DROUGHT AND FAMINE IN KENYA
Magnitude and Attempted Solutions

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ABSTRACT

The report presented in this paper forms a baseline for further reports on drought and its impact on Rural development in Kenya. It is therefore deliberately wide ranging and data is presented to highlight the major areas of concern which will be discussed in greater detail in subsequent reports.

Specifically the reports attempts to identify the relationship between drought, underproductivity, food shortage and famine. It also attempts to estimate the cost of famine to the nation and to the rural communities. The theoretical section is our first attempt to develop the conceptual tools for understanding the farmer's situation and how he and any assisting change agents attempt to cope with drought.

Some of the Governments programmes to alleviate this problem are discussed critically and suggestions for revitalizing these programs presented.

The report concludes with a long list of recommendations mainly to generate constructive discussion rather than evoke dispair as is usual when one reads about suffering and the manifold problems of rural development.

The report should be evaluated against the background empirical fact that more than 4 million Kenyans are constantly threatened by drought and environmentally derived stress. Any suggestions therefore should be practical, feasible or conceptually aim at expanding our vision.

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INTRODUCTION:

A close look at Kenyas Agricultural development strategy quickly reveals a skewed concentration of technology in high and middle potential farming areas. In his review of Kenyas Agricultural development policy, Ruthenberg attributes the rapid gross growth in agricultural production to a multiplicity of approaches.[1] At the national level the main approaches have been through land reform, increased efficiency and intensity in agricultural administration and extension (dependent upon the extension of technological packages), small holder tea development, development of coffee, pyrethrum, dairy mixed farming, farmer training and the introduction of viable cash crops. (Ruthenberg, 1964:103).

Ruthenberg and other students of rural development do not see small scale irrigation, grazing schemes, introduction of dry land cash crops such as cotton, castor oil, sisal, dates, pawpaws, marketable food crops such as Maize, Mexican 142 beans, Cassava, pigeon peas and certain bean varieties as economically viable. The dilemma of farm development in the dry areas has been then characterized by the lack of support of any major programme by planners and economists and the substitution of economic rationality by welfare conscious specialists and politicians has led to half hearted search for economic alternatives which include large scale irrigation, ranching and land settlement schemes.

It has also led to the development of a serious myopia among agricultural economists. They fail to appreciate that there exists dry land farming technology and adjustment patterns here in Kenya, in Israel, Mexico, Australia etc., which could revolutionalize extension effectiveness in these areas. This has led to

(1) Costly repeatition of half baked, ill designed projects such as the Ishiara Irrigation Scheme, the Samburu Grazing rotation, the Machakos Soil and Water Conservation programme, etc.

(2) Very frustrating research tradition where selection and training of agricultural research experts is based on the assumption that Kenyas agricultural systems lie in the Highlands, the lake basis, the Costal strip and that the only other possible land use system in the rest of Kenya can be subsumed under the term "range management".

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1. Ruthenberg states that between 1952-1965, the total production increased at an annual rate of 4.5 per cent from £74 million to £117 million.

It is not realized that the dry marginal areas have farming populations which are growing at the rate of 3½% to 33% due to in migration from other areas. (discussed in later section)

(3) The development of dry land extension system with limited technological packages which are exploited fully through the concept and practice of "Crash programmes". This darth of dryland technology leads to the indiscriminate importation of intensive wet land farming practices such as fencing, ley farming, heavy mineral fertilizer use and the extension of medium potential agricultural land crops to an extent where the risk of crop failure is increased.[2]

(4) The continued non solution of the periodic and costly famine crises which characterize these areas.

This discontinuity in agricultural development policy has led to the problem of regional disparities in development. This has many facets and implications. It implies, for example a continued increase in the gaps in per capita income, household levels of living, infrastructural complexity etc., across regions. One result of such obvious disparities is the growth of a sense of relative deprivation and marginality and the perpetuation of parochial tendencies.

The development of the above mentioned national developmental problems can therefore be seen as being closely related to the ecological potential of a region and the low level of technological know how on dry land farming. Development in the dry areas of Kenya has a weak agricultural base and in the past has tended to rely on a strong livestock base. (see Peter Rigby 1968). But, given the situation where a pastoral or semi pastoral or even agricultural people are forced (by increasing land pressure due to population growth and uncontrolled inflow of people from densely populated wetter regions) to exploit at increasing intensity a harsh environment, the concomitant increase in crop failures, famines, and epidemics leads to internal technological, social and economic strains and stressed for which there must be an adjustment if the communities were to survive.

The study reported here is aimed at understanding the patterns of adjustment. Specifically we are interested in understanding the selection of farming technology as an adaptation response to marginal

2. Within the extension service, being transfered to Isiolo, Marsabit, West Pokot Baringo, Narok Kajiado and Tana River has often been seen by the officers concerned as a disciplinary measure, leading to low officer morale and very low extension agent productivity.

farming conditions. These conditions are characterized by frequent drought, heavy shortlived rainstorms, alkalinity, floods, crop and animal epidemics, poor marketing facilities, over-emphasis on family food supply as opposed to cash farming, etc.

The aims of the study are:

(1) To study the adoption process through which farmers select farming technology as an adaptation to marginal farming conditions.

(2) To isolate the traditional technology, which are taboos and social practices compatible with modern dryland farming practices so that these can form a basis for the adaptation of new technology.

(3) To study the major research recommended technological packages and examine the Socio-economic and technical factors which influence their diffusion rate.

(4) To examine the role of occupational/activity and crop diversification in increasing farmers control over the environment. This study therefore includes a probe into the non farm activities of farm people in the marginal areas.

(5) To examine and shed light onto the famine relief and food supply and distribution problem, in both economic and welfare terms.

Nature and Scope of Research:

The current drought study which covers the following regions: Embu, Isiolo, Meru, Kitui, Machakos and Marsabit focuses on farming problems in the low potential farming areas, the semi-pastoral and pastoral areas of Eastern Kenya.

The study has now been integrated into the studies of Mr. Ben Wisner, whose report is incorporated and has extended its scope to the study of famine, its economic and social costs and the way the people living in these areas adjust to environmental stress.

Data has been collected for 16 sites on three altitudinal ecological gradients running from Mt Kenya forest edge to Kitui as shown below:

SEE MAPs I & II.

II THE PROBLEM

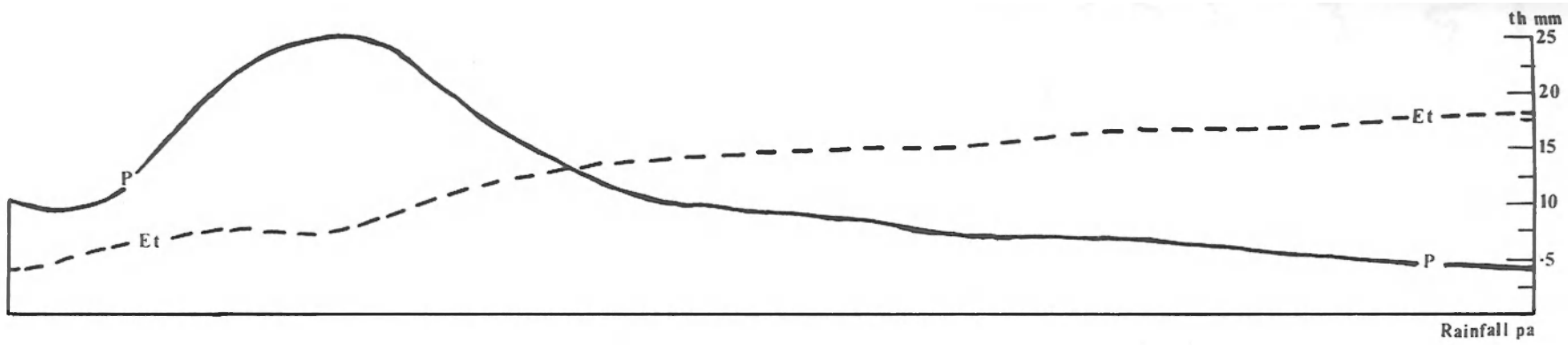
1. Drought.

Agricultural drought should be viewed as a natural, though extreme outcome of the interaction of man and nature. All human systems (for getting a living from the earth) have evolved such that they continue to function well within a range of physical conditions. When rainfall exceeds the upper limit of this range, the farmer must use practices not normally employed to protect his crop from mildew pests, and flood. Likewise when rainfall falls below the lower limit of the normal range, farmers employ practices, or adjustments, which reduce the damage caused by drought. Depending on the width of the "normal" rainfall range which "normal" farming practices allow, "drought" would be "declared" at different times by different farming systems. Thus the farmer who normally plants Katumani, plants early, and weeds early would not define a season which brought 7 inches of rain a drought season. His neighbor who normally plants local maize, plants late, and weeds late would call the season a serious drought season, and would set in motion a series of adjustments, non-normal practices, in order to feed his family. He might even leave off farming temporarily and go to seek wage work. Even such an extreme decision must be considered among the total range of adjustments to drought which farmers in Kenya are known to practice from time to time.

One of the most important results of our study so far is the realization that a relatively low cost and high benefit approach for the government in dealing with drought problems is to build upon the local patterns of adjustment to drought which have grown up in the different ecological zones of the country, fostering those which seem to be effective, discouraging some which seem wasterful, introducing new ones (like Katumani maize).

2. Drought as a national problem.

The cost of drought to the nation can be divided into the direct costs which the government incurs in alleviating the burden of drought over the affected population, primarily through famine relief. Other costs arise from production losses, value not added to the economy because activities in which farmers have invested time, money and labor fail; cattle lose weight, die, do not bear calves; plants wither or bear a fraction of their normal harvest. There are also social costs to the



