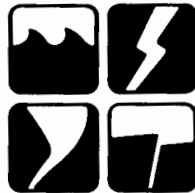


Natural Hazard Research

AN OVERVIEW OF DROUGHT IN KENYA
(NATURAL HAZARDS RESEARCH PARADIGM)

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PREFACE

This paper is one in a series on research in progress in the field of human adjustments to natural hazards. It is intended that these papers will be used as working documents by the group of scholars directly involved in hazard research as well as inform a larger circle of interested persons. The series was started with funds granted by the U.S. National Science Foundation to the University of Colorado and Clark University but now is on a self-supporting basis. Authorship of papers is not necessarily confined to those working at these institutions.

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INTRODUCTION

The study of drought is not the historical task of any one discipline; rather it emerges from a synthesis of the methods and findings of a number of physical, biological, social and humane sciences (Burton, Kates and Kirkby, 1974). One well-known product of such a synthesizing approach is the Natural Hazards Research Paradigm which has its historical origin in the problem of flood control in the USA (White, 1945). The author states this "pursuit of a public policy issue led to a simple research paradigm and a model of decision-making dealing with how man copes with risk and uncertainty in the occurrence of natural events" (White, 1973, 193). The paradigm consists of systematic efforts to

- (1) Estimate the extent of human occupancy in areas subject to extreme events in nature.
- (2) Determine the range of possible adjustments by social groups to those extreme events.
- (3) Examine how people perceive the extreme events and resultant hazard.
- (4) Examine the process of choosing damage-reducing adjustments.
- (5) Estimate what would be the effects of varying public policy upon that set of human responses.

(White, 1974, 4)

Definition

Kaltenhauser (1972) defines drought as "a meteorological excursion from normal of sufficient size and duration as to cause serious damage to the established plant, animal, or human life systems." The Canadian

summary (Visvader and Burton, 1974, 6) agrees that " a period of water shortage becomes a drought only when cultural or biologic activity becomes constricted." Furthermore a definition of agricultural drought must be sensitive to the energy-moisture balance. In the words of the Canadian summary (Ibid.):

While a lack of precipitation is basic to a drought situation, modification of the environment or man's activities (to increase water supply or decrease demand) may either ameliorate or exacerbate the impact of the physical element of drought.

Man's role at every stage (not just in mechanical response to the fait accompli) in defining the nature of a drought cannot be overemphasized and is as important in underdeveloped countries as in a country such as the USSR, where man helps define drought through large-scale hydrotechnical projects on an interbasin transfer of river water (Gerasimov and Zvonkova, 1974, 48). Water demand can be increased just as surely by migration of poor farmers into drier country or by a misguided "fixation" on maize rather than locally available millet in eastern Kenya or by "irresponsible multiplication of cement-tank reservoirs" leading to overstocking in northern Somalia by "parliamentary deputies during the 1960's who sold their votes for cement-tank permits, and who built the tanks with embezzled government funds." (Davidson, 1975b, 303). Nor is the reduction of water demand dependent on capital intensive technology, as even brief acquaintance with peasant agronomy shows.

Official recognition of drought requires another sort of definition, more difficult to achieve. Recognition in Kenya is not pre-arranged by an elaborate structure of legislation as it is in other parts of the world (Heathcote, 1974). There exists no special communication system by which the reports of distress from administrators, agents of the

technical ministries, voluntary agencies, or the business community (including large farmers) are correlated. Such decisions as the relief from personal tax are made by the Provincial Commissioner, hence ultimately the Office of the President which stands at the top of the administrative hierarchy of Province, District, Division, Location and Sublocation. The Treasury makes decisions concerning money for Famine feeding and other forms of immediate relief. The "recognition" of drought required to justify the decision to raise the price paid for cattle, indirectly subsidizing affected groups without the direct use of famine feeding, might be made by the Ministry of Agriculture but not by the Kenya Meat Commission, who have the power to act. Hence there usually exists in the case of each large-scale drought a period of confusion resulting from a number of uncoordinated "definitions" of drought.

During this period four "voices" tend to be heard above others. The definitions of small and medium-sized farmers, where represented at all, are heard in parliamentary debate. Such debate as well as the pronouncements of voluntary agencies, especially missions, are given edited coverage by the news media, which, generally speaking for government, constitute a third "voice." The fourth is the voice of the large farmer, the only farmers to be well organized in Kenya. Their organizations such as Kenya Farmers' Association lobby intensively but with little use of the news media.

Out of the period of confused and conflicting definitions of drought there emerges, if the situation is bad enough, an ad hoc committee for the coordination of "relief." Conflicting "recognitions" are sublimated during a period of intense humanitarian aid. During this period the dominant "definition" is that of the Office of the President which may or may not

co-opt various technical ministries (Health, for instance) in defining, more precisely, which Divisions, Locations, etc. are actually suffering "drought" and which are not. The Office of the President also co-opts the services of some powerful institutions such as the Army and Air Force which generally do not claim to have any "definition" of drought.

This consensus definition only lasts through the period of emergency "relief." The institutions whose cooperation is required for rehabilitation, reconstruction, not to mention permanent prevention of future occurrences of a similar magnitude (for instance the Agricultural Finance Corporation, the Kenya Meat Commission, etc.) do not share a common definition of drought.

Spatial Distribution and Areal Extent

Drought is a potential hazard for agriculture in nearly all of Africa because over the vast majority of the surface of the continent very high evapotranspiration rates are not equalled by available moisture. Kenya is no exception. In fact nearly 80% of its land area (440,300 km² of 567,000) is unlikely to receive more than 30 inches (762 mm) of rainfall more than three or four years out of ten. Ominde (1971, 146) chooses this 30 inch isohyet as the boundary of the "semi-arid and arid" lands of Kenya. "On this basis," he remarks, "the semi-arid and arid lands of the Republic generally form a wide arc around the core region of the Central highlands and the westward-sloping plateau bordering Lake Victoria." The commonly accepted lower limit of high-potential land in Kenya is a reliable 35 inches of rainfall. Map 1, taken from Taylor's Computer Atlas of Kenya (1971) shows the distribution of such high potential land in Kenya.

Although from Map 1 it is clear that on the basis of evaporative needs

rainfall could fall short enough to cause "serious damage to established plant, animal, or human life systems" almost anywhere in Kenya (this becoming increasingly unlikely where potential evaporation falls below 1600 mm), serious drought generally limits itself to Ominde's "wide arc around the core region" (Ominde, 1968). This core region is in fact the former White highlands and is Kenya's agricultural heartland (Odingo, 1973).

Within this wide arc of drier land and high potential evaporation the risk of drought is again differentiated, the lower and drier parts generally being more prone to drought, although major qualifications according to demographic and livelihood patterns will be pointed out later. 33% of Kenya's land area receives from 20-30 inches (508-762 mm) annually. Another 17% receives from 10-20 inches (254-508 mm), and over one quarter of the land area (27%) has under 10 inches rainfall a year (Ominde, Ibid.)

It has been estimated that 2.4 million persons live in the zone receiving from 20-35 inches rainfall annually (ILO, 1972). These 2.4 million are mainly small farmers with some livestock. Since a number of factors combine to produce a growth of population in this zone far in excess of the average national growth and since the rainfall regime in much of this zone is likely to fail to meet crop needs one year in three, it is this smallholder-dry farming zone of lower rainfall which is most likely to suffer "constricted cultural or biologic activity" due to drought. My study area, indeed the whole of the Eastern Foreland Plateau, some of the drier parts of the coast, and substantial parts of the Rift Valley, falls into this zone.

This is, of course, not to forget the million or so pastoralists who inhabit the zone which receives between 10 or even fewer inches up to 20 inches of rainfall. A set of related factors are making these

people as vulnerable to drought as the smallhold dry farmers. The major pastoral areas are in the Southwest-South central areas (South Nyanza, Narok, and Kajiado), the Northwest (Samburu, Turkana), and the North-Central and Northeast (Marsabit, Isiolo, Mandera, Wajir, Garissa, and parts of Tana River District). Map 2 delimits the Eastern Foreland Plateau, other major areas of smallhold dry farming and the major pastoral areas.

These zones of highest potential drought suffering are also zones of actual suffering. In 1961-62 famine relief maize totaling 23,839 tons was distributed in Narok, Kajiado, Machakos, and Kitui districts. 4, 189 tons went to the extreme Southwest (Taita, Kwale, Kilifi, and Lamu District). 3,219 tons were distributed in the small but densely populated area of lower Fort Hall, lower Kiambu and lower Embu Districts. A further 1,539 tons went to Baringo District in the Rift Valley and a total of 1,127 tons among the pastoral people of Samburu and Turkana Districts (see Map 3-3).

The 1970-72 drought eventually extended to all of these areas again, but the major suffering included in addition the whole of the northern pastoral area and the lower parts of Meru. In 1970-72 the South (Narok and Kajiado) and the Southeast (Taita, Kwale, etc.) did not suffer as much as in 1961 mostly because drought was not followed by flooding as it was in 1962.

Frequency, Magnitude and Duration

Kenyan evidence suggests the occurrence of three types of drought: national, regional, and local. The national drought, which directly affects the production of more than 10% of Kenya's population, lasts two or more growing seasons, and generally involves serious loss of production in most ecological zones and usually in two or more Provinces. This type

of drought seems to occur about once every decade. Farmers in the eastern Kenya study mention very serious droughts in 1913-18, 1925, 1936, 1946, 1954, and, of course, the droughts of 1961 and the early '70's. Ojany and Ogendo (1974, 63), as noted earlier, give 1928, 1933-4, 1939, 1942-4, 1952-5, 1960-1 and 1965 as major drought years. Droughts of 1933-4 and 1942-4 are remembered by Luo in the West as well as by Easterners. Heavy livestock losses are usually involved in this type 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). In such a drought it is not uncommon for crop production even in the highlands to be affected as was the high potential coffee-tea zone on Mt. Kenya during 1970-71.

The regional drought, which directly affects the production of less than 10% of the population at a time, 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 occurrence of this kind of "regional" drought varies according to the kinds of crops grown, densities of livestock and particular kinds of grazing. With local maize one would expect such a drought once every three or four years. With full adoption of drought-resistant Katumani maize it might occur only one time in every eight years. Millet in northern Kitui and southeastern Tharaka seems to fail on an average once in five years. It is arguable that with full utilization of crop, agronomic and other adjustments currently available, the regional scale drought could be avoided. The eight-yearly failure of drought-resistant maize would thus be "synchronized" into the pattern of occurrence of "national" droughts since another characteristic of the "national" event is that it tends to have a high absolute intensity (Parra, 1971). The theoretically possible

disappearance of the "regional" drought is, in fact, predicted by one of the "global hypotheses" of National Hazards Research which states that full adoption of "modern" adjustments to hazard is generally followed by a decrease in the frequency of small hazard events while the serious ones either remain unchanged or become more frequent. At present, however, one expects the regional drought to take place two or three times in each decade. If stocking densities are low enough, pastoralists seem well-adapted to getting through a single season's failure of the rains by increasing their range of movement with their herds.

The local drought probably occurs every year somewhere in Kenya. Especially in the marginal agricultural zones on the Eastern Foreland Plateau the variability of rainfall is such that individual ridges and sublocations can experience crop failure or serious shortfalls in harvest because of localized combinations of slope, soil, and rainfall conditions. Porter has calculated the probabilities of failure in Machakos and Kitui (Porter, 1965, 1976):

TABLE 1

Probability that Transpiration Requirements
Will Be Met by Precipitation for
Various Growing Seasons

<u>Station</u>	<u>A g r i c u l t u r a l S e a s o n s</u>		
	<u>4 Month</u>	<u>4 Month</u>	
	<u>Main Rains</u>	<u>Grass Rains</u>	
	<u>Probability</u>	<u>Probability</u>	
	<u>commencing</u>	<u>commencing</u>	<u>commencing</u>
	<u>April</u>	<u>February</u>	<u>October</u>
MACHAKOS			
Konza	.29	.50	.17
Machakos	.86	.86	.80
Kangundo	.90	.90	.90
Kiu	.20	.20	.40
Mbooni	.25	.90	.90
Seed Farm	.57	.80	.83
Iveti	.20	.90	.90
Athi River	.57	.60	.33
Kibwezi	.10	.10	.55
KITUI			
Katse	.10	.10	.28
Mivukoni	.10	.10	.10
Enzui	.10	.10	.25
Mwingi	.10	.10	.50
Tseikuru	.10	.10	.18
Ngomeni	.10	.10	.14
Tharaka	.10	.10	.14
Kitui	.45	.72	.80
Migwani	.10	.35	.86
Yatta	.10	.28	.60
Endau	.10	.10	.35
Kanziko	.10	.10	.29
Mutha	.14	.14	.22
Ikutha	.10	.10	.14

It is obvious, especially for the stations in Kitui, that without additional drought-mediating adjustment, crop failure would be more common than success. The average probability of success for the grass rains (the more reliable ones) for this set of data from Kitui (even when data from some of the district's scarce high-potential land is averaged in) is .35, only

four years in ten. Success rates of only one or two years in ten are not uncommon.

Fortunately the local drought can still usually be handled by traditional gift and loan relations among the farmers and their kinsmen and friends (although this may be dying out) and by the normal social welfare allotments made to District authorities. However, as noted earlier, these areas of low crop success rates demanding elaborate sets of agricultural and other managerial adjustments are increasingly becoming the destination of poor migrants from areas of landlessness and unemployment. Some of these arrive with little experience of dryland farming under these conditions (Owako, 1971). Others are burdened with labour constraints which limit them to below-subsistence-sized acreages. All are handicapped by lack of capital and poor access to government services. Some of the poorest of these migrants have recently been moving into the plains which border the Tsavo game park around the last three stations listed on Porter's table. These newcomers are in double jeopardy because not only are they trying to establish themselves where success of more than one to three years each decade demands much ingenuity and effort, but government is uneasy about the future impact of these new settlements on the republic's most famous game park. Not only nature but also government refuses to smile on their undertaking, though theoretically "local" droughts, like regional ones, are avoidable.

