Useful Trees and Shrubs for Ethiopia

Identification, Propagation and Management for 17 Agroclimatic Zones

Azene Bekele-Tesemma




Edited by
Bo Tengnäs, Ensermu Kelbessa,
Sebsibe Demissew and Patrick Maundu

World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

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RELMA in ICRAF Project

World Agroforestry Centre, East Africa Region, Nairobi Kenya, 2007

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Contents

Foreword

Ethiopia is one of the most important biodiversity hotspots in the world. In 1790, the first European, James Bruce of Scotland, documented only 18 plants in his *Natural History of Ethiopia*. Today, nearly seven thousand plant species, one thousand of which are endemic to Ethiopia, are documented in the *Flora of Ethiopia* (2003). Sadly, many of the species are in danger of extinction because of rapid conversion of forest to agricultural land and over-grazing.

International efforts to document the rich flora of Ethiopia began in earnest in 1986 with the Ethiopian Flora Project of the Ethiopian Government through the Addis Ababa University and the Swedish Government through the Swedish Agency for Research Cooperation with Developing Countries (SAREC).

This book is the second edition of an earlier book (1993), also led by Dr. Azene Bekele-Tesemma and his team. The main aim of this extensively revised book is to benefit the rural people of Ethiopia by encouraging them to grow more trees and shrubs for various reasons, including income generation, timber, medicines, soil fertility, honey production, biodiversity and watershed protection.

The Regional Land Management Unit (RELMA) has published a well-known series of books on useful trees for Kenya, Eritrea, Ethiopia, Tanzania and Uganda. This is the last of the series because the RELMA project ended in December 2006. We are most grateful to Dr. Azene and his team for this great effort, which will have a lasting impact. Many of the RELMA staff, including Dr. Azene, remained at the World Agroforestry Centre (ICRAF), Nairobi.

This book is intended for use by staff involved in agricultural extension at all levels and in the educational system, both in specialist training of foresters and agriculturalists as well as in high schools and teacher training colleges.

It is our hope that the book will be widely used — both in the extension services and education — in Ethiopia to encourage present and future generation to appreciate and keep alive the great botanical heritage of Ethiopia.

Professor Chin Ong
RELMA manager, ICRAF

Acknowledgements

This book is a revised version of *Useful Trees and Shrubs of Ethiopia: Identification, propagation and management for pastoral and agropastoral communities*, published in 1993 as Technical Handbook No. 35 in a series developed by the Regional land Management Unit (RELMA). Various institutions and many individuals made significant contributions to both versions. It is not possible to name each one of them, but we thank them all for their invaluable contributions.

During the production of the first version in 1993, I was unable able to travel to Gambella and Benishangul-Gumuz administrative regions for logistical reasons. It was not also possible for me to go to the Semen mountains of the Amhara Regional State and the Tigray Highlands because these areas were conflict zones in the fighting between Tigray People's Liberation Front and Ethiopia's former socialist government. Since the study did not cover these areas, it missed six important agroclimatic zones and an equal number of important vernacular languages. It also left out 21 important species.

I would like to take this opportunity to thank the Bureaus of Agriculture and Rural Development of the two Regional State Governments for organizing all the logistics that were required to make this additional study possible, and RELMA for financing the project.

At the onset of the study for this revised edition, RELMA conducted a readers' survey that yielded valuable feedback on the first book. The survey confirmed the publication as one of the most used reference books in the fields of agriculture and forestry. The readers appreciated the utility of the book and recommended several changes to make it even more useful.

Readers recommended that each species be classified by agroclimatic zones. They also wanted colour photos used and additional information on certain species and updated illustrations. Some of the readers recommended that the information be presented in a way that would make the book useful to other countries in the region. All these recommendations have been addressed in this revised edition. For instance, classification by agroclimatic zones makes the information applicable outside Ethiopia.

I would like to thank the management of RELMA in ICRAF project for allowing me to undertake research for this book and for financing its production.

Some of the drawings taken from the first version were drawn anew. We in the RELMA in ICRAF project are grateful to the illustrators and all those who allowed us to reuse various illustrations. We are especially grateful to Luise Gull for the drawing of *Ficus carica,* and the Oklahoma

State University, Department of Agricultural Communications (indicated by 'O' in the credits for illustrations) for allowing us to use illustrations of *Discopodium penninervum, Erica arborea, Hypericum quartinianum, H. revolutum, H. roeperianum, Maesa lanceolata, Pittosporum viridiflorum, Rhoicissus tridentata, Salix mucronata (S. subserrata), Schefflera abyssinica, Steganotaenia araliacea, Tamarix aphylla,* and *Woodfordia uniflora.* These drawings first appeared in *Families of Flowering Plants in Ethiopia* by W. C. Burger (Oklahoma Agricultural Experiment Station Bulletin No. 45, O. S. U. Press, Stillwater, Oklahoma 1967).

Some of the drawings from *Plants of Zanzibar and Pemba* by R. O. Williams (Z), and from *Kenya Trees and Shrubs* by I. R. Dale and P. J. Greenway (D G) used in the first edition of also appear in this revised version. The copyright for these illustrations still rests with the original publishers.

Several original illustrations have been prepared for this version, many based on specimen from East African Herbarium in Nairobi. We acknowledge the assistance of the head of the herbarium, Dr. Siro Masinde, and other staff, particularly Mr. Geoffrey Mwachala, Mr. Geoffrey Mungai, Mr. A. F. Odhiambo and Ms. Brenda Nyaboke. We thank the herbarium for permission to photograph many of the dried specimens that are used in this book. A few more were photographed by Dr. Ensermu Kelbesa of Addis Ababa University Herbarium. We are grateful for the assistance.

Many thanks also go to Mr. Patrick Maundu of Bioversity International, Nairobi, who provided some of the photographs and to Dr. Tadesse Wolde Mariam Gole for the photograph of *Aloe vera.*

Dr. Mike Gilbert, Dr. J. B. