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36

F O R E W O R D

The ARTI Field Laboratory in Beminiwatte in the Kegalle district was set up to serve a long-felt need for conducting intensive and in-depth studies at village level to supplement macro studies done by the Institute in other areas of the country and also to carryout programmes of action for agricultural and rural development on a trial or pilot project basis.

Starting with a socio-economic survey , a number of studies were conducted on both technical and agro-ecological factors as well as socio-economic aspects. Based on the findings of these studies a number of action programmes were conducted by the Institute with the active cooperation and participation of the departments of agriculture, minor export crops and the Agrarian Services together with rural Institutions like the agricultural productivity committee and cultivation committees. Some of the more important action programmes were the Home garden project, group production (paddy and poultry) and the Highland development programme. The ARTI's role in these programmes was that of an innovator and catalyst, introducing programmes and guiding both the field level officers of various departments and the farmers.

This publication brings out three important studies, on which some action programmes were based. The first one conducted by the ARTI on Farmer decision making attempted to identify certain socio & economic institutional constraints to increased paddy production. The second study conducted by the Land and Water Use Division of the Department of Agriculture was a survey of the rice growing soils and land use patterns on highlands in the area to examine the conditions and resource limitation to rice and highland crop production. The third was in fact a series of studies on rice conducted on cultivators' fields to investigate whether technical & environmental constraints were responsible for the low yields reported.

The active participation and unstinted support of the field staff of the extension and research divisions of the Department of Agriculture and the farmers in the area contributed to the successful completion of these studies. My thanks are also due to the three researchers who conducted these studies and prepared the reports.

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C O N T E N T S

SOME FACTORS INFLUENCING FARMER DECISION MAKING AND THEIR IMPLEMENTATION OF DECISIONS

A.M.T.GUNAWARDANE *

The studies on monitoring of management practices in paddy cultivation carried out in Yala 1975 and Maha 1975/76 seasons in the Beminiwatte Field Laboratory area attempted to identify certain technical and environmental constraints that act as impediments to increased paddy production. Socio-economic and institutional factors affecting paddy production in the area did not receive sufficient attention in these studies. Hence, it was thought necessary to study the various socio-economic and institutional factors that operate against achieving higher yields in paddy production in this area. It is with this back-ground that this exercise was proposed.

The emphasis in this study are on various improved management practices in paddy cultivation examining the reasons that lead to the use or non - use of these practices by farmers. An attempt has been made to distinguish the factors that influenced the decision making process (mental process of decision making) from the factors affecting the implementation of the decision.

This paper is based on information collected from 20 farmers from the Beminiwatte Field Laboratory area in the Maha 1976/77 season. The information collected was on their cultural practices with emphasis on the factors that influenced their decisions regarding these practices and problems they faced in implementing their decisions. The information was collected through fortnightly visits to the farmers concerned and was recorded in a record book maintained for the purpose**.

In writing up of the paper various management practices have been considered separately for convenience of discussion.

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** Mrs. S.Weralugolla, Economic Assistant, Land and Water use Division, Department of Agriculture collected the data for the study through fortnightly visits to the farmers concerned.

A. Use of improved varieties of paddy.

In general a high rate of adoption of improved varieties is observed in this area. The information obtained in relation to adoption of improved varieties by the selected farmers supports this view (Table 1.)

Table 1. SELECTION OF PADDY VARIETIES BY FARMERS

Variety	No: of farmers cultivated in Maha	No: of farmers intending to cultivate the variety in Yala
BG 11-11*	15	8
BG 90-2 *	2	11
BG 94-1 *	-	1
BG 34-6 *	2	-
Suduru Samba	1	-
Total	20	20

(* New high yielding varieties)

When examining the reasons for adoption of these varieties it is observed that two groups of reasons have influenced the decisions of farmers. (Table 2.) These are:

1. The superiority of the variety in terms of yield, newness, quality of the rice, resistance to diseases, higher price paid for paddy and short age of the variety.

2. The influence of 'external' factors, e.g. varieties grown by other farmers in the tract , availability of seed paddy with the farmer or with a neighbour , variety used in the area and the influence of the landlord.

Judging from the number of farmers who gave reasons ,although the superiority of the variety (The relative advantage of the variety over the other as explained in 1 above) could be considered as the major criterion for selection, other factors not related to quality of seed too had been responsible for the farmers' decisions. This is particularly evident in the reasons given for slecting varieties for the Maha season (See Table 2.)

Table 7. REASONS FOR SELECTING VARIETIES OF PADDY BY FARMERS

Reasons.	No: of farmers giving the reasons for selecting a parituclar variety in Maha.	No: of farmers giving the reasons for the variety intended to be selected in Yala.
High yield potential	14	19
Based on varieties grown by other farmers in the tract	4	-
A newly introduced variety of paddy	-	6
Better quality of rice	-	1
Availability of seed paddy with a neighbour	2	-
Availability of seed paddy with the farmer	1	-
Farmer had used the particular variety before	1	1
Variety used in the area	1	-
General low susceptibility to pests and diseases	1	-
Early heading (before drought sets in)	1	-
Higher price paid for paddy	1	-
On the advice of the landlord	1	-

The reasons for selecting varieties for Maha were reported by farmers after the commencement of the season while the reasons for yala have been given few months prior to the season. Thus, the two categories give a series of reasons that would have influenced the farmers' decisions immediately before action was carried out and sometime prior to action. It is likely that factors such as high yield would have been the main criterion for selecting a variety sometime before the commencement of for the season. But at the time of actual operation various other factors could affect his decision and the farmer may take an alternative decision to suit the conditions he is affected with. This could be supported by taking some of the reasons given for adopting varieties in Maha such as, the influence of other farmers in the tract, easy availability of seed

paddy either with the farmer or with a neighbour, varieties used in the area , and the influence of the landlords.

Looking at the varieties the farmers cultivated in Maha and intended to cultivate in Yala, an appreciable change over from BG 11 - 11 to BG 90 - 2' is seen (The latter is considered equally superior to even better that the former variety). This represents the extent of farmers expectations, to changing to a variety claimed to be superior to the one they cultivate at present. However, it is very likely that the picture could change at the time of planting with more farmers adopting BG 11 - 11 or another variety due to the influence of various 'external' factors at the time of cultivation.

Another important factor that should be pointed out at this discussion is the importance given to the *'newness'* of a variety. The fact that the variety being new was given as one of the reasons by an appreciable number of farmers for selecting the variety. This was mentioned in relation to BG 90 - 2. This could be the result of farmers being exposed to a number of varieties in the past with constant improvement in performance that they interpret newness in relation to superiority.

The investigation attempted to identify the extent of influence of outside personnel with regard to farmers decisions on the selection of paddy varieties, in addition to the reasons for their decisions taken. Elevan farmers reported the influence of others on their selections. The influencing persons were other farmers and KVSs as reported by six and four farmers respectively and the landlord in the case of the other. Their influence had been to adopt a particular variety (prescriptive function) and not to adopt improved varieties in general. The decision to use improved varieties had already been taken by them.(farmers' themselves).

The previous discussions indicate the farmers awareness of improved varieties and knowledge of their performance. Further it indicates that the farmers are motivated to change if newer varieties are available. This could be the combined effect of concerted extension effort coupled with the availability of superior varieties in the past. This makes the present task of the extension worker much simpler. The situation suggests that even

Both BG 11 - 11 and BG 90 - 2 belong to the same age group.

any other improved varieties that will be available in the future should reach farmers with little extension effort provided the availability of seed is assured.

B Fertilizer use

The manner in which the fertilizers were used by the selected farmers is presented in table 3. As revealed in the investigation 4 major factors appear to have influenced farmers decisions on fertilizer use. They are:-

1. Farmers knowledge and expetience on fertilizer use
2. Influence of outside personnel
3. Unavailability of fertilizer at the required time
4. Financial constraints faced by farmers.

