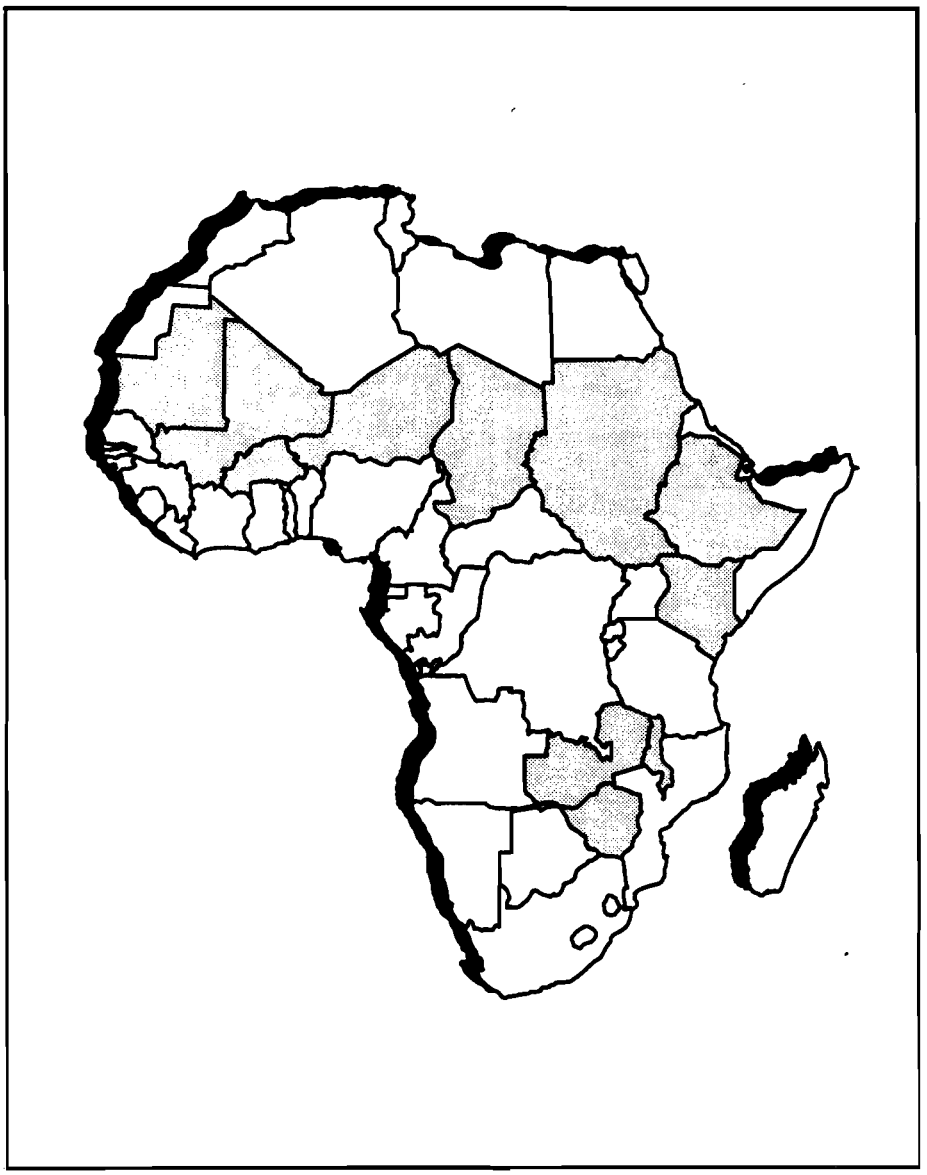
Vulnerability Assessment



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Vulnerability Assessment

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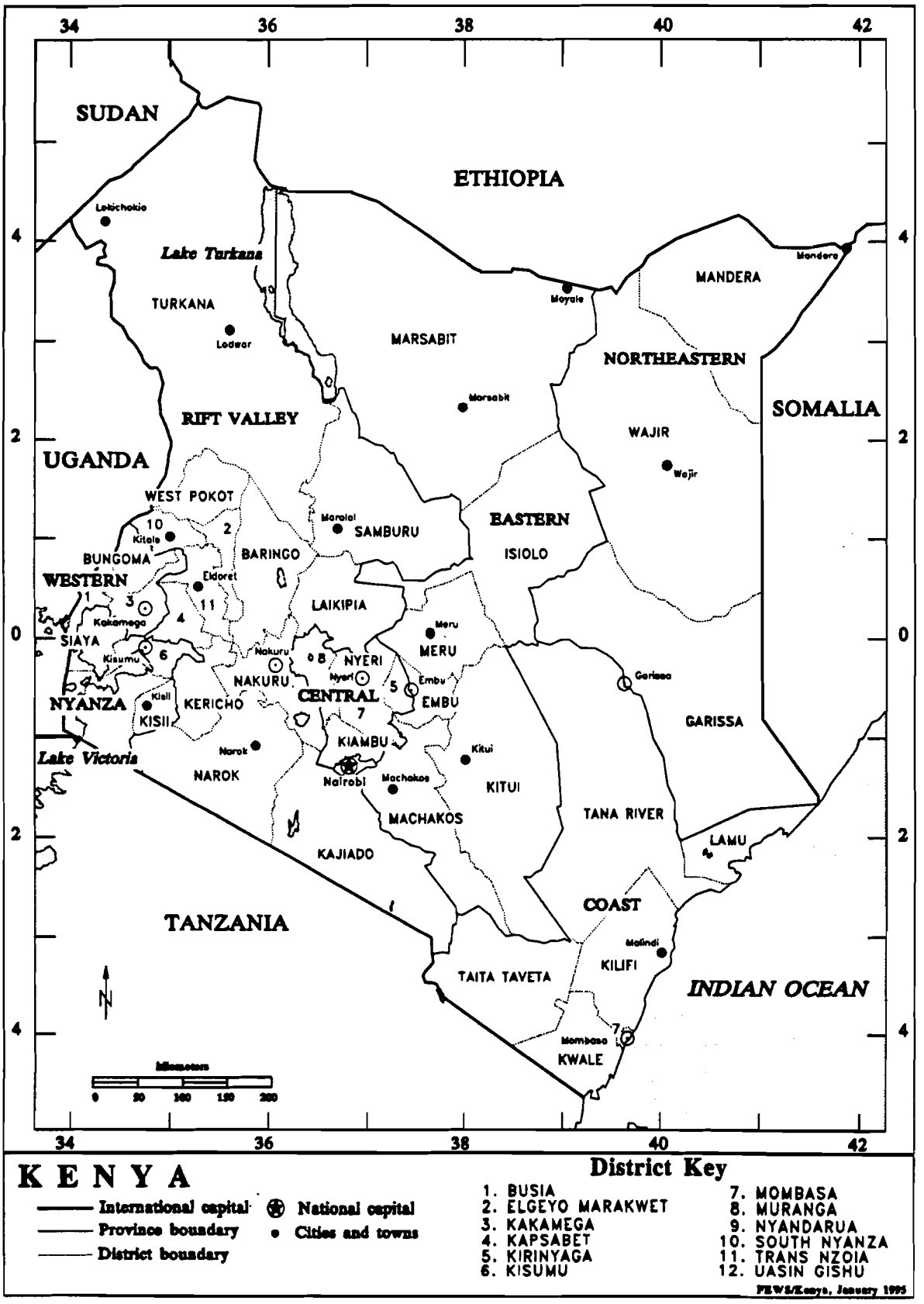

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KENYA

General Vulnerability Declines Following 1993/94 "Long Rains" Harvest

Based on a report released by USAID/Kenya January 10, 1995

SUMMARY

Food insecurity in Kenya declined in mid-1994 as a result of good "long rains," lower food prices, and a reduction in civil unrest. Roughly 900,000 thousand people, or 3.4 percent of the national population, remain moderately to highly vulnerable, this includes nearly 427,000 pastoralists in the northern arid districts. Other pastoralists and subsistence farmers in semi-arid areas are moderately vulnerable, and over 1.3 million pastoralists and subsistence farmers are slightly to moderately vulnerable. Vulnerability for the urban poor has decreased significantly due to lower food prices and reduced inflation.

The number of people that were moderately to highly vulnerable peaked in 1992 and 1993 following a series of shocks including: a severe nationwide drought, national food shortages, high inflation, economic reforms, and tribal clashes. During that period, population groups in many pastoral and agricultural zones were "at-risk" to famine, or extremely vulnerable to food insecurity. Food security problems affected regions of the country which are normally food secure, in addition to the chronically food insecure areas. During this period, urban food insecurity also increased markedly.

Pastoralists in the arid north are the most chronically vulnerable group in Kenya, due to the high risk of drought and the lack opportunities for income diversification away from livestock production. A number of pastoral areas which would offer the best opportunities for food security continue to be off-limits due to raiding and civil insecurity.

OBJECTIVE

The Vulnerability Assessment (VA) for Kenya helps to identify the characteristics and geographic locations of population groups vulnerable to food insecurity and famine. The geographic/administrative unit level of analysis for the VA is the Division. Because vulnerability is not a static condition, this assessment attempts to characterize vulnerability over time, examining:

- chronic or "baseline" vulnerability
- vulnerability during the 1992–93 period, when Kenya was hit by successive shocks including drought, national food shortages, high inflation, economic reforms, and tribal clashes
- current vulnerability at the end of 1994

This effort hopes to increase understanding about how, where, and why food insecurity occurs in Kenya. Baseline vulnerability examines the risk of food insecurity in the absence, or before the onset of, shocks such as drought or civil insecurity. The retrospective analysis of vulnerability during the 1992–93 period is considered important because Kenya probably came closer to a national famine in that period than in any other time in recent history. Identification of groups and regions that became vulnerable to famine in 1992 and 1993 might assist in responding to future shocks. The analysis of current vulnerability will provide a basis for assessing needs and for monitoring the upcoming season.

METHODOLOGY[1]

Much of the data available for Kenya covers the entire country at the district level or deals at the local level within just one or two districts. In terms of food insecurity, a national picture was required, but a district level analysis was considered too broad. To the extent possible, analysis in support of this VA was conducted spatially using Geographic Information Systems (GIS) at the division level. All data were scaled using the Z-score calculation[2] which ranks indicators across the country. This allows an analysis of *relative* vulnerability to famine (which division is most vulnerable compared to other divisions), but not *absolute* vulnerability (how vulnerable is the division).

The recent creation of new districts and divisions complicated the analysis. The digital maps used for this assessment include 47 districts (see Map 1) and 255 divisions, although some of the data were collected when there were only 42 districts. The number of districts was expanded to 52 in 1994, and an unknown number of new divisions have been created.

To analyze vulnerability to food insecurity or famine, Drought Risk, Depth of Household Entitlement Base, and Physical Insecurity indicators were compiled.

VULNERABILITY

Division-level Analysis

Current vulnerability

Vulnerability to famine decreased significantly in late 1994. The good 1994 "long rains" season in major agricultural zones, combined with increased availability of food due to imports, low inflation, and a lessening of physical insecurity, generally reduced vulnerability levels across the country. An estimated

3.4 percent of the national population, or about 900,000 people, remain moderately to highly vulnerable to food insecurity (see Map 2 and Table 1). Early indications point to a good 1994/95 "short rains" season throughout most of the country which could further reduce vulnerability, although it is too early to predict the outcome of the season.

Some 460,000 people, just under two percent of the national population, remain highly vulnerable. More than 90 percent of this group are pastoralists in the eight arid districts (including Tana River).[3] The remainder are subsistence farmers or agropastoralists in the same districts. This group remains moderately to highly vulnerable because of the relatively poor 1994 "long rains," continued physical insecurity, and a high risk of recurrent drought. Physical insecurity, affecting almost all divisions in this category to some degree, continues to be a primary cause of food insecurity.

An additional 1.3 million people are currently considered moderately vulnerable to food insecurity. Two-thirds of this group are pastoralists, including pastoralists outside of the arid north in Loitokitok and Magadi divisions of Kajiado District. The remainder are subsistence farmers, mainly in eastern portions of the country (Kitui, Tharaka-Nithi, Tana River, Taita Taveta, and Machakos districts).

Another 450,000 people are considered slightly to moderately vulnerable. This group includes subsistence farmers in semi-arid areas of Embu, Kitui, Machakos, and Makueni districts, and pastoralists in less drought-affected parts of Garissa, Isiolo, and Samburu districts. Two divisions bordering Lake Victoria, Bondo in Siaya District, and Maseno in Kisumu District, also fall into the slightly to moderately vulnerable category due to erratic weather conditions.

The numbers in parenthesis in Table 1 indicate each division's ranking in the analysis of chronic vulnerability, and allow a comparison between baseline and current food insecurity. Many of the divisions in the highly vulnerable category have a lower ranking in terms of chronic vulnerability (such as Kibish, Galole, Moyale, and Sololo divisions). Raiding and insecurity are the primary factors causing this change. Damage from elephants and crop loss due to drought cause parts of Taita Taveta and Kajiado districts to be more food insecure at present than historically.

The largest decreases in the number of households that are at least moderately vulnerable to famine in 1994 have occurred in major agricultural areas such as Uasin Gishu, Nakuru, Trans Nzoia, and Nandi districts where the "long rains" were good and ethnic tensions have subsided. Crop destruction by elephants continues, but good rains in the national parks have reduced competition for food and water between wildlife and humans. Pastoral insecurity also improved in some areas, most notably Wajir District and parts of Marsabit District. Insecurity in North Eastern Province is closely tied to the situation in Somalia. Increases in violence in Somalia have often spread quickly into Kenya.

Recent vulnerability

Recent vulnerability examines the changes in baseline vulnerability during the 1992–1993 period. This period is significant because of the combination of shocks which hit the country, including severe drought in agricultural and pastoral areas, ethnic clashes, war in neighboring Somalia, economic reforms, the continued suspension of foreign balance of payments assistance, unprecedented levels of inflation, and devaluation of the currency.

Nationwide, more people were moderately to highly vulnerable during this period than during any other period in recent history. Examining the drought alone, the 1992–93 period was worse in many ways than the 1984 drought. Although agricultural production declined to similar levels and vegetative growth followed similar patterns, the population of Kenya had increased by six million people. Widespread famine may have been averted largely due to the fortunate coincidence of low maize prices in the world and regional markets, combined with the liberalization of imports and the relief efforts of the Government of Kenya, donors, and NGOs. If drought in the main agricultural areas of Kenya had occurred one year earlier when world food prices were very high due to the drought in southern Africa, Kenya may not have been able to import the estimated 1.2 million MT of maize which arrived in mid-1992 and mid-1994. A major crisis could have resulted.

Physical insecurity and drought increased the levels of vulnerability to famine in Kenya during the 1992 and 1993 period. Drought hit areas in southern and western Kenya which normally have a relatively low drought risk. Although drought also hit traditionally drought-prone areas in northern and eastern Kenya, the measurement of chronic vulnerability already incorporated the high drought risk in these areas so the change in vulnerability is less dramatic.

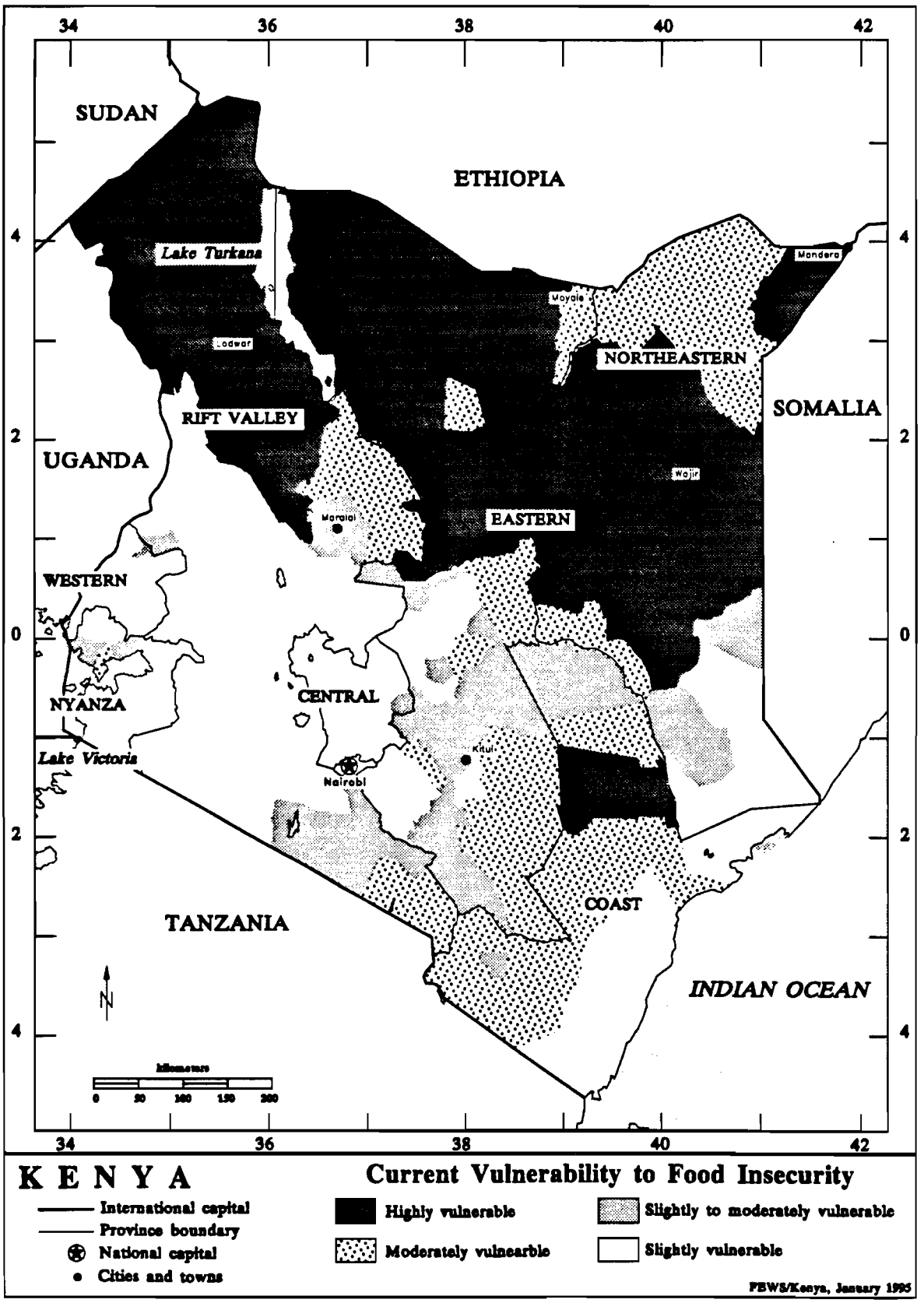
The most vulnerable divisions were nearly all affected by some form of insecurity. Out of the 50 most vulnerable divisions, 46 were affected by one or more types of insecurity. Tribal clashes hit areas with high agricultural potential, causing vulnerability to increase in areas which were not considered to be chronically vulnerable, including Nakuru, Bungoma, Uasin Gishu, and Narok districts. Pastoralist insecurity also changed the picture of vulnerability in the arid districts in the north. A number of divisions which are among the least drought-prone in the north, such as Kibish in Turkana District and Moyale in Marsabit District, became severely insecure. Conflict and raiding in areas with relatively good vegetation contributed to increased vulnerability throughout the districts as pastoralists hit by drought were unable to move their animals into the few good grazing areas.

The most vulnerable divisions were not confined to the arid north. Osupuko in Narok District and Maseno in Kisumu District fell into the ten percent most vulnerable divisions in Kenya. The second most vulnerable decile was more widely spread across the country, including all of Taita Taveta District and most of Laikipia District.

Chronic Vulnerability

The FEWS Project defines chronic vulnerability as "long-term conditions that predispose a particular group or region to food insecurity." Not surprisingly, the regions considered to have the greatest long-term vulnerability are concentrated in arid zones of northern Kenya (see Map 3). Out of the 255 divisions analyzed, the most vulnerable ten percent all lay in Turkana, Marsabit, Samburu, Isiolo, Mandera, Wajir, and Garissa districts. Variation in vegetation is the largest single

Map 2. Kenya: Current Vulnerability to Food Insecurity



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Map 3. Kenya: Chronic Vulnerability to Food Insecurity

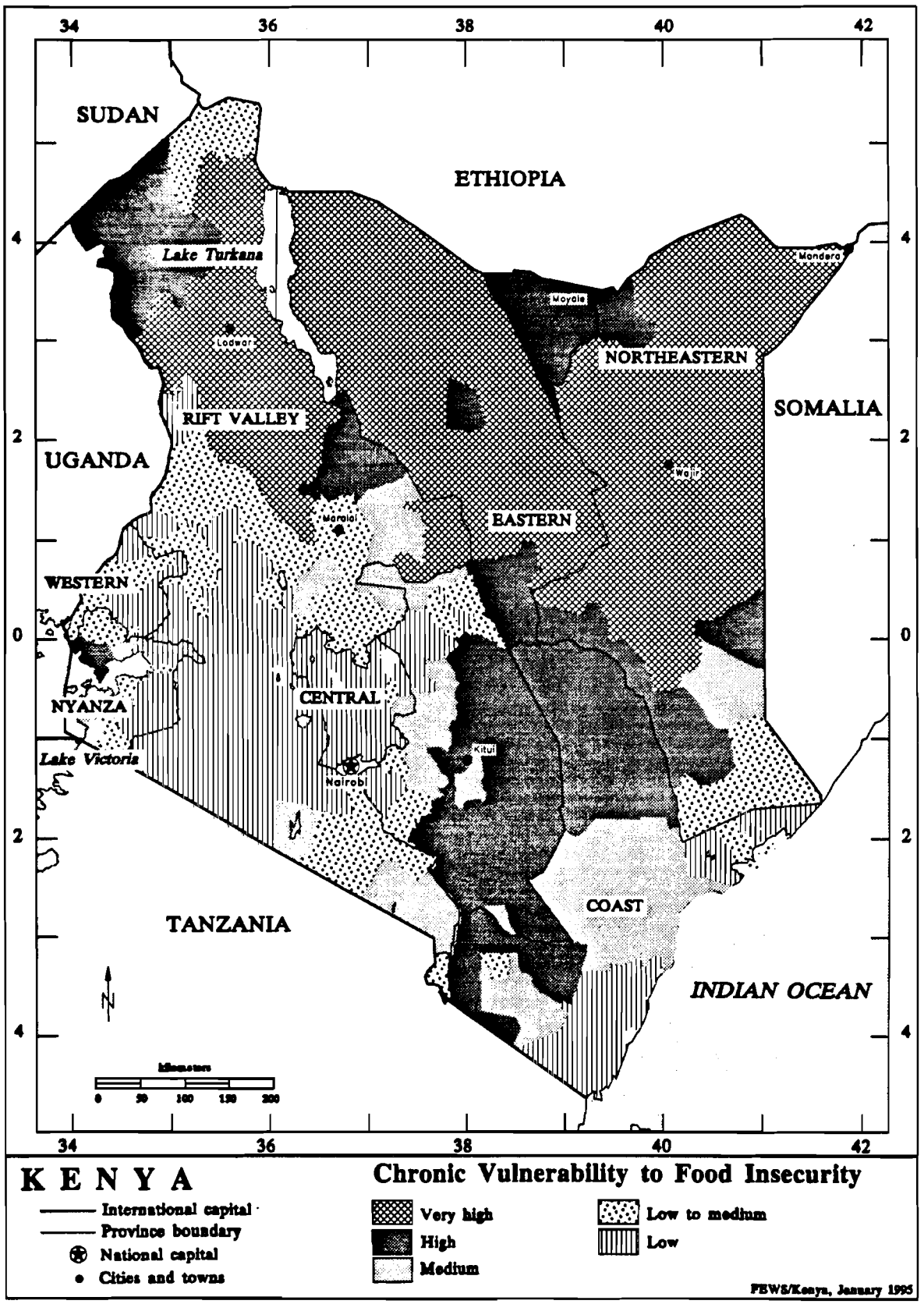

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Table 1. Kenya: 1994/95 Summary of vulnerability

Division	Rank	District	Total population	Vulnerable pastoralists	Vulnerable subsistence farmers	Total vulnerable
Highly vulnerable						
North Horr	(4)	Marsabit	37,410	29,928	—	29,928
Lokitaung	(2)	Turkana	31,497	25,198	3,150	28,348
Loiyangalani	(3)	Marsabit	14,302	11,442	—	11,442
Central (Kalokol)	(1)	Turkana	48,378	38,702	4,838	43,540
Lokori	(7)	Turkana	24,029	19,223	2,403	21,626
Katilu	(6)	Turkana	27,530	22,024	2,753	24,777
Griftu	(5)	Wajir	27,691	22,153	—	22,153
Sericho	(9)	Isiolo	12,919	7,751	646	8,397
Modogashe	(12)	Garissa	15,316	12,253	—	12,253
Laisamis	(10)	Marsabit	18,263	14,610	—	14,610
Buna	(23)	Wajir	5,299	4,239	—	4,239
Merti	(22)	Isiolo	14,823	8,894	741	9,635
Turkwel	(19)	Turkana	31,479	25,184	3,148	28,331
Dadaab	(15)	Garissa	6,284	5,027	—	5,027
Central	(24)	Wajir	42,928	30,049	—	30,049
Wajir-Bor	(21)	Wajir	13,752	11,002	—	11,002
Habaswein	(17)	Wajir	15,958	12,766	—	12,766
Kibish	(80)	Turkana	2,633	2,107	263	2,370
Central	(8)	Mandera	30,423	21,296	—	21,296
Waso	(16)	Samburu	9,764	7,323	976	8,299
Kakuma	(28)	Turkana	39,517	31,613	3,952	35,565
Fino	(13)	Mandera	18,269	14,615	913	15,529
Galole	(38)	Tana River	54,934	31,862	8,240	40,102
Sololo	(40)	Marsabit	6,801	5,441	340	5,781
Moyale	(39)	Marsabit	16,867	11,807	1,687	13,494
Subtotal			567,064	426,508	34,050	460,558
Moderately vulnerable						
El Wak	(20)	Mandera	26,824	21,459	—	21,459
Mutomo	(34)	Kitui	124,850	—	8,740	8,740
Baragoi	(29)	Samburu	38,101	28,576	3,810	32,386
Garba Tulla	(37)	Isiolo	14,191	8,515	—	8,515
Takaba	(14)	Mandera	19,152	15,322	—	15,322
Mbalambala	(31)	Garissa	12,001	9,601	—	9,601
Banissa	(11)	Mandera	20,574	16,459	—	16,459
Rhamu	(18)	Mandera	14,585	11,668	729	12,397
Rarieda	(41)	Siaya	150,677	—	60,271	60,271
Bute	(27)	Wajir	10,771	8,616	—	8,616
Loitokitok	(61)	Kajiado	98,136	34,348	—	34,348
Tharaka	(30)	Tharaka-Nithi	87,540	—	6,128	6,128
Garsen	(53)	Tana River	55,742	32,330	8,361	40,691
Central	(25)	Garissa	47,248	23,624	—	23,624
Mutito	(35)	Kitui	83,381	—	5,837	5,837
Taveta	(75)	Taita Taveta	48,385	2,419	1,452	3,871
Central	(44)	Marsabit	30,603	12,241	9,181	21,422
Bura	(32)	Tana River	28,595	16,585	4,289	20,874
Voi	(58)	Taita Taveta	57,270	2,864	1,718	4,582
Mwatate	(65)	Taita Taveta	61,276	3,064	1,838	4,902
Wamba	(63)	Samburu	23,137	17,353	2,314	19,666
Yatta	(59)	Machakos	127,227	—	6,361	6,361
Madogo	(36)	Tana River	22,700	13,166	3,405	16,571
Magadi	(68)	Kajiado	19,114	6,690	—	6,690
Subtotal			1,222,079	284,898	124,434	409,332

Table 1. Kenya: 1994/95 Summary of vulnerability (*continued*)

Slightly–moderately vulnerable

Division	Rank	District	Total population	Vulnerable pastoralists	Vulnerable subsistence farmers	Total vulnerable
Gachoka	(56)	Embu	133,127	2,663	25,294	27,957
Liboi	(26)	Garissa	5,004	4,003	—	4,003
Kyuso	(33)	Kitui	121,067	—	8,475	8,475
Maseno	(70)	Kisumu	160,315	—	43,285	43,285
Central	(55)	Isiolo	44,731	22,366	4,473	26,839
Masinga	(52)	Machakos	92,089	—	4,604	4,604
Lorroki	(85)	Samburu	59,130	44,348	5,913	50,261
Kapsokwony	(134)	Bungoma	50,939	—	5,094	5,094
Bura	(43)	Garissa	7,682	6,145	—	6,145
Saboti	(77)	Trans Nzoia	181,040	—	34,398	34,398
Bondo	(45)	Siaya	141,856	—	56,742	56,742
Central	(82)	Kajiado	115,664	40,483	—	40,483
Wundanyi	(91)	Taita Taveta	65,449	3,272	1,963	5,236
Makueni	(48)	Makueni	216,141	2,161	34,583	36,744
KwaVonza	(47)	Kitui	136,120	—	9,528	9,528
Mwingi	(49)	Kitui	123,677	—	8,657	8,657
Nithi	(51)	Tharaka-Nithi	205,132	—	14,359	14,359
Kibwezi	(46)	Makueni	177,938	1,779	28,470	30,249
Faza	(96)	Lamu	20,586	—	618	618
Mwea	(62)	Kirinyaga	124,106	—	18,616	18,616
Cheptaisi	(166)	Bungoma	89,165	—	8,917	8,917
Mau	(165)	Narok	137,528	45,384	12,377	57,762
Jarajila	(69)	Garissa	2,605	2,084	—	2,084
Subtotal			2,411,093	744,484	575,234	1,319,719

Summary of current vulnerability

	Pastoralists	Subsistence farmers	Total vulnerable
Highly vulnerable	426,508	34,050	460,558
Moderately vulnerable	284,898	124,434	409,332
Slightly–moderately vulnerable	744,484	575,234	1,319,719
Total	1,455,890	733,718	2,189,609

Percent of national population

	Pastoralists	Subsistence farmers	Total vulnerable
Highly vulnerable	1.7	0.1	1.8
Moderately vulnerable	1.1	0.5	1.6
Slightly–moderately vulnerable	2.9	2.3	5.2

Source: FEWS/Kenya

factor explaining this vulnerability, and pastoralists constitute the vast majority of the vulnerable population in these areas.

The second most vulnerable category is more diverse, both geographically and socioeconomically. Some divisions in this category are in pastoralist areas with a slightly better natural resource base and more significant household assets than the first category. Other divisions in this category lay in semi-arid eastern Kenya, including much of Eastern Province and the inland areas of Coast Province. Vulnerable households in these areas are both small-scale agriculturalists and pastoralists. Both of these categories would be considered moderately vulnerable to food insecurity, using baseline indicators. The food security of these groups is most likely to deteriorate quickly as a result of shocks such as drought or physical insecurity. The next three categories have long-term conditions which render them slightly to moderately vulnerable to food insecurity. This group includes a few pastoral divisions, a number of semi-arid agricultural areas, plus a few divisions within districts normally considered part of the high potential area.

ANALYSIS OF SOCIOECONOMIC GROUPS

Vulnerability to famine for the most at-risk socioeconomic groups has reduced significantly in the past six months. However, the 1992–93 period caused severe hardships and the loss of assets for many people in the four most vulnerable socioeconomic groups: pastoralists, subsistence farmers, the urban poor, and newly destitute urbanized pastoralists. Data used in this VA to measure assets are not robust enough to capture changes from year-to-year, but it is certain that those affected by a reduced asset base will not have recovered fully.

If the ongoing "short rains" season continues to be adequate, vulnerability for pastoralists and subsistence farmers will further decline. A good 1995 "long rains" season would probably return most households to pre-1992 levels of vulnerability. Conversely, a poor season would have immediate negative consequences due to the reduction in assets over the past two years. Even with another good rainy season, vulnerability in the arid north will remain above chronic levels due to the likely continuation of pastoralist insecurity.

Pastoralists

Pastoralism is the primary economic activity in all of the divisions included in the most chronically vulnerable 10 percent of divisions in Kenya. Some pastoral divisions in the arid districts are only moderately vulnerable, while a number of pastoral divisions in semi-arid districts are just slightly to moderately vulnerable to chronic food insecurity. Primarily pastoral parts of Narok District are among the least chronically vulnerable divisions in the country. In other words, pastoralism does not necessarily result in vulnerability, although the most vulnerable households are pastoralists.

Most pastoralists who are not chronically vulnerable to food insecurity have access to areas with relatively better quality land with a smaller variation in vegetation. Within the arid districts, Jarajila in Garissa District, Kibish in Turkana District, and Lorroki in Samburu District have the lowest level of chronic vulnerability.[4] These three divisions have per capita High Potential Equivalents (HPE) above the national average.

Other indicators included under the "depth of the household entitlement base" help explain why some pastoralists are less vulnerable than others. Pastoralists in Narok and Kajiado districts have better physical access to markets, and therefore would be expected to receive a higher price for their animals. Poor roads and insecurity further increase the cost of marketing animals from remote areas in the north to major population centers.

Only limited opportunities for nonagricultural income or cash crop production exist in the arid pastoral districts. Small-scale gold mining and basketry in Turkana District, the collection of gum arabic in Isiolo, Marsabit, and Turkana districts and limited vegetable production in areas closer to markets are practically the only alternative income earning possibilities open to pastoralists in arid districts. When security permits, cross-border trade in small stock and camels can be an important source of income in North Eastern Province and Marsabit District. The recent influx of refugees from neighboring countries offered some short-term income earning opportunities (such as charcoal making or employment with relief agencies), but these will decline as the refugees are repatriated.

The number of animals owned by pastoral households is the key factor in determining relative vulnerability. The district-level data used here to calculate per capita Tropical Livestock Units (TLUs) provides gross estimates of animal populations, but it is insufficient for more detailed analysis. In addition to the absolute number of animals, herd composition appears to be linked to vulnerability.

Camel ownership seems to be an important factor differentiating the level of vulnerability among pastoralist households facing similar environmental conditions. The TLU calculations in this model simply convert all animals into equivalents based on their weight. In times of drought, however, camels are more than "worth their weight" because of their drought resistance and ability to graze farther away from watering points than other animals.

Attempts were made to gather quantitative and qualitative estimates of the percentage of households owning camels per division. The results of the chronic vulnerability analysis change significantly for primarily pastoralist divisions if the percentage of households owning camels is factored in. North Eastern Province and parts of Marsabit District become relatively less vulnerable when camel ownership is included. Communities which are not traditional keepers of camels, such as the Borana in Marsabit District and the Samburu, become more vulnerable. These data were not integrated into the primary analysis because the estimates are very rough and comparable indicators were not available for non-camel keeping areas. In future iterations of the VA, separate analyses of pastoral and non-pastoral areas may be conducted and additional efforts may be placed on understanding the correlations between camel ownership and vulnerability.

Many of the divisions that were most vulnerable to food insecurity during the 1992 and 1993 period were also in pastoral areas in northern Kenya. Unlike chronic vulnerability where the most vulnerable divisions were spread throughout all seven

northern districts, in the 1992–93 period, the most vulnerable divisions were located in just four arid districts: Turkana, Marsabit, Wajir, and Garissa. All divisions in Turkana and Marsabit districts fell within the most vulnerable 10 percent of all divisions, reflecting both the severity of drought and physical insecurity.

Two divisions of Narok District with large pastoralist populations, Osupuko and Mau, ranked among the most vulnerable 10 percent of all divisions in the 1992–93 period. The pastoralists in these divisions were food insecure because of drought which decimated livestock herds, while agriculturalists lost crops due to drought, and were the most common victims of ethnic violence in the area. Vulnerability also increased for pastoralists in Loitokitok (Kajiado District) due to drought.

Subsistence Farmers

Subsistence farmers, defined as food crop farmers who consume more of their own production than they sell, are considered to be the most vulnerable rural residents after pastoralists. In the divisional analysis, the most chronically vulnerable subsistence farmers are located in the following districts and divisions:

- Kitui — Kyuso, Mutomo, Mutito, Kwa Vonza, and Mwingi divisions
- Tharaka-Nithi — Tharaka Division
- Makueni — Kibwezi and Makueni divisions
- Tana River — Bura and Madogo divisions
- Siaya — Rarieda and Bondo divisions

With the exception of the two divisions in Siaya District, the most vulnerable subsistence farmers live in the semi-arid regions of eastern Kenya. These areas are characterized by much lower per capita TLU holdings than the arid districts and relatively low per capita holdings of good quality land. Although the risk of drought is slightly lower than the most vulnerable pastoral divisions, the variation in vegetation is still well above the national average.

The vulnerability of subsistence farmers in Kitui and Makueni districts is reduced by the high share of nonagricultural income in those districts. According to the 1992 WMS, nearly half of the household income in these two districts comes from nonagricultural sources, primarily wages, self-employment, and transfers.

Rarieda and Bondo divisions in Siaya District are the only divisions outside of eastern and northern Kenya to fall into the slightly to moderately vulnerable category. These two divisions bordering Lake Victoria suffer from a significant degree of variation in vegetation, increasing the risk of drought. The divisions fall within Agroclimatic Zones IV and V and have a relatively high population, resulting in a low per capita HPE ratio.

In the 1992–93 period, most vulnerable subsistence farmers were found in areas where drought was combined with tribal clashes and/or crop destruction by elephants. Vulnerability in Laikipia, Taita Taveta, Uasin Gishu, and Nakuru districts can be attributed evenly to both drought and insecurity. Insecurity was caused by the elephant menace in the first two districts and tribal clashes in the later two districts. Part of Laikipia district was also hit by relatively minor tribal clashes.

Increased vulnerability for farmers in Yatta (Machakos District) and along the northern shores of Lake Victoria in Siaya District was caused by drought; while food insecurity in parts of Kitui and Tana River districts was caused by drought and banditry/raiding.

Urban Poor

The model used to assess vulnerability does not attempt to capture urban vulnerability. Urban vulnerability differs greatly from rural vulnerability, where climatic conditions and market accessibility are of paramount importance. In urban areas, vulnerability is more closely linked to income opportunities, the price of food, and other basic commodities.

Most available data on urban areas concentrates on measuring poverty, which is not directly equivalent to vulnerability to food insecurity or famine. However, recent survey data suggests that urban residents are less likely to be poor than rural households. The 1992 Welfare Monitoring Survey indicated that the urban population of Nairobi and Mombasa comprises roughly nine percent of the national population, while poor households in the two centers comprise between four and six percent of national poverty.

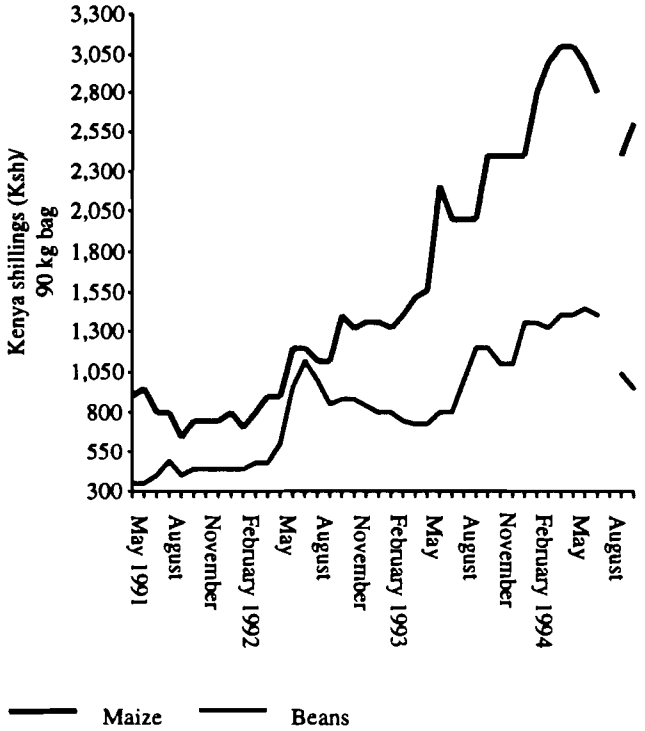
The incidence of food poverty is also less in urban areas than in rural areas. The urban poor are most likely to be casual laborers or informal sector workers. In Nairobi, most of the poor live in the sprawling slums, with Korogocho, Mukuru, and Kibera recording the lowest income per household head.[5] The population density reaches as high as 50,000 people per square kilometer in these slums,[6] where public services such as water and sanitation are virtually nonexistent.

Analysis of nominal retail prices suggests that food insecurity increased in major urban centers in the 1992–94 period. This change was due mainly to inflation and rising maize and bean prices. Maize and bean prices have increased consistently from late 1991 (see Figure 1). After two years of steady increases, prices have started to decline following the bumper 1994 "long rains" harvest. Rising prices were especially hard on the poor, who spend a larger share of total income on food than the nonpoor.[7]

The minimum wage has not kept pace with the sharp increases in consumer prices, especially food prices (see Figure 2). Urban vulnerability was probably at its height during the period between August 1993 and August 1994. During this period, maize and bean prices had increased 200 to 300 percent, respectively, over the base period while the minimum wage increased less than 50 percent. The May 1994 increase in the minimum wage and the subsequent decline in food prices started to reduce the gap between wage increases and the cost of living. While this narrowing has reduced vulnerability for the urban poor employed at low wages, an estimated 410,000 people remain unemployed in urban areas.[8] Nearly 1.5 million people are estimated to work in the informal sector (almost the same number as "modern sector" wage employment). Many informal sector workers are underemployed, earning less than the gazetted minimum wage.

The recent decline in food prices is likely to reduce urban vulnerability back to normal levels, where the poorest urban residents are considered slightly to moderately vulnerable. During the period of stress in 1992 to mid-1994, it is clear that

Figure 1. Kenya: Nairobi maize and bean prices—May 1991–present



Source: FEWS/Kenya

some of the urban poor became moderately vulnerable. Targeted assistance programs such as the World Food Program urban feeding program helped mitigate the effects of the national food shortages and economic reform, and may be necessary in the future.

