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FARMING SYSTEMS ECONOMICS : FITTING RESEARCH TO FARMERS' CONDITIONS.

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Abstract:

Appreciation of the farmers production environment has been shown to be of importance in trying to bridge the gap between the research recommendations and the needs of the small scale farmers.

Various systems of intercropping maize and beans are compared. The recommended method is compared with the farmers' present methods taking into account not only the inputs and outputs but also physical, economic and social factors. Pure stands of maize and beans are also included in the comparison.

The recommended method is found to require too much planting labour for the small scale farmers in the semi-arid area of Machakos, Kenya, where timely planting is crucial in view of the short growing period.

INTRODUCTION.

Kenya has an agricultural based economy. The major objective of the Scientific Research Division of the Ministry of Agriculture is to solve the problems of the farmers and make technology advances, both in plant breeding and crop production. In the past, agricultural research in Kenya was oriented to solving problems of large scale farms. Since, the late 60's there has been an increased emphasis in orienting agricultural research to the needs of the small scale farmers. Small scale farmers are the majority in the country. Of Kenya's 15 million people, 10.3 million live on small scale farms, (Integrated Rural Survey, IRS, 1977).

Small scale farms, especially of the tropics differ in many respects from the large scale farms. The latter are commercialised, mechanized and specialized. The small scale farmer has few dealings in input and product markets. He uses labour intensive production methods. His primary objective is to produce enough to feed his family and to sell when necessary, to meet his minimal cash needs.

In Kenya, small scale farming is a way of life and is affected by all those factors that can be termed as farm environment. This includes physical, institutional,

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1. This paper was presented at the "Second Symposium on Intercropping in Semi-Arid Areas" University of Dar-es-Salaam, Tanzania. August, 1980.

economic and social factors. Researchers who hope to influence the farmer must take all these factors into account. Therefore a multidisciplinary approach is necessary. As Nickel (1975) points out, it is increasingly becoming clear that the research structure must deal with more than the usual various disciplines and individual commodities. It must deal with integrated farming systems. This is more so, (he continues) because developing countries are faced not merely with achieving increased production on nation-wide basis but also with achieving increased income for large numbers of small scale farmers.

Kenya is no exception to this. The 1970 - 83 National Development Plan lists productivity and income of small scale farmers as a major objective. To accomplish this objective, a change is needed in the current approach to the design of agricultural research and implementation of the resulting recommendations. As in most developing countries, there is a gap between recommendations and the needs and potentials of small scale farms. The Scientific Research Division (SRD) has incorporated farming systems economics in an effort to bridge the gap. Use of this multidisciplinary approach is anticipated to yield findings and recommendations that are more attuned to the target farming community, thus, more likely to have positive impact on small scale agriculture, than has been possible previously. This paper tries to show how farming systems economics has contributed to intercropping work with maize and beans.

Agronomic work had already established a number of technical advantages from intercropping systems. Thus, it was found to be relevant to evaluate alternatives in terms of economic criteria taking into account of the choices, constraints and objectives of the farmer. As a contribution to the multidisciplinary investigation into the comparative advantage between mono-crops and various forms of intercropping maize and beans, a series of pre-survey investigations were carried out in August - December 1978, in three bean growing areas of the country where the Project* conducts trials. These included Kisii and Kakamega in high potential areas and Machakos which is in the semi-arid area.

The objectives of the pre-surveys were threefold :-

i. To identify farm practices to be incorporated in future experimental programmes as treatment and non-treatment variables;

ii. To identify farm constraints that should be investigated further;

iii. To make a preliminary assessment of the economic benefits of mixed crops as compared to pure stand crops of maize and beans.

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* Grain Legume Project based at National Horticultural Research Station, Thika.

The pre-surveys consisted of informal farmer interviews and discussion with the extension authorities of the area. The findings from the pre-surveys contributed to the following season's trials by providing information on the farmers' management practices i.e. highlighting two aspects : What is done and Why done that way.