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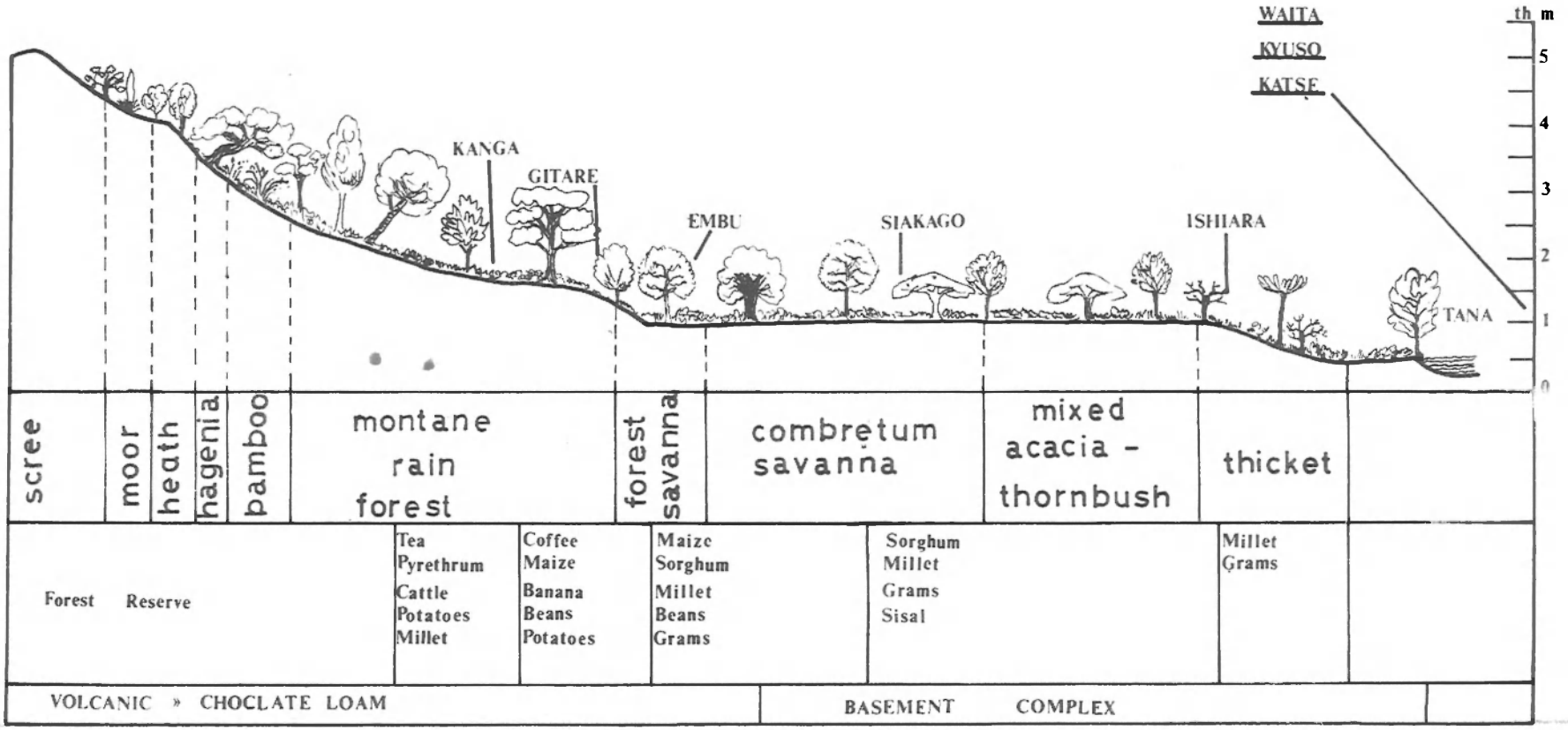
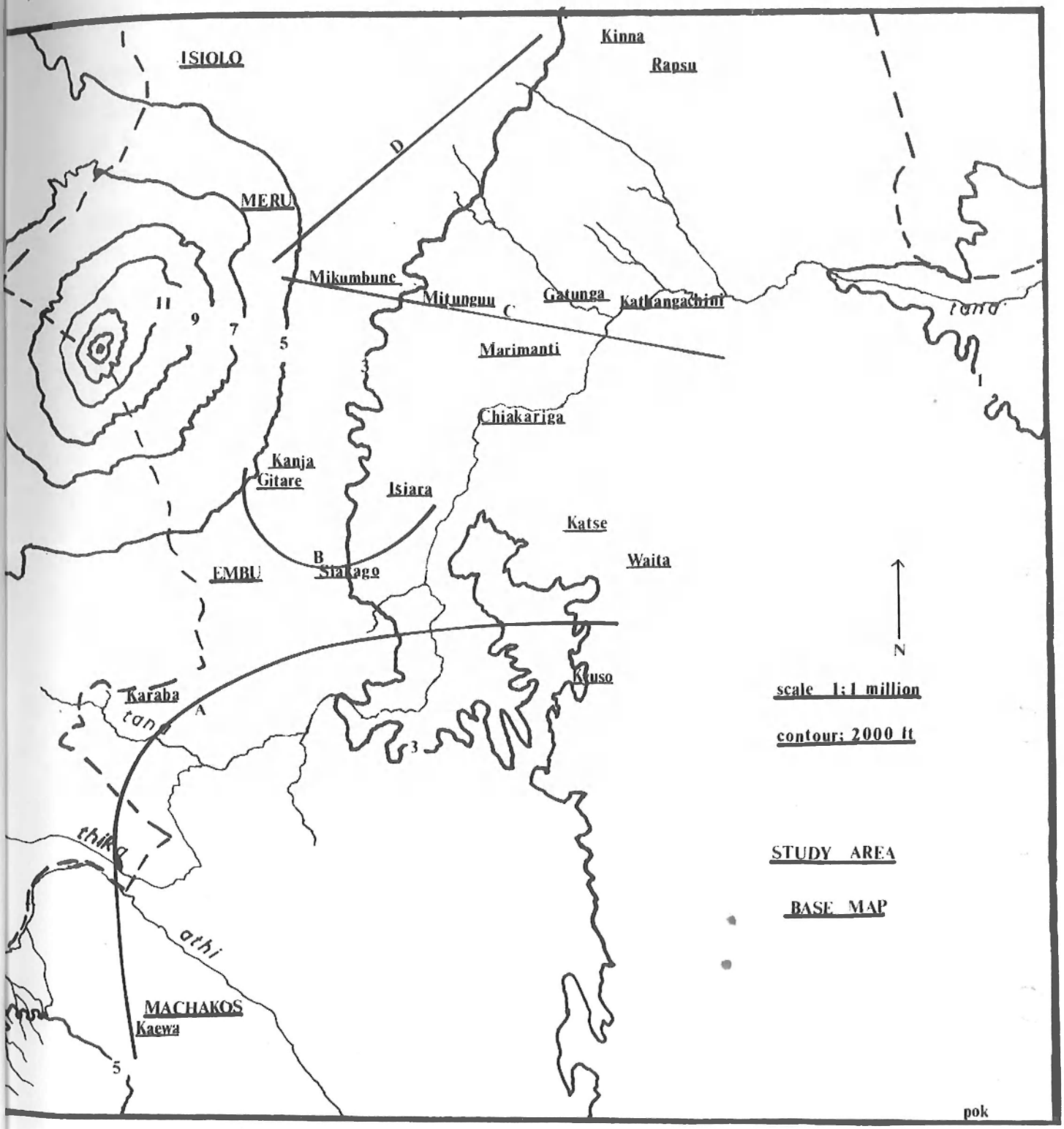


source: brown & cocheme, 1969.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nation measured by increases in nutritional problems and nutritionally related diseases, family and community disruption, misery and loss of human dignity. Finally it has been noted that drought has an important overall impact on the pace of technological change and rural development in the affected areas, which though most difficult to quantify, has significant negative and positive roles.

(a) Famine relief. Rough calculations show that during 1961 Kenya spent for internally purchased maize and transportation alone Shs.12½ millions (5,500,000 for transportation to railheads for distribution and about 7,000,000 for maize pruchased from the Maize and Produce Board.)[1] That year about 40% of the famine relief maize came free from the U.S.A.

Strictly, in accordance with the national goal of self-reliance the value of this free maize should be added to the 1961 cost. We have attempted a similar estimate for famine relief cost to Kenya during January 1970 - January 1971 and find this to have been about 20,000,000 shs.[2] These figures give an idea of the range of magnitude only. However when comparing the figures 12 million and 20 million, the reader should keep in mind that the 1961 figure does not estimate the cost of vitaminazing vegetable oil and other related famine relief costs. Further credibility is lent these estimates when one notes that Tanzania spent 20,000,000 Shs. on famine relief during 1969.

(b) Production losses. We are unable at the moment to make a total Kenyan estimate with any degree of confidence; however it has been calculated that Tanzania (whose general rainfall reliability pattern is similar to Kenya's) looses on the average about 10% of primary production

1. M.J. Roberts, Famine and Floods in Kenya 1961. Government Printer, Nairobi, 1962, pp 15 & 52.

2. We derived the cost of =/50 per person, per day for relief in 1961. For 1970-71 we estimated an average of 100,000 relief recipients every month for a year. According to newspaper accounts relief began at a low level, peaked at 250,000 recipients and would tail away to around 50,000 for several months of rehabilitation.

(loss minerals) a year (about 4% ofits GNP). Maize production losses were estimated to be about 45 million shs. a year (0.6% of GNP).[3] working with 1962 figures, we estimate that 1961 losses to the Kenyan livestock industry alone could have been as high as 140,000,000 shs. Again these figures should be taken only as indications of the range of magnitudes of loss. With such magnitudes in mind one will be better able to assess the value of certain drought and famine prevention investments which are discussed later.

It has been estimated that the total cost of the 1961-2 drought and floods was £10,000,000.[4] This seems a reasonable figure (probably a low estimate) judging from the information we have been able to piece together so far. If this is so, then it would seem that the ratio of total costs to famine relief cost is about 10:1. This seem a safe rule of thumb.

(c) Social costs. Drought alone does not account for large scale starvation except where a population is highly vulnerable. A single season drought can be usually met by late-planted catch crops, sales of animals, loans, and "bush" foods. A series of such droughts (2 or more seasons) or combinations of drought, flood, and/or pest invasion (in 1961-62 Kenya suffered all three) will intensity food shortage to the point where the danger of some death is present. The case of the "single" one season drought contrasts with the extreme condition present in civil war (Congo 1960, Biafra 1969) where massive population movements and destruction of crops and animals prevent the use of catch crops, forest, and animal reserves, thus producing tragic hunger.

Within this general picture, children of weaning age experience during drought a considerably higher risk than the "normal" 30-40% under five mortality rate characteristic of much of Africa. Decrease in caloric intake and milk supply can precipitate clinical

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3. R.W. Kates and Ben Wisner "The Role of Agricultural Drought in a Developing Economy: Examples from Tanzania and Kenya, Discussion Paper, UNESCO Seminar on Natural Hazards, Godollo, Hungary, August 4-9, 1971, pp. 3-5.

4. E.A. Standard 11 January, 1971, "Relief Plan for Drought Province." The author here seems to claim that "relief" cost £10,000,000 in 1960. We can get nowhere near this figure in our own estimates, so we take it as a journalistic error. He probably means the total cost of drought 1960 was £ 10,000,000.

protein-calorie malnutrition, a risk that may also be increased by lower domestic water use, hence poorer hygiene and greater danger of diarrhoea. A further controversial aspect of protein-calorie malnutrition is its possible retarding effect on the mental development of surviving children. Although there is considerable literature on this topic, no clear answer has been agreed upon. However the possibility exists that drought and the resulting famine may contribute to poor school preformance and mental/emotional development of thousands of Kenya children.

(d) Rural development may in some cases actually be speeded up by drought. We have observed the role of drought in the process of innovation and the adoption of new economic ideas. We describe these findings in our next report.

However, it is difficult to say whether such possibly positive effects balance the clear losses to the nation when the sequence of orderly rural development (as described in the Development Plan) is thrown out of phase by a drought and resources are diverted into investments like famine relief where they are only marginally productive (since the recipients are usually not engaged in much productive activity while they are on relief) and have very low rates of return.

