

FAMINE CRISES & INNOVATION:PHYSICAL AND SOCIAL FACTORS AFFECTING NEW CROP ADOPTIONSIN THE MARGINAL FARMING AREAS OF EASTERN KENYA

by

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This paper gives preliminary information from a study being done in the dry areas of Eastern Kenya, aimed at analyzing economic and social factors which affect agricultural innovation in marginal farming areas. In particular, we will begin from an aspect perceived by the people as being important, the likelihood of famine. The topic of food shortage will be used to draw together information on both the environments and on the cultures found in the area being studied. It will also give a focus to our discussion of government's extension services, which have been trying to introduce new crops suited to the special situation of marginal farmers. The disappointing response so far achieved will be documented and discussed, in terms of standard innovation theory and/or orthodox economic approaches to development problems. The data should make clear how important it is, when one is dealing with programs of directed social change, to keep the total socio-economic setting in the picture.

To date four strategically located communities have been studied, using standard small-scale social survey techniques. All four are located within the drier portions of Embu and Machakos Districts. They have been paired to facilitate comparisons, to include two WaKamba communities and two Embere communities, and within each culture to contrast a well established, central community with a peripheral community farming new lands. Their descriptive characteristics (amplified below) give rise to the naming scheme which will be used throughout this paper: a) Central Machakos, b) New Machakos, c) Central Embere, d) New Embere. The distinguishing features of each community are:

(a) Central Machakos: A long-settled sub-location within central Machakos, chosen for its typicality to the conditions of lower Machakos, and because it has been the basic testing ground for the development of new, quick maturing varieties of "Katumani Maize." The sub-location also borders on the area sampled in Judith Hoyer's earlier study (to be reviewed later).

(b) New Machakos: A small community of immigrant WaKamba, who until 1967 did not hold rights to the land they cultivated, and who have evolved a unique system of agricultural exploitation of their environment. The system entails a high proportion of female labourers in the total community of 400 adults.

(c) Central Embere: A long-settled area within central Embere, again chosen for its typicality and to take advantage of other survey work which had already been done in the vicinity.

(d) New Mberere: A small community on the periphery of Mberere, where a local development scheme (since discontinued) led to a recent concentration of farmers around a water furrow.

Within these four communities some 133 Household Heads have been interviewed, and it is hoped to extend these samples as the study progresses. This paper is meant as only a very tentative discussion of the first two seasons' results; a full presentation of field data in more systematic form must wait the completion of further fieldwork, and the machine processing of the long interview questionnaires which were used (1).

I. THE NATURE OF THE PROBLEM

1. The Physical Background

Traditionally, the problems of farming in dry lands are seen to be mainly environmental in origin. The low rainfall, the severe effects of thundershowers on the bare ground, the infertility of soils derived from an old basement complex--these are causes commonly given for the chronic famines which have been experienced traditionally in the drier areas of East Africa. This view is being increasingly challenged, (2) and we shall see several ways wherein the social contexts of modern farming accentuate the problem. Nevertheless, for descriptive purposes it seems logical to begin with the physical and ecological factors.

As one moves out from Mt. Kenya into the lower areas, a boundary is reached between the volcanically derived soils and the older soils derived from the basement complex of irregularly banded migmatitic gneiss and granitoid gneiss. Three of the four communities lie beyond this boundary, so that they show the typical free draining red loams so characteristic of red zones. Especially in Mberere, the soils tend to be lateritic and gravelly. This is the area where Government has had to devote most of its efforts since the thirties to soil erosion control and famine alleviation, where in the 1950s the ALDEV "mangalata" (Kikamba for "eroded, bare") soil conservation campaigns were waged (3). Originally an area of acacia, comiphora bushland, the land has come under more exploitive cultivation as population pressure has grown. It is probable that the indigenous system of shifting cultivation had broken down as much as twenty or more years ago in many areas. Today the soils are extremely deficient in nitrogen, potassium, and phosphates. According to field estimates, one acre may require over five tons of farmyard manure in order to initiate response to fertilizer use:

(1) Field research in 1966 and 1967 which has been a part of a larger research design on Agricultural Innovation in Embu District. E.R. Watts, Miss J. Mills, and J.R. Morris have been conducting the research in the upper, "high potential" areas of the District.

(2) Cf. A. Mascarenhas, "Aspects of Food Shortages in Tanganyika (1925-45)," U.E.A. Social Science Conference Paper No. 447, January 1967.

(3) Well described in the Ministry of Agriculture publication, African Land Development in Kenya, 1946 - 1962.

There is one exception to this picture of declining soil fertility, the community listed as "New Machakos". Here, where the village lies on flat, slow draining plains, the soils are possibly Montmorillonitic; their retention of water far into the dry season is one of the village's chief assets.

But the factor of most immediate concern to the people is rainfall. We can list the main problems under three sub-headings:

(a) Low rainfall: Ranging from 23 inches per annum to 32 for all parts, the low rainfall totals per year are coupled with extremely high evapotranspiration and with high runoff.

(b) Poorly distributed rainfall: The fact that some effective rainfall is received in six months of the year is misleading; when the distribution by month and by week is looked at, the lack of rainfall adequate to sustain crops becomes more apparent. For example, in lowland Machakos the total yearly rainfall occurs within 50 to 80 days. Actual figures for one year are given below: (no. of days effective rainfall listed below per month)

| Short Rains Season | | | | Long Rains Season | | | |
|-------------------------------------|---------|--------|--------|-------------------|---------|--------|------|
| OCT. | NOV. | DEC. | JAN. | MARCH | APRIL | MAY | JUNE |
| 3.06" | 8.76" | 2.57" | 0.46" | 0.50" | 2.23" | 0.92" | 0.0 |
| 11 days | 14 days | 4 days | 5 days | 4 days | 10 days | 6 days | |
| (Days per month on which it rained) | | | | | | | |

It should be noted that the crops planted during the long rains season above failed. The general picture is given in Appendix I, a probability table from which the likelihood of crop failures can be calculated. In spite of the example above, it can be seen from the table that on the whole the long rains are the more reliable--an estimate with which farmers (4) concur when discussing the risks associated with their farming system.

(c) Secondary effects of long dry seasons: The actual length of the dry spell can become very long indeed, if two or three consecutive seasons should fail. In these instances the water tables are drastically lowered, even making it difficult to rely on the usual sand wells in river basins. With the failure of crops, per se, can come as well failure of water supplies first for stock and then for people, the failure of grazing, and so forth.

The actual occurrence of a food shortage is, of course, not just a matter of the environment; it is the combined result of a given system of technology, a set of social and economic institutions governing storage and distribution, and the particular pattern of a given season's rainfall. On the whole, however, given the situation where an agricultural people are forced by population pressure to exploit an environment where rainfall cannot always supply their needs, the rainfall pattern must be listed as the immediate cause of most food shortages, even though the impact and severity of the shortage is affected by other factors. Dowker's estimate, from the forementioned rainfall probability tables, that food shortages could be expected once every three years, seems to agree with historical accounts. Between the 1860s and 1965 the WaKamba and the Mbere have experienced twelve or so serious famines, all of which old farmers can recount with a history of family members died, members who migrated to Kikuyu, etc. In the same period there have been over twice as many less significant times of food shortage which did not reach famine proportions.

2. The Socio-Economic Background

The influence of social and economic factors on food shortages can be seen most easily in the concept of a balance required between labour demands and energy supplies. From the accompanying table overleaf, the spacing of seasonal activities can be traced against the likely food supplies. In the peak periods of energy demand, e.g., May and November, people will usually have some maize left but the bean supply will have ended. Pastures are normally dry by May, and tend to be overgrazed between May and October so that milk supplies drop sharply. No wild green vegetables are available. The period from November to March is especially difficult if the short rains have not been adequate. The Christmas season brings family pressures for new clothes, and it is the season when families will use sugared coffee or tea, bread, rice and meat--luxuries which have a high prestige value. There are childrens' parties between December 24th. and January 2nd. when they go wild in "zawadi parades" to show their presents in local shops and Sunday School competitions (even non-Christians join in). On top of these cash demands are those for hiring ploughs, tractors, or labourers to open land for the new season. Since the food from the farm usually lasts from June to about September, the heavy Christmas expenditures coincide with the period when the family will anyway need to use their cash reserves to purchase ordinary food. If for any reason the short rains crop fails, families may have exhausted the savings needed to prepare for the new cropping season, and the months from February to June will be grim indeed.

