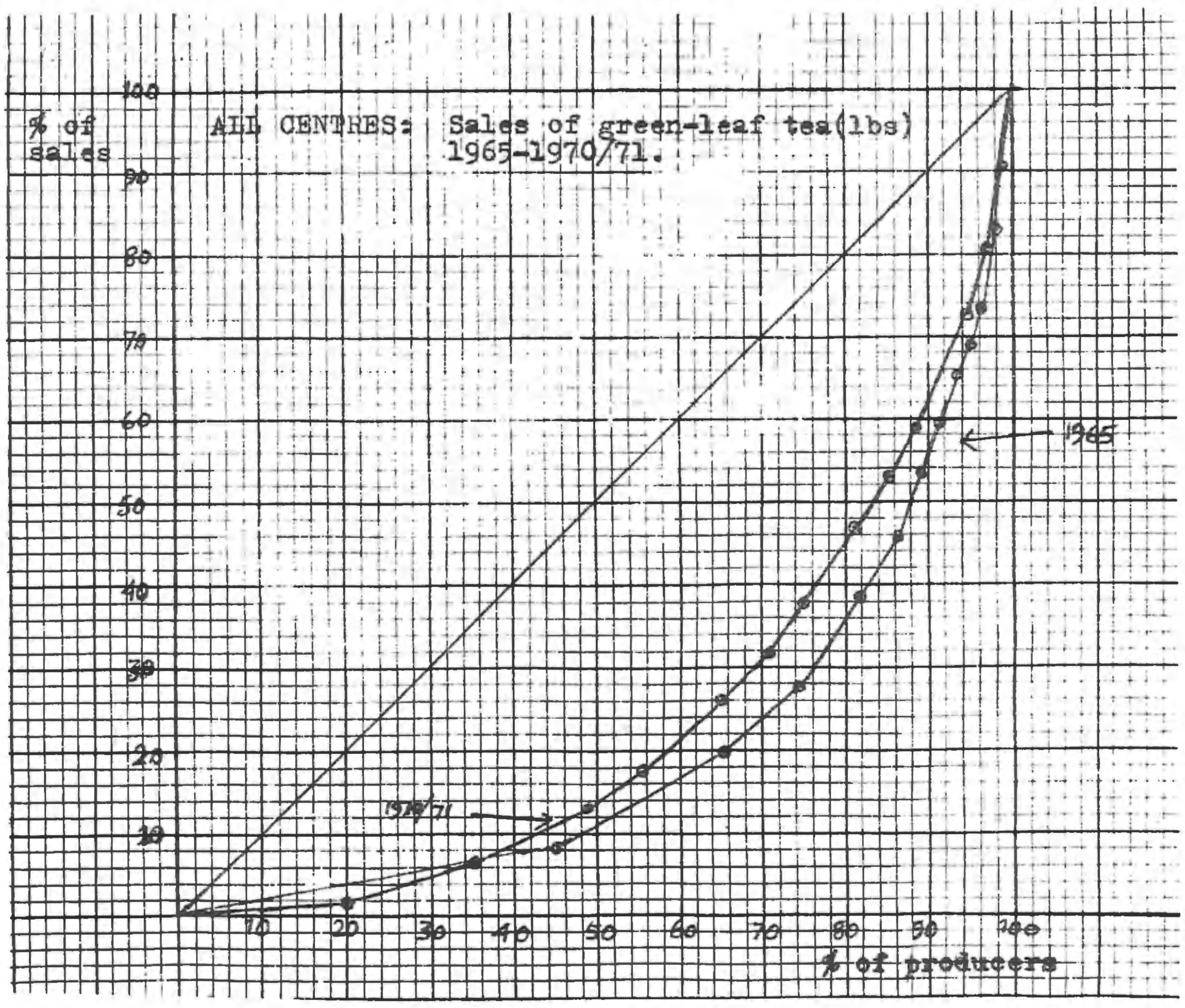
Now, in conjuction with a reading of the Lorenz curves for all centres, milk and tea [Figure 2a, 2b] Table 3 shows that the reduced concentration in sales of milk (as shown by the Gini Coeffieciont) is more marked than the reduced concentration of tea sales. However, the overall measure disguises that whilst the relative position of the lower groups of households remains constant in the case of milk, the relative position of the bottom 35% of households, producing 6% of the total tea green leaf sales, has worsened over the period since 1965. The relatively high

FIG 2: LORENZ CURVES FOR MILK AND TEA SALES.