Fortunately Kenya is not alone in its serious attempt to find a rational solution to its seemingly chronic drought problem. Drought was considered at the international Symposium on Famine, Saltsjobaden, Sweden in 1970 and the International Geographical Union's Commission on Man and Environment will devote an entire session to the problem of drought at its 1972 meeting in Canada. At that session research very much like that currently underway in Kenya will be described by workers from Australia, Brazil, Mexico, Nigeria and Tanzania. Thus the possibility of fruitful dialogues is opening on alternatives to periodic famine relief. [Mr. Ben Wisner is already in Canada representing the Kenyan Study team July 2 1972]

3. Types of Drought

For purposes of planning and policy, we have distinguished among several different kinds of drought problems in Kenya. A historical analysis of droughts over the past 30 years gives the following types:

(a) The national drought which directly affects the production of more than 10% - 15% of Kenya's population, lasts two or more growing seasons, and generally involves serious loss of production in most ecological zones and usually two or more Provinces. This types of drought seems to occur about once each decade. We have not done a complete historical survey, however, farmers in our eastern Kenya study mention very serious droughts in 1913-18, 1925, 1936, 1946, 1954, and, of course, the droughts of 1961, and 1970. This most severe and wide-spread type can cost the government up to Shs. 20 million for famine relief alone. Heavy Livestock losses are usually involved in this types of drought, and can amount to 40-50% or more of the herds (e.g. Kajiado Masai herds in 1961 and Samburu herds in 1970). Rehabilitation of herds takes longer than reseeding of farm lands. Beans planted in the later case will give a catch crop in three months. However with loss of condition, reduced calving rates, increased mortality among calves, and sales of the breeding nucleus of a herd serious undersupply of milk can remain a problem in a pastoral area for 6-12 months after the meteorological "end" of the drought.

Most ecological zones are affected by loss of production during such drought. Our interviews with 600 farmers in high, medium, and low agricultural potential zones of eastern Kenya reveal food crop shortages in even the high potential coffee/tea zone near the Mt. Kenya forest. In their totality these characteristics of the "national drought" present a unique challenge to government policy which is different from the challenge presented by the "regional" and "local" droughts.

(b) The regional drought which directly affects the production of less than 10% of the population of Kenya, lasts one or two growing seasons, and is generally confined to the medium and low potential areas, especially the semi-arid, dry-farming zone and the arid and very arid rangelands. The occurence of this kind of "regional" drought varies according to the kind of crops grown and densities of livestock and of particular kinds of grazing, With local maize one would expect such a drought once every 3 or 4 years (Mbithi 1967). With full adoption of

Katumani it might occur only one time in every eight years. (Dowker 1963) Millet in northern Kitui and south eastern Tharaka seems to fail on an average once in five years. Thus on the average one should plan for 2 or 3 such regional occurences each decade. Within living memory of the farmers interviewed in Tharaka (lower Meru) there were such droughts in 1951, 1954, 1961, and 1970. If stocking densities are low enough, pastoralists seem well adapted to getting through a single season failure of the rains by increasing their range of movement with their herds. If the cost of famine relief in a "national" drought is 20 million, such a "regional" drought probably costs around 5-10,000,000 shs.

(c) The local drought probably occurs every year somewhere in Kenya. Especially in the marginal agricultural zones of the eastern plateau foreland (Machakos, Lower Embu, Lower Meru, Kitui, Tana River, Kwale, Lamu and Kilifi districts). Part of Rift Valley and Western and Nyanza Provinces the variability of rainfall is such that individual ridges and sublocations can experience crop failure or serious short-falls in harvest because of extremely localized combinations of slope, soil, and rainfall conditions. This type of drought is usually handled well by traditional gift and loan relations among the farmers and their kinsman and friends and by the normal social welfare allotments made to District authorities. However when we discuss population growth in these marginal areas somewhat later, it will be apparent that since some areas within the marginal agricultural zone are growing at more than 10 times the average population growth rate for the nation, even these local droughts could become an increasing drain on national resources and a serious obstacle to rural development. The 1961 Kenyan budget contained K.shs. 50,000 as the 'normal' fund for local drought. However we would multiply this by at least 10 to give the actual average annual cost of such droughts = K.shs. 500,000.

So far, in defining three types of drought in Kenya we have considered only the pattern of rainfall, its variability, and the pattern of agricultural potential, be it high, medium, or low (marginal). However in considering the impact of a given drought on the people affected and its cost to the nation, it is also of prime, perhaps greatest, importance to look at the pattern of population and population growth in Kenya.

All of Kenya's north and northeast* provides the livelihood of only 562,217 persons. The population of this part of Kenya is growing (at about 2% p.a.) below the national average rate of increase, which is about 3.2% per year. The southern arid zone, comprized mostly of Kajiado and Marok districts, contains 208,122 persons. Although the 1970-71 famine in the north and northeast without doubt presented a great challenge to local and national administrators and caused great suffering, it must be remembered that this event is not typical, nor is its recurrence highly probable. A drought that would simultaneously affect most of the north and northeast and the southern range areas is even less probable. In the long run the area of Kenya which shows the greatest famine potential is the marginal agricultural zone in the east of the country.

The marginal zone of the eastern plateau foreland** provides the livelihood of over 1,250,000 persons. Furthermore population growth in certain parts of this zone exceeds 10 times the national average (up to 33% per annum in parts of Machakos) (See Map 3). Kwale district is now one of the most important distinations for the entire nation's rural-rural migration.*** The very dense (500-700 per square mile) population of highland Machakos is very fast redistributing itself into the drier, marginal parts of the district (Makueni, Makueni south, and Yatta). The absolute grazing area available in these parts in much more limited than that in the extreme north of the country, furthermore the in-migrants are mostly engaged in a significant amount of cultivation of maize, millet, and sorghum to meet their requirements.

Thus considering the absolute population levels as of 1969, the rate of population growth, and the type of subsistence economy, it is clear that the people of the eastern marginal lands are more vulnerable to drought induced famine, and the overall, long run famine potential is highest in this zone. If population continues to grow in this marginal zone at present rates, with no significant change in technology, even a local drought (as defined above) could mean massive relief problems for the national government.

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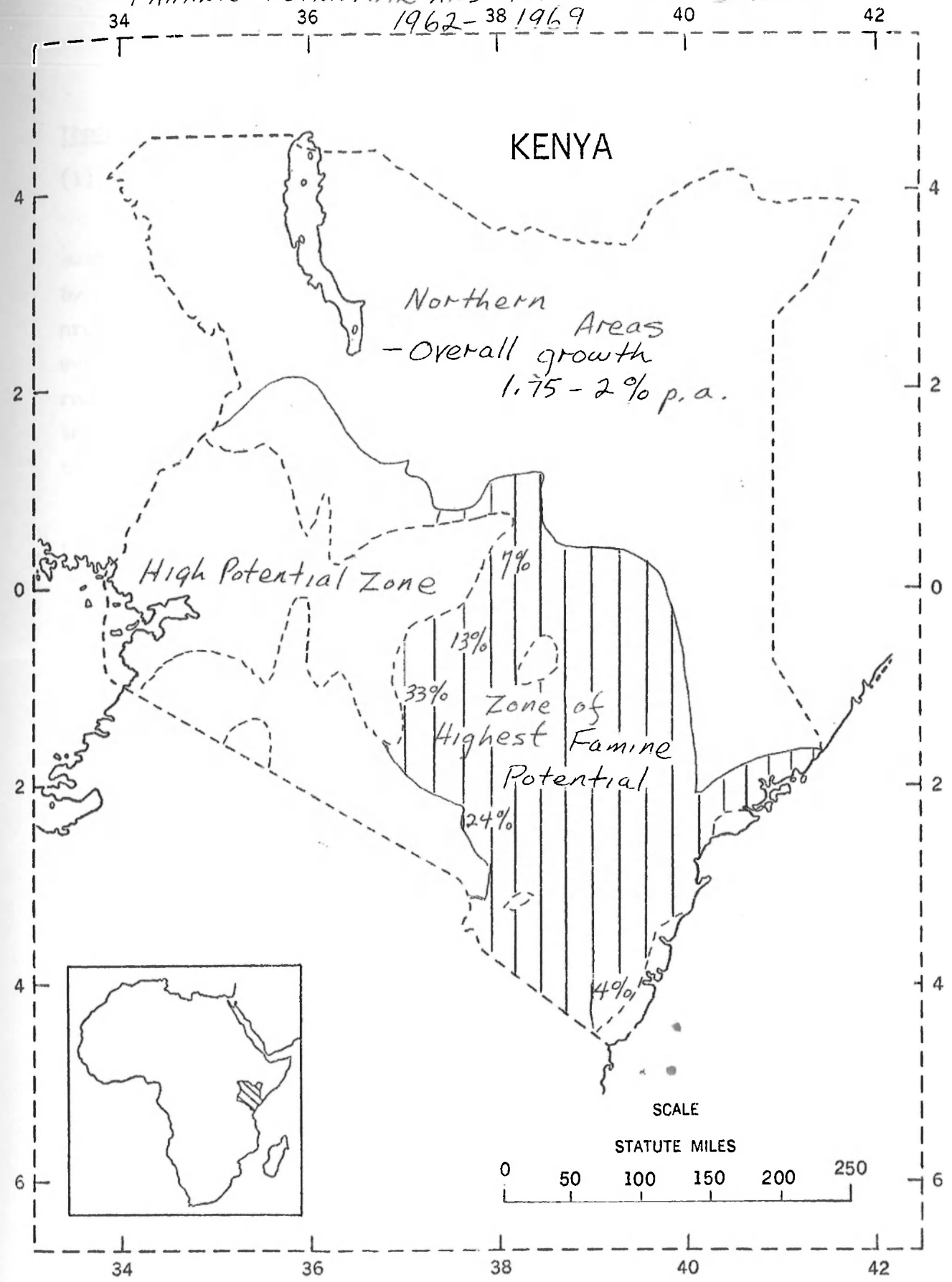
* Turkana, Samburu, Marsabit, Isiolo, Mandera, Wajir, and Garissa.

** Kwale (part of Coast & all of Hinterland divisions), Kilifi(No. and so divisions), Tana River, Taita (Voi division), Embu (Mbere division), Kitui (all except Central division), Machakos (all except Central and Northern Division)

*** S.H. Ominde, Land and Population Movements in Kenya Heinemann, London, 1968, p. 159.

**** In our field trips we met a D.A.O. who was historical about similar encroachment of cultivators in the Northern dry edge of the Laikipia Plateau.

FAMINE POTENTIAL AND POPULATION GROWTH



Key:

contains high potential land

eastern plateau foreland

33% percentages indicate population growth rates very much higher than national average, 3.2% p.a.

Theoretical Frames of Reference.

(1) Physical Resource Endowment Approach:

A drought is an environmental shortage of enough moisture to sustain established plant, animal, or human life systems. It may be caused by a host of factors the chief of which is often lack of sufficient precipitation. But other factors such as increased run-off due to overgrazing and bad vegetalian cover, decreased cloud cover (increased solar radiation), dry, hot winds which may accompany the reduced precipitation, lowered water tables and salinity are all factors which might reduce the available soil water.

The above indicates that availability of soil moisture in relation to the demands for such water is what constitutes a measure of drought. An off season crop, or variation in the timing, the sequence and regularity of precipitation for example might produce drought conditions. The choice of a high moisture requiring crop or increased plant/animal or human population might lead to the introduction of drought conditions in an area where there was no predence of one.

Alternatively, judicious choice of plant and animal populations, appropriate cropping sequences or complementing precipitation with any form of irrigation might arrest drought conditions.