A trial was then designed in conjunction with an agronomist with the objectives of studying various mixed cropping systemsof maize and beans. The currently recommended system was compared with the farmers' system and with monocropping systems. Labour was found a very important constraint in most of the areas; thus labour was one of the items recorded.

MATERIALS AND METHODS.

Katumani maize variety (short maturity variety) and Mwezi moja (popular local short maturity bean) were used. The treatments were:-

A - Monocrop maize - 75 cm x 30 cm (44,000 plants/ha)

B - Mono crop beans - 50 cm x 10 cm (200,000 plants/ha)

C - Mixed maize and beans as recommended.

Maize - 75 cm x 30 cm (44,000 plants/ha)

Beans - 2 bean rows equidistant, 15 cm intrarow (178,000 plants/ha)

D - Close to traditional practise.

Maize - 200 cm x 40 cm (25,000 plants/ha)

Beans - 100 cm x 15 cm (40,000 plants/ha)

E - Higher population than traditional.

Maize - 100 cm x 25 cm (40,000 plants/ha)

Beans 1 100 cm x 15 cm (66,666 plants/ha)

The design used was completely randomized block; 5 treatments and 5 replicates. The plots were large (15m x 10 m) to prevent inflation of the labour coefficients. No fertilizer was used in the first season. Response to fertilizer has been negligible in the Dryland Farming Research Station, Katumani, as shown by previous project work (Mavua and Marimi, 1975). He showed that other conditions, particularly soil moisture and therefore, time of planting, are more important limiting factors. See tables 4a and 4b. In the following season fertilizer was applied despite the fact that it had been shown to be unprofitable. This was done in order to measure fertilizer application labour requirements and the expected negative effects of increasing weeding labour requirements.

The trial sites were clean weeded (2 weedings) and routine stalk borer control was carried out for maize.

The trials were conducted in three locations, namely, Katumani (Machakos), Kisii and Thika. The first is a semi-arid area, the second a high potential area and the third is in a medium potential area. The maize and bean varieties used were those appropriate for the areas, i.e., Mwezi moja bean for Katumani, Rosecoco (GLP-2) for Kisii and Canadian Wonder (GLP-24) for Thika. For this paper only data from Katumani is used and only preliminary results are available. Yield and labour requirements for the gross plots are recorded. In harvesting, each block is harvested per day, with an order that allows each treatment to have a chance of being the first to be harvested.

RESULT AND DISCUSSION.

Table 1 gives the labour requirements for various operations for the various systems while Table 2 gives the yields of maize and beans in kg per hectare.

TABLE 1. MEAN LABOUR INPUT IN VARIOUS SYSTEMS (Manhours)
Katumani Dryland Research Station.

System	Planting	1st weeding	2nd weeding	Thinning	Harvesting	Threshing	Total Mhrs/ 150m	MD/h
A	3.58	4.19	2.03	1.00	2.43	1.37	14.60	139
B	9.39	5.09	2.42	-	2.15	2.09	21.14	201
C	17.15	6.15	3.16	0.59	3.97	3.10	34.10	325
D	3.11	3.55	2.59	0.55	3.61	1.50	14.91	142
E	5.48	3.39	3.16	0.48	3.43	1.58	17.52	167

TABLE 2. MEAN YIELDS OF VARIOUS SYSTEMS (kg/ha).

SYSTEM	BEANS	MAIZE
A	-	4339
B	1723	-
C	768	3444
D	331	2800
E	371	3231
F_t	5.10 * significant	1.35 (NS)

KEY to Tables 2 and 3.

A - Purestand maize as recommended, 75 cm x 30 cm.

B - Purestand beans as recommended, 50 cm x 10 cm.

C - Maize and beans as recommended.

- Maize, 75 cm x 30 cm, and 2 bean rows equidistant, 15 cm intrarow.

D - Close to traditional practice maize, 100 cm x 40 cm and beans 100 cm x 25 cm.