Damage Potential

Definitions are called for. The first sort of damage to spring to mind is, of course, the loss of human life through outright starvation, thirst, or indirectly through increased vulnerability to disease. The

economic cost of drought to a country like Kenya can be divided into direct costs, production losses, social costs, and the costs of long-term ecological and other damage. Direct costs of drought include the cost of famine relief, losses due to importation of food at high world market prices, and the costs of drought-avoidance by both government and large private farmers. Government costs might include the cost of research and development of drought-resistant crop varieties; while private sector costs would include a range of privately purchased "modern" adjustments to drought, the cost of which is reflected in increased costs of production. Production losses are the sum of all value not added to the economy because activities in which farmers have invested time, money and labour fail: cattle lose weight, die, do not bear calves; plants wither or bear a fraction of their normal harvest. Social costs to the nation would include decreased productivity due to poorer nutrition and nutritionally-related diseases; break-up of families, self-help groups, cooperatives, block ranching schemes and other small-scale economic organizations; unplanned migration; and general social dislocation and unrest. Some forms of long-term damage are obvious, e.g. wind erosion of valuable soil or loss of forest resources through fire; however, long-term damage to the economy through the creation of large foreign debts requiring expensive maintenance over a generation or more is of perhaps of the same magnitude of national cost. Other such long-term costs include the creation of a large population of pauperized nomads and landless farmers requiring care at public expense for decades and the disruption of orderly, planned economic growth according to the Development Plan.

Finally, there are urban costs of drought which will be treated separately to maintain comparability with other national overviews,

although in Kenya's case the separation of urban and rural costs is not as helpful as it is elsewhere.

The loss of human life can only be estimated crudely. The orders of magnitude of potential losses are well known. Death tolls of well over a million persons have been recorded in India. The Sahelian drought is thought to have claimed 100,000 lives up to 1973¹. Likewise the wastage of human life in Ethiopia may have been of the order of 100,000 (Theierl and Moser, 1974). In highly organized situations deaths due to droughts of even very great intensity can be drastically reduced. Davidson (1975b) reports from Somalia that in a drought that has been building in intensity for seven years - were a third of all goats and sheep, one quarter of all cattle and a tenth of the camels have died, and where about 750,000 or 25% of the total human population are in relief camps - still the death toll is no more than 3,000 by 1975. The situation in Kenya in 1970-72 probably fell somewhere between the Ethiopian and Somali scale².

A chief agent of mortality was cholera which entered Kenya from Somalia in early 1971 and spread quickly throughout the North as far south as Isiolo and northern Kitui. Despite government efforts to vaccinate as soon as the threat was clear, the loss of life was high among weakened people living under unsanitary conditions exacerbated by the scarcity of even drinking water. At one point in 1971 there was only one

¹Morris and Sheets, 1974; Brun and Kovess, 1974; Seaman, et.al., 1973

²Before the drought baseline nutrition (Blankhart, 1974) and health (Cox, 1972b) among the Kenyan pastoral peoples was not good. Overlying the stress of hunger there was also cholera which, among a weakened population, had a high fatality (Mngola, 1974; Mwingi Hospital, 1971; Maua Hospital, 1972; Cox, 1972b). Cholera spread widely and rapidly in the north (Cox, 1972a; Roberts, 1972): There was one reported case in 1967, none from 1968-1970, 768 in 1971, 45 in 1972, none in 1973, and 402 in 1974 (WHO, 1969; 1970; 1975a-d). If 768 cases were reported in 1971, given the extreme isolation and limited coverage of medical infrastructure in the North, one must assume there were a total of several thousand cases of cholera, possibly with an overall fatality of 50%.

water tanker to supply drinking water over 60,000 mi² of Barsabit District! Special government vaccination teams were sent to areas along the Somalian and Ethiopian borders in late 1970 and early 1971 as well as parts of Wajir, Moyale, Isiolo, Lamu, and Kilifi (E.A. Standard, 16 Dec. 1970). Unfortunately cholera vaccination loses most of its effectiveness within three months, so those vaccinated had little better protection against the disease at the height of the epidemic than the unvaccinated.

The pattern of diseases among Kenyan pastoralists during normal times is different than that among sedentarists. The nomad does not generally suffer from the "great baseline diseases" (Cox, 1972) such as malaria and hookworm which debilitate Kenyans dwelling in more humid zones. Malnutrition, tuberculosis, meningitis, and measles are present with low to moderate endemicity, and it is these diseases, in addition to cholera, which increased in incidence and fatality especially among the young, old, and weak during the drought. The same pattern has been observed in the Sahel, where deaths from measles and meningitis accounted for a large percentage of the 100,000 lives lost.

I have estimated production losses in four ways: by simple comparison of drought impacts in similar economies; by application of the results of Kates (Kates and Wisner, 1971) who calculated the long-term average loss in Tanzania based on the regression equation relating rainfall and maize yield; by direct valuation of specific reported losses, especially dead livestock; and finally, by indirect valuation based on percentage decreases for particular items in the GNP statistics for 1971. None of these methods produces results agreeing exactly with estimates made by others, nor do my methods agree with one another; yet there emerges a commonly agreed magnitude of loss.

At the highest level of aggregation, simple calculation reveals that if the 6.7% growth rate in GNP is achieved in 1968-9 had been maintained during 1970 and 1971 rather than progressive decreases to 6.3 and 5.7 respectively (GOK - Economic Survey, 1972), the GNP in 1971 would have been higher by K5 million. Such a calculation is not very helpful, perhaps positively misleading, because it has been demonstrated in other disaster situations that disaster relief, rehabilitation, etc. actually can generate goods and services (especially the latter) in some of the GNP categories (e.g. transportation, government) which partially mask real losses in other sectors.

One makes clearer headway if one concentrates on losses to the agriculture and livestock sector. Table 2 shows decreases in farm production for sale in Kenya for 1970 and 1971 in relation to growth rates in 1969. By this indirect method I calculate a loss in production totalling about K11 million for the listed commodities plus losses in some minor crops such as lint cotton, oil seeds, and honey. The losses in coffee and tea production suggest an additional dimension to the definition of the "national drought" given above. It would seem generally to be the case (although not necessarily) that a national drought tends to extend to the highland areas producing Kenya's chief cash crops. Given the spatial distribution of high potential land, the patterns of ownership and land use, and the regime of rainfall one cannot imagine a drought which would affect only or chiefly the highlands but not the lowlands. Conversely, droughts affecting only "the wide arc" of lower potential land are common. Most of these do not involve much of the highland's cash crop potential and are of "regional" or "local" scale as defined above. These might be grouped together and termed the "poor man's drought." When a drought

occurs which affects the agricultural production of the highlands belonging to the national bourgeoisie, the term "national drought" refers not only to the large extent of impacts and long duration of the event but also mirrors the fact that the rich farmers, I.e. a group with national influence and political power, have been touched directly. Yet another implication of such a distribution of losses is that with commercial grain production affected (vide the entry for wheat, for instance), there is more difficulty in redistributing production to provide subsistence in the poorer, lowland areas.

The average decrease in production for all items in Table 2 is 15%. This is of the same magnitude as the 10% loss in agricultural production quoted by Kates and Wisner (1971) from the Tanzanian National Accounts for 1964-65.

Livestock losses cannot be computed in this way because forced sales tend to mask real losses to the herds. Thus livestock sales increased by 6% in 1970 and by 7% in 1971. This increase was despite the fact that pastoralists were initially reluctant to sell. Reluctance to sell until both man and beast were near starvation and epizootic quarantines in some of the major beef producing areas (e.g. Kajiado) initially produced a decrease in deliveries to the Kenya Meat Corporation (KMC).

In early 1971 KMC's main Athi River factory reported that deliveries were down 40% over the previous year. KMC requested the government to put up the producer price, but was refused. Events took their course, and eventually the Ministry of Agriculture was buying nearly dead animals in Wajir for as little as K£6.25 a head.

TABLE 2
Decreases in Farm Production for Sale¹

Commodity	Annual Growth			1971 Value if Growth Had Been Maintained (K millions)	Loss in 1971
	1969	1970	1971		
Coffee	+24%	+10%	+ 2%	20.2	1.6
Tea	+18%	+12%	-11%	14.2	3.3
Maize	-26%	-35%	+20% (some recovery but still 38% below 1968 level)	6.8	2.6
Wheat	+10%	- 9%	- 7%	5.5	0.9
Milk	-	+ 9%	-12%	11.8	2.5
				Sub-total	10.9
				(Minor losses: lint cotten, oil seeds, ² honey, ³ etc.)	0.3
				Total	11.2

1. Based on Table on page 85 of "Africa 73" and Kenyan Economic Survey, 1972.

2. Based on Clough, 1973, 4.

3. Estimate based on anecdotal evidence of drought impact, e.g. Daily Nation, 2 Dec. 1970, in which Kitui Honey Marketing Cooperative Society reports production decreased by 33% and a loss of 10,000 pounds of honey.

It is estimated that in 1969 the Kenyan herd was composed of 9 million cattle, 5 million goats, and 4 million sheep. Of these animals 4.5 million cattles, 1.25 million goats and 2 million sheep were said to inhabit the semi-arid and arid zones (Carruthers, 1972). My conservative estimate is that during 1970 and 1971 the drought killed one-fourth of the cattle (one million) and one-tenth of the goats and sheep (300,000 head). Valuing the cattle at K₵10 each and the small stock at K₵1.00 each, one calculates the livestock loss to have been K₵10.3 million.

If one adds together the marketed crop losses and livestock losses computed so far, one gets K£21.5 million. The livestock calculation contains the subsistence component already, but the figure for crops doesn't include losses of subsistence crops.

Despite the well-known difficulties of estimating and valuing subsistence production (Clark and Haswell, 1964; Heyer, 1965), an attempt must be made to complete the calculation of production loss. Of the subsistence staples (maize, sorghum, millet, sweet potatoes, cassava, and bananas), maize and bananas are far more sensitive to drought than the others. Assuming a subsistence production of 750,000 tons of maize in a normal recent year (IBRD, 1975) with a value of K£15 million and an annual production of 500,000 tons of bananas with a value of K£10 million, it is possible to estimate losses of the order of K£3.75 million for maize and K£1 million for bananas using a loss rate of 25% for maize and 10% for bananas. Together these subsistence crop losses total K£4.75 million in 1971. Added to the sub-total for marketed crops and livestock, a grand total production loss of K£26.25 million is calculated to be due to the 1970-72 drought. For the sake of convenience I will round this to K£25 million.

As mentioned earlier, Kates' inspection of the Tanzanian National Accounts for 1964-65 revealed a general decrease for agricultural production of 10%. This was due, in part, to a drought that year which would probably have been a "regional" event by my definition if it had occurred in Kenya.³ The overall decrease in agricultural production in Kenya,

³In fact Kenya did experience a drought and some production loss in 1965 which was "regional" in scale, i.e. did not affect the highlands, affected several regions and more than 10% of the population. The Kenyan Ministry of Agriculture Annual Reports (Vol. I, p. 1 and Vol. II, p. 61) describe "a serious drought" which produced complete crop failures in some areas also affected by cutworms and armyworms. A crash maize-planting programme and grain imports resulted, including yellow-maize aid from the USA.

1970-71, was probably greater than this, perhaps of the order of 15% (if one can generalize from the average percentage reduction of the marketed items calculated above). It is interesting to note that 15% of the K£168 million of GNP attributed to agriculture and livestock in 1971 works out to be £25.2 million - quite close to the figure just arrived at for total production loss, K£26.25 million.⁴

This roughly K£25 million loss is for the "national" event. Something of this order of magnitude was most likely lost in 1961-62.⁵ These are the biggest losses attributable to single events. In a ten-year period one can expect one such event, two "regional" droughts with associated losses of something less than half as much as the large event, say K£10 million each, and smaller "local" droughts every year bringing total losses of K£5 million, that is K£500,000 each. Such a distribution of losses is admittedly schematic, idealized, and based on the past twenty or thirty years alone. Nevertheless the resulting total losses for a ten-year period, K£50 million, when averaged over the ten years gives a figure for average annual production loss due to drought which agrees remarkably well with Kates' results for Tanzania.

⁴The reader should keep in mind that these estimates are intended to give an appreciation of magnitudes, not actual values! They could be out by ± K£5 million or more and are really only useful in appreciating the general significance of drought in the range of costs and losses in the developing economy.

⁵Losses in 1961-62 were probably about K£10 million. No full costing exists; however, some indication of the magnitude of loss is given in reports at that time. Wheat losses were estimated by the then-Minister of Agriculture, Mr. Blundell, to have been K£1 million (Kenya Farmer, Jan. 1962, p. 1). The Masai and Samburu lost 180,000 and 80,000 head of cattle respectively (Kenya Farmer, Nov. 1961) which means a total livestock loss nearer to 500,000 for all affected areas; a loss of K£5 million. In addition to losses to wheat farmers the Ministry of Agriculture Annual Report, 1962, Vol. I, p. 1, mentions severe losses of barley, beans and maize. The same source reports that Kenya's agricultural exports decreased from K£31.4 million in 1960 to K£30.7 million in 1961 (Ibid., p. 15).

Kates based his calculations on a regression equation of the form

$$Y_i = a - bX_i$$

where Y_i = marketed production of the i th region/moving average of the i th region $\times 100$

where X_i = average % of normal rainfall for the i th region (a minimum of 4 stations for regions, 33-36 for the nation as a whole)

(Kates and Wisner, 1971, 4)

He found that average annual losses from drought were 0.6% of GNP. The Kenyan GNP was K£485.5 million in 1970 and K£513.4 million in 1971. The average of the two years is about K£500 million (499.45) - a manageable figure to work with. Rounding Kates' 0.6% to an even 1% of GNP, one calculates an average loss for Kenya of K£5 million, or K£50 million over a ten-year period. One can work backwards from this ten-year total loss estimate and get more or less the same figure for 1971 losses as I did by the direct method. The problem is to divide a K£50 million loss over one big event, two moderate ones, and ten small ones which stand in the following relations to one another:

$$x + 2 \frac{x}{2} + 10 \frac{x}{80} = 50^6, \text{ which, when solved for } x, \text{ gives}$$

$x = 23.53$, that is, a single big event involving losses of about K£24 million, two "regional" events with losses of about K£12 million each (11.76 rounded up), and ten "local" events entailing production losses of about K£300,000 each (294,118 rounded off).