Farmers' knowledge and experience as an influencing factor.

As regards decisions of farmers on fertilizer use, the investigation indicates that the decisions farmers have taken are based mostly on their own knowledge and experience. All farmers (twenty in number) had made their decisions to use fertilizer on their own,while fourteen of them had made their decisions on quantities and times of application of fertilizer based on their own knowledge. Hence, farmers knowledge of the manner of using and the advantages of using fertilizer could be considered as the most important factor influencing their use.[1]

In examining some of the reasons given by farmers for using fertilizer in the manner as practiced by them, it was evident that knowledge and past experience had played a significant role. Some of the evidences are:-

(i) Basal fertilizer was not used as the field was not cultivated in the previous season . Farmers believe that accumulated fertility as a result of leaving the field fallow for one season is sufficient for raising the next seasons crop ; at least as far as the basal fertiliser requirements are concerned.

(ii) A tendency to apply all Urea in one dose instead of two split applications was observed. As a result the quantities used were very much higher than what has been recommended for any single dose.

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[1] Two farmers reported complete knowledge of fertilizer recommendations of the Department of Agriculture while another two expressed their complete unawareness. The rest indicated incomplete knowledge of fertilizer recommendations.

Table 3.

Type, Quantity and time of application of fertilizer and extent fertilised.

Farmer No:	Basal			1st Top dressing (UREA)			2nd Top dressing (UREA)			3rd Top dressing (TDM)		
	QUANTITY (lbs)	* TIME (Weeks)	EXTENT (Acres)	QUANTITY (lbs)	* TIME (Weeks)	EXTENT (Acres)	QUANTITY (lbs)	* TIME (Weeks)	EXTENT (Acres)	QUANTITY (lbs)	* TIME (Weeks)	EXTENT (Acres)
1	112	0	1	56	2	1	28	-	1	56	6	1
2	168	0	1,25	112	4	1,25	-	-	-	112	8	1,25
3	-	-	-	112	3	1	-	-	-	56	8	1
4	112	-1	1	28	2	1	28	4	1	112	8	1
5	112	2	1	56	2	1	28	4	1	112	8	1
6	56	0	0,75	56	4	0,75	-	-	-	112	8	0.75
7	-	-	-	28	2	1	28	4	1	112	8	1
8	-	-	-	-	-	-	112	6	1	-	-	-
9	112	0	1	28	2	1	28	4	1	-	-	-
10	112	0	1	28	2	1	28	4	1	56	8	1
11	-	-	-	28	2	1	56	5	1	56	8	1
12	28	2	0,5	-	-	-	-	-	-	56	8	0.5
13	168	0	0,75	28	2	0,75	-	-	-	112	8	0.75
14	56	2	1,50	56	2	1,50	-	-	-	112	8	1.50
15	112	0	0,75	56	2	0,75	56	4	0,75	56	8	0.75
16	112	0	0,75	28	4	0,75	-	-	-	-	-	-
17	336	0	2	168	2	2	-	-	-	280	2	8
18	140	0	1,25	56	4	1,25	56	6	1,25	-	-	-
19	-	-	-	112	2	1,50	-	-	-	112	8	1.50
20	-	-	-	56	3	1,50	112	6	1,50	-	-	-

* Time in weeks ; '0' refers to the time of planting

This tendency could be due to their incomplete knowledge of the use of urea fertilizer and could also be the result of non-availability at the required times. This results in using all the fertiliser (Urea) when it is available. However, if farmers are convinced of the fact that split applications are more suitable it could be expected that they will make an attempt to buy and store when available and use in split doses.

(iii) Tendency to apply whatever fertiliser that is available rather than to use what is recommended. This could be due to the combined effect of unavailability and incomplete knowledge. TDM has been applied instead of Urea as the former was easily available.

(iv) Application of fertiliser in quantities less than the recommended and the application earlier or later than the recommended time. This is dependent on what farmer thinks is the most suitable level of application for his own situation, and also on availability.

(v) Application of Urea based on the appearance of the crop. This will result in fertiliser being applied only when the crop shows deficiency symptoms.

(vi) Use of organic mannure instead of the recommended basal fertiliser V_2. This is partly the result of non-availability and financial problems.

(vii) Delaying the application of Basal mixture due to unfavourable weather conditions at the recommended times of application. This indicates the farmer's knowledge of the undesirable effect of bad weather on fertiliser.

(viii) Non-use of V_2 basal as past experience with V_2 had been discouraging ; the farmer does not see advantages of using it.

INFLUENCE OF OUTSIDE PERSONNEL:-

As mentioned the influence of outside personnel on farmers decisions on fertiliser usage was not significant. Only six farmers reported influence of

outsiders in their decisions, Of them four indicated the influence of extension personnel and their role had been a ' prescriptive one' influencing the quantities and times of application. Decision to use fertilizer has been made on their own. The influence of the landlords was evident in the case of the other two farmers. One of the landlords, by supplying fertilizer in adequate quantities and at recommended times had influenced the farmer to adhere to the recommendations. While in the other, the landlord disapproved the use of fertilizer by the farmer as according to the rent agreement the farmer could increase his share of the harvest depending on the inputs he uses. In both these situations the role the farmer played was marginal. None of the farmers reported any influence of neighbour farmers or their family members on their decisions on fertilizer use.

UNAVAILABILITY AS AN INFLUENCING FACTOR

Unavailability of fertiliser at the required time and required quantities had been an important factor influencing farmers decisions on fertiliser use. Unavailability has resulted in non-application, delayed or early application, application below recommended levels, sometimes over application as in the case of using all Urea in one dose instead of split applications, use of V_2 mixture along with first dressing of Urea and substituting one type of fertiliser to another. These actions by farmers would have had a definite impact on the yields received by them. However, the above listed actions indicate that most farmers have made appropriate decisions based on their knowledge and experience within the constraints and limitations under which they carried out their cultivation operations.

FINANCIAL CONSTRAINTS AS AN INFLUENCING FACTOR:

Financial problems had played an important role regarding farmer decisions where fertilizer use is concerned. Non-application of certain dressings of fertiliser, using quantities less than what is recommended, and use of organic manures instead of recommended basal fertiliser mixture were some of the ways farmers attempted to overcome this problem.

Only two of the farmers reported borrowing money for the cultivation operations. Of them only one borrowed an appreciable amount from an institutional source. Of the 18 who had not borrowed money, 7 indicated the non-require-

ment of credit (ability to carry out cultivation operations without borrowing) While 2 indicated that their landlords supplied them with the required inputs . Of the balance, the seven who responded, reported the unavailability of sources to borrow money and their dislike for borrowing. It is seen therefore that these were the farmers whose fertiliser usage could have been affected by financial problems. The former group probably due to their unawareness of institutional lending sources or inability to borrow from such sources and the latter due to their attitudes towards borrowing,had refrained from obtaining credit.

The foregoing discussion indicates that as far as fertiliser use is concerned, most farmers operate within two constraints, that of availability of fertilizer and financial contraints faced by them. Within these two constraints, the decisions by farmers as far as fertiliser use is concerned, are dependent mainly on their knowledge and experience. There is very little influence of outside individuals except for the influence of the extension personnel and landlords in the case of tenant farmers. The influence of extension has been *'prescriptive'* influencing the dosages and times of application.

The evidence indicate that most farmers bear favourable attitudes towards fertiliser. They are aware of its advantages and are motivated to use fertiliser. However, with the contraints they are faced with,their knowledge determines to a large extent their decisions on *'how'* to use fertiliser. Thus, the role of extension in this situation should be of improving the existing knowledge on fertiliser and not of promoting farmers to use fertiliser. Rogers and Shoemaker[1] identifies three types of knowledge a person should 'possess to adopt a practice adequately, they are awareness knowledge , *'how to'* knowledge (information necessary to use an innovation properly) and principles knowledge (knowledge dealing with the functioning principles of innovation). It is the latter two types of knowledge that farmers need under this situation.

