# FEATURES

## ECONOMICS OF AGRO–CHEMICAL USE IN PADDY PRODUCTION: EXPERIENCE AT GAL OYA

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*The use of various intensive cropping practices and the adoption of fertilizer responsive high yielding crop varieties have aggravated the pest and disease problem in agriculture in recent years, as we showed in our January 1983 special issue on Pesticides. There is no doubt that agro-chemicals have today to play a very significant role in agriculture, and in a country like Sri Lanka which imports most of its agro-chemical requirements the costs of these chemicals have now become an important factor in deciding whether the local farmer can operate profitably or not. Another debatable issue, in the present context, is the extent to which farmers could derive economic benefits from the use of agro-chemicals.*

*In this study A. S. Widanapathirana and C. M. Wijayaratne of the Agricultural Research and Training Institute (ARTI) have concentrated their survey on selected conolization units of the Gal Oya Scheme in attempting to measure the impact of chemical use in paddy production. They conclude that chemicals constitute an important component in paddy production costs and that the use of weedicides and insecticides is widespread. In the Gal Oya colonies the intensity of herbicide use does not appear to be directly related to the yield of paddy; and so too in the case of insecticides. This study questions the economic justification for present or increased levels of agro-chemical use at Gal Oya and maintains that because of the considerable health and environmental dangers posed by the use of chemicals further study into these subjects is urgently required.*

