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CONTENTS

MANUFACTURING

AGRONOMY AND HARVESTING

IRRIGATION

GENERAL PAPERS

THE ECONOMICS OF CLONAL REPLANTING ON TEA ESTATES IN MALAWI

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1. INTRODUCTION

1.1 Background

In the 1960s Tea Research Foundation (Central Africa) (TRFCA) started selecting and testing clones for yield and tea-making quality, rooting and vigour, drought tolerance, and pest and disease resistance. These clones are continuously being released for planting on tea estates in Malawi in order to replace old seedling tea bushes and ensure the long-term productivity and competitive edge of the industry through higher growth rates in both yields and quality.

In Southern Africa seedling tea is relatively low-yielding and of inherently poor-quality due to its poor response to increased fertilizer dosage and susceptibility to moisture stress and pests and diseases, despite good management levels on the tea estates and in the factories. Furthermore, real world tea prices have been characterized by downward trends over the years, and average prices for seedling tea have been well below those realised from sales of clonal invoices. Continued seedling tea production may, therefore, have little scope to cope with any future downward movements in the tea prices.

The first clones were released by TRF(CA) in the 1960's and tea estates in Malawi started planting them as early as 1965 through both extensions of areas planted with tea as well as replanting of seedling tea bushes. By 1994, 2,243 hectares (15 percent of the area planted with tea) were already under clones, and 71 percent of this was achieved through extensions while only 29 percent was due to replanting of old seedling tea bushes. It is quite apparent from this scenario that tea planters preferred to continue harvesting old seedling tea bushes and to extend into new areas where available. This practice enabled tea estates to maintain an income stream which would then be increased when the clones from the extended areas came into production.

However, towards the end of the 1970's it was observed that there was very little virgin land left in the tea growing areas of the country on which to plant the clones, and the TRF(CA) anticipated an upsurge in clonal replanting now that investments that were previously earmarked for extensions would be available for replanting.

To ensure maximum potential from the replanting programme an experiment was carried out from 1978 to 1994 to test the effect of different methods of cultivation and rehabilitation on the soil and yield of the replanted clones. The cultivation and rehabilitation methods that were tested were: minimum tillage; plough only; plough and rip; no rehabilitation; one year rehabilitation; and two-years rehabilitation. In all rehabilitation treatments Guatemala grass was used as the rehabilitation crop.

After subjecting the experimental results to both agronomic evaluation and statistical analysis the following recommendations to tea planters were made:

(a) Minimum Tillage (CO), which involves cutting-off old seedling bushes at ground level after pruning into heavy wood, and killing-off the stumps by removing re-growths in order to deplete starch reserves. This method of cultivation reduces soil erosion, and maintains the favourable physical and chemical properties of the soil, as well as reducing the risk of *Armillaria*.

(b) Plough only (C1), which involves uprooting old seedling tea bushes after pruning into heavy wood, removing all bushes, levelling the land and then ploughing once at about 15cm deep. This method of cultivation exposes the soil to destructive forces of rain and sunshine, but gives a yield advantage during the early years of replanting over minimum tillage.

(c) No rehabilitation (RO), which involves planting the land with clones immediately following the minimum tillage or ploughing operations.

(d) One-year rehabilitation (R1), which involves rehabilitating the land for one year before planting the clones. Rehabilitation gives a yield advantage over no rehabilitation.

1.2 Objectives

Although considerations other than pure economic worth of clonal replanting are important in making replanting investment decisions, by and large, decisions have to be taken after evaluating the economic worth of replanting. The present economic analysis, therefore, aims to present the overall picture of changing from seedling tea production to clones, and the economic benefits resulting from that change using the results of the experiment as well as data on cost and returns of clonal replanting obtained from some of the tea estates in both Mulanje and Thyolo.

It is anticipated that this economic analysis will help tea planters to weigh the benefits to be gained from replanting which are in the form of higher yields and improved quality that has a price advantage on the world markets where prices for seedling tea continue to remain under pressure, against the seedling tea uprooted in the form of foregone earnings potential from such tea.

Specifically, the study presents the results of the experiment from a commercial perspective by evaluating the economic worth of the four recommended replanting investment options, ranking them according to the magnitude of returns they generate on the capital employed, and comparing them with continued seedling tea cultivation.