The best way of achieving this objective of imparting the required knowledge is through farmer education programmes. Printed matter pamphlets and journals may also be used for this purpose. The extension service also appears to have an additional function with regard to credit. This is (i) creating a favourable attitude towards credit (ii) making more farmers aware of the lending institutions and procedure of lending.

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[1] Rogers, E.M. Shoemaker , E.F., (1970) - Communication of Innovations, a Cross Cultural Approach; The Free Press , New York.

C,. Transplanting of Paddy.

Random transplanting of paddy is the commonly adopted method of stand establishment in the area particularly in the Maha season. As in other mid - country areas transplanting is the traditional practice of establishing the crop in the area and is made possible by the availability of skilled female labour and the system of exchange labour (attan) prevailing in the area.

All farmers except one tansplanted their crops in the season under study. The method adopted was random transplanting. Higher yield that could be obtained and the better weed control that can be achieved were given by 16 and 13 farmers respectively as the reasons for practicing transplanting. Five of the farmers also identified transplanting as the practice *'used to them'* in establishing the crop . These reasons indicates the advantages of transplanting over broadcast sowing as perceived by the farmers which have lead to their selection of the method. The possibility of obtaining higher yield as a result of transplanting being mentioned by a very large proportion of farmers indicates that farmers are well aware of the advantages of the practice.

Although a majority of farmers with assured water conditions have considered better weed control, as an additional advantage , few who were farming under unassured water conditions had considered this as important. This suggests the complementary relationship between transplanting and the availability of an assured water supply in achieving good weed control. It is under assured water conditions that transplanting can bring about a substantial control of weeds.

The above listed reasons supports the farmers preference for selecting transplanting over broadcast sowing. The investigation also attempted to examine the reasons for their selection of random transplanting as against row transplanting. Most farmers have doubted the relative advantages of row transplanting over random transplanting. This should be looked at from the point of view of the advantages of transplanting that farmers had mentioned namely higher yields and better weed control. In regard to weed control row transplanting could be advantages only if weed control is carried out using rotary weeders. But if weed control is carried out

either manually or by flooding the *liyadda* as is commonly practiced in the area, this method is not likely to have any special advantage. Further, row transplanting is costly in terms of labour and demands more skill. It is doubtful whether the increase in yield that can be obtained is sufficient to compensate the extra effort.

D. Pest Control Measures

Incidence of pest is a major problem affecting paddy cultivation in the area. Eighteen farmers have reported incidences of pests in the season under study. These farmers have referred to 42 cases of pest incidences with specific measures taken to control the pest. In the 42 cases of pest incidence although 6 pest types have been reported by the farmers concerned only three of these are of major importance judging from the number of cases reported. The farmers havee used 15 different types of insecticides in controlling the pests although only 4 of these were used by more than three farmers each.

These figures indicate the complexity of pest problems that farmers in the area face . The complex nature of the decision is evident from the fact that a large number of farmers (12 out of 18) have sought the advice of the extension staff in combating the pest problems. Ten of them have sought the advice of the KVS while the balance had contacted the Agricultural Instructor. Like in the case of fertiliser the role of the extension agent had been '*prescriptive*' function. In most cases farmers sought the assistance of the extension agent to identify the insect and recommending to him a type of insecticide (likely including its availability) to tackle his problem.

As was mentioned earlier only 4 types of insecticides were used extensively by the farmers concerned. It is seen that these were the types that were available freely in the area. Two of these types were available with the APC while another was available at the extension centre. The fourth was a type that had been popular among farmers for sometime and a type that is freely available in most rural areas. Hence, it is seen that a major factor determining the selection of insecticide, is its availability in the area.

The sources of insecticides for the farmer were the Agricultural Service Centre [1] (including the sales centre of the APC and the extension centre) and private traders in the area. Farmers have indicated their preferences to buy from institutional sources as they are less expensive than the private sources. None of the farmers had indicated any difficulties in obtaining spraying equipment. However, most of their requirements of spraying equipment have been met by private sources .

It appears necessary for the extension services to pay greater emphasis to aspects of pest control (compared to other management practices) in their farmer education programmes.

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[1] The farmers from whom the information was collected had their fields not far away from the Agricultural Service Centre and that two types of insecticides were available with the APC in addition to types marketed by the extension service.

CONCLUSIONS

In general a high level of adoption of improved practices is observed. There is evidence of farmers being aware of the improved practices in paddy and further they are convinced of the advantages of these practices. However, some of them lack the detailed know-how required to adopt the practice correctly.

There was very little or no influence of other individuals either family members, neighbour farmers or extension personnel on farmers decisions to adopt improved management practices. However, farmers sought the advice of others particularly of extension personnel in deciding the types, dosages, etc., particularly of fertilizer and agro-chemicals. Thus, the role played by the extension personnel had been a *'prescriptive'* function rather than a *' promotional'* one. Such a role could be expected from extension personnel in relation to a crop like paddy where extension work on improved management practices has been carried out for a considerable number of years.

The dependence on extension personnel was greater when the practice became more and more complex and a decision making became complicated such as on the control of pests.

There was also evidence that in most instances farmers do decide on dosages, time of application etc., without consulting extension personnel. In such situations the knowledge possessed by the farmer becomes a major determinent influencing the manner in which farmers carryout the practices. Thus, the importance of qualitative up grading of the knowledge possessed by the farmer through farmer educational programmes becomes apparent.

The investigation indicates that with reference to pest control farmers are in need of more information particularly information specific to their problems. Controlling a pest or a disease is different from other management practices in that it involves a reaction to a problem while other management practices are routine actions performed by a farmer. It is therefore, a difficult decision from the farmers point of view. Further,he needs to have a knowledge of the pest, the damage it causes and ways and means of controlling it. This is seen from the fact that a large number of farmers sought the assistance of extension personnel. Greater emphasis could therefore be paid to pest control (compared to other management practices) in farmer education work.

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RECONNAISSANCE SURVEY OF RICE GROWING SOILS*

S.SOMASIRI *

The socio-economic survey carried out by the Agrarian Research and Training Institute indicated a very high variability in the rice yields per acre in the Beminiwatte APC area. It also showed that a very high percentage of the farmers used new high yielding varieties and fertilizers. Insptite of the apparent high level of crop management, the yields per acre were too low. Therefore the survey of the rice growing soils in the area was undertaken to examine the conditions and resource limitation to rice production and to assess the resource potential. This study was of a preliminary nature from which the following conclusions were made.

1. Most of the rice growing soils in the area are confined to a system of inland valleys. Only a small percentage was in terraced upland slopes.
2. Within a valley (tract) the soil drainage conditions were closely related to the shape of the valley and the position in the valley. The level sites of stepped valleys, level narrow valleys and the valleys without drainage ways consist of poorly drained soils. The valley side slopes, sloping sections of the stepped valleys consist of imperfectly drained soils. Steeply sloping valleys , side slopes of strong gradients and terraced upland slopes consist of well drained soils.
3. The hydrology, thus the water availability during the growing season is closely related to the valley form and the landscape in addition to the rainfall.

(a) Narrow level to moderately sloping valleys with medium relief are well supplied with phreatic water.

(b) In the medium to high relief landscape, the water supply in the valleys are good.

(c) In the low relief region, specially in short valleys, broad valleys valley side slopes, terraced upland slopes the water supply can be poor. Unless supplementary irrigation can be found in these

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situations, the shortage of water would be a serious limitation.

Even in a given tract, the yield potential is highly variable. Suitable cultivation may prove useful in increasing the yield. Different soil and water management to suit the resource conditions is definetely needed.