The first effects of a food shortage are seen in the economic sphere: the sale of poultry by women and children, the illicit sale of stored grain, glut in the livestock markets, lowered prices of sand in the river beds, a ready supply of casual labour, and, of course, depletion of any cash savings.

If extended, the dry period alters also the fabric of social life. This can be heard in the songs of women as they communally thresh millet, songs inherited from one year to the next. Some of the evils mentioned in those songs as going along with famine are:

- (a) Wife beating and family quarrels by the husband, often leading to the breakup of a nuclear family,
- (b) Men migrate to other areas, and the women and children are left behind helpless,
- (c) Increase in a particular type of juvenile delinquency, called "Mbulili",
- (d) Farms and fields are abandoned, as homesteads retrace,
- (e) Women, even mothers with four or five children, leave their homes and may marry whoever can provide them with food (it is interesting that in Mberu where conditions are most harsh over 60% of the farmers have had one or more divorces).

TABLE I REPRESENTATIVE APPROXIMATION OF ENERGY DEMAND IN RELATION TO ENERGY RESERVES

| MONTH | ENERGY DEMAND | FARM LABOUR NEEDS | SEASON | FARM SUPPLY OF FOOD ENERGY | MONTH |
|-------|----------------|---|---------------------------------|----------------------------|--------|
| Jan. | Medium | Harvesting Beans Feeding maize, cotton | Short Season | Poor | Jan. |
| Feb. | High Medium | Finish harvesting beans. Harvesting & threshing millets. Harvest maize Feed Livestock with straw | Long Season 'Less reliable' | Medium | Feb. |
| March | Low High | Clean field Ploughing and planting maize, beans, sweet potatoes | | Good | March. |
| April | | Spray cotton, Weeding spraying cotton | | Good | April |
| May | Medium | Picking and grading cotton | | Poor | May |
| June | Medium | Harvesting beans | Dry cold season | Poor | June |
| July | Medium to Low | Picking & grading cotton Harvesting Maize | | Medium Medium | July |
| Aug. | | Harvesting pigeon peas | Hot Dry season | Medium | Aug. |
| Sept. | Low | | | | Sept. |
| Oct. | High | Ploughing Planting cotton, maize pulses & millets | Short Season 'More reliable' | Poor Poor | |
| Nov. | High | Millets Weeding cotton food crops | | Poor | Nov. |
| Dec. | Medium | Scaring birds from millets | | | Dec. |

Alongside one must remember the normal physical consequences of food shortage: the increases in the rates and seriousness of diseases, the reduced ability of people to perform hard physical labour, and so forth. The nutritional stress is hardest upon those who can least afford it, the pregnant or lactating mothers, the infants, the sick, and the aged.

Traditionally, therefore, the people showed a psychological association between any possible causes of rain failures and subsequent famine. When anything new happened, the people thought it would prevent rain from coming. Lindblom (an anthropologist who studied the WaKamba in the early part of this century) tells how when the railway first came it was called, "the black rope across our land," "the black snake," etc. The people then offered sacrifices, as they thought that the building of the railway would stop the rains. Even today, taking an oath at certain times of the year, or putting "kithangona" (a buried charm), are still thought to be dangerous in this respect. The logic given is that this is trifling with God, the Maker of rain, who can be angered.

Here perhaps one has a functional explanation for the motivations which underlie the various traditional agricultural rituals. The Akamba, Mberu, and Kikuyu all recognize the presence of spirits of their ancestors, "aimu". The concept of "aimu" is varied, but in general it means that the ancestors have close contact with the living, that they could give friendly warnings through witchdoctors, or special people, or by possession at specific dances like the "Kilumi." The aimu expect constant attention from their living relatives, usually through sacrifices under Migumo trees (rain shrines) in secluded areas, or through food sprinkled on the ground before eating. Inattention from the living elders, or the contravention of certain ritual prescriptions, was thought to bring down their anger. If purification did not follow, disaster would befall the individuals through the loss of crops, of soil fertility, the death of herds or children, or the failure of rains. As put by Lindblom, "In a poorly watered country such as Ukambani, with its recurring droughts-- they have unfortunately all too often great reason for offering sacrifices for rain." (See Lindblom further for a long list of items which could be contravened and so bring misfortune upon the family, lineage, or villoge.)

Another area of traditional concern, the high value placed upon livestock in WaKamba life, could also be related to the role of cattle and smallstock as a reserve store of value to tide the family over the lean seasons. In part, this was simply a very practical means of security. It appears that women from the plains established partners on the hills--the better watered areas most likely to have extra food--usually but not always with affinal relatives. These partners from the lowlands would send milk to their hill

partners in exchange for equivalent fruits, vegetables, sugar cane and green maize. The articles change with the seasons, but in times of scarcity a partner may get free articles with the implicit understanding that this would be reciprocal in the future. (It is hoped to give more study to this relationship in further fieldwork.) By this means one's relatives by marriage were brought into the family's security network, since these would be the ones most likely placed in a different environment.

Even today the high value put on livestock can be traced in peoples proverbs and in their aspirations. Asked the question, "Let us suppose a farmer has harvested crops and after selling them and paying all his debts and school fees, he has left a balance. What would he do with this extra money?" farmers answered as follows:

| | Mbere Central | Mbere New | Machakos New | Machakos Central |
|--|---------------|-----------|--------------|------------------|
| Put in Bank | 32 | 10 | 66 | 35 |
| Buy cattle | 8 | 45 | 27 | 25 |
| Bury it | 12 | 15 | 4 | 12 |
| Mis.: pay tax, buy clothes, food, family | 44 | 0 | 0 | 20 |
| Never get extra | 4 | 30 | 0 | 8 |

LABOUR MIGRATION

% Males working Outside

Machakos Central

65%

Mbere Central

57%

In the two scheme areas movements to work outside was 34% in New Mbere and 8%* in Immigrant Machakos. The traditional areas therefore show a higher labour migration than the scheme areas.

The table gives indication that even though most people cannot now hope to have many cattle, livestock are still highly valued. It could be argued that the fragmentation of the traditional communal grazing grounds, and the loss of cattle as a store of surplus value, leaves the community more vulnerable to famine now than it was traditionally.

A similar pattern emerges with respect to land. Under circumstances of substantial labour migration--made necessary in order to find the money to survive the dry spells--the elders are left with greater de facto control over farm households. Yet those away also have a stake in maintaining the traditional land rights (against any who might want to change them), since it is only by this means that they can sustain their own claims while absent. The overall attitudes towards land and investment are therefore conservative ones, which do not encourage the younger, more progressive men in the community to develop agricultural solutions to the problems of the environmental limitations. This can even be seen in the attitudes towards education, looked upon as an escape and as a protection from outside forces bent on change, and in the institutions for raising capital funds among women's groups.

* The male population in New Machakos had increased from 430 in 1966 to 520 in 1967.

II. SOME SOLUTIONS

When files in the District Agricultural Offices show that famine relief measures of one sort or another have had to be mounted almost one out of every three years--either in the October to March period, or from May to June--it is not surprising that the problem has been a major departmental concern over the years. The area has a long history of sporadic ad hoc campaigns, mainly of a rather coercive nature. There have been anti-goat campaigns, compost making campaigns, latrine digging campaigns, communal dam making campaigns, communal terracing campaigns, and even compulsory de-stocking campaigns. Since these are discussed elsewhere for Lower Embu by E.R. Watts, I will merely summarize the history of previous "extension" efforts in table form. (see Annex)

On the more positive side, two main strategies have been followed: i) capital works programs, such as the ALDEV supplied rural water storage dams and irrigation furrows, and ii) the introduction of new cash and food crop enterprises to the farming system. (A third main approach, that of land registration, has not yet been applied to all four of the case communities.) Discussion will be limited to the strategy of new crop introduction, since this is the aspect of current extension programs where innovation theory and farm management analysis have most to offer. In particular, we will discuss the adoption of a new food crop--Katumani maize--in comparison (more briefly) to alternative new cash crops, cotton and tobacco. First, however, a brief review of the other cash-earning farm enterprises is necessary to make clear the lack of any viable perennial high value cash crop.

