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DROUGHT IN EASTERN KENYA: COMPARATIVE
OBSERVATIONS OF NUTRITIONAL STATUS
AND FARMER ACTIVITY AT 17 SITES

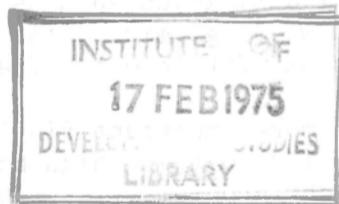
by

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DROUGHT IN EASTERN KENYA

by

B. Wisner & P.M. Mbithi

ABSTRACT

This paper is the first of a series of reports dealing with man-environment-technology relationships. In this study, agricultural drought is viewed as a natural, though extreme, outcome of the inter-action of man and nature. All human rural systems are seen as organized to continue to function within diverse environmental circumstances and therefore "adjusting" to give rise to practices, institutions and linkages which increase adaptation and consistency.

The study attempts to portray farm level decision making as an adjustment behaviour and relates this to environmental circumstances. It shows that many diverse rural activities such as praying, rainmaking, irrigation, crop spacing, frequent weeding, migration, prostitution, poaching and intensified reciprocity norms all fit into the framework of adjustment behaviour.

One of the more important findings of the study is the realization that a relatively low cost and high benefit approach for government, in dealing with drought problems, is to build dry land farming research and development programmes upon the local patterns of adjustment. This arises from the realization that the complexity, variety and flexibility of farm and village adjustments are closely tied to existing local techno-socio-economic definitions of the environment and not to central planning statistical insights.

THE REALITY OF DROUGHT

Twice during 1970-71 the rains reached only 50-75% of the long-term average in many parts of Kenya. This contributed to outright crop failure and livestock death or serious production losses which directly affected the livelihood of about three million Kenyans (about a third of the population). At the peak of the ensuing famine nearly a tenth of these persons were being supported by famine relief. For the nation as a whole, the impact of these events was mediated by the presence of one of East Africa's most highly developed highland economies, where the direct effects of drought are seldom felt. Indeed Kenya's generous mixture of extremes of environment and degrees of rural development make the national assessment of such a thing as drought particularly difficult. Even in the middle of the vast expanse of the northern rangeland one encounters islands of arable agriculture such as those on Mt. Marsabit, where Burji from Ethiopia and Kenyans bring in harvests of wheat, tef, and maize from a narrow highland vantage overlooking the Kaisut and Didi Galgala deserts. However, despite the difficulty of national assessment of drought's significance, this paper attempts to review the lessons of this most recent drought in the light of an ongoing research program which the authors have undertaken in eastern Kenya and in the light of the history of drought and drought-policy in Kenya over the past 20 years.

The focus of the authors' work has been the individual farm family and small community in drought affected areas. Even for purposes of national assessment this seems to be a viable, if not necessary, starting point. However, it is difficult for a reader unfamiliar with East Africa to grasp the concrete reality of drought at such a level of disaggregation, what it means to the peasant farmer and his family, how their lives are subtly altered in some ways, violently wrenched in others. An attempt is made to sketch actual, albeit crude portraits of some farmers we have gotten to know. Our 17 study sites in eastern Kenya contain nearly the full range of environmental and economic variations found in Kenya (Map 1). They were chosen to lie on several altitudinal gradients from the "high potential" coffee-tea zones such as those on the slopes of Mt. Kenya, through the "medium potential" cotton-maize zones, out onto the semi-arid plains of the Upper Tana River Basin where millet, goats, and thornbush dominate the landscape (Pratt, et al., 1966).

For the sake of simplicity the following portraits are taken from only three of the sites. All three are inhabited by farmers of the Kamba tribe, one of the six tribal groups considered in the study as a whole. This "Kamba Gradient" contains examples of both extremes of environment presented by the range of study sites and one intermediate site.

The three sites are Map 2:

Katse: Far Northern Division of Kitui District, 12 miles from the Tana (Kenya's largest) River near its northern bend, 2,500 feet a.s.l., 555 mm p.a. rainfall (22.6"), S.D. of rainfall = 45% of the annual average.

Karaba: Mbeere Division of Embu District, just south of the Mwea-Tebere Rice Irrigation Scheme to the east of the foot of the Central (formerly "white" Highlands, 4,000 feet a.s.l., 762 mm p.a. (30"), S.D. of rainfall = 35% of the annual average.

Kaewa: Central Division of Machakos District, in the Iveti hill mass just 50 miles southeast of Nairobi, 5,500 feet a.s.l., 1,270 mm p.a. (50"), S.D. = 25% average.

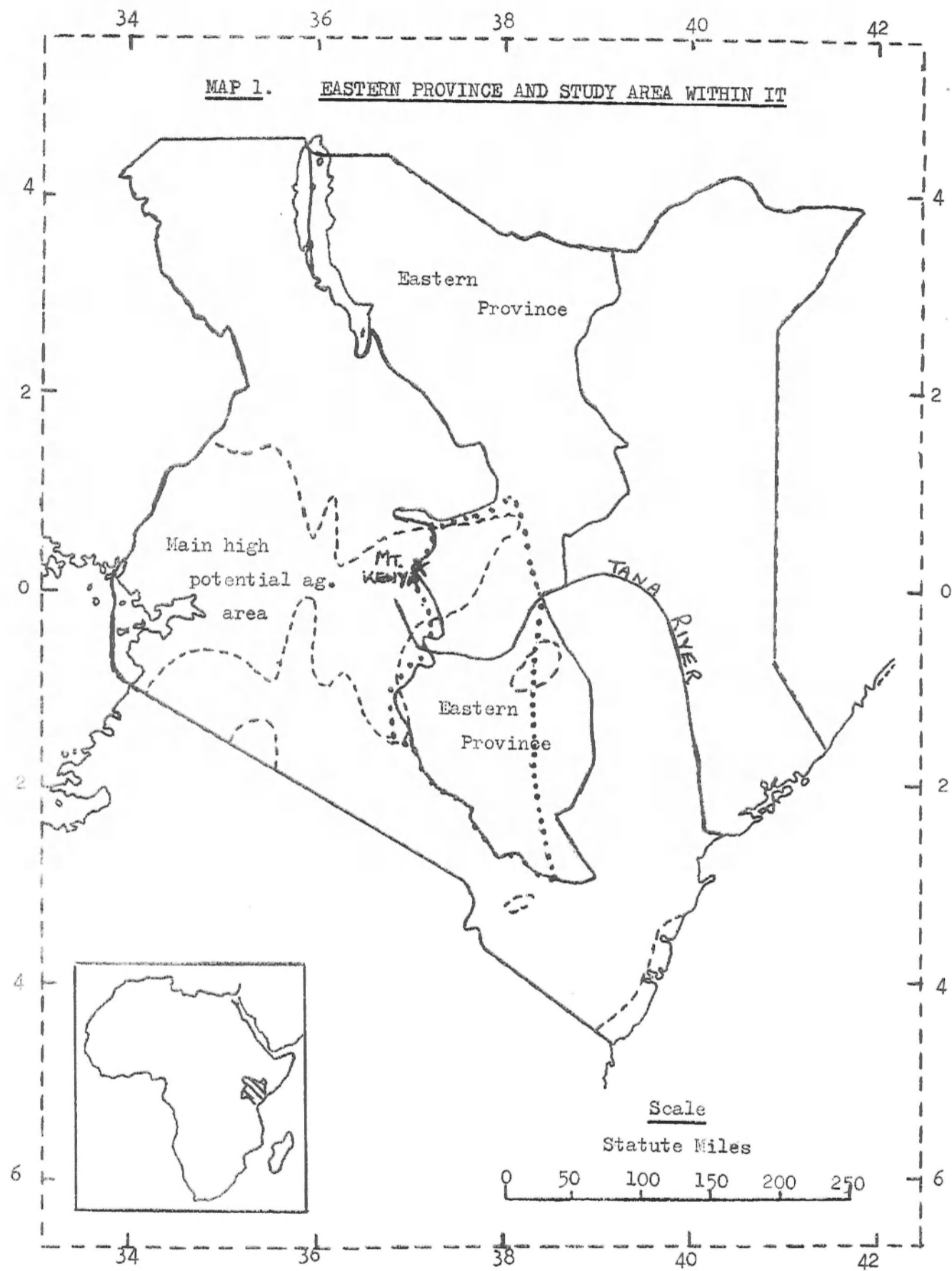
Following these three slices through the life situations of Kamba farmers there is a discussion of drought in the context of Kenya's national economic, fiscal, and rural development goals. The third section proposes a typology of drought and famine potential in Kenya. The next section relates all the foregoing to a theoretical framework within which the search for patterns of farmer response to drought can take place. Sections five and six report on patterns of adjustment to drought which we have begun to identify. The final section explores the possible approaches which the government might take toward solutions to the problem of drought.¹