II SURVEY OF THE LAND USE PATTERNS IN THE UPLANDS

Uplands constitute a significant part of the land resources in Beminiwatte APC area (ARTI - socioeconomic survey). Most of the uplands are small holdings, less than 5 acres. The income levels from the uplands were shown to be very low.

As a first step in the improvement of the level of income, from the highlands in the area, any improvement on the cropping intensity and crop management has to be based on the present patterns of land utilisation. Thus, a survey of the land use patterns were carried out and the following classification was used in the follow up highland development programme.

1. Bare lands - coconut mono-cropped, abandoned tea or rubber
2. Coconut inter-cropped with Banana
3. a) Coconut , Banana with yams, and tubers and other tree crops with homestead.
   b) Coconut, Banana with yams, and tubers and other tree crops without homestead.
4. Mixed forest garden on upland. Homegardens with a variety of crops.
5. Mixed forest gardens on steep slopes.

The land use patterns; 1, 2 and 3 have the greatest potential for development. The land use patterns 4 and 5 are generally confined to very small holdings- less than one acre in a majority of cases. In such gardens drastic changes may be required to make an impact on the production. Therefore at the initial stages, such changes can not be recommended. The patterns ; 1, 2 and 3 have the greatest potential for improvement. Further improvements on the highlands should be based on definite quantitative data from the follow up studies.

III. HIGHLAND DEVELOPMENT EXPERIMENTS AND DEMONSTRATIONS

The land use patterns ; 1,2 and 3 were selected for the highland development programme. In the development of the highlands soil conservation measures were installed at the commencement of the programme. The land -use pattern 3 was improved by the introduction of new crops and organisation of the crops according to the soils and the landscape. The patterns ; 1 and 2, the cropping intensity was increased by the introduction of minor export crops, inter cropping with banana or pineapple or pasture. A diagramatic representation of the highland demonstration plots are given in the pages that follow. (See Annex I)

1. The development of the highlands were well accepted by the farmers in the area. They have shown a keen interest in developing their own lands.

2. The results of the minor export crops would be shown only after few years.

3. Banana under coconut, with good management has given good yields. However, the analysis of the farm records are needed.

4. Though most farmers are interested in the development of their highlands, most of the farmers tend to neglect the highland crops for no apparent reason. They seem to have no idea on the value for fertilization of the highland crops. Even the farmers in the demonstrations, expect the government to supply free fertilizer and agro-chemicals.

5. The land use pattern, I , coconut mono-cropped tea or rubber (abandoned) appear to be the result of absentee landlords, tenure problems, or for the use of livestock. In the development of pasture for dairy purposes, it would be better to select these highlands, that are in category 1 for the purposes of maintaining livestock.

6. Dairy development in lands of category 1, in the farms of those who have very little experience seems to be risky. It would be better to provide training in the management of livestock before such enterprices are recommended.

RESEARCH ON RICE IN CULTIVATORS' FIELDS

I. BALASURIYA.*

INTRODUCTION

A socio-economic survey was carried out by the Agrarian Research and Training Institute (ARTI) in the *Beminiwatte* Agricultural Productivity Committee Area in *Maha* 1973/74 and *Yala* 1974. In connection with rice cultivation it was reported that despite the use of improved -high yielding varieties (HYVs), fertilizers, transplanting and approximately 30 percent of the rice area having supplementary irrigation the yields were well below the average for the Kegalle district (i.e. (a) *Maha* - 34.6 bu/ac vs 54.5 bu/ac for *Kegalle* district (b) *yala* 28.4 bu/ac vs 39.3 bu/ac for Kegalle district). Therefore, it was decided to investigate whether technical problems and constraintsx were responsible for the low yields reported.

In 1975 the Field Trials Division, Department of Agriculture, was assigned the task of identifying the technical constraints and problems for achieving high rice yields together with suggesting remedial measures. For this purpose the following investigations were carried out:-

a) "Monitoring of Management Practices on Rice in Some Selected Paddy Parcels - Yala 1975.

b) In-depth Studies on Rice Cultivation in Cultivators' Fields.

(i.e. Use of improved rice varieties and fertilizers, crop management, cropping patterns etc.)

Inadequacy of staff and poor transport facilities were persistent constraints for this work. In yala 1976 unfavourable weather (i.e. drought) adversly affected the programme of field experiments.

In carrying out this assignment the Field Trials Division maintained close contact with the A.R.T.I. and agencies of the Department of Agriculture which were associated with the Beminiwatte Field Laboratory Project.

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This summary Report incorporates the main findings from work done during Yala 1975, Maha 1975/76 Yala 1976 and Maha 1976/77.

CONCLUSIONS

PART 1. - MONITORING OF MANAGEMENT PRACTICES ON RICE IN SOME SELECTED PADDY PARCELS - YALA 1975.

1. Improved high yielding varieties of medium and short duration were popular and extensively cultivated in this area. i.e. Medium duration :- BG 11-11 and H_4 (4-4½ months), B_g 90-2 (3 3/4 months), Short duration :- B_g 34-6 (3½ months), B_g 34-8 (3 months). The use of varieties of varying duration is related to the variability in the e water supply between and often even within the same rice tract.

2. A significant feature emerging from the minitoring was the strikingly low use of the recommended V_2 Basal N P K Mixture, even when growing improved varieties, which contains all the phosphorus, half the potassium and a little nitrogen. Infact, of the farmers monitered 46% did not apply any V_2 Basal Mixture at all and application of phosphorus and potassium fertilizer was only .12 - 15% and 15 - 17% respectively of the quantities recommended("low level" recommendation). The use of nitrogen was higher but nevertheless lower than recommended for new improved medium and short duration varieties i.e. 34 - 41% of the "Low Level" recommendation.

NOTE:- (a) " Low Level" Recommendation:- 69-29-38 lb N, P_2O_5, K_2O / ac

(b) High Level Recommendation:- 81-29-38 lb N, P_2O_5, K_2O / ac

It was evident that very little attention was paid to the cecessity for proper timing of fertilizer applications. The latter appeared to be done mainly on individual preferences rather than according to the recommended times of application.

Therefore, the low yields reported appeared to be mainly due to a combination of inadequate, unbalanced and inappropriate use of fertilizers together with meagre knowledge of the management practises required for obtaining high yields with improved varieties.

3. In Yala 1975 the scarcity of fertilizers, inability to obtain fertilizer requirements as and when required at the village level together with the high cost of fertilizers prevailing at the time appeared to be significant contributory factors for the unsatisfactory and haphazard use of fertilizers. In order to ensure adequate and correct use of crop inputs viz. fertilizers, insecticides and weedicides, it is necessary that they be readily available to farmers at the village level. Furthermore, to encourage their use by farmers these inputs should also be reasonably priced.

4. The main environmental constraints for rice cultivation in this area were the unreliable water supplies, reduced solar radiation in the narrow valleys which are flanked by sharply rising highland impeded drainage in scattered areas during rainy weather and evidence of very low available phosphorus in some rice tracts.

5. Where supplementary irrigation was available both medium and short aged varieties were random transplanted whereas under purely rainfed cultivation broadcast sowing was popular and the predominant method of crop establishment. Therefore, it appeared that transplanting is closely associated with a reasonably stable water supply whereas broadcast sowing is linked with an unstable water supply. It requires to be borne in mind that an unreliable water supply creates difficulties for raising nurseries and also for transplanting seedlings at the correct age on to fields.

6. In several instances it was evident that the farmers' choice of improved varieties was not appropriate to their water supply. Although varieties of the medium age group were popular among farmers e.g. B_g 11-11, H_4, etc., their cultivation should be encouraged only in those fields where a stable water supply is available for a 4½ months variety. Short aged varieties (i.e. 3½ & 3 months) are the appropriate choice for fields with unstable water supplies.