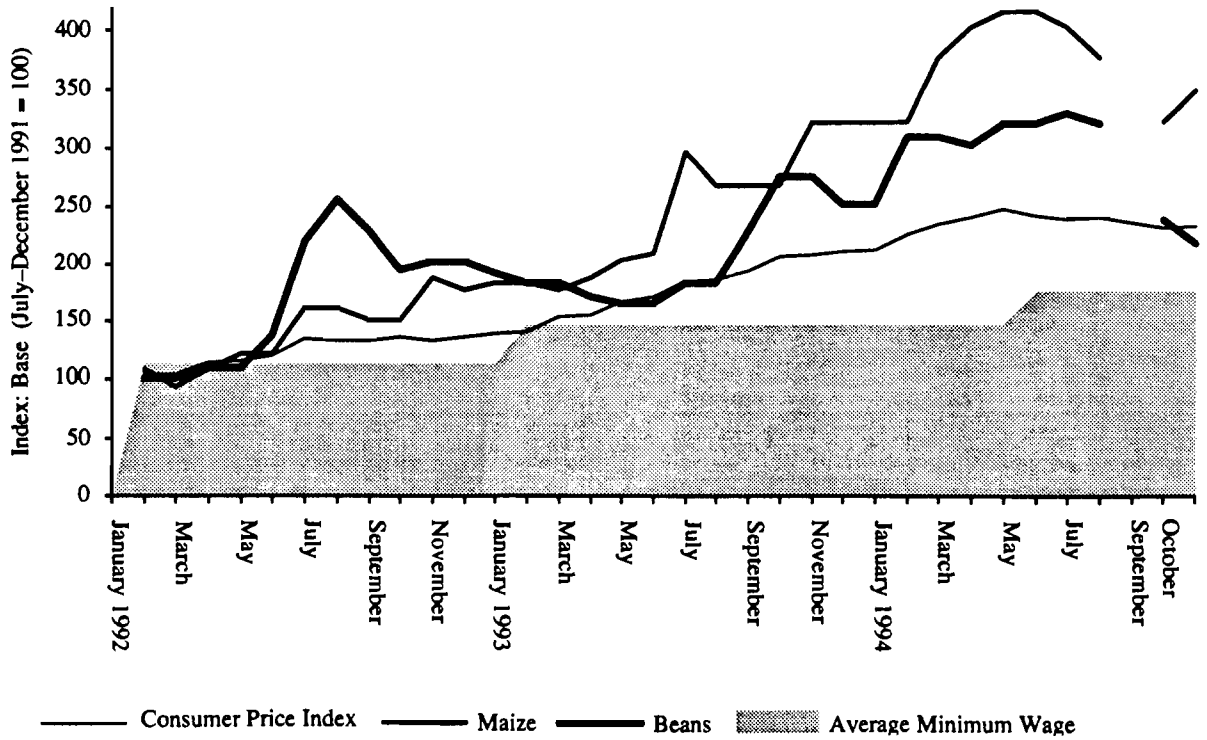
Newly Destitute Pastoralists

One highly vulnerable subgroup of the urban poor are destitute pastoralist households living on the outskirts of northern towns like Wajir, Mandera, and Lodwar. Many of these households were impoverished by the 1984 drought, and became destitute when they lost all of their remaining animals in the 1992/93 drought. Small-scale NGO restocking activities are underway, but implementation has proven difficult. Food insecurity for this subgroup is likely to increase as relief food distributions and NGO-operated Food for Work programs are phased out, probably in 1995. It is difficult to estimate how many people fall into this category, although it is likely to exceed several thousand. Countless other destitute pastoralists have migrated into urban centers outside the arid north.

District Level Analysis

The results of the model were aggregated up to the district level by averaging the results for all divisions within each district. Nairobi and Mombasa were removed from the analysis to avoid distorting this primarily rural assessment with data from

Figure 2. Kenya: Index for maize, beans, consumer prices,* and the minimum wage in Nairobi—1992–present



* = Consumer price index for low-income groups

Sources: USAID/AGR,CPI , 1994 Economic Survey, and CBS

urban areas. The aggregation eliminated the important variation within districts, and allowed for a simpler analysis (using 47 districts units rather than 255 divisions). Several districts have a large degree of variation in chronic vulnerability among divisions, including Baringo, Bungoma, Embu, Garissa, Kajiado, Machakos and Meru. In all cases, the variation results from agroecological zones cutting across districts leaving some divisions in low potential zones and other divisions in high potential zones. In Machakos District, for example, Kathiani, Kangundo, and Central divisions have a much lower ranking in terms of chronic vulnerability than Masinga, Yatta and Mwala Divisions. In Embu, the two divisions closest to Mount Kenya, Runyenjes and Manyatta, are less chronically vulnerable than Gachoka and Siakago.

The variation within districts was even more pronounced in the 1992–93 period, when drought and clashes hit some divisions in a district more than others. In Baringo, vulnerability increased in Nginyang and Kabartonjo while the higher potential areas of Ravine, Mogotio, and Tenges remained relatively less vulnerable. In Bungoma, ethnic clashes and drought combined to make divisions near Mount Elgon much more vulnerable than other divisions in Bungoma. All of these differences are smoothed over when divisional level vulnerability is aggregated up to district level.

Table 2 lists the current, recent, and chronic vulnerability by district, ranking from most to least vulnerable for each temporal category and giving the Z-scores for each category. Negative Z-scores mean that the district is more vulnerable relative to the national average, while the magnitude of the Z-score from zero indicates how anomalous the district is from the mean. Z-scores can not be compared across time because of the different indicators used for current, recent, and chronic vulnerability.

Current Vulnerability

The most vulnerable districts are the northern arid districts plus semi-arid districts east of Nairobi (see Table 2). Preliminary estimates of district level 1994 "long rains" maize production confirm the improvement in most high potential agricultural areas. Production was above the five-year average in a number of key maize growing districts, including Kericho, Bungoma, Narok, Uasin Gishu, Trans Nzoia, and Nandi. Many victims of ethnic clashes have resumed agricultural production in these districts so the good harvest should assist in their recovery.

The "long rains" harvest was again below normal in Eastern Province, especially Kitui/Mwingi, Makueni, Machakos, Meru, Nyambene, and Tharaka-Nithi districts. Although stress increased after this poor harvest, the third consecutive poor harvest in many parts of Eastern Province, relief activities continue and good national maize availability is keeping prices down. The "long rains" harvest accounts for a smaller share of annual production in these districts than the "short rains," so the harvest in January/February 1995 will be critical.

The "long rains" were mixed in the arid northern districts. Drought recovery started and relief inputs have been scaled back. The positive signs from the ongoing "short rains" should result in continued recovery and a further cutback in relief supplies, assuming the season continues normally.

Recent Vulnerability

District-level vulnerability changed dramatically during the 1992–1993 period. Narok District moved from the least vulnerable district assessed (45th of 45 districts) to the 14th most vulnerable. Taita Taveta, Laikipia, Kirinyaga, Uasin Gishu, and Nakuru districts also became significantly more vulnerable during this period than during the baseline period.

Drought and physical insecurity were equally important contributors to the increased vulnerability in these districts. Tribal clashes and crop destruction by elephants also resulted in increased vulnerability in areas which are not chronically vulnerable (see Map 4).

Turkana, Marsabit, and Wajir were the most vulnerable districts during the period, followed by Taita Taveta, Samburu, Mandera, Laikipia, and Isiolo.

Chronic Vulnerability

The arid districts in the north are the most chronically vulnerable compared to other districts in Kenya, although the semi-arid districts of Tharaka-Nithi and Tana River rank higher than Samburu in district-level vulnerability.[9] The semi-arid districts of Kitui, Makueni, Taita Taveta, Laikipia, Machakos, and Kajiado districts also show relatively high levels of chronic vulnerability.

Interestingly, Narok District is the least vulnerable district based on long-term factors. The per capita high potential land equivalents (HPE) in Narok are among the highest in the country, due to its relatively good land and low population.[10] Animal ownership is also high and physical accessibility to markets is relatively good. Narok became one of the most vulnerable districts in the country during the 1992–93 period due to a combination of prolonged drought and tribal clashes. Tribal clashes resulted from a number of complex factors, but the fact that Narok has some of the least populated, good quality land remaining in Kenya certainly has contributed to population influxes and the resultant tribal tensions. The change in vulnerability in Narok over time highlights the fact that all areas are potentially vulnerable to food insecurity if certain shocks occur.

CONCLUSIONS

Table 3 presents a summary of vulnerability through 1994 by socioeconomic group. Current agriculture conditions throughout much of Kenya are good. "Short rains" precipitation levels were adequate in most growing areas except for small pockets in Eastern province that received late and again, insufficient, rainfall.

Maize prices have fallen as a result of additional imports and interprovincial transfers. The agroclimatic outlook for the 1995/96 season is promising as the effects of an active El Niño

Map 4. Kenya: Recent Vulnerability — Insecurity 1992–94

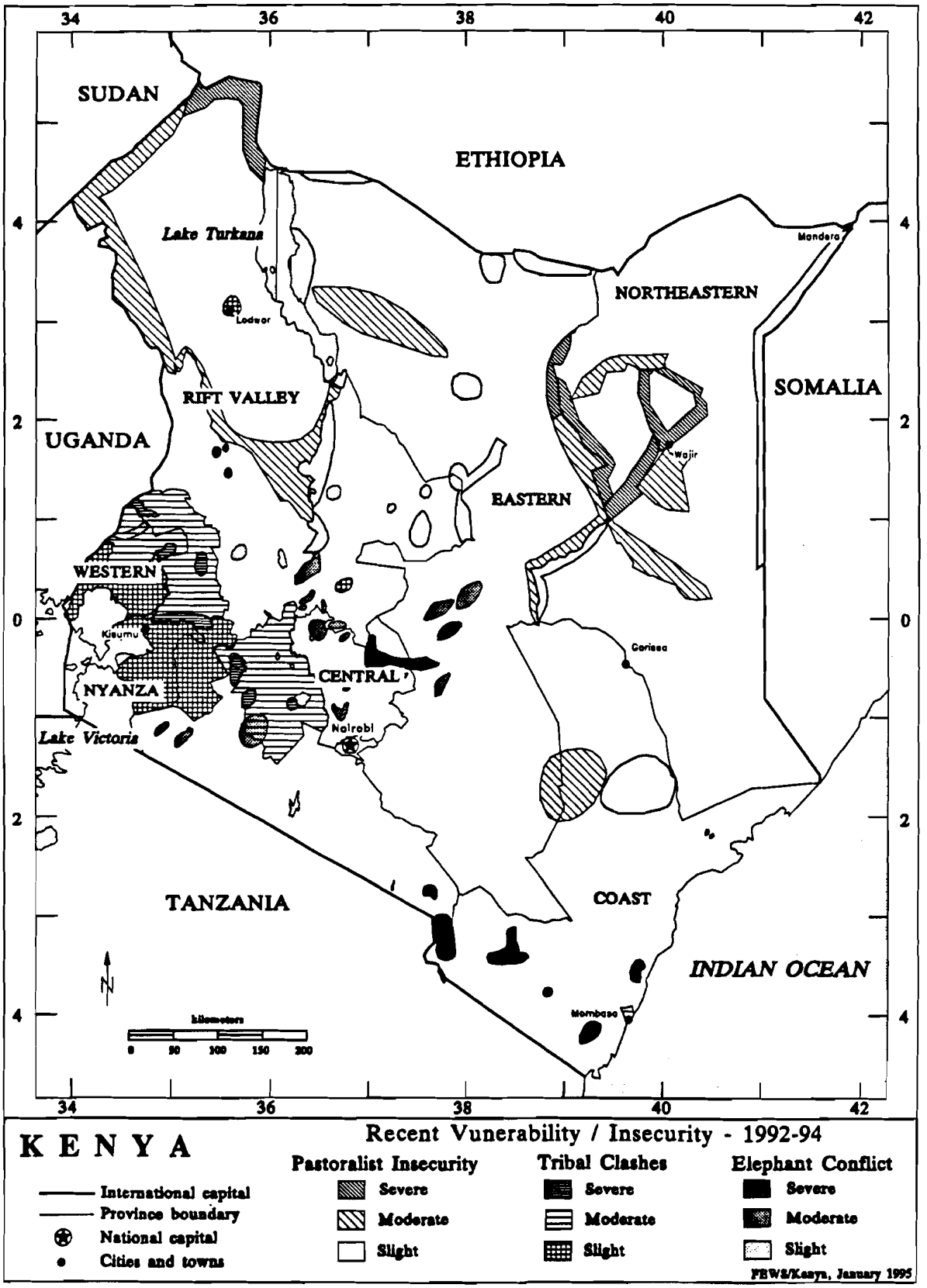


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Table 2. Kenya: Ranking of district vulnerability across time

District	Current (Dec. 1994)		Recent (1992 & 1993)		Chronic (baseline)	
	Rank	Z-score	Rank	Z-score	Rank	Z-score
Turkana	1	-5.00	1	-3.47	1	-2.13
Marsabit	2	-4.52	2	-3.18	4	-1.72
Wajir	3	-3.97	3	-2.74	3	-1.73
Isiolo	4	-3.38	8	-1.68	5	-1.34
Mandera	5	-3.17	6	-1.92	2	-1.89
Tana River	6	-2.73	11	-1.42	8	-0.98
Samburu	7	-2.61	5	-1.97	9	-0.97
Taita Taveta	8	-2.24	4	-2.13	12	-0.49
Garissa	9	-2.10	15	-1.03	6	-1.06
Tharaka-Nithi	10	-1.99	10	-1.47	7	-0.99
Kitui	11	-1.86	16	-0.95	10	-0.96
Kajiado	12	-1.84	17	-0.89	16	-0.19
Machakos	13	-0.99	21	-0.56	15	-0.28
Makueni	14	-0.84	25	-0.34	11	-0.56
Laikipia	15	-0.72	7	-1.70	14	-0.33
Embu	16	-0.64	27	-0.28	24	0.16
Bungoma	17	-0.56	18	-0.81	25	0.20
Trans-Nzoia	18	-0.42	13	-1.20	18	-0.01
Siaya	19	-0.37	28	-0.24	13	-0.39
Kirinyaga	20	-0.28	12	-1.22	23	0.11
WestPokot	21	-0.06	23	-0.49	22	0.10
Kwale	22	0.16	19	-0.66	34	0.77
Busia	23	0.19	24	-0.46	17	-0.07
Kilifi	24	0.26	35	0.07	26	0.24
Meru	25	0.30	30	-0.07	29	0.48
Narok	26	0.31	14	-1.07	45	1.29
Kisumu	27	0.38	20	-0.61	27	0.39
Homa Bay	28	0.54	31	-0.05	19	0.00
Lamu	29	0.56	29	-0.11	31	0.53
Baringo	30	0.87	32	-0.05	28	0.40
Nakuru	31	0.90	22	-0.54	36	0.99
Migori	32	1.08	37	0.26	21	0.07
Uasin Gishu	33	1.08	9	-1.66	20	0.01
Nyandarua	34	1.15	33	0.01	33	0.71
Kakamega	35	1.21	36	0.26	32	0.67
Vihiga	36	1.28	38	0.33	30	0.49
Nandi	37	1.38	26	-0.29	35	0.91
Nyeri	38	1.40	34	0.06	44	1.21
Muranga	39	1.70	43	0.78	41	1.11
Bomet	40	1.80	39	0.47	38	1.00
Kiambu	41	1.93	44	1.09	43	1.20
Nyamira	42	2.04	41	0.55	40	1.10
Kisii	43	2.18	42	0.77	37	0.99
Kericho	44	2.28	40	0.52	42	1.16
Elgeyo Marakwet	45	2.39	45	1.13	39	1.04

Source: FEWS/Kenya

event could again bring above-average rainfall to high potential areas in western Kenya.

Economic uncertainty within the maize market is of some concern, but maize should be readily available throughout much of 1995. Additional civil strife could cause disruption to planting and crop maintanence, and could again create food insecurity in areas of population movement.

Endnotes

1. See the Methodology Annex for a more complete discussion of the indicators and calculations used in this exercize.
2. For each indicator the average and standard deviation were calculated. The absolute figure for each division is subtracted from the national average, and then divided by the standard deviation. The result, the Z-score, is an indicator of how many standard deviations the division is away from the national average for that indicator. A negative Z-score means the division is below the national average, while a positive Z-score means the division is above the national average. The degree of difference from zero (above or below) indicates how anomalous the result is from the mean.

Table 3. Kenya: Vulnerability summary by socioeconomic group

Group	Baseline vulnerability	1992–93 vulnerability	1994 vulnerability
Pastoralists			
arid districts	slight–moderate	high	moderate–high
semi-arid districts	—	moderate–high	slight–moderate
Subsistence farmers			
semi-arid districts	slight–moderate	moderate	slight–moderate
high potential districts	—	slight–moderate	slight–moderate
Urban poor	slight–moderate	moderate	slight–moderate
"Urbanized" pastoralists	—	extreme	high

Source: FEWS/Kenya

3. The population data for the arid districts is considered unreliable. The mobility of the population makes it nearly impossible to get an accurate count or assign a home location to pastoral households. Data are based on the 1989 census which, although problematic, remains the only source of divisional level population estimates.
4. Chronic vulnerability excludes physical insecurity.
5. World Bank, "Kenya Poverty Assessment," July 14, 1994, p. 24.
6. Kenya Population Census, Table 1.
7. Food receives a 44 percent weight in the low income group's consumer price index compared to 21 and 14 percent for the middle and upper income groups, respectively.
8. Republic of Kenya, Economic Survey 1994, p. 50.
9. Samburu District is traditionally considered one of the seven districts of the "arid north", although some of its land falls in Agro-Climatic Zones 3–5. Tana River District, laying outside the north and with a mixed population of pastoralists and riverine agriculturalists is sometimes lumped together with the other districts of the "arid north".
10. This is based on estimated 1994 population, extrapolated from the 1989 census and including the 1979–89 growth rate. Narok District had a growth rate of 6.49 percent between 1979 and 1989—the highest rate in the country.

METHODOLOGY APPENDIX

To analyze vulnerability to food insecurity or famine, Drought Risk, Depth of Household Entitlement Base, and Physical Insecurity indicators were compiled. A comprehensive discussion of the methodology follows in both an overview and practicle application form.

Indicator Overview

Drought Risk — Eighty percent of Kenyan households earn their livelihood from agriculture, which includes food, cash crop production, and animal husbandry. One of the most important determinates of vulnerability is the relative risk involved in agricultural activities. Drought is the most significant risk to agricultural production in Kenya. Other less readily measurable risk factors exist including: pests, floods, unavailability of inputs, etc.

Imagery from the NOAA AVHRR satellite[1] for each 10-day period from 1982 to 1991 was used to identify the frequency of large, unseasonal variations in vegetation. For the two growing seasons ("long" and "short" rains), the coefficient of variation of the cumulative vegetation was calculated for each division. Divisions with normally low cumulative vegetation and a high degree of variability across years were determined to have the highest probability of drought. Conversely, areas with normally high total vegetation and low variability across years were determined to have the lowest probability of drought.

To measure the performance of the 1992–94 seasons for the analysis of recent and current vulnerability, the cumulative vegetation for each growing season was compared to the average (1982–1990) cumulative vegetation for each division.

Depth of Household Entitlement Base — Food insecurity and famine are complex events that do not result solely from a decline in food production or availability, but also from a decline in an individual household's ability to acquire food. Therefore, vulnerability to food insecurity and famine can not be measured by agroclimatic factors alone. Some households can withstand a major drought with little or no change in consumption patterns, while other households may suffer severe food insecurity during a relatively minor drought.

Theoretically, a thorough measurement of all household income sources would allow a precise assessment of a household's ability to cope with drought or other shocks. Income in this sense would include earnings from the sale of labor, goods and services, earnings from goods produced by the household for its own consumption and based on the value of household assets, and transfers. In practice, however, available data are not complete enough to accurately measure all of these income sources.

Several large national household budget surveys, such as the 1992 Welfare Monitoring Survey (WMS), have attempted to measure income sources. Although the survey provided useful data on some indicators, it failed to capture all sources of household income in sufficient detail to understand households' abilities to cope with shocks. The assessment of poverty was a primary objective of the WMS, and the results of that effort differ significantly from the results of the present study.[2] In part, the divergent results are due to the difference between poverty and vulnerability, as summarized by Chambers (1989).[3]

> "Vulnerability is distinct from poverty. It represents not lack or want, but defenselessness, insecurity and exposure to risks, shocks and stress...and difficulty coping with them."

In the absence of a complete picture of household income, a composite indicator called, the depth of the household entitlement base, was created to measure the ability of the household to acquire food. This indicator measures resources available to the household in addition to its primary direct entitlement—its ability to produce food for its own consumption. The indicator included:

- the number of livestock units per capita
- the share of income from nonagricultural activities
- the share of income from cash crops
- the hectares of good quality land equivalents per capita
- the physical accessibility of urban infrastructure

Data on the first three indicators were available only at the district level, and were extrapolated to the divisional level. The fourth and fifth measures were conducted spatially (i.e. irrespective of administrative boundaries), and then aggregated up to the divisional level based on the Agro-Ecological Zones of Kenya, the Gazetteer of Populated Places, and the 1989 census.

Food price data would have been useful for measuring the ability of households to purchase food. Price data covering 1979–94 were analyzed, but poor data quality and limited geographic coverage prevented its integration into the methodology.

Physical insecurity — Physical insecurity continues to be a significant cause of food insecurity in Kenya. Various types of insecurity have existed in Kenya for years, but recently, insecurity has been exacerbated by conflict in Somalia, drought, and political factors. For the purpose of this assessment, three types of physical insecurity were measured: pastoralist insecurity, tribal clashes, and crop destruction by elephants. All three forms of insecurity were categorized as slight, moderate, or severe for each division (see Map 3). The assessment of chronic vulnerability excluded physical insecurity, while it was included in the measurement of recent and current vulnerability.