Katse: Dry River Highways Leading Through The Thorn Bush²

The Elliot's Bread truck shutters grinds its way along the stony road forty miles north of Mwingi, administrative center of Far Northern Division of Kitui District, a favorite rest stop for the army convoys going to and from Garissa in the northeast. Forty miles north. Drier all the time as you draw nearer the Tana River. Acacia gives way more and more to dry thorn scrub and huge, lonely out-crops of rock standing in the sandy soil of the ancient basement complex. Now and then the truck passes a small boy herding goats and a few cattle. It's difficult to drive livestock through the bush, so boys prefer to follow the dry river beds in search of the remaining grass. Elliot's Bread truck shutters into second gear as it plummets into a drift across a small

1. Elaboration of certain of these contents can be found in the following papers: P.M. Mbithi and Benjamin Wisner, "An Evaluation of the Katumani Maize Breeding Programme for the Dry Areas: The Relation of Peasant and Governmental Response to Environmental Uncertainty," IDS Working Paper, May 1972; Benjamin Wisner, "Welfare Gradients and Environmental Gradients: Observations on the Relationship between Nutritional Well-being and the Physical Environment," IDS Working Paper, forthcoming, 1972; Benjamin Wisner, "On Complementary and Conflicting Belief Systems: The Case of the Pastoral Boran-Become-Irrigation-Farmer Viewed from the Perspective of Long-term Nutritional and Ecological Stability," Institute of African Studies Seminar Paper, University of Nairobi, forthcoming.

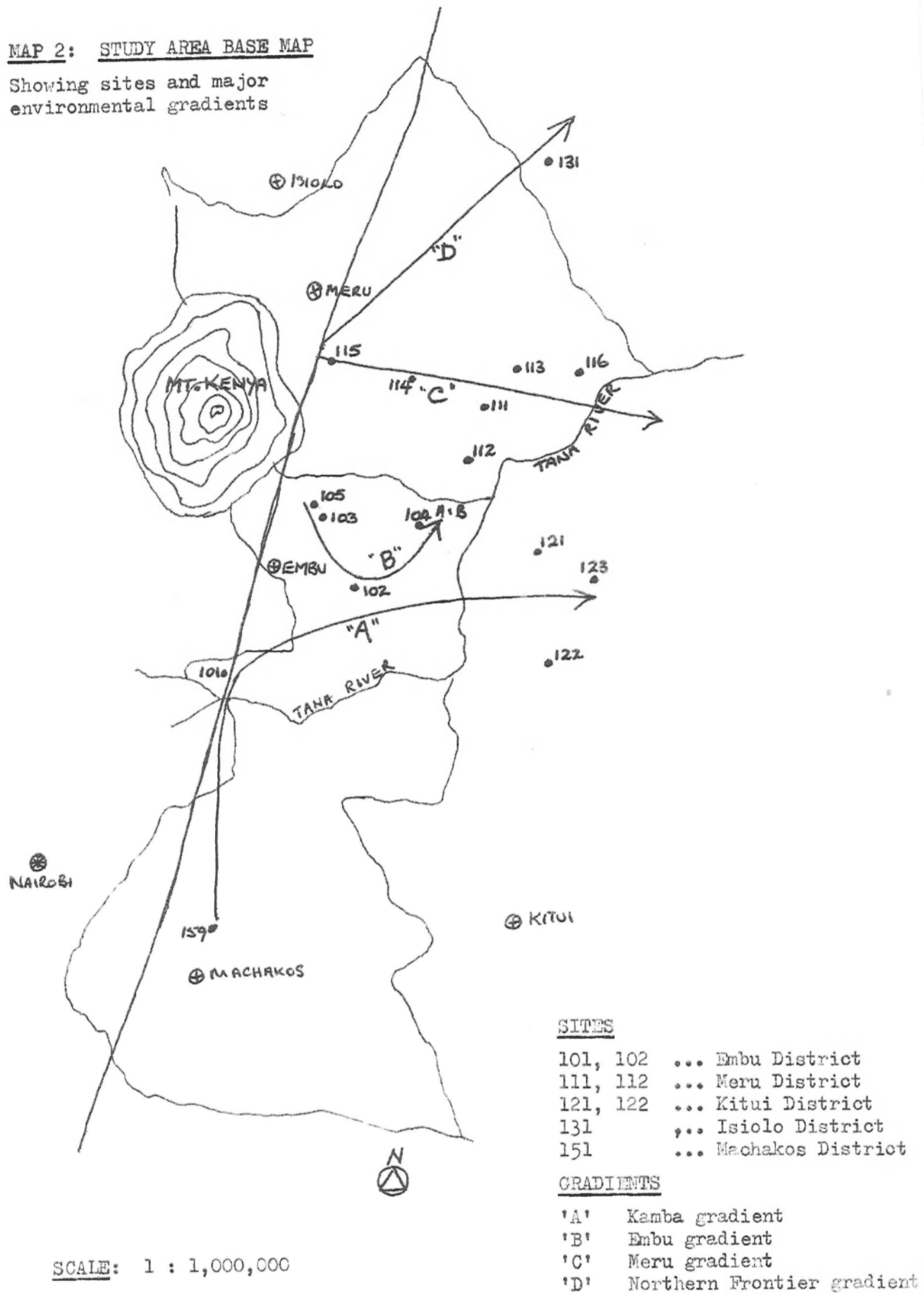
2. Names of persons in these portraits have been changed or only the first names used.



Areas of high potential agricultural land are delimited by dashes.
 Study area, enlarged in Map 2, is delimited by dots.

MAP 2: STUDY AREA BASE MAP

Showing sites and major environmental gradients



river. When the rains are heavy even larger trucks have been washed away while fording such streams. Now women dig six feet deep into the sand and lift out water. Donkeys and children with small hand carts stand around waiting.

Many people in Katse have been on famine relief for months. The rains have failed for two seasons. Munyasia knows the routine well by now. In 1961, 1965, and again this year he went to Runyenjes, high on the Embu side of Mt. Kenya to work on farms to buy food for his family. Unfortunately he finds he has to pay as much as 70 shillings for a bag of maize, more than twice the normal price. For this reason some of his neighbors prefer to be paid in kind for their casual labor in places like Runyenjes. Munyasia has no cattle left, and has only planted one and a half acres of cowpeas and bulrush millet this season. The routine of distant farm labor for the head of household and famine relief for his dependents has little to recommend it. If he crosses the Tana river and walks to Runyenjes, it is 35 miles, 150 by bus.