7. The comparison of crop-cut yields with those reported by farmers showed very significant under reporting of yields, with a general value of 30 - 35% of the crop-cut yield. This tends to cast some doubt on the value of questioning farmers for drawing conclusions on yields without adequate supporting

quantitative data from Crop Cutting Surveys, random sampling, etc.

PART II. - IN-DEPTH STUDIES ON RICE CULTIVATION IN CULTIVATORS' FIELDS

(a) FERTILIZER INVESTIGATIONS

Preliminary investigations were carried out in Maha 1975/76 and followed up with comprehensive field experimentation in Yala 1976 and Maha 1976/77. The new improved variety B_g 11-11 was used with transplanting and supplimentary irrigation.

1. EVALUATION OF CURRENT FERTILIZER RECOMMENDATIONS

(i) A highly significant -yield response viz. 13-15 bu/ac was obtained with the use of the "*Low Level*" recommendation (i.e. 69-29-38Ib,N, P_2O_5, K_2O/ac) and a further increase of 4-10 bu/ac with the "*High Level*" recommendation (i.e. 81-29-38). These data show the beneficial effects of applying the current fertilizer recommendations for improved 4-4½ months varieties.

(ii) Use of half the "*Low Level*" recommendation (i.e. 34.5-14.5-19), containing NPK, gave a highly significant yield increase of approximately 9 bu/ac over the "*No Fertilizer*" control. Therefore, where farmers are unable or reluctant to apply the full quantity of recommended fertilizer the application of half the erecommended quantity is both beneficial and profitable.

2. USE OF THE V_2 BASAL NPK MIXTURE

The monitoring of management practices of farmers revealed that in this area farmers appear to have little confidence in the benefits from the V_2 Basal NPK Mixture, which contains rook phosphate as the source of phosphorus.

NOTE:- 46% of the farmers sampled did not apply the V_2 Basal NPK Mixture, -while the balance applied very much less than recommended).

Nevertheless, its application, at planying, resulted in a significant

increase in yield of 7-10 bu/ac. However, when the application of this V_2 Basal NPK Mixture was delayed until the 3rd week after transplanting the benefit was relatively small i.e. and increase of 4-5 bu/ac. Since farmers do not appear to receive their fertilizers on time late applications are inevitable, hence a low benefit obtained from its application. This may explain the reluctance of farmers to apply the V_2 Basal Mixture. Therefore, the V_2 Basal NPK Mixture should be applied at planting and not delayed beyond 3 weeks after planting. (i.e. for 4-4½ months varieties).

3. SUBSTITUTION OF CONCENTRATED SUPERPHOSPHATE FOR ROCK PHOSPHATE IN THE V2 BASAL NPK MIXTURE

The sunstitution of concentrated superphosphate in place of the currently recommended rock phosphate has given consistant and significantly higher yields, ie. approximately 7-8 bu/ac (range:- 4-15 bu/ac). Furthermore, when the V_2 Basal NPK Mixture with concentrated superphosphate was applied 3 weeka after planting the reduction in yield was less than with reock phosphate.

Furthermore, the following aspects in favour of concentrated superphosphate are noteworthy:-

(a) It was observed that with concentrated superphosphate there was a more rapid elongation at the early vegetative stage, hence better weed competitive ability than with the recommended rock phosphate.

(b) In some rice tracts of the Beminiwatte APC area there was evidence of phosphorus deficiency occuring in scattered pockets. The latter probably due to iron carried by the inter-flow water from the highland. In these areas plots with rock phosphate showed characteristic symptoms of phosphorus deficiency i.e.narrow erect bluish-green leaves, compact tillering and stunted growth, whereas plots with concentrated superphosphate were either free of these symptoms or showed them in mild form. Where phosphorus deficiency symptoms were observed the yield differnce between concentrated superphosphate and rock phosphate was as high as 15 bu/ac.

(c) Since farmers do not receive their fertilizers on time the use of concentrated superphosphate in the Basal NPK Mixture would help to reduce the yield reductinon owing to delayed application of this mixture,

(d) The evidence to date strongly indicate that for improved varieties the currently recommended rock phosphate source of phosphorus for rice in the area requires to be changed to concentrated superphosphate.

4. INCREASE OF THE QUANTITY OF NITROGEN APPLIED AT PLANTING

It was found that increasing the quantity of nitrogen in the V_2 Basal NPK Mixture from 4.5 Ib to 10 Ib N/ac was highly beneficial. The yield increases being 6.2 bu/ac and 5.3 bu/ac with rock phosphate and concentrated superphosphate respectively.

NOTE:- Alles and Balasuriya (1973) have reported on the beneficial effect of increasing nitrogen applied at planting for Bg 11-11 in the Wet Zone.

Furthermore, increasing the quantity of nitrogen in the V_2 Basal NPK Mixture has the added advantage of reducing the risk of nitrogen starvation when farmers delay or are unable to apply the 1st Top Dressing of nitrogen 2 weeks after planting owing to rain, insufficient water in fields or inability to obtain fertilizers.

5. RESPONSE TO NITROGEN FERTILIZER

Witholding the recommended quantity of nitrogen in the "Low Level" recommendation i.e. 68.9 Ib N/ac resulted in a greater reduction in yield than for the recommended quantity of phosphorus, i.e. 28.6 Ib P_2O_5/ ac as rock phosphate , in the presence of potassium. This tends to indicate that on soils in this area new improved varieties respond well to nitrogen fertilizer.

6. PART SUBSTITUTION OF ROCK PHOSPHATE IN THE V_2 BASAL NPK MIXTURE WITH CONCENTRATED SUPERPHOSPHATE.

With a view to exploring the possibility of economizing on the use of concentrated superphosphate a treatment with 50% substitution of rock phosphate with concentrated superphosphate in the V_2 Basal NPK Mixture was tested. The results showed that although this treatment gave a higher yield than with rock phosphate only, nevertheless the yield increase was lower than with a full substitution with concentrated super phosphate.

(b) VARIETAL INVESTIGATIONS

1. VARIETAL EVALUATIONS

In the Medium Age Group (i.e. 4-4½ months) the new improved varieties B_g90 -2, B_g 11-11, B_g9 6-3, LD 125 and H_4 performed well, in decending order, -in the Maha season, when cultivated according to the recommended management practices.

A significant contributory factor for the outstanding performance and high yield increase of B_g 90-2 over the other varieties could be its shorter duration. (i.e. 3 3/4 months), when compared with a duration of 4-4½ months for the other varieties. This enabled B_g 90-2 to escape any adverse effects of water stress.

2. VARIETAL RESPONSE TO NITROGEN

When using the *'High Level"* recommendation with the above mentioned varieties (i.e. 81-29-38 N, P_2O_5. K_2O/ac) all varieties, except H_4, gave significantly higher yield sover the *"Low Level"* recommendation (i.e.68-29-38). This indicated that the new improved varieties e.g. B_g 90-2, B_g11-11, etc., had a better response to high levels of nitrogen than H_4, a reason for which is the better lodging resistance of the former varieties when compared with the latter.

3. CHOICE OF AGE GROUP

Although the 4-4½ months age group was popular among farmers, nevertheless this age group was not well adapted to many rice tracts owing to inadequate water supplies. Therefore, farmers in areas with an unreliable water supply should be advised and encouraged to use shorter duration varieties e.g. B_g34-6, B_g 4-1 and B_g 34-8, rather than medium duration varieties. This would ensure stable yields and minimise the risk of yield reduction or crop failure owing to water stress.

The experience todate tend to indicate that in this area 4-4½ months varieties have a wider application in the Maha season than in Yala.

