PN-AAK-017

Tanzania
Rural Roads
Feasibility Study

Final Report
Volume III
Environmental Assessment

Prepared for
U.S. Agency
for International Development

LYON associates, inc.
in association with
James R. Snitzler Associates, Inc.

TABLE OF CONTENTS

I. Description Of The Project: Background Information

A. Reasons For The Project I-1

1. Background
2. Project Goals

B. Project Activities and Features I-5

II. Description Of The Project Area Environment

A. Natural Environment II-1
B. Human Environment II-21

III. Probable Environmental Impact Of Project Implementation

A. Impact Of Population Influx III-1
B. Impact Of Increasing Agricultural Production. III-3
C. Impact Of Increasing Livestock Production III-6
D. Impact Of Improved Health Facilities. III-7
E. Impact Of Improved Educational Facilities III-8
F. Impact Of Road Construction and Maintenance Activities. III-9

IV. Relationship Of Proposed Action To Land Use Plans, Policies and Controls IV-1

V. Probable Adverse Environmental Impacts Which Cannot Be Avoided. V-1

VI. Alternatives To The Proposed Action (If Significant Negative Impacts Are Discovered). VI-1

VII. Irreversible and Irretrievable Commitment of Resources. VII-1

VIII. Bibliography. VIII-1

LIST OF TABLES

		Page
TABLE I - 1	LENGTH OF ROADS SELECTED FOR REHABILITATION (KM)	I - 9
TABLE I - 2	LOCATION OF REHABILITATION TEAMS	I - 9
TABLE II - 1	MEAN ANNUAL RAINFALL	II - 6
TABLE II - 2	STUDY AREA LIVESTOCK POPULATIONS AS PERCENTAGE OF NATIONAL TOTALS, 1978	II - 12
TABLE II - 3	SUMMARY OF LIVESTOCK POPULATION BY STUDY REGIONS, DISTRICTS AND MAJOR ANIMAL CATEGORIES, 1978 CENSUS	II - 14
TABLE II - 4	SOURCES OF VILLAGE WATER SUPPLY, SINGIDA REGION	II - 16
TABLE II - 5	WATER SUPPLY BY REGION, PEOPLE SUPPLIED WITH CLEAN WATER AS PERCENTAGE OF TOTAL REGIONAL POPULATION	II - 18
TABLE II - 6	POPULATION AND DENSITY BY REGION AND DISTRICT OF THE STUDY AREA, 1967 AND 1974	II - 22
TABLE II - 7	AGE, SEX AND HOUSEHOLD SIZE IN DODOMA, SINGIDA AND KILIMANJARO REGIONS	II - 24
TABLE II - 8	REGIONAL SUMMARY OF PER CAPITA INCOME	II - 25
TABLE II - 9	REGIONAL HEALTH SERVICES SUMMARY, 1978	II - 27
TABLE II - 10	NUMBER OF PERSONS SERVED BY MEDICAL DOCTORS, REGION AND DISTRICT SUMMARY, 1978	II - 28
TABLE IV - 1	LAND USE BY DISTRICTS, SINGIDA REGION	IV - 2
TABLE IV - 2	LAND USE BY DISTRICTS, DODOMA REGION	IV - 3
TABLE VI - 1	SUMMARY OF ENVIRONMENTAL IMPACT.	VI - 1

LIST OF PLATES

		Page
PLATE III - 1	TANZANIA STUDY AREAS LOCATION MAP	I - 3
PLATE IV - 3	DODOMA REGION ADMINISTRATIVE DISTRICT AND DIVISION	I - 6
PLATE IV - 4	SINGIDA REGION ADMINISTRATIVE DISTRICT AND DIVISION	I - 7
PLATE IV - 5	KILIMANJARO REGION ADMINISTRATIVE DISTRICT AND DIVISION	I - 8
PLATE VII - 1	PRESENT CLASSIFICATION OF SELECTED ROADS DODOMA REGION/MPWAPWA DISTRICT	I - 10
PLATE VII - 2	PRESENT CLASSIFICATION OF SELECTED ROADS DODOMA REGION/DODOMA DISTRICT	I - 11
PLATE VII - 3	PRESENT CLASSIFICATION OF SELECTED ROADS DODOMA REGION/KONDOA DISTRICT	I - 12
PLATE VII - 4	PRESENT CLASSIFICATION OF SELECTED ROADS SINGIDA REGION/SINGIDA DISTRICT	I - 13
PLATE VII - 5	PRESENT CLASSIFICATION OF SELECTED ROADS SINGIDA REGION/IRAMBA DISTRICT	I - 14
PLATE VII - 6	PRESENT CLASSIFICATION OF SELECTED ROADS SINGIDA REGION/MANYONI DISTRICT	I - 15
PLATE VII - 7	PRESENT CLASSIFICATION OF SELECTED ROADS KILIMANJARO REGION/SAME DISTRICT	I - 16
PLATE VII - 8	PRESENT CLASSIFICATION OF SELECTED ROADS KILIMANJARO REGION/MWANGA DISTRICT	I - 17
PLATE IV - 2	TANZANIA SINGIDA AND DODOMA REGIONS ETHNIC GROUPS	II - 23

I. DESCRIPTION OF THE PROJECT: BACKGROUND INFORMATION

A. Reasons for the Project

1. Background

Tanzania is a large country geographically with a widely dispersed population. The total land area is 945,000 square kilometers and the population is estimated to be about 15 million, concentrated largely along the Indian Ocean cities of Dar es Salaam, Tanga and Mtwara. Inland, substantial pockets of population are found in the Kilimanjaro region and along the shores of Lake Victoria.

The main economic activity in Tanzania is agriculture, with primary products being cotton, coffee, sisal, tobacco, cashew nuts, and bananas. The economic growth of the country has been constrained by a lack of adequate transport, particularly roads. This is partly due to the widely dispersed population of the country and to poor maintenance of the road system.

The Government of Tanzania's decentralization policy, adopted in 1972 to reduce inequalities in income distribution, gave substantial power to the country's 20 administrative regions. In the road sector, this policy resulted in responsibility for road construction and maintenance being given to Regional and District authorities for all but trunk roads, which remain the responsibility of the Ministry of Works.

The Regional and District authorities, however, have neither had the funds necessary, nor the required staff and equipment, to properly maintain the roads under their jurisdiction. The result is an inadequate system of main, regional, district and local feeder roads which are often impassable during the rainy seasons. In fact, even the main trunk roads often wash out after heavy rains.

Several international lending agencies have been assisting the Government of Tanzania in improving trunk, regional and local roads and in improving the capabilities of agencies responsible for road development in the country. A study of feeder roads in the western part of Kilimanjaro and in Arusha was completed in 1977.[1,2,3] A study of feeder roads has also been completed in the Tabora region, just west of Singida

(1,2,3) See Bibliography

and Dodoma.[4] USAID has awarded a contract for carrying out a regional development plan for the Arusha region, which includes a feeder road component; and the World Bank has just embarked on its Fifth Highway Program, which includes studies of trunk roads in the northern and western parts of the country.[5] Several other projects which impact on road development are either underway or have been completed in other parts of the country.[6,7,8,9,10,11,12,13]

This environmental assessment is Volume III of the Tanzania Rural Roads Feasibility Study. It has been compiled for the most part on the basis of work done by all members of the study team which included environmental, geotechnical, highway, maintenance, equipment engineers; economists, social scientists and training specialists. Data contained in Volumes I and II were freely used and plate numbers used in Volume I have been kept unchanged.

2. Project Goals

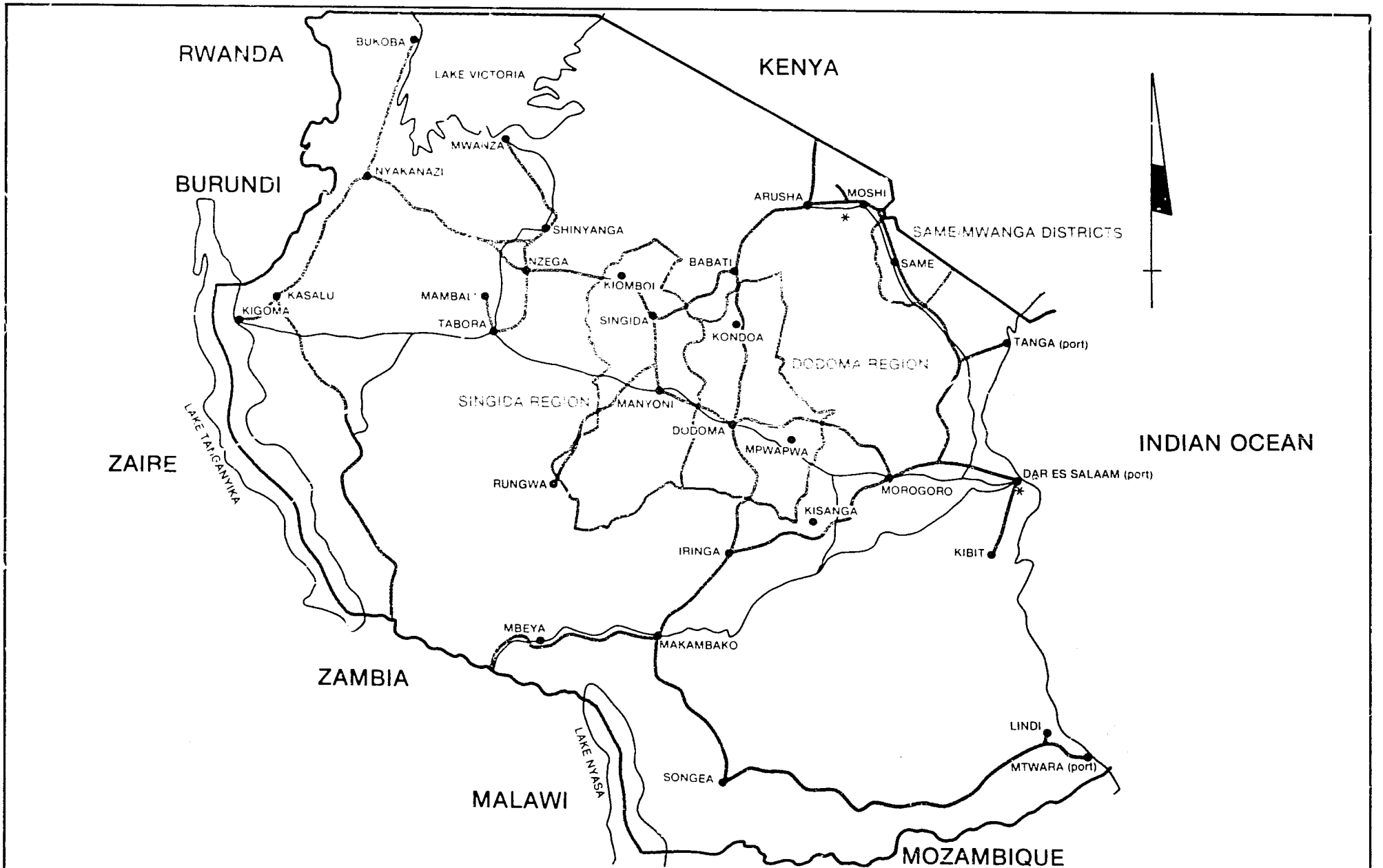
The USAID sponsored project comprises preparation of a rural road feasibility study in the Dodoma and the Singida Regions and part of the Kilimanjaro Region. Plate III - 1 shows location of the 3-region study area totaling 98,589 square kilometers, with a population of 1,794,000. Specific goals of the feasibility study include:

a. To provide a capability to rehabilitate and/or construct and maintain low cost rural access roads in the regions of Singida, Dodoma and East Kilimanjaro, and to assist in the construction of a designated quantity of roads to ensure the districts are more accessible to rural development programs and social services.

b. To assure that rural roads and COMWORKS capability development in Arusha being undertaken pursuant to the Arusha Regional Planning and Village Development Project is consistent with that projected by the team to be undertaken in Singida, Dodoma and East Kilimanjaro.

c. To encourage commerce by reducing travel costs and travel time for people and goods on some 4,650 kilometers of roads of varying classification.

(4,5,6,7,8,9,10,11,12,13) See Bibliography



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Tanzania Study Areas Location Map
Plate III-1

Legend

- Railroad
- Region
- * International Airport
- Trunk Road

Ref. Atlas of Tanzania, 2nd Edition, 1976

d. To improve the administration, planning, construction and maintenance capacity of the region and district Ministry of Communications and Works.

e. To increase access opportunities for small farmers of the three regions to the agricultural inputs and services required for increased agricultural production, including improved seed varieties, fertilizer and technological advances.

The principal objective of this feasibility study was to create within the three regions, the indigenous capacity, in terms of manpower, knowledge, equipment and finances, to construct and maintain rural access roads.

B. Project Activities and Features

To reiterate, the primary objective of the Tanzania Rural Roads Feasibility Study is to provide assistance in the construction or rehabilitation of a designated quantity of rural roads in Dodoma Region, Singida Region, and the districts of Same and Mwanga of the Kilimanjaro Region. Rehabilitation or construction is to insure accessibility of the rural areas in these districts to the many services that are necessary for increased agricultural production. Further economic benefits that will accrue are reduced travel time and costs for people and goods and to provide services where none now exist due to unsatisfactory or impassable roads.

Along with the physical construction of rural roads, an equally important objective is to provide a capability within the districts to rehabilitate and maintain these rural roads by improving the administrative, planning, construction and maintenance capacity of the regional road organizations. Administrative districts and divisions for the three regions are indicated in plates IV - 3, IV - 4, and IV - 5. This capability is to be acquired through training of manpower, purchase of new and repair of old equipment, along with the formation of an organization that can function effectively on a permanent basis rather than for a rapid temporary rehabilitation program. It can be appreciated that providing the on-going maintenance and rehabilitation capability is as important as the rehabilitation itself.

The proposed rehabilitation program will involve basically three operations:

1. Clearing and shaping, in which the roadway is cleared of vegetation and the ditches cut and shaped with the excavated material being used to form a properly crowned road section.
2. Embankment and surfacing, which follows the clearing and shaping operation, will include rehabilitation of the roadway by importing borrow for embankment and granular surfacing material, as well as repairing erosion damage and constructing erosion controls.
3. Culvert construction and drift and bridge repairs are to be carried on concurrently with embankment construction. Repair or replacement of

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Dodoma Region Administrative Districts and Divisions
Plate IV-3

Legend

- Division
- District
- Region
- Railroad
- Trunk Road

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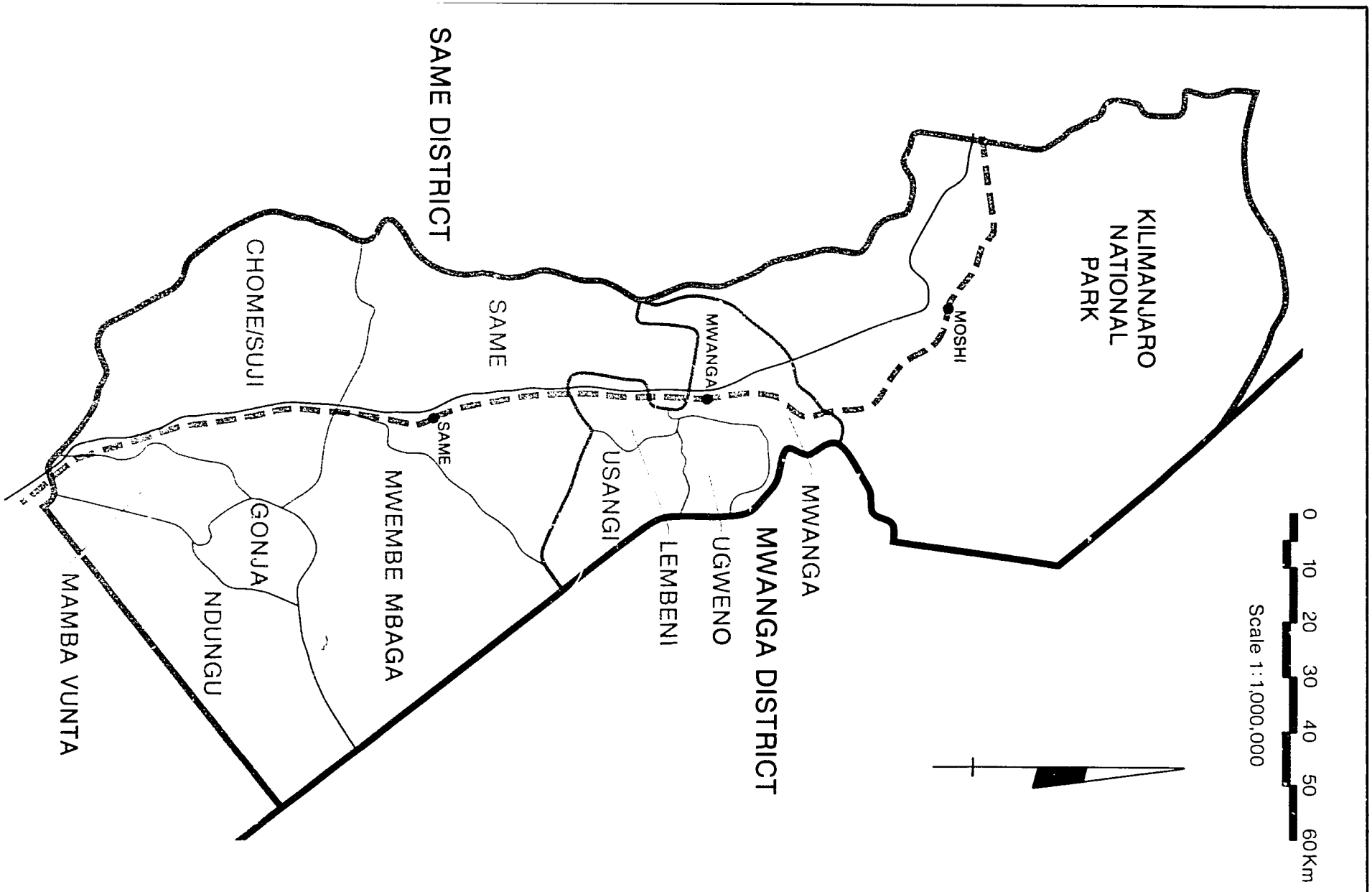
Singida Region Administrative Districts and Divisions
Plate IV-4

Legend

- Division
- District
- Region
- Railroad
- Trunk Road



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Kilimanjaro Region Administrative Divisions of Same and Mwanga Districts
Plate IV-5

Legend

- Division
- District
- Region
- Railroad
- Trunk Road

damaged culverts and installation of new culverts will be included. Drifts and bridges are also repaired or replaced and scour protection provided. Lengths of roads proposed for rehabilitation in each region are summarized in the following table & shown in Plates VII-1 thru VII-8.