For generations the Kamba have moved about exchanging goods and services with kinsmen and people of allied tribes during hard times. Marriages still take place, social visits are paid, small civil cases heard, beer still brewed. Generations of Kamba have learned well the unwritten lessons of dry farming in the area — intercropping, drought resistant crops, staggered planting, large shifting fields. And there is still land available.

But sometimes extreme drought challenges even the central-most unwritten teaching. This season Kaugi managed to plant only three acres — sorghum, bulrush millet, and local maize since he was unable to get early maturing seed from the government. In 1965 he had to go find work in Chuka, also high on the Embu side of Mt. Kenya, about as far away as Runyenjes. However, in 1961 and this year he was able to get enough money from sales of livestock and cattle hides to make ends meet. He has a 14 month old daughter who is fortunate still to be on the breast. She weighs 90 percent of the standard weight for her age.³ Had she been weaned during this drought, one would have had to expect the worst. Especially since cholera swept close by this part of northern Kitui midway through the drought.

3. 'Standard weight' refers to the Harvard Standard Weight-for-Age. See D.B. Jelliffe, The Assessment of the Nutritional Status of the Community W.H.O. Monograph No. 53, Geneva, 1966.

Simeon hasn't any livestock, but has interplanted six acres of the more drought resistant crops: Bulrush millet, sorghum, cowpeas, pigeon peas, and green grams. In 1961 and 1965 he sold livestock like Kaugi, but now he has a job as a night watchman in Nairobi, so he is able to send money back to his wife. His 17 month old son has been weaned, but is still 90% of his standard weight. This is an accomplishment considering that more than a third of the children in this area are near or below the 70% mark, where clinical signs of malnutrition are quite obvious. However, this accomplishment cost him long absences from his family.

Karaba: Black Cotton Soil and Spice

The smell is everywhere. Women, children threshing oceans of spice for sale: for purchase of grain this year, for school fees, school uniforms and taxes next season if the rains are good. The drought hasn't hurt Mutuku very much. He has bred his own variety of maize by crossing the government's early maturing variety with local maize. He interplanted this with coriander, yellow and black grams, and beans on two five acre plots which he cultivated with a rented tractor. The maize harvest was not good, but there was money from the sale of spice and grams to buy flour. In fact he has sent some food to relatives who live on the Yatta plateau, across the Tana River in northern Machakos.

He is fortunate. The black cotton soil holds moisture well. The market for spice and grams is well established. Of the eight people living in his household, five are strong adult workers. His eight cattle are safely off near the river and some are at the grazing scheme ten miles away, where there is still enough grass. All three children under five in the household are above 80% of the standard weight for their ages.

There have been worse times. In 1965 Mutuku had to work as a laborer on the huge famous Mwea-Tebere rice irrigation scheme just a few miles north of Karaba. Now he sits outside "New High Life" beer club in the smell of spice and evening light and talks it over with other Kamba who have been immigrating to Karaba since the early 1940's. Goats and ancient tractors pass by slowly in the dust. Water sellers wheel steel drums on unsteady hand carts. A queue has formed in front of Old Man Kisoa's butchery. Around the bumpy dusty square of half half-finished shops and beer clubs, women thresh spice. The sun glints off the windows of the teacher's house behind a "living fence" made of euphorbia; the drinkers chat: "You can usually tell if the rains are going to be poor. If August and September are cloudy. . ." "And if the lightning in October is weak . . ." "Or if the 'Masolo' birds do not appear early."

Most of these men have had to work as casual laborers in the past when the rains have been unusual. But they don't go far away to work. Usually down to the rice scheme. And as soon as the rains break, there is a flurry of activity as they work the heavy black soil and plant as much as quickly as they can. Many have a few cattle which they keep in camps as far away as Yatta. And then, of course, there is the spice.

Kaewa: Women In The Valley Bottoms The map sings like a blind mzee, sweet half truths drowned in honey wine, whine of the stringed zeze.⁴

Try to tell Mrs. Imara she lives in Ministry of Agriculture inspected, measured, mapped and certified high ecological potential, agro-economic zone, Iveti hills, 5000-6000 a.s.l., central Machakos!

Many factors in highland Ukamba increase the vulnerability of the people to drought despite the favorable soil and annual average rainfall. Iveti is very densely peopled (500-750 per square mile). The farm plots are small and fragmented. Quite a few men have left the area to take up jobs in Nairobi, which is only 50 miles away (Redlich, 1971, p. 7).⁵ Others have migrated down into the plains to the east in an attempt to find more land.

As a result women in central Iveti have begun to take over many of the agricultural tasks traditionally allocated to men: clearing of the fields, digging irrigation furrows, planting bananas, yams, sweet potatoes, sugarcane, and tobacco, fertilizing the ground, and producing juice from sugarcane. The last mentioned is now a very important source of income, especially during droughts.

Mrs. Imara buys 2/- worth of sugarcane, presses out the juice with a wooden press at home, spends 50 cents to get the tin of juice to Machakos market, and makes 2/50 profit when it is purchased for the manufacture of local beer. She also buys single trees at 5/- each and burns charcoal. From a tree she is able to produce two or three bags of charcoal worth 5/- each. She also sells firewood to her neighbors.

4. Gloss: 'mzee' is Swahili for elder, old man; 'zeze' is a traditional stringed instrument; 'Ukamba' or 'Ukambani' refers to the traditional homeland of the Kamba tribe, now mostly contained by Machakos and Kitui Districts of Eastern Province.

5. In Kombo sublocation, bordering the Kaewa study site, from 48 percent to 72 percent of the families have a member employed outside the sublocation depending on the "village" within the sublocation. L.C. Redlich, 1971, "The Role of Women in the Kamba Household," Occasional Paper, Dept. of Sociology, University of Nairobi. Mimeo. p. 7.

Such income is very important to her family's well being during a drought. But it all takes time. Her husband has migrated down to the plains, where in 1970-71 things were worse than in Iveti, nearly as bad as in Katse, so no financial help could be expected from him. At home in Kaewa 12 persons are dependent on Mrs. Imara's five acres. Two of these are over 50 years old and six are under 15. There is one adolescent boy and two young women to help Mrs. Imara who is 60. The household owns no livestock, but fortunately does own a small plot of valley bottom land which continues to produce cabbages, some sugarcane, cassava, sweet potatoes, arrow roots, and kidney beans. These crops are sold during good seasons, but become increasingly important famine reserves depending on the severity and duration of a drought. She doesn't own any coffee which plays a role in the famine economy of other households in Kaewa.

Her children are very important to Mrs. Imara, and she feels a heavy responsibility for all the children in the household. Indeed $\frac{3}{4}$ of the women in this area engage from time to time in local self-help projects to build and support schools for their children (Roberts, 1962). However, with no milk cows and such a small amount of cash income, the children seem inevitably to be subject to heightened nutritional risk during droughts.

There are two children under three in the household. One child is still on the breast at 17 months and measures 80% of the standard weight for her age. She may be undernourished, but is not in clear danger. The 25 month old has been weaned and is typical of this highest risk group--weanlings during a drought. He has attained only 60% of the normal weight for his age. He suffers from eye trouble and diarrhea. His hair has changed color and texture, one sign of protein-calorie malnutrition. To make matters worse, he was recently burned while playing near the cooking fire.

Kaewa is normally a reasonably prosperous and progressive yeoman farming area where government development programs have been active since the early 1950's. In this final portrait it should be clear how difficult it is to separate the "drought problem" from the general problem of rural development.