1. Other Cash Enterprises

Sisal used to be the "lifeline" of the dry areas, and so it deserves first mention. But over the years prices to the farmer have fluctuated, and recently (last June) have fallen to the lowest mark yet, 25 cts. per lb. The Machakos sisal factory closed a few years ago, and since then farmers have been unable to sell their sisal through normal channels. In Mberere buying has also fallen off, and the Meka sisal factory--the remains of a Ministry sponsored sisal out-grower's scheme--faces closure because the factory site lies below the water level for the new Tana River dam at Kindaruna. The current prices are so low that no farmer is prepared to decorticate it. Where there is no other source of cash, a wife and her children may decorticate sisal in the afternoons by hand, wash it and dry it. In the morning it will be sold for food. A family of five could do five pounds and at 50 cts./lb. this would be enough for seven lbs. of flour and 40 cts. of milk, two meals' worth, or, alternatively, buy five lbs. maize and two lbs. beans also for two meals. At 25 cts./lb. it is not worth the very hard work. There may also be a shortage of water for washing the fibres, and these days a scarcity of hedge sisal. All of which makes sisal an unsatisfactory source of cash except in the worst emergency.

The expansion of dairying by introducing grade animals for milk production, while potentially feasible, is currently limited by the availability of water, the poor pastures, and the inadequate disease control. In the lower areas, it is not a likely innovation for mass diffusion as the local market for milk is reduced by the continuing presence of large herds of local Zebu.

Under the ALDEV Schemes, several ranching areas were set up, and owner's co-operatives eventually organized. As an alternative open to small farmers, ranching is constrained by the farm unit sizes, and it has not succeeded even where acreages are larger and many cattle present as in Mberc, Riakanau, and Kitui. Today formal ranching, as such, is limited to a few co-operatives in Machakos. None of the farmers in the sample areas held any shares in the

Livestock trading is, however, practised within the survey area. This tends to be a non-farm activity, though local cattle traders may rest their animals en route on their home farms. Trading requires some initial capital, and it is limited to very few licensed traders. Quarantine regulations greatly frustrate the movement of stock, and reduce the attractiveness of the enterprise.

Fresh fruit and vegetables could become important in the future. At present, the growing of bananas, mangoes, pawpaws, and pineapples is not economic because of the lack of organized marketing. Vegetable growing is limited to river valley bottoms, though in one community farmers are making money through the dry growing of tomatoes and chillies.

The profitability and characteristics of local dukas and small business enterprises will not be examined in this paper, but it should be noted that the duality of farming and duka trade is a common pattern in the areas studied.

None of these alternatives offer sufficient promise to the small farmer to be considered a "solution" to the food shortage problem, so that the extension services are treating Katumani maize, cotton, and tobacco as the only viable new introductions at the moment.

2. Tobacco

Tobacco was introduced into the area through a privately organized extension campaign run by the B.A.T. Company, and located in Mberc Central. From 1954 to 1962 farmers were supplied with seedlings from BAT nurseries, to be grown in their fields and then sold as green leaf to the BAT factory. This was a relatively simple process. As cotton had not yet appeared as a competitive crop, farmers found it easy to grow the half-acre required.

In 1962, a "Master Grower" system was introduced, as a part of a general reorganization of tobacco extension. Farmers were now expected to look after their own nurseries, to grow the crop, to cure it, and to sell the cured leaf to the BAT factory. Sample costs and returns per acre are given in the accompanying table, as given by the BAT office. The BAT gave loans to cover the capital costs of curing barns, but the increased operating costs were born by the farmers. The dramatic decrease in overall acreages and numbers of participating farmers is shown on the chart (Appendix III.)

The full story of why tobacco has failed to hold its own as a cash crop is not yet clear from field research done to date. It may be noted that the crop is being expanded in other parts of Kenya by BAT at the very time that operations in Mberere Central were being severely retrenched, and that peasant producers elsewhere in East Africa grow the crop successfully. At the moment, it is no longer a feasible possibility for most illiterate and poor farmers within Mberere Central, and only the relatively advanced and well-to-do farmers have been able to retain their status as "Master Farmers." Since the crop is confined to this one community out of those in the survey, we will not consider it further here.

3. Cotton

We are left with two main solutions to the small farmer's need for food and cash, both ones competitive in the drier environments of lower Machakos and Embu. The farmers' awareness of both is excellent by now, so that the problem is one of securing widespread adoption. On the practical side, the contrast is interesting because both crops are similar in the wide variation of yields obtained according to husbandry standards, and in their need^{for}/skilled handling and supplementary purchased inputs. On the organizational side, the contrast is between specialized responsibility for cash crop extension-- cotton is supervised by the Cotton Lint & Seed Marketing Board-- and the general agricultural extension services, which supervise Katumani introduction. On the theoretical side, the farmers' actual choices between cotton and Katumani give scope for testing the applicability of a linear programming approach to farm management decisions.

Cotton has been reintroduced into the survey area with much high powered publicity. Few of the civil servants and politicians who now favour it publicly as a money earner are aware that, for farmers, this is a crop which was once tried and which failed. It was originally introduced in the years between 1936 and 1942. Government's emphasis was upon marketing, but a final site for the ginners was never agreed upon. Disease, pest control, and the whole complex of husbandry and marketing activities were ignored. Farmers were viewed

TOBACCO COSTINGS

| | |
|--|-------------|
| SEED BED - 4 x 60 ft. - for 1 acre planting | |
| Labour - 1 permanent man for 6 weeks for watering @ 100/- month = 150/- | |
| Fertilizing, D.D. Fumigant, Aldrin | 8.35 |
| seed - free | |
| 1 acre plot ploughing | 66/- |
| Rent on land (Hiring terms)/yr. | 100/- |
| Planting out | 16/- |
| Ridging | 0/- |
| Fumigating(optional?) | 105/- |
| Fertilizing NPK Compound | 135/- |
| Labour for fumigant | 20/- |
| Weeding, topping, de suckering for 3 months - 2 permanent men | 360/- |
| Harvesting, transport, 6 harvests over 3 months 48m/days @ 2/50/man day | 120/- |
| Wrapping material | <u>30/-</u> |
| | 1,082/- |
| Fixed cost Burn 900/- | |
| Watering can 15/- | |
| Thermometer ? | |

| Average | Year | Gross Returns per acre | |
|-------------------------|------|------------------------|-------|
| | | Best | Worst |
| Variable Costs | 1964 | 1899/85 | 69. |
| Average at 800 - 1082/- | 1965 | 2119/20 | 6.75 |
| | 1966 | 3360/70 | 25.00 |
| | 1967 | 2036/28 | 15. |

as having a "natural desire for cash." As a consequence, quality degenerated drastically and production declined year by year. As it was put to me by a trader in Machakos Township, "It died a natural death."

Today, however, cotton is once more being urged upon lowland farmers. The Plan calls for increases in production between 1963/64 and 1969/70 of the following orders:

(In '000 lb. of Seed cotton)

| | | |
|----------------------|---------------|-----------------------|
| Embu District..... | From 13 | To 6,530 ⁺ |
| Machakos District... | " 802 | " 13,070 |

⁺Including estimated production for Meru, which in 63/64 was nil.
Figures from Appendix 12, p. 368, the Development Plan 1966 - 1970.

The success of cotton as a crop depends critically on early planting, early and frequent weeding, well timed spraying, skilled and frequent picking, and skilled grading. It is especially important that insect pests be controlled. The current price is 48 cts. per lb. for the best grade, and 23 cts. for the remainder (AR & BR). Late picking pushes cotton to the lower grade, due to fungal growth and bleaching, as does the influence of drought. Profitability of the crop is then cut by half at the least, if not by more. It is no wonder that farmers in Mbere Central and Mbere New were getting a total return in the range of from one to fifteen shillings! The problems of the crop in years of drought are shown in the Mbere Division crop figures for the last three years:

| <u>Year</u> | <u>Acreage</u> |
|--------------|----------------|
| 1964/65..... | 850 |
| 1965/66..... | 217 |
| 1966/67..... | 945 |

Source: Divisional Agricultural Files, July 1967.

Of course, drought equally complicates the arrangements made by the departmental and Board extension staff. In the last season just come to maturity, for example, the long dry spell from January to the end of March (the onset of the rains was delayed by two weeks) seemed to destroy the chance for a normal crop in the whole of Lower Embu. The effects were so apparent that some farmers were found in the field who even uprooted their immature cotton to make room for the long rains food crops, and the department cancelled its request for loan funds to cover the crop. Then, to the amazement of all concerned, the crop revived under the unusually heavy rainfall of the long rains season, and farmers began to put forward a large number of requests for cotton loans. (1)

Difficulties of these kinds have lead to a shift in policy away from small individually farmed plots (of between .3 and 1 acre each) towards communally farmed block cultivation. The idea behind block cultivation is familiar from elsewhere in East Africa--to concentrate cotton growing in

(1) From field interviews by J.R. Morris, Embu District offices.

specific areas where an extension officer can supervise the crop closely--with an added twist that the crop may be sprayed by aeroplane!