(a)



(b)



rates of growth in tea and milk, equal for all centers, has given a broadly reduced reduction in the degree of concentration for milk but accentuated the reduction, in the case of tea, towards the middle group of households. Only one centre, Gaikuyu, shows an increase in measured inequality over the period, in the case of milk and only in two centres, Gaikuyu and Gitunduti, have the upper groups of households improved their relative position, again in the case of milk. All other centres, for both cases, follow the change in measured inequality as indicated by the Lorenz curves /_ Figure 2a, 2b_/.

Transition Matrices and Relative Mobility:

It appears that the lower the overall rate of mobility, the higher is the decline in measured inequality. Since the higher rates of growth of sales have come from the areas with a higher man/land ratio, particularily in the case of tea, there is some tendency for a high rate of growth to be associated with a more pronounced decrease in measured inequality. Growth comes not merely from the internal mobility of producers over the relevant period but from the entry of new producers. If for the moment we only consider the internal mobility, then in the case of tea the rate of mobility, as measured by the relative mobility index, declines for each size group by sales, as the size group increases. (Table 4b). The lower size groups show the fastest rates of growth and the rate of growth of the middle groups is less than that of the higher groups. The monotonic relationship between relative mobility and size group applies to all centres, both lower and higher man/land ratios. The source of reduced concentration of production comes out of lower rates of mobility in the higher groups, faster rates of mobility in the lower groups accentuating the reluction in measured inequality towards the middle groups of households.

Milk, however, shows no such monotonicity. Nor does any pattern emerge out of any association between relative mobility and the degree of reduction in measured inequality. In Gatei, the highest rates of mobility are found in the upper groups, in Gaikuyu amongst the middle groups; only in Kaibei (with the highest man/land ratio) and Gitunduti (with the lowest man/land ratio) do we find that the rate of mobility decreases with the increase in the size

Table 4: Transition Matrices, 1964-1970/71, for sales from milk (gallons) and tea green leaf (lbs)

As for Table 2, the number within each cell gives the proportion (%) of households out of the total for each size group in 1965 (on the vertical column) which moved into the size groups in 1970/71 (on the horizontal row).

(a) ALL CENTRES: MILK SALES (GALLONS).

		1970/71 (SHS)							
		Deaths	<100	101-200	201-400	401-800	801-1600	1600-3200	No. of H/hds
	Entrants		22.6	24.8	32.5	17.5	2.4	0.2	544
1964 (gallons)	<100	32.7	5.7	21.1	21.1	14.4	3.8	1.0	104
	101-200	17.2	4.7	14.1	23.4	25.0	12.5	3.1	64
	201-400	10.7	8.0	12.0	13.3	40.0	13.3	2.7	75
	401-800	5.0		1.7	16.6	30.0	40.0	6.7	60
	801-1600	6.3		6.3	6.3	12.5	50.0	18.8	16
	1601-3200						42.9	57.1	7
Number of Households		57	138	177	235	176	70	17	870

Proportionate Growth in Sales:

	1/8	1/4	1/2	1	2	4	8	16	Entrants	Deaths	No. of H/ds
No. of Households	1	8	27	55	94	52	25	7*	544	57	870
% of Households (less entrants and deaths)	0.4	3.0	10.1	20.5	35.0	19.3	9.3	2.6	-	-	269
Entrants/deaths as-%-households (1971)									62.1	6.6	870

(b) ALL CENTRES: TEA GREEN LEAF SALES (lbs)

		Deaths	< 400	401-800	801-1600	1601-3200	3201-6400	>6400	No. of H/hds
	Entrants		38.0	23.0	18.3	17.5	3.8	0.4	234
1965 (lbs)	<400	19.1	18.6	14.0	22.2	23.0	2.6	0.5	230
	401-800	10.2	2.8	12.0	28.7	32.4	12.0	1.8	108
	801-1600	12.1	1.2	4.8	16.9	30.1	27.7	7.2	83
	1601-3200	3.3		1.7	5.0	30.0	45.0	15.0	60
	3201-6400					4.0	44.0	52.0	25
	>6400							100.0	7
Number of Households		67	136	102	141	173	89	39	747

Proportionate Growth in Sales

	SALES IN 1970/71/SALES IN 1965										
	1/8	1/4	1/2	1	2	4	8	16	Entrants	Deaths	No. of H/hds.
No. of H/hds	–	2	11	106	128	118	72	9*	234	67	747
% of H/hds (less Entrants and Deaths)		0.4	2.5	23.8	28.7	26.5	16.2	2.0	–	–	446
Entrants / deaths as % of H/ds (1971)									31.3	9.0	

* Includes 1 Household from each matrix with growth ratio of 32.

group of sales. We cannot explain the reduction in the measured inequality by reference to the internal mobility in the case of milk because any change in the concentration of sales implied by relative rates of mobility by exsisting producers (of 1964) may be swamped by the entry of new producers. The proportion of tea entrants, 1965-1971, was one half, 31%, of the proportion of milk entrants, 1964-1971, 62%, of the total number of producers of tea and milk in 1971. Certainly in the case of milk, there is little meaning in considering internal mobility without reference to the number of entrants and the proportions in which they enter the distribution.