DROUGHT AS A NATIONAL PROBLEM

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

problems and nutritionally related disease. Finally, it has been noted that drought has an important overall impact on the pace of technological change and rural development in the affected areas, which, though most difficult to quantify, has significant negative and positive roles.

Famine Relief -- We calculate that during 1961 Kenya spent for internally purchased maize and transportation alone K.shs.12 $\frac{1}{2}$ million: 5,500,000 for transportation to railheads for distribution and about 7,000,000 for maize purchased from the Maize and Produce Board (Roberts, 1962). That year about about 40% of the famine relief maize came free from the United States. Therefore in accordance with the national goal of self-reliance the value of this free maize should be added to the 1961 cost. A similar estimate has been attempted for famine relief cost to Kenya during January 1970-January 1971 and this is about 20,000,000 K.shs.⁶ These figures give an idea of the range of magnitude only, but we are fairly confident about the range. Further credibility is lent these estimates when one notes that Tanzania spent 20,000,000 T.shs. on famine relief during 1969.

Production Losses -- We are unable to make a total Kenyan estimate at this time with any degree of confidence; however, it has been calculated that Tanzania (whose general rainfall reliability of primary production (less minerals) a year (about 4% of its GNP) (Kates and Wisner, 1971). Maize production losses were estimated to be about 45 million shs. a year (0.6% of GNP). Working with 1962 figures, we estimate that 1961 losses to the Kenyan livestock industry alone could have been as high as 140,000,000 shs. Again these figures should be taken only as indications of the range of magnitude of loss.

It has been estimated that the total cost of the 1961-62 drought and floods was £10,000,000.⁷ This seems a reasonable figure (probably a low estimate) judging from the information we have been able to piece together so far. If this is so, then it would seem that the ratio of total costs to famine relief cost is 10:1. This seems a safe rule of thumb.

Social Costs -- Drought alone does not account for large scale starvation, except where a population is highly vulnerable. A single season drought can be usually be met by late-planted cash crops, sales of animals, loans,

6. For the period from January 1970 until January 1971 we calculate an average of 50,000 persons on famine relief with peaks as high as 250,000. At a cost of one shilling per head per day for a year, the cost comes to about 20 million shillings.

7. E.A. Standard 11 January 1971, "Relief Plan for Drought Province," the author of this item seems to claim that "relief" cost £10 million in 1960-61. We can get nowhere near this figure in our own estimates, so take it as a journalistic error. He probably means the total cost of drought and not just relief.

and "bush" foods.⁸ A series of such droughts (two or more seasons) or combinations of drought, flood, and/or pest invasion (in 1961-62 Kenya suffered all three) will intensify food shortage to the point where the danger of some death is present. The case of the "simple" one season drought contrasts with the extreme famine condition often present in civil war (Congo 1960, Biafra 1969) where massive population movements and destruction of crops and animals prevent the use of catch crops, forest, and animal reserves, thus producing tragic hunger.

Within this general picture, children of weaning age experience a considerably higher risk during drought. Decrease in caloric intake and milk supply can precipitate clinical protein-calorie malnutrition (Table 2) a risk that may also be increased by lower domestic water use, hence poorer hygiene and greater danger of diarrhoea. A further controversial aspect of protein-calorie malnutrition is its possible retarding effect on the mental development of surviving children. Although there is considerable literature on this topic, no clear answer has been agreed upon. However, the possibility exists that drought and the resulting famine may contribute to poor school performance and mental/emotional development of thousands of Kenyan children.

Rural development may in some cases actually be speeded up by drought. One of the authors has observed the role of drought in the process of innovation and the adoption of new economic ideas, including widespread though low-level involvement in the cash economy or the accelerated cropping of cattle by nomadic tribes (Mbithi, 1971). However, it is difficult to say whether such possibly positive effects balance the clear losses to the nation.

The sequence of orderly rural development (as described in the Development Plan) is thrown out of phase by a drought. Resources are diverted into investments like famine relief where they are only marginally productive (since the recipients are usually not engaged in much productive activity while they are on relief) and have very low rates of return.

THE TYPES OF DROUGHT PROBLEM AND FAMINE POTENTIAL IN KENYA

For purposes of planning and policy it might be well to distinguish among several different kinds of drought problems in Kenya. Looking at the nation as a whole over the past thirty years the following kinds of drought appear:

8. For instance the Boran of northern Kenya use at least a dozen roots and wild fruits to supplement their diet.

a. The national drought which directly affects the production of more than ten percent of Kenya's population, lasts two or more growing seasons, and generally involves serious loss of production in most ecological zones and usually two or more provinces. This type of drought seems to occur about once each decade. We have not done a complete historical survey, however, farmers in our eastern Kenya study mention very serious droughts in 1913-18, 1925, 1936, 1946, 1954, and, of course, the droughts of 1961 and 1970⁰. This most severe and wide-spread type, as noted earlier, can cost the government up to Shs. 20 million for famine relief alone. 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). Rehabilitation of herds takes longer than reseeding of farm lands. Beans planted in the latter case will give a catch crop in three months. However, with loss of condition, reduced calving rates, increased mortality among calves, and sales of the breeding nucleus of a herd serious undersupply of milk can remain a problem in a pastoral area for 6 to 12 months after the meteorological "end" of the drought.

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

b. The regional drought which directly affects the production of less than ten percent of the population of Kenya, lasts one or two growing seasons, and is generally confined to the medium and low potential areas, especially the semi-arid, dry-farming zone and the arid and very arid rangelands. The occurrence of this kind of "regional" drought varies according to the kind of crops grown and densities of livestock and of particular kinds of grazing. With local maize one would expect such a drought once every three or four years. With full adoption of Katumani it might occur only one time in every eight years.

9. Further insight into the use of oral history to establish famine chronologies can be gained from the following: in our Tharaka sample (lower Meru) taking all responses together (not relying solely on one man's memory) 47% of the years since the turn of the century had poor enough harvests to be remembered. There were 15 "worst droughts recalled" since the turn of the century. Dr. Ndeti, Department of Sociology, University of Nairobi, has dated the following famines in Kamba oral history: 1836, 1850, 1861, 1880, 1899-1901, 1910.

Millet in northern Kitui and southeastern Tharaka seems to fail on an average of once in five years. Thus, on the average, one should plan for two or three such regional occurrences each decade. Within living memory of the farmers interviewed in Tharaka (lower Meru) there were such droughts in 1951, 1954, 1961, 1965, and 1970. If stocking densities are low enough, pastoralists seem well adapted to getting through a single season failure of the rains by increasing their range of movement with their herds. If the cost of famine relief in a "national" drought is 20 million shs., such a "regional" drought probably costs around 10,000,000 shs.

c. The local drought probably occurs every year somewhere in Kenya. Especially in the marginal agricultural zones of the eastern plateau foreland (Machakos, Kitui, Tana River, Kwale, Lamu, and Kilifi districts) 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. This type of drought is usually handled well by traditional gift and loan relations among the farmers and their kinsmen and friends and the normal social welfare allotments made to district authorities. However, later when we discuss population growth in these marginal areas, it will be apparent that since some areas within the marginal agricultural zone are growing at more than ten times the average population growth rate for the nation, even these local droughts could become an increasing drain on national resources and a serious obstacle to rural development. The 1961 Kenyan budget contained K.shs.50,000 as the "normal" fund for local drought. However, we would multiply this by at least ten to give the actual average annual cost of such droughts = K.shs.500,000.

d. Famine potential. So far, in defining three types of drought in Kenya we have considered only the pattern of rainfall, its variability, and the pattern of agricultural potential, be it high, medium, or low (marginal). However, in considering the impact of a given drought on the people affected and its cost to the nation, it is also of prime, perhaps greatest, importance to look at the pattern of population and population growth in Kenya.¹⁰

All of Kenya's north and northeast provides the livelihood of only about 560,000 persons. The population of this part of Kenya is growing (about two percent) below the national average rate of increase, which is about 3.4%

10. These calculations were made on the basis of the Kenyan National Census of 1962 and 1969.

per annum. The southern arid zone, comprised mostly of Kajiado and Narok districts, contains about 208,000 persons. Although the 1970-71 famine in the north and northeast without doubt presented a great challenge to local and national administrators and caused great suffering, it must be remembered that this event is not typical, nor is its recurrence highly probable. A drought that would simultaneously affect most of the north and northeast and the southern range areas is even less probable. In the long run the area of Kenya which shows the greatest famine potential is the marginal agricultural zone, eastern Kenya.