Because farmers do not have capital to cultivate on this scale (ploughing by Ministry arranged services costs 50 - 60/-^{per} acre, dust or spraying 160 sh per acre) a system of crop loans was introduced with accompanying rules:

- (a) The extension officer will organize and supervise contract ploughing, communal weeding, and spraying.
- (b) A pulse crop (green grams or Mexican 142 beans) should be planted first on the new land before a cotton crop is grown.
- (c) The Cotton Seed and Lint Marketing Board will deduct 75/- per acre from the proceeds of either pulse crops or cotton, to pay for the initial loan. The marketing of any crop grown in the block must therefore pass through the Board's agents.

In fact, many of the farmers who planted the 1965/66 crop circumvented this rule by planting both maize and ordinary beans as the first crop. Since the combination could be used for food or ^{could be} marketed privately, the Board could not reclaim its loans directly. Thus many farmers from the 1965/66 season successfully sidestepped the Board's agents to sell the non-cotton crops privately; then drought hit the succeeding 1966/67 cotton crop in Mberu Central and very little was actually sold. The high rate of loan defaulting brought joint action by the Board's agents, by the Ministry of Agriculture, and by the administration, and stern measures were planned for the 1966/67 crop. The failure of that crop now means that farmers are more or less being forced to continue growing cotton to meet an ever growing debt load. In the face of considerable pressure, some farmers now simply refuse to grow cotton at all. As one farmer said, "I will never join a cotton block or get a loan. It is like when Bwana Silota (the European) was rounding us up for dam construction." It is at least apparent that the rather ambitious Plan targets for cotton production will not be met easily. If the targets must be met, policy will return dangerously close to the old traditions of coercive control which for so long characterized the colonial Government's approaches to the marginal farming areas.

4. Katumani Maize

Against the foregoing rather gloomy background, the case for Katumani maize at first seems unusually promising. Kenya's energetic programs of maize improvement are gaining the country international recognition as one of the few where productivity increases through varietal selection have rivalled those which have been achieved by "developed" nations. For example, one observer recently classified Kenya's programs alongside the Rockefeller programs in Mexico and the Phillipines as "a striking illustration of the general improve-

ment that is possible when other technological requirements are met"⁽¹⁾. This praise echoes that of Johnston and Nielson earlier:

A striking example has been reported by the plant breeder at the Kakamega experimental farm in Kenya. A synthetic hybrid corn grown on African farms, with careful supervision of seedbed preparation, fertilizer application, and other operations, gave yields of 140 bushels of maize to the acre, in the order of eight times as high as typical yields in the area (2).

Indeed, although Katumani cannot match the yields of the new hybrid varieties in their high potential environments, the story of its development is just as exciting. For many years the breeding strategy adopted by agronomists for the dry areas has been to select for drought resistant varieties of maize, and to compare yields with those obtained from sorghum as the indigenous alternative crop. Some successes were attained, but by and large the plant breeders never succeeded in finding a maize variety which would consistently outperform sorghum in both good and bad years. More recently, however, an imaginative strategy was adopted which took better account of the rainfall distribution. Breeding was concentrated upon finding varieties which could escape the drought by early maturity. Beginning from a quick maize Taboran from Tanzania (which had performed well in bad seasons, coming to maturity in 124 days), a program was initiated to build up self-propagating "Synthetic" varieties which could match the best yields of local maize in good years. The successful candidate was bred at the Katumani Research Station Farm, whence the name, and was released to farmers in the marketplaces for trial in 1963 as "Katumani Maize II." (The further breeding history of Katumani is complex and will be reviewed elsewhere.) The Kenya Seed Co. took over the final bulking of seed, and a mass extension program was started through a large number of supervised demonstration plots. (3)

The enthusiasm of the Government over Katumani maize can be better understood against the background of Kenya's geography. About 80% of the land surface receives less than 25" - 30" of rainfall per year. Living in this marginal environment are roughly 1 1/2 million people, or 17% of Kenya's total population. If livestock improvement will necessitate destocking and grazing controls in much of this area, the food needs of an increasing population must be met largely from more efficient agricultural exploitation of the marginal farming areas. Yet it is these very areas which are already plagued by the kind of recurring food shortages we have discussed.

(1) Sprague, G. L. "Agricultural Production in the Developing Countries." Science, vol. 157, no. 3799, pp. 774 - 778.

(2) Johnston, R. & S. Nielson. "Agricultural and Structural Transformation in a Developing Economy." Econ. Dev. & Culture Change, vol. 14, no. 3, pp. 279 - 301; p. 292.

(3) From the Katumani Research Station reports.

Like cotton, Katumani requires careful husbandry if it is to be grown successfully in the lower areas. The following essential practices were presented together as a package, which farmers were urged to adopt all at once:

- (a) row planting at a spacing of 3 x 1 feet, measured by string.
- (b) use of fertilizers and DDT (DDT to control stalk borer).
- (c) early and frequent weeding, three or four times per crop.
- (d) careful harvesting and recording.

Because of its early maturing characteristics, Katumani is unusually dependent upon early planting and fertilizer application; at the research station, even a three day delay in planting after the rains began "made a great deal of difference." These differences are well illustrated in the yields from 1965, when the Katumani Research Station managed to obtain a harvest with only 5" of rain, while at Tseikuru with 15" the Katumani maize failed. For all these reasons, Katumani gives us an excellent example for study in terms of innovation theory, since so much of its success hinges upon the diffusion of a whole package of new husbandry ideas.

The departments which were involved in the field extension campaigns were the District administration, the Agricultural Department, and Community Development. Agents were appointed by the Agriculture Department in co-operation with the administration; the Information Department got out publicity; and the chiefs were used to round up farmers for barazas. Initially, free seed for the first acre was issued. Farmers who wished to establish demonstration plots received also free fertilizer and free DDT dust.

After the initial enthusiasm waned, and it became necessary to extend the program to the less co-operative farmers, the establishment and maintenance of demonstration plots became the yardstick for measuring agricultural staff effort. (These records noting the fertilizer and DDT use for each plot continue to be kept carefully even today.) Demonstration plots became an end in itself to agricultural staff. Chiefs and headmen included the numbers of demonstration plots in their area in their reports. Farmers were quick to see that these one acre replications of the research station techniques were being taken very seriously by Government. The consequences can be seen in the two following tables, the first of %s of farmers growing Katumani and the acreage grown by each in relation to the total farm maize acreage, and the second a % breakdown for each of the package practices.

Of course, these are only tentative results. They will be much amplified when all the data has been processed. But certain conclusions already emerge. From the data given in the two tables it would appear that:

1. HIGH DEGREE OF PARTIAL ADOPTION OF INNOVATIONS

This is clearly seen with respect to the adoption of Katumani as shown in the table

| | % of Farmers Growing Maize | | % Growing Katumani | | Katumani Acreage as % of total acreage | | Yearly Maize |
|------------------|----------------------------|------|--------------------|------|--|------|--------------------|
| | 1966 | 1967 | 1966 | 1967 | 1966 | 1967 | |
| Mbere Central | 100 | 100 | 80 | 90 | 28 | 30 | H ₄ =45 |
| Immig. Machakos | 100 | 100 | 60 | 90 | 13 | 25 | N ₅ =32 |
| Machakos Central | 100 | - | 76 | - | 26 | - | N ₂ =25 |
| Mbere New | 100 | - | 100 | - | 66 | - | N ₃ =27 |

PACKAGE PRACTICES:

| | Plant 1966 | Early 1967 | Pure Stand 1966 | Stand 1967 | In Rows 1966 | Rows 1967 | Use Fertilizer | | Weed 1966 | Early 1967 | Increase Acreage | |
|------------|------------|------------|-----------------|------------|--------------|-----------|----------------|------|-----------|------------|------------------|------|
| | | | | | | | 1966 | 1967 | | | 1966 | 1967 |
| Machakos B | 80 | 100 | 20 | 10 | 63 | 40 | 0 | 40 | 60 | 20 | - | 90 |
| Mbere A | 76 | 80 | 8 | 10 | 52 | 40 | ? | 65 | 80 | 60 | - | 65 |
| Machakos A | 76 | - | 40 | - | 52 | - | 20 | - | 88 | - | - | - |
| Mbere B | 95 | - | 24 | - | 50 | - | 10 | - | 90 | - | 15 | - |

* Not among the package practices.

- (a) The rate of diffusion has been very good. Katumani was first given out to farmers around Machakos in 1963, but by 1966 we find that the % of farmers growing some Katumani is between 60 and 100% in all four communities. Further, the community with 100% is Mberu New, the most physically isolated and distant from the Machakos area where Katumani originated.
- (b) The high % of adoption can be quite misleading of the farmers' actual commitment to it as a crop. With the outstanding exception of Mberu New, Katumani does not yet constitute one third of the total maize grown. These figures would indicate that in at least three of the four communities, Katumani maize is still "on trial" so to speak, and complete "adoption" has not yet been reached.
- (c) Of the practices which do not require cash finance (as fertilizer does), the farmers seem more easily convinced to plant and weed early, and to plant in rows, than they do to plant Katumani in pure stands.

These indications from the field that the battle is not yet over are borne out by interviews with the farmers. The most significant point which is not adequately shown by the tables is that many practices which have been adopted for Katumani were also adopted for longer term maize varieties. In the absence of fertilizers, such practices would increase the competitiveness of the other varieties against the drought escaping varieties.

Also, many of the farmers choose only one or two practices--mainly early planting and weeding--and expect good harvests. While these practices on their own ensure some harvest, they may not yield the high level of productivity which keeps Katumani competitive with its rivals in the good years.

Many farmers admitted using the practices only on a very limited scale, e.g., on one plot or on an acre subdivided from the rest of the farm, in order to keep the extension staff happy and to have something to show neighbours.

The high incidence of row planting is due to the use of oxen and tractors in planting, rather than being a result of extension staff efforts. In a few areas (bordering Upper Embu) farmers were told an incorrect method of fertilizer placement to accompany Katumani, with the result that seeds were placed directly on top and thereby "burned" to slow germination.⁽¹⁾ Again, it is possible that the continuation of intercropping of Katumani with beans reflects the farmers' rational adjustment to the risks of a very bad drought, so they will at least be able to salvage some food from their crop.

It can be seen that data on the responsiveness or resistance of farmers to new campaigns can be very useful. As far as the marginal farming areas are concerned, it suggests that the high adoption rates sometimes found at first may conceal the reality of many partial adoptions and of the short life of innovations which are taken up. It is hoped that further study of the situation may suggest ways to keep the current cotton and Katumani campaigns from going the way of the anti-goat and terrace building campaigns of the past.

(1) Suggested by J.R. Moris from his interviews near Embu town.

Section 3 - Concluding Chapter

Approaches to Problems of Agricultural Development

A. THE ORTHODOX APPROACH

As seen earlier the paper deals with a study of directed change in the overall National effort to effect economic development. While this implies that the study must base its conceptual models on modern economic theory, it is realised that this may not be sufficient. Economists in developing countries realise that modern economic theory was written by and tailored for developed countries and the particular models may have to be modified drastically for use in Africa. For example:-

- (a) Modern economic theory tends to be narrow and tends to overlook social and political influences on economic development of individual countries. The recognition of scarce resources, the mobilization of these resources, and their allocation to competing enterprises, either at national or regional level, depends very largely on the political and hence the Bureaucratic structure; for example Tanzania's and Kenya's present development strategies.
- (b) Economic theory does not fully describe the absence or presence of slow rate of development - that is it does not fully analyse the presence of disproportionate or heterogenous factors of production and the consequences of alternative policies e.g. relying on import of skilled manpower, capital etc. or embarking on a policy of self reliance.
- (c) The problems of introduction of new innovations like cash crops to peasant farming, where pressure of land is great. Surely the problem is different where it is possible to grow these crops along side of the basic food crops than where it is not possible?
- (d) Differences in population. In India and Pakistan (where most work on development economics has been done) it is possible that they are in fact fighting against Malthusian predictions and experiencing very re-tarded rate of development, whereas low populated under developed countries may face very different problems.
- (e) The level of natural resources and the existing level of Development of the infrastructure and the economy as a whole. These will call for modification, for example, where the infrastructure is poor, level of literacy is poor and rural people are subsistence peasant cultivators for example Mberc and Machakos Kikumbuliu, it becomes increasingly difficult to talk of perfect competition with any degree of confidence.

Indeed while available data is very limited and studies are based on small samples, the tendency for many workers to supplement their work with many assumptions, I suggest, contributes one of the major weaknesses in converting the results to major practical issues.

B. THE LINEAR PROGRAMMING APPROACH

Judith Meyer's work in Machakos¹ was an attempt to show how Linear programming analysis of a group of small farmers in dry lowland Machakos is able to throw light on the potential for improvement, through modification of farm production constraints and the relative merits of alternate crop innovations on the farm.

Linear programming is a special case of an output/input model in which there is a choice, and the functions are linear, subject to resource constraints. This model as it stands calls for the following basic assumptions.

- (a) No economies or diseconomies of scale.
- (b) Farmers have and make straight forward choices once their assumed constraints, likes and dislikes are satisfied.
- (c) Activities represented are discrete rather than continuous choices.

1. J. Meyer, Linear Programming model for peasant Agric. in Kenya, E.A.I.S.R. Conf. Paper 1965.

Linear programming depends critically on the particular assumptions and co-efficients used. The use of data collected in oral interviews with peasant farmers where no records are kept, means more painstaking data collection is essential. The task is momentous and however thorough some ends are often left untied. Some of these ends which were noticeable in the study were:-

- (a) The study was in 1962/63. Cotton was introduced in the same year and Katumani Synthetic II was only one year old. Consequently there was very little Katumani grown in Massi at the time of study. Only two farmers growing cotton could be studied. The rest of the information appears to be from research stations and government files which has its own peculiar limitations.
- (b) The paper admits that 1962/63 was a normal year. Yet the model had to have data for low rainfall and high rainfall. She used correlation constraints for these periods obtained from interviews with traders and agricultural officers (admitted AI level)
- (c) Yield fluctuation for the high, medium and poor years is therefore an estimation.

Yet the conclusions derived appear rather conclusive:-

1. That cotton is not an improvement over traditional food crops especially in low rainfall areas, given a high maize shortage price. When Katumani is considered, cotton cannot compete at all.
2. If constant maize price be assumed, cotton becomes much more attractive in all rainfall conditions. Even Katumani maize cannot compete although it can be grown as a subsidiary crop.

That is in the interests of cotton, maize growing should be discouraged and apparent agreement with Mathews Report."

As a senior extension official said, "I find Miss Hoyer's work interesting academically, but if it will help us here in Machakos, I do not know. You see, she thinks we export maize, but we have not even solved our famine problem". "Cotton is quite a different aspect. It is a cash crop which we think has a great future and it will expand as we modify our approach - for example our cotton block system".

Perhaps the most important factor ignored in Hoyer's analysis is the fact that performance of cotton and maize in research station data even when we allow for the low level of inputs differs not only quantitatively but also qualitatively. In an earlier part of the paper it was shown that Katumani maize without early planting early weeding, and good spacing might fail just like the local maize. Indeed the current situation is for Katumani failures on a scale which is alarming, when rainfall is under 12" season. Therefore Heyers minimum yields for Katumani or rather the assumption of 'non crop failure' might be an over-estimation.

Apparently the study ignored the process of innovation so aptly described by Rogers². At the time of study many farmers may not even have been aware of cotton or Katumani. By assuming that farmers find it as easy to make choices as the computer, the model overlooks several factors - (a) that in the marginal regions the choices are few and in fact boil down to cotton, Katumani, commercial beans and tobacco, (b) Management implies the making of decisions concerning the farm. But taking Hoyer's estimate that "67% of male population is away leaving old men, incapacitated people and farms are in effect run by women" and also that "these are peasant women who won't take any employed job" it is possible that there might be very little 'management' and what may exist may be routine with very strong traditional cultural tinge.

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1. Report of the Maize Commission of Enquiry, Kenya, Nairobi 1963.
 2. E. Rogers, Diffusion of Innovations; MacMillan Co. pp. 76-119.

By assuming no economies or diseconomies of scale, one cannot, using the model, describe the place of the communal self help projects, communal cotton block mechanisation programmes, traditional Mwethya groups, ujamaa villages, etc. Secondly, assuming a linear response to factors of production one ignores certain agronomic factors. For instance, Plant Pathologists know that soils might 'lose heart' for no apparent reason and no amount or degree of weeding, fertilizing or terracing will increase yields. Given farming standards in Masii and Muputi - the classical dry areas of Central Malawi - one must admit that the systems of farming encourage nematode bacterial and fungal infections to increase rather than decrease, and many soils must have lost this heart as shown by the endemic diseases of such crops as maize - (Kinyaiithi) pigeon peas (ilake) beans (Kathwa, Kinyaiithi) etc. Also these areas were the classical examples of the 1950s "Mangalata" sheet erosion problem! Given that there is very little shifting cultivation and that the use of manures and fertilizers has been minimal one understands such answers as 'yes Sir, last year. I broadcast a bag of fertilizer there, but nothing happened, so this season I decided not to use anything.