Transition Probability Matrices, Entrants and Deaths:

(i) Tea: The number of entrants as a proportion of households in 1971 does not show any great variation between centres. The proportions in which entrants have entered the size distribution by groups does show some variation by centres. Entry into the lowest size group, less than 400 lbs., is proportionately lower for centres with a lower man/land ratio and higher for centres with a lower man/land ratio. Correspondingly, entry into the middle size groups is proportionately higher for centres with a lower man/land ratio.

TABLE 5: TEA ENTRANTS, 1965-1971, INTO SIZE GROUPS BY SALES (lbs.) BY %:

	<400	<800	<1600	<3200	<6400	>6400	% of H/hds. 1971	No. of Entrants
Kaibei	26.8	12.7	23.9	29.6	5.6	1.4	33.8	71
Gatei	31.8	22.7	20.5	22.7	2.3	0	28.0	44
Gaikuyu	40.3	32.5	16.9	7.8	2.6	0	40.3	77
Gitunduti	59.5	19.0	7.1	9.5	4.8	0	30.2	42
All Centers	38.0	23.0	18.3	17.5	3.8	0.4	31.3	234

we saw that the rate of mobility of existing producers is higher at lower size than middle size groups. Since entry is over the span of the relevant period and if the distribution of entrants by year of entry is not different between centres then the higher proportion of entrants in the lower size groups of the centres with a lower man/land ratio (Gaikuyou and Gitunduti) implies that a lower proportion have been able to grow into the middle size groups. There is some differentiating factor <u>within</u> the group of entrants which gives them different rates of growth, for over the period all entrants must have passed through the lowest size group. This barrier against growth for some of the entrants is higher in the centres with a lower man/land ratio, lower rates of growth of output and a lower measured reduction in inequality.

If we take the transitional probabilities from the period 1965-1971, to become 'as if', equilibrium probabilities, then we can evaluate the effect of entry and death upon the distribution. To transform the expost transitional probabilities into equilibrium probabilities requires that we accept no change in the history behind the equation which has produced a particular concentration of output. There is no sense therefore, in which the normative distributions of the number of producers, between size groups, can become a set of predictions. The distributions derived from the equilibrium probabilities enable the drawing out of tendencies behind the historical concentration of output, 1965-1971.[6]

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6. The normative transitional probabilities were produced from the inverse matrix of the transitional probabilities from the period 1965-1971. When solved as a system of 6 equations, for the 6 size groups, the solution gives the normative distributions for a further seven year period:

Let P_{ij} be the probability that a member of group i moves to group j over the next period, where $i = 1, \ldots, 6_j$ and $j = 0, 1, \ldots, 6_j$

and $\sum_{j=0}^{6} P_{ij} = 1$ for all i.

Then

$$\sum_{i=1}^{6} P_{ij} N_i + A_j = N_j$$

for $j = 1, \ldots, 6$

where N_i = number in group i.

N_j = number in froup j ($= N^{*}_{t+1}, N^{**}_{t+1} \ldots$)

A_j = new entrants during the next period in group j.

R. Porter, T. Ryan, B. Wasow and the University of Nairobi computing centre provided assistance in the formulation and computation of the normative distributions.

TABLE 6: NORMATIVE DISTRIBUTIONS BY SIZE GROUP OF GREEN-LEAF SOLD(lbs) FOR ALL CENTRES

size group by sales (lbs)	1965 % of Producers	1971 % of Producers	$N^*_{(t+1)}$	$N^{**}_{(t+1)}$	$N^{***}_{(t+1)}$
<400	44.8	20.0	11.5	11.5	9.0
<800	21.1	15.0	8.9	8.3	8.7
<1600	16.2	20.7	12.6	10.9	10.9
<3200	11.7	25.4	21.1	16.0	14.5
<6400	4.9	13.1	26.9	15.2	16.7
>6400	1.4	5.7	19.0	38.1	40.2
N =	513	680	998	965	413
Gini Coefficient	.595	.528	.452	.426	

(i) $N^*_{(t+1)}$, gives the normative distribution upon the transition probabilities of 1965-1971, transformed into equilibrium probabilities, on the assumption that the entrants came into the distribution in the same number and proportions, by size groups, as for the period, 1965-1971. Here, the normative distribution results after another 6 year period.