(c) OTHER OBSERVATIONS

1. ENVIRONEMENT CONSERVATION

It was evident that in some rice tracts e.g. Rukulagama, the normal dry weather flow(water) from adjacent ridge catchments and springs was absent or drastically reduced. There appears to be in this area a close relationship between the water supply from the highland ridge catchments and rice cultivation in lowland valleys. Furthermore, in dry weather, due to the absence of surface stored water for irrigation, the rice, crop is heavily dependent on the dry weather flow. Therefore, indiscriminate and unscientific land alienation and disturbance of natural vegetation on ridge catchments should be prevented in order to avoid serious adverse effects on rice cultivation in lowland valleys.

2. PHOSPHORUS DEFICIENCY

Typical symptoms of phosphorus deficiency were observed on new improved varieties e.g. B_g 11-11 and B_g 34-8, in localised areas within some rice tracts. It was observed that these symptoms were more common in those areas where during rainy weather the ground water level is high and drainage tends to be poor.

NOTE:- The appearance of phosphorus deficiency symptoms may be explained on the hypothesis that phreatic water from highland areas carrying reduced iron and aluminium compounds caused iron toxicity and phosphprus deficiency in those areas of rice fields where this water comes to the surface. (Panabokke et al).

3. "BRONZING"

Although typical symptoms of "Bronzing" i.e. reddish-brown or purplish brown discolouration leaves, was uncommon even with the susceptible varieties e.g. B_g 11-11 , B_g 34-8. Nevertheless, an abnormal yellowing of leaf tips, a brownish mottling and leaf tip drying were observed. These symptoms were very likely a manifestation of iron toxicity. In areas where these symptoms are onserved, despite proper crop management - expecially the use of Basal N,P,K, Mixture, "Bronzing" tolerant vatieties should be recommended.

RECOMMENDATIONS

1. FARMER EDUCATION AND TRAINING

A farmer education programme requires to be undertaken dealing with the proper choice and use of improved varieties - especially in relation to the available water supply, correct use of fertilizers and management practices. Special attention requires to be paid to educating and encouraging farmers to use the V_2 Basal NPK Fertilizer Mixture.

In addition, attention is required on insect control use of weedicides and transplanting techniques i.e. " *Age of seedlings, number of seedlings / hills and depth of transplanting*".

2. USE OF CONCENTRATED SUPERPHOSPHATE

It is appropriate, on the basis of research findings, to substitute the cureently recommended rock phosphate in the V_2 Basal NPK Mixture with concentrated superphosphate for improved varieties,

NOTE:- Presently concentrated superphosphate is recommended o for parts of Kegalle District).

As an interim measure the V_1 Basal N,P,K, Mixture may be recommended until such time as the change is made in the form of phosphprus in the V_2Basal N,P,K, Mixture from rock phosphate to concentrated superphosphate.

3. TIME OF APPLICATION OF THE V_2 BASAL N.P.K. MIXTURE

When applying the currently recommended V_2 Basal N,P,K, Mixture, every effort should be made to apply it at planting.

Although delaying the application of this mixture, up to the third week after transplanting, was found to be beneficial nevertheless there was a significant yield reduction . Therefore, this Mixture should be applied at planting or preferably within ten days of planting,

4. IMPROVEMENTS IN THE SUPPLY OF AGRO-INPUTS

In order to ensure adequate and appropriate use of fertilizer, insecticides, weedicides etc. improvements are required, at the village level, in the supply of Agro-inputs.

5. REDUCED FERTILIZER APPLICATION

Where farmers are unable or reluctant to apply the full fertilizer recommendation for improved varieties (i.e. 4-4½ months) half the recommendation can be applied with benefit, provided all three major nutrients (NPK) were applied in proportionately reduced amounts (i.e.34.5-14.5-19 Ib N,P_2O_5, K_2O /ac) and the crop well -managed.

6. CORRECT CHOICE OF VARIETY

The proper choice of improved varieties is very important for exploiting their high yield potential.

Although improved varieties of the medium age group (i.e. 4-4½ months) were popular among farmers, they should be recommended only to those farmers that have a stable and adequate water supply. Furthermore, the wide range in duration among varieties of this age group (i.e 3 3/4 months - 4½ months) presents the opportunity for considerable flexibility in choosing the appropriate variety to suit the specific water supply of individual farmers.

Where the water supply is unstable, with poor or no prospects of supplementary irrigation, improved short aged varieties (i.e. 3½ and 3 months) should be encouraged in preference to medium aged varieties. This would help to minimize the risk of crop loss due to drought and contribute towards obtaining stable yields by minimizing wide yield fluctuations.

7. FERTILIZER LEVELS FOR IMPROVED MEDIUM AGED VARIETIES

With the new improved varieties e.g. B_g 90-2, B_g 11-11, B_g 96-3, and LD125 both the *"Low Level"* and *"High Level"* fertilizer recommendations (i.d. 69-29-38 and 81-29-38 Ibs N, P_2O_5 , K_2O/ac) could be used whereas with the

old improved variety H_4 only the "*Low Level*" recommendation was appropriate.

8. INCREASING THE QUANTITY OF NITROGEN APPLIED AT PLANTING

With new improved 4-4½ months varieties e.g. B_g 11-11, increasing the quantity of nitrogen applied at planting from 4.5 Ib N/ac to 10 Ib N/ac was beneficial. Furthermore, in the context of double rice cropping and where farmers are unable or do not apply the first top dressing of nitrogen two weeks after planting, increasing the quantity of nitrogen applied at planting would help to eliminate or eleviate the detrimental effects of inadequate nitrogen at the early vegetative stage.

9. INTENSIFY EFFORTS TO USE THE AVAILABLE RICE TECHNOLOGY

The investigations have , to date, not revealed any serious technical constraints for the low yields reported in the Beminiwatte A.P.C. area in Maha 1973/74 and Yala 1974. Therefore, an intensive effort should be made to encourage farmers to effectively us the available rice technology together with the refinements and modifications to the current recommendations which become appropriate as the pool of technical knowledge increases.

10. ENVIRONEMENT CONSERVATION

Conservation of land and water resources for rice cultivation is an urgent need. Particularly the ridge catchments on which depends the dry weather flow in the lowland rice valleys. Therefore, an integrated rice development programme involving technical, socio-economic and environmental aspects is desireable.

ACKNOWLEDGEMENTS

In carrying out the "*Monitoring of Management Practices in Selected Paddy Parcels - Yala 1975*" Messrs A.Wanasinghe (Agrarian Research & Training Institute) , S.Masilamany (Field Trials Division, Department of Agriculture), S.Samarakoon (Extension Division, Department of Agriculture) and M.De Silva (Land and Water Use Division, Department of Agriculture), assisted in the field monitoring aspect. Miss T.Sanmugam, Statistician (A.R.& T.I) was responsible for working out the methodology and in the selection of farmers.

The assistance rendered by these persons is acknowledged.

The field experimentation or rice in cultivators' fields was carried out with the assistance of Mr. K.A.J.H.Fernando, Miss.S.Jesudas and Mr. S. Masilamany of the Field Trials Division, Department of Agriculture. The success of the field Trials Division, Department of Agriculture. The success of the field research programme is largely due to the full and active co-operation given by all officers of the Field Trials Division, Department of Agriculture, working without adequate facilities and often under difficult conditions.