In Machakos, former homestead/kraal areas are the most fertile areas 'Maanzo' and every adult householder strives to get a portion of that land. In fact these areas are constant causes of murders and accusations of witchcraft practices. They are the most important plots from which the farmer obtains some of his statistics for researchers in order to impress. These areas are often, however, hot manure beds which demonstrate the principle of diminishing returns very clearly as maize plants lodge before maturity due to excessive Nitrogen or die early due to podsoyic conditions in the soil.

It is over 5 years since Heyer's study was completed. From the current study and observations with an Extension Officer in this area, it is quite clear that due to many factors plus storage difficulties the eating of green maize cobs and high variability in yields, famine is still endemic. Sales of maize do not necessarily mean there is a surplus since cotton is very new, sisal is no longer sold and there is no obvious cash earner in a place where school fees, and taxes are often collected by uncompromising chiefs and aggressive tribal police.

A COMPLIMENTARY APPROACH

A linear programme approach would appear to handle farm management data efficiently. It would probably stand on its own in developed farming communities.

But as seen earlier, the communities studied for this paper are more complex in that social considerations probably influence farm management decisions very significantly. A study designed to compliment farm management economics would therefore analyse the farmer in the context of the roles he plays e.g. as an economic man, as a social agent; as a father and leader of a household the socializing agent of a society; as a citizen, an owner of factors of production, etc. The peasant farmer would make decisions in all these and other spheres which have a direct influence on the use of his resources. He will allow only a certain/depend on profitability his likes and dislikes alone but also on unforeseen psychological issues like his attitude to rituals - does the innovations contravene these? His values must also be identified first. Probably these could be allowed for in a linear programming model but for such an exercise solutions which consider individual farmers alone are more likely to be representative.

/degree of risk and no more. Therefore adoption of new practices will not

For example, in the current study, introduction of new crops was found to be facing problems which could not be suitably exposed and accounted for in a linear programming model. Also throughout the paper, there has been an effort to show how the environmental factors conditions social adaptation and response to opportunities.

The author wishes to thank Mr. Jon Morris and Mr. Hall for their comments and criticisms of the paper.

7th November, 1967.

- 1900 - 1920 - Negligible activity. National effort concentrated on European settler problems.
- 1925 - Emphasis on trying new crops. Start of many seed farms, demonstrations of rotations. Locust control crops campaigns started. Planting of cassava, sweet potatoes and colocasia pushed through local chiefs and headmen. Very little extension activity.
- 1928 - 1945 - (a) In 1937 the Anti-goat campaign. This met very serious opposition in Mberere and Machakos and alienated extensionists with the local people very strongly.
- (b) Cotton introduced in 1937 - stopped in 1942¹
- (c) Reports on erosion, over stocking and over population in marginal areas began to receive attention.
- (d) Composit making campaigns. This were combined with pit-latrines digging campaigns. No. of composit pits made were used as criteria for promoting A Is. Therefore A.I.s tended to assume an aggressive attitude towards farmers.
- 1946 - 1956 - Emphasis on soil conservation - communal dam making, communal terracing and trench making and compulsory de-stocking². These were hard years when the rural people learned to hate those who were taking their cattle away.
- 1956 - 1967 - The current campaigns by the Ministry of Agriculture are as shown on page 8 and 9

1. See page 9.

2. African Land Development 1946-1956 - Ministry of Agriculture Publication Nairobi 1961.

Appendix I

| SEASONS | Kampi ya Mawe | KIMUEWA 8 yrs Ave. | Katumani Potha 47 yrs. ave. | ISHIARA 11 yrs. Avr. |
|---|------------------|-----------------------|-----------------------------------|-------------------------|
| SHORT RAINS (Oct., Nov., Dec. Jan.) | 14.81" | 14.90" | 10.06" | 13.43" |
| LONG RAINS (March, April May, June) | 10.19" | 13.6" | 12.11" | 12.66" |

| Place | % Probability of Obtaining More Than | | | | | | | | | | | | SD |
|----------------------|--------------------------------------|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|------|
| | 5" | 6" | 7" | 8" | 9" | 10" | 11" | 12" | 13" | 14" | 15" | 16" | |
| <u>Kampi ya Mawe</u> | | | | | | | | | | | | | |
| Short rains | 92 | 89 | 86 | 83 | 80 | 76 | 71 | 65 | 60 | 55 | 49 | 43 | 6.97 |
| Long rains | 90 | 85 | 79 | 71 | 62 | 52 | 42 | 33 | 24 | 17 | 11 | 7 | 3.95 |
| <u>Katunani *</u> | | | | | | | | | | | | | |
| Short rains | 89 | 83 | 77 | 69 | 60 | 50 | 41 | 32 | 24 | 18 | 12 | 8 | 4.21 |
| Long rains | 87 | 83 | 79 | 74 | 69 | 63 | 57 | 51 | 44 | 38 | 32 | 27 | 6.32 |

Note Local Maize requires 10-12" per season to silk and give a crop

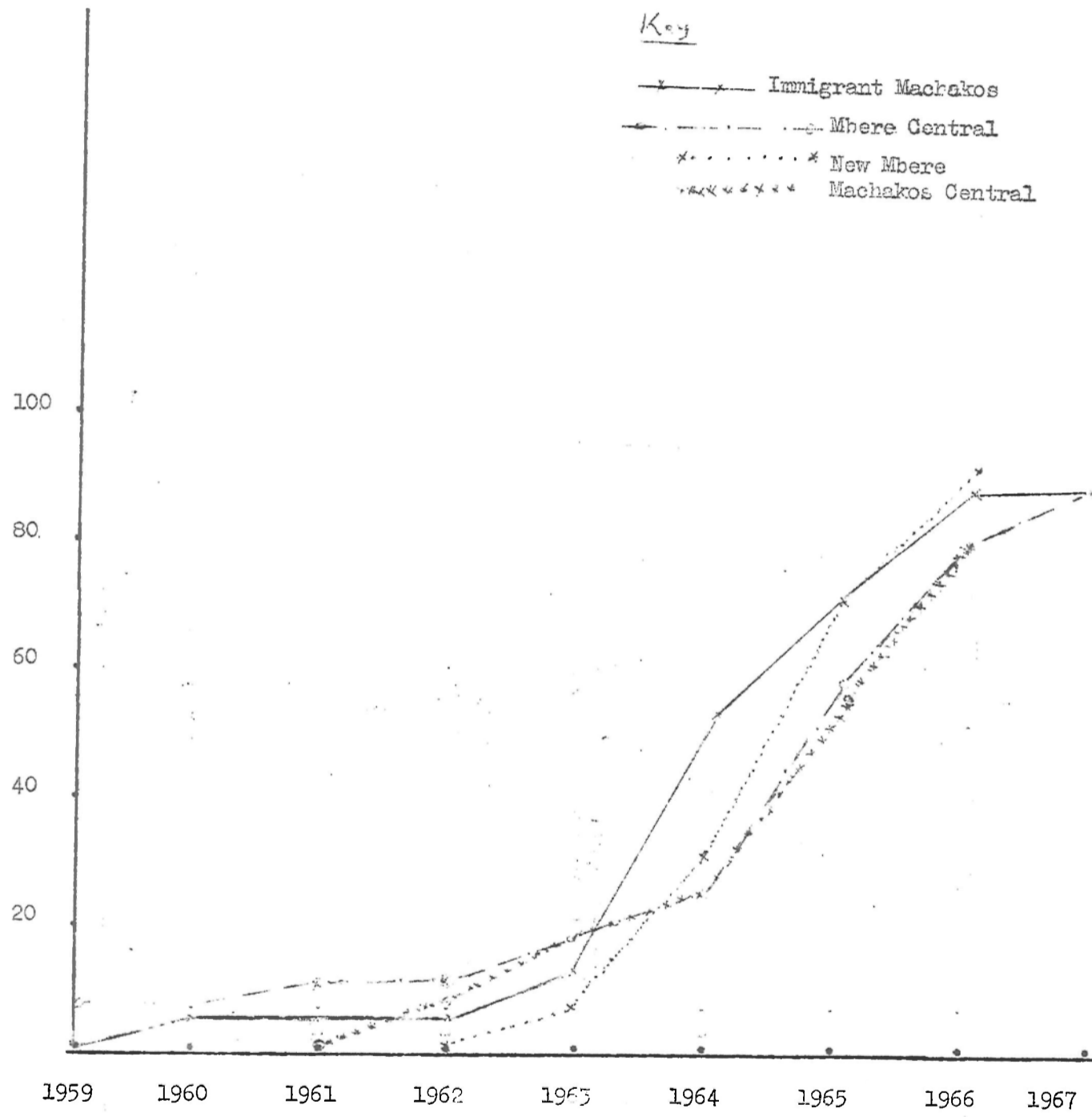
Katunani maize requires 7"

