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Economics of Moisture Conservation in Chillie Production in Sandy Regosols of Sri Lanka

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ABSTRACT. This study focuses on the economic feasibility of improving productivity of sandy regosols in chilli production in the dry zone of Sri Lanka by adding non-calcic brown soils and tank silt, and introducing an efficient irrigation system. Sandy regosols were treated with non-calcic brown soils and tank silt at the rate of 72 tons and 24 tons per hectare respectively. A Polyethylene lined furrow irrigation system was adopted over the traditional basin irrigation system and chilli was planted on ridges as well as on furrows to compare the results.

Economic and financial analysis were performed. Standard benefit cost analysis was the analytical technique used in this study. In both financial and economic analyses the highest benefit cost ratio was reported by the treatment in which treated soil, furrow irrigation with polyethylene lining furrow planting was used. Since the same treatment gave the highest significant yield ($P > 0.05$) the results of the economic and financial analyses confirmed the findings of the technical analysis. Therefore, it can be considered as the most technically, economically as well as financially feasible treatment to adopt during Yala season.

INTRODUCTION

To meet the growing demand for agricultural produce by the increasing population, improvement of less productive lands plays an important role. Sandy soils which are widely spread along the coastal regions and some districts such as Batticaloa, Ampara, and Puttalam in the dry zone and intermediate zone of Sri Lanka are less productive. In these districts a large

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extent of land is occupied by sandy soils with regosols (90-100%) and solonchacs inclusions (0-10%) (Panabokke, 1972).

The Batticaloa district belongs to the low country dry zone and covers a land area of nearly 2686 km^2 and area of inland water ways of 168.5 km^2 (Statistical abstract, Sri Lanka, 1989). The major soil groups found in the region are regosols and sand of which the physical properties such as infiltration rate, soil moisture characteristics, water movement and distribution are not favourable for crop production. They are also characterized by poor chemical properties, especially low exchangeable Potassium, available Phosphorus and cation exchange capacity. The sandy regosols lack physical properties, especially moisture retention capabilities favourable for agricultural production and therefore are less productive (Panabokke, 1972).

Farmers in this area practise surface irrigation as a traditional method which is a labour intensive, inefficient and wasteful practice. Since water is a scarce resource in this area, introduction of economically viable moisture conservation measures and less expensive, efficient irrigation methods are prerequisites for the improvement of crop productivity of regosols.

It has been shown that addition of tank silt and non-calcic brown soil and introduction of efficient irrigation systems help to improve moisture conservation and productivity of these soils (Rajeswaran, 1991). Therefore, the objective of this study was to investigate the economic feasibility of adding tank silt and non-calcic brown soil to conserve moisture and the use of a polyethylene lined furrow irrigation system over the traditional method of basin irrigation in chillie production in the regosols of Sri Lanka.

METHOD

This experiment was conducted in 1989 *Yala* season with the local variety of chillie, MI 1 at the Faculty farm, Eastern University, Vantharumoolai, in Batticaloa district. Seventy two tons of non calcic brown soil and 24 tons of tank silt were added to improve the physical properties of regosols, especially the moisture conservation. The performance of the improved soils was compared with that of polyethylene lined ridge and furrow irrigation system. Plants grown on ridges were compared on the performance with those grown on ridges. Sandy soils were considered as the control and the treatments in this experiment were:

1. control soil and basin irrigation method;
2. control soil, furrow irrigation with polyethylene lining ridge planting;
3. control soil, furrow irrigation with polyethylene lining furrow planting;
4. treated soil with basin irrigation;
5. treated soil, furrow irrigation with polyethylene lining ridge planting; and
6. treated soil, furrow irrigation with polyethylene lining furrow planting;

Further details on the experimental layout can be found in Rajeswaran (1991). Plants were harvested at 90, 120, 135, 150, 165 and 180 days after planting and the average yield of each treatment was calculated.

Standard benefit cost analysis was adopted to measure the additional benefits over the added costs due to type of treatments. Standard benefit cost ratio measures the additional revenues over the added costs due to treatments at the margin where MC equals MR.

$$\text{Benefit cost ratio} = \frac{\text{Present value of benefits}}{\text{Present value of costs}}$$

Financial analysis

In the financial analysis only the cash flow of resources was taken into consideration to assess the worthwhileness of the types of treatments to the individual investor. The revenues from the yield were measured at the farm gate price in the area were considered as benefits. Cost of production of chillie per hectare was obtained by adding the labour costs of operations such as nursery preparation and establishment , application of nursery fertilizer, nursery weed control, nursery pest management, general land preparation, ploughing, levelling, preparation of beds and ridges where applicable, transplanting, fertilizer application, weed control, earthing up, pest control, harvesting and processing, and costs of materials, inputs, machinery and irrigation. Cost of irrigation was calculated by adding the establishment cost of a tube well and the cost of the pump, pumping cost of water and maintenance cost of the pump and tube well. Cost of polyethylene materials needed per hectare, lining cost of polyethylene and cost of soil amendment required for a hectare where applicable were added to the total cost of production per hectare in order to obtain the total cost of treatment required for a hectare. All the costs were measured at the market prices in the area. An annual borrowing rate of 15% interest was added to the total cost of treatments for 6 month period to avoid short term cash problems of the farmer.