Pastoralist insecurity has continued for so long in some areas that it may appear to be a chronic problem, but excluding it from the baseline assessment allows for an examination of areas which would be more food secure if man-made insecurity could be controlled. This assessment only considered insecurity in pastoral areas in terms of the constraints on grazing and marketing opportunities. It intentionally excludes banditry and other forms of opportunistic violence which severely constrain the movement of travelers, nongovernmental organizations (NGOs), and others, but which do not necessarily affect pastoralist movements. Insecurity is greatest around national borders and between tribal boundaries. Many of the conflict zones lay in fertile grazing regions, and thus contribute significantly to vulnerability, especially when grazing land is limited due to drought.

Tribal clashes between 1991 and 1993 caused serious economic disruptions in agriculturally productive zones, and

resulted in food insecurity for victims and others. Food production declined, food stocks were destroyed, and businesses were closed. While clashes have subsided, the impact of the clashes has not disappeared as some areas remain unsettled and economic losses have not been fully recovered.

Destruction of crops by wildlife, especially elephants, is a devastating problem in some communities. The problem is not new, but the impact on food security appears to have increased recently for several reasons. The number of elephants in Kenya has recovered steadily with the success of antipoaching operations, while human population growth has pushed agriculturalists closer to national parks and other areas with concentrations of wildlife. During the past few years, drought in Tsavo, Amboseli, and Maasai Mara national parks brought elephants outside park boundaries in search of food and water. The development of tourist lodges outside park boundaries has resulted in operators encouraging the movement of animals into areas near the lodges—and into nearby farms. In addition, the system of government compensation for losses caused by wildlife has faltered, so the impact on food security is greater than it would be if compensation for crop destruction, loss of life, or injury were automatic. Although crop destruction by elephants is not a man-made problem, it is controllable if resources (electrical fencing and guaranteed compensation) are made available.

Practical Application

Drought risk

To calculate chronic vulnerability, the historical data on the variability in vegetation from year to year was extracted from satellite imagery at the fourth administrative unit (division). The variation in the long and "short rains" were calculated separately and then weighted by "long rains" and "short rains" dependency for each division.

The start of season date, the peak of season date, the peak of season vegetative value, the length of season, and cumulative vegetation were examined to determine which indicator best captured climatological variability in Kenya. These indicators have been used in various combinations in the Sahel to measure variability in vegetation. However, in the Sahel the vegetative seasons are unimodal, the topography is relatively simple, and the crop varieties are few. The complex nature of Kenyan topography and climatology complicated the analysis significantly. Vaariations in altitude, temperature, and soil types result in many permanent and annual crop patterns.

Calculations involving start dates and peak dates proved inconclusive because the complex topography of Kenya causes the seasonal vegetation in one area to peak before the season begins in other areas. Similarly, the peak of season value was an inadequate measure because of the distinct seasonal patterns prevailing in various areas of the country.

The length of the growing season is an important determinate of the success of an agricultural campaign or the adequacy of grazing land. However, there is not one "adequate" length of season in Kenya. FEWS attempted to gather information on maize varieties grown in different agroecological zones to compare the length of season of each variety for each agroecological zone against the actual length of season derived from satellite imagery. Because maize is not the only important crop, similar information would be necessary for other food crops and pastureland. The effort required for this type of analysis precluded its inclusion in this assessment.

Variability in cumulative vegetation proved to be the most useful indicator of climatic variability. The FEWS II-developed software programVegetative Analysis in Space and Time (VAST), calculates the coefficient of variation of cumulative vegetation for any defined season, extracting statistics from the Image Display and Analysis (IDA) program. The analysis included the following steps (columns refered to in Table KA-1):

- The coefficient of variation (CV) was extracted for each division for each year from 1983–1991 for both the long and "short rains" periods (March–July and August–February, respectively). The average CV for 1983–1991 was calculated for each season. Z-scores were computed (Columns B & C).
- The cumulative vegetation for each season was summed and the share of total vegetation generated in each season was calculated (Columns D & E). These shares were multiplied by the respective CVs and summed in order to determine one seasonally weighted CV (Column F).
- The average annual cumulative vegetation was calculated for each division (Column G). The Z-scores were computed (Column H).
- The average of the seasonally weighted CV and the annual cumulative vegetation was calculated (Column I).

The third step was necessary because several areas in Kenya showed a high degree of variation within high vegetation zones, especially in the minor growing season (e.g., Tongareni and Bungoma). The coefficient of variation for these areas appeared equal to the variation in marginal areas where there is a high degree of variation in the major growing season such as Kitui. Averaging the CV with the annual cumulative vegetation highlighted the low vegetation areas, where variation is likely to be equated with crop failure. The final column (I) was used to determine the quality of the natural resource base in the measurement of chronic vulnerability.

For the measurement of recent and current vulnerability, the cumulative vegetation for three recent agricultural seasons was compared to average cumulative vegetation for the season. The inclusion of the past three seasons allows for a measurement of the cumulative effects of consecutive droughts.

For the recent vulnerability calculation, the most recent three seasons were the 1993/94 "short rains," the 1993 "long rains," and the 1992/93 "short rains." For the assessment of current vulnerability, the three most recent seasons were the 1994 "long rains," the 1993/94 "short rains" and the 1993 "long rains." The seasons were weighted as follows: most recent = .5, second most recent = .3, and third most recent = .2. Data for cropping season were multiplied by the share of normal cumulative vegetation produced in the "long rains" and the "short rains."

Districts with the highest Z-scores had the largest difference in vegetation in the previous three seasons compared to normal.

The depth of the household entitlement base

To measure the ability of households to command resources and access food even in times of drought, some measure of assets was necessary. A composite index was developed including:

- number of tropical livestock units per capita
- share of income from nonagricultural activities
- share of income from cash crops
- hectares of high potential land equivalents per capita
- accessibility to urban infrastructure

There was no simple way to weight each of the five components used to calculate the depth of the household asset base, so a simple average was taken for each division.

Tropical Livestock Units per capita

Livestock is an important asset for most rural households in Kenya. For small-scale agriculturalists sheep, goats, and sometimes other animals are held in reserve to be sold in the event of a poor harvest or to meet periodic or extraordinary cash requirements. Among some communities, milk from small stock is also consumed. Cattle are also very important for food security, household and market milk, and meat production. Animals are undoubtedly the most important asset for pastoralists, both for direct household consumption of animal products and for income derived from market exchange.

Data availability on livestock populations is limited. The last national survey by the Department of Remote Sensing and Rural Surveys (DRSRS) was conducted in 1987/88. District level aerial surveys have been done in some pastoral districts but comparable data for the rest of the country are not available. Regular estimates of animal populations are made by Ministry of Agriculture (MoA) field staff. The quality of these data varies, and there are some significant differences between MoA estimates and recent aerial surveys carried out in the arid districts. However, the advantages of using the same data set for the entire country were thought to outweigh the known weaknesses in the MoA data, so this data has been used.

Tropical Livestock Units (TLUs), defined as 250 kilograms of live weight, are used to convert different animal species into one equivalent measure. It is difficult to estimate an average weight of an animal species in Kenya. Improved dairy and beef cattle, for example, weigh significantly more than indigenous species of cattle held in the arid north. Similarly, Somali camels weigh much more than camels kept in Turkana. Data disaggregated by sub-species are not available, so this analysis simply used one set of TLU conversions for the arid district and one set of TLU conversions for the non-arid districts. Additional refinements could be made in the future, using more disaggregated data and conversion factors to reflect regional differences in animal weights and values.

The TLU conversion factors used were:

Non-arid districts		Arid districts	
sheep =	0.125 TLU	sheep =	0.095 TLU
goats =	0.100 TLU	goats =	0.095 TLU
cattle =	0.810 TLU	cattle =	0.660 TLU
amels =	1.200 TLU	camels =	1.200 TLU

The TLU conversions for the arid districts are from the Drought Monitoring Project (DMP). The conversions for the non-arid districts are FEWS estimates. Data on district level percentages of improved and unimproved stock were not available, so FEWS/Kenya assumed that 20 percent of all cattle in non-arid areas is improved. This yielded an average cattle weight of just over 200 kilograms.

The TLU data were converted to a per capita basis using estimates of the 1990 human population by district. The district-level growth rate between the 1979 and 1989 census data was used to update the 1989 district populations. The per capita TLU figures were then normalized using the Z-score statistic (see Table KA–2). Because the livestock population figures were available only at the district level, data had to be spread (disaggregated) to the divisional level.

Share of income from nonagricultural activities

Households with a larger share of income from nonagricultural activities are less vulnerable to the climatic variability captured in the first indicator. Non-rainfall dependent income sources such as services, manufacturing, and trade may protect households from the effects of drought. Some income sources which are not directly rainfall dependent, such as furniture making, may be tangentially linked to rainfall (if there is a drought, the furniture maker's farming customers may have less disposable income to spend on furniture), but these indirect linkages cannot be measured easily.

Data on the share of income from nonagricultural activities are derived from the 1991 Welfare Monitoring Survey (WMS) for the non-arid districts. Nonagricultural income is assumed to be the sum of wage income, self-employment income, rents, and income from others. The share of income from nonagricultural activities for the arid districts was estimated by FEWS.

The district-level share of income from nonagricultural sources was normalized using Z-scores. The district result was assigned to all divisions within the district. Although the WMS data can be calculated at the divisional level, the CBS sample frame used is only statistically valid at the district level (see Table KA–3).

Share of income from cash crops

Income from cash crops is also assumed to reduce exposure to adverse climatic conditions. Although tea, coffee, pyrethrum, cashews, and other cash crops can be affected by drought, the impact on household income is not as immediate or severe. The data on cash crop income were derived from the WMS for the non-arid districts. For the seven arid districts, estimates were compiled by FEWS. District-level data weres normalized and are presented in Table KA–4. The district figure was assigned to the divisional level.

High Potential Equivalents per capita

The High Potential Equivalents (HPEs) attempt to compare the land potential across agroclimatic zones on a per capita basis. The availability of good quality land is an important indicator of household resources. Average farm size data does

not capture land quality. Farm sizes are much larger in marginal areas of Eastern Province than in Western Province, yet the income potential may be much lower because of soil quality and climate. Similarly, land in Central Province may support a much higher population density than land in Coast Province.

This indicator provides a measure of land quality and population density by estimating the potential income derived from an average hectare in each of the seven agroclimatic zones (ACZ). The total hectares in each ACZ in each division were aggregated, converted to high potential equivalents, and then divided by the divisional population (see Table KA-5).

The methodology used in this analysis calculates the differences between the seven ACZs which characterize land based on soil moisture availability. However, the analysis does not capture the differences within a single ACZ. For example, within ACZ-1, the highest zones, Upper Highland (UH1), will be very different in their climatic and productive potential from the lowest ones, Lowland 1 (L1), found along the coast. To get the clearest picture about land potential, it would have been necessary to disaggregate each ACZ by the various agroecological zones (AEZs) to capture temperature and altitude. Time did not allow such a detailed analysis, but this effort should be undertaken in the future.

The Farm Management Handbook (FMH), Volumes IIA (West Kenya), IIB (Central Kenya) and IIC (East Kenya) have been used as the main reference to calculate the ACZ conversion factors.[5] Due to logistical limits, representative regional sampling has been attempted. In particular, the data for ACZ-1 to ACZ-3 has been mainly derived from the Farm Management Handbook (FMH) volume for West Kenya. Although this represents a limited sample, the data from West Kenya provides a fairly reliable indicator of what to expect in other zones. For ACZ-4, FMH volumes for West Kenya and Central Kenya were used, while for ACZ-5 to ACZ-7 the FMH volumes for Central and East Kenya were the main basis for analysis.

The districts referred to in developing the HPE for ACZ-1 to 3 were Bungoma, Kakamega, Busia, Siaya, South Nyanza, Kisii, and Kisumu. For ACZ-4, Bungoma, Kakamega, Busia, Siaya, South Nyanza, Kisumu, Trans Nzoia, Uasin Gishu, Nakuru, Narok, Muranga, Kiambu, Nyeri, Nyandarua, and West Pokot were the reference districts. For ACZ-5 to ACZ-6, West Pokot, Samburu, Laikipia, Narok, Nakuru, Nyandarua, Baringo, Elgeyo Marakwet, Embu, Meru, Machakos, Kitui, Taita, Kajiado, Tana River, Lamu, Kilifi, and Kwale were the reference districts. Only Samburu District was used for ACZ-7 from the FMH. However, the Range Management Handbooks for Marsabit, Wajir, and Mandera districts were referenced. In all, over 31 districts were made reference to during the development of this methodology.

Three major crops were used for comparison between ACZs. For permanently cropped land, tea was used as the reference crop. In areas where tea is not found, coffee was converted into Tea Equivalent Units (TEUs). For perennial land, maize was used as the reference crop, with Maize Equivalent Units (MEUs). For pasture land, Dairy Equivalent Units (DEUs) were used for comparing milk yields.

For each ACZ, the yields of the crops above were estimated using data contained in the Farm Management Handbook by districts. For example, for ACZ-1, yields would be estimated for the various AEZs ranging from Upper Highland (UH1) to Lowlands (L1) for the sample districts. The district averages would then be used to arrive at a sample average. For example, maize yields in ACZ-3 may vary from 5.6 tons/ha in district A to 2.1 tons/ha in district B. If only these two districts were used as sample districts, an unweighted average of 3.85 ton/ha would be recorded for the ACZ in question.

In general, yields and production potential varied greatly, particularly as one moved from higher to lower altitude AEZs within the same ACZ. The aggregate figures provided for each ACZ under the current methodology thus hide significant AEZ differences within it. Further differentiation in the future, first by ACZ and then by AEZ would provide a much richer analysis of land potential.

The following assumptions have been made (see Table KA-6 for land use percentages):

- *Permanently cropped land*: throughout the HPE calculations, permanently cropped land is taken in terms of Tea Equivalent Units (TEUs). Although tea is only grown in ACZ-1, and coffee is grown in ACZ-1 to 3, tea has a much higher yield and value than coffee. Thus in terms of measuring the highest potential for a crop, TEUs are used for permanently cropped land for ACZs 1 to 3, and coffee data have been converted to TEUs.

  For the purposes of this calculation, a TEU is defined as a yield of 4.8 tons/ha/yr at the price of Kenya Shillings 47,615 per ton. The price was obtained by taking the five year unweighted average of calendar prices for 1989-1993 from the 1994 Economic Survey.[5] The average yield is a composite one for West Kenya, based on the FMH estimates of the AEZ potential. This could be modified later with inclusion of data from East Kenya to make it a more comprehensive and robust indicator.

  TEUs are used for ACZs 1 to 3. Farmland use statistics are used to arrive at the proportion of land that is permanently cropped, and this proportion is then converted in a tea equivalent unit.

- *Perennially cropped land*: throughout the HPE calculations, perennially cropped land is measured in terms of Maize Equivalent Units (MEUs). Maize is grown in ACZs 1 to 4, and marginally in ACZ-5. However, for the purposes of this exercise, maize is taken to grow from ACZs 1 to 4. Although maize is grown in ACZ-5, in many cases, livestock would provide a higher potential use of the land. The MEU is defined as a yield of 3.8 tons/ha/yr at the price of Kenya Shillings 5,220 per ton. The price was obtained by taking an unweighted average of calendar year prices for 1989-1993 from the 1994 Economic Survey. The average yield is a composite one, based on the FMH estimates of AEZ potential in West Kenya, and Central Kenya. It covers all the main maize growing zones, but it could be made more robust by inclusion of data from the more marginal zones in the future.

  MEUs are used for ACZs 1 to 4. Farmland use statistics from the FMH are used to arrive at the proportion of land that is perennially cropped, and this proportion is then converted into a maize equivalent unit.

- *Pasture land*: the milk yields are based on a Livestock Unit yielding 1,500 kg of milk per year. This may appear rather high, given that only 20–30 percent of Kenya's herd is improved. However, once this is converted into LUs per hectare, the high yields are diminished by the low carrying capacity of the land in zones 5 to 7. The assumption of the LU yielding 1,500 kg of milk/yr still provided credible results for the arid zones. The Dairy Equivalent Unit (DEU) is based on the ACZ–1 value of 2.8 tons of milk/ha/yr for the West Kenya case sample.

  DEUs are used for ACZs 1 to 7. Farm land use statistics were used from the FMH for ACZs 1 to 4, and all land for ACZs 5 to 7 was converted into pasture equivalents.

  Pasture land provides value in terms of animals produced for slaughter in addition to milk production. However, this analysis assumed converted pasture land into HPEs based only on milk yields for two reasons: detailed data on livestock offtake rates would have been required and the value of livestock is already included in the analysis in terms of TLUs per capita.

High Potential Equivalents (HPE)

The HPE is calculated based on values of price and yield realized for ACZ–1. Table KA–6 indicates the average productive capacity of the various ACZs for the four main commodities of maize, tea, coffee, and milk.

The methodology provides a relatively simple means of calculating High Potential Equivalents. Even without using price and income figures, one can easily see from the physical yield figures and land use patterns that the different ACZs have significant differences in potential. Initial calculations using the data above yielded the following ratios:

ACZ–1:	1 ha =	1 HPE
ACZ–2:	3 ha =	1 HPE
ACZ–3:	5 ha =	1 HPE
ACZ–4:	6 ha =	1 HPE
ACZ–5:	67 ha =	1 HPE
ACZ–6:	135 ha =	1 HPE
ACZ–7:	421 ha =	1 HPE

Accessibility to urban infrastructure

Past surveys have shown that most Kenyans rely heavily on markets. Even subsistence farmers normally sell produce after the harvest to meet other cash needs and later purchase food from the market. Most pastoralists are also market dependent, relying on markets for the purchase of grains and other commodities and sale of animals. As a proxy for physical market access, an accessibility index was created.

Accessibility between settlements and urban areas was modeled using a *gravity model*. Two variables are central to this approach:

- the distance between points (origin & destination)
- the "pull" or *attractiveness* of the destination point (i.e., the market).

Population was used as a proxy measure of a market's attractiveness. A market destination point having a relatively large population would have a relatively large attractiveness value, and vice-versa. An intermediate accessibility value was generated for each settlement-destination pair. This exercise involved 165 markets, thus 165 intermediate access values were generated for each of the 2,162 settlement points (356,730 possible combinations). A final accessibility value is generated for each settlement, which is the summation of all it's intermediate access values.

The mathematical equation representing the accessibility index is:

$$\frac{\text{attractiveness index of a market center}}{(\text{distance between the location and the market})^2}$$

A *distance-decay* function is achieved by squaring the distance, thus making the case that accessibility declines exponetially as distance increases. A larger distance decay effect is introduced by using a larger exponent (i.e., cubing the distance rather than squaring). This analysis utilized only the square of distance, as it was deemed sufficient for representing diminishing physically accessibility with increasing distance.

Actual roads and rail data were not used as part of this exercise. Time constraints did not allow for incorporating such data into the analysis. Incorporating transportation infrastructure data into this work would surely give one more confidence in the end results. The infrastructure data should be added into the analysis at a later date. Although network analysis was not done, a digital map of the roads network was overlaid onto the accessibility maps generated. A purely visual interpretation of the results showed roads and accessibility, correlating as one would intuitively expect.

The market/destination points were chosen from the 1989 Kenyan Census data. The 165 most populated places (as of 1989) were used as markets, and their 1989 population figures were projected to 1994 using division specific growth rates. The attractiveness values of the markets, taken from 1994 population estimates, ranged from more than 1.6 million in Nairobi, to less than 1,000 in Witu.

The settlement/origin points were taken from the U.S. Defense Mapping Agency Gazetteer of Kenya (1978). The digital data was converted from the Rutgers University Global Grass data set (*Sites of the World*, 1994). The "populated place" features from the gazetteer file were extracted, and duplicate records, settlements located at 1 point having many names, were removed. This left a total number of 2,162 settlements, as origin points, for the market access exercise.

A GIS[6] was used to compute the distance measurements from the settlements to the markets. The process was automated using the *ArcInfo* macro language, which resulted in considerable time saving during data processing. The input data was georeferenced in decimal degree units of latitude and longitude, thus the resulting distance measurements were in decimal degrees. The results were output to a database file, and the units were converted from decimal degrees to km. (1 degree = approx. 110.8 km.).

The *ArcInfo* georeferenced points (settlements and markets) were converted to *AGIS* format, and the distance measurements were imported (joined to) their respective settlements. Since

accessibility was calculated with point/settlement precision, it was necessary to then aggregate (average) the results up to the geographically larger Division level.

The results were sent from Washington to Nairobi for review, and to solicit suggested improvements to the model. After a series of discussions (FEWS/W, FEWS/Kenya, FEWS Tulane), it was suggested that the model was capturing both accessibility for rural populations to urban markets, and urban populations to their own urban markets. After aggregating the data from the point/settlement level to the polygon/Division level, it became apparent that this dynamic, where single points were acting both as settlements/origins and as market/destinations, was having an unwanted effect on the final results. To adjust for this effect, a second iteration of the model was run where all access values for settlements 0–2km. away from a market (i.e., urban populations) were removed when calculating accessibility. This adjustment had the desired effect of lowering accessibility values for a number of divisions in Northeastern Province (bordering Somalia and Ethiopia) where previous accessibility values were suspiciously high.