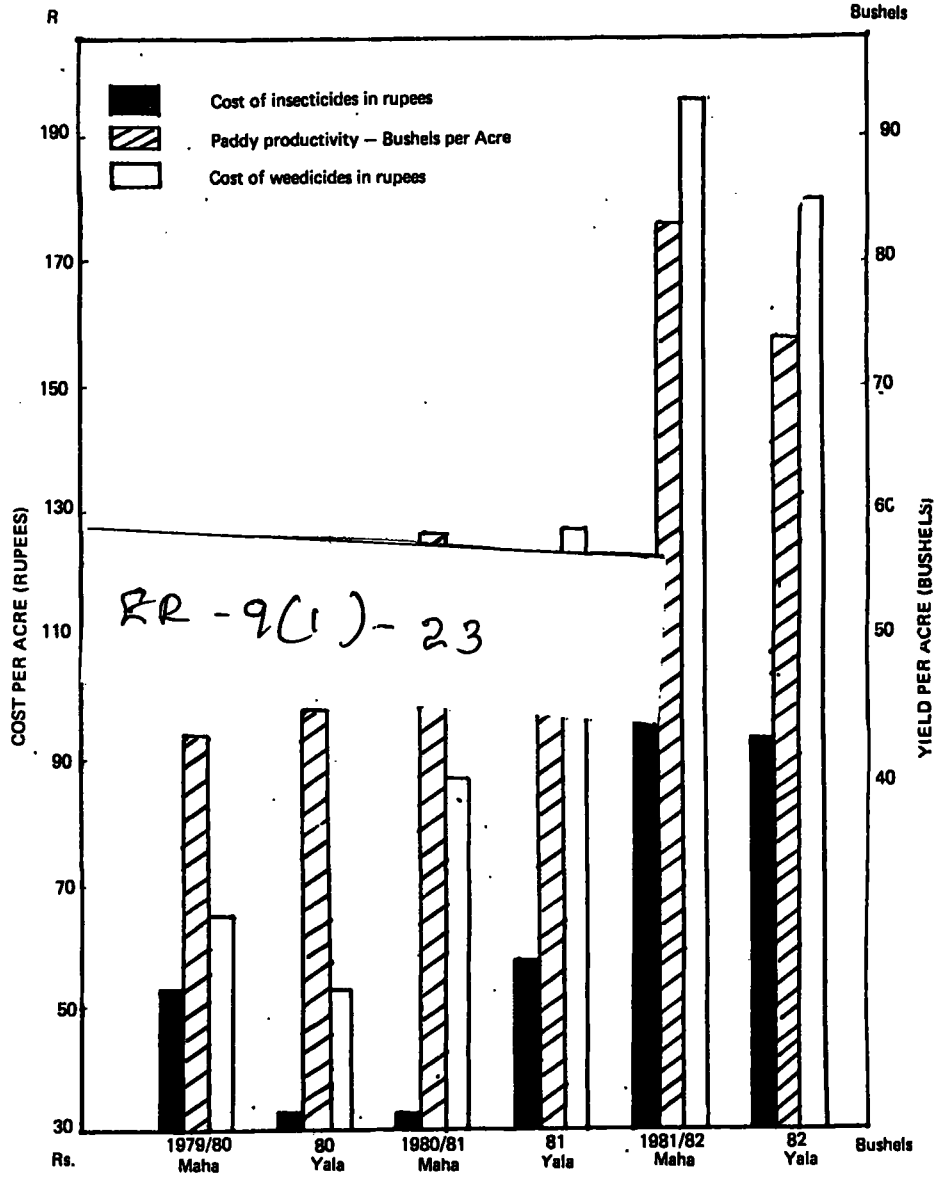


FIG. 1 Cost of chemicals in relation to paddy productivity

Chemicals that are widely being used in agriculture include:
(1) Fertilizer – to improve nutrition of crop plants; (2) Growth regulators – to induce better crop growth, in order to achieve desired timing and to up grade the quality of crop yield; (3) Pesticides – to combat insect pests and other pathogenes which infest crop plants; and (4) Herbicides – to control weeds that compete with crops. All of the above are known collectively as agro-chemicals.* The use of these chemicals in agriculture is considered important in that each boosts crop output, particularly in intensive and multiple cropping systems necessitated by dwindling farmland in the country.

The adoption of fertilizer responsive high yielding crop varieties, improved planting and after-care operations, staggered planting techniques, the use of irrigation and other intensive cropping paractices have aggravated pest and disease problems greatly. The use of

* Although agro-chemicals refer to herbicides, insecticides, fungicides and chemical fertilizers, the word chemical is used to denote the former three types of chemicals only, throughout this paper.

agro-chemicals therefore, has played a far more significant role in modern agriculture mainly because of the higher incidence of pest and disease outbreaks which account for a crop loss of 5–40%.

As most agro-chemicals are imported, a substantial portion of Sri Lanka's foreign exchange is allocated annually for chemicals. The local price of such chemicals is also increasing because of the high world-wide inflation rate. Therefore, the cost of chemicals can greatly affect the profit margin of paddy production unless the increased production cost is offset by a substantial increase in paddy production.

The objectives of this paper are to determine whether or not there are any real economic benefits from the use of agro-chemicals and to present an overview of chemical use in paddy production in Gal Oya. The data for this study was collected from records that have been maintained since the 1979/80 Maha season in selected colony units of the Gal Oya colonization scheme. For this purpose colony unit No.2, which has an assured/abundant water supply was selected because the use of inputs depends on availability of water. However for comparative purposes data collected from unit 'D', where there is unreliable/inadequate water supply is also presented, wherever applicable.

Table 1 Use of Agro-chemicals by Variable factors

| Season | 1979/80 | | 1980/81 | | 1981/82 | |
|---|---|---|---|---|---|---|
| N | | | | | | |
| % farmers using: | | | | | | |
| a.weedicides | 78 | 86 | 90 | 100 | 100 | 97 |
| b.insecticides | 69 | 61 | 80 | 70 | 93 | 62 |
| Number of different chemical formulations applied: | | | | | | |
| a.weedicides | 4 | 6 | 3 | 5 | 5 | 6 |
| b. ticides | 11 | 8 | 10 | 5 | 14 | 10 |

The investigation shows that the paddy farmers at the Gal Oya scheme use three distinct types of chemicals for the control of weeds, insect pests and diseases. The use of weedicides is most prevalent, followed by the use of insecticides. The use of other chemicals (fungicides) for the control of diseases is very low. However, the study has highlighted many differences in the types, application techniques and other aspects of chemical use across seasons, between the two colony units and even within the same colony unit.

Sections 1 and 2 discuss the position regarding weedicides and insecticides respectively, while section 3 attempts to analyse the cost of chemicals in general. The final section presents the findings of the investigation.

## Weedicides

More and more farmers are using weedicides; and almost all farmers have been using chemicals to control weed infestations during the last few seasons (Table 1).