TABLE I - 1 - LENGTH OF ROADS SELECTED FOR REHABILITATION (km)

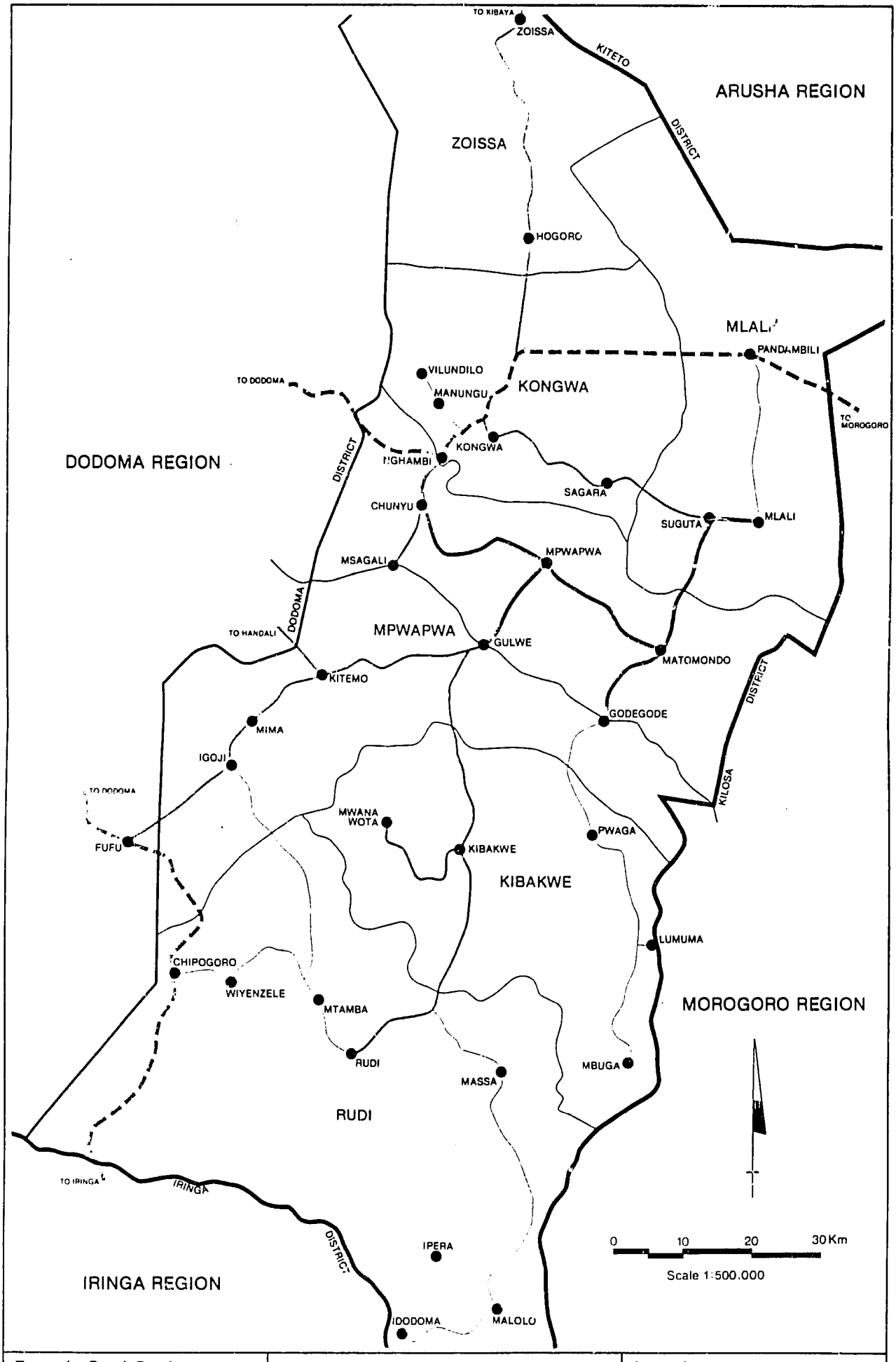
PRESENT CLASSIFICATION

Region	District	Local Main	District	Feeder	Totals
Dodoma	Mpwapwa	112	301	230	643
	Dodoma	0	481	616	1,097
	Kondoa	155	247	136	538
	Subtotals	(267)	(1,029)	(982)	(2,278)
Singida	Singida	0	196	154	350
	Iramba	24	250	183	457
	Manyoni	0	82	486	568
	Subtotals	(24)	(523)	(323)	(1,375)
Kilimanjaro	Same	163	198	0	361
	Mwanga	93	127	102	322
	Subtotals	(256)	(325)	(102)	(683)
	TOTALS	547	1,882	1,907	4,336

Distribution and location of the four field rehabilitation teams to perform the indicated work are shown in Table 2.

TABLE I - 2 - LOCATION OF REHABILITATION TEAMS

Region	Number of Maintenance Teams	Tentative Location of Center	Clearing & Shaping, km	Embankment & Surfacing, km
Dodoma	2	Chenene, Handali	760	530
Singida	1	Ikungi	460	265
Kilimanjaro (Same/Mwanga)	1	Same	225	150
		Totals, per year	1,445	945
		Totals, 3-yr.program	4,335	2,835



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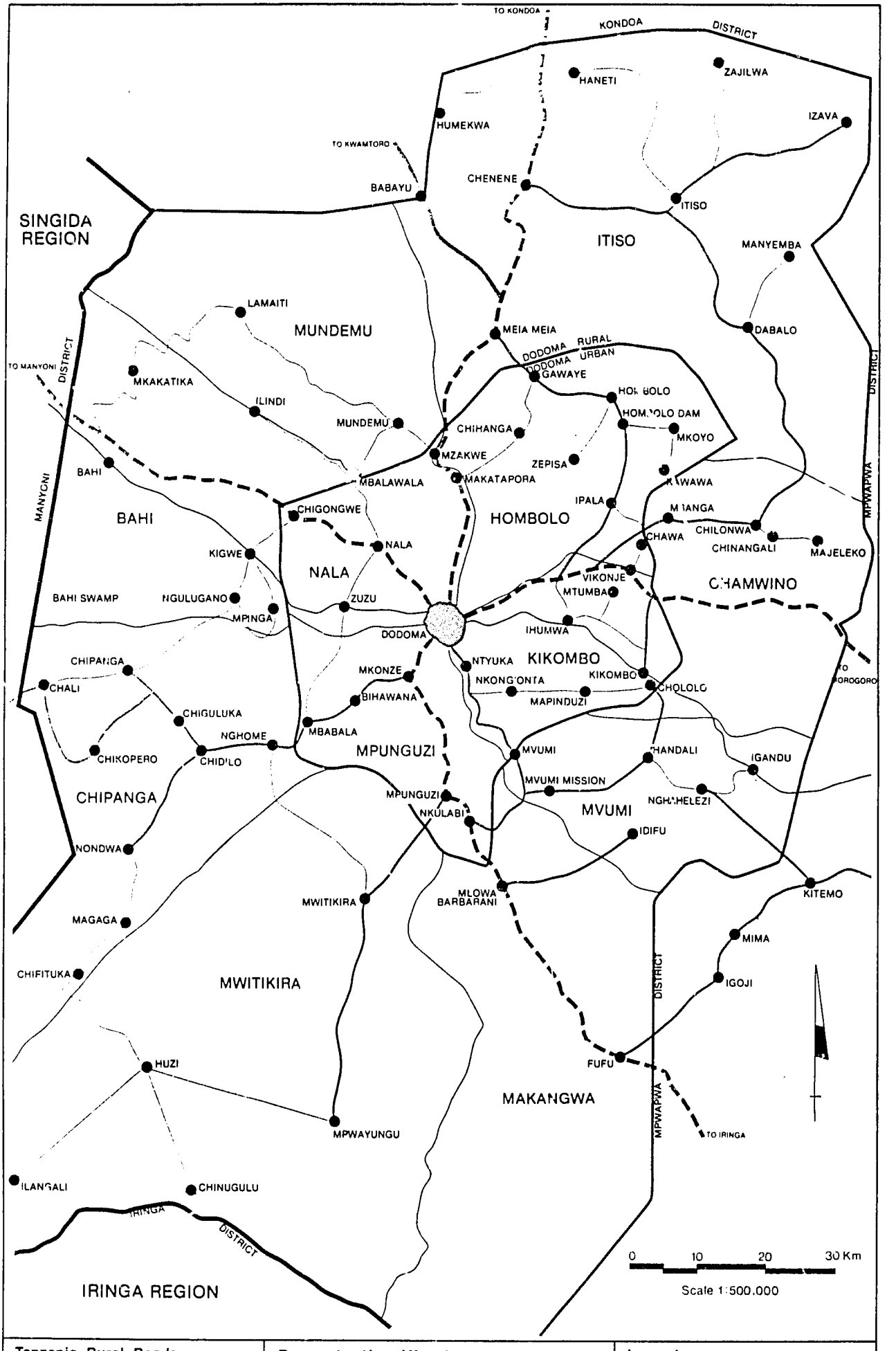
Present Classification of Selected Roads Dodoma Region / Mpwapwa District
Plate VII-1

Legend

- Railroad
- Division
- District
- Region
- Feeder Road
- District Road
- Local Main Road
- Trunk Road



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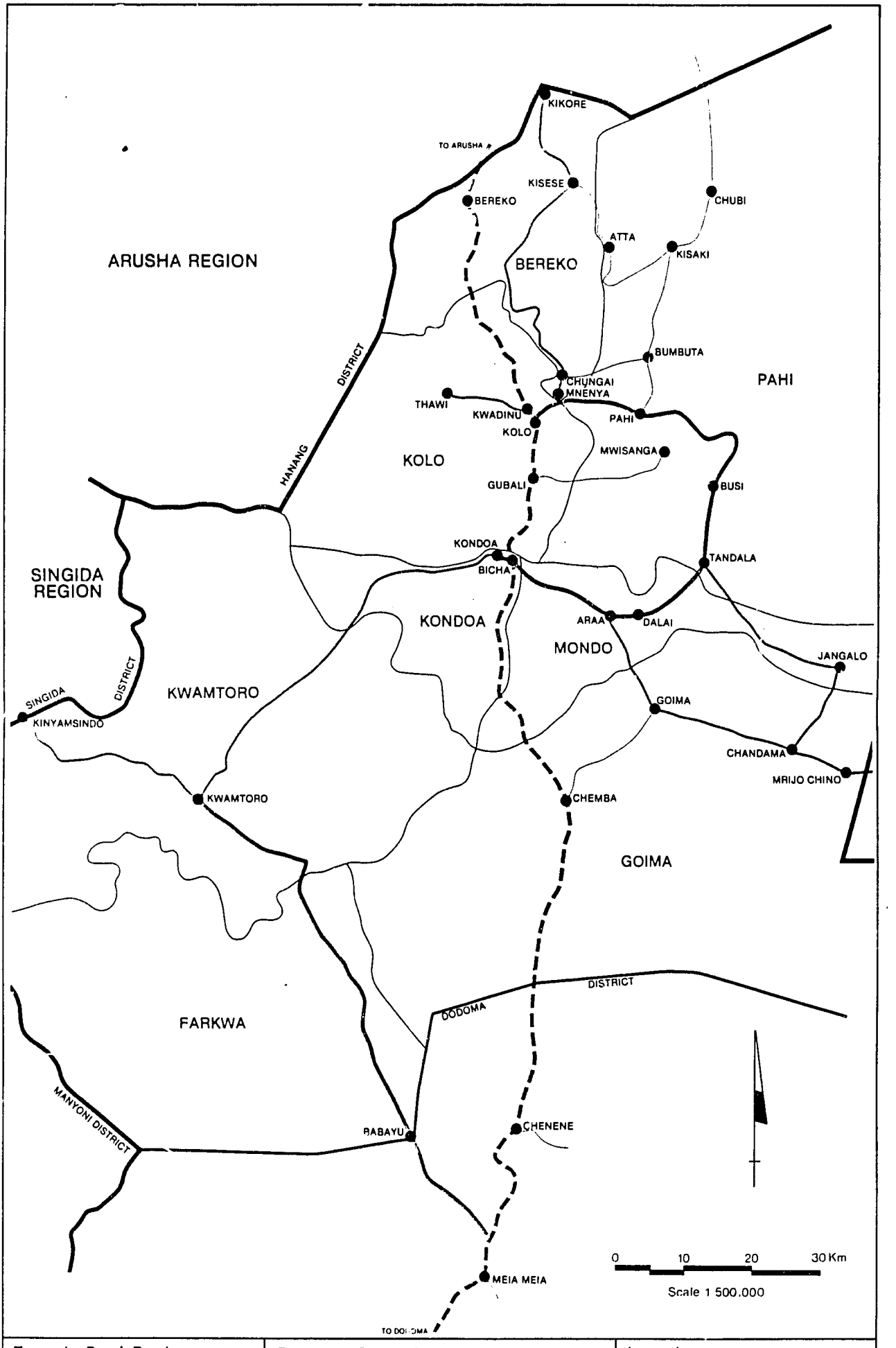
Present Classification of Selected Roads
Dodoma Region / Dodoma District
Plate VII-2

Legend

- Railroad
- Division
- District
- Region
- Feeder Road
- District Road
- Local Main Road
- Trunk Road



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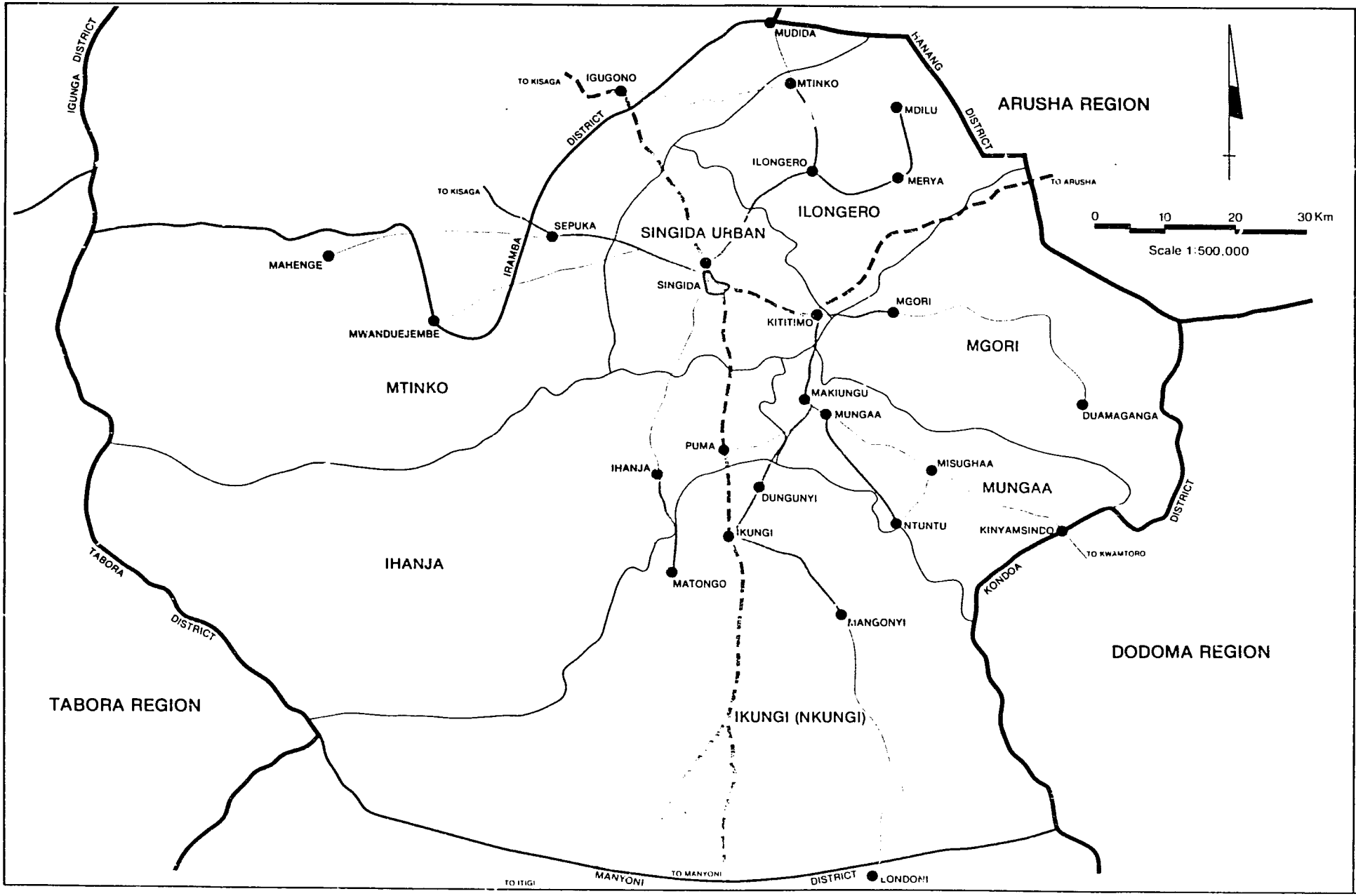
Present Classification of Selected Roads Dodoma Region / Kondoa District
Plate VII-3