Physical Insecurity

Information on physical insecurity was gathered from nearly 30 separate sources. Due to the sensitive nature of the indicator, the sources of information will not be named here, but their contribution is gratefully acknowledged.

The three types of physical insecurity (pastoralist insecurity, tribal clashes, and elephant conflict) were all plotted on maps and coded according to severe, moderate, and slight insecurity. For each division, the highest degree of insecurity was taken. Divisions with severe insecurity were assigned a Z-score of -2, divisions with moderate insecurity were assigned a Z-score of -1, divisions with slight insecurity were given a Z-score of -.5, while divisions with no insecurity were given a Z-score of 0.

Endnotes

1. Images derived from the Global Area Coverage (apprx. seven kilometer resolution) received from the Advanced very High Resolution Radiometer (AVHRR) sensors on board the National Oceanic and Atmospheric Administration Polar Orbiting series of satellites. See Key Terms list on the inside back cover for more details.
2. In the WMS, Busia, West Pokot, Kericho, and Bomet record the highest prevalence of poverty. Those same districts are not considered to be highly vulnerable in this VA, ranking 17, 22, 38, 1nd 42 out of the most vulnerable of the 45 districts analyzed. An explanation of the difference between the results of the WMS and this assessment is that the WMS did not capture all houshold income sources, and therefore categorizes these districts as having a high prevalence of poverty.
3. *Vulnerability, Coping and Policy*, IDS Bulletin, Volume 20: No.2, pp. 1–7.
4. The Republic of Kenya: Farm Management Handbook, Volumes 11A, B, C.
5. The Republic of Kenya: Economic Survey 1994.
6. The "NEAR" module in *PC ArcInfo* was used in these calculations.

Table KA-1: Variation in vegetation—highest to lowest variation

Division	District	B	C	D	E	F	G	H	I
Central (Kalokol)	TURKANA	-4.39	-3.77	100	0	-4.39	0.04	-2.77	-3.58
Loiyangalani	MARSABIT	-2.61	-2.86	50	50	-2.73	0.05	-2.67	-2.70
North Horr	MARSABIT	-2.32	-2.95	65	35	-2.54	0.07	-2.46	-2.50
Lokitaung	TURKANA	-2.46	-2.58	68	32	-2.50	0.07	-2.46	-2.48
Lokori	TURKANA	-1.58	-2.86	77	23	-1.87	0.09	-2.26	-2.07
Griftu	WAJIR	-1.87	-1.85	54	46	-1.86	0.11	-2.06	-1.96
Katilu	TURKANA	-1.72	-2.13	74	26	-1.83	0.11	-2.06	-1.95
Sericho	ISIOLO	-2.32	-1.40	35	65	-1.72	0.12	-1.96	-1.84
Dadaab	GARISSA	-1.28	-1.49	40	60	-1.40	0.13	-1.86	-1.63
Merrti	ISIOLO	-1.28	-1.30	43	57	-1.29	0.12	-1.96	-1.63
Laisamis	MARSABIT	-1.13	-1.40	47	53	-1.27	0.12	-1.96	-1.62
Central Mandera	MANDERA	-1.13	-1.85	68	32	-1.36	0.13	-1.86	-1.61
Mogodagshe	GARISSA	-1.28	-1.30	39	61	-1.30	0.13	-1.86	-1.58
Habaswein	WAJIR	-1.28	-1.12	48	52	-1.20	0.14	-1.76	-1.48
Turkwel	TURKANA	-0.69	-2.31	76	24	-1.08	0.13	-1.86	-1.47
Wajir-Bor	WAJIR	-1.13	-0.85	57	43	-1.01	0.13	-1.86	-1.44
Buna	WAJIR	-1.13	-0.67	64	37	-0.97	0.13	-1.86	-1.42
Central Wajir	WAJIR	-1.13	-0.67	56	44	-0.93	0.14	-1.76	-1.34
Waso	SAMBURU	-1.28	-0.57	48	52	-0.91	0.14	-1.76	-1.34
Central Garissa	GARISSA	-1.13	-0.85	32	68	-0.94	0.15	-1.66	-1.30
Tabaka	MANDERA	-0.99	-0.85	60	40	-0.93	0.17	-1.46	-1.20
Liboi	GARISSA	-1.13	-0.94	46	54	-1.03	0.18	-1.36	-1.19
Banissa	MANDERA	-0.99	-1.30	59	41	-1.12	0.19	-1.26	-1.19
Fino	MANDERA	-0.99	-0.48	62	38	-0.79	0.16	-1.56	-1.18
Kakuma	TURKANA	0.05	-2.86	84	16	-0.41	0.13	-1.86	-1.14
Garbatulla	ISIOLO	-1.28	-0.48	40	60	-0.80	0.17	-1.46	-1.13
Bura (TANA)	TANA RIVER	-1.43	-0.21	30	70	-0.58	0.15	-1.66	-1.12
Madogo	TANA RIVER	-1.13	-0.57	35	66	-0.78	0.17	-1.46	-1.12
Sololo	MARSABIT	-0.54	-0.85	61	39	-0.66	0.16	-1.56	-1.11
Bute	WAJIR	-0.84	-0.76	60	41	-0.81	0.18	-1.36	-1.09
Rhamu	MANDERA	-0.69	-0.67	60	40	-0.68	0.17	-1.46	-1.07
Galole	TANA RIVER	-1.58	-0.12	31	69	-0.57	0.16	-1.56	-1.07
Baragoi	SAMBURU	0.05	-1.12	48	52	-0.56	0.17	-1.46	-1.01
Bura (GARISSA)	GARISSA	-0.84	-0.48	42	58	-0.63	0.18	-1.36	-1.00
El Wak	MANDERA	-0.39	-0.21	60	40	-0.32	0.15	-1.66	-0.99
Jarajila	GARISSA	-0.84	-0.76	45	55	-0.79	0.20	-1.16	-0.98
Garsen	TANA RIVER	-0.69	-0.39	42	58	-0.52	0.18	-1.36	-0.94
Central Isiolo	ISIOLO	-0.84	-0.21	45	55	-0.49	0.18	-1.36	-0.93
Moyale	MARSABIT	-0.69	-0.39	59	41	-0.57	0.19	-1.26	-0.91
Mbalambala	GARISSA	-0.39	-0.39	38	62	-0.39	0.18	-1.36	-0.88
Mutomo	KITUI	-1.58	-0.57	30	70	-0.88	0.23	-0.86	-0.87
Kyuso	KITUI	-0.99	-1.21	39	61	-1.12	0.26	-0.55	-0.84
Mutito	KITUI	-1.58	-1.03	34	66	-1.22	0.27	-0.45	-0.84
Tsavo Western	MAKUENI	-1.43	-0.21	26	74	-0.53	0.21	-1.06	-0.79
Tsavo East & West	TAITA TAVETA	-0.99	-0.03	37	63	-0.38	0.20	-1.16	-0.77
Meru National	MERU	-0.99	-1.03	44	56	-1.01	0.27	-0.45	-0.73
Loitokitok	KAJIADO	-0.54	-0.12	34	66	-0.26	0.20	-1.16	-0.71
Magadi	KAJIADO	-0.54	0.25	51	49	-0.16	0.19	-1.26	-0.71
Tharaka	NITHI	-1.28	-1.21	42	58	-1.24	0.30	-0.15	-0.70
Masinga	MACHAKOS	-0.99	-0.57	40	60	-0.74	0.25	-0.66	-0.70
Central Marsabit	MARSABIT	-0.25	-0.30	45	55	-0.28	0.21	-1.06	-0.67
Gachoka	EMBU	-0.84	-0.67	41	59	-0.74	0.27	-0.45	-0.60
Atta	MACHAKOS	-0.69	-0.57	39	61	-0.62	0.27	-0.45	-0.54
Kibish	TURKANA	1.23	-1.12	73	27	0.60	0.15	-1.66	-0.53
Rarieda	SIAYA	-0.69	0.25	59	41	-0.31	0.24	-0.76	-0.53
KwaVonza	KITUI	-0.25	-0.94	38	62	-0.68	0.28	-0.35	-0.51
Wamba	SAMBURU	-0.39	0.16	40	60	-0.06	0.22	-0.96	-0.51
Mwingi	KITUI	-0.99	-0.94	37	63	-0.96	0.31	-0.05	-0.50
Mwala	MACHAKOS	-0.84	-0.57	37	63	-0.67	0.29	-0.25	-0.46
Kibwezi	MAKUENI	-1.13	-0.48	27	73	-0.66	0.29	-0.25	-0.46
Makueni	MAKUENI	-0.39	-0.57	35	66	-0.52	0.28	-0.35	-0.44
Siakago	EMBU	-1.13	-0.94	40	60	-1.02	0.33	0.15	-0.43
Central Kajiado	KAJIADO	-0.10	0.06	40	60	0.00	0.23	-0.86	-0.43
Voi	TAITA TAVETA	-0.25	0.16	37	63	0.01	0.23	-0.86	-0.42
Bondo	SIAYA	-0.54	0.25	53	47	-0.17	0.25	-0.66	-0.41

Table KA–1: Variation in vegetation—highest to lowest variation (*continued*)

Division	District	B	C	D	E	F	G	H	I
Kisauni	MOMBASA	1.23	-0.67	71	29	0.68	0.17	-1.46	-0.39
Ngong	KAJIADO	0.05	0.34	54	46	0.18	0.22	-0.96	-0.39
Pumwani	NAIROBI	-0.25	-0.03	39	61	-0.11	0.25	-0.66	-0.38
Makadara	NAIROBI	-0.25	-0.03	39	61	-0.11	0.25	-0.66	-0.38
Central Kitui	KITUI	-0.84	-0.94	35	65	-0.90	0.33	0.15	-0.38
Mwea	KIRINYAGA	-0.39	-0.67	42	58	-0.55	0.30	-0.15	-0.35
Tigania	MERU	-0.99	-0.48	42	58	-0.69	0.32	0.05	-0.32
Mukogondo	LAIKIPIA	0.20	-0.12	41	59	0.01	0.25	-0.66	-0.32
Mwatate	TAITA TAVETA	-0.39	0.25	36	64	0.02	0.25	-0.66	-0.32
Central Nairobi	NAIROBI	-0.10	-0.21	38	62	-0.17	0.27	-0.45	-0.31
Embakasi	NAIROBI	0.05	0.06	42	59	0.06	0.25	-0.66	-0.30
Kibera	NAIROBI	-0.69	0.34	46	54	-0.13	0.27	-0.45	-0.29
Central Machakos	MACHAKOS	-0.39	-0.12	40	61	-0.23	0.28	-0.35	-0.29
Taveta	TAITA TAVETA	-0.39	0.34	37	63	0.07	0.26	-0.55	-0.24
Ntonyiri	MERU	-1.13	0.52	44	56	-0.21	0.29	-0.25	-0.23
Ng'arua	LAIKIPIA	-0.10	0.25	72	28	0.00	0.27	-0.45	-0.23
Malindi	KILIFI	0.35	-0.39	53	47	0.00	0.27	-0.45	-0.23
Kathiani	MACHAKOS	0.05	0.16	40	60	0.11	0.26	-0.55	-0.22
Nithi	NITHI	-1.13	-0.39	38	62	-0.67	0.34	0.25	-0.21
Tongareni	BUNGOMA	-0.84	-2.13	83	17	-1.06	0.38	0.65	-0.20
Nyatike	MIGORI	-0.25	-0.39	47	53	-0.32	0.32	0.05	-0.14
Central Laikipia	LAIKIPIA	0.20	-0.03	52	48	0.09	0.28	-0.35	-0.13
Alale	WEST POKOT	0.94	-1.12	79	21	0.51	0.24	-0.76	-0.13
Amagoro	BUSIA	-0.99	-0.03	70	30	-0.70	0.36	0.45	-0.12
Maseno	KISUMU	1.09	0.06	55	45	0.63	0.23	-0.86	-0.12
Igembe	MERU	-1.28	0.16	42	58	-0.45	0.34	0.25	-0.10
Kasarani	NAIROBI	0.64	-0.03	38	62	0.23	0.28	-0.35	-0.06
Kilome	MAKUENI	0.35	-0.48	38	62	-0.17	0.32	0.05	-0.06
Makuyu	MURANGA	-0.10	-0.67	40	60	-0.44	0.35	0.35	-0.04
Rumuruti	LAIKIPIA	0.49	0.25	61	39	0.40	0.27	-0.45	-0.03
Thika	KIAMBU	0.35	-0.03	37	63	0.11	0.30	-0.15	-0.02
Masalani	GARISSA	0.20	0.25	55	46	0.22	0.29	-0.25	-0.02
Mbita	HOMA BAY	-0.54	0.52	54	46	-0.05	0.32	0.05	0.00
Ukwala	SIAYA	-1.43	0.16	57	43	-0.75	0.39	0.75	0.00
Kimilili	BUNGOMA	-0.39	-1.49	86	14	-0.55	0.37	0.55	0.00
Butula	BUSIA	-1.58	0.34	62	39	-0.85	0.40	0.85	0.00
Wundanyi	TAITA TAVETA	-0.10	0.43	30	71	0.28	0.29	-0.25	0.01
Kangundo	MACHAKOS	-0.10	0.06	39	62	0.00	0.32	0.05	0.02
Saboti	TRANS NZOIA	-0.10	-1.85	84	17	-0.40	0.36	0.45	0.03
Kacheliba	WEST POKOT	0.79	-0.57	80	20	0.52	0.27	-0.45	0.03
Ndia	KIRINYAGA	-0.54	-0.03	45	55	-0.26	0.35	0.35	0.05
Lorroki	SAMBURU	0.94	0.52	58	43	0.77	0.25	-0.66	0.06
Mbooni	MAKUENI	0.35	-0.39	35	65	-0.13	0.34	0.25	0.06
Webuye	BUNGOMA	-0.39	-1.03	81	19	-0.51	0.38	0.65	0.07
Sirisia	BUNGOMA	-0.69	0.52	76	24	-0.40	0.37	0.55	0.08
Budalangi	BUSIA	-0.39	0.52	56	44	0.01	0.33	0.15	0.08
Lugari	KAKAMEGA	-0.25	-1.67	83	17	-0.49	0.38	0.65	0.08
Hulugho	GARISSA	0.79	-0.30	57	43	0.32	0.30	-0.15	0.08
Amukura	BUSIA	-0.99	0.34	61	39	-0.47	0.38	0.65	0.09
Timau	MERU	0.20	0.43	40	61	0.34	0.30	-0.15	0.09
Rongai	NAKURU	0.20	0.43	78	22	0.25	0.31	-0.05	0.10
Yala	SIAYA	-1.13	0.43	63	37	-0.56	0.39	0.75	0.10
Nginyang	BARINGO	1.53	-0.85	80	20	1.05	0.23	-0.86	0.10
Boro	SIAYA	-1.13	0.16	55	45	-0.55	0.39	0.75	0.10
Butere	KAKAMEGA	-1.13	0.06	68	32	-0.75	0.41	0.95	0.10
Nakuru Mun.	NAKURU	0.35	0.43	70	30	0.37	0.30	-0.15	0.11
Funyula	BUSIA	-0.84	-0.21	51	49	-0.53	0.39	0.75	0.11
Kinango	KWALE	0.20	0.16	56	44	0.18	0.32	0.05	0.11
Winam	KISUMU	0.79	0.34	54	46	0.58	0.28	-0.35	0.11
Mumias	KAKAMEGA	-1.13	0.34	70	30	-0.69	0.41	0.95	0.13
Msambweni	KWALE	1.53	-0.21	59	41	0.82	0.26	-0.55	0.13
Soy	UASIN GISHU	0.20	-1.94	84	16	-0.14	0.36	0.45	0.15
Kanduyi	BUNGOMA	-0.54	0.25	75	25	-0.34	0.38	0.65	0.15
Nambale	BUSIA	-0.99	0.06	58	42	-0.54	0.40	0.85	0.15
Ndhiwa	HOMA BAY	-0.69	-0.21	47	53	-0.44	0.39	0.75	0.16
Lurambi	KAKAMEGA	-0.54	-0.85	73	27	-0.62	0.41	0.95	0.16

Table KA–1: Variation in vegetation—highest to lowest variation (*continued*)

Division	District	B	C	D	E	F	G	H	I
Mochongoi	BARINGO	0.49	-0.39	76	24	0.28	0.32	0.05	0.16
Likoni	MOMBASA	2.57	0.52	67	33	1.89	0.16	-1.56	0.17
Amu	LAMU	1.09	0.25	59	41	0.74	0.28	-0.35	0.19
Ugunja	SIAYA	-1.13	0.79	63	37	-0.42	0.40	0.85	0.22
Parklands–South/West	NAIROBI	0.49	0.34	35	65	0.39	0.32	0.05	0.22
Kesses	UASIN GISHU	0.35	-2.40	81	19	-0.18	0.38	0.65	0.24
Faza	LAMU	1.68	1.34	58	42	1.54	0.21	-1.06	0.24
Rangwe	HOMA BAY	-0.54	0.25	59	41	-0.22	0.39	0.75	0.27
North Imenti	MERU	-0.39	0.25	41	59	-0.02	0.37	0.55	0.27
Kiharu	MURANGA	-0.25	0.34	41	59	0.10	0.36	0.45	0.27
Mpeketoni	LAMU	0.79	0.06	61	39	0.51	0.32	0.05	0.28
Sigor	WEST POKOT	0.64	0.34	66	34	0.54	0.32	0.05	0.29
Emuhaya	VIHIGA	-0.39	0.25	63	38	-0.15	0.39	0.75	0.30
Mogotio	BARINGO	1.23	-0.39	77	23	0.86	0.29	-0.25	0.30
Central Imenti	MERU	-0.54	0.52	41	59	0.08	0.37	0.55	0.32
Kendu Bay	HOMA BAY	-0.10	0.70	64	36	0.19	0.36	0.45	0.32
Migori	MIGORI	-0.10	-0.12	44	56	-0.11	0.39	0.75	0.32
Runyenjes	EMBU	0.05	0.16	39	61	0.11	0.37	0.55	0.33
Kapsokwony	BUNGOMA	0.35	-1.12	78	22	0.02	0.38	0.65	0.34
Chepareria	WEST POKOT	0.79	-0.57	74	27	0.43	0.34	0.25	0.34
Kapenguria	WEST POKOT	0.64	-0.03	74	26	0.47	0.34	0.25	0.36
Matuga	KWALE	2.57	-0.57	69	31	1.59	0.23	-0.86	0.37
Ol-Kalou	NYANDARUA	0.20	0.98	64	37	0.49	0.34	0.25	0.37
Khwisero	KAKAMEGA	-0.10	-0.39	62	38	-0.21	0.41	0.95	0.37
Kwanza	TRANS NZOIA	0.49	-1.03	81	20	0.19	0.37	0.55	0.37
Marigat	BARINGO	1.53	0.16	77	23	1.21	0.27	-0.45	0.38
Osupuko	NAROK	0.64	0.79	44	56	0.73	0.32	0.05	0.39
Bahari	KILIFI	1.68	-0.48	71	29	1.05	0.29	-0.25	0.40
Tenges	BARINGO	1.09	-0.39	72	28	0.67	0.33	0.15	0.41
Ganze	KILIFI	0.79	0.34	56	44	0.59	0.34	0.25	0.42
Mombasa Island	MOMBASA	1.38	1.43	69	31	1.40	0.26	-0.55	0.42
South Imenti	MERU	-0.25	0.52	37	63	0.24	0.38	0.65	0.44
Mau	NAROK	1.09	0.98	60	40	1.04	0.30	-0.15	0.44
Cherangani	TRANS NZOIA	0.94	-2.22	81	19	0.34	0.37	0.55	0.44
Dagoretti	NAIROBI	-0.39	1.07	40	60	0.48	0.36	0.45	0.47
Mukurweini	NYERI	-0.54	1.07	48	53	0.31	0.38	0.65	0.48
Gichugu	KIRINYAGA	0.64	0.43	43	57	0.52	0.36	0.45	0.49
Changamwe	MOMBASA	0.94	0.98	75	25	0.95	0.32	0.05	0.50
Kikuyu	KIAMBU	0.49	0.79	39	61	0.68	0.35	0.35	0.51
Mt. Kenya Forest	NYERI	-1.28	1.16	36	64	0.28	0.39	0.75	0.52
Manyatta	EMBU	0.79	0.06	44	56	0.38	0.38	0.65	0.52
Kieni East	NYERI	0.20	1.07	43	57	0.69	0.35	0.35	0.52
Kaloleni	KILIFI	0.64	0.25	70	30	0.52	0.37	0.55	0.54
Ikolomani	KAKAMEGA	-0.10	0.52	62	38	0.14	0.41	0.95	0.55
Witu	LAMU	0.79	-0.03	58	42	0.45	0.38	0.65	0.55
Vihiga	VIHIGA	-0.10	0.98	58	42	0.35	0.39	0.75	0.55
Kabartonjo	BARINGO	1.83	-0.67	78	22	1.28	0.30	-0.15	0.56
Lower Nyakac	KISUMU	0.35	0.43	64	36	0.38	0.39	0.75	0.56
Nyando	KISUMU	0.49	0.70	57	43	0.58	0.37	0.55	0.57
Kigumo	MURANGA	-0.39	0.70	38	62	0.29	0.40	0.85	0.57
MountKenya	MERU	-0.25	0.98	30	70	0.61	0.37	0.55	0.58
Sabatia	VIHIGA	-0.39	0.61	60	41	0.01	0.43	1.15	0.58
Oljoroorok	NYANDARUA	0.79	0.89	67	33	0.82	0.35	0.35	0.59
Ainabkoi	UASIN GISHU	0.49	-1.03	70	30	0.04	0.43	1.15	0.60
Bahati	NAKURU	0.79	0.70	64	36	0.76	0.36	0.45	0.60
Kiambaa	KIAMBU	0.79	0.61	29	71	0.66	0.37	0.55	0.61
Limuru	KIAMBU	0.79	0.79	34	66	0.79	0.36	0.45	0.62
Ravine	BARINGO	0.49	0.25	65	35	0.41	0.40	0.85	0.63
Gilgil	NAKURU	1.09	1.16	64	36	1.11	0.33	0.15	0.63
Kabarnet	BARINGO	1.38	-0.03	74	26	1.02	0.34	0.25	0.63
Cheptaisi	BUNGOMA	0.79	-0.03	68	32	0.53	0.39	0.75	0.64
Njoro	NAKURU	0.49	0.61	68	32	0.53	0.39	0.75	0.64
Naivasha	NAKURU	1.53	1.34	54	46	1.44	0.30	-0.15	0.65
Rongo	MIGORI	0.35	0.16	50	50	0.25	0.42	1.05	0.65
Moiben	UASIN GISHU	1.23	-1.40	82	18	0.76	0.37	0.55	0.66
Kipipiri	NYANDARUA	1.09	0.70	54	46	0.91	0.36	0.45	0.68