As table 1 shows the number of different weedicides had increased to 6 in 1980. Costs have increased as the use of herbicides has spread. According to Figure

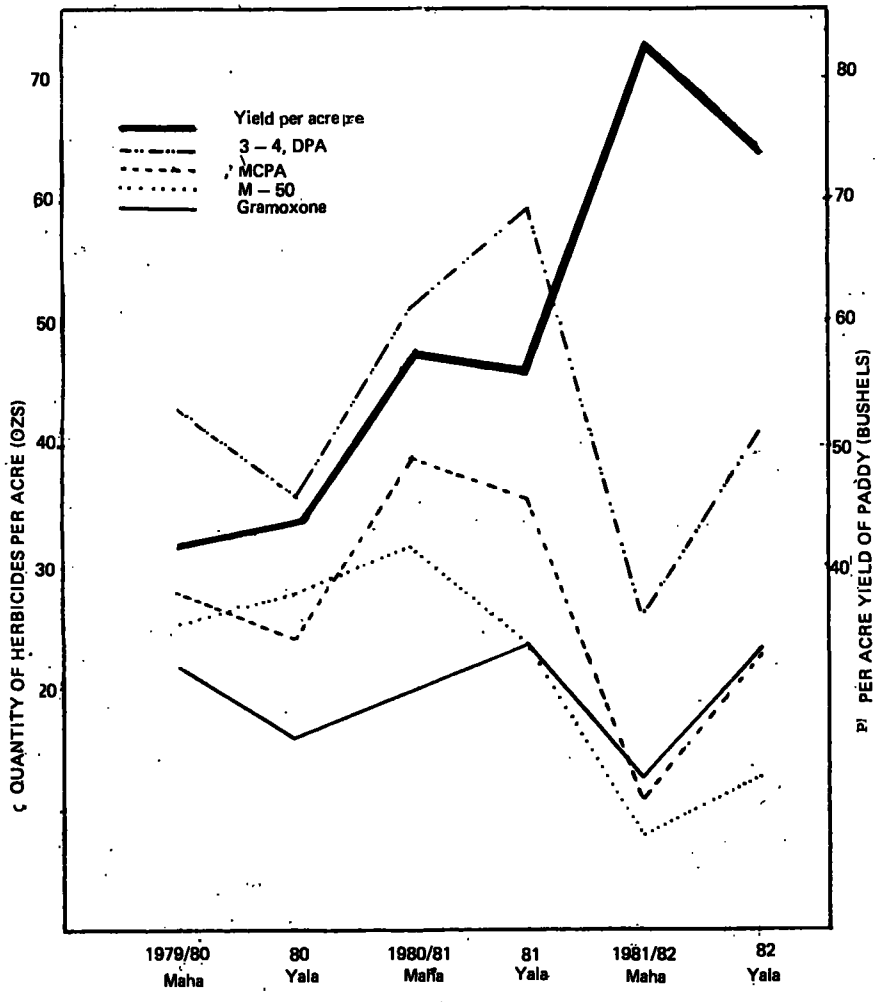


FIG. 2: Yield of paddy in relation to herbicide inputs. :ide inputs.

1, the per acre cost of weedicides has shown an almost three-fold increase in 1982 from its value in 1979/80. The increase in per acre cost of weedicides may be due to one of the following three reasons;

(a) increase in price of chemicals with fixed quantity,
(b) increase in the actual quantity of chemicals with fixed price and,
(c) increase in price as well as quantity of chemicals.

Figure 2 indicates that the quantities used of most of the herbicides have come down in 1980 compared to 1979/80 Maha season. This is reflected in the decline in the per acre cost of weedicides shown in figure 1 during the same period. During the 1980/81 and 1981 seasons, both costs and intensity of use went up. From 1981 Yala to 1981/82 Maha the cost of weedicides has registered a steep rise. However, the actual quantities of all 4 herbicides have dropped to the lowest level. Therefore, the increase in cost of herbicides necessarily is due to an increase in price as the real quantities of herbicides used have come down. Further, a comparison of changes in per acre paddy yields with changes in herbicides quantities (Figure 2) reveals that yield has increased irrespective of herbicide inputs. For example the yield rose from 43 bushels per acre in 1979/80 Maha to 44 bushels per acre in 1980 Yala, while the quantities of weedicides registered a decline. Yields reached an all time high value in 1981 Yala, while the absolute levels of all 4 herbicides were reduced to the lowest level of the 6 seasons investigated.

An increase in herbicide prices increased cost without a corresponding increase in yield, since yields are apparently not directly related to herbicide use levels. In effect, profitability decreases with the use of herbicides.