Legend
- Railroad
- Division
- District
- Region
- Feeder Road
- District Road
- Local Main Road
- Trunk Road



Legend

- Railroad
- Feeder Road
- Division
- District Road
- District
- Local Main Road
- Region
- Trunk Road

Present Classification of Selected Roads
Singida Region/Singida District
Plate VII-4

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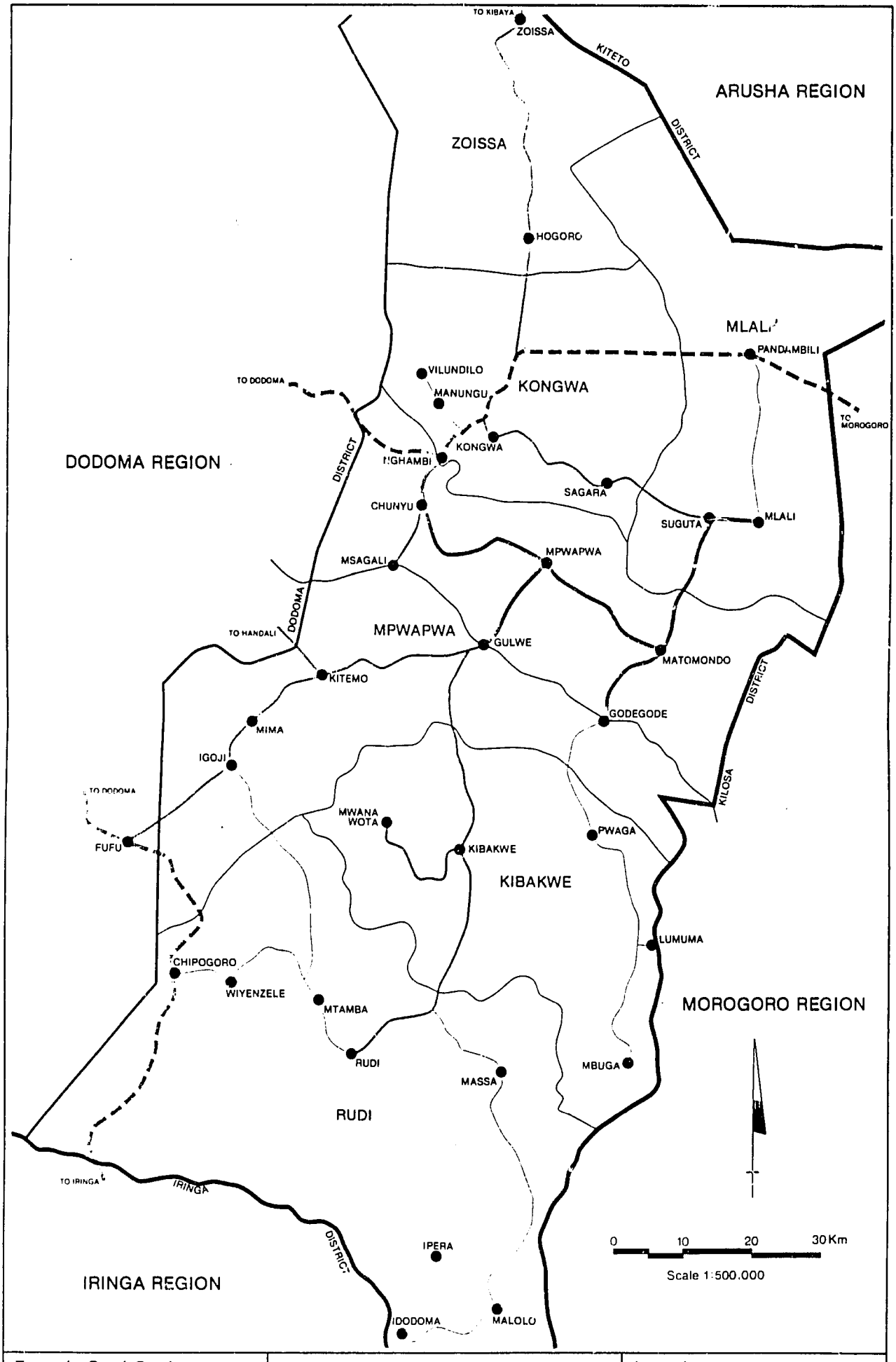

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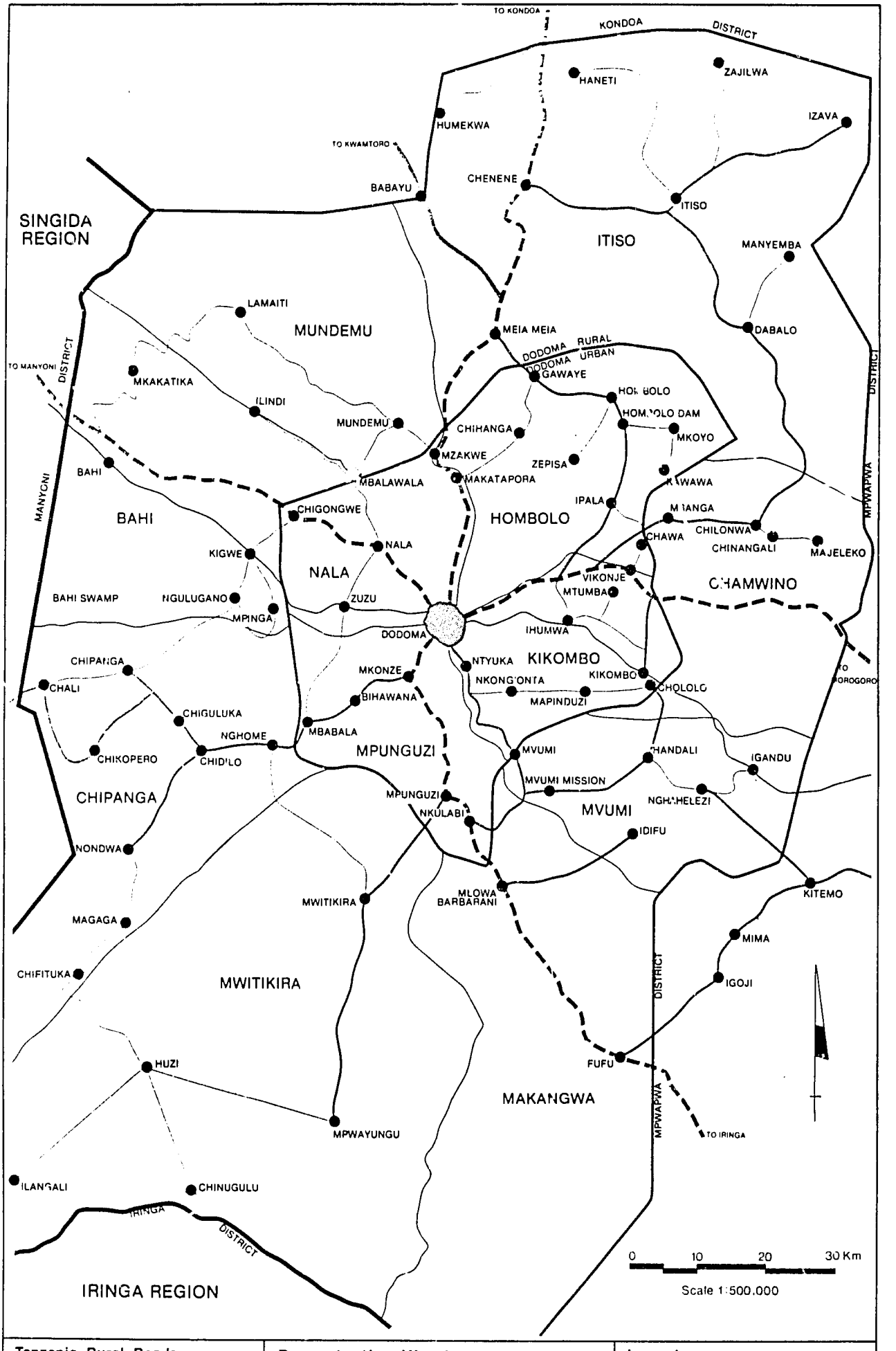
Present Classification of Selected Roads Dodoma Region / Mpwapwa District
Plate VII-1

Legend

- Railroad
- Division
- District
- Region
- Feeder Road
- District Road
- Local Main Road
- Trunk Road



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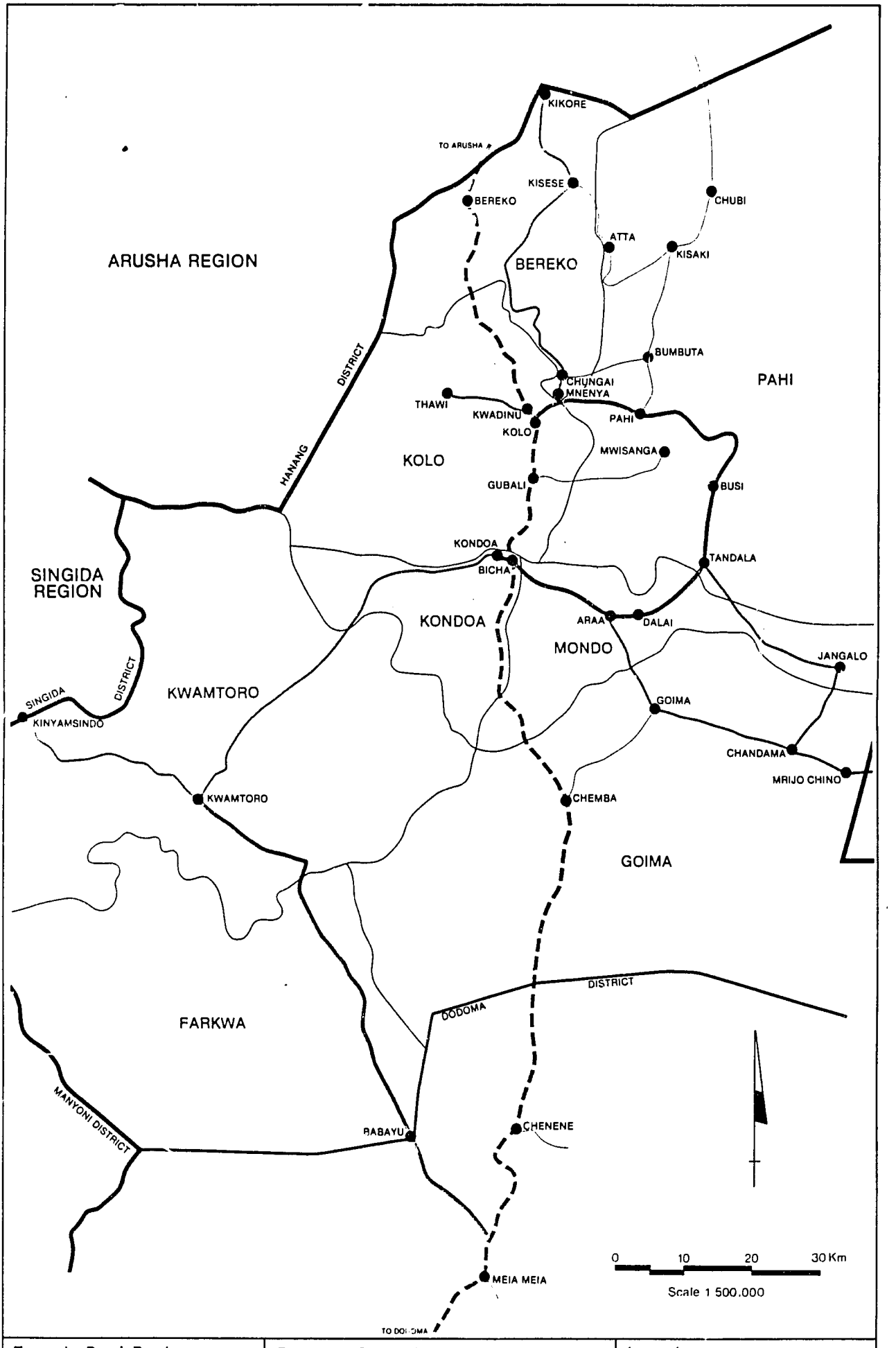
Present Classification of Selected Roads
Dodoma Region / Dodoma District
Plate VII-2

Legend

- Railroad
- Division
- District
- Region
- Feeder Road
- District Road
- Local Main Road
- Trunk Road



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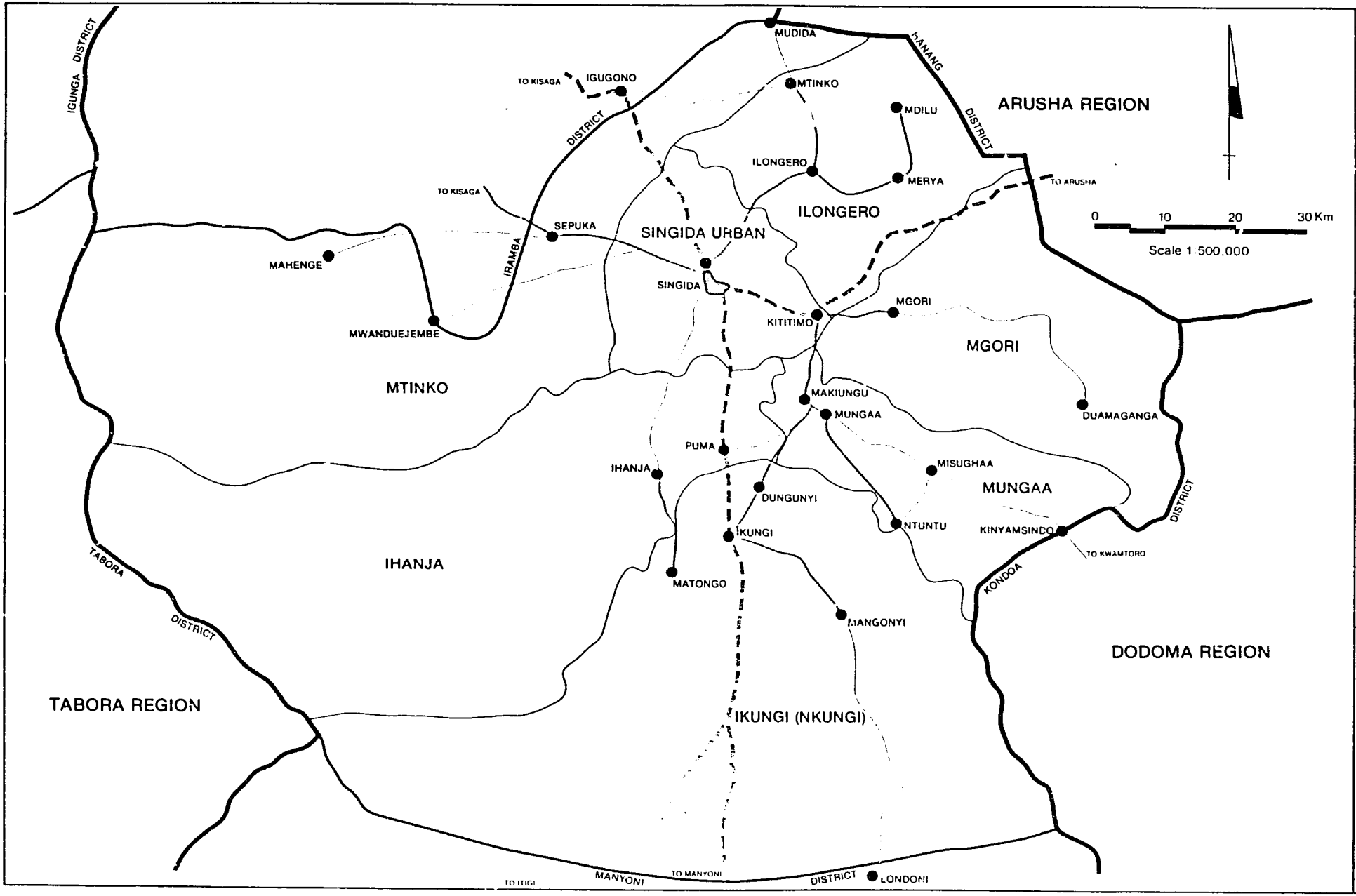
Present Classification of Selected Roads Dodoma Region / Kondoa District
Plate VII-3