⁶The denominators in this expression are based on the relative magnitudes of the national, regional and local event. One rough guide to relative magnitude is the amount spent on famine relief. MOA Annual Report, 1962, Vol. 1, p. 18, states K£4 million was spent on relief in 1961-62. This compares with the K£0.05 million District Welfare Fund used for local droughts by a ratio of 80:1. The regional event usually calls for up to half the relief needed during a national drought, between £1-2 million. For instance, Tanzania spent T£1 million on relief in 1969.

Both Kates' and my methods of estimating losses are closely tied to the theoretical and practical difficulties incorporated in the idea of the "GNP." It has already been noted that relief operations can generate streams of goods and services, the presence of which in aggregate figures tends to hide real losses. In addition some production increases may result from drought conditions which are in fact real increases, however won at the expense of future production, e.g. hides, skins, charcoal, and fish production all can increase during drought but at the expense of depleting herds, deforesting at rates below those sustaining yield over time, or over-fishing. Above all there is the entire critique of GNP as a sensitive measure of human well-being and development. One may legitimately question the significance of the loss of a cow or a bag of maize to a peasant household. Does the cash value of these losses, K£5 for the cow, perhaps K£2 for the maize adequately mirror the diminished levels of nutrition, health, security and general well-being of the family? More is involved in this question than the simple inadequacy of "price" to measure subjective utility. If the concrete struggle of individual families is lost in the abstraction of price, how much more lost is in the aggregation of abstractions known as GNP?

Such doubts and difficulties notwithstanding, three closely coinciding estimates have been generated for the production loss due to drought in 1970-71:

K£26.25 million
K£25.2 million
K£23.53 million

The average of these is K£25 million. I have also estimated that the long-term average loss due to drought is K£5 million a year, about 1% of GNP. This is equivalent to the complete destruction of all goods and

services in Kenya once every century; one enormous potlatch every hundred years - some kind of cruel and tragic "leap year." Stated in this way the magnitude of loss sounds large indeed, but one must recall that the major industrial countries of the world have been incurring even larger losses and, indeed, more frequently. One need only think of the occurrence in nearly every recent generation of a major war! Such loss has been said not only to have been weathered quite well by the industrial nations, but even to have been a spur to growth and technological innovation in their economies. In a similar vein some see signs that the present "energy crisis" will produce new efficiencies which will ultimately benefit industrial economies. This line of thinking bears similarities to that of Ester Boserup, who has argued that population growth spurs agricultural systems on to new forms of organization and higher productivity (Boserup, 1965). How does drought in Kenya fit into this picture of loss and innovation, waste and renewal?

Relief feeding is the most obvious of the direct costs of drought to government. In 1961-62 a total of 33,913 tons of food (maize, beans, powdered milk, and meat) were distributed over a wide areas as seen above on Map 3. This cost K\$4 million although several thousands of tons of maize was donated by the U.S.A. as they did in 1965 and in 1971 (Roberts, 1962; MOA Annual Report, 1962 Vol. I, p. 18).

In the absence of official figures for relief food in 1970-72, I have estimated relief on the basis of the scale and duration of the feeding programme. During the last half of 1970 and the first half of 1971 an average of 100,000 people were fed daily at an average cost (including transportation, administration of feeding centres, etc.) of Kshs. 2/ - per day. This takes into consideration a peak of 250,000 persons a day tapering off to 50,000 a day. The peak during 1961-62 was 400,000 persons a day. In fact

feeding was continued in some places through the middle of 1972 at a lower level. The cost of feeding can thus be estimated as

$$\text{Kshs. } 2/ - \times 100,000 \times 365 = \text{Kshs. } 73,000,000/ -.$$

That is, K53,650,000 for a year and about half that amount for another year, giving a total of about K5.5 million.

It is instructive to compare this amount with the total amount of foreign relief aid given to the Sahelian countries affected by drought over the period 1967-73 (Morris and Sheets, 1974, 129). That was K114 million for six countries for six years, or about K3 million per country per year. Assuming a population of 25 million in the six affected countries, this works out to about K0.75 per person per year. If one allowed for the local contribution toward relief by doubling this figure, one would still have only K1.50 per capita per year. The Kenyan relief total, when worked out on a per capita basis, is of a similar magnitude, but even smaller: K0.5. Of course only 4 million of Kenya's 12 million people were directly affected by the drought (only about 6% of these ever received famine relief). On this basis the sum is K1.50 per affected person. Likewise, at most, only half the Sahelian states' population was directly affected, so the comparable figure there would be K3.00 per person per year.

A related cost in addition to the direct fiscal burden of famine relief is the sum of losses incurred over the long term of buying cereals at high prices on the world markets when there are shortages in Kenya and selling abroad at prices often below the prices paid to producers in Kenya in years of over-production. This cycle of unprofitable buying and selling on the world market can in part be attributed to the uncertainties of weather in Kenya. It is not uncommon for Kenya to buy and sell in the same year. Table 3 gives this impression.

TABLE 3
Cereal Imports and Exports 1961-1966
(Tons)

	<u>1961</u>	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>
Imports	121200	85900	13500	1000	103800	172500
Exports	2600	61300	88300	1700	600	9000

(Source: FAO Trade Yearbook, 1967)

It is difficult to cost these losses due to untimely trading. However, even if the cost were as little as 1% of the value of the total volume of agricultural trade (about K£87 million in 1971), this still would be nearly a million pounds (K£0.87 million).

In addition to the cost of famine relief and the cost of unprofitable grain trading there are the costs of added recurrent expenditures by the social services, especially the Ministry of Health. The MOH estimate for 1971-72 recurrent expenditure was K£7.5 million. The cost of dealing with the epidemic of cholera and the additional burden of disease upon the population weakened by the drought may have increased this by as much as 10%, costing K£0.8 million. Various other social services in the towns were strained by the influx of migrants from the drought, but this will be considered under "urban losses" below.

The cost of avoidance or reduction of damage due to drought is a very complex matter; however, I will attack the problem simply and directly by focussing only on public and private (large-scale) expenditures. An analysis of the various activities of the Ministry of Agriculture reveals that a certain percentage of the development and recurrent expenditures relate directly or very closely to drought hazard abatement. The percentage varies from Department and Division, with irrigation, crop development, credit, and livestock having larger percentages than areas such as "training"

or "rural development." The same is true of other agriculturally related Ministries.⁷ If one takes an average estimate of 1% of the total public expenditure on agriculture as related closely to drought abatement, then the cost in fiscal 1970-71 would have been K£1.3 million (IBRD, 1975, 451). The cost of specific programmes may be misleading. For instance the breeding programme to develop a drought-resistant maize cost no more than K£200,000 from 1958 until the seed's first release in 1964 with another K£100,000 being spent on more recent genetic improvements. Of course the bulk of the abatement costs are not so direct but are contained in the very structure of such activities as livestock marketing and irrigation.

Kenya has a large and quite modern large-scale private farming sector. Following Visvader and Burton (1974), one can expect that such drought abatement expenditures as the use of overhead sprinkler irrigation in some coffee plantations, specialized mechanical cultivating-planting-irrigation furrow-digging machines, etc., will appear as increased costs of production in this sector. Visvader and Burton (1974) list the following kinds of increased costs of operations due to drought:

- (1) Crop insurance premiums
- (2) Finding new water sources
- (3) Reducing water losses
- (4) Implementing other water-conserving practices

One difficulty in costing these activities is that the large-scale farming sector receives much special attention and aid from the government. Insurance premiums are subsidized, water resource development is in large part a public investment, etc. The areas of highest large-scale private investment in abatement are coffee, tea, dairy, and wheat, with large-scale maize and large-scale private ranching benefiting most from public expenditure. If one takes 10% of the 1971 value of marketed coffee, tea, milk,

⁷Lands and Surveys; Natural Resources; Wildlife and Tourism; Settlement.

and wheat as a rough indicator of the magnitude of production costs related closely to drought abatement, a figure of K~~4~~ million emerges.

Thus one arrives at the following estimate of direct costs of drought in 1970-71:

Relief	K 5 5.5 million
Loss on grain trade	K 1 1.0 million (rounded)
Increased social service	K 1 1.0 million (rounded)
Public abatement	K 1 1.3 million
Private abatement	k 4 4.0 million
	<hr/>
Total	K 1 12.8 million

Long-term costs are all "economic" broadly speaking because they all relate in various ways to the ability of Kenyans to produce wealth and improve the material conditions of their lives. However, some long-term impacts affect more directly the means of production (and since Kenya is overwhelmingly agricultural this means is largely the land resource) while others relate more directly to the relations of production and overall economic structure.

In 1974, Maurice Strong, then the head of the UN Environment Programme based in Nairobi is supposed to have told a group of Kenyans that he feared that each year the Tana River carried top soil of a value equalling the nation's GNP into the Indian Ocean. Whether or not his estimate of soil's value was accurate, there is no question that erosion is a major problem for Kenya. Drought can contribute to this erosion problem especially by increasing the vulnerability of vast areas to wind erosion. Pasture can also fall victim through the direct effect of dry conditions on the natural vegetation, through overgrazing, and through an increased frequency of fire. Another similar ecological damage can be done to valuable forest resources. Indeed during 1971 there were serious forest fires in Nyanza Province as well as in the Mt. Kenya forest. During drought there is often an increase

in the rate of deforestation for the burning of charcoal - an important source of non-farm income for the poor who fall back on such income when crops fail. For the same reason the amount of "honey hunting" increases, and since this activity relies on the use of fire for dislodging bees from the hive, the hazard of fire must also increase, especially in dry conditions. A less tangible long-term cost in the ecological sphere, though on very much in the minds of the Kenyan government, is the death of game animals and possible subsequent losses to the tourist trade.

Of more direct relevance to the structure of the Kenyan economy and the relations of production are a whole series of tendencies which are reinforced by food crises, especially the decreasing viability of the small-holding, the increasing reliance of many small farmers on forms of wage labour, and the increasing shift of labour to the urban areas. These effects, which surely must have large long-term costs associated with them, are mentioned together with long-term damage to the resource base or means of production to emphasize their great potential cost.

Debt and reliance on foreign aid has been shown to have a great shaping effect on the economies of underdeveloped countries (Payer, 1974). Drought may have a role in prolonging reliance on foreign aid and, as the cases of India and Tanzania in 1974 show, can also produce large debts and run down foreign exchange. So far foreign exchange crises in Kenya have not been precipitated by foreign grain purchases, but this cannot be ruled out in the future if long-term policies do not reduce famine potential. The second "Club of Rome" report projects as an unavoidable constant throughout five quite different "scenarios" for South Asia an ever-increasing reliance on foreign investment and rising foreign debt, whether from massive food imports (as much as 500 million tons per year in one "scenario") or through

loans for industrialization (Mesarovic and Pestel, 1974, 121-127).

Kenya is, of course, nowhere near such a desperate situation, but debt is already a large burden. In independent Africa as a whole in 1966 debt service payments were estimated to be about 26% of gross aid inflow. It is projected that in 1975 they will have risen to 53% (Davidson, 1975a, 100). Kenya is (so far) one of the least burdened. She made external debt payments of K£5.6 million in 1971-72 while receiving about K£20 million in aid (ILO, 1972, 569) - service came to only 28% of inflow, only about 6% of aid plus K£73.2 million inflow from exports and K£4.9 million from re-exports. Still one notes that Kenya imported K£183.7 million worth of goods in that year and ended with a trade deficit of K£-105.6 million (GOK, Economic Survey, 1972). It is thus not unthinkable that a possible "scenario" for Kenya would include as sequelae of drought and famine foreign exchange crises, increasing burden of debt, and increasing reliance on aid (which may well become more difficult to come by, although Kenya is one of the "favored" countries in Africa mentioned in the US State Department's "Korry Report"). At the moment the only clear evidence of drought's effects in this sphere is the continuing high percentage of foreign aid financing for development of water resources (about 60%) whereas the share of foreign aid in overall development budget is down to less than 40% (ILO, 1972, 571 & 573).

Like the long-term costs just discussed, social costs can be enumerated but only quantified with great difficulty, if at all. Broken families, large-scale migration - especially to already swollen urban areas - must also have large social costs associated with them. Drought is also thought to disrupt orderly implementation of what programmes exist for the poorer rural areas. At least 60% of cotton development loans are in default, and such a state of

affairs, at least partially a result of drought, does not improve the climate for investment in the country's poorer areas.

Urban losses are not at all like those in the industrialized countries, where the main category of loss from drought "is limited largely to water-using commercial activities such as industrial processing, golf courses, and car washes" that are subject to restrictions and increases in costs (Visvader and Burton, 1974, 8). Of course the costs of urban water supply in Kenya are affected by drought. The Nairobi reservoir is often nearly dry in times of drought, and water pressure was quite low in 1971, especially in the African "estates" (E.A. Standard, Feb. 13, 15 & 16, 1971). The Nairobi City Council received a K£3.5 million loan from the World Bank about this time for expansion of the reservoir (Ibid., 20 Nov., 1970). Climate-related fluctuation of the water level must be responsible in part for the need to expand. Other towns (e.g. Machakos and Naivasha) reported water shortages during this period. However, such "urban costs" must be quite small relative to the costs associated with increased urbanward migration, slum growth, and the added strain on urban services due to drought. These latter sources of urban cost set the urban areas apart from their counterparts in industrial countries.

It would be appropriate to finish up a discussion of "damage potential" with an attempt to arrive at a "total cost of drought" figure, but I must disappoint the reader for obvious reasons. The sum of production losses and direct costs for 1970-1971 comes to about K£37.8 million - a figure surely as ultimately unreliable as it was hard to come by. The rest is even more difficult. Most of the "long-term costs" could be as large or as small as one wished, depending on the discount rate chosen, and are, in any case, by their very nature a matter for complex predictions, not accountancy.

If, for instance, forestry contributes only 1% of GNP in Kenya today, who is to day it couldn't contribute much more if forest resources in the industrialized world continue to be run down, or less if they are not? Social costs share these difficulties when it comes to assigning monetary costs. However, for the sake of the human urge to name and specify I will assume that all these less quantifiable costs come to at least as much as the production losses and direct costs already tallied. If so, then the total cost at K£75.6 million comes to well over one-tenth of GNP for Kenya in 1971, K£500 million. Even at half or one-quarter this amount it should be clear that although drought does not carry with it the burden of great physical damage to infrastructure, its cost is of the same order of magnitude as that of hazard events that do sweep away bridges, roads, smash buildings, etc. Compare, for instance, the damage from the following floods (Baird, et.al., 1975, 28):

Malaya (1970)	£ 17 million
Brazil (1971)	£ 34 million
Bangladesh (1971)	£ 39 million
Italy (1970)	£ 55 million
Philippines (1971)	£ 100 million

and the Peruvian earthquake which did £241 millions worth of damage.