(ii) $N^{**}_{(t+1)}$ gives the normative distribution on the assumption that entrants came into the distribution as for 1965-1971 but deaths leave the distribution, not concentrated around the lower groups but in equal proportions from each size group.

(iii) $N^{***}_{(t+1)}$ gives the normative distribution on the assumption that deaths leave the distribution in equal proportions, entrants coming into the distribution step wise downwards from the lowest size group.

Were the transitional probabilities to remain constant for any other similar period with the same number and proportions of entrants [$N^*_{(t+1)}$] then the decline in measured inequality would be greater than from 1965 - 1971. There is a shift upwards in the proportions of producers within each size group of the distribution. Since mobility out of middle and lower groups is higher than out of higher groups, by making the proportion of deaths constant between size groups, the resulting distribution pushes a higher proportion of producers into the higher size groups. Were inheritance to mean the break up of tea holdings and in the extreme case, were the break up to affect all size groups equally, then a lower proportion of producers could be concentrated around the middle groups $[N^{**}_{(t+1)}]$. With normative deaths and a step wise distribution of entrants $[N^{***}_{(t+1)}]$, the normative distribution is little different from the second case.

Over 1965-1971, the reduction is measured inequality has been constrained by the bulk of deaths going out of the lower groups and the weighting of entrants towards the lower size groups. The focus of deaths and entrants upon the lower size groups also worsen the relative position of the lower size groups over the period under review.

(ii). <u>Milk:</u> The centres with a higher man/land ratio show a higher proportion of entrants to producers in 1971 than those with a lower man/land ratio. There is however less variation between centres in the proportions which the entrants have entered the distribution by size groups. In every centre, the highest proportion of entrants is centered upon the middle group, up to 400 gallons.

TABLE 7: MILK ENTRANTS, 1964-1971, INTO SIZE GROUPS (GALLONS) BY %

	<100	<200	<400	<800	<1600	<3200	% H/hds 1971	No. of Entrants.
Kaibei	22.4	28.4	33.3	14.4	1.5	0	64.3	201
Gatei	19.7	23.6	30.7	22.0	3.9	0	69.0	127
Gaikuyu	29.0	24.6	29.0	15.8	1.8	0	63.0	114
Gitunduti	19.6	19.6	37.3	19.6	2.9	1.0	53.4	102
all Centers	22.6	24.8	32.5	17.5	2.4	0.2	62.5	544

<u>Gaikuyu</u>, the centre showing the only <u>increase</u> in measured inequality also shows the highest proportion of entrants within the lower size groups. As entrants started to sell milk from 1964 and excludes those producers who entered after 1964 but stopped selling before 1970, and as the number of entrants in Gaikuyu is no different from the mean number

of entrants for all centres, some part of the explanation for increased inequality comes from the inability of a relatively larger number of entrants to expand their sales into middle groups.

TABLE 8: DEATHS, 1964-1971, AS A PROPORTION OF 1964 PRODUCERS OF SOLD MILK

	Deaths, % of 1964 Producers	Deaths % of 1964 producers 200 gals.	Number of Deaths
Kaibei	16.8%	20.0%	19
Gatei	15.8%	34.8%	9
Gaikuyu	16.4%	27.2%	11
Gitunduti	20.0%	33.3%	18
All Centres	17.6%	26.8%	57

Gaikuyu, however, shows little difference in the proportion of deaths out of 1964 producers of sold milk, or in the proportion of deaths from the lower groups (of less than 200 gallons) within the 1964 Distribution (Table 8). There is only/some slight tendency for the proportion of deaths to be higher in the centres with a lower man/land ratio.

TABLE 9: NORMATIVE DISTRIBUTIONS BY SIZE GROUPS OF MILK SOLD, 1964-1971

Size group by sales (gallons)	1964 % of Producers	1971 % of Producers	N* (t+1) % of Producers	N** (t+1) % of Producers.	N*** (t+1) % of Producers
< 100	32.0	17.0	3.0	19.7	19.9
< 200	19.6	21.8	7.5	22.5	21.9
< 400	23.0	28.9	11.7	23.1	20.3
< 800	18.4	21.7	18.5	17.8	17.4
< 1600	4.9	8.6	38.4	10.5	12.8
< 3200	2.1	2.1	21.1	6.3	7.9
N =	326	813	8174	2404	
Gini Coefficient	.522	.487	.366	.563	