Legend
- Railroad
- Division
- District
- Region
- Feeder Road
- District Road
- Local Main Road
- Trunk Road



Legend

- Railroad
- Feeder Road
- Division
- District Road
- District
- Local Main Road
- Region
- Trunk Road

Present Classification of Selected Roads
Singida Region/Singida District
Plate VII-4

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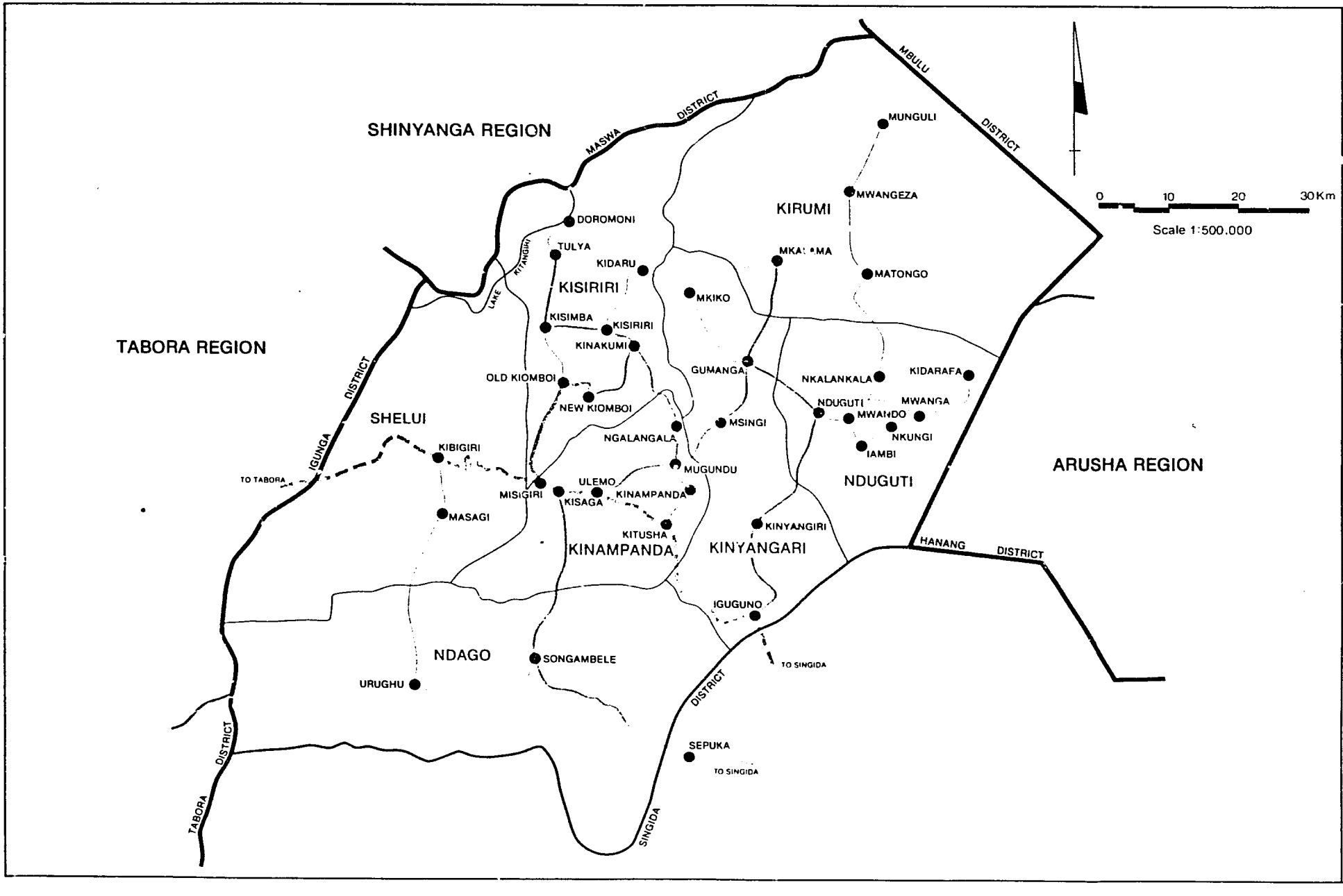

Present Classification of Selected Roads
Singida Region/Iramba District
Plate VII-5

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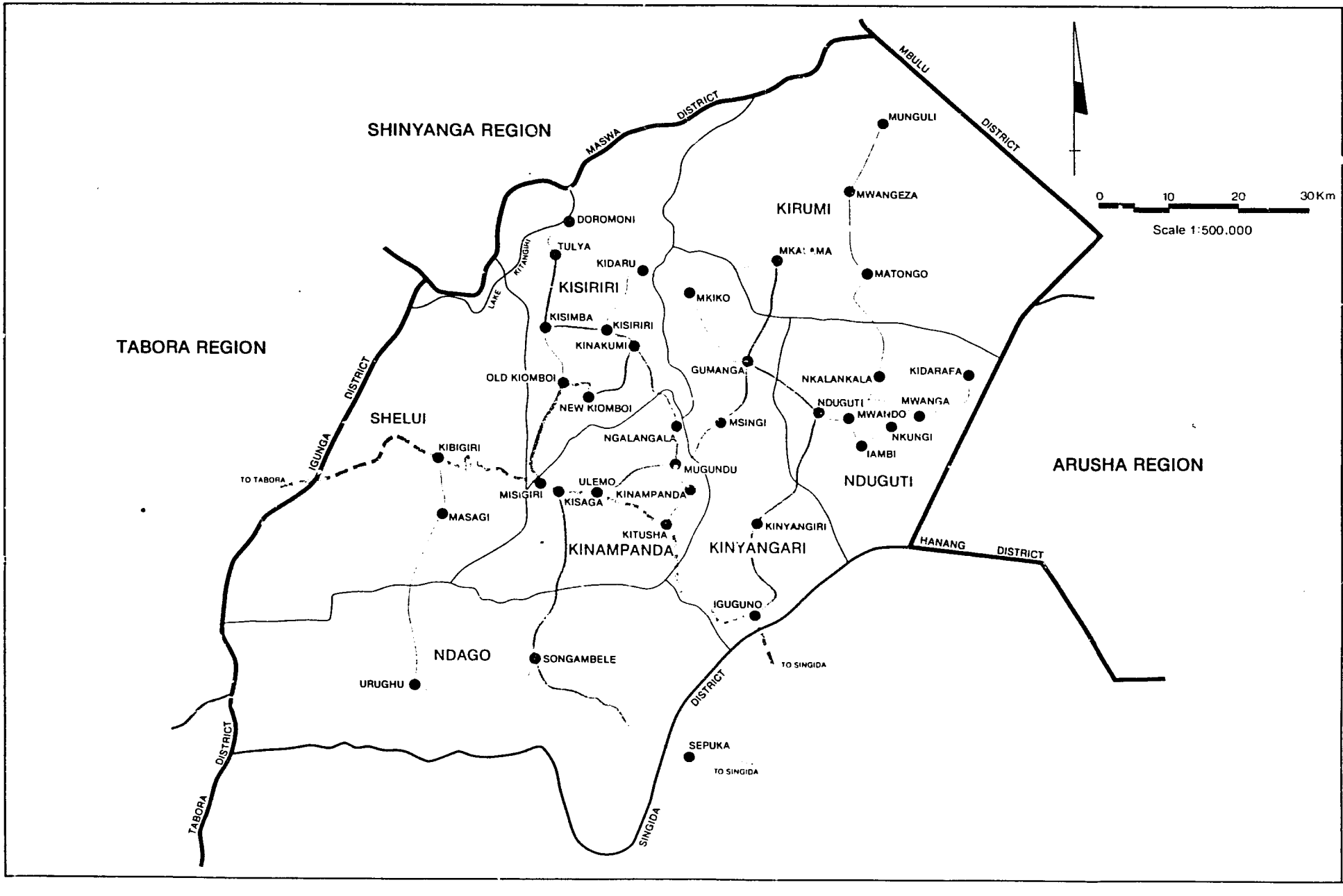

Present Classification of Selected Roads
Singida Region/Iramba District
Plate VII-5

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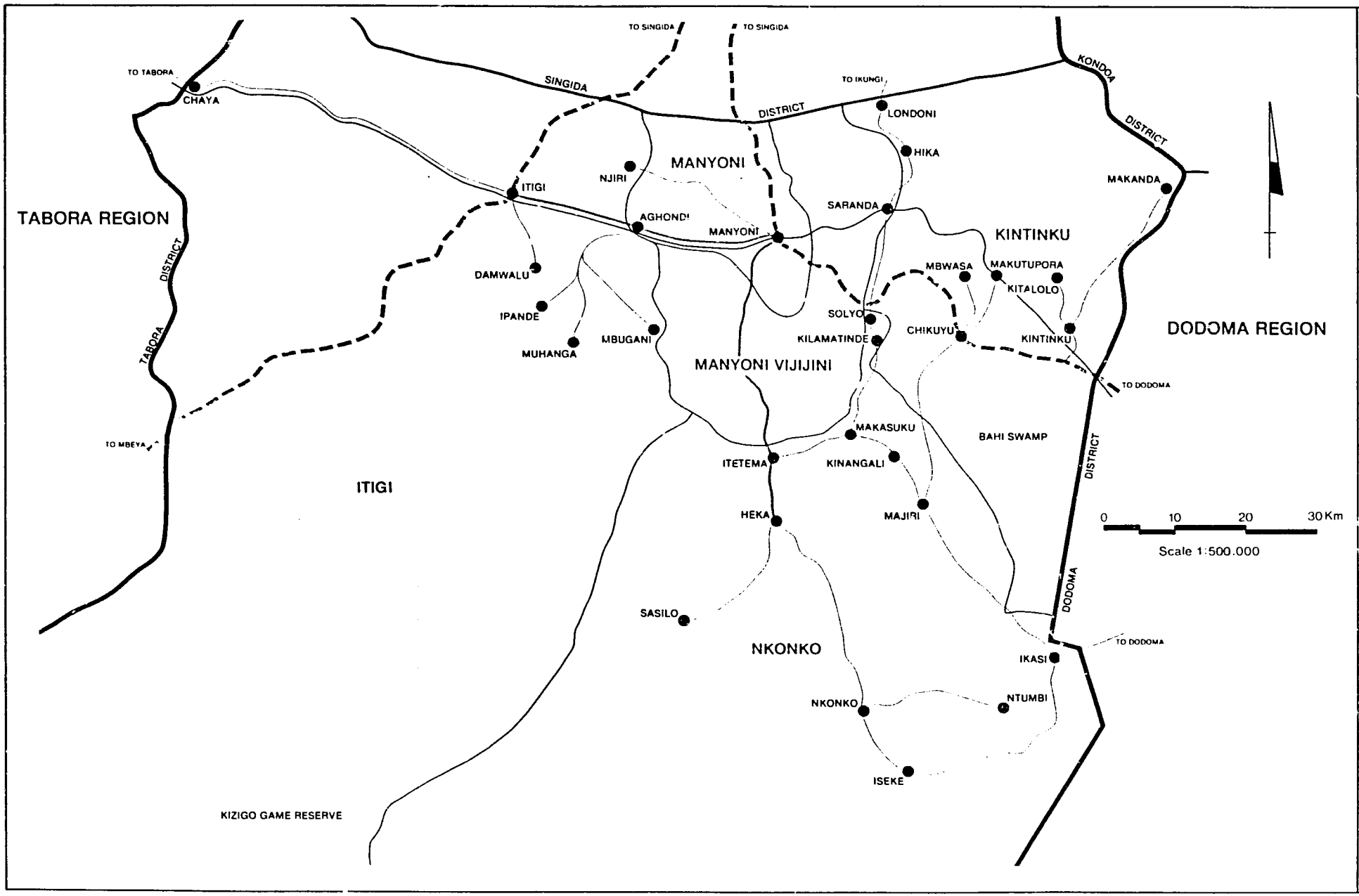
TABORA REGION
TABORA DISTRICT
TO TABORA
CHAYA
TO MBEYA
ITIGI
KIZIGO GAME RESERVE
SINGIDA DISTRICT
TO SINGIDA
TO SINGIDA
ITIGI
NJIRI
AGHONDI
MANYONI
MANYONI
DAMWALU
IPANDE
MUHANGA
MBUGANI
MANYONI VIJIJINI
TO IKUNGI
LONDONI
HIKA
SARANDA
SOLYO
KILAMATINDE
KINTINKU
MBWASA
MAKUTUPORA
KITALOLO
CHIKUYU
KINTINKU
MAKANDA
KONDOA DISTRICT
DODOMA REGION
TO DODOMA
BAHI SWAMP
MAKASUKU
KINANGALI
ITETEMA
HEKA
MAJIRI
SASILO
NKONKO
NKONKO
ISEKE
IKASI
NTUMBI
DODOMA DISTRICT
TO DODOMA
0 10 20 30 Km
Scale 1:500.000
Legend
Railroad
Division
District
Region
Feeder Road
District Road
Local Main Road
Trunk Road
Present Classification of Selected Roads
Singida Region/Manyoni District
Plate VII-6
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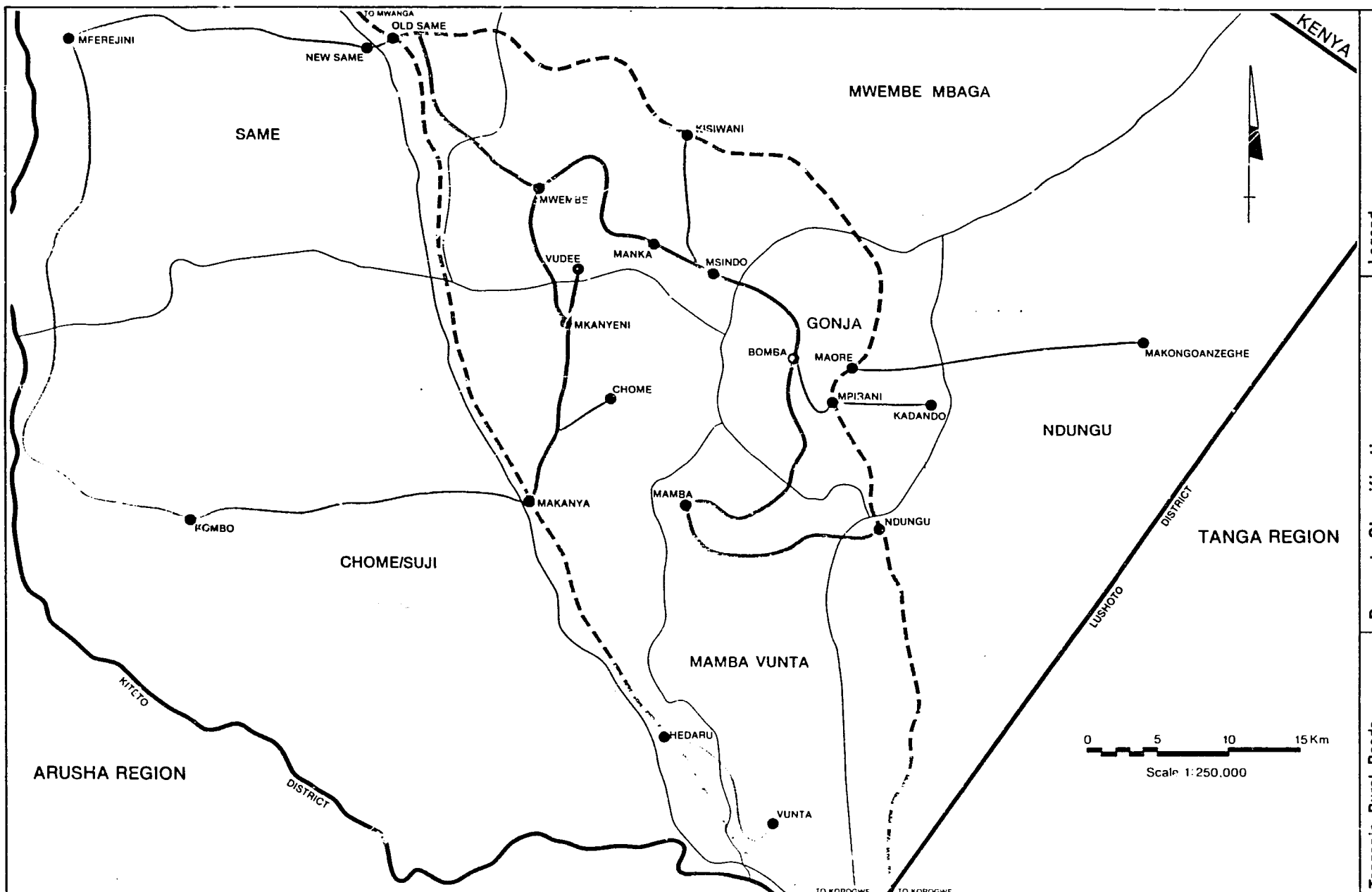