Forecasting Ability and Warning Time

Forecasting ability in East Africa leaves much to be desired. There exists to date no system allowing one to forecast the overall adequacy of meteorological conditions for a given growing season. At one extreme research is underway at the East African Meteorological Department (EAMD) in Nairobi to enable prediction about ten days in advance of the onset of monsoonal rains. At the other extreme some work suggests a cyclic nature in the long-period rainfall variations in Kenya, the cycle having a mean

duration of five years giving minima in 1940/41, 1944/45, 1950, 1954/55, 1961, 1965, and 1970/71 (Morth, 1966). Although studies of atmospheric circulation have yielded improved understanding of the causes of the general aridity of tropical East Africa, especially its northern portions (Trewartha, 1961; Flöhn, 1964), one seems still a long way from predicting seasonal or multi-seasonal drought - the prime requirement of any meteorological contribution to reducing potential damage to agriculture.

Because of these deficiencies the emphasis of the EAMD has been more on providing information useful for informed risk-taking than on forecasting per se. One aid has been the provision of statistical analyses of rainfall (Griffiths, 1958) and the preparation of tables of rainfall probabilities and confidence limits (Lawes, 1969) which, at least theoretically, facilitate better long-term adjustment of crop choice and land use to rainfall patterns.

Warnings of drought conditions come from monthly monitoring of agro-meteorological conditions and the progress of crops at 62 agricultural, hydrological, and synoptic stations in Kenya. In 1972 an "agricultural meteorology section" was established within the EAMD which has as its brief the compilation of data from these stations for agricultural purposes and the development and expansion of the network of such stations in East Africa. The section provides a service to answer routine enquiries and has attempted to develop daily and weekly radio bulletins highlighting weather information of agricultural importance. Its analyses also find their way into the monthly journal of the Kenya Farmers' Association, Kenya Farmer.

In all of this, however, there is an obvious and perhaps understandable bias in favour of the large-scale, English-speaking farmer in the former "scheduled" areas of Kenya. This bias can be seen most clearly in the EAMD's

most recent attempt at warning and short-term forecasting, a monthly publication started in 1973 called "Farming Weather: A Summary of Recent Weather as it may affect your farm or farming area." In the words of the EAMD (1973, 3),

"Farming Weather" is a summary of recent weather trends in selected areas, interpreted for the farming community. Carefully chosen stations are considered as being representative of their surrounding area. . . . Wherever possible we identify the importance for production of any weather element which appears to be deviating significantly from the normal for the time of the year and, if important trends are becoming apparent, and are likely to affect production, these are mentioned.

As of June 1973 "Farming Weather" was based on data from only ten reference stations for the whole of East Africa. Not only was it necessary to make assumptions about the representativeness of stations for the "surrounding area," in some cases further assumptions must be made on the basis of geographical analogue about the applicability of data to non-contiguous areas. Thus "Machakos Area" with its reference station at Katumani Agricultural Research Station includes all of Machakos, Kitui, and Narok Districts. Further expansion of the data base is planned, and despite its shortcomings, the system does constitute an attempt at short-term forecasting which synthesizes both meteorological and agricultural data for those who can understand the language. For instance, the publication's "Agricultural Highlights for June" included the following comments:

Machakos was dry and droughty conditions reported. These conditions affected the growth of maize, sunflower and sorghum. Maize is reported tasseling. The dry spell seems to have affected the citrus which has given a poor yield. . . . In the Kiambu area, conditions were wetter and the moisture reserves in the soil higher (means of 30% soil moisture is reported for the upper layers). Growth development has not been impaired. At Kabete, barley is reported to have passed the earing stage, maize is flowering whilst the beans (replanted) are growing normally. The coffee is in no phenological stage though there has been some harvesting . . . (EAMD, 1973, 10)

The only access the small Kenyan farmer has to such information is through the extension service of the MOA, but unfortunately the linkages between EAMD through MOA to the field extension worker are not functional.

For the majority of small farmers in Kenya, forecasting and warning ability lies in the completely separate sphere of individual weather lore passed on from father to son and mother to daughter and of the more specialized skills of the rain makers and prognosticators. This system of individual and communal lore attempts more than EAMD and, in fact, seems to achieve no less. However, as the system of traditional forecasting and warning is rooted in religion, a preliminary sketch of the elements of a representative religious system, the Kamba, must precede further comparison of modern and traditional science in Kenya. The following brief outline is based on several works on Kamba religion (Middleton, 1953; Hobley, 1910; Lindblom, 1920) and detailed discussions with one of my research assistants, a Kamba, Frederick Katule.

The Kamba believe that the spirits of dead ancestors (aimu) are quite concerned with the well-being and day-to-day life of those who are alive at any time. They are generally benevolent but can punish wrongdoing and inattention from the living. They also believe in the existence of a completely benevolent "supreme" being called Ngai or Mulungu or Mumbi. The aimu require very frequent attention, and a small amount of daily food is generally set aside for them. At harvest and planting times as well as any time of public distress, including drought, public sacrifices to Ngai take place at the local shrine (ithembo) which is usually located on a hill with a fig tree (muumo). Shrines are fairly localized, being sometimes the shrine of a particular family (utui) or of a small village (kivalo) of people related in kinship. Sacrifices there are supervised by a local "healer" (mundu mue).

His function in the community cuts across the more highly differentiated roles of priest, doctor, psychiatrist, epidemiologist, weather forecaster, and futurologist of industrial society. The sacrifice usually takes the form of an animal of pure color and no deformities. The sacrifice is offered to Ngai, who is asked to send rain at the normal time or merely to send it, if rain is late or irregular. Ngai is thought to be the only being capable of influencing the weather; however, the ancestral spirits (aimu) can speak through a specialized sort of healer, enabling the community to have foreknowledge of what kind of season it will be.

The relationship between the aimu and Ngai is complex - involving metaphysical problems not unlike those implied by the Christian notion of the Trinity, according to Katule - but for the purposes of this discussion it is enough to note that the aimu do not influence weather, only aid in its prediction. This difference is seen in the different verbal formulae used on different occasions. At the family sacrifice to the aimu the family elder merely says "Na muikundia vau" meaning "And you relatives, you get your share from that . . ." At the collective ithembo sacrifice the officiating elder would say "Ngai twa uthembea utunenge mbua" meaning "Ngai, we offer you this sacrifice so that it may rain . . ."

Only a specially gifted "healer" or mundu mue is able to predict. He is called a mwathani. The mwathani is the closest thing to a weather forecaster, although he also predicts famines and epidemics. The connection among abilities to predict such diverse calamities lies in the quite common African view of disaster, both collective and private, as the result ultimately of some unwholeness or disruption in the relationships between people. This belief has been expressed well as it applies to the health of the individual, and suits as well departures from community well-being signalled by drought or other disasters.

. . . health is uzima. It is wholeness; man is never alone as an individual but always part of a whole, a part of his kin, his clan, lineage, family past and present which again, through an elaborate symbolic framework, relates the human race with the nature around and with the whole universe. Health is to retain that uzima, wholeness, and to be a part of it in such a way that the basic balance is not disturbed. Man's wholeness was essentially preserved when he remained as an integrated part of the whole and lived in harmony. . . If there were problems between groups of people or individuals with varying interests in the group, it resulted in shaken health . . .

From the point of view of health, then, the most important factors affecting health in this kind of traditionally based society are the relationships between people.

(Swantz, 1972, quoted in Wisner, 1976)

If the aimu are pleased with the attention they have been receiving, they send messages of impending epidemics, droughts, and other disasters through the mwathani. He has quite a good deal of influence over the choice of crops and planting date under some circumstances. Katule recalls a situation a number of years ago when one mwathani was convinced that the coming season would not be adequate to support maize, so counselled the farmers to plant millet. Another mwathani disagreed and thought the rain would be sufficient for maize. The second was correct, and the first was "peacefully driven out" of the village, and women sang derisive songs about him as they threshed the millet. There would appear to be a selective mechanism at work to eliminate unsuccessful forecasters (as yet unused in the East African civil service!). With such odds at stake for the mwathani as well as the community, there must be some basis for the predictions, not blind chance. What could it be?

Every Kamba farmer has a certain amount of knowledge of the signs of the onset of the rains: the budding of certain trees, the behaviour of animals, certain meteorological events like lightning in a certain area of

the horizon at a certain time, winds, etc. At present one can only assume that the mwathani makes use of a much more detailed set of signs. In doing so he differs only slightly from the EAMD forecaster whose theory about atmospheric circulation, temperature gradients, etc. is no more coherent at this time and who makes use of a similar set of signs albeit measured more precisely and more conservatively used.

It should be noted quite explicitly at this point that it is much easier to predict famine as a complex agro-meteorological-socio-economic event than it is to predict meteorological drought. Such predictive ability makes use of the empirically established fact that vulnerability of families and communities in the semi-arid zone is increasing, thus the tolerance for variations around average physical conditions of all sorts (rainfall, plant disease and pest endemicity, vermin density, rate of erosion) is also decreasing. As tolerance for variation of physical parameters decreases, the probability that one or more parameters will exceed the tolerances increases. Hence ultimately it becomes less and less important to predict agricultural drought as it becomes easier and easier to do so.

Adjustments, Availability and Access to Them

A very large number of possible adjustments and adaptations to drought exist. Some elements in a farming system which have the effect of reducing moisture waste, optimizing available soil moisture, etc., have become routine practices which do not vary much from season to season and tend to be uniformly distributed over a resource-use system practiced by a more or less homogeneous socio-economic class of managers. These can be called adaptations. Other elements in a resource-use system with similar drought mediating, escaping, or coping properties are only invoked when there is a

moisture crisis. They constitute and are generally perceived as departures from "normal" farming or ranching practice. These can be called adjustments. In a total system like Kenyan agriculture, where there are widely different social classes, income groups, and, some would have us believe, widely divergent levels of "progressiveness" among farmers, one man's adaptation can become another man's adjustment given economic and technical conditions allowing access. A cooperative group of poor farmers to the east of Mount Kenya individually earning no more than K£60 a year could incorporate as an adjustment stubble mulching and summer fallow as practiced by the farmer who earns over K£1000 a year living on the western slopes of the same mountain, for whom the practices are a routine adaptation of his dryfarming system. They could if they too had access to a certain level of mechanization, etc.

Surely the number of possible adjustments and adaptations agricultural man has evolved over 10,000 years of farming in the face of climatic uncertainty would number in the hundreds if one catalogued all the nuances of agronomic practice - treating the use of ridging ploughs, discs, duck-foot cultivators each individually - if one listed the various insurance schemes and systems of agricultural credit in all their national diversity and went into the characteristics of each drought resistant crop known. No matter how long the list, one thing is certain about all adjustments and adaptations to drought: each one has its cost. Drought can, in fact, be defined in terms of the cost of adjustment (Hewitt, 1971):

Drought is simply a period in which moisture availability falls below the current requirements of some or all the living communities in an area and below their ability to sustain the deficit without damage, disruption or excessive costs. (emphasis mine)

Given the very great differences in income of different groups of farmers in Kenya, one would expect to find a correspondingly great range of adjustments and adaptations from the simplest and least expensive to the most costly in terms of money, time, and energy. Kenya's skewed income distribution together with the demonstrable imbalance in regional development means unequal access among classes of farmers to credit, machinery, and ultimately power and time; for one must remember, quoting Dr. Kenneth Blaxter (Laurie, 1975, 775)

. . . revolution in agriculture is basically concerned with time: there is a time to sow and the land can be worked only when the land is right. When you had only horses it was extremely difficult always to cultivate land at the right time, but now with larger energy inputs this can be done. This is one of the great advantages of the reservoir of power at the farmer's disposal. It's not really energy we're talking about, but power - energy per unit time - which is the determinant of the agricultural system.

True in temperate lands, this statement is equally true in the tropics and especially in the dry tropics where nitrogen and phosphorous surges accompany the onset of the rains. From the standpoint of basic agricultural ecology the biggest and smallest farmers and ranchers confront the same temporal constraints and have potentially similar needs for power. The issues in Kenya therefore reduces to one of access to the means of practicing adjustments and adaptations to drought.

Table 4 lists a number of the most important possible practices known to help in mediating or escaping the effects of drought. These practices have been drawn from several textbooks of agriculture⁸, from surveys of the ecology and economy of arid lands⁹, and from a number of collaborative

⁸Kanitar, 1944; Russell, 1961; Duckham and Masefield, 1970.

⁹UNESCO, 1951-1964, *passim*; White, 1960; Hills, 1966; Dregne, 1970; Evenani, 1971; Dakshinamurti, *et al.*, 1973; Grigg, 1970 & 1975.

studies of the human response to drought in a number of countries (White, 1974). They are ordered in functional categories based on those developed in natural hazards research but modified for Kenyan conditions (ILO, 1972, 308). I have also tried to indicate the relative access of various income groups among Kenyan farmers and ranchers to these practices.

Two things should emerge from study of Table 4. First is the great number and diversity of possible adjustments. Second is the highly unequal access to them. I have based my analysis of access on a natural hazards research model of choice of adjustment that attempts to explain an individual's choice in terms of the adjustment's economic efficiency, ecological possibility, technological feasibility, and social acceptability (White, 1973, 211). Kenyan realities, however, necessitate a shift of emphasis in such an analysis from choice to constraint (Rieser, 1973; Wisner, 1974; 1975).