2. EXTENSION AND REPLANTING INVESTMENT ANALYSIS

2.1 Cash-flow analysis

The analysis of cash-flows is intended to allow the investment and operating costs and gross returns of the four extension and replanting investment options together with their net cash-flows per hectare to be readily identified on an annual basis. From such net cash-flows the pay-back period as well as the point at which gross returns from each replanting investment option begin to exceed those of continued seedling tea cultivation can be then be obtained using cumulative net cash-flows.

Detailed cash-flow budgets, which include man-day and tractor-hour requirements for various operations are shown in Appendix 2.

(a) For extension, which involves the expansion of area not previously planted with tea, only the initial investment, operating costs and their gross returns directly attributable to the extension investment option have been included in the analysis.

(b) For replanting, which involves uprooting old seedling tea bushes and planting clones on the same ground, costs include the foregone earnings potential of the uprooted seedling tea plus the new costs directly attributable to the replanting investment option; returns include the production, manufacturing and marketing costs saved by not continuing with seedling tea cultivation plus the new income from the replanted clones.

It must be noted that no specific study was carried out to determine the establishment costs of extension. However, since most extensions are undertaken on land recovered from coffee or Eucalypt plantations etc., it has been assumed that their establishment costs would be similar to those attributable to replanting.

2.1.1 Pay-back period

Pay back (break-even) period is the time taken for the expected returns from any of the extension and replanting investment options to fully recover their initial investment and operating costs. In the present study pay-back periods have been estimated using 80 percent of the yields of the rain-fed clones obtained from experimental data and for irrigated clones where no actual time-series of yield data was available, 40 percent increase above those adjusted rain-fed yields for clones, and 30 percent yield increase for seedling tea (Appendix 1). This adjustment has been done to reflect the fact that the tea industry's yields are, in general, lower than those obtained from research results. Yield data obtained from the replanting programmes of the tea estates confirmed this fact. However, such direct data has not been used in this analysis because it only covered the first three to five years of replanting. As for prices, the highest average prices obtained by the tea industry in 1994 for main grades of clones (US$1.12) and seedling tea (US$0.92) have been used in the analysis. Table 1 gives the details of the pay-back periods for the extension and replanting investment options.

Table 1 Pay-back periods for clones under the four extension and replanting investment options (years)

INVESTMENT OPTION		CORÓ	COR1	CIRO	CIRI
Extension	Rain-fed	4	5	4	5
	Irrigated	5	5	4	5
Replanting	Rain-fed	8	9	7	8
	Irrigated	8	8	7	8

The results in Table 1 generally show that CIRO gives the shortest pay-back period under extension and replanting investment options, closely followed by C1R1, and C0R0 with CORI coming out with the longest pay-back period.

The results further show that extension investment options give shorter pay-back periods than replanting investment options. This is because the investment costs of extension are lower than replanting, since no potential yield is forgone as a result of extension; instead, total production is actually expanded by such a programme.

However, the cheapness of extension can be quite deceptive. Extension may necessitate the building of a new factory to cope with the substantial increase in the production of tea on an estate. This, in effect, would increase the cost per kilogram of made tea of extension making it greater than that involved in replanting. Because, under the latter, the marginal increase in production of the high yielding clones over the seedling tea uprooted may only require eventual modernizing and enlarging the capacity of the existing factory, the cost of which could be much lower than that involved in building a new factory altogether.

In addition, extension does not solve the problems of the tea industry in terms of quality improvement, since the investment spent on extension is not available for replanting and the area covered by the low-quality seedling tea remains the same. Unless the tea industry in Malawi undertakes a replacement programme, whereby for every area of clones planted on fresh ground an equal area of old seedling tea is uprooted after the new plantings come into full production, concentration on extension may not be able to maintain the tea industry in an economically viable state of development and avoid adverse effects on its long-term productivity and competitive edge on the world markets. Replacement can also help tea estates to maintain a fairly stable cash-flow and liquidity while pursuing their replanting investment programmes.

2.1.2 Marginal Analysis

Any extension or replanting programme will not be worthwhile if it does not eventually yield higher returns than continued seedling tea cultivation. Cumulative net cash-flows have, therefore, been used to obtain the period it takes for returns from the extension or replanting investment options to exceed those of continued seedling tea cultivation. The higher the marginal returns the shorter is such a period (*Table 2*).