Present Classification of Selected Roads
Kilimanjaro Region / Same District
Plate VII-7

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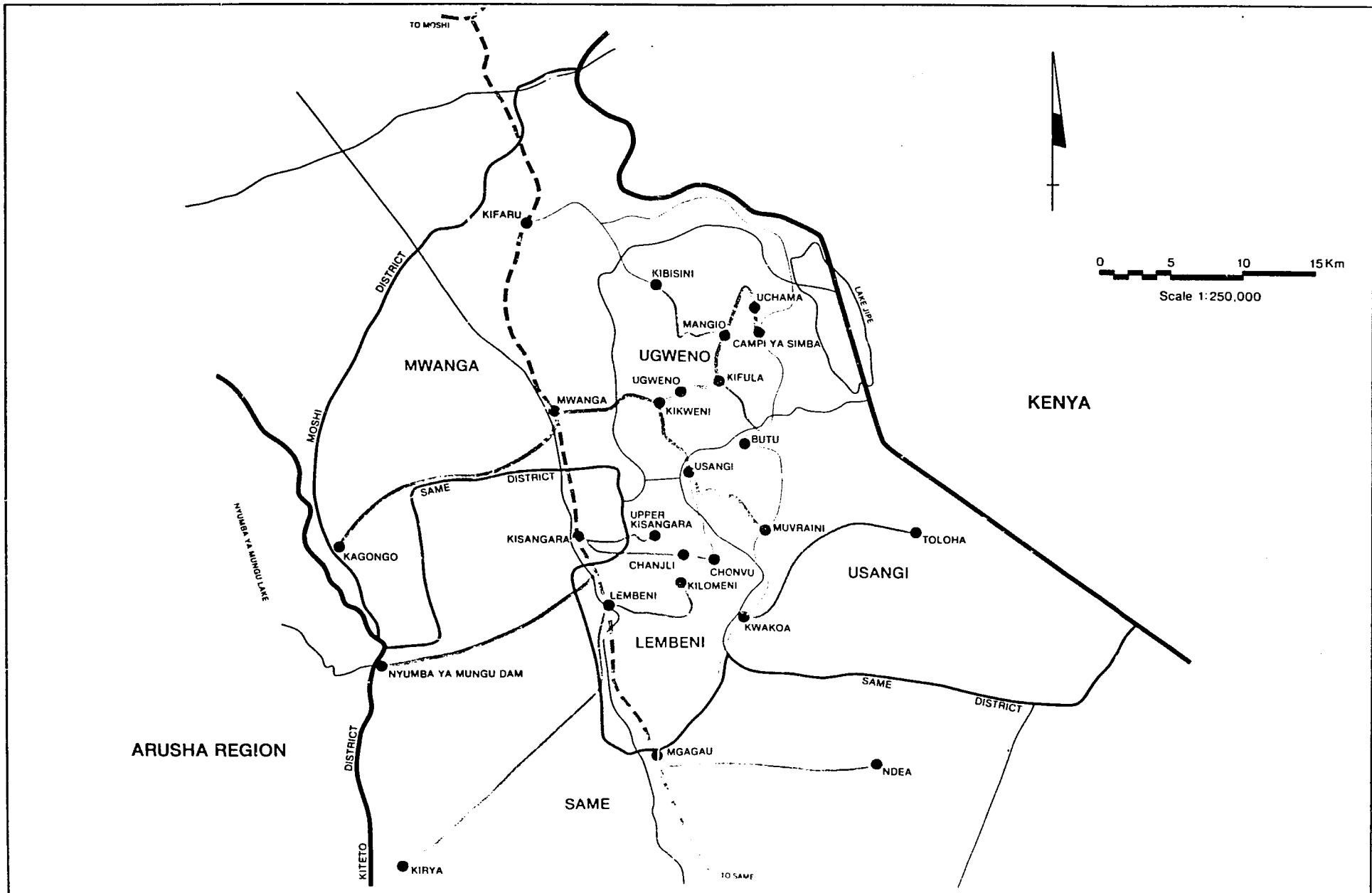

Legend
- Railroad — Feeder Road
- Division — District Road
- District — Local Main Road
- Region — Trunk Road

Present Classification of Selected Roads
Kilimanjaro Region / Mwanga District
Plate VII-8

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The overall program is scheduled to complete 4,335 km of clearing and shaping and 2,835 km of embankment and surfacing during 3 years. Culvert and bridge and drift repairs are estimated at 17,280 lineal meters

Local contractors have limited resources and consequently the rehabilitation work is proposed to be done by an organization within the Ministry of Works, maintaining a close association with the Regional and District Engineers. A mix of labor-intensive and equipment-oriented construction is proposed as being most cost-effective with the manpower skills presently available in Tanzania.

Each Rehabilitation Field Team will be headed by an expatriate engineer Team Leader, supported by expatriate Mechanical and Equipment Operation Superintendents, all with local Counterparts, and supporting shops, office and operating crews performing the rehabilitation work. Virtually each of the operators, mechanics and many of the skilled personnel will have a trainee assigned to him.

A Project Coordinating Team, to be based centrally, will be made up of a Project Coordinator; Highway Engineer; Highway Engineering/ Training Supervisor; Parts and Supply Managers; and an Office Manager. All of these expatriates will train an assigned Counterpart.

Training will be an integral part of the rehabilitation program. During the rehabilitation, training will be provided for seven engineers, eight superintendents, two administrators, and 132 skilled personnel, out of 272 locally hired individuals for the program.

On-the-job-training will be supplemented with self-study and other training materials utilizing the expatriates as instructors. Training programs will be prepared and the presentation supervised for consistency. Progress of the trainees will be monitored and certifications awarded when competency has been achieved.

A 3-year follow-on maintenance program is recommended, with expatriate engineers providing training and direction. The training program would continue with new trainees. The organization of the teams would remain largely the same, but called Maintenance Teams. At the end of the second 3-year period, the responsibility for the Teams would have been evolved to the Counterparts and the Maintenance Engineer in the Ministry of Works.

The maintenance effort will commence as soon as the individual roads have been rehabilitated. Routine maintenance will be largely handled by labor-intensive methods, employing 4,560 "maintenance contractors," each performing maintenance duties on an average of 1.5 km of roadway. Other functions, such as grading and resurfacing with granular material, will be performed periodically by the Maintenance Teams. At the completion of the rehabilitation program, the maintenance phase will be fully implemented and the maintenance teams will assume responsibility for the entire team area.

II. DESCRIPTION OF THE PROJECT AREA ENVIRONMENT

A. Natural Environment

1. Geology

The rock types that occur in Tanzania are typical of much of tropical Africa. Most of the country consists of pre-Cambrian rocks which have been divided into two major systems. The Paleozoic is represented by the Karroo Series of rocks which are found in the eastern part of the country. A narrow band of Mesozoic and Cenozoic sediments occur along the coast.

The Rift Valley system has had a major influence on the geology as well a the topography of western and north central Tanzania. This influence was not limited to the major rift faulting which occurred. General large scale uplift preceded the faulting, producing the broad plateaus. Volcanic activity was also associated with the Rift faulting; in Tanzania, this apparently began after the faulting was initiated. Most of these volcanoes are now considered extinct or dormant, but a few are still active.

The widespread Tertiary erosional surfaces common throughout Africa are also found in Tanzania. These are of particular significance because they are important possible sources of materials. Extensive concretionary or indurated ironstone have developed on most of these surfaces and many of these deposits have been preserved. The most extensive is the mid-Tertiary surface, sometimes called the Africal Surface. The major locations include the greater part of the central plateau from Dodoma to Lake Tanganyika. The main Serengeti Plain and the Masai Steppe are part of this surface, as is the main surface of the southern central region. In the south it is found around Songea and extends easterly across the Karroo sediments into the coastal region.

The Dodoma System of pre-Cambrian age are the oldest rocks in Tanzania. These coarsely crystalline metamorphic rocks are schist, quartzite, amphibolite and hornblende-gneiss, acid-gneiss, and other types of gneiss. Migmatites also occur and granite is widespread. The Dodoma Series is found in the west central part of the country,

principally in the Tabora, Mbeya and Iringa Regions with scattered outcrops in the southern part of the Dodoma Region.

Quartzites and volcanics compose the Nyanzian System which overlies the Dodoma System in the northwestern part of the country. Principal occurrences are in the Mara, Mawanza, Shinyanga and Singida regions. The principal rock is a "banded ironstone." The volcanics have been slightly metamorphosed.

The Kavirondian System is associated with the Nyanzian; both may be considered Middle pre-Cambrian. This system is made up principally of conglomerates, feldspathic sandstone, quartzites and volcanics. Both systems have been largely intruded or altered to granite or grandiorite. This granitic rock is widely exposed from east of Dodoma to west of Mwanza and from the Kenya border as far south as Njombe.

Metamorphosed sedimentary and volcanic rocks make up two complementary systems. The Usagaran System is found in the eastern part of the country, in most places in contact with the granite mentioned above on the west and extending as close as 40 kilometers from the coast. These rocks continue into Kenya in the north and Mozambique in the south. The Ubendian System occurs in the west, between Lake Tanganyika and Lake Nyasa. Both systems are made up of a wide variety of metamorphic rocks including marble; quartzite; graphitic schist; hornblende; biotite- and garnet-gneiss; acid-gneiss; granulite and charnockite.

The Karagwe-Ankolean System occurs mainly in the northwestern part of the country, in West Lake Region, with smaller occurrences north of Lake Nyasa and east of Lake Tanganyika. The principal rock types are phyllites and quartzites, although schist, sandstone, augen-gneiss and migmatite are also mentioned. Granites and grandiorites have intruded this series.

The Bukobian System, which also occurs in the west, is late pre-Cambrian but may extend into the Paleozoic. It occurs in a wide strip from south of Kigoma to north of Bukoba. It includes a wide assortment of rocks, mudstone, shale and phyllite, sandstone, arkose, quartzite, conglomerate and limestone. The most important rock types, however, are the flood basalts and andesites.

The only Paleozoic rocks in Tanzania are the Karroo Series. The type locality in the country is in the Songea District, where the rocks are termed the Songea Series. This series is composed of massive feldspathic sandstone, coarse sandstone with some conglomerate siltstones and shales, carbonaceous shales and coal seams.

Marine limestones, mudstones, sandstones, shales, conglomerates and marls occur in a narrow irregular strip along the coast. These penetrate up to 150 kilometers inland. The rocks are Jurassic, Cretaceous, Tertiary and Quaternary in age. No marine rocks are found west of this belt.

Continental sediments of Cretaceous, Tertiary and Quaternary age occur inland. The older sediments, found in the Mbeya and Tabora regions, are mainly sandstones and sands. In the central and northern regions, limestone, silt and other continental sediments were deposited in lakes and shallow basins formed by the warping of the surface which occurred during the Rift faulting.

It is believed that volcanic activity began in late Cretaceous time, associated with the Rift Valley faulting. There were two major centers. The activity in the south was at Mount Rungwe and the Poroto Mountains southeast of Mbeya. In the north the volcanics produced Mount Kilimanjaro, Mount Meru and many others to the west and south, including Mount Hanang near Babati. The volcanic activity extended into Kenya and Ethiopia. The rocks are typically alkaline volcanics: olivine basalt, alkali basalt, phonolite, trachyte, nephelinite and extensive pyroclastics such as tuff and ash.

2. Soils

The soils of Tanzania are complex and variable. Most of the soils are lateritic or partially laterized. The three principal tropical soil types in Tanzania are ferruginous soils, ferrallitic soils and ferrisols.

The major problems in road location are terrain, rainfall and soil conditions. Often these are related. The higher rainfall tends to occur at higher elevations, and among the various soil-forming factors, the soil type that forms is most influenced by rainfall.

Soil type and rainfall have also played an important role in agricultural development. Desirability of climate for health and comfort have also been important factors. The Pare Mountains with their elevated rainfall, cooler climate and relatively deep soil development for a mountainous area provide good soil and climate for certain crops and a more desirable and healthful place to live than the surrounding lowlands where other types of crops are also raised. The Rubeho Mountains in Mpwapwa district on the other hand have less rainfall, shallower soil development, and are generally populated in the valleys where fertile soils occur.

Road development in the Pare Mountain has occurred, despite the difficult terrain, because of the agricultural potential. Problems in construction have included steep grades, earth and rock excavation, slope stabilization problems and erosion. Road development in the Rubeho Mountains have been generally restricted to valleys where excavation problems have been minor and where rock excavation is rarely required.

In all parts of Dodoma and Singida regions, rainfall is often intense. This is characteristic of tropical storms, and storm damage to roads and bridges is a common occurrence. This is particularly true when maintenance is lacking because of debris and drainage structures which do not function. Erosion of the roadway almost certainly follows and considerable damage can occur in one severe rainstorm.

The soils in much of Dodoma and Singida are particularly susceptible to erosion. They are generally sandy loams which contain insufficient fines to provide cohesive resistance to erosion and the tractive force of flowing water. Erosion protection at old structures is important and many problems with bank erosion have occurred in these regions.

The "black cotton" clays or silty clays swell with moisture provided by rains, lose strength and become slippery. Heavy vehicles easily bog down.

The soils in Dodoma and Singida regions, as well as in the Mwanga and Same districts of Kilimanjaro, are such that trafficability is not a problem even during rainy seasons. Many roads can be traveled year-round that have little or no surfacing material. Many others are affected for relatively short periods during rains.

The number of days per year that a road is likely to be impassable is impossible to predict because it is dependent on many factors such as rainfall intensity and duration, the type of soil, the time between rains, number of vehicles and axle loads, and drainage and wind, among other factors. For a few vehicles per day, say less than 5, perhaps up to 50mm rainfall may occur before an earth road in an essentially granular subgrade becomes impassable. In clayey soils, 25mm may be the maximum for 5 vehicles.

3. Climate

Generally speaking, there are three climatic zones in Tanzania:

a. The hot and humid coastal region with a mean annual temperature of 76° F. and two rainy seasons between October and June.

b. The hot and arid Central Plateau with low humidity and low rainfall (100-500mm/year). There are considerable climatic variations within this zone.

c. The semi-temperate areas of the major mountain system, such as Kilimanjaro, Meru, the Crater Highlands to the west, the Southern Highlands, Usambara Mountains, and to a lesser extent, the Pare Mountains. Temperatures are considerably lower and rainfall considerably higher.

Dodoma and Singida regions fall in the hot and arid zone of the Central Plateau. Variations occur, particularly in Mpwapwa district, but most of the remainder of these regions have between 400 and 800mm rainfall annually, which is low for a tropical country.

Same and Mwanga districts also have low rainfall, between 400 and 600mm annually, except at the higher elevations of the Pare Mountains where over 1,000mm of rain may fall. Most of the mountain areas receive at least 800mm annually.

In Table II-1 are summarized rainfall data for stations that are considered representative of most of the district in which they lie. No station is given for Mwanga district, but the two in Same district are considered representative of Mwanga district. The variation between the two stations illustrates the variation of rainfall with elevation; Makanya lies on the surrounding lowlands while Suji mission is in the Pare Mountains.

TABLE II - 1 — MEAN ANNUAL RAINFALL

Station No.	Identification	Years of Record	Mean Annual Rainfall, mm
96.3600	Mpwapwa Agricultural Station	49	701
96.3501	Dodoma Meteorological Station	52	559
94.3515	Masange, Kondoa	25	743
95.3400	Mayoni District Office	47	644
94.3401	Singida District Office	50	672
94.3417	Kiomboi Administration Building, Irambi	16	830
94.3701	Makanya, Hasani Sisal Estate, Same	37	501
94.3704	Suji Mission, Same	38	864

The small seasonal variation in temperature is exceeded by the diurnal range which is greatest over the Central Plateau where it can be as much as 20° C. and least along the coast where it is about 8° C.

4. Vegetation

Bushland and thicket interspersed with large cultivated areas are the major vegetation types in the Dodoma and Singida regions. Some forested areas occur in the Same district. Bushland and thicket is composed principally of dense shrubs and small trees with perhaps a ground cover of grass. This is the predominant vegetative cover in the more arid regions. Wooded grasslands are located mainly along the flood plains of the major rivers.

5. Wildlife

Tanzania has a rich heritage of wildlife; it rightfully boasts of having within its borders the widest and most exciting varieties of wildlife in the whole world. It is estimated that about four million wild animals inhabit Tanzania — including elephants, rhinos, lions, leopards, and buffalo. Also found in many parts of the country in abundance are cheetahs, hyenas, antelope, rare oryx, generuk, and gazelles.

All three study regions, Dodoma, Singida and Kilimanjaro, have a variety of wildlife. For instance, in Dodoma region, there are a good number of wild animals scattered all over but mainly in the region's two Game Controlled Areas. There is no game park or related tourist industry in the region. The protected areas are the Mkungenero controlled area situated in the eastern part of Kondoa District and bordering Arusha district; and Kengwa controlled area, the area north of Kongwe Sub-District which includes Kongwa Ranch and extends nearly up to Hogoro and Mkutani Ujamaa Villages. Wildlife species commonly found include herbivorous animals such as buffalo, dikdik, elephants, Grant's gazelles, Thomson's hogs, impala, greater kudu, white bearded wildebeest, zebras, giraffes, and birds such as ostriches; and carniverous animals such as lions, hyenas, and a small breed of leopard.