Sensitivity analysis

A sensitivity analysis was performed to avoid the uncertainty on the availability of financial resources of the farmer. Different annual interest rates namely 15%, 20%, and 25% for the 6 month period were separately added to the total costs of treatments and benefit cost ratios were recalculated for each interest rate to test the stability of the results of the benefit cost analysis under the uncertainty of interest rates.

Since all the transactions done within a period of less than one year undiscounted benefits and costs were used in the analysis. Benefit cost ratio for each treatment was calculated by dividing the relevant total benefits by the total cost of the treatment.

Economic analysis

In the economic analysis, all the market prices were converted into shadow prices by using the conversion factors given by the National Policy Planning Division, Ministry of Policy Planning and Implementation. The following conversion factors were used to adjust the relevant market prices for their shadow prices.

1. Agriculture conversion factor = 0.785
2. Surplus labour = 0.722
3. Chemical and Petroleum products = 0.650
4. Road transport = 0.814
5. Machinery and equipment = 0.776

According to the National Policy Planning Division, there is surplus labour in the agriculture sector. Thus, the conversion factor for surplus labour was used in the calculations (Ministry of Policy Planning and Implementation, Sri Lanka 1991).

Farm gate price of chilli, seed prices, and prices of non calcic brown soil and tank silt were converted into their shadow prices by using the agricultural conversion factor. Conversion factor for scarce labour was used to convert market labour wage rates to shadow wage rates. Prices of pesticides, fertilizer and fuel converted into their shadow values by using the conversion factor given for petroleum products. Tube well cost and water pump prices were converted into their shadow values by using the conversion factor for machinery and equipment.

Family labour and hired labour were included in the economic analysis. Since the land rent is a redistribution of benefits in the society the value zero was used as the conversion factor to obtain shadow value of land rent.

THE DATA

The yield data were obtained from the thesis research titled "Effect of polyethylene lined furrows on growth and yield of chillies while regulating water retention/release characteristics of sandy regosols" conducted by J.B. Rajeswaran in 1989 *Yala* season at the Faculty Farm, Eastern University, Vantharumoolai in the Batticaloa district.

The average farm gate price of chilli in the area during 1989 *Yala* season was used as the market price of chilli. At the same time, average selling prices of inputs such as seeds, pesticides, fertilizer, fuel, polyethylene, tank silt, and non calcic brown soil were taken as their market prices. Average costs of water pump and of establishing a tube well as specified by Rajeswaran (1991) were used as the market price of the water pump and tube well. Average tractor hiring rates in the area were used as the market hiring rates of transport.

RESULTS AND DISCUSSION

Pod yield

Pod yields of all treatments (except of one) were significantly higher ($P > 0.05$) than that of the treatment of control soil and basin irrigation. The treatment of control soil, furrow irrigation with polyethylene lining, ridge planting was the exception and it resulted in the lowest average yield of 1681 kg per hectare. The highest yield of 7987 kg per hectare was reported by the treatment of treated soil, furrow irrigation with polyethylene lining, furrow planting that was significantly higher than any other treatment at 5% level. There were no significant differences (P>0.05) observed among the treatment of control soil, furrow irrigation with polyethylene lining furrow planting and of treated soil, furrow irrigation with polyethylene lining ridge planting (Table 1). Treated soil, furrow irrigation with polyethylene lining, furrow planting was the best treatment among the types of treatment tested (Table 1).

Table 1. Average yield of chillie of different treatments (Fresh weight of pods in kg).

Treatment	Average Yield (kg)
Control soil, basin irrigation	3445.23[a]
Control soil, furrow irrigation with polyethylene lining ridge planting	1680.90[b]
Control soil, furrow irrigation with polyethylene lining furrow planting	4713.67[c]
Treated soil, basin irrigation	6763.78[d]
Treated soil, furrow irrigation with polyethylene lining ridge planting	4225.14[c]
Treated soil, furrow irrigation with polyethylene lining furrow planting	7987.04[e]
LSD	487.84

Means followed by a common letter are not significantly different at 5% level.

Financial analysis

The benefit cost ratios of all the types of treatment were greater than one except of those of control soil, furrow irrigation with polyethylene lining, ridge planting and of treated soil, furrow irrigation with polyethylene lining, ridge planting (Table 2).