These factors clearly indicate that economic stress due to drought is a factor of existing technology, available moisture and prevailing edaphic and meteorological conditions. This introduces the concept of critical thresholds of drought (stress) under a given technological base. The concept of critical thresholds of stress within resource-use and crop production systems is useful in understanding land use change (Boserup), population dynamics (Eyre, 1971) at the macro-ecological level and the phenomenon of spontaneous, localized innovation at the micro-ecological level. For example at Rapsu, across the Eastern Meru Boundary with Isiolo District, we identified a somali community which on its own, has identified critical threshhold of drought for cotton black soils and sandy loams, so that by careful soil study/farm planning and choice of a cropping sequence; and through unique community discipline; they have developed a viable water use system from limited irrigation water and have optimized output and hence the population carrying capacity of the black soils.

Thus the problem of drought and famine in Kenya is not a uniform phenomenon related to precipitation or any one single factor but is related to the community or micro-ecological threshold level of stress which is itself determined by the level of indigenous or pro-modern technological adaptation achieved.

The utility of Katumani maize, for example, which has been hailed as the salvation of the dry areas can be evaluated against the fore-going discussion. The view that Katumani gives the same returns for all areas of similar rainfall is a gross over-simplification. Our research has revealed a more complex situation. We have uncovered four basic patterns:

(1) Communities which have low adoption rates, but are still getting along during drought.

(2) Communities which have high adoption rates, but are still undergoing considerable stress.

(3) Communities which have high adoption rate of Katumani and contrast very favourably with surrounding communities without it.

(4) Communities without Katumani which are in serious trouble.

The same scheme has been found in relation to small scale irrigation. Our resource endowment approach attempts to understand this phenomena.

(2) The Farmer Situation-System Approach.

Understanding the inter-connected relationships potrayed as:

Site ⟶ technology ⟶ drought ⟶ Famine

challenges a simple resource-endowment approach significantly, since one must really account for site characteristics as they relate to the level of technology and the impact of famine. No one doubts that this is a dynamic relationship and one must measure or account for the dynamism that gives different thresholds of stress for different communities.

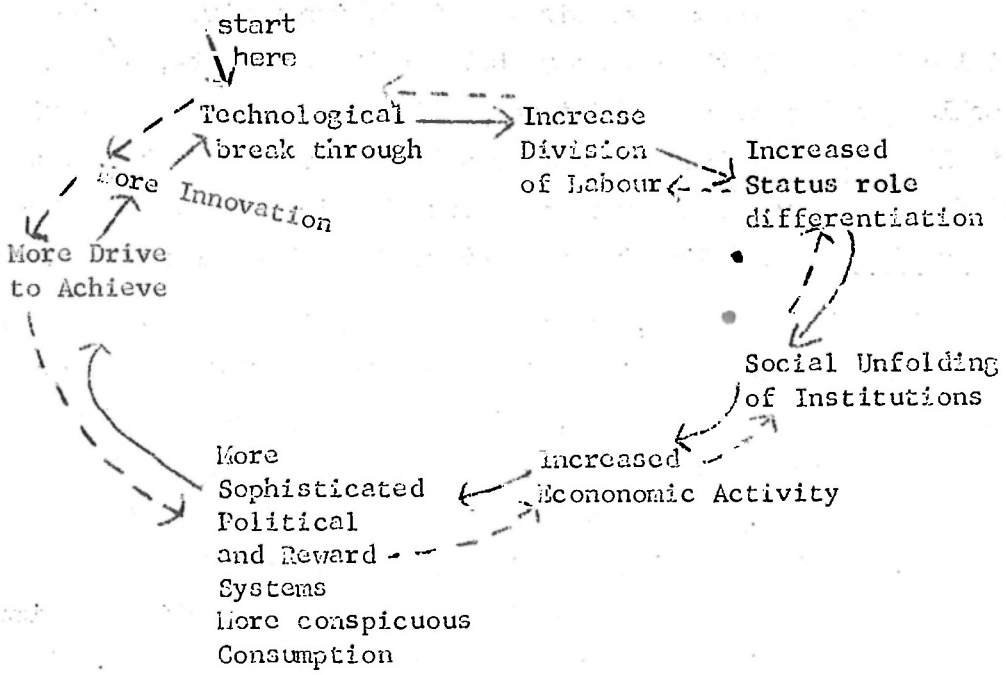
The theoretical framework which gives more heuristic advantage and better analytical scope for understanding how farmers adjust to farming in dry areas of Kenya must combine the elements for explaining adjustment to stress as an innovative behaviour and community complementary social behaviour.

As seen on table I adjustment behaviour, in an empirical sense,

transends simple disciplinary boundaries and needless to say, cannot be explicated by the use of one theoretical model such as an economic behavioural model or a simple resource use model or even a simple sociological explanatory scheme.

The theoretical framework which we find useful in our study borrows from the sociological environmentalists such as Spencer, Oscar Lewis, Sol Tax and builds upon two conceptually distinct sociological theories of change -- the Innovation theory spearheaded by Everett Rodgers and Lionberger and the System-Communication theory as developed by Frank and Ruth Young (1968).

The Sociological environmentalists see mans grasp and harnessing of technology as the basic cause of economic and social advance. Thus, increased social division of labour and hence economic and social complexity are seen as springing from increased technological innovation. Thus historically, for example, the kingdoms of Mesopotamia and Egypt were based on unique irrigation technology and flourished in otherwise desert conditions etc. While this analysis may on the surface seem obvious, we wish to submit that the direction of causation could very well be in one direction as in the other.



Adapted from Evett Hagens Model: In "On the theory of Social Change" Prentice Hall 1962.

Thus, Everett Rodgers opposite view of transfer of technology among farmers from external systems is that this transfer is only possible under a given social system and a threshold social capacity to enable a reasonable evaluation of the technology is a pre-condition for its acceptance. Thus in his view technological advance is only possible when there is a threshold social advance. To him an idea is likely to be adopted when it is seen by the social system as communicable i.e., explicable in existing social symbols; when it is perceived as not complex; when its relative advantages are easily evaluated and when it is divisible i.e,, it can be adapted to the situation of the adopting unit. Rodgers /1960/.

Rodgers approach corresponds closely with Youngs interpretation of Emile Durkheim, (1964) Goffman, 1959, 1961, 1963, W.I. Thomas,(1928) and Burke (1957, 1965). This approach is represented clearly in Goffmans "Presentation of self in Everyday life." Goffman and Thomas see human behaviour in terms of role-playing. To them, man is constantly behaving as though he is on the stage. He is constantly behaving to project an image; to dramatize his ego ideal, to communicate his interpretation of the immediate situation. In his interpretation however Young shifts the level of analysis from the individual level to that of a social system.

Youngs approach emphasizes that all innovative behaviour of any social unit - be it the farm household or the community, - is a result of collective awareness and interpretation of the change situation, and that all reality in this respect is patterned into cognitions, values, beliefs and behavioural norms and taboos to give a collective consesus for behaviour and define the parameters for allowable innovativeness.

In this framework, the peasant farmer in the marginal region, for example, is conceived as living in a dynamic and fluid environment, one that is full of complex values, beliefs and cues for particular action, such as as taking certain adjustment action under varying stress conditions. The peasant farmer, according to this frame of reference is not apathetic, childlike, waiting for famine relief or government officers to tell him how to feed his family. He is always acting to dramatize his image and awareness of his surroundings and thus creates his gods, his social norms and interaction patterns to respond effectively to the physical albeit metaphysical reality.

In action terms, farmers see their economic functions as complimentary to community functions rather than competitive since survival of the economic system in such a harsh environment, for example, is seen as dependant upon the social traditional insurance systems such as

the famed nomads reciprocity, the well known communal rights to limited resources such as salt licks, watering places, livestock routes etc. Among the agriculturalists this relationship is demonstrated by common rights to drinking water holes, cooperative work parties, irrigation water use taboos, community crop sequence norms, community agricultural rites and strong sense of "unclean" practices.

Our view of adjustment behaviour/shifts therefore from simple behavioural traits such as simple economic acts under normal variations in production processes to total social system change under extreme environmental calamities. Thus selling of surplus grain to top up income from a poor cotton crop represents the former case whereas total migration of families to new settlement sites or complete family fragmentation under severe famine represents the former. Many of these adjustment practices and elements of organization have been institutionalized over the years, and are now permanent features of the agricultural and social systems. Examples of this are the characteristic mixture of crops and livestock and the widely spaced network of farm fields, cattle camps, and fields belonging to kinsmen which spread over large areas and which insure at least some little affected or unaffected economic activity during a local drought. However, during regional and national droughts which affect the sites studied these built-in features of the systems are not adequate to meet the threat of famine. In these cases other practices and arrangements appear which one does not often encounter during normal rainfall seasons. Such "adjustments" encountered at the farm level include the following:

TABLE 1

FUNCTION OF ADJUSTMENT	SPECIFIC ADJUSTMENTS
Affect the rainfall source	Pay a rain maker; pray ; Perform locality purification rites . Seed clouds.
Increase Moisture availability by:	
Change of location	Plant larger areas ; plant scattered plots; plant in low-lying wet places; move cattle.
Improve soil moisture storage and distribution	Make ridges; irrigate

FUNCTION OF ADJUSTMENT	SPECIFIC ADJUSTMENTS
Scheduling for optimal soil moisture	Plant dry; plant with the first rains; plant early; wait to plant only with obviously enough rain; staggered planting; plant without any plan (randomly)
Reduce moisture need by:	
Eliminate moisture waste	Weed more; stop planting when rains are poor
Change physiological/technical requirements of crops	Plant drought resistant crops; Plant drought escaping crops
Accept or insure oneself against losses	Do nothing; look for wage work nearby; look for wage work far away; sell cattle; use savings; hunt or fish; collect bush foods; store a previous bumper crop; non-farm economic activity (burn charcoal; make bricks; trade; crafts, bee-keeping, beer brewing)
Distribute or share loss	Send children to a kinsman's; move to a kinsman's farm; move to a settlement scheme; ask help friends; family; ask help of the government; ask help/loan of the cooperative

Table 2 summarizes the percentage of farmers naming a given adjustment among the three most preferred and most frequently practised. The three sites from which data is taken are fairly representative.

TABLE 2

PREFERRED ADJUSTMENTS

HIGH POTENTIAL: KAEWA (Ivēti, Machakos)		MEDIUM POTENTIAL: KARABA (Embu)		LOW POTENTIAL: KATSE (Kitui)	
ADJUSTMENT	%	ADJUSTMENT	%	ADJUSTMENT	%
Plant in wet valleys	63	Wage labour	68	Buy food	81
		Buy food	56	Sell livestock	61
Plant early	63	Help from kin	42	Wage labour	58
Buy food	50	Sell livestock	27	Long distance wage labour	29
Pray	38				
		Help from gov't	26	Help from kin	26

The Hypotheses

The Hypotheses which we hope to test in the series of reports from our drought studies include the following:

(1) Adjustment behaviour to environmental stress become more comprehensive (overlaps many areas of social reality) and clearly defined as probability (calculated) of a given environmental stress (drought) increases.