Table KA-1: Variation in vegetation—highest to lowest variation (*continued*)

Division	District	B	C	D	E	F	G	H	I
Kandara	MURANGA	0.94	0.61	36	64	0.73	0.38	0.65	0.69
Tot	ELGEYO MARAKWET	0.94	0.06	59	41	0.58	0.40	0.85	0.72
Aberdare Forest	NYERI	0.20	0.06	37	63	0.11	0.45	1.36	0.73
Malava/Kabra	KAKAMEGA	0.35	0.98	71	29	0.53	0.41	0.95	0.74
Suneka	KISII	0.35	0.34	63	37	0.34	0.43	1.15	0.75
Chepalungu	BOMET	-0.10	1.52	47	53	0.76	0.39	0.75	0.76
Oyugis	HOMA BAY	0.64	0.16	64	36	0.47	0.42	1.05	0.76
Mosop	NANDI	0.79	-1.03	78	22	0.39	0.43	1.15	0.77
Mt. Elgon Forest	BUNGOMA	1.23	-0.03	58	43	0.70	0.40	0.85	0.78
KieniWest	NYERI	0.35	1.34	41	59	0.93	0.38	0.65	0.79
Magombo	NYAMIRA	0.35	0.52	51	49	0.43	0.43	1.15	0.79
Mbogoini	NAKURU	1.38	0.61	68	32	1.14	0.36	0.45	0.79
Githunguri	KIAMBU	-0.25	1.07	25	75	0.74	0.40	0.85	0.80
Gatundu	KIAMBU	-0.25	0.98	27	73	0.65	0.41	0.95	0.80
Nyamira	NYAMIRA	0.94	-0.12	57	43	0.48	0.43	1.15	0.82
Marani	KISII	0.49	0.34	56	44	0.43	0.44	1.25	0.84
Mt. Kenya Forest	EMBU	-0.69	1.43	33	67	0.73	0.41	0.95	0.84
Upper Nyuakac	KISUMU	0.94	0.98	65	35	0.95	0.39	0.75	0.85
Londiani	KERICHO	1.09	-0.12	64	36	0.65	0.42	1.05	0.85
Ndaragwa	NYANDARUA	1.83	0.79	56	44	1.37	0.35	0.35	0.86
Muhoroni	KISUMU	1.09	1.07	60	40	1.08	0.38	0.65	0.86
Bomet	BOMET	0.05	1.61	53	47	0.79	0.41	0.95	0.87
Lolgorian	NAROK	0.35	1.43	39	61	1.01	0.39	0.75	0.88
Kehancha	MIGORI	0.05	1.34	39	61	0.84	0.41	0.95	0.90
Kisii Mun.	KISII	0.49	0.89	56	45	0.67	0.43	1.15	0.91
Aldai	NANDI	0.64	0.98	58	42	0.78	0.42	1.05	0.92
Hamisi	VIHIGA	0.49	0.98	58	42	0.70	0.43	1.15	0.93
Mathira	NYERI	0.05	1.61	45	55	0.91	0.41	0.95	0.93
Kilgoris	NAROK	0.35	1.34	43	57	0.91	0.41	0.95	0.93
Southern	ELGEYO MARAKWET	1.09	0.06	64	36	0.72	0.43	1.15	0.94
Central & Eastern Marakwet	ELGEYO MARAKWET	1.53	-0.21	73	27	1.06	0.40	0.85	0.96
Mt. Kenya	KIRINYAGA	-0.69	1.61	37	63	0.76	0.43	1.15	0.96
Molo	NAKURU	1.38	0.16	60	40	0.89	0.42	1.05	0.97
Kipkelion	KERICHO	1.68	-0.21	65	35	1.02	0.41	0.95	0.98
Kapcherop	ELGEYO MARAKWET	1.09	0.25	56	44	0.72	0.44	1.25	0.99
Nyamache	KISII	0.20	1.43	48	52	0.84	0.43	1.15	1.00
Kangema	MURANGA	-0.10	1.71	36	64	1.06	0.41	0.95	1.00
Borabu	NYAMIRA	0.94	0.79	49	51	0.86	0.43	1.15	1.01
Bosongo	KISII	0.64	0.98	50	50	0.81	0.44	1.25	1.03
Kiunga	LAMU	1.68	1.52	65	35	1.62	0.36	0.45	1.04
Kubo	KWALE	1.38	0.34	66	34	1.03	0.42	1.05	1.04
Kinangop	NYANDARUA	0.35	1.43	37	63	1.03	0.42	1.05	1.04
Olokurta	NAROK	1.53	0.89	57	43	1.25	0.40	0.85	1.05
Kilibwoni	NANDI	1.68	-0.76	62	38	0.75	0.45	1.36	1.05
Ogembo	KISII	0.64	1.07	49	51	0.86	0.44	1.25	1.06
Shinyalu	KAKAMEGA	0.64	0.98	57	43	0.79	0.45	1.36	1.07
Konoin	BOMET	0.49	0.89	41	59	0.72	0.46	1.46	1.09
Gatanga	MURANGA	0.35	1.71	31	69	1.28	0.41	0.95	1.12
Masaba	KISII	0.35	1.98	47	53	1.21	0.42	1.05	1.13
Northern	ELGEYO MARAKWET	1.23	0.70	61	40	1.03	0.44	1.25	1.14
Irianyi	KISII	0.94	1.43	51	49	1.18	0.43	1.15	1.17
Lari	KIAMBU	-1.28	1.89	22	78	1.19	0.43	1.15	1.17
Tetu	NYERI	0.64	1.89	49	52	1.30	0.42	1.05	1.18
Tindiret	NANDI	1.53	0.61	55	45	1.12	0.44	1.25	1.19
Nyeri Mun.	NYERI	0.64	2.71	52	48	1.63	0.39	0.75	1.19
Belgut	KERICHO	0.64	1.52	55	46	1.05	0.45	1.36	1.20
Kapsabet	NANDI	1.53	0.34	64	36	1.10	0.45	1.36	1.23
Buret	KERICHO	1.23	1.34	46	54	1.29	0.45	1.36	1.32
Olenguruone	NAKURU	1.97	0.61	50	50	1.29	0.45	1.36	1.32

Table KA-1: Variation in vegetation—highest to lowest variation *(continued)*

Division	District	B	C	D	E	F	G	H	I
Othaya	NYERI	0.79	2.44	40	61	1.80	0.41	0.95	1.38
Ekerenyo	NYAMIRA	1.97	1.16	59	41	1.64	0.44	1.25	1.45

Key:
B = LR_COV_Z
C = SR_COV_Z
D = LR_SHARE
E = SR_SHARE
F = WHT_COV_Z
G = AV_CUM (1983–91)
H = AV_CUM_Z
I = AV_COM+CUM

Table KA-2: Tropical Livestock Units per capita—1990

District	1990 Animal population					TLUs	1990 Human population	TLU/cap	Z-score
	sheep	goats	beef	dairy	camel				
Baringo	282,000	780,050	220,000	91,000	523	365,793	295,667	1.24	0.03
Bungoma	55,150	40,630	327,080	40,340	—	308,567	758,193	0.41	-0.58
Busia	25,480	61,830	171,340	2,210	—	149,944	437,805	0.34	-0.63
Elgeyo Marakwet	182,000	154,000	126,000	54,500	—	184,355	219,484	0.84	-0.26
Embu	33,540	131,960	78,020	46,650	—	118,371	369,026	0.32	-0.64
Garissa	200,000	400,000	600,000	—	42,466	503,959	123,504	4.08	2.12
Homa Bay/Migori	171,100	230,560	494,500	2,280	—	446,835	1,126,974	0.40	-0.59
Isiolo	251,790	525,000	393,750	—	52,937	397,194	73,409	5.41	3.10
Kajiado	787,560	738,080	733,330	31,680	—	791,911	276,777	2.86	1.23
Kakamega/Vihiga	86,000	65,000	395,370	60,740	—	386,699	1,430,392	0.27	-0.68
Kericho/Bomet	167,040	154,600	312,620	353,270	—	575,711	885,200	0.65	-0.40
Kiambu	64,400	46,970	28,070	153,770	—	160,037	940,232	0.17	-0.75
Kilifi	31,720	166,360	212,490	15,090	—	204,941	632,324	0.32	-0.64
Kirinyaga	13,540	38,600	23,710	72,490	—	83,475	399,174	0.21	-0.72
Kisii/Nyamira	49,580	67,200	175,140	86,390	—	224,757	1,177,630	0.19	-0.74
Kisumu	114,240	105,770	253,710	5,510	—	234,825	696,579	0.34	-0.63
Kitui	84,720	479,650	482,660	7,740	—	455,779	660,608	0.69	-0.37
Kwale	73,620	149,790	267,820	1,620	—	242,428	395,059	0.61	-0.43
Laikipia	359,460	235,500	251,560	27,150	791	295,187	222,713	1.33	0.10
Lamu	8,000	26,000	26,000	1,600	—	25,956	58,739	0.44	-0.55
Machakos/Makueni	186,380	173,310	198,940	43,900	—	237,329	1,436,044	0.17	-0.76
Mandera	169,550	177,120	143,200		76,003	218,649	124,833	1.75	0.41
Marsabit	513,450	660,050	368,410		92,160	465,225	128,300	3.63	1.79
Meru/Tharaka-Nithi	286,000	314,830	235,910	168,540	—	394,838	1,173,961	0.34	-0.63
Mombasa	2,230	7,450	3,200	1,560	—	4,879	481,664	0.01	-0.87
Muranga	42,920	55,340	15,130	174,920	—	164,840	868,588	0.19	-0.74
Nakuru	635,170	113,120	184,540	275,120	—	463,033	905,100	0.51	-0.50
Nandi	37,440	33,050	76,430	321,690	—	330,462	456,984	0.72	-0.35
Narok	1,490,470	950,650	845,000	56,600	—	1,011,670	428,090	2.36	0.86
Nyandarua	230,600	50,360	6,970	256,410	—	247,199	363,100	0.68	-0.38
Nyeri	112,000	52,250	9,050	137,090	—	137,598	627,222	0.22	-0.72
Samburu	280,310	355,400	187,180		13,168	199,733	118,469	1.69	0.36
Siaya	114,490	167,500	468,050	2,450	—	412,166	662,483	0.62	-0.42
Taita Taveta	50,000	155,000	130,500	11,000	—	136,365	208,282	0.65	-0.40
Tana River	241,440	408,860	547,000		52,425	485,709	133,360	3.64	1.80
Trans Nzoia	49,000	25,350	50,000	105,000	—	134,210	410,390	0.33	-0.64
Turkana	1,000,890	1,958,190	417,450		102,078	679,123	183,028	3.71	1.85
Uasin Gishu	62,450	67,030	22,000	285,650	—	263,706	456,720	0.58	-0.45
Wajir	383,000	487,000	322,000		153,362	479,204	123,675	3.87	1.97
West Pokot	251,000	133,400	202,300	16,060	541	222,236	239,639	0.93	-0.20

Notes: TLUs calculated using DMP figures for arid districts including TanaRiver: goats = .095; cattle = .66, and camel = 1.2. For Non-Arid lands: sheep = .125; goats = .1; cattle = .81; camel = 1.2.

Sources: Republic of Kenya, Ministry of Planning and National Development, Agricultural Data Compendium, Kangethe Gitu; camel data from Livestock and Wildlife Data Summary, 1987/88, Kenya Rangelands, DRSRS, 1989

Table KA–3: Income from nonagricultural activities—as share of total income
(percent)

	Wage employment	Self employment	Cash transfers	Rent	Other	Total nonagriculture
Baringo	31.32	13.18	3.85	0.39	5.08	53.82
Bomet	20.32	10.53	2.18	0.17	7.15	40.36
Bungoma	19.54	16.56	6.45	1.40	6.51	50.47
Busia	8.36	7.50	12.43	0.36	6.26	34.91
Elgeyo Marakwet	15.79	13.53	2.40	1.12	3.28	36.13
Embu	15.08	5.98	8.85	0.52	7.31	37.75
Garissa	—	—	—	—	—	7.22
Homa Bay	7.60	24.93	10.60	0.25	4.44	47.82
Isiolo	—	—	—	—	—	10.00
Kajiado	37.96	20.42	2.84	4.55	1.59	67.36
Kakamega	14.24	8.22	11.14	0.59	4.79	38.98
Kericho	20.32	10.53	2.18	0.17	7.15	40.35
Kiambu	38.62	16.33	4.72	0.98	2.36	63.01
Kilifi	32.15	23.30	11.12	0.90	6.21	73.68
Kirinyanga	19.57	8.80	4.69	1.08	5.55	39.69
Kisii	10.90	10.19	2.62	1.41	10.84	35.96
Kisumu	12.04	14.18	8.53	2.63	2.62	40.00
Kitui	28.90	13.83	8.43	0.38	5.39	56.93
Kwale	30.74	29.73	6.91	1.55	3.03	71.96
Laikipia	30.70	8.90	5.97	0.41	5.60	51.58
Lamu	35.75	27.30	5.31	0.40	4.20	72.95
Machakos	25.77	17.99	6.65	1.98	2.75	55.13
Makueni	23.97	20.59	5.19	0.25	3.27	53.28
Mandera	—	—	—	—	—	8.33
Marsabit	—	—	—	—	—	15.00
Meru	7.03	16.29	3.12	0.35	1.72	28.51
Migori	6.92	20.25	2.89	0.72	2.55	33.33
Muranga	21.53	11.76	10.13	0.78	5.90	50.11
Nakuru	31.04	13.66	4.19	0.39	2.03	51.32
Nandi	25.46	8.11	4.90	0.37	6.95	45.79
Narok	14.15	5.90	2.11	3.75	1.52	27.44
Nyamira	11.51	9.19	4.94	3.30	15.93	44.86
Nyandarua	13.08	10.46	5.28	1.21	2.76	32.79
Nyeri	19.16	22.50	3.51	1.47	3.97	50.61
Samburu	—	—	—	—	—	15.00
Siaya	4.04	24.32	9.60	2.04	2.77	42.77
Taita Taveta	25.97	13.92	15.21	0.28	3.89	59.27
Tana River	9.27	10.74	11.28	0.48	6.45	38.23
Tharaka-Nithi	7.03	16.29	3.12	0.35	1.72	28.51
Trans Nzoia	21.75	9.17	11.51	0.00	4.65	47.08
Turkana	—	—	—	—	—	5.00
Uasin Gishu	16.35	9.56	0.24	0.16	0.59	26.89
Vihiga	23.80	5.67	16.95	0.65	4.96	52.03
Wajir	—	—	—	—	—	8.33
West Pokot	11.66	8.49	3.12	1.57	1.96	26.79

Source: Non-arid districts from Welfare Monitoring Survey, CBS, 1992; Arid districts–FEWS divisional level estimates

Table KA–4: Income from cash crop production—as share of total income

District	Income share from cash crops	District Z-score
Baringo	0.23	-0.77
Bomet	4.62	0.18
Bungoma	4.61	0.18
Busia	5.76	0.43
Elgeyo Marakwet	3.06	-0.16
Embu	8.90	1.11
Garissa	—	-0.82
Homa Bay	0.12	-0.80
Isiolo	—	-0.82
Kajiado	—	-0.82
Kakamega	10.99	1.56
Kericho	4.62	0.18
Kiambu	5.24	0.31
Kilifi	1.36	-0.53
Kirinyanga	2.62	-0.20
Kisii	10.22	1.39
Kisumu	2.38	-0.31
Kitui	0.40	-0.74
Kwale	6.64	0.62
Laikipia	0.10	-0.80
Lamu	—	-0.82
Machakos	6.9	0.67
Makueni	1.1	-0.59
Mandera	—	-0.82
Marsabit	—	-0.82
Meru	18.27	3.14
Migori	1.17	-0.57
Muranga	8.87	1.10
Nakuru	9.62	1.26
Nandi	0.19	-0.78
Narok	5.54	0.38
Nyamira	9.03	1.14
Nyandarua	5.48	0.36
Nyeri	7.79	0.87
Samburu	—	-0.82
Siaya	0.38	-0.74
Taita Taveta	2.01	-0.39
Tana River	1.08	-0.59
Tharaka-Nithi	18.27	3.14
Trans Nzoia	—	-0.82
Turkana	—	-0.82
Uasin Gishu	0.21	-0.78
Vihiga	3.20	-0.13
Wajir	—	-0.82
West Pokot	0.01	-0.82

Notes: Arid districts assumed to have no cash crop production. Z-scores used in the final analysis were calculated at divisional level and differ slightly from district level results.

Sources: Non-arid districts from Welfare Monitoring Survey, CBS, 1992.

Table KA–5: High potential land equivalents per capita

		Unweighted areas (Km²)								Weighted areas (Km²)										
Division	District	A	B	C	D	E	F	G	Total	H	I	J	K	L	M	N	Total	1994 Pop.	HPE/cap	HPE_Z
Alale	WEST POKOT	0	355	135	670	924	536	0	2,620	0	118	27	112	14	4	0	275	21,179	1.297	5.06
Witu	LAMU	0	0	0	221	715	324	0	1,259	0	0	0	37	11	2	0	50	3,969	1.257	4.88
Olokurto	NAROK	446	832	224	96	0	0	0	1,598	446	277	45	16	0	0	0	784	64,617	1.213	4.67
Jarajila	GARISSA	0	0	0	0	0	2,977	2,686	5,663	0	0	0	0	0	22	6	28	2,605	1.091	4.11
Kapcherop	ELGEYO MARAKWET	323	312	25	0	0	0	0	660	323	104	5	0	0	0	0	432	42,860	1.008	3.72
Osupuko	NAROK	171	892	1,864	5,174	2,305	0	0	10,405	171	297	373	862	34	0	0	1,738	174,401	0.996	3.66
Konoin	BOMET	937	0	0	0	0	0	0	937	937	0	0	0	0	0	0	937	101,328	0.924	3.33
Kibish	TURKANA	0	0	0	0	81	591	6,514	7,185	0	0	0	0	1	4	15	21	2,633	0.800	2.75
Lolgorian	NAROK	25	945	354	442	0	0	0	1,765	25	315	71	74	0	0	0	484	64,682	0.748	2.51
Wamba	SAMBURU	0	0	75	639	589	3,769	109	5,181	0	0	15	106	9	28	0	158	23,137	0.685	2.21
Sigor	WEST POKOT	143	177	201	384	341	957	0	2,202	143	59	40	64	5	7	0	318	51,856	0.613	1.88
Londiani	KERICHO	223	310	0	0	0	0	0	533	223	103	0	0	0	0	0	327	56,676	0.576	1.71
Bura (Garissa)	GARISSA	0	0	0	0	0	5,224	2,156	7,380	0	0	0	0	0	39	5	44	7,682	0.570	1.68
Molo	NAKURU	1,034	376	52	0	0	0	0	1,462	1,034	125	10	0	0	0	0	1,170	209,639	0.558	1.62
Olenguruone	NAKURU	152	21	0	0	0	0	0	173	152	7	0	0	0	0	0	159	29,266	0.542	1.55
Ainabkoi	UASIN GISHU	404	377	183	0	0	0	0	964	404	126	37	0	0	0	0	566	104,769	0.541	1.54
Ravine	BARINGO	220	486	253	0	0	0	0	958	220	162	51	0	0	0	0	433	80,235	0.539	1.54
Kacheliba	WEST POKOT	0	0	111	692	871	135	0	1,809	0	0	22	115	13	1	0	151	29,450	0.514	1.42
Northern	ELGEYO MARAKWET	110	157	67	36	1	0	0	370	110	52	13	6	0	0	0	182	36,424	0.498	1.35
Mochongoi	BARINGO	0	2	43	111	180	0	0	336	0	1	9	18	3	0	0	30	6,160	0.493	1.32
Tot	ELGEYO MARAKWET	212	60	94	60	69	83	0	577	212	20	19	10	1	1	0	262	53,297	0.492	1.32
Kilgoris	NAROK	354	603	164	0	0	0	0	1,121	354	201	33	0	0	0	0	588	121,845	0.482	1.27
Sololo	MARSABIT	0	0	0	0	466	2,416	3,232	6,115	0	0	0	0	7	18	8	33	6,801	0.478	1.25
Kieni West	NYERI	167	122	227	326	1	0	0	843	167	41	45	54	0	0	0	307	64,561	0.476	1.24
Baragoi	SAMBURU	0	0	89	521	3,486	2,213	634	6,943	0	0	18	87	52	16	2	175	38,101	0.458	1.16
Mpeketoni	LAMU	0	0	0	582	589	244	0	1,416	0	0	0	97	9	2	0	108	23,836	0.452	1.13
Tinderet	NANDI	572	186	0	0	53	0	0	811	572	62	0	0	1	0	0	635	141,981	0.447	1.11
Chepareria	WEST POKOT	6	140	507	690	175	15	0	1,533	6	47	101	115	3	0	0	272	61,081	0.445	1.10
Tenges	BARINGO	0	5	210	153	3	0	0	370	0	2	42	25	0	0	0	69	15,661	0.441	1.08
Borabu	NYAMIRA	180	71	0	0	0	0	0	251	180	24	0	0	0	0	0	204	49,319	0.413	0.95
Garsen	TANA RIVER	0	0	0	913	717	6,391	7,555	15,577	0	0	0	152	11	47	18	228	55,742	0.409	0.93
Timau	MERU	9	192	211	254	238	0	0	905	9	64	42	42	4	0	0	161	40,315	0.400	0.89
Southern	ELGEYO MARAKWET	231	173	148	281	72	0	0	905	231	58	30	47	1	0	0	366	91,696	0.399	0.89
Loiyangalani	MARSABIT	0	0	10	34	336	1,684	12,903	14,967	0	0	2	6	5	12	31	56	14,302	0.391	0.85
Lugar	KAKAMEGA	283	512	6	0	0	0	0	801	283	171	1	0	0	0	0	455	123,152	0.370	0.75
Mogotio	BARINGO	0	0	299	443	502	0	0	1,244	0	0	60	74	7	0	0	141	38,626	0.365	0.73
Lari	KIAMBU	355	51	33	0	0	0	0	438	355	17	7	0	0	0	0	378	104,957	0.360	0.71
Kwanza	TRANS NZOIA	340	121	640	0	0	0	0	1,101	340	40	128	0	0	0	0	508	141,817	0.358	0.70
Lorroki	SAMBURU	0	0	338	677	1,545	578	0	3,138	0	0	68	113	23	4	0	208	59,130	0.351	0.66
Mosop	NANDI	273	444	0	0	59	0	0	776	273	148	0	0	1	0	0	422	124,369	0.339	0.61
Amukura	BUSIA	303	24	0	0	0	0	0	327	303	8	0	0	0	0	0	311	92,359	0.337	0.60
Kinangop	NYANDARUA	212	407	193	48	0	0	0	861	212	136	39	8	0	0	0	395	117,854	0.335	0.59