The marginal zone of the eastern plateau foreland provides the livelihood of over 1,250,000 persons. Furthermore, population growth in certain parts of this zone exceeds ten times the national average (up to 33% per annum in parts of Machakos) (Map 3). Kwale district is now one of the most important destinations for the entire nation's rural-rural migration (Ominde, 1968). The very dense (500-700 per square mile) population of highland Machakos is very fast redistributing itself into the drier, marginal parts of the district (Makuneni, Kakueni south, and Yatta). The absolute grazing area available in these parts is much more limited than that in the extreme north of the country, furthermore, the immigrants are mostly engaged in a significant amount of cultivation of maize, millet, and sorghum to meet their requirements.

Considering the absolute population levels as of 1969, the rate of population growth, and the type of subsistence economy, it is clear that the people of the eastern marginal lands are more vulnerable to drought induced famine, and the overall, long run famine potential is highest in this zone. If population continues to grow in this marginal zone at the present rates, with no significant change in technology, even a local drought (as defined above) could mean massive relief problems for the national government. At present growth rates the northern areas should still remain capable of coping with local droughts and most regional droughts even 20 years hence. This is apt to suggest that the present focus of national attention on the northern areas is misplaced. Change has to occur there as well, and programs of livestock improvement, improved marketing, water supply, small scale irrigation, rural industry, and dry land farming in islands of medium potential such as the Marsabit and Moyale areas are all sensible. The fact remains that the eastern marginal lands makes it the part of the country where the potential for famine is greatest.

OUR THEORETICAL FRAMEWORK

Agricultural drought should be viewed as a natural, though extreme outcome of the interaction of man and nature. All human systems for getting a living from the earth have evolved such that they continue to function well within

a range of physical conditions. When rainfall exceeds the upper limit of this range, the farmer must use practices not normally employed to protect his crop from mildew, pests, and flood. Likewise when rainfall falls below the lower limit of the normal range, farmers employ practices, or adjustments, which reduce the damage caused by drought. Recent cross-cultural studies suggest that such adjustments to drought can be classed as attempts to modify the man-environment interaction known as "drought" by 1) affecting the rainfall source (prayer, spacing, rainmaking); 2) increasing moisture availability to crops (planting early, irrigating, ridging); 3) reducing moisture need (planting resistant crops, weeding frequently); and 4) bearing, sharing, or spreading the loss (asking help from kinsmen, borrowing money) (Kates, 1972).

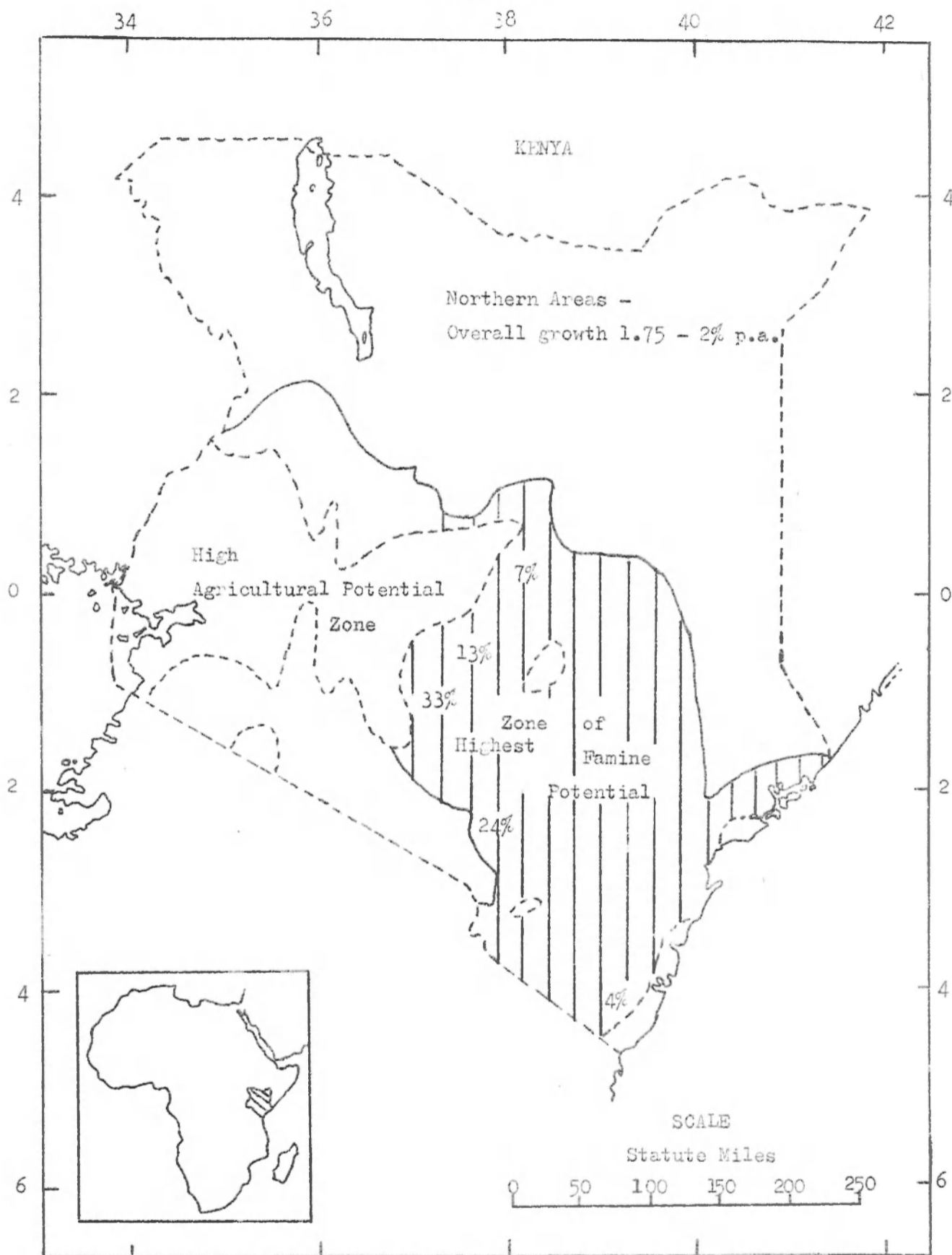
Depending on the width of the normal rainfall range which normal farming practices allow, "drought" would be declared at different times by different farming systems. The farmer who plants early maturing maize, plants early, and weeds early would not define a season which brings seven inches of rain a drought season. His neighbor who normally plants local maize, plants late, and weeds late would call the season a serious drought season, and he would set in motion a series of adjustments, non-normal practices, in order to feed his family. He might even leave off farming temporarily and go to seek wage work. Such an extreme decision must be considered among the total range of adjustments to drought which farmers in Kenya are known to practice from time to time.