In Kenya the economic, ecological, technological and social aspects of relative access to adjustment are not separate spheres nor is choice a purely subjective matter independent of constraints. Large-scale and peasant farming are only two separate sectors for the purposes of accounting. In practice they are interdependent and interacting parts of the same political economy; that is, a national (and ultimately international) system for allocating productive resources and surplus. In this system it is clearly the large-scale, rich and very rich farmers who lead. The entire structure of the agricultural economy including such sub-systems as finance, research, extension, marketing, and patterns of drought adjustment are tailored to maximize the profits and range of choice of the biggest farmers. Since farmers big and small "compete" for the same capital in the form of credit, extension services, veterinary aid, etc., the big farmers' gain is often the small farmers' loss. The system increases the range of choice of drought

TABLE 4
Access of Kenyan Farmers¹ to Possible² Drought Adjustments³

Accessibility by Class⁴

<u>Adjustment</u>	<u>Very Rich</u>	<u>Rich</u>	<u>Middle</u>	<u>Poor</u>	<u>Very Poor</u>
<u>AFFECT OR KNOW THE RAINFALL SOURCE</u>					
Cloud seeding	+?	0	0	0	0
Met. forecast	+	+	+?	0	0
Trad. rite/predict ⁵	0	+?	+	+	+
Pray	+	+	+	+	+
<u>INCREASE MOISTURE BY: CHANGING LOCATION</u>					
Move stock by truck	+	0	0	0	0
Move stock by rail	+	+	0	0	0
Use fattening yards	+	+	0	0	0
Controlled grazing	+	+	+	0	0
Send stock to kin	+	+	+	+	+
Move with stock	+ ³²	+	+	+	+
Plant larger area	+	+	+	0	0
Plant distant field	+	+	+	+	+
Plant scattered plots	+	+	+	+	+
Plant bottom land	+	+	+	+	+? ⁶
Shift to new farm	+	+	+	+	+
Share-cropping?					
<u>IMPROVING SOIL MOISTURE STORAGE AND DISTRIBUTION</u>					
River basin transfer	0	0	0	0	0
Sprinkler irrigation	+	0	0	0	0
Pumped irrigation	+	+	+	0	0
Gravity irrigation	+	+	+	+	0
12 Flood retreat irrig.	+ ³²	+		+	+
Harvest run-off	+	+	+	+? ⁸	+? ⁸
Stubble mulch	+	+	+?	0	0
Strip cropping	+	+	0	0	0
Terracing	+	+	+	0	0
Ridging	+	+	+	+	+? ⁶
Fallowing	+	+	+	+	+
Intercropping	+	+	+	+	+

A c c e s s i b i l i t y b y C l a s s

<u>Adjustment</u>	<u>Very Rich</u>	<u>Rich</u>	<u>Middle</u>	<u>Poor</u>	<u>Very Poor</u>
SCHEDULING FOR OPTIMAL SOIL MOISTURE					
Reseed pasture ⁹	+?	0	0	0 ₆	0 ₆
Plant dry	+	+	+?	0 ₆	0 ₆
Eliminate phosphate deficiency to ensure good root growth	+	+	+? ¹⁰	+? ¹⁰	+? ¹⁰
Replant if failure	+	+	+	+?	0 ¹¹
Wait to plant for enough rain	+	+	+	+	+? ¹²
Plant with 1st rains	+	+	+	+	+? ¹³
Stagger planting	+	+	+	+? ¹¹	+? ¹¹
<u>REDUCE MOISTURE NEED BY:</u> ELIMINATING MOISTURE WASTE					
Selective hericides against weeds	+?	0	0	0 ₁₄	0 ₁₄
Weed more/early weeding	+	+	+	+? ¹⁴	+? ¹⁴
Prolong fallow if poor rain	+	+	0 ¹⁵	0 ¹⁵	0 ¹⁵
CHANGING PHYSIOLOGICAL OR TECHNICAL REQUIREMENTS OF CROPS					
Plant drought-resistant cash crops	+	+	+	+? ¹⁶	+? ¹⁶
Plant new d-r varieties	+	+	+	+	+? ¹⁷
Plant old d-r varieties	+ ¹⁹	+	+	+? ¹⁸	+? ¹⁸
Plant many varieties	+	+	+	+	+
<u>DIVERSIFY</u>					
A share in urban business	+	+	+?	0	0
A share in rural business	+	+	+	+? ²⁰	0
Non-farm economic activity ²¹	+ ²²	+	+	+	+
Find wage work nearby	+ ²²	+	+	+	+
Find wage work far away	+ ²⁴	+	+	+	+? ²³
Hunt, fish or poach	+ ²⁴	+	+	+	+

A c c e s s i b i l i t y b y C l a s s

<u>Adjustment</u>	<u>Very Rich</u>	<u>Rich</u>	<u>Middle</u>	<u>Poor</u>	<u>Very Poor</u>
<u>DISTRIBUTE OR SHARE</u>					
<u>LOSS</u>					
Air-lift fodder	+? ²⁵	0	0	0	0
Crop insurance	+	+	0	0	0
Bank overdraft	+	+?	0	0	0 ²⁶
Loan or help from co-op	+	+	+ ²⁷	+? ²⁷	0 ²⁷
Other loans	+	+	+? ²⁸	0	0
Default on loan	+	+	+? ²⁸	0	0
Move to a settlement scheme	+	+	+?	0 ²⁹	0 ²⁹
Personal tax relief	+	+	+ ³⁰	+? ²⁹	0 ²⁹
Famine relief	+	+	+	+	+
Ask help (seed, food, labour) from kin	+	+	+	+	+
Ask help from gov't.	+	+	+	+	+
Ask help from church	+	+	+	+	+
Send children to kinsman's	+ ³¹	+	+	+	+
Move to a kinsman's farm	+ ³²	+	+	+	+
Move to a famine camp	+	+	+	+	+
Move to an urban slum	+	+	+	+	+
<u>BEAR THE LOSS</u>					
Draw down savings	+	+	+?	0 ³³	0 ³³
Sell shares/liquify assets	+	0	0	0	0
Store fodder	+	+?	0	0	0
Buy fodder	+?	0	0	0	0
Buy food	++	+	+	+	+? ³⁴
Store bumper harvest	+	+	+	+	+? ³⁴
Sell livestock	+ ³²	+	+	+	+
Bleed livestock	+ ³²	+	+	+	+
Collect bush foods	+ ³²	+	+	+	+
Systematically decrease family food intake	+ ³²	+	+	+	+ ³⁵
Eat seed	+ ³²	+	+	+	+

¹"Farmer is to be taken very broadly to include pastoralists and commercial ranchers, plantation managers, large-scale grain farmers, semi- and quasi-subsistence peasant farmers, and even intensive horticulturalists who ship their produce to Europe by Jumbo Jet.

²This list by no means tries to exhaustively cover all of what men have done (e.g. the subterranean canals of antiquity) or what he could do with contemporary technology (e.g. desalination) to reduce the risk and impact

of drought. This list's range begins just beyond what rich Kenyan farmers have already begun to practice (e.g. cloud seeding) and finishes with traditional adjustments that are still practiced widely (e.g. bleeding livestock).

³"Adjustment" is used here as convenient shorthand for both adjustments and adaptations as defined earlier.

⁴Classes of farmers are defined by income. "Very rich" farmers have an income in excess of £1000 a year. "Rich" earn between £200 and £1000 a year. "Middle" between £200 and £60 a year. "Poor" have an income between £20 and £60 annually; while the "very poor" earn no more than £20 in a year.

Relative proportions of these classes of farmers in the "farming community" are as follows (approximately -- source: ILO, 1972, 74):

Very rich	18,000 households	1%
Rich	190,000	10%
Middle	460,000	23%
Poor	1,000,000	51%
Very poor	310,000	16%
	<hr/> 1,978,000 farm households	101% (rounded to 100)

⁵The European heritage contains "traditional" magical and mystical predictive systems as well, e.g. the use of farming almanacs and the practice of "water witching." The frequency of these practices among the remaining white farmers in Kenya is unknown.

⁶Cultivating the heavy and possibly water-logged soils of the valley bottom as well as the practice of ridging and dry planting all require added labour where, in the case of the poor farmer, there is little or no money to hire it nor to buy the extra calories that would allow him and his family to provide this extra labour without living for a time in caloric deficit.

⁷Colin Leys records that many of the alleged "members" of some of the high-land settlement schemes are in fact disguised share-croppers working for scheme participatns at what works out to be a very low real wage (Leys, 1975, 182).

⁸This is, of course, a matter of scale. Without mechanization some peasants, e.g. the Hehe of So. Tanzania, do harvest runoff by felling trees across hillsides; however large-scale water-harvesting, e.g. lens-shaped pits for rangeland pasture improvement, requires heavy mechanization to which the peasant has no access.

⁹In their work "Reseeding Denuded Pastoral Land in Kenya" Bogdan and Pratt (1967) summarize experiments in Kenya in Baringo, Turkana, and Kitui and also give notes on "tropicalizing" -- see Blaut (1964) -- temperate rangeland reseeding equipment and practices. What emerges is that reseeding is a large-scale operation relying on mechanization.

¹⁰Russell (1961, 422) notes that phosphate deficiency in the soil inhibits the development of a vigorous root system, without which the plant cannot make optimal use of soil moisture later.

^{11, 12, 13}As mentioned in Note 6, labour constraints dominate the poor farmer's ability to practice many such drought adjustments. Other constraining aspects of the domestic economy affect access as well, e.g. the farm family tends to eat seed reserves when food shortage reaches a certain intensity, this seed is not available for replanting. With little reserve of any kind, the poor farmer cannot afford to wait until he is sure that the rain will be sufficient but must plant earlier, hoping to get something.

¹⁴The labour constraint appears again.

¹⁵It is more difficult for poor farmers relying on manual labour to control bushy regrowth, and it is therefore difficult for them to prolong or extend fallows. The less rich farmers and upper middle farmers have debts to service and repay (and are more likely to be foreclosed upon than the very rich -- Leys, 1975, 102), so they also find it difficult to prolong fallow, waiting for the rain.

¹⁶There is not only a wider variety of all cash crops available for highland and large-scale farming in Kenya than for lowland, small farming, but are also better developed markets for the more drought resistant cash crops of the large-scale sector, e.g. barley, grapes.

¹⁷Poor farmers must get maximum income from any new crops. D-r maize does not provide as much income as local maize or cotton under wet conditions.

¹⁸Several factors work against expansion of traditional d-r food crops like sorghum and millet. Bird hazard requires a high input of time spent guarding the crop, and as children go in increased numbers to school and the woman's labour is needed in non-farm economic activity (e.g. beer brewing, gathering firewood for sale), such guard time is harder to provide. Also the market for such crops has never been encouraged; hence surpluses of such crops are difficult for the poor farmer to convert to cash for his increasing cash needs.

¹⁹Despite clear evidence that intercropping of multiple varieties is an effective adjustment (see Porter, 1965, who found 6 varieties of millet in Kilungu fields), the government extension staff discourage this practice. A further alarming trend is toward large-scale monocropping among rich farmers. Many critics of the monocropping produced by the "green revolution" elsewhere have emphasized the increased plant disease hazard this practice causes.

²⁰Mbithi (1970) found 60% of rural households in eastern Kenya had at least a small share in a local shop.

²¹E.g. charcoal production, brick making, beer brewing, honey and gum arabic collection, basket work and other handicrafts, collection of firewood for sale.

²²It should also be borne in mind that the very rich usually earn salaries for sitting on cooperative society boards or doing salaried work for the government.

²³There is little work available where most of the community is poor.

²⁴The "very rich" equivalent of poaching by the poor and very poor is hiring gangs of men to kill animals on a large scale for their "trophies" which are exported illegally or sold to tourists.

²⁵Actually practiced in Australia (Heathcote, 1974).

²⁶Cooperative societies are simply very rare in the lowlands among poor farmers in Kenya.

²⁷Most farmers in Kenya are not eligible for loans in any case because registered ownership of one's farm is required for security.

²⁸Little action is taken against the very rich and rich who default on loans (Leys, 1975, 102).

²⁹Most of these poorer farmers are not liable to the minimum personal tax payment of 48 Kshs. Only those earning over Kshs 960 (~~248~~) a year or those thought by the local assessment committee to have large livestock reserves or stores of material wealth (despite low income) are liable to this payment. (See Brokenshaw and Nellis, 1971, 10-11).

³⁰Distribution of famine relief in 1970-71 tended, oddly enough, to peak in the medium potential zone and to fall off as one moved into drier and drier areas where one would have suspected greater need. A typical progression, from Mikumbune near the Mt. Kenya forest zone to Kathungachini near the Tana river is as follows:

<u>Site</u>	<u>% receiving relief</u>
Mikumbune	0
Mitunguu	14
Chiakariga	54
Gatunga	29
Marimanti	22
Kathungachini	5

The Eastern Kenya Study also revealed a tendency for relief to be concentrated around administrative centres, e.g. Chiakariga in the above example. Turning to Kyuso Division of No. Kitui, the divisional centre, Kyuso, had 29% of households receiving relief while in Katse, just 15 miles away, only 17% received famine relief. In Waita, having much more favorable environmental conditions than either Kyuso or Katse, we found 45% of the farmers received relief.

³¹The very rich variation on this practice is to send children to boarding school in Nairobi or in England.

³²These adjustments are theoretically accessible to the very rich and rich although clearly they would seldom find them necessary and would also have to overcome strong social taboos to use them. Rich farmers do, on occasion, find their lot cast with the poor. See, for instance, Death in the Northeast by de Castro (1966).

³³There are practically no facilities for savings deposit by the poor farmers in Kenya although some proposals to utilize cooperative societies have been made (Trapman, 1974, 73-76).

³⁴The poor farmer's "normal surplus" (Allan, 1965; Porter, 1970) tends to be sold off at low prices and not stored as it was once. Furthermore, maize, which has replaced sorghum and millet in the diet of most farmers, does not store as well as the traditional grains.

³⁵This practice has an insidious "multiplier effect" as if it is the productive members of the family who suffer reductions, their working ability declines at a time when other adjustments require greater output. If it is the children or old who suffer, they run greater risks of impaired health as a result.

adjustment for about 50,000 of the richest farm families at the cost of decreasing the range of choice, that is, adding additional constraints, on the action of the rest.

Such interaction between classes of farmers works on many levels. Public credit to a big farmer to buy overhead sprinkler irrigation draws down the fund of resources that might have gone to smaller farmers. In 1971-72, K&3.1 million in loans under the Guaranteed Minimum Return Seasonal Crop Credit Scheme (GMR) went to 5,500 farmers only. At another level, the use of sprinkler irrigation is only profitable in a highly developed capitalist market economy. There are thus set up in the Kenyan agricultural economy forces toward more and more efficient profit maximizing which are not limited to the large-scale farmers themselves. The same public corporations which buy the large-scale farmer's maize also buy the small surplus of the poor peasant. Institutions that supply credit to the one group influence the definition of "credit-worthiness" of the other. Big farmers influence the producer prices for food crops. Tied to such a system, but at its margins, the poor farmer finds he needs more and more cash to get by. Traditional food crops are abandoned. Farm labour is siphoned off into casual rural wage labour or migrant labour. Cash-crops are encouraged by the government.