- Local maize will succeed 1:3 years
- Katunani will fail only 1:8 years

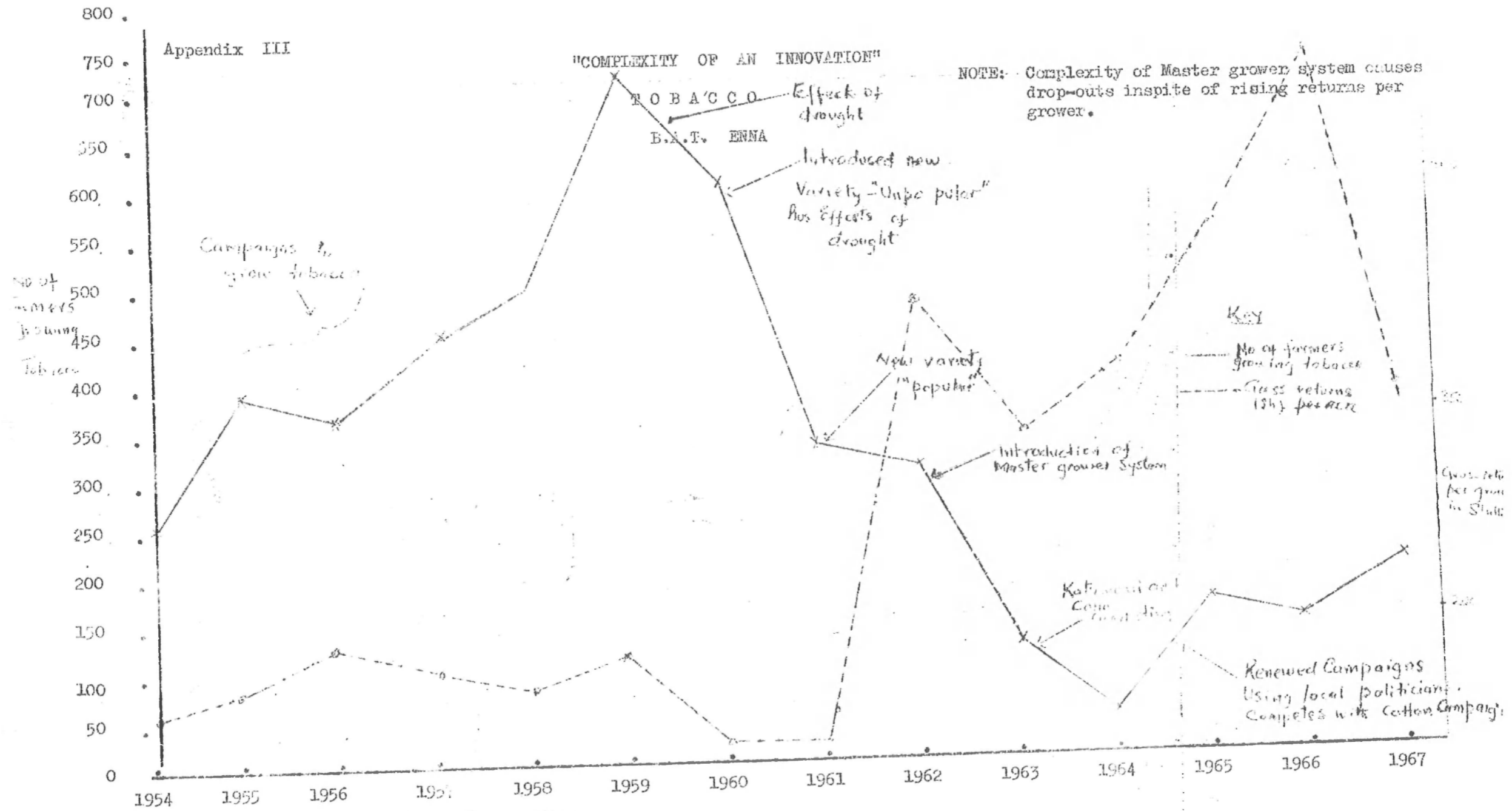
* Source Dowker, Katunani R. Station (unpublished) 1960

Appendix II

Cummulative Percentage of Farmers who have Adopted Katumani
Over Successive Years



Appendix III



Source: B.A.T. Enna Office

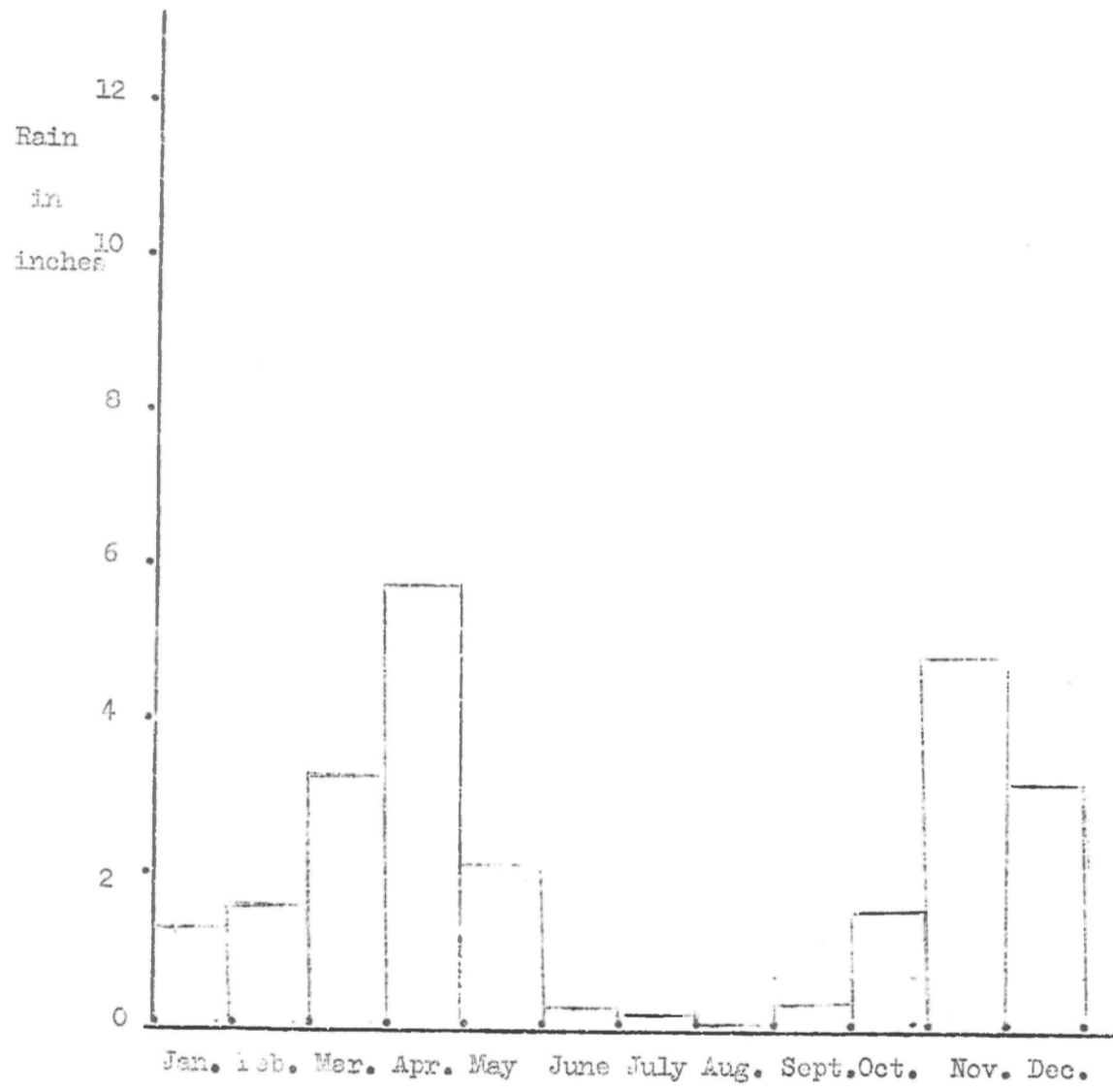
36

Appendix IV - A

KATUMANI-MACHAKOS

Annual Rainfall Distribution

Mean Yearly Total for 47 years = 24"