E - Higher population than the traditional maize, 100 cm x 25 cm, and beans 100 cm x 15 cm.

DISCUSSION.

The data shows the recommended system C requires the highest amount of labour. However, the labour information is more usefully utilized when different operations requirements are considered rather than the total. Recommended system C takes 5 times as much planting labour as the farmers' system D. This system therefore might be a poor system if planting labour is critical. In this area, this turns out to be the case.

To get adequate yields, planting has to be done at the beginning of the rains for the beans to take advantage of the very undependable rain. The growing period is very short (Marimi 1975) making the time of planting very crucial. Figure 1 gives a twenty year average of weekly rainfall in Machakos. The rainfall is bimodal. The long rains lasting approximately three months (March, April, May) while short rains cover about 8 weeks (last week of October to third week of December). The long rains are followed by one almost completely dry period of 4 to 5 months. Period following short rains is not always dry. The marginality of the rains in this area is not due to the total amount in a season but, the length of the rainy season and predictability.

A change from system D to system C would mean a farmer who normally takes 3 days to plant a set area with maize and beans would take about 15 days ! Considering the importance of time of planting (not only maize and beans but also for the other crops), the only way the farmer can adopt this would be:-

i. Hire extra labour - is it available at this time ?
- Can he afford it ?
- Will it pay ?

ii. Reduce the area under this crop of maize and beans.
- Would the yields compensate for the yield from the unplanted area ?

To help make the decision more than just the cost of labour

should be considered. Table 3 gives mean yields and returns to the constraining factor planting labour.

Of the three intercropped systems, the returns to planting labour seems to be higher for system D (farmer's) and low for system C (recommended). A shift from D to C shows a 70 percent fall in the returns to planting labour while to E (slightly higher population than farmer's), show a 30 percent fall i.e. from 18/= to 5/= and 12/= respectively. Thelatter seems more attractive. The returns per unit of labour used is 12/=. Of course what the farmer considers as his opportunity cost for his labour (or his time) is an important factor. But the slight change to (E) from the existing system (D) seems more attractive for this area proving further, what De Groot * has found in his bean Density in maize work. His work shows a row of beans in between maize rows best fits this area.

TABLE 3. MEAN YIELDS AND RETURNS TO PLANTING LABOUR (KSH/MANHR).

System	Yield Maize	Yield Beans	Yield value (Ksh)	Yield value - seed cost (Ksh)	Returns/unit planting labour (Ksh/hr)
A	4339	-	4340	4290	17.90
B	-	1723	6030	5710	9.00
C	3444	768	6130	5800	5.00
D	2800	331	3960	3870	18.70
E	3231	371	4530	4380	12.40

Note :
- Price of maize taken as 1 ksh per kg.
- Price of beans taken as 3.50 ksh per kg.
- Price of maize seed - 3.50 ksh per kg i.e. 35/ 10 kg bag.
- Price of bean seed - as for consumption since no bean seed available in the market. 3.50 ksh/kg.
- Labour hiring at 10 ksh per manday (8 hours).
- Column (5) got from dividing (4) with planting labour requirement per ha (Table 1).
- Land Equivalent Ratios (L.E.R.) for C, D and E are 1.24, 0.84 and 0.96 respectively.

* De Groot was a member of the Grain Legume Project till June 1989.

The other alternative of reducing crop area, to be able to adopt system C seems feasible. System C gives the highest land equivalent ratio (L.E.R.). Table 3. This means, should land be a more constraining factor, this alternative is better. Such would be the case in Kisii where population density has been reported to be over 425 persons/sq. km.

Many reasons have been raised to explain failure to adopt improved methods developed by research at agricultural establishments. The practical problems of applying the results of research efforts to small-scale farming are manifold (Lever 1970). Instances have been quoted where results of research efforts although technically sound are treated as unacceptable by the small scale farmer (Edward, D. 1961).