(2) Indigeneous Systems of adjustment behaviour at the farm and community level form a logical cummulativeness with adopted modern technical recommendations.

(3) Perception of the utility of a given technology (such as Katumani) will increase with increased frequency of drought hazards.

(4) Famine relief is associated with increased probability of drought but not with low community technical base, etc.

4. METHODOLOGY

(a) STUDY DESIGN

The problem as outlined in the last section is choice of technology as it is related to social and economic adjustment to drought. Maladjustment, whether socially or technologically derived is characterized by endemic under-productivity, frequent localized stresses and occasional serious regional famines or epidemics. The focus of this study therefore is to analyse the relationships between ecology, social and economic structure and choice of technology as a response to environmental stress.

To be able to understand the rationale for farm and community adjustments to environmental stress, it was essential to control on the nature of the environment and pinpoint specifically the frequency, degree and duration of the stress. As shown in the theoretical discussion, the frequency, degree and duration of drought in Eastern Kenya is related to

(a) Altitude
(b) Rainfall and Temperature
(c) Soils, topography and water table
(e) Existing level of farm and community technology.

The design adapted, attempted to control on a-c, by locating an altitudinal gradient, from the forest edge of mount Kenya down across the Tana River to the dry regions of Kitui and Tharaka. See Map I. The three altitudinal

gradients include (1) The Meru-Tharaka Gradient, (2) The Embu Gradient and (3) The Machakos-Embu-Kitui-Kamba Gradient.

It will be seen therefore that by selecting communities along these gradients, it could be assumed that communities at the same level on the gradient have similar adjustment problems and any differences in adjustments would be caused by factors other than environmental. With such a design, the challenge of the study is to relate technology to social and economic attributes of the units studied and relate these to the dependent variables such as perceptions of recommended dry land farming techniques, traditional division of labour and changing roles among family members, innovativeness within the various farm sectors such as mechanization, agronomic practices, animal husbandry and other social performance variables such as social participation and level of living.

(b) UNITS OF STUDY: As indicated earlier the two units of study are (1) the farm household and (2) the sublocation. According to Map II, sixteen sublocations (sites) along 3 altitudinal gradients were studied and 610 farm households in all of these sites were interviewed.

(c) SAMPLING DESIGN: 16 rural communities (sublocations or complex villages) were selected to represent three rainfall/altitudinal strata - (1) high potential stratum above 5,000 ft and above 50" rainfall, (2) medium potential 3,000 ft to 5,000 ft and 30" to 50" rainfall stratum and (3) low potential stratum under 30" rainfall and under 3,000 ft altitude.

These sites were randomly selected from a sampling frame of villages within each stratum along the gradient.

Within each community, a sampling frame of farm households was prepared from the sub-chiefs tax list which was brought up to date by additional on the spot enumeration of all household heads. This enumeration proved essential as women household heads and new migrants or emigrants would not be shown on the tax list.

From this pre-enumerated tax list, a 10% or more random sample was drawn by selecting every nth farmer; so that, for example in Karaba, out of a list of 450 household heads, 45 were drawn by taking every 10th household head.

(d) DATA COLLECTION: For data collection, a standard questionnaire, with structured and unstructure questions was used. Due to anticipated problems of interviewer bias in interpreting the original English questionnaire, we recruited vernacular speaking undergraduates who, at the training phase interpreted the questionnaire from English to Mbere, Somali, Mery and Kamba and for consistency checks translated the vernacular version, in their own words into English. Actual data was collected through actual interviews with household heads. This exercise proved difficult as there was still the looming scare of cholera in Isiolo district, Tharaka and Northern Kitui. In addition, these regions have very few roads and moving through thornbushes made it impossible to use bicycles or any cars.

Nevertheless, the mortality rate of the sample, through outright refusals and interviewer fatigue was not as high as anticipated and the average refusal rate was 1-3 household heads per site. We corrected for this by drawing larger original samples than required and if no refusal were encountered we interviewed all.

Data on nutritional Status of children was also collected by weighing all babies under the age of five, using the standard basket scale. The shoulder and head circumference of these babies were also recorded. These figures, compared with standard measures give a quick measure of level of malnutrition. This measure is one of the indicies used to quantify environmentally and socially derived stress on the populations in these regions.

5. RESULTS.

SOME MEASURES OF THE PROBLEM

(i) Famine Relief and Drought

One of the hypotheses outlined in this study predicts postive relationship between the degree of famine and increased frequency of drought.

The following table potrays this relationship.

TABLE TWO (PTO)

The logically anticipated positive relationship between proportion of families receiving famine relief in 1970 and gradient of increasing drought stress is confirmed only for the Embu gradient where the high potential Tea and Coffee zone of Kanja and Gitare received no relief and dryland Ishiara received most.

The Machakos Gradient infact shows negative relationships. During field work, we found that certain chiefs centres such as Kyuso received more famine relief than Katse and Waita. Nevertheless the negative trend especially between Kaewa and the Kitui communities cannot be explained away by the factors of infrasture and food supply only.

The factors which appear to explain this trend further were given to us by the DAO Machakos. He felt that Eastern Province does not have a subsistance technology for the highly populated heavily exploited Machakos hillmasses. "We have been so busy pushing Katumani maize in the lowlands and Coffee husbandry in certain areas of the hills that we have ignored the survival needs of these densely populated steep hillsides of Machakos"* This observation applies in general to the agricultural production priorities in Eastern Province where campaigns for pushing

* Personal Communication DAOs Office Machakos Jan. 1972.

TABLE 2 PERCENT FAMILIES RECEVING FAMINE RELIEF 1970

(A) EMBU GRADIENT

	High Altitude			Low
	KANJA	GITARE	SIAKAGO	ISHIARA
YES	0	0	7	28
NO	100	100	93	72
%	100	100	100	100
n	32	61	68	53

(B) MERU - THARAKA GRADIENT

High Altitude					Low
MIKUMBUNE	MITUNGUU	CHIAKARIGA	GATUNGA	MARIMANTI	KATHANGA
0	14	54	29	22	5
100	86	46	71	78	95
%100	100	100	100	100	100
n=34	29	28	28	23	22

(C) MACHAKOS - KITUI GRADIENT

	High	Altitude		Low
KAGWA	KARABA	KYUSO	MAITA	KATSE
89	60	45	29	17
11	40	55	71	83
%100	100	100	100	100
n=37	45	22	14	23

N = 541

cash crops such as Cotton, Coffee, Macadamia nuts and Castor oil and the unique Katumani programme have led to the detrioration of food crop husbandry and productivity, especially for the more density populated heavily exploited highland zones. Thus although Kaewa is above 5,000ft the low technological base makes it a high recipient of famine relief.

The second observation about famine relief is highlighted by the Meru Tharaka Gradient. It should be noted that as one moves from the medium potential Mitunguu Community, the proportion of families receiving famine relief increases to 54% in Chiakariga and then drops gradually to a very low level in Kathangachini. This appears to indicate that as one moves to more isolated and more arid regions, the supply of famine relief diminishes. This can be accounted for by several factors (a) Farm steads tend to rely more on their own resources, such as milk, blood, wild game and fruits etc. (b) Information on degree of suffering is not Communicated to famine relief committees accurately and in time (c) the transportation and collection of famine relief food is constrained upon by distances, criteria for qualification as a famine relief recipient etc.

(ii) Degree of Suffering and Frequency of Drought.

A first impression of the overall suffering due to drought can be obtained from Table 3. There we have scored farmers' responses to several of the questionaire items to give a comparable index of the amount of drought suffering they themselves perceive. The score is based on the number of serious famines they remember, the level of hunger (mild), crop and animal losses (moderate), and death of people remembered and reported (severe), Site number 115 is near 6000 feet on the Meru side of Mt. Kenya, and the gradient falls toward site number 116, just 6 miles from the Tana River in the Sanseviaria - bush zone. There is clearly an increase in the overall suffering due to drought as one proceeds along the gradient.

TABLE 3

HISTORY OF DROUGHT SUFFERING

ALONG MERU - THARAKA GRADIENT

(% of all farmers in a site)

SITE	NO SUFFERING	NEGLIGIBLE SUFFERING	MILD SUFFERING	MODERATE SUFFERING	SEVERE SUFFERING	
115	0	5%	90%	5%	0	100%
114	0	0	75%	25%	0	100%
112	0	0	45%	50%	5%	100%
113	0	0	25%	50%	25%	100%

Malnutrition is certainly an important dimension of the problem. It is central to the government concern with famine relief, but also the general level of nutrition in an area determines to a great extent the vulnerability of groups of persons to the stress of drought, just how long they can remain healthy and productive on reduced diets, and also to what extent one can expect an increase in the incidence of such diseases as diarrhoea and pneumonia and increases in morbidity/mortality due to such diseases as measles and tuberculosis.

Table 4 summarizes preliminary observations of the nutritional status of children under three years and the quality of adult diet along a typical gradient. The assessment of the status of children was done weight, age, and other physical measurements along.

The figures are percentages of the children who, on the basis of these measurements, are in clear danger due to mulnutrition.

TABLE 24

CHILD NUTRITION AND ADULT DIET
IN 6 DROUGHT STUDY SITES

	HIGH POTENTIAL	MEDIUM POTENTIAL		LOW POTENTIAL		
SITES	MIKUMBUNE	KANABA	SIAKAGO	CHIAKARIGA	KATHANGATHINI	KATSE
ADULT DIET*	16	15	17	14	10	14
CHILD NUTRI.**	10	13	26	15	25	38

* This scores the quality of the food eaten the previous day in terms of vitamins, type of starch, number of meals, and expensive "extras" such as sugar and oil.

** This is the percentage of the children under three years who measured 70% of the standard weight for their age or below. This is the level below which one generally expects to find clinical signs of malnutrition, and it should be taken as an indication that the child is probably highly vulnerable to measles, pneumonia, etc and is, in short, in considerable danger.

The picture here is not as clear as in Table 1, overall suffering. Many local factors influence the quality of diet and the condition of children, and further analysis is required to make sense out ofthe site-to-site differences observed. However it is clear that in the two driest sites (on the extreme right of the table) a significant and disturbingly high percentage of children are in danger. Both these sites lie in the "eastern plateau foreland-marginal zone" mentioned earlier as the zone of highest famine potential in Kenya. They are both in the Upper Tana River Basin for which considerable planning of water resources has taken place. However according to present studies (the ILACO Tana River study being the most recent) proposed large-scale Tana river development will not affect these areas at all.

(iii) Animal losses, as one would expect, are concentrated in the low potential zones. Here again all the data have not been analysed, but an indication of the magnitude of drought impact on livestock can be seen in the Kitui sites.

In our Kitui sample of 120 farmers only 53% owned cattle because, as many explained, they had just sold the last of their cattle this year to make ends meet. 59% owned goats or sheep. 71% said they sell more cattle during a drought period than they do during good times. 74% sell more goats and sheep during bad times. 76% of the sample had had cattle die in droughts before 1970 and the same percentage had cattle die during the 1970-71 drought. Our best estimate is that from 20 to 33% of the cattle in Far Northern Kitui died in the 1970-71 drought. 1965 was the last time serious cattle death had been experienced in the area, and the level of death was only slightly higher during 1970-71.