The 5,000 square mile Ruaha National Park is located about 150 miles south of Dodoma and the 1,000-square mile Tarangire National Park, about the same distance north. The 3,500-square mile Rungwa Game Reserve is located about 150 miles southwest of Dodoma, while the 1,400-square mile Mkomati Game Reserve is located some distance east of Same District of Kilimanjaro Region.

As the population of cities in the three regions under study increased during the past few years, wildlife species and their numbers have decreased in the vicinity of such urban centers. Some of the reasons for the decline of animal population and species include destruction of wildlife habitat, limited area of surface water availability, and, most important of all, the viewpoint held by many who consider wildlife as obstacles to good land use planning.

Likewise, for the last few years, the number of wild animals in the rural areas has also been decreasing steadily, not only due to natural causes such as drought conditions caused by poor rainfall, but as a result of increased poaching by illegal hunters. Tanzanian Government has realized this problem and has begun to take measures to minimize such illegal slaughter of wild animals in several regions of the country. As a conservation measure in certain areas, it has indefinitely prohibited hunting and capturing of wild animals. However, poaching is continuing

because the lack of good roads, vehicles and fuel supply all prevent apprehension of poachers.

6. Air Quality

There are no current regulations on air quality control within the area under study. No actual air monitoring was made; however, air quality appears to be good from observation, since there is very little vehicular traffic.

7. Agriculture

Agriculture is the main economic activity of Tanzania. It accounts for about 39 percent of the Gross Domestic Product and about 78 percent of the total value of exports.[1/] The major agricultural exports are coffee, cotton, sisal, cloves, tobacco, cashew nuts, and tea. About 84 percent of the labor force is employed in the agricultural sector,[2/] while nearly 60 percent of the agricultural production is at the subsistence level.[3/] For the three regions of this study, agriculture also dominates the economic activity. For example, in Dodoma region, about 87 percent of the rural population is presently engaged in agriculture (90 percent of the males and 84 percent of the females).[4/] In 1974, about 94 percent of the population of Dodoma region was reportedly dependent upon agriculture for their livelihood.[5/]

Nearly all of the agricultural labor in Dodoma is self-employed, with agricultural workers representing less than one-half of one percent. Similar conditions regarding the role of agriculture prevail in the other two study regions, Singida and the Same/Mwanga districts of Kilimanjaro.

Agricultural practices with regard to food and cash crops in Dodoma and Singida are similar since the crop husbandry is similar. In the case of the Same and Mwanga districts of Kilimanjaro region, some of the agricultural practices differ from the other two regions.

1/ The United Republic of Tanzania, The Economic Survey, 1977-78, printed by the Government Printer, Dar es Salaam, Tanzania, 1979.

2/ The World Bank, World Development Report, 1979, Annex II, p. 162.

3/ Computed from data in The Economic Survey, 1977-78, Table 4, p. 12.

4/ The National Demographic Survey of Tanzania, 1973, as cited in Tanzania Dodoma Interim RIDEP, Main Report, p. 129, January 1979.

5/ C.I.D.A., Dodoma Region Integrated Rural Development Plan, January 1975, p. 20.

Agriculture as practiced in the Dodoma and Singida regions has been dependent for many years upon the traditional methods of shifting cultivation coupled with the production of subsistence crops. Both regions have very little developed irrigation, and thus have been dependent upon erratic and inadequate rains in many parts of the two regions.

Shifting cultivation in Tanzania involves moving into a new area; clearing land through cutting and burning; and then planting, weeding, cultivating and harvesting the first crop. The land is then left fallow for another two to three years, while other plots are being treated in the same manner. Although leaving the land fallow allows the soil fertility to rejuvenate itself, destruction of the vegetation cover oftentimes leads to serious erosion before the new weeds, native grasses and brush have had time to take over.

The ash residual from burning of the vegetation, which is left on the land, also adds to the soil fertility, but complete destruction of the vegetation without an immediate replacement cover crop such as legumes, following the harvesting of the initial cereal crop, leads to the erosion problem mentioned previously.

Shifting cultivation has been practiced to a lesser extent in the Same and Mwanga districts of Kilimanjaro region. This is largely because the mountainous areas of these districts with their dense populations have an acute land shortage, especially in the North Pare Mountains. There has been some shifting cultivation on the plains, where parcels of land are largely owned by people who live in the mountains, but this type of cultivation has been quite limited.

In recent years, continuous cropping has begun to evolve for a number of reasons, including:

a. The ujamaa program, which has brought rural families together into the villages with more or less defined boundaries. The ability to engage in shifting agriculture is thus limited as more of the new village land is developed;

b. The growing population and increase in livestock have put pressure on land use and land availability;

c. Prohibition against clearing native forests; and

d. Encouragement by the government of intercropping of cereals such as sorghum and bulrush millet which, when grown in combination, tend to reduce the chances of crop failure. Of even greater importance in the present intercropping program is that of legumes being planted with cereals. The legumes increase the fertility of the soil by largely replacing the nitrogen absorbed by cereals.

Intercropping has been a normal practice for many years in the Pare Mountains of Same and Mwanga districts,[1/] but the practice was not always aimed at increasing the fertility of the soil. For example, coffee and bananas (and occasionally fruits) are normally interplanted. Although a major reason for this interplanting is to provide shade for the coffee trees, the bananas do provide an additional food subsistence crop, and at the same time increase utilization of the scarce land. Maize, beans and cassava are also interplanted in these districts. In this instance, beans (a legume crop) serve to restore soil fertility.

The average size of areas of cultivation in the three study regions are small, since they are representative of smallholders utilizing traditional methods of hand cultivation limited by the size of families.[2/]

In the Singida region, the average area cultivated in 1975 was reported as 1.6 hectares (3.8 acres).[3/] For the Dodoma region, the Dodoma Regional Development Committee established three acres as a minimum for each family to cultivate, of which two acres were to be in food crops and one acre in cash crops.[4/] Agricultural crop specialists in the region indicated that most of the farm community had exceeded this minimum, with actual area of cultivation now averaging 3-4 acres for food crops, and 1 acre for cash crops. The average farm size in the Same/Mwanga district is estimated at somewhat less than 1 hectare (2.4 acres) in the Pare

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1/ See Bureau of Resource Assessment and Land Use Planning, University of Dar es Salaam, Agro-Economic Zones of Northeastern Tanzania, Research Report No. 13, p. 63.

2/ There are exceptions to this in some areas such as Kondoa and Iramba districts where a substantial number of oxen are being utilized for plowing and cultivation.

3/ Australian Development Assitance Bureau, Singida Integrated Livestock Development Study, Volume I, p. 36.

4/ Information provided by District Agricultural Development Officer, Dodoma Rural District.

Mountains with all of it under cultivation every year. In the plains areas of Mwanga and Same the farms are estimated to average from 1 to 2 hectares (2.4 to 4.8 acres), with most of the land cultivated, although on the larger farms some land is often left fallow.[1/]

The major crops among the cereals grown in the Dodoma and Singida regions are maize, sorghum and millet (bulrush and finger). Maize is the primary and preferred subsistence crop (and a major commercial crop) although the people also consume other cereals. Other food crops grown include sweet potatoes, yams, and cassava (which are planted as famine reserve crops), mixed beans, small quantities of cowpeas, pigeon peas, and various fruits and vegetables. To this listing from Same/Mwanga, one must add sugar cane, bananas, and paddy. The so-called cash crops, which are also largely food crops of a type, but are grown primarily for commercial purposes, include the oilseeds (sunflower, castor, simsim [sesame], groundnuts), grapes, cotton and tobacco. Other cash crops of greater importance to the Same/Mwanga districts are coffee, cardamom and sisal.

The government is encouraging planting of new varieties of sorghum (Lulu and Serena), which are more drought-resistant than the traditional varieties. Similarly, it is encouraging the expansion of bulrush millet, which is also of a drought-resistant type. An expansion in sunflower production is also being urged by govern officials in both the Dodoma and Singida regions. Improved seed for this crop, as well as some castor and sesame, is being distributed to a number of the villages throughout both regions. This is a part of the national Third Five Year Development Plan which seeks to stimulate increased oilseed production among other agricultural goals.

Growers of grapes in the Dodoma urban and rural districts are being urged to expand production in order to provide an assured and adequate supply to the new winery to be constructed near Dodoma town.

8. Livestock

Livestock contributes about one-third of the total agricultural sector

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1/ BRALUP, Agro-Economic Zones of Northeastern Tanzania, pp. 63, 66.

contribution. It is a major source of income and of food supply to a large percentage of the population within the study regions, expecially with regard to Dodoma and Singida regions. These two regions are major exporters of cattle to other regions, and the nation is beginning to develop an export meat industry. Relative importance of the three study areas to the nation's livestock population in 1978 is illustrated in the following table:

TABLE II - 2 — STUDY AREA LIVESTOCK POPULATIONS AS PERCENTAGE OF NATIONAL TOTALS, 1978

Study Areas	Cattle	Goats	Sheep
Dodoma	9.2	10.8	8.4
Singida	6.5	7.6	6.7
Same/Mwanga Districts	1.7	3.7	3.0

Source: Computed from data in Ministry of Agriculture, The 1978 Livestock Count in Mainland Tanzania and Beef Demand and Supply Study, September 1979, and data supplied to the consultant by the Regional and District Livestock Officers for each of the study areas.

According to the Livestock Population Census of 1978, Tanzania's cattle population totaled about 12.0 million head.[1/] This compares with about 6.5 million head in 1954, the only other year in which there has been an official count. The annual average growth rate between 1954 and 1978 was 2.2 percent. This rate, less than the population growth rate for the same period, reflects the drought years of 1973-75 when herds were greatly depleted both from increased marketings because of lack of pasture and from deaths due to starvation. In recent years, the herds have been in a replenishing stage.

Cattle population census data for 1954 and 1978 (with estimates for intervening years for the study areas) show cattle numbers for Dodoma region nearly doubling over the 28-year period (1954-78), while those for Singida region increased by about two and one-third times. For

1/ Ministry of Agriculture, the 1978 Livestock Count in Mainland Tanzania and Beef Demand and Supply Study, September 1979, p. 26, Table I.

the Same/Mwanga districts (formerly Pare), the increase was nearly two and one-half times. The annual average growth rates for the three study areas during this 28-year period were as follows:

Dodoma region	— 2.3
Singida region	— 3.1
Same/Mwanga districts	— 3.2

The annual average growth rates for all three study areas are above the 2.2 percent national average.

Historical trends in cattle population by districts within the two regions, Dodoma and Singida, show that Mpwapwa district had the highest annual average rate (2.8 percent) and Kondoa district the lowest (1.7 percent). The low rate for Kondoa probably reflects the recent movement of cattle out of the badly eroded areas. In the Singida region, Singida Rural District has had a growth rate of nearly 4 percent, the highest of any of the districts in the two regions. In contrast, Manyoni district has only 1.1 percent, the lowest annual average rate within both regions.

Comparisons among the study areas by actual numbers of head in 1978 show Dodoma with 1.1 million cattle, leading Singida by about 324,000 head. The Same/Mwanga districts combined with slightly over 200,000 head, accounted for about one-half the total cattle population of Kilimanjaro region in 1978.

For the other major categories of the livestock population (goats and sheep), Dodoma has about 600,000 goats and 420,000 sheep, while Singida has about one-half the Dodoma totals for goats and sheep (Table II - 3). In the Same and Mwanga districts, the number of goats were about equal to the number of cattle (206,500 head), while the sheep population is about one-half the other two (108,000 head).

On a district basis, Dodoma Rural District has the largest cattle population in the region (46 percent of the total), and also for the 9 districts in the study area. Kondoa and Mpwapwa are other important cattle districts in the region, while in Singida region, Singida Rural and Iramba districts together account for about 86 percent of the region's total cattle population. Relatively similar relationships exist among the districts of the two regions in terms of goats and sheep (Table II - 3).

Livestock market sales at the approximately 104 market facilities operated by Tanzania Livestock Marketing Corporation in Dodoma and Singida

TABLE II - 3 — SUMMARY OF LIVESTOCK POPULATION BY STUDY REGIONS, DISTRICTS AND MAJOR ANIMAL CATEGORIES, 1978 CENSUS

Region and District		Cattle	Percent of of Total	Goats (Number of Head	Percent of Total	Sheep	Percent of Total
Dodoma							
Dodoma Rural		507,434	46.1	189,535	31.7	116,993	39.0
Dodoma Urban		113,048	10.2	67,592	11.3	17,807	5.9
Mpwapwa		230,553	20.9	145.785	24.4	67,439	22.4
Kondoa		252,037	22.8	194,979	32.6	98,347	32.7
	TOTAL	1,103,072	100.0	597,891	100.0	300,586	100.0
Singida							
Singida Rural 1/		338,842	43.5	189,323	45.2	108,878	45.4
Iramba		328,314	42.2	188,456	45.0	111,076	46.3
Manyoni		111,687	14.3	41,352	9.8	19,839	8.3
	TOTAL	778,843	100.0	419,131	100.0	239,793	100.0
Kilimanjaro							
Same		131,007	63.3	130,149	63.0	77,785	72.0
Mwanga		75,844	36.7	76,399	37.0	30,276	28.0
	TOTAL	206,851	100.0	206,548	100.0	108,061	100.0

1/ Includes cattle from Singida Urban.

Source: Appendix Tables

regions averaged about 114,000 head per year over the period of 1978 and 1979. About 60 percent of the total number of head sold were cattle, with 34 percent goats and the remaining 6 percent sheep.

Sales in all three categories of animals were larger from the Singida region than from Dodoma. This is perhaps reflected in the fact that the total livestock population of Dodoma is larger than that of Singida, which indicates that the former may be retaining its livestock for a longer period of time than the latter.

9. Water Resources

Rural water supply system information was collected on two bases — quantitative data on existing facilities, and qualitative comment on the transportation problems associated with providing village water. Information was collected through field interviews with district water engineers, and through reference to the Dodoma Water Master Plan[17], the Singida Water Master Plan, and the Kilimanjaro Water Master Plan. There were other sources of information on water supply that were reviewed[18,19,20,21].

There are wide differences on the types of water systems, dispersion of resources (water sites), efficiency of systems and potentials for development among the nine districts included within the study regions, as discussed in the following sections.

a. Dodoma Region

(1) Of the total 162 water schemes in operation in the region, only 94 are classified as suitable.

(2) The types of water sources in the region include boreholes, waterholes, springs, dams and rivers.

(3) The Dodoma district has 48 boreholes, 11 waterholes, and 3 dams. 27 of the boreholes are considered unsuitable, and 4 of the waterholes are classified as unsuitable.

(4) The Kondoa district has 53 water systems: 30 boreholes, 9 waterholes, 13 springs, and 1 dam. Of the 30 boreholes, 9 are classified as unsuitable. 6 waterholes and 6 of the springs are unsuitable. The dam water is considered unsuitable.

(5) The Mpwapwa district has 47 water systems: 34 boreholes, 6 waterholes, 4 springs, and 3 rivers. 16 of the boreholes and 2 of the waterholes are considered unsuitable.

(17,18,19,20,21) See Bibliography

b. Singida Region[1/]

(1) There are a total of 307 village water supply systems in the Singida region. Of these, 156 systems are considered to have serious problems, such as: contamination, quality of water, and distance to supply by villages (over 6 km round-trip considered as a problem). A breakdown of the sources of village water supplies for the region is in Table II - 4.

(2) Of the 139 water systems in the Singida district (rural and urban), approximately 70 percent are considered inadequate in terms of quantities and distance to source or otherwise unsuitable due to being polluted.

(3) The Iramba district has 105 supply systems. Of this total, 45 or 42 percent of the systems are considered inadequate.

(4) In the Manyoni district, 24 of the 63 water supply systems are considered inadequate.

c. Kilimanjaro Region - Same/Mwanga Districts[2/]

TABLE II - 4 — SOURCES OF VILLAGE WATER SUPPLY, SINGIDA REGION

Type of Supply	Whole Region No.	Whole Region %	Iramba No.	Iramba %	Singida No.	Singida %	Manyoni No.	Manyoni %
Shallow wells	119	39	39	37	62	44	18	29
Boreholes	71	23	19	18	24	17	20	44
Wells in rivers	52	17	31	29	12	9	9	14
Springs	24	8	4	4	16	12	4	6
Lined wells	22	7	3	3	16	12	3	5
Dams	12	5	6	6	9	6	-	-
Flowing rivers	3	1	3	3	-	-	-	-
Swamps	1	-	-	-	-	-	1	2

(1) There are 158 water systems providing service to the district's population.

1/ Water Master Plan Singida Region, Australian Development Assistance Bureau, Government of Australia, Summary Report, 1978.

2/ Water Master Plan Kilimanjaro Region, Final Report, Japan International Cooperation Agency, Vol. VII, 1977.

(2) Of the total number of operating systems, 17 are classified as surface water sources, 13 are boreholes, and 128 are springs.