The dialectic of choice and constraint emerges quite clearly if one considers in more detail just three adjustments: insurance, improved crop varieties, and irrigation potential.

Crop insurance in Kenya is part of the Guaranteed Minimum Return Seasonal Crop Credit Scheme which was started in 1942 as a wartime measure to encourage crop production among large-scale farmers (Trapman, 1974, 64). The programme consisted of advances made to farmers and guaranteed minimum

prices for the crops included in the programme. These originally were sunflower, linseed, vegetable seed, grass, potatoes, rice, flax, oats, barley, rye, wheat, and maize. Originally a minimum of 100 acres had to be sown to these crops if a farmer was to qualify. Now the programme has been modified to cover only maize and wheat, and the minimum acreage has been reduced to 15 acres. Since 1955 the scheme has been financed by a vote in the Ministry of Agriculture allocating funds to the Cereals and Sugar Finance Corporation, a statutory board which has as its agent the Agricultural Finance Corporation and the Kenya Farmers' Association. The last-mentioned functions as the buying agent for the Wheat Board and also buys maize in Rift Valley Province for the Maize and Produce Board.

Maximum advances in shillings per acre and the allowable uses for the credit advanced is determined each year by the MOA. In 1972 the maximum advance for maize and wheat was Kshs. 180 per acre and could be spent for seeds fertilizer, pesticides, contract cultivation, fuel, machinery repairs and spares, bags, harvesting, and transport (Trapman, op. cit., 65). Between 1969 and 1973 the premium for crop insurance could also be paid from this advance, but now the Agricultural Finance Corporation insists on cash in an effort to separate credit from insurance (Trapman, Ibid.). Applications for the scheme are reviewed by a District Agricultural Committee, but decisions are made centrally.

Participants in the GMR are supposed to inform the District Agricultural Sub-Committee concerned as soon as they suspect a crop failure. An inspection team from the Sub-committee visits the farm and determines if the farmer may claim for compensation and whether it would pay to harvest the crop at all. A crop failure is defined as "a yield below that which is adequate to repay the maximum advance allowable" (Trapman, Ibid.). Farmers

who experience failures for other than reasons of natural catastrophes two years running are excluded from future participation. Claims are paid by the Central Agricultural Board with funds budgeted by the MOA.

As noted above, this expensive programme extends to only 5-6,000 farmers, the average participant receiving K\$560 credit in 1971-72. Furthermore, since loan repayment is not good and since in most years premiums paid do not cover compensation paid out, the whole system functions as a national subsidy for the large-scale maize and wheat farmers.

Improved crop varieties have received intense interest in recent years as belief in a "green revolution" waxed (Brown, 1970) and waned (Byres, 1972; Griffiths, 1974). Of all the potential genetic improvements for drought-resistance and yield identified by the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), only the potential of maize has been developed in Kenya in a way accessible to the poor farmer. Promising sorghum and millet varieties developed by East African Agriculture and Forestry Research Organization (EAAFR0) in Serere, Uganda, (EAAFR0, 1969, 1970) were apparently lost during the recent ascension to power of General Amin. The Kenya Seed Company began bulking hybrid wheat for large-scale farmers.

A drought-resistant composite maize called Katumani has been developed since 1958 for the small farmers in semi-arid conditions. First distributed in 1964, the seed has faced a series of problems familiar by now to critics of the "green" or genetic revolution. Success with Katumani demands adoption by the small farmer of a whole "package" of agronomic practices including early planting, frequent weeding, and use of pesticides. Although Katumani does not regress genetically as fast as hybrids, mixed stands of Katumani and local maize are not recommended because of cross-breeding, and every two or three years fresh Katumani seed (at about K\$1 per kilo) is recommended.

Use of fertilizer is also recommended, though not essential.

However, Heyer (1971) has shown that unless Katumani is fertilized and tended with large amounts of labour for weeding, it cannot surpass local maize yields in a year of above average rainfall in Machakos and does not compete with the revenue from cotton in such a year. Confidence of many farmers in Katumani was further shaken by unscrupulous sales to farmers in Eastern Province of hybrid seed under the label of Katumani in 1971 with disastrous results. The Kenya Seed Company has also had difficulties bulking and distributing the seed because it is grown (quite profitably) by large farmers under contract for the KSC around Kitale, where the longer season usually produces a harvest of seed too late for that year's planting in the lowlands. One sees that even in the production of drought-resistant seed for the poor farmers there are rich farmers ready and able to make a profit! The result of this accumulation of large and small problems with Katumani has been an adoption rate far below that expected.

Irrigation potential in Kenya is depicted in Map 4 (Ojany and Ogindo, 1973, 146). It shows a total of 350,000 irrigable acres of which only about 15,000 are irrigated at the present time. About 4% of the potential is actualized. In the Canadian national hazards summary Visvader and Burton report that 2 million of a potential 3 million acres are irrigated, that is, 66% of the potential. Map 4 does not, however, indicate the considerable potentials for irrigation that exist along the Ewaso Ngiro River, where a World Bank Mission estimated there are 66,000 acres irrigable (Ominde, 1971, 155). Nor does it mention the potential of small-scale, unorganized irrigation in the Upper Tana Basin, although a Kenyan government report pointed out this potential twenty years ago (Brown, 1955). Together with small-scale potential in even more arid zones, e.g. on the Daua River border with

Somalia, around Mount Marsabit, the Huri Hills, etc., the total potential for irrigation in Kenya may easily be 500,000 acres.

The problem with irrigation, as with crop insurance, is who benefits. Small-scale organized irrigation is confined to about 6,000 hectares, almost exclusively on coffee estates and on growing horticultural crops such as pineapples (ILO, 1972, 411). It is likely that this sort of irrigation will expand quickly, but its expansion does little to secure the existence of the hundreds of thousands of families living on small dry farms in zones of uncertain rainfall. On the contrary, its expansion would constitute a further subsidy to large-scale farming and tend to drain away more technical manpower and capital from the needs of less profitable sectors. The ILO Report continues (op.cit., 416),

Small-scale organized irrigation could be encouraged, particularly for horticultural crops. To facilitate this, there must be more training, more credit, perhaps more subsidies for equipment or recurrent costs, more extension advice and more channels for marketing. It is estimated that by 1990 sprinkler irrigation might cover 20,000 hectares (50,000 acres), an increase of 14,000 hectares (35,000 acres), this increase being partly on small holdings with valleyfloor or drained swamp land. The operation of equipment and cultivation might create 23,000 additional jobs.

In other words, what the poorest sections of the "farming community" can at most look forward to from such schemes is the slightly increased chance of finding a job when constraints on their own set of adjustments become so severe they are forced off the land in search of livelihood.

Kenya's National Irrigation Board supervises large-scale organized irrigation projects covering 13,200 acres such as the well-known Mwea-Tebere rice growing scheme which provides nearly all of Kenya's rice and irrigation settlements in the Kano Plains in the West. As with other settlement schemes in Kenya, like those in the former White Highlands, membership rarely falls

to the poor or very poor farmers. Prior residence in a settlement area by no means assures one of inclusion in the scheme. Four hundred families were made landless (with compensation) on the Kano Plains when that scheme began. Those few families who participate (500 in the Kano Plains scheme, a few thousand in Mwea) earn high incomes and usually end up hiring the cheap labour of non-participants and the landless. Indeed, wage work in nearby Mwea-Tebere turned out to be a major adjustment to drought practiced by the dryland farmers of Karaba, one of my study sites. Some authorities have become alarmed that the welfare benefits of these irrigation schemes do not seem to spread very far and have suggested that plot sizes be reduced and income goals lowered to accommodate more participants (ILO, 1972, 413-415, 420).

The only sorts of irrigation at all relevant to the needs and constraints of poor farmers in dry areas are the so-called small-scale unorganized or minor irrigation projects. These are generally self-help activities based on local perception of resource potential and local initiative with little or no help from the government. The Ministry of Agriculture's Water Development Division (WDD) has recently been given a brief to aid in planning and starting such projects. WDD recognized 32 minor schemes totalling about 5,000 acres. The potential welfare value of such irrigation has been recognized in principle, although there seems to be confusion about the amount of aid deserved. On the one hand the ILO Employment Mission states that,

A large expansion of these schemes could be contemplated. They confer considerable local benefit in terms of a more diversified and secure local source of food and partly offset expenditure on famine relief. In some areas, where livestock potential is almost exhausted, they offer one of the few alternatives to migration. In areas destined for group grazing even a small irrigation scheme would be a considerable advantage. It might form a focus for a nucleus settlement and hence an area where services and amenities could be made available. (op.cit., 417)

On the other hand the same report finds the "great merit" of such schemes to be their establishment and maintenance in large part by self-help since "they are generally too small to be economically developed and operated by the government directly." The National Irrigation Board, at least, is unambivalent in its attitude to such schemes: it wants nothing to do with them because they are not profit-making. The ambivalence seems to lie with government, which has impressive (though contradictory) plans for the whole of the Upper and Lower Tana Basins. Some versions of the plans for the Tana River would provide small-scale irrigation for 175,000 families, but it is unclear how WDD's skeleton staff for Minor Irrigation could possibly "encourage" irrigation on this scale (ILO, 1972, 416). Other versions concentrate attention on the Tana's hydroelectric potential. Still other versions plan irrigation as an expansion of existing Lower Tana schemes and the area surrounding Mwea-Tebere without including the large number of poor farmers living near the Tana in its middle reaches (ILACO, 1971).

In brief, one sees clearly the reappearance again - in the case of crop insurance, irrigation, crop improvement - of the basic problems of unequal access, gross income disparity, and regional imbalance. These are, indeed, the burdens which any attempt to equalize access to drought adjustments must face. Those who pose the problem as one of "modernizing" an essentially "less progressive" peasantry are not facing the true magnitude of these burdens. Darfur in Sudan boasts terraces 2,500 years old developed as water conservation aids. Neither neolithic farmer nor modern peasant lacks such ability. The peasants of Kenya's eastern foreland plateau and other dry-farming areas are not "slow" to take up new adjustments which fit within the increasingly narrow set of constraints governing their lives. The problem for them is threefold: First, their lives are becoming more

tightly constrained (this is the kingpin issue of "marginalization"). Second, there is unequal access to possible adjustments. Third, even if a poor farmer does have the opportunity to try a "modern" adjustment, it does not come alone, but as part of an interdependent system of practices fashioned for the needs of agro-industry. These simply do not fit the peasant's pattern of constraints.

Perception of Drought Adjustment

It has nearly become a platitude of socio-environmental science that man does not act directly on his surroundings but rather indirectly through a perceptual and cognitive filter composed of elements of culture, personality, childhood experience, recent experience, and even immediate bodily states (Wapner et al., 1973). Natural hazards researchers have focussed a good deal of their work on developing a valid and useful model of individual perception and choice of adjustment. This has led, in turn, to specialized research in the application of psychological tests to this area of behavior¹⁰ and to the development of a questionnaire approach to eliciting adjustment practices and evaluations (White, 1974). Table 5 shows the results of asking nearly 600 farmers in eastern Kenya what they did during drought. Spontaneous responses were recorded first, then the remainder of a standard list of 25 adjustments were "probed" if the farmer had not mentioned them. For each adjustment the farmer was asked if it was a good or bad thing to do (irrespective of whether he actually did it or not). He was also asked to give reasons for saying it was a good or bad thing to do.

The list of adjustments generated is considerably shorter than the list of 76 possibilities summarized in Table 4. One reason is that such a

¹⁰Barker and Burton, 1970; Golant and Burton, 1970a, 1970b; Schiff, 1972; Saarinen, 1974.

structured interviewing technique tends to miss some adjustments even though the schedule opens at one point to allow the spontaneous response. Another more revealing reason brings one back to the realities of unequal access in Kenya. Interviewing was carried out only in Eastern Province, one of the less developed provinces in Kenya. Further more, no "very rich" or "rich" farmers appear in the sample. The interviewers' subjective assessment was that on the basis of material wealth visible at the homestead 15% of the sample were "relatively" rich by local community standards, while 41% fell into an average group and 45% were poor.

TABLE 5

The Practice and Evaluation of Adjustments
in Eastern Kenya (N=595)

<u>Type</u>	<u>Adjustments</u>				<u>Evaluation (%)</u>							<u>Reasons¹</u>						
	<u>Use(%)</u>	<u>Good</u>	<u>Bad</u>	<u>D.K.</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
Buy food	96	96	1	3								&	+					
Pray	93	15	2	3													
Plant before 1st rain	80	81	10	9								&	+					
Plant drought-res. crop	72	78	9	13								+	&					
Plant dry	71	72	20	8								+	&					
Ask help from kinsman	66	74	18	8									&		+			
Weed more	64	74	13	13								&	+					&
Seek wage work nearby	60	74	15	11														
Plant with 1st rain	59	60	29	11								&	+					?
Sell cattle	53	68	7	25									+					
Cultivate low wet place	48	74	9	17								+	&					
Move to kinsman's farm	47	55	36	9								&	?			+		?
Seek wage work far away	40	52	32	16								?	+	&	&	&		
Move cattle	36	59	11	30								+	&					
Collect bush food	36	46	31	33								+	&					?
Dig ridges	33	53	23	34								&	+					?
Hunt or fish	26	40	37	33								+	&	?	?			&
Quit planting	23	19	69	12								?	+	?				&
Ask help from gov't.	21	62	16	22									&	&				+
Send children to kinsman	17	27	59	14								&				+		&
Irrigate	16	67	12	21								+	&	?	?			?
Try to get loan	15	57	14	29									?	&	?			+
Ask help from co-op	14	51	10	39								&						+
Pay rainmaker	11	15	41	44													
Do nothing	1	1	71	28											+	&		&

(Footnote on bottom of next page)

Table 6 tells one a great deal about the model dryland farmer in Kenya's zone of highest famine vulnerability. Being quite poor (yearly income between KSh20 and KSh60 only), his repertoire of drought adjustment is narrow. Only ten adjustments, the first ten listed on Table 5, are practiced by half or more of the sample. However, these "top ten" adjustments span the full range of functional types of practice

TABLE 6

Top Ten Adjustments to Drought
in Eastern Kenya
by Functional Type

TYPE	adjustment (% practicing)
AFFECT OR KNOW THE RAINFALL SOURCE	pray (93)
INCREASE MOISTURE	plant before 1st rain (80)
	plant dry (71)
	plant with 1st rain (59)
REDUCE MOISTURE NEED	plant drought resistant crops (72)
	weed more (64)
DIVERSIFY	seek wage work nearby (60)
DISTRIBUTE OR SHARE LOSS	ask help from kinsman (66)
BEAR THE LOSS	buy food (96)
	sell cattle (53)

¹Reasons given by respondents for evaluating an adjustment as good or bad were coded into the following eight classes:

- (1) Farmer has not heard of the adjustment.
- (2) Farmer thinks local environment is favorable or unfavorable.
- (3) Farmer doesn't know how to do it.
- (4) Farmer thinks it would pay or wouldn't pay.
- (5) Farmer cannot afford it.
- (6) Farmer is encouraged or discouraged by the effect adjustment would have on others.
- (7) Farmer doesn't think it would work.
- (8) Other reason (not shown; see text).