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

This emphasis on the complexity, variety, and flexibility of farm and small community-level adjustments rests within the general framework of human ecology (Burton, *et al.*, 1968), and micro-sociological theory (Mbithi, 1967 and 1970). Such an approach focuses initially on the environmental experience and cognition of small groups of farmers and on the range of nondeviant resource exploitation within the group. Although classical innovation theory is appropriate to our study, our starting point focuses on "spontaneous, localized innovation or adjustment" rather than on the process of adoption of an innovation which originates outside of the group. In our view, man is a creative actor, attempting to cope with an environment which is both physical and sociological, which is constantly changing and exhibits very unreliable patterns. Through choice of

MAP 3 FAMINE POTENTIAL AND POPULATION GROWTH

1962 - 1969



KEY



contains high potential land

eastern plateau foreland

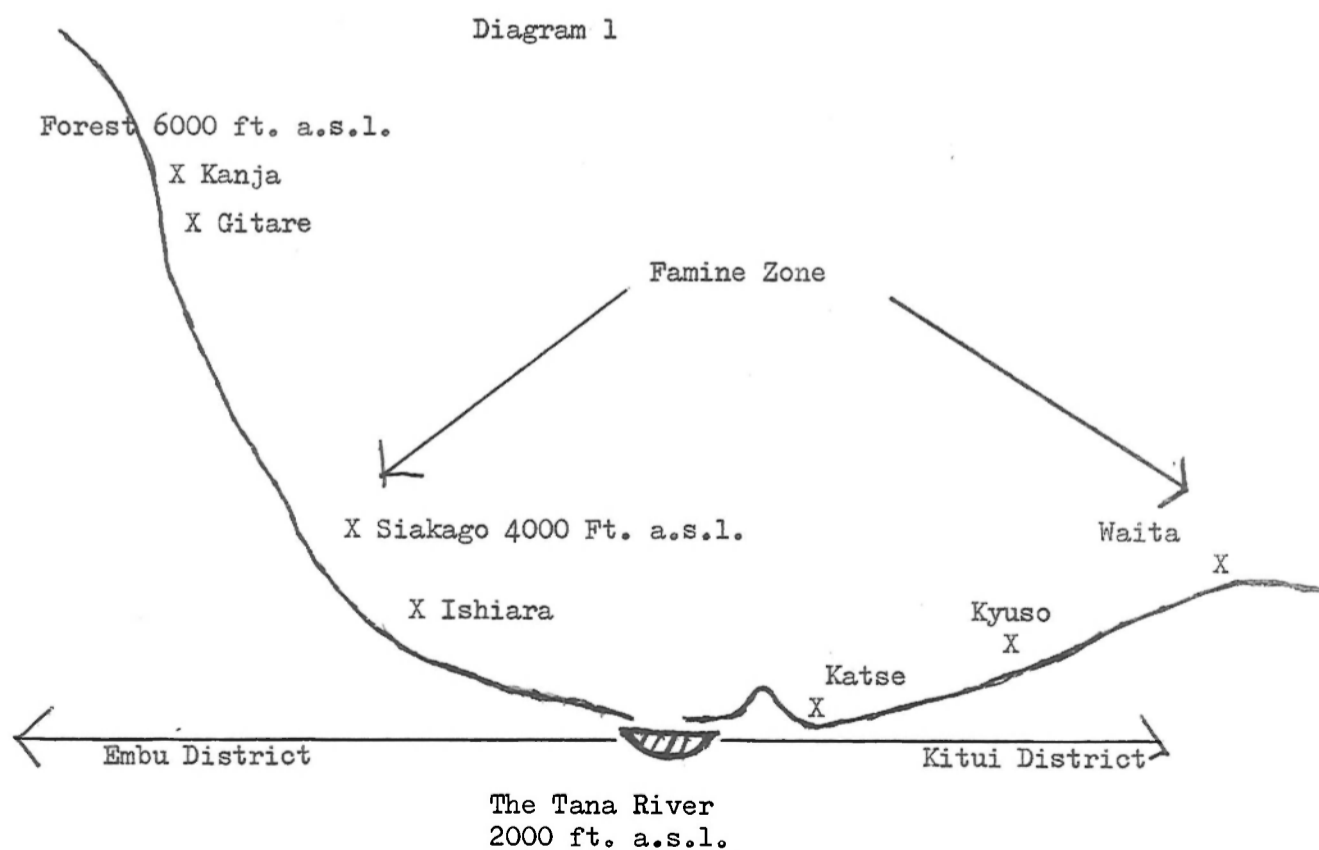
percentages indicate population growth rates very much higher than national average, 3.2% p.a.

technology, ritual means, and functional social linkages, man "adjusts" to and improves upon his environment to increase its productive capacity and reduce risk.

STUDY STRATEGY IN EASTERN KENYA

Map 2 shows the sites we are currently studying. They have been chosen to give information about the farm level impact of drought and response of farmers in a range of ecological zones nearly representative of Kenya. Therefore these sites can be arranged, for the sake of analysis, along several "gradients" from high altitude, high potential lands of higher, more reliable rainfall down to low altitude, marginal agricultural preferably ranching lands of lower, less reliable rainfall. Diagram 1 shows one such gradient which begins near the Mt. Kenya forest on the Embu side and falls through the "medium" potential, sub-humid and semi-arid zones of Mbeere division, across the Tana river to the "marginal" thorn bush lands of Far Northern division, Kitui. Other possible gradients are indicated by arrows on Map 2. To complete the eastern Kenya picture we have also conducted interviews in Isiolo district and have made background studies in Marsabit in the extreme north. In all 610 randomly selected farmers have been interviewed and about 120 children weighed and measured for purposes of nutritional assessment.

This information has just recently reached the stage of systematic computer analysis, therefore the following progress report will be based on preliminary hand sorting of data and on general impressions.



DROUGHT IMPACTS AND PATTERNS OF ADJUSTMENT

A first impression of the overall suffering due to drought can be obtained from Table 1. We have scored farmers' responses to several of the questionnaire items to give a comparable index of the amount of drought suffering they themselves perceive. The score is based on the number of serious famines they remember, the level of hunger, crop and animal losses, and death remembered and reported. Site number 115 is near 6,000 feet on the Meru side of Mr. Kenya, and the gradient falls toward site number 116, just six miles from the Tana River in the Sansevieria-bush zone. There is clearly an increase in the overall suffering due to drought as one proceeds along the gradient.

TABLE 1

HISTORY OF DROUGHT SUFFERING ALONG MERU-THARAKA GRADIENT
(Percent of all Farmers in a Site)

SITE	NO SUFFERING	NEGLIGIBLE SUFFERING	MILD SUFFERING	MODERATE SUFFERING	SEVERE SUFFERING
115	0	5%	90%	5%	0
114	0	0	75%	25%	0
112	0	0	45%	50%	5%
116	0	0	25%	50%	25%

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

Table 2 summarizes preliminary observations of the nutritional status of children under three years and the quality of adult diet along a typical gradient. The assessment of the status of children was done: weight, age and other physical measurements alone. The figures are percentages of the children who, on the basis of these measurements, are in clear danger due to malnutrition. *

TABLE 2
CHILD NUTRITION AND ADULT DIET IN SIX DROUGHT STUDY SITES

SITES	HIGH POTENTIAL		MEDIUM POTENTIAL		LOW POTENTIAL	
	MIKUMBUNE	KARABA	SIAKAGO	CHIAKARIGA	KATHUNGACHINI	KATSE
Adult Diet*	16	15	17	14	10	14
Child Nutri.**	17	13	26	15	25	38

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

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

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

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

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

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

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

In the medium potential areas at most 50% of the households kept a significant reserve of grains.¹¹ Here the effect of diversification and extensive dryland cultivation was obvious. In Karaba, even though the maize harvest had been very bad, they still had cowpeas, green, yellow and black grams, and cardamon to sell. These farmers cultivated large acreages with rented tractors, and their children seemed not much worse off than the children in higher areas. By contrast the farms in Siakago, Mbeere division of Embu, just 25 miles away were not mechanized and were much smaller with fewer crops. Farmers there were in more trouble, and twice as many children of Siakago were found to be malnourished than in Karaba.