Table KA-5: High potential land equivalents per capita *(continued)*

		Unweighted areas (Km²)								Weighted areas (Km²)										
Division	District	A	B	C	D	E	F	G	Total	H	I	J	K	L	M	N	Total	1994 Pop.	HPE/cap	HPE_Z
Rongo	MIGORI	476	0	0	0	0	0	0	476	476	0	0	0	0	0	0	476	145,153	0.328	0.55
Buna	WAJIR	0	0	0	0	0	0	7,169	7,169	0	0	0	0	0	0	17	17	5,299	0.321	0.52
Garba Tulla	ISIOLO	0	0	0	21	167	4,838	1,304	6,330	0	0	0	4	2	36	3	45	14,191	0.317	0.50
Kapsabet	NANDI	409	25	0	0	160	0	0	595	409	8	0	0	2	0	0	420	134,307	0.313	0.48
Rumuruti	LAIKIPIA	33	292	290	483	1,307	751	0	3,156	33	97	58	81	20	6	0	294	94,107	0.313	0.48
Kikelion	KERICHO	162	325	0	0	0	0	0	487	162	108	0	0	0	0	0	270	87,157	0.310	0.47
Hulugho	GARISSA	0	0	0	0	500	4,701	0	5,200	0	0	0	0	7	35	0	42	13,749	0.307	0.46
Tongareni	BUNGOMA	176	357	0	0	18	0	0	552	176	119	0	0	0	0	0	296	96,748	0.306	0.45
Kilibwoni	NANDI	109	168	0	0	0	0	0	277	109	56	0	0	0	0	0	165	54,947	0.300	0.43
Magadi	KAJIADO	0	0	37	153	669	1,909	0	2,768	0	0	7	25	10	14	0	57	19,114	0.298	0.42
Ndaragwa	NYANDARUA	112	167	515	41	0	0	0	835	112	56	103	7	0	0	0	278	93,743	0.296	0.41
Nambale	BUSIA	366	65	7	0	0	0	0	438	366	22	1	0	0	0	0	389	131,878	0.295	0.40
Lurambi	KAKAMEGA	376	0	0	0	70	0	0	446	376	0	0	0	1	0	0	377	131,861	0.286	0.36
North Horr	MARSABIT	0	0	0	0	141	1,256	39,725	41,122	0	0	0	0	2	9	94	106	37,410	0.283	0.34
Mau	NAROK	0	336	781	573	1,427	0	0	3,117	0	112	156	96	21	0	0	385	137,528	0.280	0.33
Belgut	KERICHO	591	460	51	0	0	0	0	1,101	591	153	10	0	0	0	0	754	269,645	0.280	0.33
Ol Joro Orok	NYANDARUA	53	165	162	0	0	0	0	380	53	55	32	0	0	0	0	141	51,741	0.272	0.30
Kakuma	TURKANA	0	0	0	90	627	8,760	7,558	17,035	0	0	0	15	9	65	18	107	39,517	0.271	0.29
Butula	BUSIA	241	0	0	0	0	0	0	241	241	0	0	0	0	0	0	241	89,319	0.270	0.29
Othaya	NYERI	257	5	0	0	0	0	0	263	257	2	0	0	0	0	0	259	96,299	0.269	0.28
Kehancha	MIGORI	179	400	0	0	0	0	0	580	179	133	0	0	0	0	0	313	119,271	0.262	0.25
Turkwel	TURKANA	0	0	0	186	842	3,656	4,719	9,403	0	0	0	31	13	27	11	82	31,479	0.260	0.24
Kangema	MURANGA	510	26	0	0	0	0	0	536	510	9	0	0	0	0	0	518	203,586	0.255	0.21
Kubo	KWALE	0	0	359	252	82	0	0	692	0	0	72	42	1	0	0	115	45,223	0.254	0.21
Kapsowony	BUNGOMA	126	0	0	0	0	0	0	126	126	0	0	0	0	0	0	126	50,939	0.248	0.18
Central-eastern	ELGEYO MARAKWET	39	163	158	100	88	0	0	548	39	54	32	17	1	0	0	143	57,634	0.248	0.18
Ukwala	SIAYA	254	63	6	0	0	0	0	323	254	21	1	0	0	0	0	276	111,861	0.247	0.18
Cheptaisi	BUNGOMA	218	0	0	0	0	0	0	218	218	0	0	0	0	0	0	218	89,165	0.245	0.17
Njoro	NAKURU	166	334	393	0	0	0	0	892	166	111	79	0	0	0	0	356	145,957	0.244	0.16
Mumias	KAKAMEGA	584	0	0	0	0	0	0	584	584	0	0	0	0	0	0	584	240,266	0.243	0.16
Nginyang	BARINGO	0	0	40	231	2,629	1,566	0	4,466	0	0	8	39	39	12	0	97	40,349	0.241	0.15
Lokori	TURKANA	0	0	0	2	673	3,391	9,209	13,275	0	0	0	0	10	25	22	57	24,029	0.239	0.14
Kabartonjo	BARINGO	0	71	177	470	862	82	0	1,661	0	24	35	78	13	1	0	151	64,104	0.235	0.12
Ugunja	SIAYA	204	0	0	0	0	0	0	204	204	0	0	0	0	0	0	204	87,259	0.234	0.12
Waso	SAMBURU	0	0	0	0	12	2,031	2,935	4,978	0	0	0	0	0	15	7	22	9,764	0.227	0.09
Kabarnet	BARINGO	0	112	248	238	48	0	0	646	0	37	50	40	1	0	0	127	58,443	0.218	0.04
Dadaab	GARISSA	0	0	0	0	0	0	5,758	5,758	0	0	0	0	0	0	14	14	6,284	0.218	0.04
Yala	SIAYA	253	156	0	0	0	0	0	408	253	52	0	0	0	0	0	305	141,022	0.216	0.03
Wajir-Bor	WAJIR	0	0	0	0	0	0	12,488	12,488	0	0	0	0	0	0	30	30	13,752	0.216	0.03
Ndhiwa	HOMA BAY	133	521	42	0	0	0	0	696	133	174	8	0	0	0	0	315	146,980	0.214	0.03
Kipipiri	NYANDARUA	62	136	237	153	0	0	0	589	62	45	47	26	0	0	0	181	85,325	0.212	0.01
Bundalangi	BUSIA	43	0	220	80	0	0	0	343	43	0	44	13	0	0	0	100	47,518	0.211	0.01
Ol-Kalou	NYANDARUA	38	167	274	125	0	0	0	604	38	56	55	21	0	0	0	169	81,001	0.209	0.00
Gatanga	MURANGA	184	33	44	0	0	0	0	261	184	11	9	0	0	0	0	203	98,208	0.207	-0.01

Table KA–5: High potential land equivalents per capita *(continued)*

		Unweighted areas (Km²)								Weighted areas (Km²)										
Division	District	A	B	C	D	E	F	G	Total	H	I	J	K	L	M	N	Total	1994 Pop.	HPE/cap	HPE_Z
Lamu	LAMU	0	0	0	238	647	210	0	1,095	0	0	0	40	10	2	0	51	24,551	0.207	-0.01
Soy	UASIN GISHU	4	279	447	0	48	0	0	777	4	93	89	0	1	0	0	187	91,485	0.204	-0.02
South Imenti	MERU	266	113	33	1	0	0	0	412	266	38	7	0	0	0	0	310	153,371	0.202	-0.03
Butere	KAKAMEGA	212	0	0	0	0	0	0	212	212	0	0	0	0	0	0	212	105,755	0.201	-0.04
Buret	KERICHO	261	204	0	0	0	0	0	465	261	68	0	0	0	0	0	329	164,723	0.200	-0.04
Merti	ISIOLO	0	0	0	0	0	0	12,330	12,330	0	0	0	0	0	0	29	29	14,823	0.198	-0.05
Bomet	BOMET	180	258	63	0	0	0	0	501	180	86	13	0	0	0	0	279	143,794	0.194	-0.07
Sirisia	BUNGOMA	253	189	0	0	0	0	0	442	253	63	0	0	0	0	0	316	167,572	0.189	-0.09
Bosongo	KISII	204	0	0	0	0	0	0	204	204	0	0	0	0	0	0	204	108,234	0.188	-0.09
Kanduyi	BUNGOMA	346	325	0	0	0	0	0	671	346	108	0	0	0	0	0	455	247,835	0.183	-0.12
Moiben	UASIN GISHU	6	102	956	0	0	0	0	1,065	6	34	191	0	0	0	0	232	126,833	0.183	-0.12
Ntonyiri	MERU	121	164	207	228	430	173	0	1,323	121	55	41	38	6	1	0	263	144,064	0.183	-0.12
Liboi	GARISSA	0	0	0	0	0	46	3,696	3,741	0	0	0	0	0	0	9	9	5,004	0.182	-0.12
Central Imenti	MERU	123	165	107	70	33	0	0	498	123	55	21	12	0	0	0	212	119,816	0.177	-0.15
Gilgil	NAKURU	0	34	194	500	289	0	0	1,017	0	11	39	83	4	0	0	138	78,279	0.176	-0.15
Tetu	NYERI	134	88	65	0	0	0	0	287	134	29	13	0	0	0	0	176	100,999	0.175	-0.16
Chepalungu	BOMET	40	755	140	0	0	0	0	936	40	252	28	0	0	0	0	320	184,596	0.173	-0.16
Masalani	GARISSA	0	0	0	0	0	5,061	0	5,061	0	0	0	0	0	37	0	37	22,039	0.170	-0.18
Masaba	KISII	165	0	0	0	0	0	0	165	165	0	0	0	0	0	0	165	97,102	0.170	-0.18
Migori	MIGORI	47	693	131	0	0	0	0	872	47	231	26	0	0	0	0	304	179,800	0.169	-0.18
Khwisero	KAKAMEGA	144	0	0	0	64	0	0	208	144	0	0	0	1	0	0	145	86,469	0.168	-0.19
Saboti	TRANS NZOIA	112	498	121	0	0	0	0	731	112	166	24	0	0	0	0	302	181,040	0.167	-0.19
Magombo	NYAMIRA	236	0	0	0	0	0	0	236	236	0	0	0	0	0	0	236	141,666	0.166	-0.20
Habaswein	WAJIR	0	0	0	0	0	0	11,124	11,124	0	0	0	0	0	0	26	26	15,958	0.166	-0.20
Gatundu	KIAMBU	311	73	99	0	0	0	0	484	311	24	20	0	0	0	0	356	214,876	0.166	-0.20
Central Laikipia	LAIKIPIA	0	0	33	672	2,875	22	0	3,602	0	0	7	112	43	0	0	162	97,722	0.165	-0.20
Webuye	BUNGOMA	213	117	0	0	0	0	0	330	213	39	0	0	0	0	0	252	153,049	0.165	-0.20
Suneka	KISII	119	0	0	0	0	0	0	119	119	0	0	0	0	0	0	119	72,150	0.165	-0.20
Nyamache	KISII	242	0	0	0	0	0	0	242	242	0	0	0	0	0	0	242	148,181	0.163	-0.21
Rongai	NAKURU	0	0	729	8	0	0	0	737	0	0	146	1	0	0	0	147	91,336	0.161	-0.22
Iriyani	KISII	125	0	0	0	0	0	0	125	125	0	0	0	0	0	0	125	77,825	0.161	-0.22
Muhoroni	KISUMU	37	467	158	0	12	0	0	674	37	156	32	0	0	0	0	225	142,463	0.158	-0.24
Nyatike	MIGORI	0	7	451	224	0	0	0	682	0	2	90	37	0	0	0	130	82,329	0.158	-0.24
Tharaka	NITHI	0	0	48	713	482	301	0	1,544	0	0	10	119	7	2	0	138	87,540	0.158	-0.24
Ogembo	KISII	227	0	0	0	0	0	0	227	227	0	0	0	0	0	0	227	147,071	0.154	-0.25
Kapenguria	WEST POKOT	0	0	287	642	0	0	0	929	0	0	57	107	0	0	0	164	106,994	0.154	-0.26
Igembe	MERU	175	85	91	65	112	27	0	554	175	28	18	11	2	0	0	234	155,444	0.151	-0.27
Nithi	NITHI	164	236	182	156	0	0	0	737	164	79	36	26	0	0	0	305	205,132	0.148	-0.28
Laisamis	MARSABIT	0	0	0	0	6	1,248	7,435	8,689	0	0	0	0	0	9	18	27	18,263	0.148	-0.28
Kieni East	NYERI	0	36	159	274	96	0	0	565	0	12	32	46	1	0	0	91	62,338	0.146	-0.29
Ngong	KAJIADO	0	0	26	599	3,062	5	0	3,692	0	0	5	100	46	0	0	151	104,491	0.144	-0.30
Marani	KISII	228	1	0	0	0	0	0	229	228	0	0	0	0	0	0	228	158,357	0.144	-0.30
Cherangani	TRANS NZOIA	0	39	601	0	0	0	0	640	0	13	120	0	0	0	0	133	92,418	0.144	-0.30
Mbogoini	NAKURU	6	74	91	187	2	0	0	361	6	25	18	31	0	0	0	80	56,657	0.142	-0.31
Nyamira	NYAMIRA	172	12	0	0	0	0	0	184	172	4	0	0	0	0	0	176	124,915	0.141	-0.31

Table KA–5: High potential land equivalents per capita *(continued)*

		Unweighted areas (Km²)								Weighted areas (Km²)										
Division	District	A	B	C	D	E	F	G	Total	H	I	J	K	L	M	N	Total	1994 Pop.	HPE/cap	HPE_Z
Madogo	TANA RIVER	0	0	0	0	0	2,423	5,766	8,189	0	0	0	0	0	18	14	32	22,700	0.139	-0.32
Central Kajiado	KAJIADO	0	0	18	209	7,381	1,597	0	9,205	0	0	4	35	110	12	0	160	115,664	0.139	-0.33
Msamsweni	KWALE	0	113	679	262	2,100	27	0	3,181	0	38	136	44	31	0	0	249	182,681	0.136	-0.34
Kisii Mun.	KISII	34	0	0	0	0	0	0	34	34	0	0	0	0	0	0	34	25,233	0.136	-0.34
Ganze	KILIFI	0	0	1	578	1,747	745	9	3,080	0	0	0	96	26	6	0	128	94,478	0.136	-0.34
Amagoro	BUSIA	12	231	0	0	0	0	0	243	12	77	0	0	0	0	0	89	65,930	0.135	-0.34
Mbita	HOMA BAY	0	107	538	427	0	0	0	1,071	0	36	108	71	0	0	0	214	160,304	0.134	-0.35
Loitokitok	KAJIADO	0	18	131	263	1,122	4,950	0	6,484	0	6	26	44	17	37	0	129	98,136	0.132	-0.36
Vihiga	VIHIGA	113	0	0	0	94	0	0	207	113	0	0	0	1	0	0	114	87,681	0.130	-0.36
Bute	WAJIR	0	0	0	0	183	847	2,097	3,126	0	0	0	0	3	6	5	14	10,771	0.130	-0.37
Ng'arua	LAIKIPIA	0	19	183	250	1,170	233	0	1,854	0	6	37	42	17	2	0	104	80,329	0.129	-0.37
Kigumo	MURANGA	202	61	198	12	0	0	0	473	202	20	40	2	0	0	0	264	205,443	0.128	-0.37
Tigania	MERU	141	248	140	96	432	66	0	1,124	141	83	28	16	6	0	0	275	217,752	0.126	-0.38
Siakago	EMBU	0	0	134	312	324	0	0	770	0	0	27	52	5	0	0	84	66,256	0.126	-0.38
Kiunga	LAMU	0	0	0	0	1,686	330	0	2,017	0	0	0	0	25	2	0	28	22,127	0.125	-0.39
Boro	SIAYA	64	274	268	9	0	0	0	615	64	91	54	1	0	0	0	210	172,213	0.122	-0.40
Makuyu	MURANGA	0	0	371	264	0	0	0	635	0	0	74	44	0	0	0	118	97,481	0.121	-0.41
Kimilili	BUNGOMA	99	0	0	0	0	0	0	99	99	0	0	0	0	0	0	99	82,487	0.120	-0.41
Central Marsabit	MARSABIT	0	0	47	101	198	697	1,038	2,080	0	0	9	17	3	5	2	37	30,603	0.120	-0.41
Runyenjes	EMBU	97	63	85	0	0	0	0	245	97	21	17	0	0	0	0	135	113,415	0.119	-0.42
Bahati	NAKURU	13	159	417	3	0	0	0	592	13	53	83	1	0	0	0	150	128,670	0.116	-0.43
Moyale	MARSABIT	0	0	0	0	627	825	1,596	3,048	0	0	0	0	9	6	4	19	16,867	0.114	-0.44
Tabaka	MANDERA	0	0	0	0	0	1,282	5,180	6,463	0	0	0	0	0	9	12	22	19,152	0.114	-0.44
Oyugis	HOMA BAY	37	340	129	0	0	0	0	507	37	113	26	0	0	0	0	177	155,728	0.113	-0.44
Mutitio	KITUI	0	0	25	218	1,702	3,445	0	5,389	0	0	5	36	25	26	0	92	83,381	0.110	-0.46
Manyatta	EMBU	102	51	37	0	0	0	0	190	102	17	7	0	0	0	0	126	115,613	0.109	-0.46
Marigat	BARINGO	0	0	7	70	1,197	0	0	1,275	0	0	1	12	18	0	0	31	28,560	0.109	-0.46
Voi	TAITA TAVETA	0	12	0	123	1,909	1,232	0	3,277	0	4	0	21	28	9	0	62	57,270	0.109	-0.47
Malindi	KILIFI	0	0	0	1,469	2,023	3,595	436	7,522	0	0	0	245	30	27	1	303	282,005	0.107	-0.47
Ekerenyo	NYAMIRA	154	72	0	0	0	0	0	226	154	24	0	0	0	0	0	178	166,321	0.107	-0.47
Mukogondo	LAIKIPIA	0	0	0	0	843	267	0	1,110	0	0	0	0	13	2	0	15	13,642	0.107	-0.47
Katilu	TURKANA	0	0	0	19	65	2,449	2,990	5,523	0	0	0	3	1	18	7	29	27,530	0.107	-0.47
Gichugu	KIRINYAGA	98	90	44	0	0	0	0	231	98	30	9	0	0	0	0	136	128,270	0.106	-0.48
Kiharu	MURANGA	141	110	123	34	0	0	0	408	141	37	25	6	0	0	0	208	199,827	0.104	-0.49
Naivasha	NAKURU	0	15	216	415	1,449	0	0	2,095	0	5	43	69	22	0	0	139	134,594	0.103	-0.49
Mutomo	KITUI	0	0	0	40	3,619	8,238	1,499	13,396	0	0	0	7	54	61	4	125	124,850	0.100	-0.50
Rangwe	HOMA BAY	81	215	138	19	0	0	0	453	81	72	28	3	0	0	0	183	186,993	0.098	-0.51
Modogashe	GARISSA	0	0	0	0	0	4	6,278	6,282	0	0	0	0	0	0	15	15	15,316	0.098	-0.52
Matuga	KWALE	0	41	207	132	0	0	0	379	0	14	41	22	0	0	0	77	79,122	0.097	-0.52
North Imenti	MERU	49	264	60	37	127	0	0	537	49	88	12	6	2	0	0	157	167,122	0.094	-0.53
Limuru	KIAMBU	33	117	43	56	35	0	0	284	33	39	9	9	1	0	0	90	97,381	0.093	-0.54
Griftu	WAJIR	0	0	0	0	0	0	10,671	10,671	0	0	0	0	0	0	25	25	27,691	0.092	-0.54
Gachoka	EMBU	0	16	88	480	825	0	0	1,409	0	5	18	80	12	0	0	115	133,127	0.087	-0.57
Githunguri	KIAMBU	76	52	47	0	0	0	0	175	76	17	9	0	0	0	0	103	120,973	0.085	-0.57
Kinango	KWALE	0	0	0	349	3,530	125	0	4,004	0	0	0	58	53	1	0	112	133,020	0.084	-0.58