"+" indicates the modal response. "&" indicates the next most frequently given kind of reason or reasons. "?" indicates other sorts of reasons given by at least 5% of the sample.

The fact that five of the "top ten" are agronomic adjustments mirrors the fact that no "pure" pastoralists were included in the sample. Although livestock was of varying degrees of importance in the domestic economies studied, arable farming was important everywhere, and Porter's description of complex refinements in such land use systems was supported by my findings (Porter, 1970; 1976).

One should note some possible contradictions among the "top ten." The five agronomic adjustments demand an increase in labour. Among these poor farmers there was usually not enough spare cash to hire labour. Cash from the sale of cattle had to go for buying food, an almost universal practice. Earning cash to hire weeders, etc., by wage labour is self-defeating since it obviously requires the farmer to reduce his labour on his own farm. Labour is energy. Energy is food. Here is a bottleneck, for recent measurements in Zambia (Tompson, 1972) show that hoe-digging of ridges requires 180 calories per hour. A farmer eating 1800 calories would need 1200 for basal metabolism and specific action (minimum bodily needs). This leaves over only enough for three hours digging. Weeding is, of course, less demanding, but it is obvious that from the basic viewpoint of ergonomics, there is little potential for meeting the additional demands of extra weeding and very strenuous seed-bed preparation in dry soil as is necessary for early planting. Three points of importance emerge from this: the importance of kinbased helpmate exchange of labour; the potential usefulness of mechanization if available; the fact that the farmer is likely to be living and working at a caloric deficit during this critical period.

The large frequency of food purchases and attempts to find wage-labouring opportunities should dispel any lingering impressions that Kenya's agricultural economy is divided neatly into "dual" economies, one modern and com-

mercial, one for subsistence. Casual wage work, when available, is generally "up-mountain" from the lowland sites studied and is therefore not strictly local but nevertheless should be distinguished from long-distance wage migration to places like Mombassa and Nairobi. Recurrent bad years ensure the participation of lowland farmers at very low rates of wage or for payment in kind in the cotton, coffee, and banana cultivation by richer farmers higher up the mountain. Reliance on local food purchases puts the small farmer at the mercy of food price fluctuations and speculation by larger farmers and traders. One has here further evidence that the farmers most vulnerable to drought are those at the margins of Kenya's capitalist farming system, not those "outside" it. No one is outside of it. The system of capitalist relations of production developed since late colonial times has produced an environment which favours the growth and increasing security of the large-scale farmer. The spread and successful penetration of the same system throughout the rural areas has created an environment which prejudices the growth and security of the small farmer, a process which leads to marginalization, involution, and increased famine vulnerability.

Having first monetized the economy, Kenyan capitalism is now swiftly commercializing it and proletarianizing the small farmer. The landless numbering over 300,000 families and increasing each year are fully proletarianized into low-paid rural wage labour or city unemployment. The small farmer is forced into greater reliance on seasonal rural labouring and non-farm activities for cash. The alternative to semi- or full proletarianization for both strata of the poor peasant class is exodus into more and more environmentally challenging territory. The net effect of all of these processes is to put great pressure on the traditional set of drought adjustments ("folk" adjustments) which is the patrimony of the lowland farmer. At the

geographical margins of the heartland of capitalist farming many of the small farmer's folk adjustments become unviable because the small farmer can simply not afford them. Kin-help is clearly declining. Around the base of Mt. Kenya transhumance patterns are blocked on one side by the expansion of coffee and cotton holdings, on the other by the expansion of game parks.

The situation is one primarily characterized by constraint. This is, of course, not to deny choice, but a look at the sort of reasons given by farmers in their evaluations of different adjustments demonstrates the overwhelming influence of economic and environmental constraints.

The most frequently encountered reasons were couched in terms of environmental favourability or economic profitability. Evaluations of 36% of the adjustment listed were made primarily in economic terms. Another 28% were primarily based on environmental favourability. Together these two sorts of reasons were given as the major evaluative criteria of 64% of the listed adjustments. These two factors appear as significant in the judgment process of the farmer in all but four of the 25 adjustments, and two of these four are adjustments pertaining to religion for which none of the seven classes of decision criteria seem to fit.¹¹

The only adjustments that a significant number of respondents had either not heard of or didn't know how to do were "asking for help from a cooperative society (75 farmers (13%) had never heard of doing such a thing),"asking the government for help" (89 farmers (15%) didn't know how to go about it), and "trying to get a loan" (37 farmers - 10% of a subsample of 358 - didn't know how). In other matters knowledge and awareness seemed not to be the limiting factors. Peasants knew how to dig ridges and to irrigate, and they thought these adjustments were good ideas, 53% evaluated ridging favorably,

¹¹ Almost all (84% and 82%) responses about evaluation of prayer and rain-making fell outside the categories used to classify criteria.

but only 33% could do it. 67% felt irrigation was good, but only 16% were able. The constraints in both cases were environmental and economic.

In the case of government and co-op assistance and loan applications the most frequent response was that it was simply not feasible, just wouldn't work - a judgment reflecting either lack of familiarity with the bureaucratic systems or cynicism, or both. Table 7 ranks adjustments by the degree of divergence between their positive evaluation and their actual practice. This gives a crude measure of the degree of constraint at work.

TABLE 7
Constraints on Choice of Adjustment

<u>Adjustment</u>	<u>% Used (a)</u>	<u>% Positively Evaluated (b)</u>	<u>(b-a)</u>	<u>Type of Primary Constraint</u>
Irrigate	16	67	51	Environment
Loan	15	57	42	Feasibility
Government help	21	62	41	Feasibility
Co-op help	14	51	37	Feasibility
Farm low, wet places	48	74	26	Environment
Move cattle	36	59	23	Economic
Dig ridges	33	53	20	Environment
Seek wage afar	40	55	15	Economic
Sell cattle	53	68	15	Economic
Hunt or fish	26	40	14	Environment
Seek wage nearby	60	74	14	Economic
Send child to kinsman	17	27	10	Social
Collect bush food	36	46	10	Environment
Weed more	64	74	10	Economic
Move to kinsman's farm	47	55	8	Social
Kin help	66	74	8	Social
Drought-resist. crops	72	78	6	Economic

One interesting relationship to emerge from this table is the relatively slight degree of constraint exercised by social inappropriateness as compared with the more extreme degree of constraint placed on farmers by their environmental and economic circumstances and the perception of infeasibility which seems to be associated with adjustment requiring contact with the major

bureaucratic institutions of credit, marketing, and state power. The impression that economic and environmental criteria dominate the peasant evaluation of adjustments is strengthened by the fact that probing revealed an economic motive behind even some of the "social" reasons. Reluctance to send a child to a kinsman's or to move there to farm is often because the kinsmen are also poor and struggling against the same drought conditions.¹²

Profile of the Modal Dryland Farmer of the Eastern Foreland Plateau of Kenya

The modal¹³ household head of the 610 farm families I studied is a man¹⁴ between 19 and 49 years of age. His tribal affiliation and language is Bantu, most probably Kamba. Let's call him Kaugi. He owns a small farm under traditional tenure, usufruct. It is most likely not his father's land, but around four acres Kaugi has cleared himself. This land is not registered with the government.

Kaugi devotes three acres to food: maize, millet, sweet potatoes, pumpkins, beans, peas. Up to one acre is devoted to crops for sale: grams, castor beans, perhaps some cotton. Kaugi is a quasi-subsistence farmer¹⁵, devoting less than 25% of his time to cash crops.¹⁶ His labour resources are not great. His family consists of only his wife and three children under

¹²Under special conditions where kin tend to drift apart spatially into different ecological zones such help is more common; (see Rigby, 1970).

¹³Use of the mode removes the influence of irrigation schemes and highland sites chosen not for representativeness but as controls or possible glimpses at future adjustment patterns. Where two or more modes exist, this will be pointed out.

¹⁴19% of household heads were women.

¹⁵Following Symonds (1967, 174).

¹⁶Approximately only, since everything is intercropped.

15: a son and two daughters. Altogether this amounts to only 2.5 Man-Equivalents of labour. Maintaining caloric equilibrium on the prevailing diet, the family can work six hours a day or 105 man-equivalent-hours a week. By taxing their bodies during peak periods of labour requirement, the family could generate 175 man-equivalent-hours a week, but do so at a net caloric cost. Kaugi's farm provided 0.8 acres per person, 1.6 acres per man-equivalent. He owns one or two cows and half a dozen goats.

Kaugi is a Christian. He can read a little, but has attended less than six years of primary school. He believes droughts are a purely random occurrence and has experienced two or three such bad years in the ten years he has been resident in the present place. At these times he says he and his family suffered severely, although he has not received famine relief.

We visited Kaugi during a period of deep drought, in August 1971. By then the past three rainy seasons (main rains 1970-71, main rains, 1971) had been abnormal. He and his family were at the end of their reserves, and he was depressed, starkly realistic, even cynical in his attitudes. This may account for his evaluation of his present place of residence, which emphasized its disadvantages. Nevertheless he did not know of a better place to which he could go to farm. This should not be taken as a sign of bucolic naivete or inexperience of the wider world, for Kaugi had travelled, most recently in search of wage labour. His judgment reflects the realities of intense competition for better land in Kenya. He knows he has little chance in such a scramble.¹⁷

The worst drought he recalls is 1965-66. This is interesting because from the point of view of agro-meteorology 1953 and 1961 were in fact much more intense droughts.

¹⁷See, for instance, C. Leys, 1975.

His thinking about what to do next was dominated by constraints rather than numerous possibilities. These constraints centered mostly on his own limited economic circumstances and the limitations of his local environment. He had already sold one cow and was thinking of selling the remaining one. Food was dear in the shops and the price paid for livestock had fallen. He had asked his kinsmen for help in replanting once, but they had their own troubles by now, and, in any case, his family had been forced to eat his remaining stock of seed corn. He was able to bring in a little income by selling charcoal and honey, and his wife made a little money brewing beer; however, it was looking as though he would have to leave home again soon to try to find temporary wage work. One of his three children, the middle one, was clearly malnourished, with clinical signs of mild-moderate kwashiorkor and low weight-for-age. The others were light for their ages and heights, although they were not clinically malnourished. They had all been ill on and off for nearly a year with diarrhea, colds, coughs, fevers, skin and eye infections.

Returning to the Natural Hazards Paradigm, one may summarize the argument of this chapter as follows:

- (1) Drought can affect almost all areas of Kenya, but especially the wide arc of semi-arid land around the central highland core. Around 4 million persons are directly vulnerable to drought: that is, those persons making their living in the drier 80% of the country.
- (2) The range of possible adjustments to drought in Kenya is very wide, including some of the most modern practices of agro-industry; however, access to these is unequal as a function of income and regional imbalance.
- (3) People in eastern Kenya perceive drought very much as environmental scientists in the metropolises do: the majority view them as a random event, with a minority inclining toward models of regular occurrence, possibly involving cyclicity.

(4) The process of choosing damage-reducing adjustments in eastern Kenya seems to involve modifying routine activities by adding or subtracting enterprises, activities, or elements of activity patterns according to the strict constraints placed by family economic circumstances and the local environment. Local environmental and economic opportunities are sought out first, before looking for help farther away. Likewise, the familiar institutional framework of kin help is exhausted before more exotic institutions are confronted, e.g. cooperative society, lending organ, or central government.

(5) To discuss the probable effects on human drought response of varying government policy would extend this overview too far in scope. However, preliminary collation of evidence suggests that drought vulnerability is related to a very broad range of government policies, indeed to its overall approach to rural development and to farming. We have also seen that drought is quite costly. Even with this small amount of information it is clear that changes in government policy must necessarily produce major shifts in vulnerability, as, to be sure, major shifts - for the worse - are proceeding in the face of official inaction.