In this case where a change to the recommended system calls for five times the planting labour, adoption might not be very rapid though the yields are higher (Table 2). Farmers have been shown to be conscious of the competition between work and leisure for the available time by Farrington, J. (1975) with Malawi cotton farmers. Seetisarn, M. (1976) says labour may become critical if a new cropping system requires shortening of certain operations, as might be in the above case.

Hatch (1976) feels research designed to deal with farmers' problems should benefit from the farmers expertise. The farmer knows more about why he does what he does than researchers do. We must put together what he knows with what we know. Anderson (1976) is of the same opinion. He stressed that perception of the environments in which the farmers operate and performance of alternative technologies in these environments is important in agricultural research geared to solve farmers' problems.

In Kenya, one of the objectives of introducing farming system economics in agricultural research was interpretation of research findings from the farmers point of view. What would it mean for a Machakos farmer to change from his low yielding system to the higher yielding recommended system of producing maize and beans ? As shown above, knowledge of his objectives and resource constraints - quantity andtime of availability is important. For labour, not only the quantity and qualtiy (sex, age, etc) but also, the time it is most in demand. The diagnostic survey for the area revealed labour to be a constraint in addition to the moisture availability. The fact that the recommended system tends to require too much labour at planting might be a shortcoming in adoption especially in this area where time of planting is crucial.

CONCLUSION

Effective research can be said to begin and start with the farmer. The small farmer is an important client for new technology developed for the purpose of increasing basic food production. Bartlett (1976) agrees the farmers are the customers for whatever results are generated. For products to sell, they must have what the customers need and be

tailored to fit with their conditions. This multidisciplinary approach combines the efforts of the disciplines, plant breeding, agronomy and economics meeting the common goal of raising the farmers productivity.

This paper hopes to show that labour whose availability had formally been taken for granted, can no longer be viewed in that light. It is gratifying that Hasselbach and Ndegwa (1980) have made a move to fit research to farmers conditions by considering labour peaks in the competative relationship work on maize-bean mixtures i.e. having farmers constraints (labour) in mind.

Food production will continue to be based on small-scale farms for a long time in Kenya. Farm size is decreasing with increase in family numbers (IRS 1977). As such, there is need to identify those constraints that hinder increased production in agriculture and bottlenecks in adoption of the developed technologies.

The technology discussed above is very promising (yield wise), the only constraint is planting labour as shown. Introduction of a simple, cheap planting device could probably remove the limitation to adoption of the recommended system. In fact, the limitation is only very real in the semi-arid area where the painting time is crucial.

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TABLE 4. YIELD RESPONSES OF KATUMANI MAIZE TO DIFFERENT LEVELS OF 20 - 20 - 0 FERTILIZER IN KG/HA.

Site : Katumani Dryland Research Station.

Treatment	0 kg	75 kg	150 kg	225 kg	300 kg	Average
Rep 1.	4981.80	5086.36	4972.73	4759.09	4377.25	4835.29
Rep 2.	4400.00	5095.46	4854.60	4277.27	4368.18	4599.10
Av.	4690.90	5090.01	4913.67	4518.18	4372.73	4717.20
Difference as % mean	12%		2%	11%	-	5%