In the low potential areas normal reserves were highest. Eighty-seven percent of the farmers in Katse normally store large amounts of grain. In these areas a large assortment of crops were grown. These include bulrush millet, sorghum, cowpeas, pigeon peas, and many varieties of grams. Even at that the millet harvest had all but failed in many areas.

11. In Katse (Kitui) average reserves left over from the previous season when the next season's harvest came in were $3\frac{1}{2}$ bags of millet, $1\frac{1}{2}$ bags of maize, $1\frac{1}{2}$ bags of cowpeas, 2 bags of sorghum; a total of 7 bags of grain and $1\frac{1}{2}$ bags of pulses. With this they could make it through a single season's crop failure, especially with some non-farm income and sale of livestock, but not two seasons in a row, which they faced in 1970-71. The system in this part of Kitui has obviously adapted to the fact that the so-called "long rains" (April peak) fail more frequently than the "short rains" (November peak). By contrast, Karaba had an average reserve of only 3 bags of grain and $\frac{2}{3}$ bag of assorted legumes.

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

Individual Adjustment to Drought

As anticipated in Section 4, all agricultural systems have characteristic ways of coping with extremes of physical factors such as drought. Many of these practices and elements of organization have been institutionalised over the years, and are now permanent features of the agricultural and social systems. Examples of this are the characteristic mixture of crops and livestock and the widely spaced network of farm fields, cattle camps, and fields belonging to kinsmen which spread over large areas and which insure at least some little affected or unaffected economic activity during a local drought. However, during regional and national droughts which affect the sites studied, these built-in features of the systems are not adequate to meet the threat of famine. In these cases other practices and arrangements appear which one does not often encounter during normal rainfall seasons.

Table 3 summarizes the percentage of farmers naming a given adjustment among their three most preferred and most frequently practised. The three sites from which data is taken are fairly representative. They are the same three which provided the background for our introductory portraits.

It is interesting to note how agronomic adjustments (planting in wet valleys, planting early) predominate in the primarily agricultural/horticultural site in highland Machakos. However, even though such agronomic adjustments do not rank among the most preferred in the two drier zones, there is much that can be done to improve dry farming technique and there would probably be much scope for extending knowledge of these adjustments among the farmers in such places as Karaba and Katse.

A curious factor brought out by our field trips and interviews is the observation of unique pockets of startlingly high levels of development. Thus in these famine prone areas there are "oases" of unique development. In Taita-Taveta we have unique local production of high quality bananas; in Karaba-Embu we have a unique, locally developed peasant tractorized maize and coriander production; in Kimutwa, Machakos, we have locally initiated vegetable production for export; at Mwingi-Waita, Kitui, we have a unique bushland livestock industry for the beef market in Nairobi and Mombasa.

This factor of unique localized development needs careful study in other areas. Questions like "Who supplies the initiative? Who identifies uniquely advantageous circumstances for self help innovations" etc., are questions which have never been asked before because all initiative has been assumed to come from the government. But when one travels across the dry expanses of Marsabit, Moyale, Kitui, etc, one begins to appreciate that government initiative has been very limited. One also becomes convinced that even if government initiative were available, without local cooperation, very little is practicable. This brings out once again the importance of a thorough understanding of local farmer and community response to drought and the relevance of micro-geographical and sociological approaches to the problem.

PRESENT AND POSSIBLE GOVERNMENT APPROACHES TO DROUGHT

A close look at Kenya's agricultural development strategy quickly reveals a skewed concentration of technology in high and medium potential farming areas. In his review of Kenya's agricultural development policy, Ruethenberg attributes the rapid growth in agricultural production to a multiplicity of approaches (Ruethenberg, 1966).¹² At the national level the main approaches have been through land reform, increased efficiency and intensity in agricultural administration and extension (dependent upon the extension of technological packages), small holder tea development, development of coffee, pyrethrum, dairy mixed farming, farmer training, and the introduction of viable cash crops.

Ruethenberg and other students of rural development do not see small scale irrigation, grazing schemes, introduction of dryland cash crops such as cotton, castor beans, sisal, dates, pawpaws, marketable food crops such as maize

12. Ruethenberg states that between 1952-1965 the total production increased at an annual rate of 4.5 percent from £74 million to £117 million.

Mexican 142 beans, cassava, pigeon peas, and certain other legume varieties as economically viable. The dilemma of farm development in the dry areas has been characterized by a lack of support for any major programme by planners or economists, and the substitution of economic rationality by welfare conscious specialists and politicians has led to half-hearted searching for economic alternatives which include large scale irrigation, ranching, and land settlement schemes.

It has also led to the development of a serious myopia among agri-dryland farming technology and adjustment patterns here in Kenya, cultural economists. They fail to appreciate that there exist, in Israel, Mexico, Australia, etc. which could revolutionize extension effectiveness in these areas. This in turn has led to:

1. Costly repetition of ill designed projects such as the Ishiara irrigation scheme, the Samburu grazing rotation scheme, the Machakos soil and water conservation program.

2. Very frustrating research traditions, where selection and training of agricultural research experts is based on the assumption that Kenya's agricultural systems lie exclusively in the Highlands, the Lake basin, and the coastal strip. This goes together with the assumption that the only other possible land use system in the rest of Kenya can be subsumed under the term "range management." It is not realized that the dry, marginal areas have farming populations which are growing at rates up to 33% per annum due to in-migration from other areas.

3. The development of dry land extension systems with limited technological packages which are to be exploited fully through the concept of "crash programs". This derth of dryland technology leads to the indiscriminate importation of intensive, wetland farming practices such as fencing, ley farming, heavy mineral fertilizer use, and the extension of medium potential field crops to an extent where the risk of crop failure is increased.¹³

4. The continued nonsolution of the periodic and costly famine crises which characterize these areas.

If the governmental approach to date has not been adequate to meet the drought problem, what changes might improve the approach?

1. Government can support and foster existing effective adjustments to drought on the local level. On the community level these adjustments can be made even more effective through cooperative exploitation of localized resources through self-help activities.

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

2. Government can provide limiting factors needed for increased effectiveness of local and community adjustments. Often constraints seem to be credit and markets, but less commonly knowledge. Individuals and potentially small groups of individuals in the driest areas are aware of highly localized resource potential (a seasonal swamp, stream bottomland, small but highly fertile and irrigable areas). However, the key to government involvement in such an area must be flexibility and small scale planning. For this one would need highly motivated Locational Agricultural Assistants and Junior Agricultural Assistants (the lowest echelon extension worker). Incentives would have to be created to motivate the present LAA's and JAA's and some additional training would probably also be required. We can imagine a cadre-cum- LAA who would act as advocate for groups of farmers in the marginal zone, cutting across ministerial boundaries to work out the details of credit, land tenure, association registration, and technical problems arising out of the people's own identification of a unique community resource and its potential exploitation.