$N^{*}_{(t+1)}$, $N^{**}_{(t+1)}$, $N^{***}_{(t+1)}$ give normative distributions under similar assumptions as for the case of tea [notes under Table 6). The first normative distribution [$N^{*}_{(t+1)}$, under the assumption of entrants entering and deaths leaving the distribution in the same proportions as the 1965-1971 period] pushes a higher proportion of producers into the upper groups where the change over the period, 1964-1971 increased the proportion of producers in the middle groups of the distribution. The degree of concentration as measured by the Gini Coefficient is extremely sensitive not to the number of entrants and the proportions in which they enter the distribution, but to the distribution of deaths. The second normative distribution [($N^{*}_{(t+1)}$] assumes entrants come in by the same numbers and proportions as over 1964-1971 but that deaths are distributed equally by all size groups This severe assumption shows that a relatively lower number of deaths in the lower groups but higher number in the middle and upper groups, relative to the positive distribution over 1965-1971, prevents the relatively high rate of mobility of the surviving households in the lower and middle groups from producing the lower degree of concentration, as was the tendency for the period under review. With equally distributed deaths, a higher proportion of surviving households in the lower groups, upon reaching the middle range of the distribution, leave as deaths and a lower proportion more into the upper groups of the distribution. The resulting degree of concentration (.56) is similar to the degree of concentration measured in 1964 (.52). A step wise distribution of entrants [$N^{***}_{(t+1)}$] unlike the clustering of entrants around the middle groups as over 1964-1971) with equally distributed deaths does not produce a concentration of sales substantially different from the positive distribution of entrants [($N^{**}_{(t+1)}$.]

Until we discuss some implications resulting from the changed concentration of sales, it should be noted that deaths, in the case of milk, do not represent a ceasing of production but also a withdrawal from sales, confining production to have consumption.

[3] The Concentration of Assets and the Law of Proportionate Effect; the Case of Tea.

In measuring the changed concentration of tea (green leaf) output, we are faced with the problem of the yield augmenting effect stemming from the mere maturity of tea stumps. From the time of first production, tea stumps give a natural increase in yield up to the 5th or 6th year after planting. Since the owners of larger tea acreages in 1965 . planted tea in the early 1960's, their relatively low rate of mobility may be a function of the age distribution of their stumps. With a higher proportion of tea stumps planted more than 5 or 6 years before 1965 the owners of larger tea acreages show relatively lower rates of mobility than the owners of smaller tea acreages, a higher proportion of which was planted less than 5 or 6 years before 1965. The relatively high rate of mobility of the owners of smaller acreages in 1965 may result because their stumps are producing over a period which concides with the natural yield augmenting effect of maturation.

To eliminate this problem we now measure the degree of the concentration of stumps over the period 1963-1969, which gives the stocks of stumps in production over the period 1965-1971 (since at least two years is required before stumps come into production). In so doing we can also test the law of proportionate effect.

The law of proportionate effect[7] enables us to

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7. The simplest outline of the Law of Proportionate Effect is in Singh and Whittington, Growth, Profitability and Valuation, Chapter 4, pp. 73-93. We have followed their interpretation and methods closely, to the point of Plagiarism,, since both suit our purpose. No formalism is intended in testing this particular Law since the relationship between size of assets and proportional growth is an elementary basis for any study of differentiation between households over time. R. Gibrat stated the Law in Les inegalites economiques, Paris, 1931. Some variants have been developed by Rutherford , Income Distribution: a new model, Econometrica, 1965 and M. Kalecki, 'On the Gibrat Distribution,' Econometrica, 1945. Kalecki's elaboration reduces the law to a weaker form: that propotionate growth declines with increases in size .

test the relationship between the size and growth of tea holdings. More precisely, the Law holds that the probability of any tea holding growing at a given rate over any period of time is independent of the initial size of the holding, where initial size — in our case — is measured by the number of tea stumps held in 1962/3.[8] Households with a small or medium size of holding have as much chance of growing at a given rate as do households with a larger size of holding. There must be some chance that any household's holding grows proportionately to the original size of that holding and that the sum of these chances are distributed normally. Singh and Whittington give the basis for the Law: "The proportionate change in the size of a [holding] during any period of time is a stochastic phenomenon which results from the cumulative effect of the chance operation of a large number of forces acting independently of each other".[9] Chances of growth in the size of holdings depend upon the expected income from the sale of green leaf in terms of the past income from sales; where the household is dependent upon wage labour for the tea enterprise then the decision making process will be concerned with profitability.