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APPENDIX A

Kenyan Land Potential

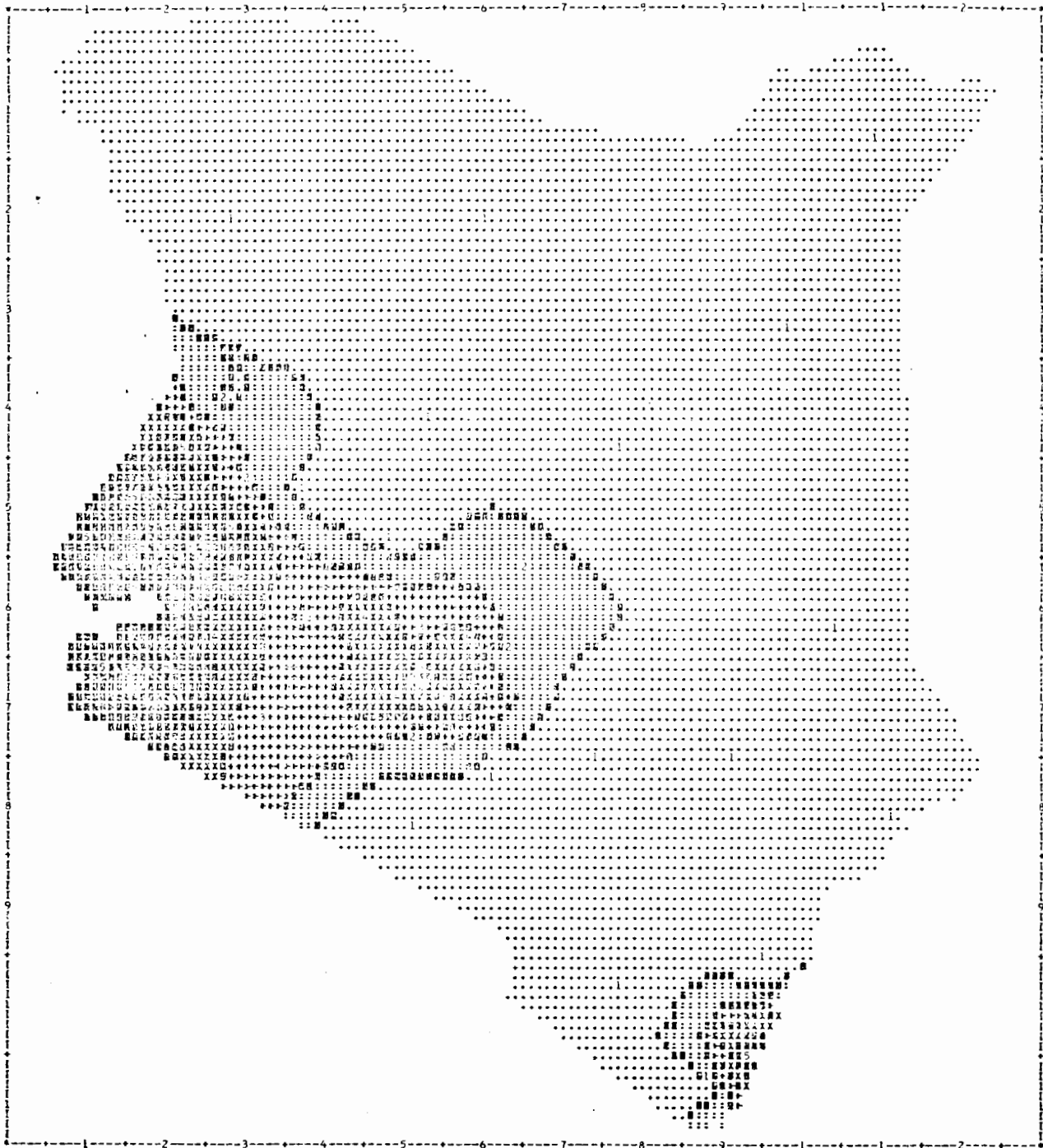


Figure I: High Potential Land as a Percentage of Total Land by District

Based on 1962 data.

Level					
MINIMUM %	0.0	20.00	40.00	60.00	80.00
MAXIMUM %	20.00	40.00	60.00	80.00	100.00

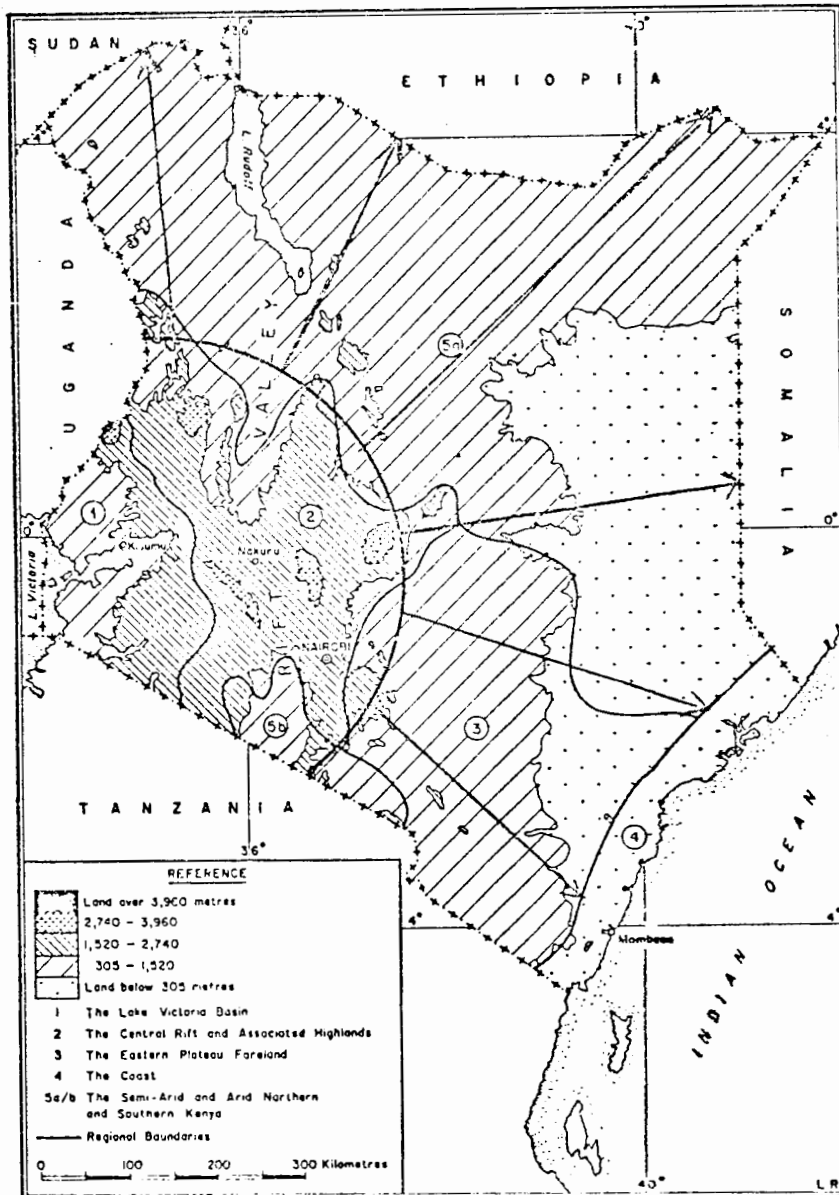
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of data points 17 5 3 4 12

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Map 2

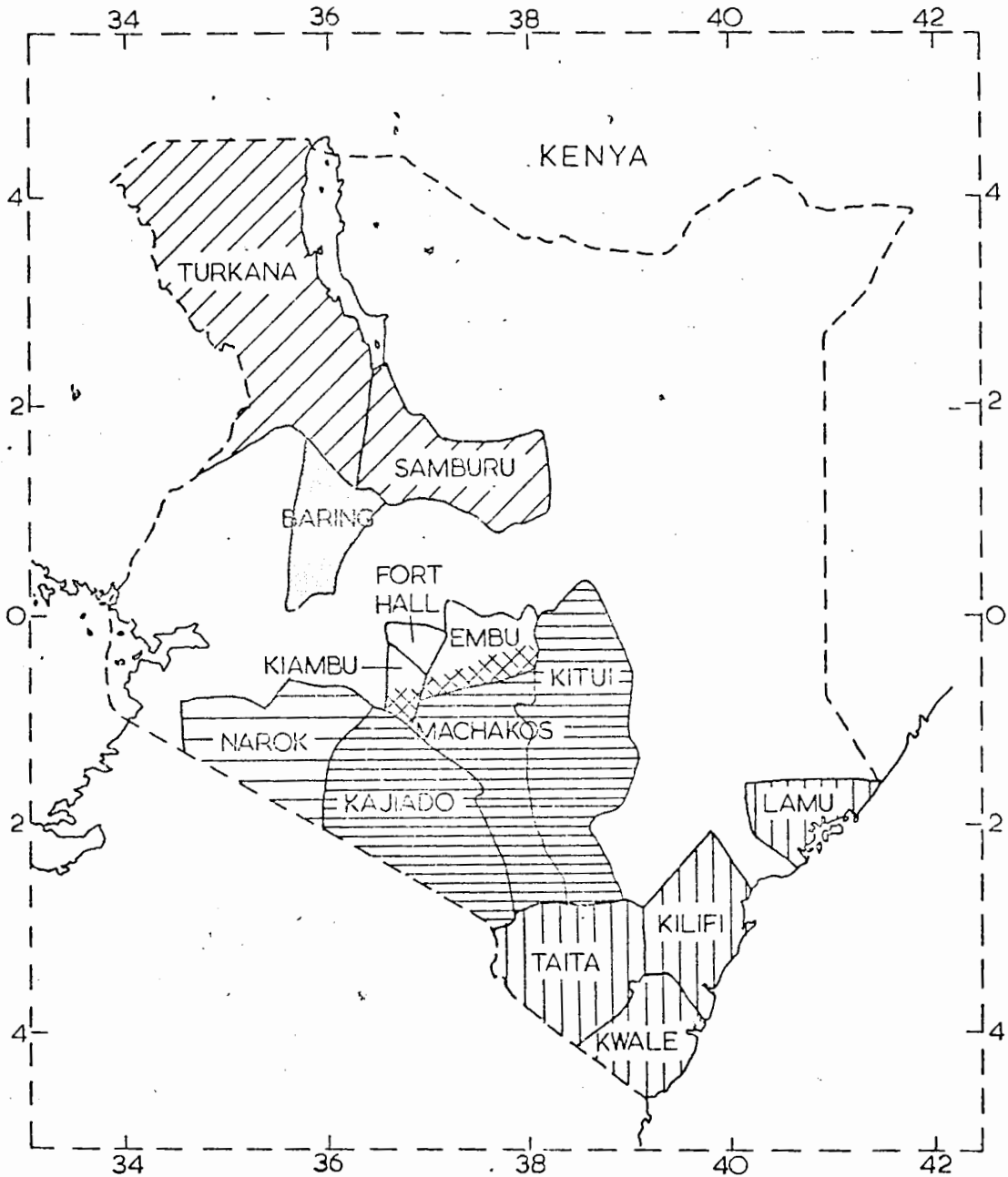
The 'Wide Arc' of Kenya's Drier Lands

Effectively most land below 1520 metres on this map is considered to be 'medium to low potential' -- best suited to shifting peasant cultivation or extensive ranching. However map 2 is intended to schematize the relation between highland core and lowland periphery. The areas delimited are not exact.

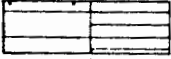






Source: After Ominde, 1968.

MAP 3 FAMINE RELIEF 1961 - 62

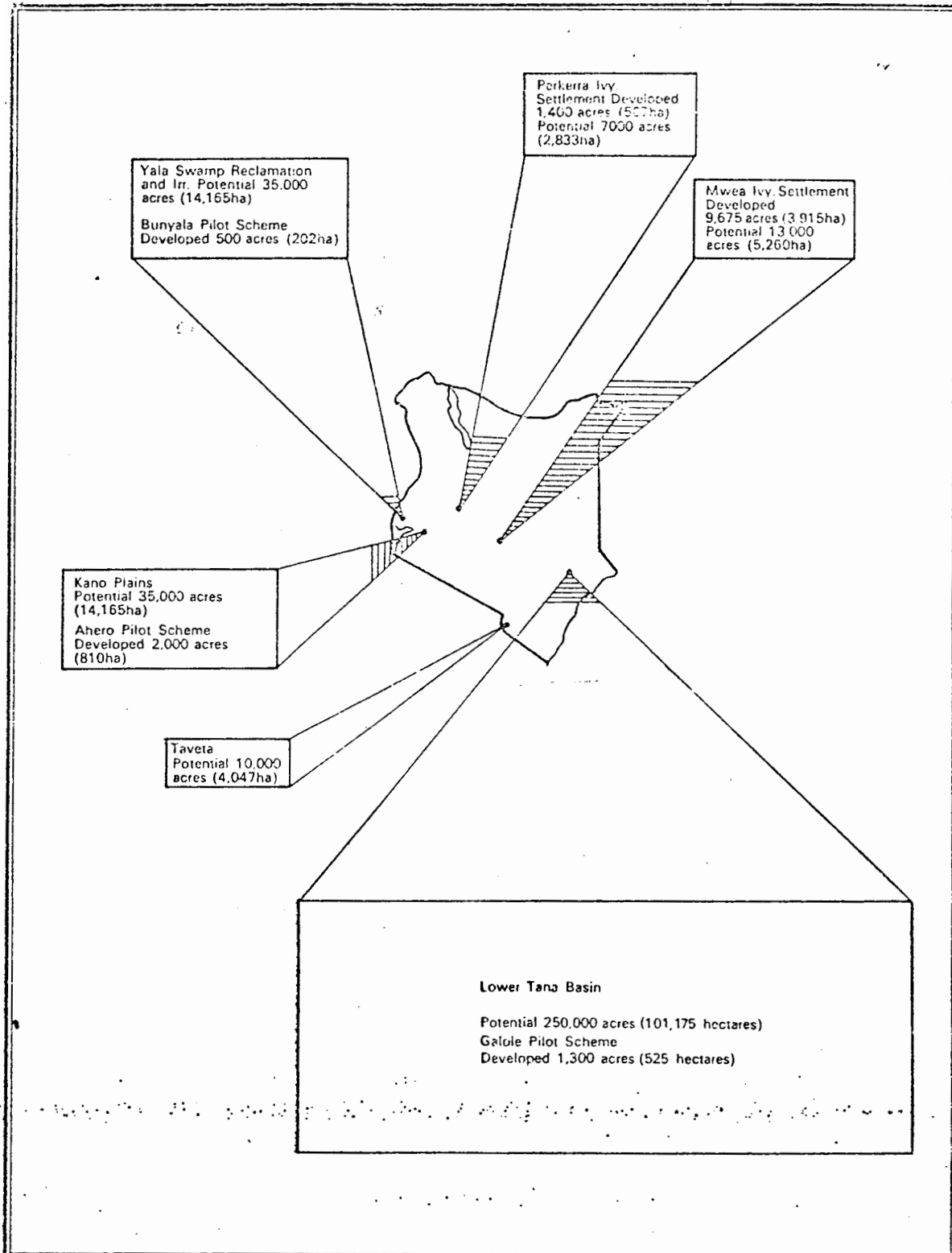


KEY

- | | | | |
|---|--------------|---|--|
|  | 238,393 bags |  | 32,193 bags (lower Fort Hall, Kiambu & lower Embu) |
| lesser major recipient area | |  | 15,392 bags |
|  | 41,886 bags |  | 11,265 bags |

SOURCE : After Roberts, 1962.

Map 4
Kenyan Irrigation Potential



SOURCE: Ojany & Odingo, 1973