Forced sale and death of livestock are not the only ways in which the impact of drought is felt. Farmers reported that one in four calves born during a good time die while young. The death rate of calves increased to two out of everythree during the recent drought. Furthermore 29% of the farmers had been forced to sell milch cows. Thismust be taken as a very drastic decision because it means less milk for the children of the family and a much slower rate of herd replenishment once grazing is restored and calving rates are normal.

(1V)Crop losses must be seen in the light of the normal food crop reserves in an area and the cropping pattern. In the high potential areas it was found that farmers didn't normally keep a large reserve of grain, but relied on purchased maize bought with coffee or tea earnings. These people reported that they had had some maize, but had eaten it green in the fields. They of course found it difficult to purchase maize because of the nation-wide shortage. However Irish potatoes, cassava, yams, and vegetables (especially, cabbage) were still harvested.

In the medium potential areas at most 5?% of the households kept a significant reserve of grains. Here the effect of diversification and extensive dryland cultivation was obvious. In Karaba, even though the maize harvest had been very bad, they still had cow peas, green, yellow, and black grams, and cardamon to sell. These farmers cultivated large acreages with rented tractors, and their children seemed not much worse off than the children in higher areas. By contrast, the farms in Siakago, Mbeere division of Embu, just 25 miles away were not mechanized and were much smaller with fewer crops. Farmers there were in more trouble, and twice as many children of Siakago were found to be malnourished than in Karaba.

In the low potential areas normal reserves were highest, 87% of the farmers in Katse normally store large amounts of grain.[9] In these areas a large assortment of crops were grown. These include bulrush millet, sorghum, cow peas, pigeon peas, and many varieties of grams. Even at that the millet harvest had all but failed in many areas. More information about crop losses will be presented in another report.

V. Migration is another significant dimension of the drought problem. It was found that short term migration to the nearest upland area in search of wage employment was very common in the marginal zones of Meru, Embu, and Kitui. Tharakans (lower Meru) tended to go to the Nyambeni range and up toward Meru to pick coffee and work at other agricultural tasks. Mbeere (lower Embu) travelled to the lower slopes of Mt. Kenya of the Embu side and to Chuka. The Kamba in Kitui sometimes crossed the Tana River and travelled to the farms on the Embu side of the mountain, others went toward Mombasa. These wage migrants are usually paid in kind and carry food back to their families at intervals. This has the benefit of providing some food for the people of the area and a large, but unreliable seasonal labor supply. However such migration also tends to disturb family life and drains the affected areas of labour which could plant catch crops when the rains break and engage in other local anti-drought measures of the self-help variety described another report, on self help and non farm activities (Mbithi 1970)

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(9) In Katse (Kitui) average reserves left over from the previous season when the next season's harvest came in were 3½ bags of millet, 1½ bags maize, 1½ bags cowpeas, 2 bags sorghum: 7 bags of grain and 1½ bags of pulses. With this they could make it thorough a single season's failure, especially with some non-farm income and sale of livestock, but not two seasons in a row, which is what they faced in 1970-71. The system in this part of Kitui has obviously adapted to the fact that the so-called "long rains" (April peak) fail more frequently than the "Short rains" (November peak).

By contract Karaba (likewise a Kamba settlement, but in a medium potential zone) had an average reserve of only 3 bags of grain (maize) and ½ bag of assorted legumes.

VI. IMPLICATIONS ON NATURE OF NON FARM OCCUPATIONS.

Under normal non drought conditions the most common form of non farm occupation which still continues to take up most of the farmers' time along the Machakos Kitui and Embu gradient is the keeping of stores (dukas) in rural market centres. On the average, 15% of the farmers interviewed were involved in either keeping a duka, butchery, eating house (hoteli) or some form of a bar. It was found that the majority of the storekeepers had had a paid job and had retired to farming and storekeeping. This would be logical since to open up such stores one needed some original capital for construction of the store or for renting one and stocking it with goods. The inventories for Kimutwa and Karaba market shops ranged between 700 shillings to about 20,000 shillings per shop. Most of the capital was invested in the brick or stone buildings and storage facilities, that is, in real estate.

Such stores open for business at about eight in the morning and close late in the evening. Often one finds members of the family alternating in running the shop, especially the literate young wives and school children. On market days however (mainly once or twice a week) most members of the family will help at the counter as it is expected that customers will bargain to their satisfaction before deciding on the price they wish to pay. A market day at Ishiara, for example, is an important event all the way from Embu to Mumoni and Tharaka, a diameter of over 40 miles. This market place will hold over 800 buyers and sellers at 11 a.m. although it has only about eight functional stores and on a normal week day it will hold a population of only 20-50 people at any one time.

(Table 5 about here)

Table 5 shows.....

Table 5 shows the most common forms of non farm occupation, under normal farming conditions for prone sections of the two gradients.

TABLE 5

TYPES OF NON FARM OCCUPATIONS

Job Type		% Household Members	
	B	Female	Male
1.	Shopkeeping (General store, Butchery, Eating House, bar etc.)	0	30
2.	Beer Brewing (often illegal)	29	5
3.	Casual Labour	25	14
4.	Petty Trade: Sale of Snuff Tobacco, grain, Food items, drugs Vegetables etc.	23	6
5.	Bicycle repair, shoe-repair, Tailoring, Masonry and Carpentry	0	30
6.	Lorry and Bus Transport		10
7.	Weeving, rope making (e.g. beads stringing) Matt making etc.	10	2
8.	Curving, Beehive making, arrows-bows making, dance drums making, Arrow poison brewing	0	8
9.	Livestock Trade	0	4
10.	Water Carting	0	3
11.	Medicine men, antiwitch-craft healing	6	3
12.	Pottery	2	0
13.	Part time teaching, preaching etc.	2	3
14.	Other	10	9
		107	127*
Number with some kind of Non farm job	== ==	48	38
Total Householders accounted for % without a non farm job	==	163 70	51** 34
Total sample of Households	==	100	
Total Households in 4 sublocations	==	1462	

** Note that 65% of the Adult males and 6% of the adult women were away on employment outside the study areas and were not included in the sample.

* In some cases household members held more than one non farm job.

*** This data includes only 4 sites - Lower Machakos (Kimutwa), Karaba Shiakago and Ishiara.

Table 5 reveals some interesting patterns. The figures show that a higher proportion of women hold non farm jobs when compared to men. Also, the nature of non farm jobs and their distributions shows a strong sexual bias. Men keep shops, perform repair jobs, capentry and masonry, keep bees, make arrows, engage in livestock trade etc. Women specialize more in beer brewing, casual labour, petty trade, weeving, pottery and witchcraft healing.

But this table, which represents non farm job occupations under normal conditions does not highlight the unique role women play in the desperate bid for survival under famine crisis situations and the more stable aspects of non farm activity. Data for the 1961 and 1965 food shortage periods shows a different pattern from what is presented in Table 5.

TABLE 6

Non Farm Activities Which Took Prominence 1965 Famine Crisis

Job Type	% Household Members	
	Female	Male
Beer Brewing (Often illegal)	30	12
Casual Labour	25	20
Middlemen in Food Trade and Rural Petty Trade	10	5
Selling Crushed Stones and Heaped Sand	15	5
Selling Firewood, Charcoal	10	8
Rope Making, Basket Making,	16	0
Poaching	0	10
Other (Often unemployed or persuing usual activities as shown in Table 5 above.	4	57
	110	117
n = 214	163	51

The available data and supplementary data collected shows that the jobs which took prominence in the 1961/65 famines were, beer brewing 30% women 12% males, search for casual labour; excavation for stones and sand, poaching and unauthorized hunting, petty food trade.

The table also shows quite clearly that in the famine crises, the women tended to adopt more and occupy a leading role as breadwinners.[4] The women were found to be most active in illegal beer brewing and as middlemen in food trade. They would buy grain from one market place and sell it in small quantities, in another. They were thus useful fences for black marketeers. These women would also buy creamed milk from the neighbouring cattle ranches, ferment it and sell it at market places. They would buy raw bananas from distant market places, ripen them under earthen incubators and sell them. They would sell cooked porridge, snuff tobacco, peddle wild herbs and drugs, sell dry firewood and some have been known to sell their favours to men in prison and work camps such as Magadi, Karaba, Machakos, Athi river, Thika, Nairobi etc. In this struggle to obtain food for ones family, a lot of the social norms are relaxed, families are broken and/or whole families migrate to colonize new lands. In 1965 emigration to Chimba Hills, Darajani, Mivukoni, Karaba and Meru from the 4 sublocations studied was significantly reducing the settled population. Given below are some sample responses to the question: "In the current food shortage (1965) how do you obtain food, clothing and school fees for your family?"

Mrs. Mbula — I and my Cousin Mrs. Munyao take sour skimmed milk from neighbouring ranches to police lines in Machakos Town. They in return give us wheat marsh (left overs after ground wheat grain is seived). We come home and cook this for our families.

Mrs. Mwabu — "All my children decorticate Sisal fibre from the centre of the plant, spin it into strings, ropes or just bundle them and take them to the Market (8 miles) Every weekday we get about 20 cts each - enough to get something to eat.

Mrs. Mutio — My husband works at Katumani as a Casual Labourer. But often he spends all the money on Chang'aa and we often go without food. The children have not eaten since yesterday.

Mrs. Maluki — I come from Mutonguni - Kitui, I buy cow peas and beans from Karatina and sell it on market days here at Karaba and Masinga.

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4. The prominent role played by women in self help activities in this area also adds support to the argument that it is the women who need as much training for farm and rural development as the rural men.

Mr. Mutwiwa — I have sold all my goats and have asked my wife to sell any chickens they may have. I do not know what we should do next. The headman has not reported my name for famine relief.

Mr. Malombe — My youngest son and his wife have gone to Darajani (100 miles S.E. of here) to grow some maize and start a farm. The other day he brought a bag of maize and we have no problems at the moment.

The sample answers show some short term and one long term responses to famine crisis. The system whereby members of an extended family travel to new marginal areas to open up new 'colonies' and grow crops to send back to the parent household is common in the areas studied.

It should however be noted that the study of non farm occupations through interviews of existing farm household heads logically leads one to under-estimate the innovative potential of the people who live in these areas. It is possible that successful adaptation to the harsh environmental conditions leads one to abandon farming altogether or migrate to rural or urban centres or start a full time non farm occupation.

(6) SOME FORMAL SOLUTIONS

(i) KATUMANI MAIZE PROGRAMME*

The most effective government low cost response to the alleviation of famine food shortages and human suffering in the low potential, highly populated farming areas has been the sponsoring of research and extension services for the spread of the early maturing Katumani synthetics and composites A and B. This crop variety adapts to dry conditions by growing very fast an "escaping" drought. It normally flowers in under three months.

Effective adoption of Katumani in these areas would ideally reduce moisture requirement of the main stapple - Maize from 12" per season to about 7" per season.** Rainfall probability calculations for most sites in this zone show that this would reduce the incidence of crop failure and food shortage from once in ever three years 1 : 3 to once in every 8 years 1 : 8. This means a reduction of crop failure and food shortages rate from 33⅓% to 12½% which is average for Kenya and thus a normal state.