Here we are not concerned directly with the decision making process of the or any type of household but only mention that income or profitability for each household will depend upon incomes from non tea enterprises, the number of these enterprises, their past and expected incomes, the level of wage rates [in the case of profitability], the level of application and price of non labour inputs, climatic conditions, age of the household head and so on. "During any particular period of time, some of these factors would

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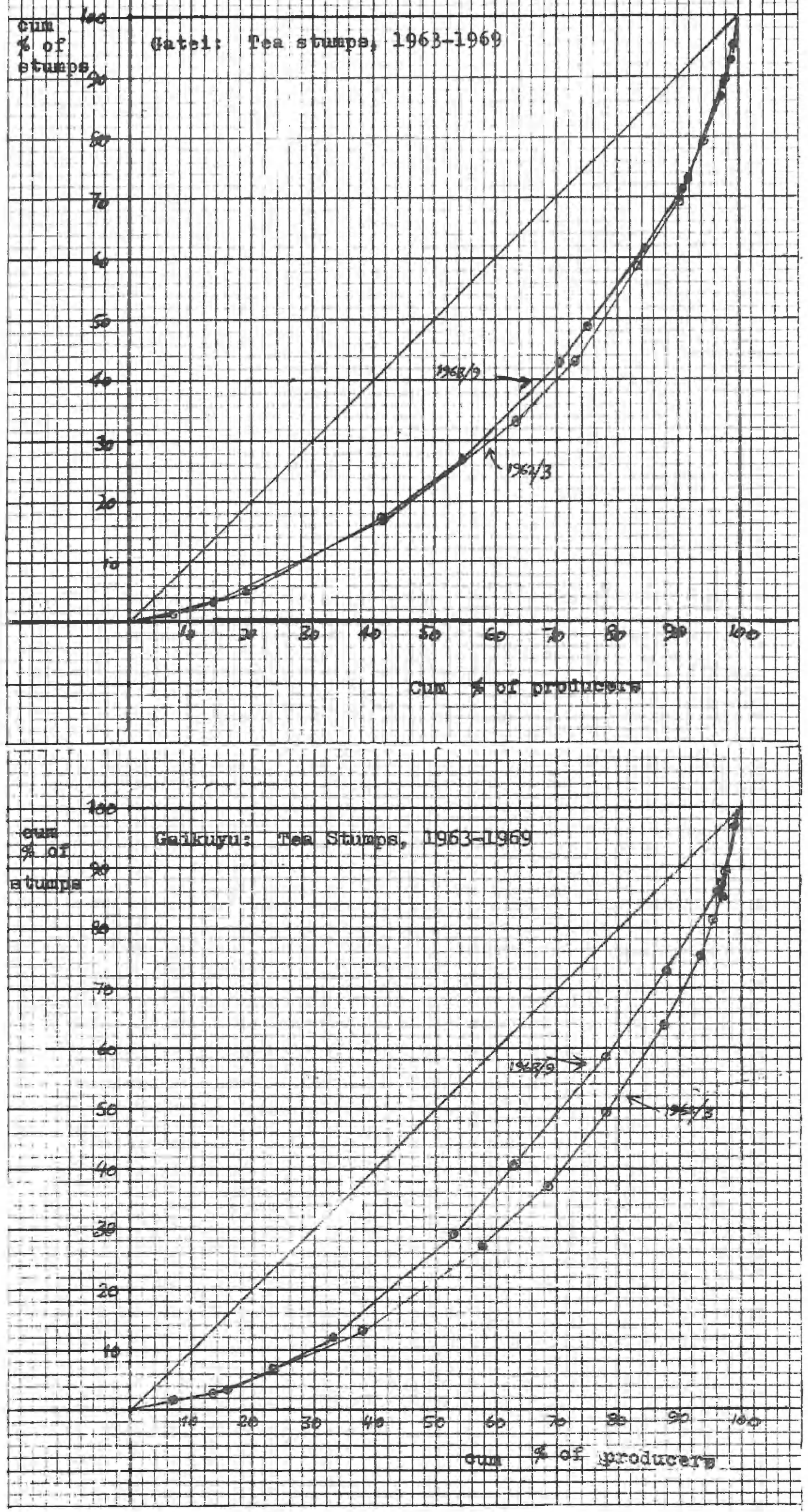
8. The analysis of assets is concerned with the stock of stumps which are yielding a positive output for sale. After planting, stumps take between two and three years to come into production for saleable green leaf. The opening period for the analysis of output was 1965; we have taken the stock of stumps recorded in planting year 1962/3 as the opening period for the analysis of assets.