Table 2 Period taken for returns from extensions and replanting investment options to exceed those of continued seedling tea cultivation (Years)

INVESTMENT OPTION		CORO	COR1	CIRO	CIRI
Extension	Rain-fed	12	13	12	12
	Irrigated	11	12	11	12
Replanting	Rain-fed	14	16	13	15
	Irrigated	13	14	12	14

The result displays a similar trend to that presented in Table 1 earlier. The period it takes for returns from extension investments, excluding factory investments costs, to exceed those of continued seedling tea cultivation is, in all investment options, lower than from replanting investments and for individual extension and replanting investment. Option CIRO has a shorter period than the rest of the options, making it a more attractive proposition for any tea planter interested in making a quick recovery of investment funds and earlier profits.

Figures 1 to 4 give graphic illustrations of both pay-back periods as well as periods when returns from the extension and replanting investment options begin to exceed those of continued seedling tea cultivation. The pay-back period for each investment option is at the point where the cumulative net cash-flows cross the zero axis, whereas the period when the investment options begin to exceed seedling tea cultivation is where the cumulative net cash-flows cross the continued seedling tea cultivation line.

Figure 1 Cumulative net cash-flow (Extension irrigated)

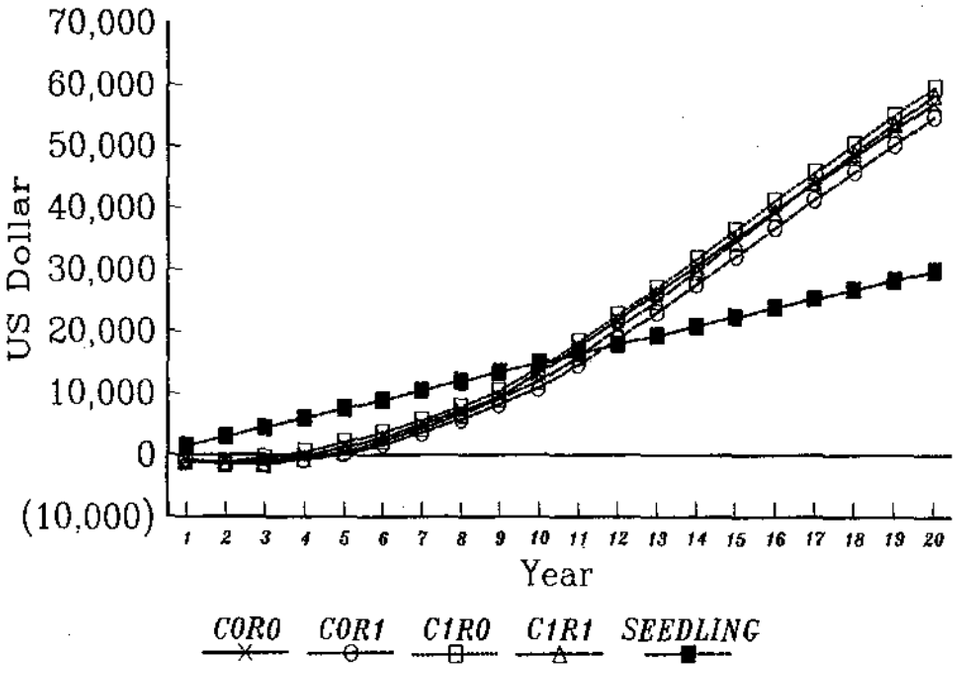


Figure 2 Cumulative net cash-flow (Extension rainfed)