Table 2. Benefit cost ratios of financial analysis and economic analysis

Treatment	Benefit cost ratio							
		Financial analysis				Economic analysis		
		0<10 miles	11<20 miles	21<30 miles		0<10 miles	11<20 miles	21<30 miles
Control soil, basin irrigation	1.05	-	-	-	1.00	-	-	-
Control soil, furrow irrigation with polyethylene lining ridge planting	0.48	-	-	-	0.46	-	-	-
Control soil, furrow irrigation with polyethylene lining furrow planting	1.21	-	-	-	1.18	-	-	-
Treated soil, basin irrigation	-	1.35	1.20	1.08	-	1.32	1.18	1.06
Treated soil, furrow irrigation with polyethylene lining ridge planting	-	0.82	0.74	0.67	-	1.22	1.08	0.98
Treated soil, furrow irrigation with polyethylene lining furrow planting	-	1.42	1.27	1.16	-	1.44	1.28	1.16

It suggests that the treatments having benefit cost ratios less than one are not financially feasible to adopt in sandy soils in the dry zone. Particularly the plants planted on ridges had given poor yields and therefore ridge planting treatment caused a considerable reduction of benefits, due to the loss of income.

The benefits were not adequate to cover the additional cost of the treatment in the ridge planting method. Therefore, the ridge planting method is not financially worthwhile to be adopted in the sandy soils of the dry zone of Sri Lanka.

All other treatments except the two with ridge planting had resulted in benefit cost ratios which were higher than that of the control soil, basin irrigation treatment (Table 2). The additional benefits were higher than the added costs on treatments in which furrow irrigation with polyethylene lining furrow planting was practised. This is mainly due to the higher effectiveness of conserving soil moisture. These treatments resulted in higher yields and a higher income than those of the traditional method, in which control soil and basin irrigation method was used. The highest significant yield ($P > 0.05$) and highest benefit cost ratio were given by the treatment in which treated soil, furrow irrigation with polyethylene lining furrow planting was practised (Tables 1 and 2), and thus can be selected as the most financially feasible treatment confirmed by the results of the financial analysis.

Economic analysis

All the benefit cost ratios were greater than one except that for the treatment with control soil, furrow irrigation with polyethylene lining ridge planting (Table 2). It suggests that this treatment with a low benefit cost ratio is not economically feasible. The benefit cost ratio of the treatment with treated soil and furrow irrigation with polyethylene lining ridge planting, it was less than one when the materials were found at a distance over 20 miles. Therefore, this treatment is not economically feasible when tank silt and non calcic brown soils are to be transported from a distance exceeding 20 miles (Table 2).

The highest benefit cost ratio was reported by the treatment with treated soil, furrow irrigation with polyethylene lining and furrow planting (Table 2). Therefore, it is the most economical treatment to adopt in sandy soils in the dry zone of Sri Lanka. The statistical analysis of the yields showed that the yield resulting from this treatment was significantly higher than those from all other treatments. The results of the economic analysis confirm the findings of the technical study.

Sensitivity analysis

As far as the results of the sensitivity analysis are revealed that there were no differences observed in the results of the benefit cost analysis performed at different annual interest rates namely, 15%, 20% and 25%, and thus, the results of the benefit cost analysis will be stable when there is an uncertainty of the interest rates considered.

CONCLUSIONS

Moisture conservation and adoption of more effective irrigation methods play an important role in increasing agricultural productivity especially in sandy soils of the dry zone. This study has dealt with the findings of the economic and financial feasibility of using tank silt and non-calcic brown soils on ridge and furrow irrigation systems and practising ridge and furrow planting methods in chilli production in the sandy soils of the dry zone of Sri Lanka.

Results of the financial and economic analyses revealed that the treated soil, ridge and furrow irrigation with polyethylene lining, furrow planting was the most economically and financially feasible treatment to adopt in the dry zone. This treatment also was significantly higher than any other treatment in the statistical analysis of the yields of the technical study. Therefore it can be concluded that the addition of 24 tons of tank silt and 72 tons of non-calcic brown soils to conserve moisture and using polyethylene lined furrow irrigation with furrow planting is the most financially and economically feasible method of producing chilli in the sandy regosols of the dry zone of Sri Lanka.

As this study was conducted under experimental conditions and the results may not represent those from farm level. Therefore, it is suggested that the study be repeated at farmers' fields prior to making final recommendations.

REFERENCES

Ministry of Policy Planning and Implementation Report on Shadow Prices for Sri Lanka (1991). National Policy Planning Department, Colombo.

Panabokke, C.R. (1972). Soils of Sri Lanka. A hand book compiled from papers presented at a seminar held at the 3rd Annual Sessions of the Soil Science Society of Ceylon, Peradeniya. 3rd July 1972.

Rajeswaran J.B. (1991). Effect of polyethylene lined-furrows on growth and yield of chillies while regulating water retention/release characteristics of sandy regosols. M.Phil. Thesis (Unpublished), Postgraduate Institute of Agriculture, University of Peradeniya, Sri Lanka.

Statistical Abstract of the Democratic Socialist Republic of Sri Lanka. (1989). Department of Census and Statistics, Ministry of Policy Planning and Implementation.