The question now is why yields have increased even with a reduction in the use of herbicide inputs, considering the importance of weed control in the cultivation of modern rice varieties. An indepth study may be required in order to answer this question. This could perhaps be explained in two ways. First, an increase in the price of weedicides may discourage the farmer from using this expensive input and force him to resort to other measures of weed control. Second, it may also be possible that the present intensity of its use might be higher than the dosage required to achieve effective control of weeds. Hence, higher intensities of herbicide use may not be related to paddy yields. The lowering in application rate in 1981/82 (Figure 2) may be due to the sudden increase in price of herbicides in the same season. However, the subsequent upward trend in application rates show the farmers have now adjusted to the prevailing high prices of herbicides. Figure 2, also indicates that the rate of application of some chemicals, for example, 3–4 DPA[2] are much higher than others such as M–50[3] and MCPA[4]. The difference in rate of application of these chemicals is partly due to the use of small quantities of M–50, MCPA etc. mixed with larger quantities of 3–4–DPA by farmers in the hope that better weed control can be achieved. The situation in unit 'D' is similar to that in unit 2 although farmers in the unit 'D' have not planted at all in some seasons because of lack of water.

Table 2 Unit cost of chemicals classified by season (Rupees per acre)

| Input | Yala* | Maha* | Mean cost 1979/80 to 1982 |
|---|---|---|---|
| Weedicides | 120.70 (76.42) | 135.40 (63.82) | 129.36 (69.48) |
| N | 87 | 89 | 176 |
| Insecticides | 62.17 (114.66) | 77.53 (90.64) | 71.13 (99.88) |
| N | 59 | 81 | 140 |

Co-efficient of variability (C.V.) values in the parenthesis.
* Mean value for 3 seasons.

## Seasonal Variation

Table 2 describes variations among farmers in cost of herbicides, where mean costs in Maha seasons are greater than in Yala seasons. However, the

Table 3 Cost of chemicals in relation to holding size (mean cost in rupees per acre)

| Season size (in acres) | Yala* 1 | Yala* 1–2 | Yala* Over 2 | Maha* 1 | Maha* 1–2 | Maha* Over 2 |
|---|---|---|---|---|---|---|
| Weedicides | 59.26 (97.75 | 142.64 (59.32) | 151.99 (69.46) | 92.52 (75.47) | 151.60 (64.10) | 144.85 (52.50) |
| Insecticides | 57.71 (76) | 55.74 (98.76) | 83.75 (150.01) | 70.17 (85.23) | 68.31 (83.48) | 52.08 (70.58) |

Co-efficient of variability values are in the parenthesis
*Mean value of 3 seasons

data is not sufficient to explain this disparity. Although mean costs are lower in Yala, the variation among farmers in per acre cost is greater in Yala seasons. This is shown by the higher co-efficient of variability (C.V.) values. Such high values show that many different approaches are adopted by paddy farmers to control weeds.

## Effect of size of holding

Table 3 presents the mean per acre cost of herbicides according to holding size. It is apparent that as holding size increases the mean cost also increases in Yala seasons. The same relationship is not clear for the Maha. However, Table 3 shown that the lowest mean cost of weedicides and the greatest variability exist with smallest holdings. The high mean cost of weedicides shown in Table 2 is apparently due to the presence of owners of larger holdings while the high variability of cost in same table might be due to the presence of owners of smaller holdings. Owners of large holdings have greater resources so that they can afford higher investments in chemical weed control. On the other hand, farmers on smaller holdings have poorer resources and are not in a position to invest much in expsnsive inputs such as weedicides. However, a detailed study would be required in order to evaluate the returns to the investment in weedicides.

## Insecticides

It can be noted from Table 1 that the majority of farmers apply insecticides for the control of insect pests. The number of insecticide formulations has also increased rapidly from 5 formulations in 1981 Yala to 14 in 1981/82 Maha season. Of the 14 different formulations, only 4 have been used in all 6 seasons under review. In otherwords, farmers have been spraying different insecticides in different seasons. Table 1 also shows that more insecticide formulations have been used in the Maha seasons than in corresponding Yala seasons. In unit 'D' which is subject to an irregular water supply, fewer insecticide formulations are used than in unit 2. In unit 'D' also, the number has been greater in Maha than in Yala. The data suggests that the application of different types of insecticides are related to the degree of water availability. Farmers in seasons/areas of abundant water use many different types of insecticides, but use fewer in seasons/areas with less water. However, the available data does not suggest the reasons for this realtionship.