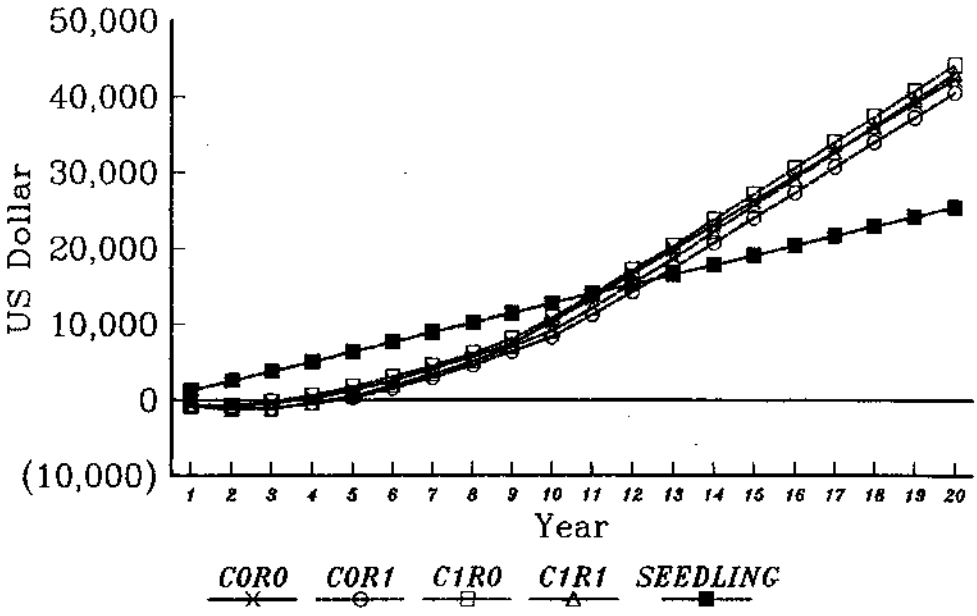


Figure 3 Cumulative net cash-flow (Replanting irrigated)

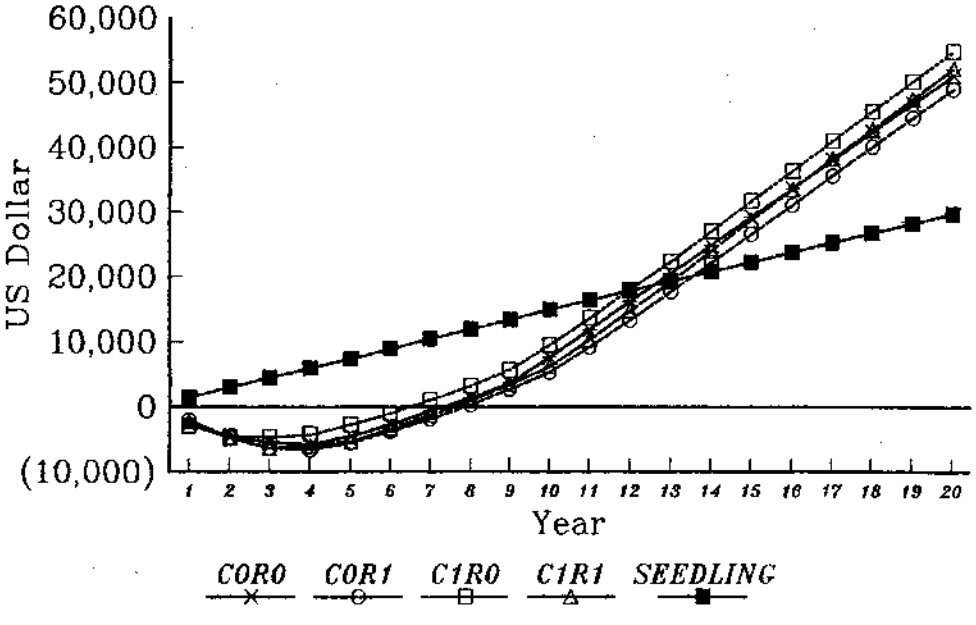
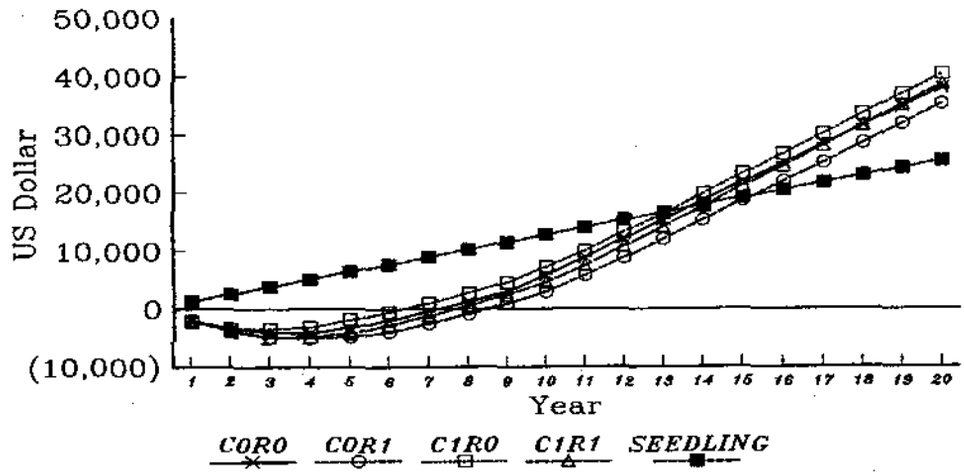