** Dowker B.D. Rainfall reliability and maize yields in Machakos District. E. Afric. for J. 28, 134 - 135.

* A specific report on the Katumani Maize programme, giving the goals achievements and suggestions for improvement is being prepared. This section highlights some crucial aspects only.

What might it mean in terms of famine relief? If in one food shortage period there are 50,000 people receiving relief, and if the cost per person is = /50 (fifty cents) per day, then:

Daily cost of relief: 50,000 x .50	=	25,000/= /day
I drought season 6 months 25,000 x 6 x 30	=	4½ million shillings.
Cost of Transport, Administration of Relief	=	N.A.

If we assume that the seasonal relief programme costs 5 million shillings, for one region, then:
The successful introduction of Katumani Maize Programme cuts this by 205/6% = 1.04 million shillings. Actually the cost cut is greater than this since frequently successful harvests of Katumani leads to increased storage capacity or marketing of surplus which introduces farmers capacity to meet food shortages independent of government support. These economies of frequent supply and surpluses would therefore reduce the governmental cost of famine relief by about 50% for the low potential farming regions.

Has Katumani Maize Programme been Successful?

Our Makerere study showed that there are over 80% farmers who use Katumani maize either for all the farm or in sections of their farms.

The critical question was, then why hasn't there been a significant (observable) reduction in the frequency of food shortages? Two findings helped shed light onto this problem:

(a) Although the average family of 5 adults requires over 3 acres of land for subsistence at the productivity level of 3-4 bags of maize/acre, the average acreage of Katumani maize was about 1½ acres.

(b) The ratio of Katumani to total maize acreage which included long growing high moisture demanding varieties was less than 40%.

Therefore the acceptance rate of Katumani in terms of effective acreage is extremely low and this explains the lack of significant improvements in the food supply problem.

Why has the Katumani Programme not been Effective?

(a) Distribution of Seed:

Due to frequent famines, farmers normally eat up all their surpluses, including any stored seed. Also, Katumani seeds can be planted consecutively for 2 seasons only. Supply and Distribution of seed early enough for planting is therefore very important.

At the introduction of the programme in 1958 - 64, Katumani seed used to be produced near the areas requiring the seed and distributed by the extension staff. At the moment, seed is produced and bulked at Kitale. This has the following disadvantages.

(i) Kitale being wetter and cooler has a longer maize growing season. Thus, the seed often matures too late to be sent to farmers in the dry areas. To quote the DAO of Machakos:

"Last season 1971-72, we hoped to plant 60,000 acres of Katumani maize. This would have stabilized our food supply for 1972 at least. But Kitale could not supply us with any seed. We bought any seed we could get from Katumani research station, and private farmers. Consequently we were able to plant only 600 acres of Katumani in the whole district! " (Personal communication at DAOs office Machakos Jan 1972).[1]

(ii) The distribution of seed must be arrange such that the cost of transportation and hence the cost of seed is reduced. Kitale is at least 300 miles from the major consumption centres excluding Baringo and the Rift Valley dry zones.

The argument for using Kitale is to cut down the probability of a total seed failure.

It is recommended strongly that seed bulking and supply should be spread out. Some at Kitale, Katumani farmer Training Centre which has over 200 acres, Kampi ya Mawe Makueni, Tseikuru, Kirinyaga, Kakamega, Marsabit, Moyale and Baringo very much using the idea of demonstration farms and testing ground for the adaptability of the breeding programme and other dry farming techniques.

1. Note because of shortage of Katumani seed at the stockists, many farmers were deceived and bought "Kilo" maize a hybrid variety which, to their dismay continues to grow without any sign of flowering till the rains are over, and then wilts.

(b) Low Adoption Rate:

It has already been shown that the effective adoption rate of Katumani is 40%. One of the major factors which explain this low adoption rate is the low effectiveness of seed bulking and seed distribution. Another factor which coversa host of other policy variables is farmer perception of Katumani maize.

The following tables indicate how farmers evaluate Katumani maize with respect to their own local maize varieties.

TABLE 7 How does Katumani Yields Compare with that of Local Maize?

(A) MACHAKOS - EMBU - KITUI GRADIENT

	High Potential				Low
	% Farmers Responding				
	KAEWA	KARABA	KYUSO	WAITA	KATSE
Better	2	20	46	50	71
Same	6	36	27	19	14
Worse	70	44	9	6	1
Don't know,	22	0	18	25	14
	%100	100	100	100	100
n=	37	45	22	16	24

(B) TABLE 8 MERU - THARAKA GRADIENT

	High Potential				Low
	% Farmers Responding.				
	Mikumbune	Chiakariga	Gatunga	Marimanti	Kathangachini
Better	9	32	47	50	60
Same	0	3	4	15	4
Worse	27	11	43	35	0
Dont know	64	54	6	0	36
%	100	100	100	100	100
n =	34	28	28	23	23

TABLE 9

(c) EMBU-MBERE GRADIENT

High Low

% Farmers Responding

	Kanja	Gitare	Siakago	Ishiara
Better	24	37	68	70
Same	0	1	17	15
Worse	25	25	15	11
DK, Not Ascertained	51	37	0	4
	100	100	100	10
n =	32	57	67	53

The tables presented above clearly indicate that perceptions about Katumani yields is related to the suitability of the crop to an ecological region. In the high potential hybrid maize and medium potential maize zones, more farmers do not know about Katumani and many feel that Katumani is w o r s e and fewer, except for Kathangachini and waita, do not know about Katumani yields.

With respect to the size of the crop, which farmers value most because of trouble with rodents, dogs, and bush pigs, we found a consistent feeling across the gradients that Katumani is worse in size than local varieties. Some of the cobs displayed to potray this were literally 2 inches long. This, it was found, relates very much to whether farmers recommended agronomic practices were low or high.

As we anticipated, more farmers did not know whether Katumani resists diseases better than local maize. On the whole, those who had an opion, said that Katumani resists better or the same as local maize.

Discussion: The Katumani maize seed has been recommended to the farmers on the basis that it yields better than local maize under conditions of 8" rainfall to 12" rainfall. But the extension workers did not inform farmers that this performance is only true under optimal husbandry conditions. Our observations of Katumani under poor exhausted and compact lateritic soils is that it grows to about 2-3 feet high, turns yellow and purple, and produces 1" cobs with or without any grain! Farmers do not like this since the wilted straw cannot be used for feeding livestock in the dry season. Local white maize on the other hand grows taller even under similar conditions and has the saving

grace of producing straw for livestock. Also, under higher rainfall conditions, local maize outyields the traditional Katumani Synthetic I-V.

The effective campaign for Katumani maizes ought to note the following:

(1) Farmers rarely use optimal husbandry practices such as 100% fertilizing, early planting 100% weeding etc. Agronomic research therefore must establish sub-optimal break-even practices so that farmers are advised on the absolute minimum requirements for a comfortable yield level.

(2) The original Katumani maize campaign was ill planned in that synthetics I-V had very low relative advantage over local maize and never attempted to contrast on the farmers own farm situations, the merits and demerits of the crop. Undoubtably, Katumani Synthetic VI and the new composites are more superior and yet, no campaign has been mounted to erase the old negative perceptions about "Katumani" and plant new ones. It is suggested that a new campaign or a change of name be attempted to increase the receptivity of the new more superior varieties.

(ii) FAMINE RELIEF:

This is the second and most publicized government programme geared at alleviating starvation, and eliminating death from starvation, alleviating malnutrition -- especially Kwashiorkor and Marasmus among children. The necessity for this programme is determined by the following factors.

(1) Environmentally derived food crises such as food shortages due to unusually long drought, floods army worm, locusts, crop disease epidemic, livestock epidemic.

(2) Socially derived stress which either affects availability of farm labour and other farm resources or directly removes the source of food. Examples would include: (a) large scale or continued cattle raids among nomadic tribes whose dependence on livestock is about 100% (b) localized rebellion which might lead to the forceful disruption of families, leaving behind destitute old or young people. The recent Shifta activities can be classified in this category.

(3) Increasing population pressure under land which has been exploited to a point beyond its carrying capacity and which under existing technology cannot support the existing population. Such a situation creates a state of endemic food shortages which slowly continue to rise toward famine proportions. Such cases are found in the Marginal Agricultural areas of Eastern Kenya, Kwale, Lamu - Tana River, etc.

The Rol of Famine Relief: If we assume for the moment, that famine relief is an efficient programme which is geared to meet the outlined types of food-related crises, then the one question we should ask is: is continued famine relief the only alternative? Obviously it is not because of the following reasons:

(a) An effective famine relief programme organized on the principle "So long as a citizen is starving he qualifies for relieve" may very likely sow its own seeds of failure.

In our research we discussed this problem with Subchiefs and District Officials at Marsabit and also interviewed Mr. Araru, the M.P. for Marsabit and Moyale, local farmers and relief recipients at Karaba, Shiakago and Machakos. From these interviews it became clear that the officials were all concerned about the creation of a class of people who are perennially dependant upon government relief. At Karaba the Chief talked of families which were always among the first in the queue. At Shiakago the Sub-chief named families who were "lazy" and were always running to the government for food.

This view endorses the principle that the long term solution of localized food shortages does not lie in famine relief reliance, but industriousness even in critical times through the introduction of alternative farm or community level dry land farming techniques and programmes.

(b) The famine programme was also underscored because according to Mr. Araru - "famine food is even being used to pay bride wealth"! The politics of famine relief are not hidden even to lay men. In our study we found that famine relief is a political resource owned by local influentials. We have no concrete data to illustrate this; but it should be obvious that the consequences of placing a commodity which is in high demand in the hands of a few individuals, without clarifying the terms of transactions are:-

(i) The creation of addition arbitrary transaction criteria which reinforce the social position of the giver.

(ii) Misallocation of the said commodity due to gradual routinization of the original criteria leading to a change of goals and targets.

(iii) Victimization of recipients in the event of failing to comply with informally established procedures.

In the areas studied, the search for social prestige, economic gain and political allies has led to the deliberate re-channelling of famine relief food or deliberate statistical adjustment so that high figures of recipients are reported.

(c) Inspite of this picture of community pre-occupation with famine relief affairs, it was found that not all deserving cases come to claim their share.

It was found that in order to receive the daily ration people had to be willing to fulfil the following requirements which often turned off certain people.

(i) Work on community projects such as road digging, cutting grass around the chiefs camp; etc.

(ii) In Northern Kenya, be willing to settle near famine relief camps.

(iii) Trek long distances to chiefs centre for daily ration Some were often too weak to cover these distances.

(iv) That often famine relief food was "hard on the stomach" and often caused diarrhoea which was worse than going hungry in such a dry climate.

(v) Be in the chiefs tax books and naturally, hardened tax evaders were loath to go anywhere near a chiefs camp.

(d) It was however found that there are certain families who appear to be chronically deserving cases.

In Northern Kenya there are several reasons for this

(i) Due to prolonged water or grazing shortage, the young members of the family move away with the livestock and eventually go beyond points of contact with the home Manyattas. This often leaves destitute old and young people and the sick. These have no means of livelihood and in an urban setting would become beggars but in these areas often move to famine relief centres.