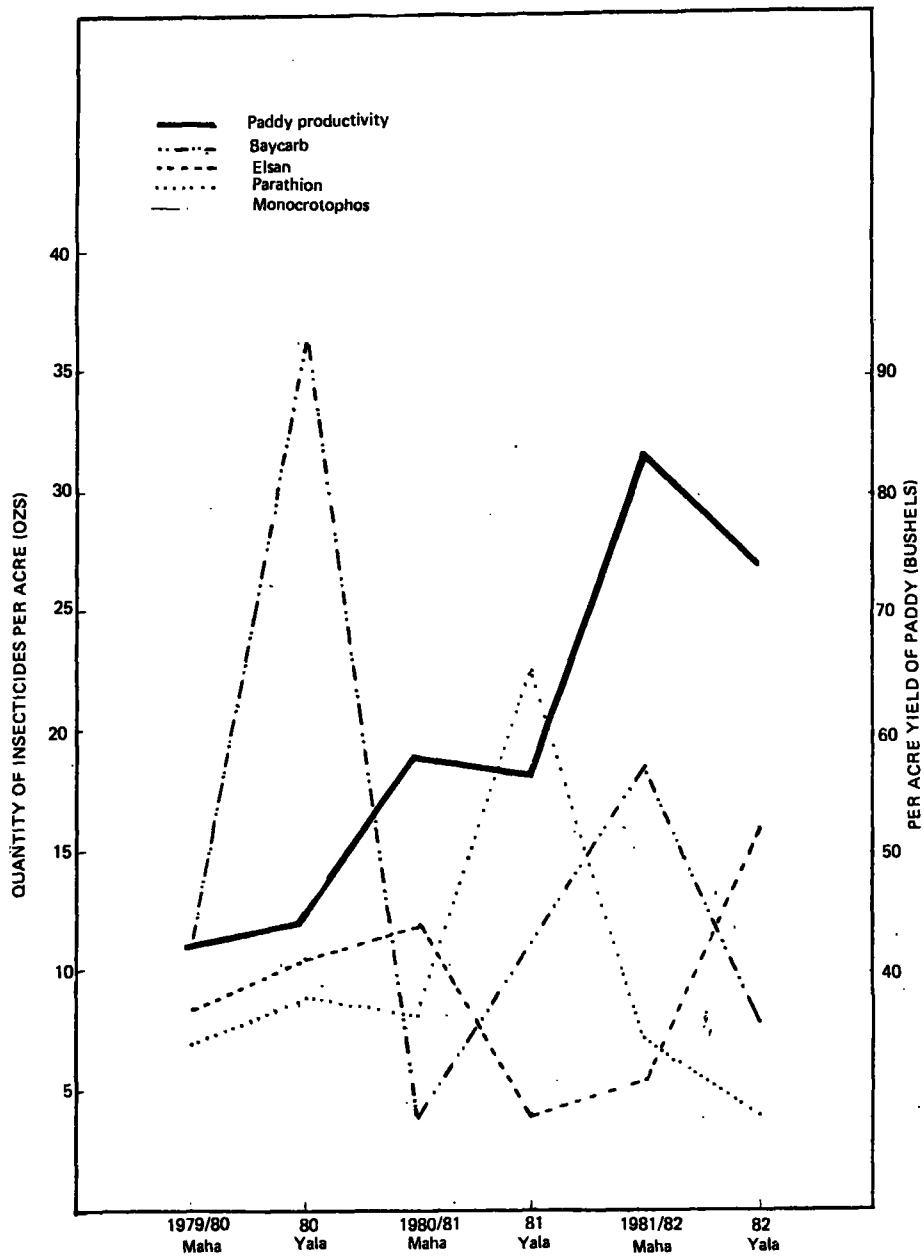

FIG. 3 Yield of paddy in relation to insecticide inputs

## Cost of insecticides

The per acre cost of insecticides has increased since the 1979/80 Maha, but at a lesser rate than that of weedicides. However, the intensity of application of all insecticides is subject to wide fluctuations. No systematic relationships can be observed between per acre yield and the land of insecticide inputs. (Figure 3). Because of the erratic changes in application rates, it is difficult to explain the steady increase in per acre insecticide cost shown in figure 1. The lack of application of some insecticides have been high while others declined during the same period; often a variety of different insecticice formulations being applied in the same season. The high intensity of certain insecticides in some seasons may coincide with the widespread occurance of certain insect pests.