Table KA–5: High potential land equivalents per capita (*continued*)

		Unweighted areas (Km²)								Weighted areas (Km²)										
Division	District	A	B	C	D	E	F	G	Total	H	I	J	K	L	M	N	Total	1994 Pop.	HPE/cap	HPE_Z
Shinyalu 1	KAKAMEGA	98	0	0	0	0	0	0	98	98	0	0	0	0	0	0	98	117,388	0.084	-0.58
Rhamu	MANDERA	0	0	0	0	0	0	5,045	5,045	0	0	0	0	0	0	12	12	14,585	0.082	-0.59
Funyula	BUSIA	0	93	143	0	0	0	0	236	0	31	29	0	0	0	0	60	72,842	0.082	-0.59
Lokitaung	TURKANA	0	0	0	0	146	756	7,581	8,483	0	0	0	0	2	6	18	26	31,497	0.082	-0.59
Mukurweini	NYERI	50	80	50	0	0	0	0	180	50	27	10	0	0	0	0	87	107,193	0.081	-0.59
Emuhaya	VIHIGA	144	0	0	0	32	0	0	176	144	0	0	0	0	0	0	144	180,118	0.080	-0.60
Kibwezi	MAKUENI	0	60	131	331	2,466	534	0	3,522	0	20	26	55	37	4	0	142	177,938	0.080	-0.60
Ndia	KIRINYAGA	95	88	184	0	0	0	0	366	95	29	37	0	0	0	0	161	205,528	0.078	-0.61
Upper Nyakach	KISUMU	0	73	114	0	0	0	0	187	0	24	23	0	0	0	0	47	61,751	0.076	-0.62
Bondo	SIAYA	0	4	280	303	0	0	0	587	0	1	56	50	0	0	0	108	141,856	0.076	-0.62
Mathira	NYERI	48	158	109	9	0	0	0	323	48	53	22	1	0	0	0	124	163,213	0.076	-0.62
Wundanyi	TAITA TAVETA	0	35	80	105	0	488	0	709	0	12	16	18	0	4	0	49	65,449	0.075	-0.62
Kesses	UASIN GISHU	0	383	193	0	0	0	0	576	0	128	39	0	0	0	0	166	222,808	0.075	-0.62
Mwea	KIRINYAGA	0	0	235	261	49	0	0	545	0	0	47	43	1	0	0	91	124,106	0.074	-0.63
Fino	MANDERA	0	0	0	0	0	0	5,457	5,457	0	0	0	0	0	0	13	13	18,269	0.071	-0.64
Maseno	KISUMU	23	179	153	0	12	0	0	367	23	60	31	0	0	0	0	113	160,315	0.071	-0.64
Mbalambala	GARISSA	0	0	0	0	0	0	3,484	3,484	0	0	0	0	0	0	8	8	12,001	0.069	-0.65
Sericho	ISIOLO	0	0	0	0	0	20	3,652	3,672	0	0	0	0	0	0	9	9	12,919	0.068	-0.65
Galole	TANA RIVER	0	0	0	0	0	2,994	6,402	9,396	0	0	0	0	0	22	15	37	54,934	0.068	-0.65
Bahari	KILIFI	0	0	231	331	0	0	0	562	0	0	46	55	0	0	0	101	152,237	0.067	-0.66
Kilome	MAKUENI	0	0	115	687	554	0	0	1,357	0	0	23	115	8	0	0	146	223,541	0.065	-0.67
Kendu Bay	HOMA BAY	0	0	365	74	0	0	0	439	0	0	73	12	0	0	0	85	132,039	0.065	-0.67
Lower Nyakach	KISUMU	0	2	178	0	0	0	0	180	0	1	36	0	0	0	0	36	56,118	0.064	-0.67
Nyando	KISUMU	0	2	419	0	0	0	0	421	0	1	84	0	0	0	0	84	132,091	0.064	-0.67
El Wak	MANDERA	0	0	0	0	0	0	7,204	7,204	0	0	0	0	0	0	17	17	26,824	0.064	-0.67
Masinga	MACHAKOS	0	0	77	149	1,196	0	0	1,423	0	0	15	25	18	0	0	58	92,089	0.063	-0.68
Kyuso	KITUI	0	0	0	31	2,733	3,686	0	6,450	0	0	0	5	41	27	0	73	121,067	0.061	-0.69
Kandara	MURANGA	56	48	132	0	0	0	0	237	56	16	26	0	0	0	0	99	175,003	0.056	-0.71
Thika	KIAMBU	0	0	162	360	242	0	0	764	0	0	32	60	4	0	0	96	172,636	0.056	-0.71
Aladai	NANDI	27	49	0	0	343	0	0	420	27	16	0	0	5	0	0	49	90,651	0.054	-0.72
Kaloleni	KILIFI	0	0	303	323	514	0	0	1,141	0	0	61	54	8	0	0	122	230,047	0.053	-0.72
Central Kitui	KITUI	0	0	52	412	846	0	0	1,310	0	0	10	69	13	0	0	92	172,853	0.053	-0.72
Mwingi	KITUI	0	0	60	196	1,510	0	0	1,766	0	0	12	33	23	0	0	67	127,198	0.053	-0.72
Mwatate	TAITA TAVETA	0	5	28	75	0	1,720	0	1,826	0	2	6	12	0	13	0	32	61,276	0.053	-0.73
Kwa Vonza	KITUI	0	0	63	204	1,558	0	0	1,825	0	0	13	34	23	0	0	70	136,119	0.051	-0.73
Central Wajir	WAJIR	0	0	0	0	0	0	9,270	9,270	0	0	0	0	0	0	22	22	42,928	0.051	-0.73
Banissa	MANDERA	0	0	0	0	0	342	3,287	3,629	0	0	0	0	0	3	8	10	20,574	0.050	-0.74
Makueni	MAKUENI	0	0	112	346	1,909	0	0	2,366	0	0	22	58	28	0	0	109	216,141	0.050	-0.74
Central Isiolo	ISIOLO	0	0	0	0	343	2,298	0	2,641	0	0	0	0	5	17	0	22	44,731	0.049	-0.74
Mbooni	MAKUENI	0	0	130	253	189	0	0	571	0	0	26	42	3	0	0	71	143,438	0.049	-0.74
Rarieda	SIAYA	0	2	183	221	0	0	0	406	0	1	37	37	0	0	0	74	150,677	0.049	-0.74
Bura	TANA RIVER	0	0	0	0	0	0	5,423	5,423	0	0	0	0	0	0	13	13	29,562	0.044	-0.77
Kangundo	MACHAKOS	0	0	106	318	345	0	0	769	0	0	21	53	5	0	0	79	184,938	0.043	-0.77
Kathiani	MACHAKOS	0	0	33	151	846	0	0	1,029	0	0	7	25	13	0	0	44	118,001	0.038	-0.80
Kiambaa	KIAMBU	3	66	121	1	0	0	0	191	3	22	24	0	0	0	0	49	143,889	0.034	-0.81
Nyeri Mun.	NYERI	0	2	107	60	0	0	0	169	0	1	21	10	0	0	0	32	99,561	0.032	-0.82

Table KA–5: High potential land equivalents per capita *(continued)*

		Unweighted areas (Km²)								Weighted areas (Km²)										
Division	District	A	B	C	D	E	F	G	Total	H	I	J	K	L	M	N	Total	1994 Pop.	HPE/cap	HPE_Z
Central Machakos	MACHAKOS	0	0	48	124	533	0	0	706	0	0	10	21	8	0	0	38	135,579	0.028	-0.84
Central (Kalokol)	TURKANA	0	0	0	0	0	0	5,583	5,583	0	0	0	0	0	0	13	13	48,378	0.027	-0.84
Nakuru Mun.	NAKURU	0	0	279	6	0	0	0	285	0	0	56	1	0	0	0	57	209,287	0.027	-0.84
Kikuyu	KIAMBU	0	23	115	66	49	0	0	253	0	8	23	11	1	0	0	43	166,044	0.026	-0.85
Winam	KISUMU	0	136	140	0	20	0	0	295	0	45	28	0	0	0	0	73	314,493	0.023	-0.86
Yatta	MACHAKOS	0	0	1	48	1,010	0	0	1,058	0	0	0	8	15	0	0	23	127,227	0.018	-0.89
Taveta	TAITA TAVETA	0	0	0	0	409	245	0	654	0	0	0	0	6	2	0	8	48,385	0.016	-0.89
Kisauni	MOMBASA	0	0	127	0	0	0	0	127	0	0	25	0	0	0	0	25	178,956	0.014	-0.90
Likoni	MOMBASA	0	0	49	6	0	0	0	55	0	0	10	1	0	0	0	11	78,481	0.014	-0.91
Parklands (West)	NAIROBI	0	0	99	0	0	0	0	99	0	0	20	0	0	0	0	20	145,629	0.014	-0.91
Kibera	NAIROBI	0	0	26	174	42	0	0	242	0	0	5	29	1	0	0	35	261,023	0.013	-0.91
Embakasi	NAIROBI	0	0	0	142	102	0	0	243	0	0	0	24	2	0	0	25	205,661	0.012	-0.91
Changamwe	MOMBASA	0	0	48	23	0	0	0	71	0	0	10	4	0	0	0	14	132,438	0.010	-0.92
Mwala	MACHAKOS	0	0	0	8	1,015	0	0	1,023	0	0	0	1	15	0	0	16	162,379	0.010	-0.92
Central Garissa	GARISSA	0	0	0	0	0	0	2,006	2,006	0	0	0	0	0	0	5	5	47,248	0.010	-0.92
Sabatia	VIHIGA	11	0	0	0	101	0	0	112	11	0	0	0	2	0	0	13	126,073	0.010	-0.92
Faza	LAMU	0	0	0	3	96	0	0	99	0	0	0	0	1	0	0	2	20,586	0.009	-0.93
Central Mandera	MANDERA	0	0	0	0	0	0	505	505	0	0	0	0	0	0	1	1	30,423	0.004	-0.95
Kasarani	NAIROBI	0	0	28	55	0	0	0	82	0	0	6	9	0	0	0	15	373,870	0.004	-0.95
Dagoretti	NAIROBI	0	0	31	0	0	0	0	31	0	0	6	0	0	0	0	6	183,550	0.003	-0.95
Island	MOMBASA	0	0	18	0	0	0	0	18	0	0	4	0	0	0	0	4	137,996	0.003	-0.96
Hamisi	VIHIGA	0	0	0	0	190	0	0	190	0	0	0	0	3	0	0	3	122,926	0.002	-0.96
Makadara	NAIROBI	0	0	1	20	0	0	0	21	0	0	0	3	0	0	0	4	155,342	0.002	-0.96
Malava/Kabras	KAKAMEGA	0	0	0	0	252	0	0	252	0	0	0	0	4	0	0	4	166,748	0.002	-0.96
Central Nairobi	NAIROBI	0	0	8	0	0	0	0	8	0	0	2	0	0	0	0	2	94,578	0.002	-0.96
Pumwani	NAIROBI	0	0	3	9	0	0	0	13	0	0	1	2	0	0	0	2	171,083	0.001	-0.96
Ikolomani	KAKAMEGA	0	0	0	0	31	0	0	31	0	0	0	0	0	0	0	0	95,660	0.000	-0.97

Key: A thru G = Agro-Climatic Zone (ACZ) 1–7 — Unweighted area (Km²)
H thru N = Agro-Climatic Zone (ACZ) 1–7 — Weighted area (Km²)

Notes: Exploratory Soil Survey Report E1, Kenya Soil Survey, Nairobi (1:1,000,000) overlayed with FEWS Kenya 1989 administrative units.
1994 population based on 1989 census plus district level intra-censual (1979–89) growth rates.
Sources: Unweighted Agroclimatic zone (ACZ) areas extracted from: W.G. Sombroek, H.M.H. Braun and B.J.A. van der Pouw, "The Exploratory Soil Map and Agro-climatic Zone Map of Kenya (1980)," 1982.

Table KA–6: Land use estimates*
(percent)

	Permanent cropping	Perennial cropping	Pastureland
ACZ–1	13.8	34.1	40.2
ACZ–2	11.9	38.1	37.4
ACZ–3	4.8	47.0	34.0
ACZ–4	2.6	41.0	44.5
ACZ–5	—	—	100
ACZ–6	—	—	100
ACZ–7	—	—	100

* = Percentages do not add up to 100 for ACZs–1–4 because estimates for nonagriculturally suitable land has been subtracted (steep slopes, rivers, urban centers, etc.) based on information from the FMH. Similar estimates of nonagricultural land were not available for districts in the other zones.

Source: FEWS/Kenya

Table KA–7: Indicative yields for selected commodities
(yield MT/ha equivalents)

	Tea	Coffee	Maize	Dairy
ACZ–1	4.8 1 TEU	1.3 0.31 TEU	3.8 1 MEU	2.8 1 DEU
ACZ–2	—	0.6 0.14 TEU	3.7 0.97 MEU	2.2 0.79 DEU
ACZ–3	—	0.1 0.02 TEU	2.6 0.68 MEU	1.5 0.54 DEU
ACZ–4	—	—	2.6 0.68 MEU	1.0 0.35 DEU
ACZ–5	—	—	—	0.13 0.04 DEU
ACZ–6	—	—	—	0.063 0.02 DEU
ACZ–7	—	—	—	0.020 0.007 DEU

Source: FEWS/Kenya

FEWS Vulnerability Index

Level of Vulnerability	Conditions of Vulnerability	Typical Coping Strategies and/or Behaviors	Interventions to Consider
SLIGHTLY VULNERABLE	**Maintaining or Accumulating Assets** and **Maintaining Preferred Production Strategy**	**Assets/resources/wealth:** either accumulating additional assets/resources/wealth or only minimal net change (normal "belt-tightening" or seasonal variations) in assets, resources or wealth over a season/year. I.e., coping to minimize risk. **Production Strategy**: any changes in production strategy are largely volitional for perceived gain, and not stress related.	**Developmental Programs**
MODERATELY VULNERABLE	**Drawing-down Assets** and **Maintaining Preferred Production Strategy**	**Assets/resources/wealth**: coping measures include drawing down or liquidating less important assets, husbanding resources, minimizing rate of expenditure of wealth, unseasonable "belt-tightening" (e.g., drawing down food stores, reducing amount of food consumed, sale of goats or sheep). **Production Strategy**: only minor stress-related change in overall production/income strategy (e.g., minor changes in cropping/planting practices, modest gathering of wild food, inter-household transfers and loans, etc.).	**Mitigation and/or Development: Asset Support** (release food price-stabilization stocks, sell animal fodder at "social prices," community grain bank, etc.)
HIGHLY VULNERABLE	**Depleting Assets** and **Disrupting Preferred Production Strategy**	**Assets/resources/wealth**: liquidating the more important investment, but not yet "production," assets (e.g., sale of cattle, sale of bicycle, sale of possessions such as jewelry). **Production Strategy**: coping measures being used have a significantly costly or disruptive character to the usual/preferred household and individual life-styles, to the environment, etc. (e.g., time-consuming wage labor, selling firewood, farming marginal land, labor migration of young adults, borrowing from merchants at high interest rates).	**Mitigation and/or Relief: Income and Asset Support** (Food-for-Work, Cash-for Work, etc.)
EXTREMELY VULNERABLE or AT-RISK	**Liquidating Means of Production** and **Abandoning Preferred Production Strategy**	**Assets/resources/wealth**: liquidating "production" resources (e.g., sale of planting seed, hoes, oxen, land, prime breeding animals, whole herds). **Production Strategy**: Seeking nontraditional sources of income, employment, or production that preclude continuing with preferred/usual ones (e.g., migration of whole families).	**Relief and/or Mitigation: Nutrition, Income and Asset Support** (food relief, seed packs, etc.)
FAMINE	**Destitute**	**Coping Strategies Exhausted**: no significant assets, resources, or wealth; no income/production.	**Emergency Relief** (food, shelter, medicine)

Key Terms

At Risk — FEWS Reports use the term "at risk" to describe populations either currently, or in the near future, expected to have insufficient food, or resources to acquire food, to avert a nutritional crisis (i.e., progressive deterioration in health or nutritional condition below the status quo). "At risk" populations require specific intervention to avoid a life-threatening situation. Food needs estimates are sometimes included in FEWS reports. Famines are the culmination of a slow-onsetting process, which can be extremely complex. The food needs of specific "at-risk" populations depend on the point in this process when the problem is identified and the extent of its cumulative impact on the individuals concerned. The amount of food assistance required, from either internal or external sources, depends upon many considerations.

Vulnerability — FEWS Reports use the term "vulnerability" to indicate relative susceptibility to food insecurity of groups of people or areas. In FEWS usage, vulnerability is always characterized by its degree: slight, moderate, high, or extreme. Extreme vulnerability is synonymous with "at risk." Vulnerability is a dynamic concept that incorporates both chronic and current conditions. Chronic vulnerability involves long-term conditions that predispose a particular group or region to food insecurity. Current vulnerability highlights short-term changes in food security status and their implications. Vulnerability analysis involves three levels of concern: food availability, food access, and food utilization. These levels are linked by a common analytical framework that interprets all relevant information for its food security impact on the diversified income generating possibilities of different groups of households.

ITCZ — The Intertropical Convergence Zone (ITCZ) is equivalent to a meteorological equator; a region of general upward air motion and relatively low surface pressure bounded to the north and south by the northeast and southeast Trade Winds, respectively. The upward motion in the ITCZ forms the rising branch of the meridional Hadley Circulation. The ITCZ moves north and south following the apparent movement of the sun. It is at its most northerly position in the summer months. The position of the ITCZ normally defines the northern limits of possible precipitation in the Sahel; rainfall generally occurs 100 to 300 kilometers south of the ITCZ, with local convective activity organized by westward moving "Easterly Waves."

NDVI — Normalized Difference Vegetation Index (NDVI) images are created at the laboratory of the National Aeronautics and Space Administration (NASA) Global Inventory Modeling and Monitoring System (GIMMS). The images are derived from Global Area Coverage (GAC) imagery (of approximately seven kilometers resolution) received from the Advanced Very High Resolution Radiometer (AVHRR) sensors on board the National Oceanic and Atmospheric Administration (NOAA) Polar Orbiting series of satellites. The polar orbit satellites remotely sense the entire Earth and its atmosphere once each day and once each night, collecting data in five spectral bands. Bands 1 and 2 sense reflected red and infrared wavelengths, respectively, and the remaining three bands sense emitted radiation in three different spectral bands. The NDVI images are created by calculating "(infrared - red)/(infrared + red)" for each pixel from the daytime satellite passes. Since chlorophyll reflects more in the infrared band than in the red band, higher NDVI values indicate the presence of more chlorophyll and, by inference, more live vegetation. A composite of daily NDVI images is created for each 10-day period, using the highest NDVI value for each pixel during that period. This technique minimizes the effects of clouds and other forms of atmospheric interference that tend to reduce NDVI values. NDVI is often referred to as a measure of "greenness" or "vegetative vigor." The NDVI images are used to monitor the response of vegetation to weather conditions.

METEOSAT — METEOSAT-based Rainfall Estimates. FEWS uses estimates of current rainfall based on cold cloud duration as measured by thermal infrared radiometers on the METEOSAT satellite. The estimates arc calculated every 10 days by the Department of Meteorology at the University of Reading in the U.K. Cold cloud duration correlates well with thunderstorm generated rainfall and, thus, is suitable for use in the semi-arid Sahel. The method works best on level terrain; hilly areas may produce local enhancements or rain-shadow areas that are not detected. In level areas the method has an accuracy of "rain/no rain" of at least 85 percent (based on a comparison with ground data). At a dekadal (ten-day) scale, 80 percent of rainfall amounts under 60 millimeters (mm) are accurate to plus or minus 10 mm, while rainfall over 60 mm is accurate to plus or minus 20 mm. This accuracy is acceptable for use in the FEWS-monitored region given that the method provides near-real-time coverage for a large area at a resolution of less than 10 kilometers.