(ii) Shifta raids and continued cattle raids normally wipe out families leaving defenseless young children who may have been herding goats. Some have been found eaten by hyenas and the lucky wander around and eventually reach a famine relief camp.

In the marginal farming areas, the disruption of families due to severe famines appears to explain the reason for the chronomic famine relief cases. Of course the emigration of young to towns leaving old people, invalids and children is another important factor.

Famine Relief and Social Security:

If the policy of discouraging the development of dependancy on famine relief is going to be tackled more realistically, we must isolate the main reason for relief - i.e. sudden food or nutritional crisis - from the welfare cases.

The formulation of famine relief policy which does not address itself to the various target groups is likely to be a deficient exercise. These target systems include; normal rural people, children and pregnant mothers, invalids and the aged.

Some of these cases need to be incorporated into a government welfare policy rather than a famine relief policy. The breakdown of Communities, families and mutual help groups under social or environmental crises creates welfare problems. In the Dry areas and in Northern Kenya in particular, these welfare cases exist in greater numbers than elsewhere in Kenya.

It is imperative therefore that we view famine relief in two dimensions: (a) The Welfare dimension

(b) The defensive stop-gap food supply efforts made under unique shortage conditions.

These dimensions separate two kinds of activities and isolate the need for government rural welfare programme which is critically need in the more harsh areas of Kenya. Deaths from famine are closely associated with (i) The aged, the crippled, the insane.

(ii) Nursing mothers and ill persons.

(iii) Children.

(iv) Widows, widowers and social outcasts.

In Kenya where Social Justice, State Welfare and respect for life and wellbeing are main themes of sessional paper No.10 the Kanu Manifesto and our Development Plan 1970-74, any government relief policy should expand on this political mandate and operationally isolate the two programmes hitherto treated as one.

SUMMARY OF MAJOR OBSERVATIONS

(1) Lack of clear cut rural development policy for the marginal farming areas of Kenya inspite of the fact that encroachment of populations from highly populated areas to these areas is leading to a rate of population increase of 10% - 30% in such areas as Eastern Meru, South Isiolo districts, Kwale district, Machakos (Makueni South, Yatta), Kilifi, Tana River, Taita (Voi division), Kitui (all except central division), Embu (Mbere) etc.

(2) The positive new research impetus at Katumani to increase the Lysine (protein) content of maize to offset malnutrition in areas where maize is the staple diet. The positive new direction in combined plant breeding - agronomic research into maize high protein grain crops such as pigeon peas cow peas, mexican 142, etc. to increase subsistence capability of the marginal areas. The positive research orientation is however constrained by:

(i) Very poor liason between grassroots extension workers who are familiar with farmer-farm problems of adapting research station technology for their own conditions. Lack of adaptability has been identified as a major constraint to the adoption of new technology by farmers.

(ii) Lack of economic bias among plant breeders and agronomists to develop alternative practice combinations which cut down the financial strain imposed by the use of optimal solutions (practices) by peasant farmers.

(iii) Ivory tower rish isolation of research stations and staff from their real target groups - Kenyan small scale farmers; leading to inability to consistently re-evaluate research programmes and identify areas of urgent intervention where their guesses are much more useful than extension officers rules of thumb.

(3) That the regional and local famines in Kenya are likely to increase, especially in the former ranching regions of the Eastern fore-land.

(4) That the famine relief programme needs to isolate Welfare cases from occasional famine relief needing cases. That this programme should be split into two - The Rural Welfare Programme and the Food Distribution Board.

(5) That non farm activities form a significant alternative to farming, especially under conditions of increased stress and this area needs further studies.

(6) That in the marginal farming areas, collective insurance through practices of reciprocity, communal dominance above individualistic desires, cooperative work sharing, etc. are all enhanced to ensure survival of the greatest number of people and are enhanced by unique social pressures.

That these social pressures transcend all fields even agrkculture where the 'cattle complex', farming taboos, etc. are more firmly entrenched than in more fluid high potential regions. This means

that new extension approaches, challenge not only rituals for seed selection, timing of planting, seed-bed preparation, weeding, pest control etc, but also threaten social positions which co-ordinate these functions such as the rain maker, ritual elder, ancestoral spirits etc. That new technology shatters the rubric of community and family life. That this new technology is often not developed for such regions and the suffering introduced is not worth the marginal gains. These points - suggest that the development of dry land technology should be adaptive rather than transformative. Since the risks of failure are much far reaching than in situations where alternatives are many.

RECOMMENDATIONS

(1) Need for a Minimum Subsistence Requirement Strategy: It is recommended that the establishment of research priorities in agriculture should reflect the current Rural Development priorities - to increase rural incomes and alleviate the growth of regional income and development disparities where in the marginal areas even subsistence levels are not assured let alone increased incomes. This means that a programme of ensuring minimum subsistence level for all Kenyans, whether achieved through better food distribution or through a programme of regional food self sufficiency should be initiated urgently.

(2) Adaptation of Modern Technology to Micro-situations as a Priority: If a programme of regional self sufficiency is adopted (and our experience with problems of predicting food shortages and transporting it to areas of need in time suggests that it may be more feasible), a more decentralized research station programme and a closer liaison between extension staff and research station staff called for.

It is recommended therefore, that the Kenya Government plan, on the medium run, an establishment of widely distributed testings/ agronomic trial farms where Government researchers meet the farmer, the economists and the extension officer to simulate the actual farm situation. The well chosen divisional testings/research posts are suggested, on the lines of the present trial stations set by Kitale and the machinery testing unit.

(3) Settlement of Pastoralists very highly risky undertaking: It is recommended that the suggestions contained in the report on the Kaputiei Group Ranches be adopted[1] i.e.: "...that the settling of nomadic and semi nomadic pastoralists requires more than physical development of the area (water development, cattle dips etc) it requires that the ecological conditions permit permanent settlement (as the reversion to semi-nomadism by the Poka members in 1971 demonstrated)".

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[1] See Halderman J.M.: An analysis of Continued Semi Nomadism on the Kaputiei Maasai Group Ranches; Sociological and ecological factors. IDS Working Paper No.28.

The implication is that the indigeneous nomadic or semi-nomadic farming systems may be more adapted to the harsh unreliable environment and any technology which indicates permanent settlement must be tested within the region and not imported or be half baked such as the current sketchly designed settlements at Sololo-Moyale, Kinna Isiolo etc.

(4) Famine relief and a minimum Rural Welfare Programme must be separated: The current measures to discourage the development of dependancy on famine relief food for families, which include proposals for stopping famine relief altogether are, we submit, rather hasty since our studies indicate that famine is a real threat to over 4 million Kenyans living in the medium and low potential farming regions of Samburu, Kuria Busia, Kwale, Narok, Machakos, Marsabit, Moyale, Kilifi, Tana River, Kitui, Meru, Embu, Turkana, Baringo, Lamu, Isiolo, Garissa, etc. It is suggested that a rural welfare programme to isolate victims of local unrest such as shifta, cattle raids etc; or cripples, the sick, old and the abandoned be instituted so as to identify the actual needs for famine relief and suggest long term strategies to alleviate the need for relief.

(5) Farm Fixation should be replaced with "Gainful Activity Fixation": Local crafts, leather and hide rural industries in pastoral areas, labour intensive mining and road works, intensive localized irrigation, fishing in Lake Rudolf, Baringo and the Tana River (especially under the new Tana Development Programme), Tourism, water, trade etc are all poorly explored and highly realistic alternative money earning activities. Our studies indicate that the concept of a "farmer" in an area where large stretches of land are "unproductive" in the traditional sense is rather unrealistic and the critical concept in these areas should be "gainful activity", per individual which stretches to include the direction of hitherto uncontrollable illegal poaching of wild game, uncontrollable illegal beer making, cattle trade, crafts, bee-keeping, medicine and anti-witchcraft herling, pottery, cloths and ornamental designs etc. It is suggested that a more realistic rural industrialization programme should have the following: (i) attempt to harness and stimulate local skills and initiative (ii) use tribal cultural craftsmanship as a base (iii) avoid using terms such as illegal poaching or illegal beer making on activities which are traditional and embark on a programme of educating rural people on the evils of some of these practices.

(6) Famine Warning System: The East African Meteorological Department is already going ahead with an improved agro-meteorological station network. It should be persuaded to site some of its new stations in Kenya's highest famine potential areas, for example, the eastern marginal lands. This would provide needed technical support for any future programme of experimentation with dryland farming techniques and also contribute to a national famine warning system. Other elements in such a warning system would have to be improved agricultural produce reporting systems and reports of the nutritional vulnerability and reserves of high risk populations.

(7) Drought and Regional Hazards Research: On the international level, Australia, Mexico, Nigeria, Tanzania and Brazil have established drought and regional hazards research programmes, to study optimal land use patterns, establish drought warning systems, advise on storage policy, advise on population carrying capacities and settlement policies etc.

Kenya, with such a notorious history of famines and with losses to the magnitude of £10 million per drought should seek international collaboration to establish such a centre even on the lines of the very successful Eastern Africa Locust Control Organization.

At the national level, the Ministry of Agriculture, with consultation with the East African Meteorological department and the University should establish a unit for Drought and Regional hazards management. Such activies would lead to the prediction of when to start and cut off famine relief and eliminate the issue of dependance. It would lead to forcasts on when pastoralists should sell off more cattle and when government marketing agencies should be more alert.

(8) Katumani Maize Programme:

The Katumani maize seed has been recommended to the farmers on the basis that it yields better than local maize under conditions of 8" rainfall to 12" rainfall. But the extension workers did not inform farmers that this performance is only true under optimal husbandry conditions. Our observations of Katumani under poor exhausted and compact lateritic soils is that it grows to about 2-3 feet high, turns yellow and purple, and produces 1" cobs with or without any grain! Farmers do not like this since the wilted straw cannot be used for feeding livestock in the dry season. Local white maize on the other hand grows taller even under similar conditions and has the saving grace of producing straw for livestock. Also, under higher rainfall conditions, local maize outyields the traditional Katumani Synthetic I-V.

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(9) Population Migration and Uncontrolled Settlement:

There is a very urgent need for a study to be undertaken to analyse why the level of population in the outlying marginal areas has soared so fast in recent years and what land and population policy, in the short run need be devised to meet this crisis.

(10) Applied agronomic field trials of new and local millet and sorghum varieties need to be tried intensively for areas receiving between 5-6 inches of rainfall per season since the existing Katumani varieties begin to produce marginally as rainfall drops below 7" per season and yet population is pushing on to these marginal areas.

(11) A grass roots storage campaign to educate household heads on seasonal and annual food planning for each family is recommended. This should go hand in hand with the mammoth national storage programme whose major problem is lack of knowledge about peasant food production capacity and consumption levels at any season, and for any region.

(12) Recommend that National land use planning should be based on the fact that the population carrying capacity of any region is not only dependant on rainfall but varies across short distances due to other factors which includes Geology-Water table, Soil texture and depth, Soil type, Slope and Aspect, Current technology, alternative non farm activities, Community innovative potential (measurable) and level of traditional technology which is to be changed. As shown in this study land on the West Iveti hills has a much lower carrying capacity that land in similar areas of Kanja and Gitaro and the lower areas of Mikumbune. Land in N.". under certain conditions can be settled.

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