3. Government can introduce new adjustments to complement existing ones. The prime case in point is the Katumani early maturing maize program. So far the most effective government low cost response to the problem of crop failure has been work in breeding, since 1958, of several synthetic and composite maize varieties which extension activity has introduced widely in the dry areas since 1964 under the name "Katumani." Effective adoption of Katumani in these areas would ideally reduce moisture requirement of maize from about 12" per season to about 7".

In 1967 a study by one of the authors revealed that 80 percent of the farmers in several dryland sample villages were using Katumani.¹⁴ The critical question then is why hasn't there been a significant reduction in the frequency of food shortages in these areas? Two further findings from the 1967 study shed light on the question.

a. Although the average family of five adults requires over three acres of land for subsistence at the productivity level of three-four bags of maize per acre, the average acreage of Katumani maize was only about $1\frac{1}{2}$ acres.

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

Therefore the acceptance rate of Katumani in terms of effective acreage is extremely low, and this explains the lack of significant improvements in the food supply problem. This partial failure of the program, which is to be discussed fully by the authors in a later paper, is not a technical failure.

14. This was a series of innovation studies by Philip M. Mbithi and others supported by Unicef and Makerere University College in 1965, 1966, and 1967.

In brief, the main problems seem to be in bulking and distributing the new seed at the proper times, in appropriate quantity, and at low cost together with the problem of farm level competition between early maturing maize and existing alternatives such as bulrush millet, cow peas, and possibly cotton.

4. Government can, probably must, work within the framework of overall patterns of risk and adjustment. A good example is the problem of drought caused migration. It could well be that on balance it is a waste of manpower and energy and contributes to regional inequalities for large numbers of men to move away from famine zones to find work. However, even if one were convinced that this is the case, there seems little one could do about it in the short term. Therefore it would seem that at a minimum the government could provide a mobile labor exchange service which, at least, could provide information on the spot in the famine area about where farm labor is required, at best provide transport to the labor deficit areas and transport back for workers and food at intervals.

Another example of working within existing patterns of adjustment is the problem of settlement. We have already pointed out the mushrooming population growth in certain parts of Machakos and Kwale. Such a situation calls for close cooperation between settlement officers and the agencies in charge of famine relief and anti-famine planning. Over the past few years the Makueni settlement scheme in eastern Machakos district has effectively tripled in size (unofficially, of course) with no corresponding increase in control over settlement or advanced planning for such an increase.

5. Government can coordinate a famine warning system. The East African Meteorological Department is already going ahead with an improved agrometeorological station network in the three member countries of the East African Community. It should be persuaded to site some of its new stations in Kenya's highest famine potential area, the eastern marginal lands. This would provide needed technical support for any future program of experimentation with dryland farming techniques and also contribute to a national famine warning system. Other elements in such a warning system would have to be improved agricultural reporting and reporting of the nutritional vulnerability and reserves of food among high risk populations. The idea of famine potential as we outlined it above is basic to such a warning system.

6. Government can take either a defensive or offensive posture while pursuing the above approaches. It is a fact that in much of Kenya drought is the dominant environmental factor. However, this only implies that drought adjustment just be the focus of development efforts. It by no means implies that government must constantly fight a defensive battle, with the implicit sad realization that rural development in the marginal and pastoral areas can never progress as far as in the better endowed zones. The idea of famine prevention or drought adjustment need not be interpreted as a negative or defensive strategy.

In line with an offensive, positive approach focused on drought as the dominant environmental factor, a strongly increased commitment to applied nutrition work is necessary with the emphasis on mobile dispensaries and rehabilitation centers, together with nutrition education and family planning. A second important feature of such an approach must be increasing cash incomes in the marginal and pastoral areas through improved marketing and rural industrialization. We have already pointed out the fallacy in the earlier "cash crop fixation" which characterized agricultural policy in Kenya. Our work leads us to conclude that the immediate need is to find markets for what people in the drought-prone areas are already producing and to increase their productivity, not to invent new cash crops.

There are indications that government is beginning to take the offensive role. For instance it is now generally accepted that all famine relief should be replaced by anti-famine programs while residual relief cases (widows, the rural blind and lame, orphans) are absorbed under the normal welfare functions of local government.

7. Government approach in the pastoral areas will have different emphasis. A recent report by one of the authors on the small irrigation scheme at Kinna, Isiolo district¹⁵, where Borana pastoralists have been resettled, contains the core of our thinking to date on the rangelands. Essentially all projects in this area should be small-scale at first. The nutritional, agricultural, and ecological as well as social problems which are present on the 200 acre scheme evaluated demonstrate vividly just how little is known about the improvement of pastoral systems and their integration with arable agricultural and horticultural systems. Secondly, development attempts should be thoroughly integrated. Thus small scale irrigation should be planned simultaneously with group ranching, perhaps as small nuclei or growth centers in the middle of larger ranching schemes with whom the vegetable cultivators would have reciprocal exchange relations. Development efforts in the pastoral areas should be phased so that in the early phases obvious improvements in the standard of living of the masses takes top priority. To accomplish this the first phase must be focused on such things as mobile dispensaries, improved marketing, livestock improvement, and water resource development, not initially on education which has a longer-range benefit.

15. Benjamin Wisner, "Kinna site subproject, preliminary report no.1," report commissioned by the National Christian Council of Kenya, January 1972. See also Benjamin Wisner, "Dryland Farming Settlement by Rendille Pastoralists on the Southern Slopes of Mt. Marsabit: Notes on the Viability of the Songa Scheme," Report to the National Christian Council of Kenya, April 1972.

A final, and most important, suggestion is stated well in a recent report on the Kaputiei Maasai group ranches. The report summarizes its conclusions as follows: (Halderman, 1972).

a. It should be realized by development planners that the settling of nomadic and seminomadic pastoralists requires more than the physical development of the area (water development, cattle dips, etc.) -- it requires that the ecological conditions permit permanent settlement (as the reversion to seminomadism by the Poka [group ranch pilot scheme] members in 1971 demonstrated).

b. Development plans for arid and semi-arid areas must take into full consideration: the traditional system of resource utilization of the indigenous pastoralists--so that development proposals will be based on the existing structure and be acceptable to the owners of the land and livestock.

c. The solutions to the problems of development in Maasailand require dialogue between planners, implementers, and Maasai in order to determine policy--and then cooperation by all those involved aimed at effectively implementing the proposals.

A FUTURE

Camels and ox ploughs race the communal lorry in slow motion, flood plain choreography. Receding water from the Ewaso Ngiro River will supplement the rain and fill again this year, 1995, the Society's store and the smaller kin-group silos. Bwana Uhuru pauses over the sun-drier he has been filling with vegetables. He watches the camels rock and sway into the thorn bush haze beyond the millet blocks. He looks up at the sun, whose fierce pull at evaporating soil, transpiring green still puts, and probably will always put, an edge of risk on the life of his people. However, since the first advocate-cadre arrived, nearly 20 years ago, stress has become a spice, like coriander, to his people's life. New and old ways common life and mutual help have stabilized, in part, that life.....The camels move further into the haze, through the lens-shaped pits which harvest run off, through the date palms, burdened with loads of dried vegetables and the newest edition of the Jomo Kenyatta memorial literacy manual. From behind the dispensary Uhuru hears craftsmen pounding on low cost excarts. Laughter. Small boys chuckling, chasing sodom apples near the calves and milk cows they are tending. Dry stock is off beyond Garba Tulla. He recalls the identical game. He recalls the hunger. His gaze unconsciously shifts to the dispensary where a group of mothers with their babies gossip outside the weekly well-baby clinic.

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