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af/-

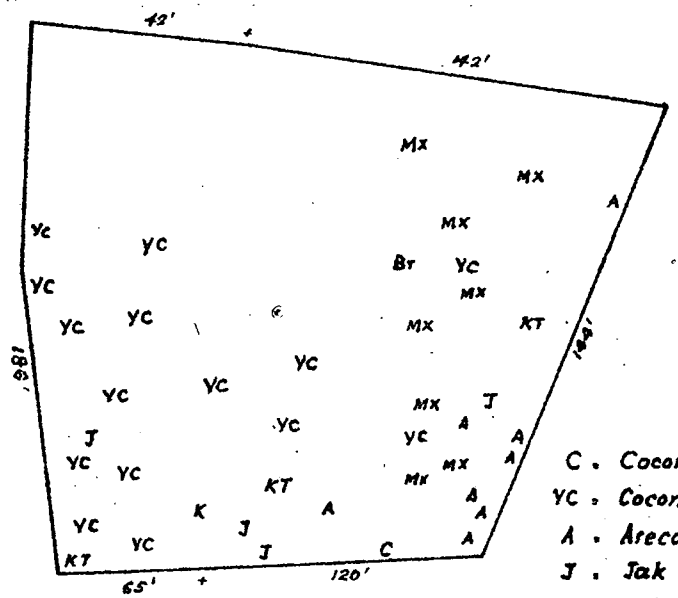
NAME OF FARMER :- W.R. WIJERATHNA.

EXTENT :- 0.75 (AC)

LAND CLASS :- I

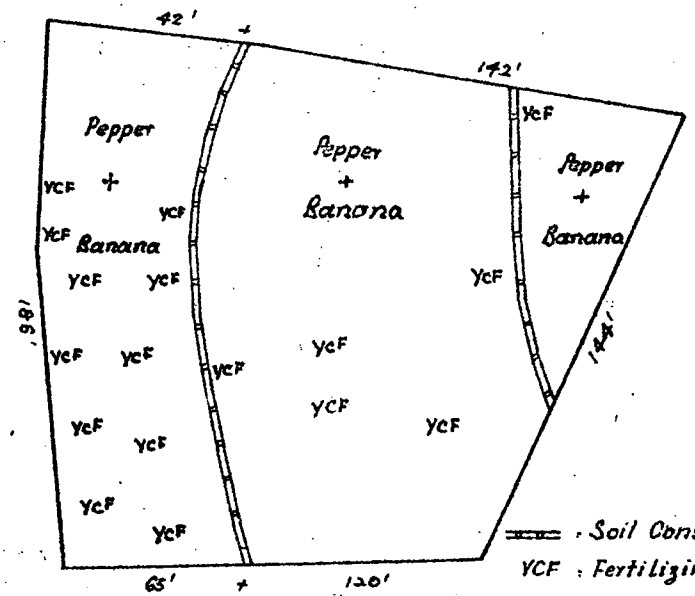
CROPPING PATTERN :- MINOR EXPORT CROPS.

SITUATION BEFORE DEMONSTRATION

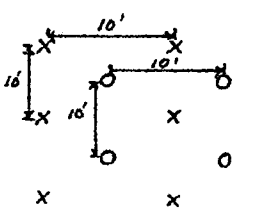


C . Coconut (adult)
YC . Coconut (young)
A . Arecanut
J . Jak
Kt = Kitul Palm
Mx . Mixed Trees.

NEW INTRODUCTIONS



= . Soil Conservation drains
YCF . Fertilizing Coconut (young)
Pepper and cloves



X = Pepper
O . Banana

Annex I

HIGHLAND DEVELOPMENT DEMONSTRATIONS

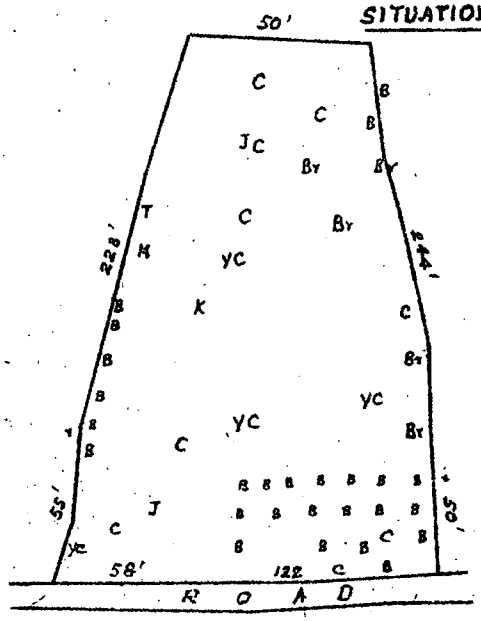
NAME OF FARMER: D.M.A. DIYASINGHE

EXTENT. 3/4 Ac.

LAND CLASS: 2.

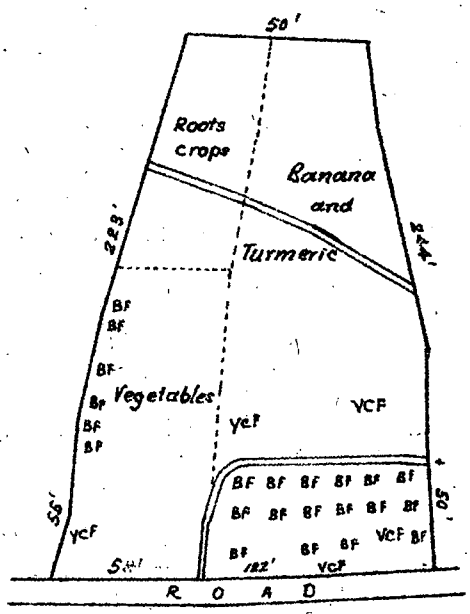
CROPPING PATTERN = BANANA UNDER COCONUT

SITUATION BEFORE DEMONSTRATION



C. Coconut (Adult)
YC: Coconut (young)
J. Jak
Br: Bread Fruit
B. Banana
M. Mango
T. Tamarind
MX: Mixed Trees.

NEW INTRODUCTIONS



▥ : Soil Conservation Drains
Banana + Turmeric
BF : Fertilizing Banana (adult)
YCF : Fertilizing Coconut (young)
Root Crops: 1. Manioc
2. Sweet Potato
3. Tannias
Vegetables: 1. Bandakka
2. Chillies
3. Capsicum
4. Raddish
5. Brinjal

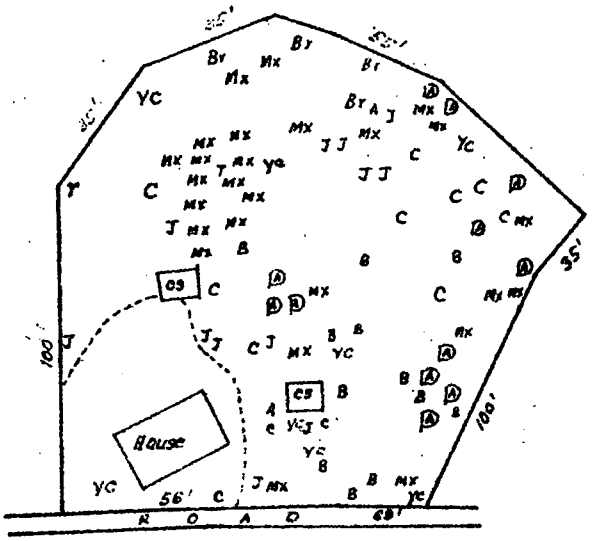
NAME OF FARMER: W. M. SEELAWARDENA

LAND CLASS: 3^{A}

EXTENT: 1 Ac.