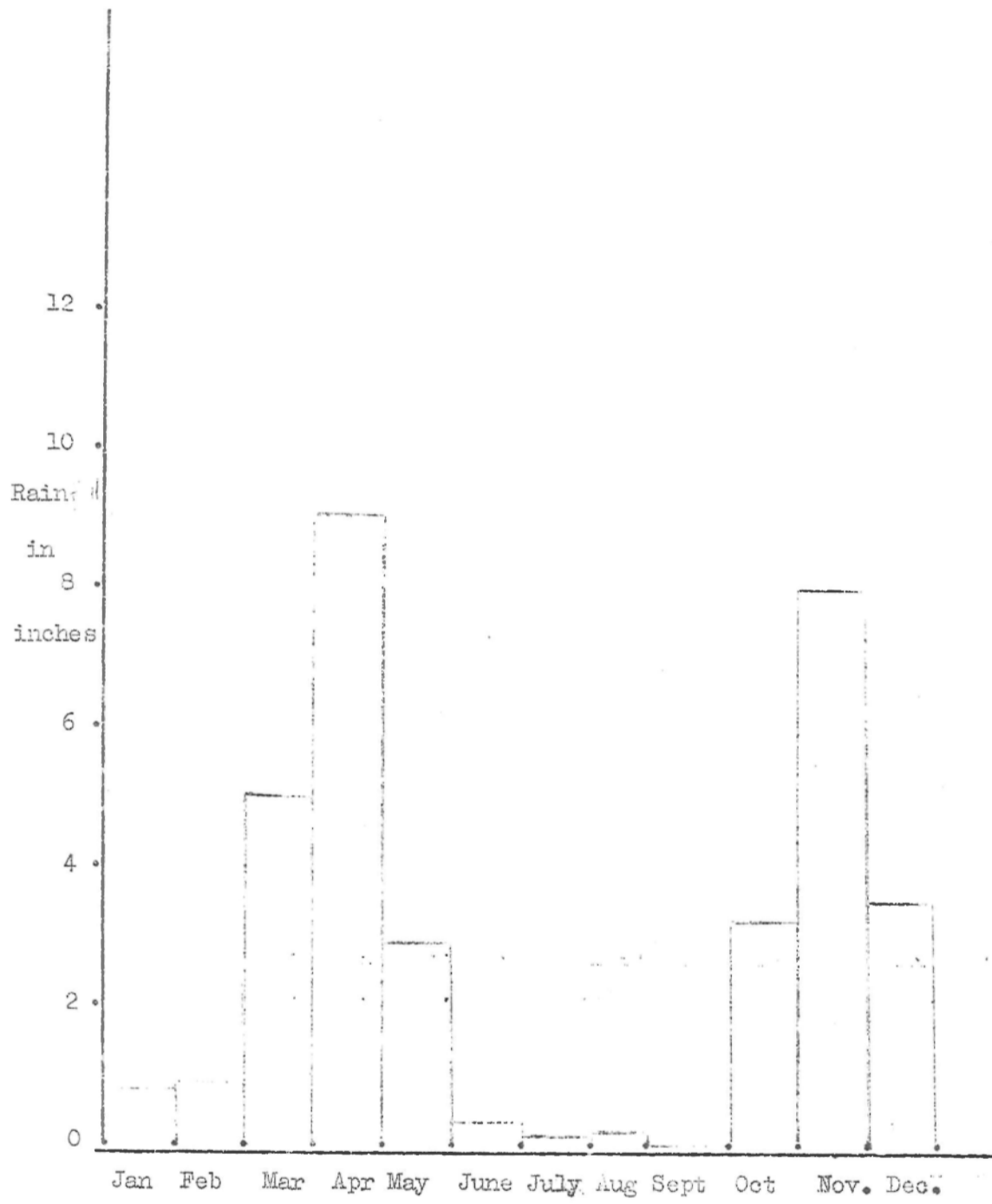


Appendix **iv** - B

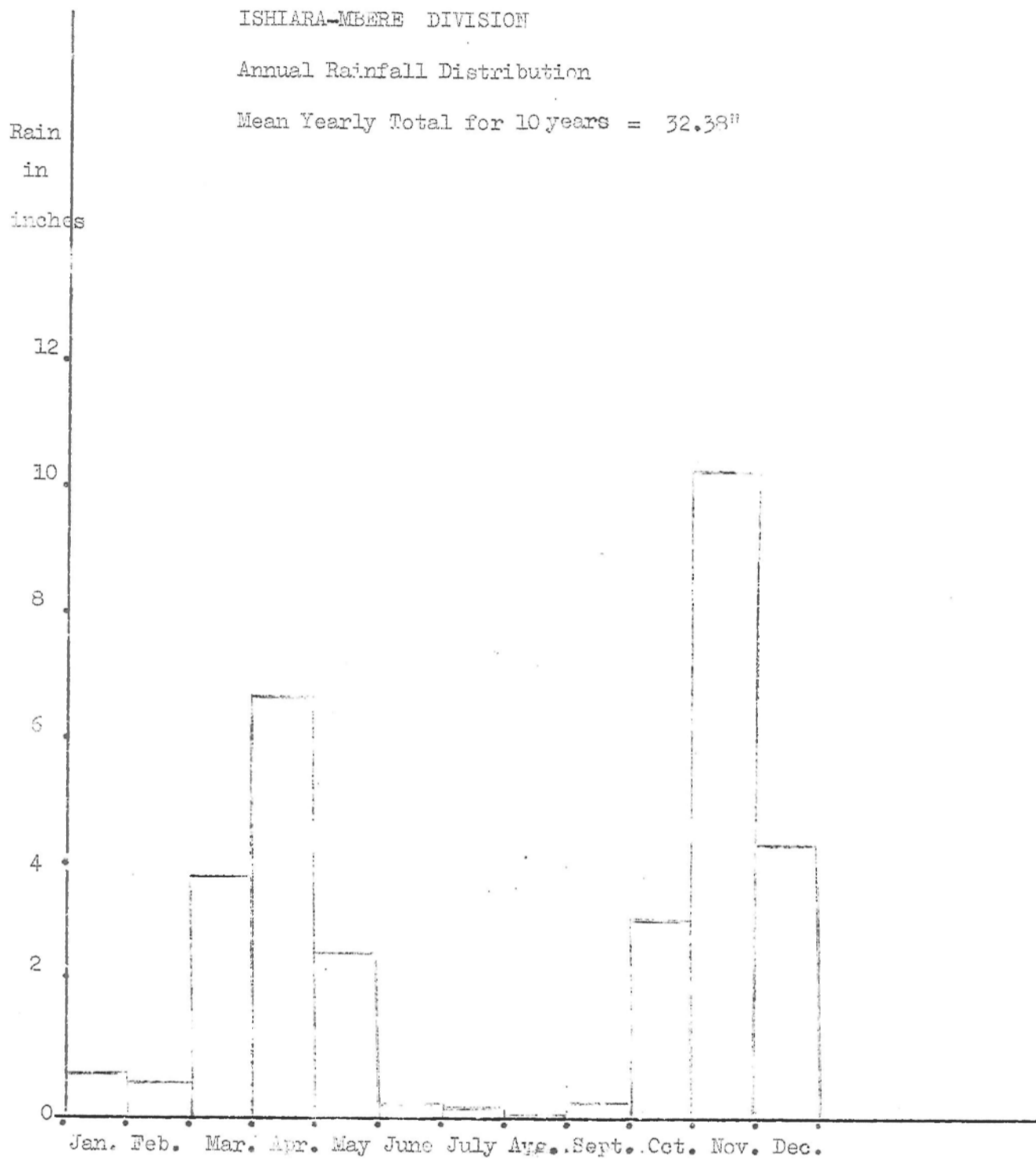
KIRITIRI MERE DIVISION

Annual Rainfall Distribution

Mean Yearly Total for 10 years = 52.39"



Appendix IV - C



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