Figure 4 Cumulative net cash-flow (Replanting rainfed)



2.2 Discounted cash-flow analysis

Although pay-back is useful as a crude screening tool, it does not take full regard of the time value for money. It also does not take full account of the magnitude of returns generated during and after the pay-back period. In the above analysis, some extension and replanting investment options are ranked as having the same pay-back period even though some of them yield extra earnings during and after pay-back period. Therefore, discounted cash-flow analysis is intended to further evaluate the economic viability of the four extension and replanting investment options, and to rank them according to the magnitude of returns they generate on the capital employed. To this effect, the costs and benefits for the specific extension and replanting investment options studied, have been discounted to take into account the foregone earnings potential of the capital invested in each one of them.

The criteria used in the present analysis to handle the time effects are the Net Present Value (NPV) and Internal Rate of Return (IRR).

The NPV is the present value of the income stream generated by the extension or replanting investment. In the current analysis, the sum of the discounted annual net cash-flows has been charted over a 20 year period to yield the NPV.

Exchanging the system of the future net cash-flows for a single discounted value makes it easy for a tea planter to compare the extension and replanting investment options. If the NPV is negative at the discount rate chosen, the investment option is not considered worthwhile because the investment capital will not be recovered. If the NPV is positive, the investment is considered economically viable as it will give the required return and a bonus which is the excess of NPV over zero, although the final decision depends on comparison of the magnitudes of the NPV for the extension and replanting investment options. The investment option which gives the highest NPV is preferred as it gives the highest returns on the capital employed.

The discount rate that has been chosen to calculate the NPV of the extension and replanting investment options is the opportunity cost of the tea planter's capital, which, for purposes of the present study, is the cost of borrowing the capital, *i.e.* the bank's lending rate.

To give a true economic evaluation of the viability of each of the four extension and replanting investment options the net cash-flows have been discounted using the real interest rate. This has been obtained by adjusting the 1994 average bank lending rate of 40 percent to allow for that year's annual inflation rate of 35 percent, resulting in a real discount rate of approximately 4 percent.

The NPV's for the extension and replanting investment options are presented in Table 3.

Table 3. Net Present Values of the Clones Under the Extension and Replanting Investment Options ('000 US Dollars)

INVESTMENT OPTION		CORO	COR1	CIRO	CIRI	SEEDLING TEA
Extension	Rain-fed	25	24	26	25	17
	Irrigated	33	32	35	34	20
Replanting	Rain-fed	21	19	23	21	17
	Irrigated	28	27	31	28	20

The result indicates that CIRO is the most attractive investment option under both extension and replanting programmes followed by CORO and CIRI, with CORI coming as the least viable option. However, all investment options give higher NPV's than continued seedling tea cultivation. So, the choice of an investment option is purely determined by the magnitude of returns on the capital employed, rather than economic viability.

2.2.2 Internal Rate of Return

The IRR indicates the maximum real interest rate that could be paid on capital invested in the extension and replanting programme and operating costs and still break-even. Thus, when the discount rate is equal to the IRR, NPV is equal to zero and pay-back is equal to the life of the investment project. When the discount rate is higher than the IRR, NPV is negative and pay-back never occurs.

The IRR for the four extension and replanting investment options are presented in Table 4.