9. Singh and Whittington, Growth, Profitability and Valuation, P. 73.

FIG: 3 - LORENZ CURVES FOR TEA STUMPS



make for an increase in the size of the [holdings], others for a decline, but their combined effect would yield a probability distribution of the rates of growth (or decline) for [holdings] of each given size. The law of proportionate effect assumes that this probability distribution is the same for all size classes of [holdings]".[10]

Now, if households with a larger size of tea holding have an equal chance of growing at the same proportionate rate -- to their initial size of tea holding -- as do households with smaller sizes of holding, then over any given period there will be a constant or increased concentration of tea holdings since the dispersion in the size of holdings is increasing over the period.[11] From Figure 3, Lorenz curves for tea stumps, Gatei shows a slight decline in measured inequality of holdings, Gaikuyu a substantial decline in measured inequality. The respective Gini Coefficients for the two buying centres, for the opening and closing years are given as follows:

Buying Centre	1962/3	1968/9
Gatei	0.41	0.40
Gaikuyu	0.43	0.34

Disproof of increased concentration is not sufficient, however, to make the law of proportionate effect invalid, since the measure of concentration includes the entrants who have

10. Singh and Whittington, Growth, Profitability and Valuation, p. 73.

11. Other implications which follow from the Law are that there is no optimum size of holding and that the rate of growth of the holding in one period has no effect upon growth in subsequent periods. The implications arise from the basic assumption that the size distribution is not normally distributed; it is some variable catching the factors such as age, education, individual characteristics, climate, which is a function of size and is normally distributed. If this variable is normally distributed, then the Law states that the size distribution is log normal or tends towards log normality.

come into the distribution since 1962/3 and we are interested in the explanation of growth of those holdings which were in production in 1965. In the form presented here, the Law becomes invalid if households from different size groups of tea holdings, show different size of proportionate growth and that the dispersion of growth rates around the common mean is different for different size groups of holdings.

To test whether average proportionate growth rates are different for different size groups of holdings we regress the growth of tea holdings on the initial size of the holding: The simplest relationship is:

$$G = a + b \log S_{1963} \qquad (1)$$

where $G = (\log S_{1969} - \log S_{1963})/t$

S_{1963} = size of tea holding by stumps, 1963

S_{1969} = size of tea holding by stumps, 1969

t = number of years the holding has been in production since 1963.

a and b are parameters.

TABLE 7: PROPORTIONATE GROWTH OF TEA HOLDINGS, BY SIZE GROUPS, 1963-1969, FOR THE FULL POPULATION OF HOLDINGS

Size 1963 acres(stumps)	No. of Households	Average proportionate Growth % p.a.	Standard Deviation	R^2	a	b
< 0.5(1750)	161	.10	.11	0.18**	0.33 (3.30)	-0.035* (2.36)
< 1.0(3500)	61	.05	.05	0.21	0.54 (1.90)	-0.064 (1.74)
> 1.0(3500)	15	.01	.07	0.11	0.24 (0.43)	-0.027 (0.41)
All size groups	237	.08	.01	0.33**	0.36 (6.73)	-0.040** (4.32)
Gatei	117	.08	.01	0.33**	0.32 (4.68)	-0.036** (3.76)
Gaikuyu	120	.08	.01	0.34**	0.41 (5.04)	-0.046** (4.03)

* significant at the 5% level.
** significant at the 1% level.
t test results are in parenthesis, for each parameter.

For the full population of households equation (1) suggests that the proportionate change in growth is equal for the given proportionate change in size, for all sizes of tea holdings.[12] The equation was tested for 3 size groups.

To test the differences between the means of proportionate growth, we used an approximate t test as devised by Cochran.[13] The average proportionate rate of growth of the smaller size group is significantly greater than the medium and larger size groups, at the 5% level; the medium size group shows a significantly higher proportionate rate of growth only at the 10% level. If this shows some tendency towards growth varying in a systematic way with the initial size of holding -- and thus an **invalidation** of the law of proportionate effect -- then some ambiguity remains in the result that proportionate growth is inversely related to size. Firstly, the dispersion of proportionate growth around the mean, as shown by the standard deviations, is significantly higher (at the 5% level)[14] for the smaller size group than medium size group; there are no significant differences between the standard deviations of the medium and larger size groups. Differences in proportionate growth <u>within</u> the smaller size group mean that while initially small holdings <u>as a whole</u> grow proportionately faster than larger holdings, a higher proportion of holdings within the small size group will show a lower rate of proportionate growth than holdings in the larger size groups.

Secondly, for all size groups, the initial size of holding accounts for less than 20% of the variance in proportionate growth (r^2 = 0.33, significant at the 1% level).

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12. Singh and Whittington, Growth, Profitability and Valuation, p. 75.

13. The test is given in G.W. Snedecor and W.G. Cochran, <u>Statistical Methods</u>, Iowa, pp. 115-116.

14. A test for the equality between any tow variances has been derived from the simple F test. Snedecor and Cochran, <u>Statistical Methods</u>, p. 117.