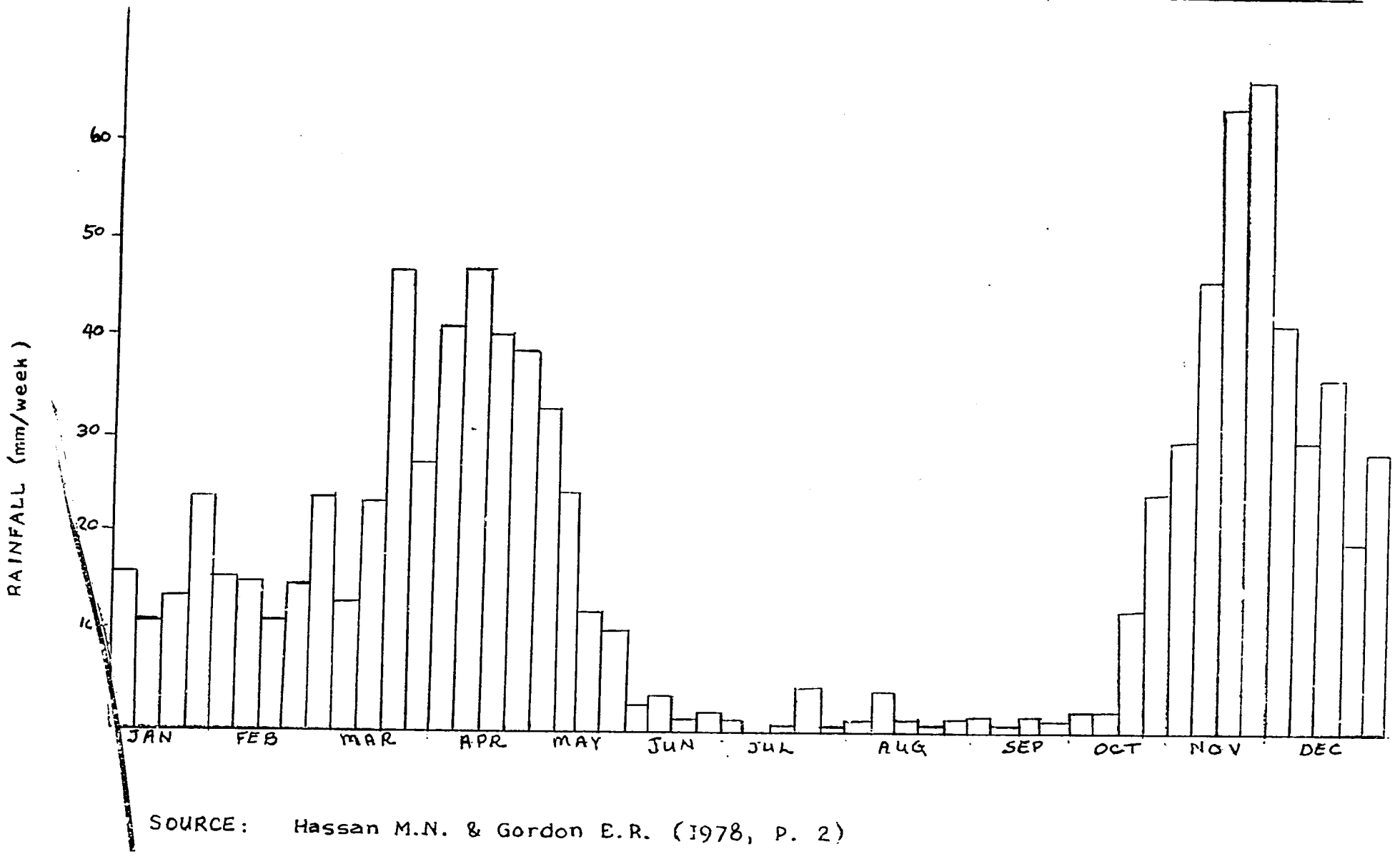
Source : Data from an experiment conducted at Katumani Research Station in Machakos by Mr. Mavua and D.Feldman.

TABLE 4 b. INCREMENTAL CHANGE IN YIELD AS PERCENTAGE OF AVERAGE YIELD BETWEEN TREATMENTS.

Treatments	0-75 kg	75-150 kg	150-225 kg	225-300 kg
Rep 1.	2%	- 2%	- 4%	- 8%
Rep 2.	15%	- 5%	- 13%	- 2%
Average.	8%	- 4%	- 8%	- 3%

Source : As above.

FIGURE I: TWENTY YEAR AVERAGE OF WEEKLY RAINFALL AT MACHAKOS WEATHER STATION.



SOURCE: Hassan M.N. & Gordon E.R. (1978, P. 2)