1. David Bull (1982) A Growing Problem —Pesticide and the Third World Poor.

Moreover, the wide differences in the type and quantity of chemicals may be due to farmers' inability to correctly

identify insect pest infestations and/ or farmers ignorance of the appropriate control measures. The fluctuations in insecticide use might also be due to the occurance of multiple types of insect pests in the same season. Two chemicals, Baycarb and Parathion which have conventionally been applied in a colony unit 2 have registered a decline in 1981/ 82 Maha season while a series of new insecticides have shown an upward trend. This change cannot be explained from the available information. Similar upsurges of new insecticides have been recorded in other parts of the world because of the emergence of insect pests having resistance to existing insecticides; the application of new insecticides is a necessity under such circumstances.[2]

2. David Bull – Ibid

Therefore, far more research is needed to identify the pattern of insecticide use, insect pest reactions and farmer behaviou with regard to insecticide use. It must also be emphasised that the increase in cost of insecticides eventually decreases the profitability as there is apparently no relationship between the per acre yield of paddy and insecticide inputs.

## Seasonal variations in insecticide use

As in the case of costs of weedicides, the cost of insecticides have also been higher in Maha than in Yala (Table 2). However, the cost per acre of insecticides was found to be much less than for weedicides in both seasons. Further, the disparity in cost between Yala and Maha is not great. Variation among farmers is greater for both seasons than for weedicides.

## Effect of size of holding

The relationship between cost of insecticides and holding size presented in Table 3 shows an increase in costs with a decrease in holding size during the Maha season. No clear relationship is observed for the Yala season. The variability is greater for the smallest holdings in Maha, while the converse is true in Yala. The high variability indicates that approach to the control of insect pests is much more complicated than for weedicides.

## Cost of chemicals in paddy production

From the above analysis it is clear that the per acre cost of chemicals is subject to wide seasonal and farm to farm variation. Chemicals also constitute an important component in the cost of paddy production. For example, for unit 2 the mean per acre cost of chemicals (weedicides, insecticides and fungicides) per season is about Rs.200/– with a range of Rs.118/– in 1979/80 to Rs.273/– in 1982 Yala (Table 2 and Figure 1). The cost of application is about Rs.50/– per acre, hence the total cash cost[3] of chemicals is approximately Rs.250/– per acre of paddy. In 1982. Yala, when the chemical costs rose dramatically, chemicals represented 15 percent of a total input cost[4] of Rs.1617/– per acre.

To what extent is the situation in Gal Oya comparable to other paddy farming areas in the Island ? It is difficult to answer this question because there is no up to-date information available for other areas. A related study was undertaken by Ranatunga et al in several paddy farming areas both in the Wet zone and the Dry Zone in 1977. According to this study the respective per acre costs of agro-chemicals range from Rs.24/– in the Kandy area to Rs.50/– in the Hambantota area; while the percentage cost of agro-chemicals of total material costs of inputs ranged from 4 percent (Kandy area) to 7 percent (Hambantota area). This study was undertaken at a time when the prices of all chemicals were much lower than at present. Yet this study indicates the variability of agro-chemical costs among different paddy growing areas. A notable feature of this study is the high cost of chemicals in the Dry Zone areas compared to that of the Wet Zone. The cost of chemicals therefore constitutes an important component in paddy production costs, which varies according to the agro-climatic areas, among farmers of a particular region and over time.

## Conclusion

This study shows the significant position occupied by agro-chemicals in paddy production costs. It also shows that the use of weedicides is widespread, followed by insecticides, while the use of other chemicals is not as high at present. The analysis indicates that the increase in costs of weedicides is mainly due to spiralling prices and is leading to a decrease in farm profitability. It also focuses attention on the differences in approaches to weed control adopted by farmers in the study area. Further, the intensity of herbicide use is apparently not directly related to the yield of paddy.

The use of insecticides, as the study reveals, is more complicated. Insecticide use is apparantly not related to the yield of paddy and the intensity of use itself is erratic. There is high variability in the per acre cost of insecticides both among seasons and among holding sizes. Increases in cost might affect profit margins as their value for paddy production is unclear.

Finally, the study questions the economic justification for present or increased levels of agro-chemical use at Gal Oya. Because of the considerable health and environmental dangers posed by chemical use, further study into these subjects is urgently required.

3. The non-cash cost of chemicals involving the following 2 components is not considered in the present analysis:
   (a) the accidental death and other possible long-term health hazard to human beings and,
   (b) the pollution of environment and disruption of the balance of eco-system causing a social cost to society.
4. Includes cost of all material inputs excluding labour in respect of colony unit 2.