For each size group, the proportion of explained variance in proportionate growth is even less and only for the smaller size group, are the r^2 and parameter b values significantly different from zero at the 5% level. In the form of a log-linear relationship, size is inversely related to growth but the strength of the relationship is weak and there are no systematic differences behind the explanation of growth by the differences between size classes. Nevertheless, that there are significant differences between the average rates of proportionate growth means that there may be some more complex, non-linear relationship between initial size and growth.

We tested for curvilinear relationships by fitting two equations, in both the normal and log form, for all size groups, Gatei and Gaikuyu separately:

$$G = a + bS_{1963} + cS^2_{1963} \qquad (2)$$
$$G = a + bS_{1963} + cS^2_{1963} + dS^3_{1963} \qquad (3)$$

where the notation follows that for equation (1).

No equation gave a better result than the log form of equation (1).[15] Any such systematic process, whereby the proportionate growth in stumps declines with the increase in the initial size of acreage, cannot be determined satisfactorily by size alone. Between initial size and proportionate growth there may be a set of intervening variables

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15. $G = a + bS_{1963} + cS^2_{1963}$
$G = a + bS_{1963} + cS^2_{1963} + dS^3_{1963}$

All Centres	Equation	N	R^2	a	b	c	d
	(2)	237	.35**	0.14 (10.44)	-.00005 (4.40)**	.000000004 (2.69)**	-
All centres	(3)	237	.34**	0.14 (8.08)	-.00006 (2.47)	.000000008 (1.00)	3x(10^{-11}) (0.50)

** significant at 1% level

* significant at 5% level

(Footnote 15 cont)

which account not merely for different rates of proportionate growth but for the difference between non-growth and positive growth for various size groups. Nearly one third of the full population of holdings showed no growth in stumps over the period 1963–1969. We therefore restricted the population to those holdings with positive growth to retest the relationships between proportionate growth and size in the forms of equations (1), (2), (3). The results for the log linear relationship (equation 1) are given in Table 8.

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15. Gaikuyu and Gatei results are little different from the all centres result and are not presented here. Gatei embraces part of the bracken Zone which, with soils of higher acidity than the Kikuyu grass Zone, produces higher yielding tea but is less suitable for dairy cattle and crop enterprises. If some increase in the rate of growth is anticipated for holdings with higher initial size, compared to holdings of lower size groups, then the d coefficient of equation (3) should show a significantly higher value for Gatei. No such result was obtained.

An illegitimate formulation, based on a hyperbolic curve, was also tested:

$$G.S_{1963} = C^* + aS_{1963} - cG + E^* \qquad (3a)$$

where S and G follow previous notation

and the constant $C^* = b + a.c$ where a, b, c are parameters and the error term $E^* = ES_{1963} + c$.

The hyperbolic form is illegitimate as the error variable not independent of the independent variable, initial size. Positive values of t will be associated and tend to increase with the increase in the values of initial size. The following r^2 values and vlues of C^*, a and c parameters were obtained:

	N	R^2	C^*	a	c
Gaikuyu	120	.76**	-19.8 (1.58)	.02 (4.40)	863.6 (13.21)
Gatei	117	.55**	-40.1 (1.54)	.02 (1.80)	1155.2 (6.94)
All centres	237	.58**	-24.1 (1.62)	.02 (3.43)	922.5 (10.96)

TABLE 8: PROPORTIONATE GROWTH OF TEA HOLDINGS, BY SIZE GROUPS, 1963-1969, FOR HOLDINGS WITH POSITIVE GROWTH

Size 1963 acres (stumps)	No. of H/holds	Average Proportionate Growth % p. annum	Standard Deviation	R^2	a	b
<0.5(1750)	112	.14	.10	0.43**	0.73 (6.33)	-.09** (5.10)
<1.0(3500)	47	.06	.05	0.31*	0.74 (2.41)	-.09* (2.22)
>1.0(3500)	10	.02	.09	0.20	0.50 (0.58)	-.06 (0.57)
All Size groups	169	.11	.10	0.60**	0.64 (11.00)	-.075** (9.13)

* significant at 5% level.
** significant at 1% level.

For the restricted population of holdings, average proportionate growth of the small group is significantly greater than the middle size group, at the 5% level. The average proportionate growth of the middle size group is not significantly greater than the larger size group at the 10% level. Again, as for the full population of holdings, the dispersion of proportionate growth around the means is significantly higher for the smaller size group than the middle size group (at the 5% level).

Differences between the standard deviations of other groups are not significant.[16]

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16. On the restircted population -- for holdings with positive growth -- we ran the regression analysis on equations (2) and (3), expressing curvilinear relationships between size and proportionate growth. The equations were fitted to both the natural and log populations, for each of the 3 size groups. Again, there was no impovement in estimation of the

(16 cont..)