(3) The Ugweno and Usangi administrative divisions in the Mwanga district have adequate water supplies based on the quantity of water. The systems in the Mwanga and Lebeni administrative divisions provide 69 and 38 percent of the current water requirememts, respectively.

(4) Water system adequacy in the Same district ranges from a low of 33 percent of the daily requirements in Mamba Vunta to a high of 99 percent in the Chome/Suki division.

During the Third Five Year Plan for Economic and Social Development, it is estimated that T/shs. 362.4 million will be spent on water projects. The main objective of the Third Five Year Plan is to provide rural population with adequate clean water supplies by 1991. In trying to achieve this important goal, efforts have been made to identify and, wherever possible, provide clean water to every village. Achieving the given long-term target necessarily means that an average of 1.5 million people should be supplied with water every year. Plans have also been prepared to supply water to every village.

In accordance with the Party's directive, the Ministry of Water, Minerals and Energy prepared a 20-year, long-term plan whose target was to supply water in rural areas so that by 1991 each village gets a source of sufficient and clean water.

Up to the end of 1971, 11.9 percent of all Tanzanians had access to clean water. In order to achieve the national objective of supplying a source of clean water to villages by 1991, it will be necessary to supply sources of clean water to 1,100,000 people per year. Table II - 5 shows the percentage of people who were supplied with water, in each region, by June 1975. It is interesting to note that Dodoma led all regions for the rural areas, with 62 percent. It was followed by Kilimanjaro with 40 percent.

TABLE II - 5 — WATER SUPPLY BY REGION
PEOPLE SUPPLIED WITH CLEAN WATER AS
PERCENTAGE OF TOTAL REGIONAL POPULATION, 1975

Region	Rural Areas	Urban Areas
Arusha	33	95
Dar es Salaam	-	-
Dodoma	62	80
Iringa	-	-
Kigoma	18	75
Kilimanjaro	40	74
Lindi	35	80
Mara	22	100
Mbeya	10	36
Morogoro	17	80
Mtwara	10	40
Mwanza	13	45
Pwani	-	-
Rukwa	15	40
Ruvuma	19	-
Shinyanga	7	84
Singida	35	60
Tabora	18	-
Tanga	15	72
West Lake	35	80

The problem that confronted implementation of the set targets included shortages of sufficient technicians to advise on technical aspects, especially at the district level. The second problem was lack of equipment. Since the decentralization was launched, the implementation of water programs has yielded substantial results, especially in respect to trench digging and pipe laying through self-help schemes.

Water is known to be the transmission vehicle for such diseases as cholera, typhoid fever and infectious hepatitis. An outbreak of chlorea occurred in two of the three study regions (Dodoma and Singida)

in March 1980. Its cause was attributed to contaminated water.

Programs for constructing dams and shallow and deep wells are being prepared and implemented. These projects are usually less costly than piped water schemes. With the general scarcity of financial resources, preference is given to the construction of shallow wells wherever possible. Projects that require large amounts of money are given second priority.

Some of the important studies related to its national water projects include the Rural Water Supply Program at Kilimanjaro, and continued implementation of the Singida and Dodoma Water Master Plans.

10. Mineral Resources

Mineral deposits in Tanzania are poorly located and development of minerals has been relatively slow. Mining industry in Tanzania started in 1921. In 1959, the annual value of mineral production in Tanzania exceeded £7 million for the first time. Although this figure is small compared with the value of mineral production from countries with large established mining industries, the mining industry of Tanzania has nevertheless grown steadily. Regional geological mapping and exploration, together with large-scale reconnaissance prospecting operations, has been initiated in certain geologically favorable areas in recent years. There can be little doubt that more mineral deposits, both large and small, will yet be discovered in Tanzania.

The rapid expansion in mineral production has been due largely to the increase in production of one mineral, diamonds. In fact, 90 percent of the total mining production value comes from diamonds. While mineral resources are an important asset of a nation's economy, minerals do not contribute significantly to Tanzanias output.

Metalliferous deposits of potential economic interest to Tanzania include gold, silver, tin, and iron; while non-metalliferous deposits of potential economic interest include diamonds, gemstone, mica, salt, gypsum, meerschaum, lime and magnesia. In the three study regions of Dodoma, Singida, and Kilimanjaro, the following mineral resources are

found of importance to Tanzania's economy:

(1) Dodoma Region — asbestos, corundum, nickel, magnesite, amethyst and rose quartz, columbite and tantalite, and phosphate;

(2) Singida Region — gold, diamonds, and brine springs; and

(3) Kilimanjaro — meerschaum and sulphur.

B. Human Environment

1. Socio-economics

a. Population

Demographic characteristics are fundamental to understanding the relationship between economic and social activity. A comparative summary of the 1978 Population Census for each of the study regions is presented in Table II - 6. This summary provides an overview of the population growth and density relationships among districts within regions. In terms of the three regions percent of total mainland population, the Dodoma region population represents 5.7 percent, followed by Singida at 3.6 percent, and the East Kilimanjaro area at 1.2 percent. As is apparent from this table, wide variations exist in population densities within the regions. The size of population and population density in each of the regions/districts provides an indication of existing demand for transportation services.

b. Ethnic Composition

The tribal groups comprising the native Africa population of Tanzania number around 130. Roughly 95 percent of Tanzania's African population are Bantu in languages and culture, with the resulting consequence that the vast majority of peoples share many linguistic and cultural characteristics. However, Kondoa district of Kodoma region contains non-Bantu peoples. Tribal composition is shown in Plate IV - 2. Pare is the primary tribal group in Same/Mwanga districts of Kilimanjaro region.

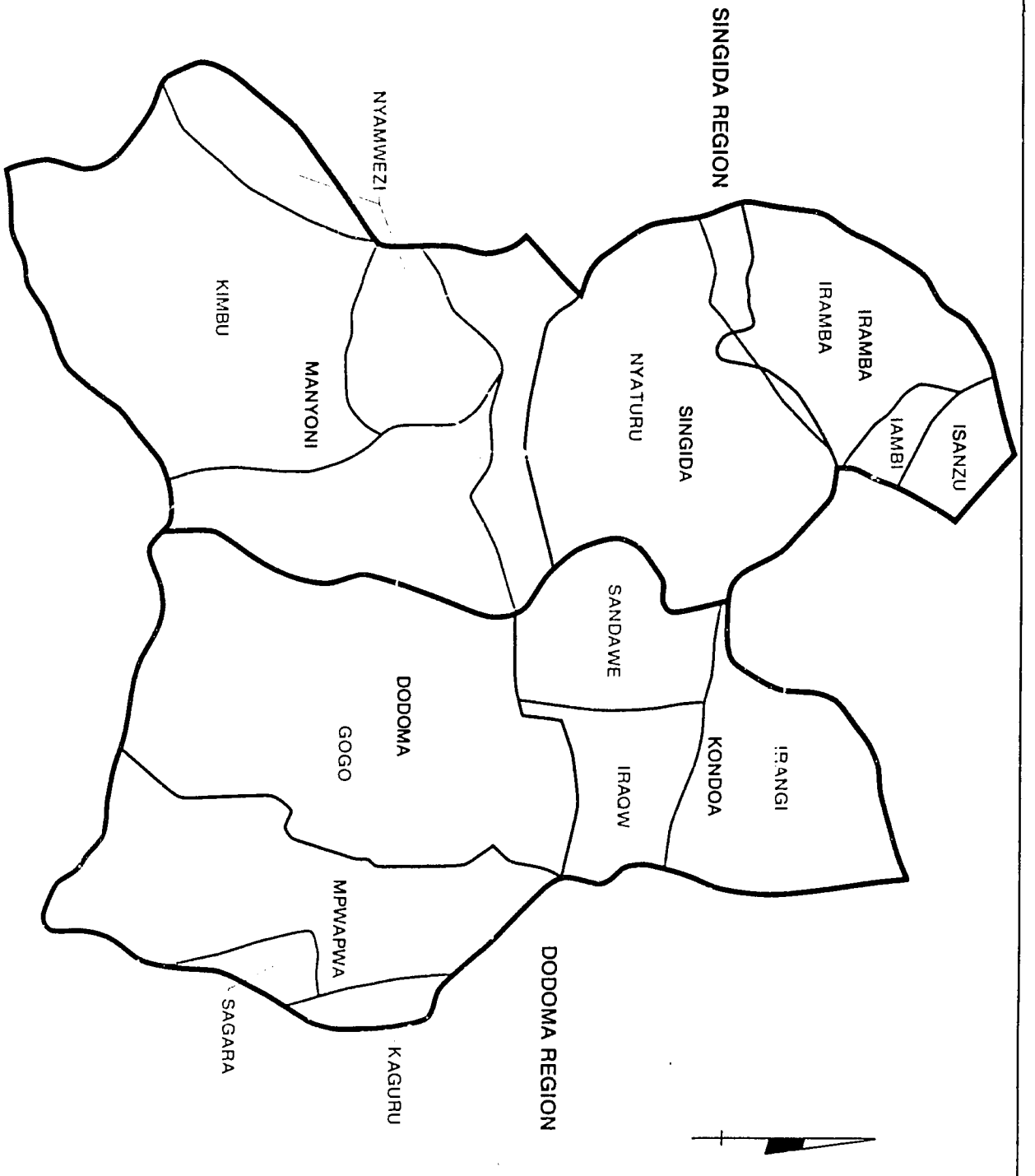
Some other characteristics of the population of the three regions are presented in Table II - 7.

TABLE II - 6

POPULATION AND DENSITY BY REGION AND DISTRICT OF THE STUDY AREA, 1967 AND 1974[1/]

Region/District	(Sq. km)	Population 1967	Population 1978	Absolute Change 1967-78	% Change	Annual Average Growth 1967-78 (%)	Population Density, 1978 (persons/sq.km)
Dodoma							
Kondoa	13,209	212,195	275,082	62,887	29.6	2.4	20.8
Mpwapwa	11,526	176,186	261,525	85,339	48.4	3.7	22.7
Dodoma Rural	16,168	220,334	276,737	56,403	25.6	2.1	17.1
Dodoma Urban	406	100,665	158,577	57,912	57.5	4.2	390.6
Kilimanjaro							
Same/Mwanga	7,930	149,635	208,164	58,529	39.1	3.0	26.3
Singida							
Singida Rural	12,164	159,398	213,732	54,334	34.1	2.7	17.6
Singida Urban	657	34,421	55,892	21,471	62.4	4.5	85.1
Iramba	7,909	183,962	242,003	58,041	31.6	2.5	30.6
Manyoni	28,620	80,157	102,403	22,246	27,8	2.3	3.6
Tanzania	885,987	12,313,464	17,527,564	5,215,095	42.3	3.0	19.8

1/ National Census Bureau, Provisional Data, March 1980.



Tanzania Rural Roads Feasibility Study
LYON associates, inc.
in association with
James R. Snitzler Associates, Inc

Tanzania
Singida and Dodoma Regions
Ethnic Groups
Plate IV-2

Legend
District
Region
Ethnic Boundary

TABLE II - 7 — AGE, SEX AND HOUSEHOLD SIZE IN DODOMA, SINGIDA AND KILIMANJARO REGIONS

Region	Total Population	Age 0-14	Age 15-34	Age 35+	% Male	Mean Household Size
Dodoma	971,921	46.7	29.4	23.9	47.5	4.8
Singida	614,030	45.4	27.6	27.1	47.3	4.6
Kilimanjaro	207,355	50.2	25.4	24.3	48.5	5.5
For Tanzania	17,527,564	46.1	30.5	30.5	49.0	4.8

These data show a heavily skewed population with nearly half of the country's population under 14 years of age. Slightly more than another quarter of the population falls between 15 and 34 years of age. A final quarter or thereabouts is above the age of 35 years. This profile reflects a growing population which will rapidly increase in size within a short period of time. Needs of the population for essential social services can be expected to increase considerably within the next few years and continue to do so within the foreseeable future.

C. Personal Income

As indicated earlier, Tanzania has an agricultural economy made up of smallholders. A traditional small holder's labor per day returns him T/shs 4.5 to T/sh 8.0. Per capita income for the three study regions is summarized in the following table.

TABLE II - 8 — REGIONAL SUMMARY OF PER CAPITA INCOME

Region	Per Capita Income, T/Shs		
	1972	1974	1976
Dodoma	525	538	750
Singida	477	517	948
Kilimanjaro	727	913	1,419
Tanzania	687	902	1,234

D. Health

An examination of health facilities, services, and the relationship between health services and the access opportunities provided by the road system was conducted as part of the field surveys. Interviews were conducted with the functional managers of health services at the district level. The functional managers serve as the district medical officers and as such were able to supply both statistical data and experienced insight as to the potential impacts of improving the rural access roads. These interviews were augmented through reference to the 1978 Regional Health Facility Inventory currently being completed by the Ministry of Health. A summary of health services data is presented in Tables II - 9 and II - 10.

TABLE II - 9 — REGIONAL HEALTH SERVICES SUMMARY, 1978

Region	District	1978 Population	Number of Hospitals	Persons Per Hospital	Total Rural Health Centers	Persons Per Rural Health Center	Total Dispen-saries	Persons Per Dispensary
Dodoma								
	Dodoma Rural	276,737	1	276,737	4	69,184	51	5,426
	Dodoma Urban	158,577	4	39,644	2	79,288	25	6,343
	Mpwapwa	261,525	1	261,525	4	65,381	40	6,538
	Kondoa	275,082	1	275,082	4	68,770	42	6,550
	TOTAL	971,921	7	138,714	14	69,421	158	6,151
Singida								
	Singida Rural	213,732	1	213,732	3	71,244	27	7,916
	Singida Urban	55,892	1	55,892	1	55,892	2	27,946
	Iramba	242,003	2	121,001	3	80,667	27	8,963
	Manyoni	102,403	2	51,201	4	25,600	18	5,689
	TOTAL	614,030	6	102,338	11	55,821	74	8,298
Kilimanjaro								
	Same	133,725	2	66,862	2	66,863	34	3,933
	Mwanga	73,630	1	73,630	1	73,630	17	4,331
	TOTAL	207,355	3	69,118	3	69,118	51	4,066

Source: 1978 Health Facilities Inventory, Tanzania Ministry of Health, 1980.

TABLE II - 10

NUMBER OF PERSONS SERVED BY MEDICAL DOCTORS, REGION AND DISTRICT SUMMARY, 1978

Region	District		1978 Population	Medical Doctors	Doctor/ Population Ratio
Dodoma					
	Dodoma Rural		276,737	5	1/55,347
	Dodoma Urban		158,577	25	1/6 ,343
	Mpwapwa		261,525	4	1/65,382
	Kondoa		275,082	4	1/68,770
		TOTAL	971,921	38	1/25/577
Singida					
	Singida Rural		213,732	4	1/53,433
	Singida Urban		55,892	1	1/55,892
	Iramba		242,003	4	1/60,501
	Manyoni		102,403	3	1/34,134
		TOTAL	614,030	12	1/51,169
Kilimanjaro					
	Same		133,725	2	1/66,862
	Mwanga		73,630	2	1,36,815
		TOTAL	207,355	4	1/51,838

Source: 1978 Health FAcilities Inventory, Tanzania Ministry of Health, 1980.

E. Cultural Resources

Important archeological and historic sites lying within or near the three-region study area, and included in the Tanzania Antiquities Department's list of antiquities, are:

1. Rock paintings near Kondoa. These paintings portray wild animals and hunting scenes. Some of these are as old as 5,000 years, and are known to be the work of the late Stone Age hunters. Work is continuing to discover additional rock paintings.

2. Mkalama Fort in Singida Region near Kiomboi. This is a 19th Century German fort.

3. Underground man-made refuges locally known as mireshe located in Kilimanjaro region.

4. Usang. Underground refuges (Mireshe) located in Kilimanjaro Region. In 1892, Chief Maguru and some of his followers are known to have been suffocated with smoke in one of these refuges.

Other somewhat lesser known archeological sites include:

5. "Tita" War Caves. Found in Puma and Ntuntu Villages of Singida district and Iambi Village of Iramba District, Ancient war arms (arrows and spears) are preserved.

6. Caves with Beehives. Found in Ntuntu Village of Singida District; ancient beehives found and still preserved.

7. Rocks with Ancient Animal Paintings. Found in Sanga and Unyambra Villages of Singida district.

8. Rocks with Footprints. Found in Mdilu Village, Singida district.

9. The House of the Woman. War Liberation Hero (LITI). Found in Singida district. She resisted German colonialism by waging war using bees.

III. PROBABLE ENVIRONMENTAL IMPACT OF PROJECT IMPLEMENTATION

A. Impact of Population Influx

The relative size of population and population density by each administration division provides indication of existing demands for services such as transportation — specifically road access to district centers. Demands for local social services and the products of the economic sectors are directly related to the size of the population within each of the administrative divisions. Although the distribution of roads is not directly related to present settlement patterns, because of the villagization program, the requirements for access, and therefore road improvements, to the existing system are related to population distribution and population density.

The size and concentration of population were employed in the comparative evaluation of the competitive merits of rural road improvements for each of the study regions by administrative division within each district, and among districts within each region.