Table 4 Internal Rate of Return of Clones Under the Extension and Replanting Investment Options (Percentage)

INVESTMENT OPTION		CORO	COR1	CIRO	CIRI
Extension	Rain-fed	>46	>40	>46	>46
	Irrigated	>46	>46	>50	>46
Replanting	Rain-fed	24-26	23-25	33-35	26-28
	Irrigated	24-26	24-25	34-35	26-28

The *magnitude* of the IRRs display a similar trend as the NPVs for each extension and replanting investment option. The IRRs clearly show that CIRO has a much greater capacity to pay for higher interest rates and still recover the capital invested in the extension or replanting programme, than the rest of the investment options. And, since an increase in interest rates also increases the pay-back period, the higher returns under CIRO will tend to enable the tea planter to absorb the burden of increases in interest rates with less adverse impact on the pay-back period than would have been experienced if another investment option with lower IRR was selected.

2.2.3 Break-Even *Prices*

The break-even price is that price at which, when a hectare of seedling tea is substituted with a hectare of clones through extension or replanting programmes, the income lost plus the new costs would be *equal* to the new income plus the costs saved. Break-even prices of the clones under the various extension and replanting investment options, as given in Table 5, can be compared with the tea planters expectations regarding future world market prices for tea as a basis for sensitivity analysis and evaluation of an investment option.

Table 5 Break-even prices of clones under the Extension and Replanting Investment Options (US$/kg)

INVESTMENT OPTION		CORO	COR1	CIRO	CIRI
Extension	Rain-fed	0.79	0.82	0.77	0.78
	Irrigated	0.74	0.76	0.72	0.73
Replanting	Rain-fed	0.88	0.93	0.84	0.87
	Irrigated	0.84	0.84	0.78	0.81

All break-even prices are lower than the pressumption of US$1.12 used in the analysis. The lower the break even price for an extension and replanting investment option the greater the capacity of such an option to absorb price declines. The higher break-even prices on the other hand have little margin to cover the risk of future downward movements in world market prices for tea. In Table 5 CIRO has a consistently greater capacity to absorb price declines than the rest of the Investment Options.

2.3.4 Yield at the time of uprooting

The criterion for selecting a seedling tea field for uprooting should be when such a field becomes uneconomic, due to old age with its attendant increase in number of vacancies which adversely affect its productivity. Break-even yield can be used to determine the time when a particular tea field is due for uprooting and replanting. When its yield is lower than the break-even yield, the field is not contributing to the economy of the tea estate and should therefore be uprooted and replanted.

3. CONCLUSIONS

The results of the analysis show that ploughing without rehabilitation (CIRO) is the most attractive investment option, as it gives early and higher returns on the capital employed, thereby helping the tea planter to sustain a fairly adequate cash-flow and liquidity; it has a much greater capacity to absorb high interest rates on borrowed capital and any future price declines on the world tea markets; and its high yields in addition to quality also operate to reduce the cost per kilogram of made tea, thereby enabling the tea planter to cope with increases in the cost of production arising from increases in wage rates and other input costs.

However, where other considerations, other than pure economic worth of an extension or replanting investment option, are taken into account then minimum tillage without rehabilitation (CORO) is the most viable proposition if the aim is to reduce erosion hazard from the replanting programme, preserve both the physical and chemical properties of the soil, or reduce the risk of *Armillaria*. Where rehabilitation is a matter of routine whenever seedling tea is uprooted for replanting with the new clones, then plough only with one year rehabilitation (C1R1) will be the most attractive proposition. Thus the choice is very much up to the tea-grower to balance any other considerations that he may have with the need to optimize returns on the capital to be invested in the extension and replanting programme.

Since the aim of introducing clones is to ensure the long-term productivity and competitive edge of the tea industry in Malawi through higher growth rates in both yields and quality, then replanting becomes irreversible. The strategy of any tea estate should therefore be to pursue a replanting investment programme without undermining investors' interest in the tea industry. This is where replacement, which helps tea estates to maintain a fairly stable cash-flow and liquidity, while pursuing their replanting investment programme, becomes a desirable strategy. However, where there in no idle land for extension then any tea field with lower than break-even yield at current prices should be replanted because it does not contribute to the economy of the tea estate.

It must be noted that this analysis only presents the overall picture of extension and replanting investment programme for the tea industry in Malawi. Individual tea estates may have to work out their own investment evaluation using their own costs and returns obtained from their own physical and financial records. Such an analysis would give more precise cash-flow details for each estate as costs and returns tend to vary from one tea estate to another and from time to time.

Finally, the results of this analysis should prove relevant to the tea industry in Malawi, at a time when an intensification of clonal replanting is being viewed as a necessity.

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