CROPPING PATTERN: MIXED HOME GARDEN

SITUATION BEFORE DEMONSTRATION



J - Jak

C - Coconut (adult)

YC - Coconut (young)

Br - Bread fruit

A - Arecanut

B - Banana

Mx - Mixed Trees

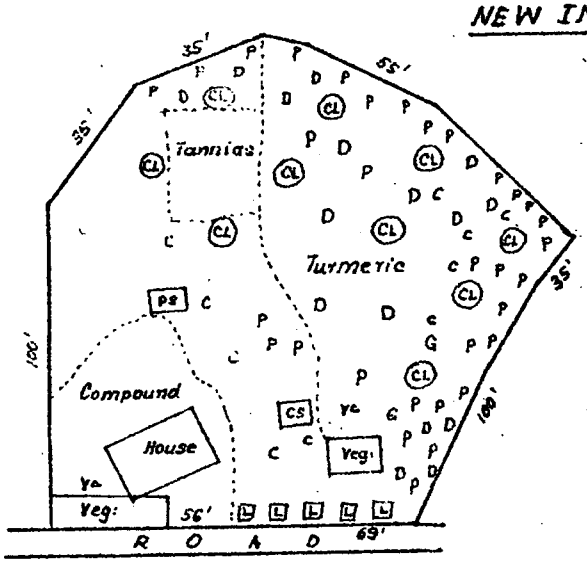
P - Pepper Vine (adult)

Ps - Poultry Shed

Cs - Cattle Shed

T - Tamarind

NEW INTRODUCTIONS



CL - Cloves

P - Pepper Vines

Turmeric

Tannias

L - Lime

D - Dioscorea

G - Guava

Veg: Vegetables for home consumption

1. Bandakka
2. Brinjal
3. Capsicum
4. Chillies - (green)
5. Raddish

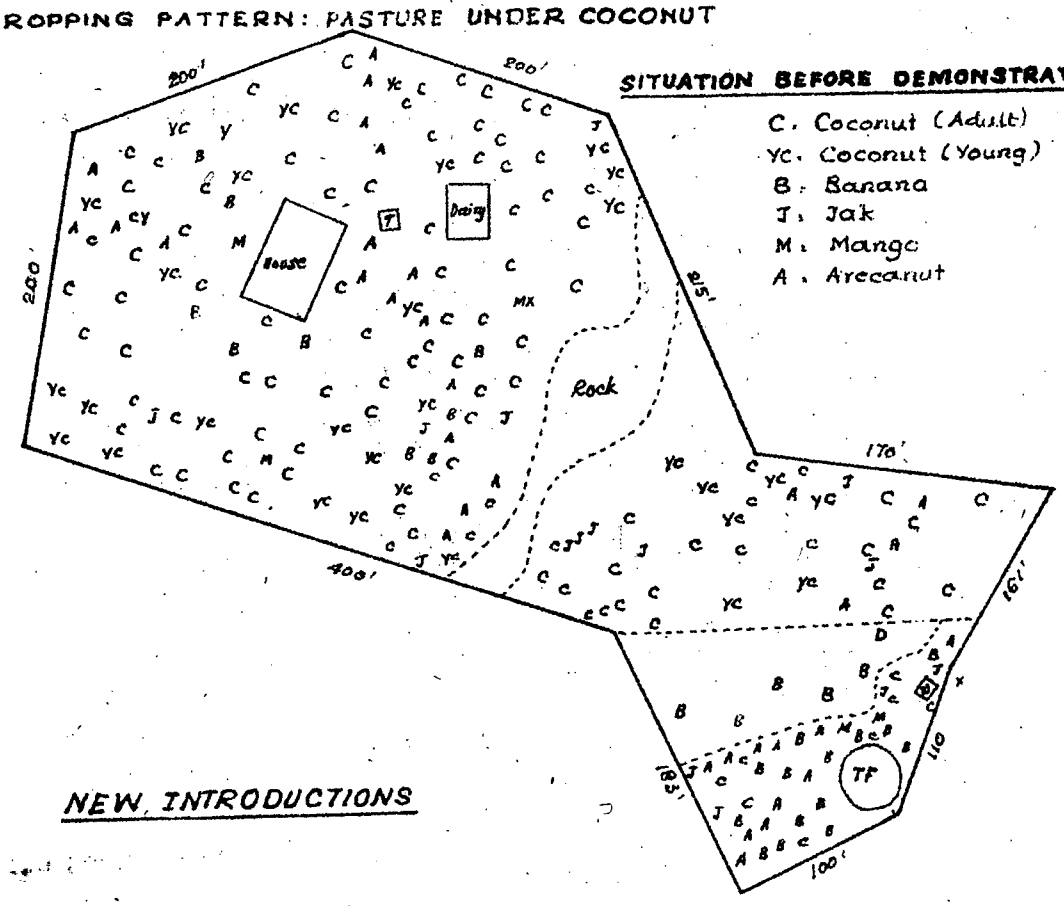
NAME OF FARMER : W.M. GUNATILAKA.

EXTENT : 5 AC.

LAND CLASS : I

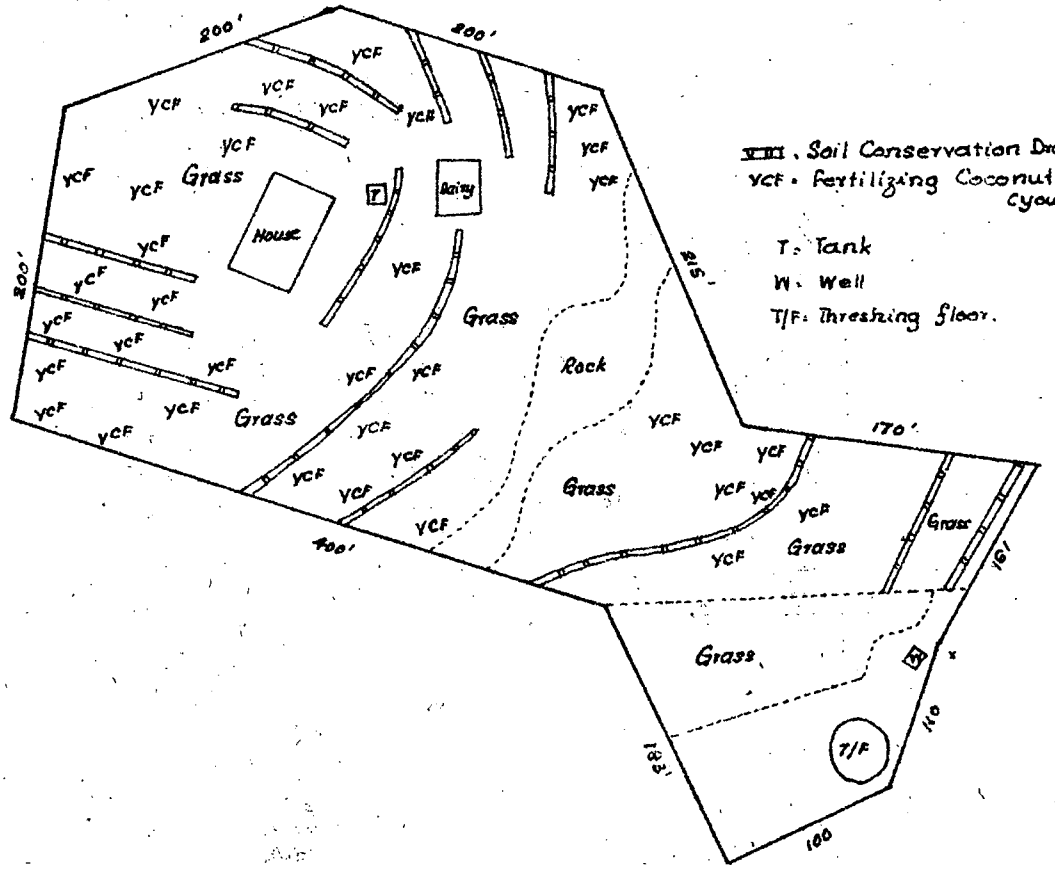
CROPPING PATTERN : PASTURE UNDER COCONUT

SITUATION BEFORE DEMONSTRATION



C. Coconut (Adult)
Yc. Coconut (Young)
B. Banana
J. Jak
M. Mango
A. Arecanut

NEW INTRODUCTIONS



Soil Conservation Drains
YCF. Fertilizing Coconut (young)

T. Tank
W. Well
T/F. Threshing floor.