Within the Dodoma region, the range of population size is distributed from 14,676 in the Forkwa division to 65,173 in the Mpwapwa division. The population densities range from 7.6 persons per square kilometer in the Forkwa division to well over 100 for all divisions in the Dodoma urban district. The range of population size in the Singida region includes a low of 13,214 in the Manyoni Vijijini division to a high of 58,133 in the Mtinko division. Densities range from a low of 1.1 persons per square kilometer in the Itigi division to 85 in the Singida urban district. The highest population in the study district of Kilimanjaro is in the Mwembe Mbaga division while the lowest is the Mwanga division of the Mwanga district. Population densities range from a low of 15 persons per square kilometer in the Mwembe Mbaga division to a high of 109 in the Ugwene division of the Mwanga district.

Extensive villagization occurred during the 1970s in Dodoma and Singida regions so that few areas are not now organized as relatively compact, ujamaa villages. This change has resulted in a major shift for most of the peoples of these regions from the typically dispersed household and/or compound settlements. In the Pare Mountains (Same/Mwanga Divisions of Kilimanjaro region) by contrast, the 1970s brought extensive changes as many

previously private enterprises were replaced or supplemented by cooperative ventures. In this area, where the population tends to be concentrated in the highlands and in some parts of the adjacent plains, there has been relatively little transformation of traditional settlement patterns. The pattern here is one of ujamaa cooperatives developing in existing villages rather than the development of ujamaa villages per se.

To the degree that the proposed program of road improvements does not alter transportation channels among rural communities, the improvement of existing roads (as opposed to the construction of new roads where none presently exist) is not likely to alter the distribution of rural communities. Most ujamaa villages in Dodoma and Singida regions are currently well established. Improved linkages among communities is not expected to alter the distribution of villages, or to cause any major shifts in population such as is typical in many situations when people find it economically attractive to move closer to an improved road. This stands in contrast to the situation which might be expected if new roads were being contemplated, or if ujamaa villages were not so firmly established as an organizational pattern in Tanzania.

Similarly, in the Same and Mwanga districts of Kilimanjaro region where villages are uncommon, the topography is such that road improvements are not likely to alter the residential patterns of rural communities. This is so because people tend to live now in those areas most suitable for agricultural, herding, and other productive activities. Moreover, most land in the productive and useful areas of these districts is currently settled, and there is simply not much flexibility with regard to a redistribution of population.

B. Impact of Increasing Agricultural Production

For the three regions of this study, agriculture dominates the economic activity. For example, in Dodoma region, about 87 percent of the population is engaged in agriculture. Similar conditions regarding the role of agriculture prevail in the other two study regions, Singida and the Same/Mwanga districts of Kilimanjaro.

Agriculture as practiced in the Dodoma and Singida regions has been dependent upon the traditional methods of shifting cultivation coupled with the production of subsistence crops. Shifting cultivation has been practiced to a lesser extent in the Same/Mwanga districts of Kilimanjaro region. This was attributed to the poor conditions of the rural access road network. As a result of no access, restricted access, or high-cost access when served by trucks, it has been extremely difficult to provide assistance to the traditional smallholder in the form of extension service crop financing and other supporting services. For instance, one of the problems associated with financing by the Tanzania Rural Development Bank is that farmers at the present time have to travel a long way to the bank offices.

In recent years, continuous cropping and intercropping have begun to evolve for economic reasons. This change from traditional to improved agricultural practices is both the result of on-going and actively planned technology improvement programs and the rural access roads rehabilitation and maintenance programs. Rates of returns for each of 11 major crops in each of three study regions have been improved significantly accounting for the net agricultural benefits. This trend signals a strong economic justification for the rural access road program. Furthermore, as shown in Volume I of this feasibility report, there is additional crop production in the study regions, other than the 11 crops for which costs and margins are available, which might improve the internal rate of return even further.

The physical impacts of rural road rehabilitation are a combination of interrelated and ancillary uses with distinct impacts. The benefits to agricultural production by improved access to markets and access to relatively advanced technology by extension services, financing and mechanization may cause, in the far-term, a consolidation of agriculture in corridors contiguous to road improvements. Additionally, improved access may shift the pattern of subsistence agriculture to that of

commercial agricultural enterprises with the increased service demands of local urbanized commercial centers.

The direct physical impacts of more intensive agricultural activity are many; however, it is probable that the technology required by intensive production shall include appropriate conservation methodologies. Although most of these physical impacts are far-term in scope, identification and discussion are appropriate to this report.

Increased production can lead primarily to the exhaustion of soil fertility despite mixed cropping practices. Crop rotations to mitigate this exhaustion shall require that more arable lands are exposed to cultivation with attendant risks of erosion and soil loss to winds and rainfall runoff, especially in mountainous regions. The increases in land under cultivation shall result in decreases in wildlife habitat, savannah grasslands and woodlands where extant. These impacts are probable in the near-term and certain in the far-term. Mitigation of the decrease in wildlife habitat is not probable without concerted governmental commitment to reservation of lands for wildlife and natural area preservation. Soil erosion impacts are manageable by existing programs for soil conservation which can be implemented by in-country agricultural extension services. Soil exhaustion land requirements and additional land requirements due to increases in commercial demand for agricultural products may require significant application of chemical fertilizers and pesticides to improve and/or maintain crop yields.

The use of chemical amendments must be carefully monitored. Inappropriate application, especially in regions with steep slopes or highly permeable soils, can result in degradation of ground and surface water supplies from contamination by pesticide drift to groundwater supplies and nutrient introduction to lakes and reservoirs. These problems are not fully understood in advanced agricultural communities and could cause extreme damage in embryonic agricultural industries. Remedies for either occurrence are technologically difficult and, in many instances, corrective measures do not exist at this time.

Other physical impacts of increased agricultural activity include those associated with the requirements of mechanization. These include

the requisite expansion of petrol storage and distribution facilities with related environmental impacts such as air quality degradation, hazardous waste disposal and fire safety. Additionally, increased agricultural production would require significant physical expansion at transfer points in the market distribution system with concommitant service requirements.

Another physical impact of increased agricultural production may be the overuse of groundwater resources for irrigation of cultivated lands. This could lead to depletion of aquifers. This impact is clearly in the far-term; however, water policy should be addressed by appropriate governmental units.

C. Impact of Increasing Livestock Production

Traditional management practices for livestock prevail throughout Tanzania, including the three-region study area. Most of the cattle are shipped by rail and some by truck through stock routes. But both services leave much to be desired. This has contributed to increasing livestock sales outside the markets (direct sales to private traders). The rural access road improvements would significantly ease the problems of overstocking, overgrazing, and outside sales. This could, in turn, boost the production of livestock in the study regions.

D. Impact of Improved Health Facilities

An examination of health facilities, services, and the relationship between health services and the access opportunities provided by the road system in Dodoma, Singida, and the Same/Mwanga districts of Kilimanjaro, was conducted to project the potential impact of improved roads on the delivery of health services. There is general consensus that monitoring of health conditions, delivery of needed supplies, and provision of health specialists from the central service center (district hospital) suffer directly from the poor quality of existing rural roads. It is concluded that the quality of existing services and the prospects for continued improvements in the health of the village populations is directly linked to the accessibility of trained medical personnel and supplies in a timely manner and on an all-season basis.

To sum up, improved access roads can be expected to have the following benefits: improved access of people to medical facilities; improved access of medical personnel to dispensaries so that regular services can be maintained and local medical personnel can be helped and monitored in their work; and facilitate the transportation of supplies to hospitals and dispensaries.

E. Impact of Improved Educational Facilities

A review of existing educational facilities in terms of location and other fundamental statistics was conducted to identify the relationship between the national commitments to education and the existing system of rural roads. From this qualitative review, it is clear that improved rural access roads will:

1. Facilitate delivery of educational supplies which are at present not delivered on a timely and reliable basis;
2. Facilitate transport of needed building supplies for classrooms and teachers' housing construction;
3. Improve the attractiveness of the teaching profession by providing needed lines of communication to social opportunities, professional discussion and workshop opportunities, and collection of salaries regularly;
4. Provide opportunities for district and zonal administrators to visit and monitor the progress in education at the remote schools; and
5. Provide easier access to outside experts to teach adult education classes.

F. Impact of Road Construction and Maintenance Activities

The physical impacts of road construction and maintenance activities are limited due to the relatively modest level of cross-sectional expansion and geometric realignment. As earlier discussed, the primary impacts of construction activity involving the loss of limited vegetation, wildlife habitat, arable land and minor losses of woodlands are generally concentrated in already disturbed areas. Thus they are less impacting than construction on new alignments. The temporary increases in air, water and noise pollution can be controlled by appropriate construction practices. Other impacts exist which are secondary to construction and maintenance. These include borrow operations, quarry operations, temporary and permanent disruption of watershed continuity, loss of and encroachment on floodplains, the impediment of watercourses, the destruction of archeological artifacts and the disruption of animal habitat and migration patterns as a result of impediments or human activity.

The physical extent of anticipated road rehabilitation makes it probable that all of these impacts will occur individually and possibly in combination. Some are permanent impacts such as borrow and quarry operations and the loss of floodplain area. The others can result in permanent adverse impacts if they are not fully apprehended in the planning and design phases. The loss of watershed continuity and impediment of seasonable and perennial watercourses can and should be mitigated by careful topographic coordination of road profiles and provisions for conveyance of waterflows through embankments without upstream impoundments. Similarly, animal migration patterns should be identified and road profiles coordinated to provide unimpeded at-grade crossing points close to original areas. This would require lengths of closed culvert drainage, in lieu of side ditches, for significant distances beyond the crossing paths. The obstruction of floodplains should be avoided or minimized to preclude flooding in often unpredictable and removed areas.

Sites of archeological or cultural potential should be identified and alignments adjusted to avoid disruption. Similarly, borrow or quarry sites should be selected to avoid areas of archeological potential. Additionally, efforts should be made to utilize existing borrow or quarry

operations and to design profiles to maximize earthwork balances over short haul distances. This would entail the minimum use of embankment profile consistent with selected design criteria.

IV. RELATIONSHIP OF PROPOSED ACTION TO LAND USE PLANS, POLICIES AND CONTROLS

As previously stated, agriculture is the main economic activity of Tanzania. About 20 percent of its land area is cropped, the other 80 percent is made up of rough grazing pastures (range land or indigenous brush) of which 18 percent is designated as game preserves or forest reserves.

Estimates of land use for two of the three study regions, Dodoma and Singida, show that for Dodoma, smallholders cultivation occupies about 317,000 hectares or 7.8 percent of the region's total area, while for Singida, the smallholder cultivation totals about 158,000 hectares, representing just over 5 percent of the area in the region.

Tables IV - 1 and IV - 2 summarize land use by district within Dodoma and Singida regions. Unfortunately, similar data are not available for Same/Mwanga districts of Kilimanjaro. It is highly likely, however, that the percentage of cultivated land area is much higher than that for Dodoma and Singida regions, particularly in the Pare Mountains where most of the population lives.

Overstocking and overgrazing (resulting in severe soil erosion) are both very serious problems throughout Tanzanian livestock industry and especially so for the semi-arid conditions of two of the three study regions, Dodoma and Singida. One of the hardest hit areas is the rolling hill country of Kondoa district in Dodoma region where the situation has become so bad that entire villages, along with their livestock, were moved out into other more favorable areas for settlement. The government is trying to reclaim the old areas — a process that will take scores of years, if at all successful.

Soil erosion has also become a serious problem in the Same as well as Mwanga districts of Kilimanjaro region. This has been brought about by the conversion of grazing areas to croplands in the plains and by using poor cultivation techniques on the mountain slopes.

The proposed project involves rehabilitation and improvement of the existing access and district road systems. No completely new roads are planned — only minor alignment changes may be necessary. Consequently, if the project is implemented, no additional land acquisition would be necessitated and existing land use patterns would not be significantly altered. Furthermore, reclamation of the areas that have suffered severe erosion may be accomplished during a shorter period of time.

TABLE IV - 1 - LAND USE BY DISTRICTS, SINGIDA REGION[1/]

Land Use Categories, District and Region		Area (Hectares)	Percent of Land Area
Singida			
Smallholder cultivation		60,000	4.7
Rough grazing		982,020	77.5
Low altitude woods and forests		217,500	17.2
Urban, rocky, swamps, etc.		7,680	0.6
	Total	1,267,200	100.0
Manyoni			
Smallholder cultivation		32,500	1.1
Rough grazing		1,096,250	38.8
Low altitude woods and forests		1,663,800	58.8
Urban, rocky, swamps, etc.		36,250	1.3
	Total	2,828,800	100.0
Iramba			
Smallholder cultivation		65,500	8.3
Rough Grazing		684,550	87.7
Urban, rocky, swamps, etc.		31,250	4.0
	Total	780,800	100.0
Singida Region			
Smallholder cultivation		157,500	5.3
Rough grazing		2,762,820	92.2
Urban, rocky, swamps, etc.		75,180	2.5
	Total	2,995,500	100.0

1/ Most data are best estimates only from 1969-71; others are from 1976-77, Australian Development Assistance Bureau, Singida Integrated Livestock Development Study, Vol. 1, p. 33.

Source: From Study of Feasibility of Developing a Livestock Extension Project for Farmers on Small Holdings in Tanzania with Emphasis on Semiarid Areas, prepared by Gail E. Pate, D.V.M,, Contract No. AID-GRI-oll-T, March 6, 1980.

TABLE IV - 2 - LAND USE BY DISTRICTS, DODOMA REGION[2/]

Land Use Categories, District and Region		Area (Hectares)	Percent of Land Area
Dodoma			
Smallholder cultivation		140,000	8.6
Rough Grazing		1,490,720	90.9
All other uses and unused areas		7,680	0.5
	Total	1,638,400	100.0
Kondoa			
Smallholder cultivation		110,000	8.4
Rough grazing		844,170	64.7
All other uses and unused areas		351,430	26.9
	Total	1,305,600	100.0
Mpwapwa			
Smallholder cultivation		66,972	5.9
Rough grazing		806,918	70.8
NDC ranches		36,440	3.2
All other uses and unused areas		228,870	20.1
	Total	1,139,200	100.0
Dodoma Region			
Smallholder cultivation		316,972	7.8
Rough Grazing		3,141,808	76.9
NDC ranches		36,440	0.9
All other uses and unused areas		587,980	14.4
	Total	4,083,200	100.0

1/ Most data are best estimates only from 1969-71.

Source: From Study of Feasibility of Developing a Livestock Extension Project for Farmers on Small Holdings in Tanzania with Emphasis on Semiarid Areas, prepared by Gail E. Pate, D.V.M. Contract No. AID-GRI-oll-T, March 6, 1980.

V. PROBABLE ADVERSE ENVIRONMENTAL IMPACTS WHICH CANNOT BE AVOIDED

The overwhelming balance of social and economic consequences of the proposed program are deemed to be beneficial and few significant adverse impacts have been identified. Increased particulate levels in the air environment and somewhat elevated noise levels during the construction period will be experienced; however, they are normal to most construction activities and will be short-lived. By implementing proper noise and dust control techniques, their levels would be kept to a minimum. Likewise, the increased levels of sediment transported during construction would be minimized by using appropriate erosion control methods.

One of the negative impacts of greater concern would be on the women, in that they would have to work harder on the farm to support the family while men are engaged in road reconstruction/improvement program.

In addition to these, there are some other possibilities which should be mentioned. These include such factors as the increase of disease which is sometimes associated with increased population mobility, increased number of alcoholics which sometimes results when community norms are disturbed and cash for purchase of alcoholic beverages becomes more available, etc. However, few such problems are apparent and, insofar as projections based on available data are possible, these problems are not expected either to be serious or to warrant changes in the project as proposed.

VI. ALTERNATIVES TO THE PROPOSED ACTION (IF SIGNIFICANT NEGATIVE IMPACTS ARE DISCOVERED)

Significant data has been presented in the earlier sections of this report concerning the inventory and analysis of environmental factors that would be impacted if the project is implemented. A summary of impact analysis is presented in Table VI - 1.

TABLE VI - 1 — SUMMARY OF ENVIRONMENTAL IMPACT

Factor	Environmental Impact Rating	
	Beneficial	Adverse
Population Influx	None	None
Agricultural Production	High	
Livestock	High	
Health Delivery Services	High	
Education	High	
Vegetation/Wildlife	Moderate	
Economic	Low	
Air Pollution		Low
Social*		Low
Land Use		Low
Cultural	None	None

*Impact on women.

It is evident from the data in the above table that the project as planned would greatly improve and enhance the quality of life and environmental conditions within the three-region study area.

Since the adverse impacts are not insurmountable, no alternatives were considered. If the "no build" alternative is adopted, the people of the study area would be denied the many beneficial consequences that the project is expected to produce.

In light of this, it is recommended that the rural road rehabilitation program should be carried out as planned.

VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Development projects often permanently alter land use patterns. However, since this project comprises improvement and rehabilitation of the already existing network of access roads within the three-region study area, no acquisition of any additional land will be necessitated. Erosion and sedimentation processes will result in temporary and minor degradation of some surface water sources of water supply. Discharge of particulates into the air environment during the construction phase would result in minor degradation of ambient air quality in the vicinity of the project area. Both the above effects will, however, be short-lived and will last until completion of the project. Depletion of natural resources such as materials of construction, e.g. gravel, etc., and petroleum products for operating the road building equipment will be unavoidable and normal. Public utilities and services will be committed as required.

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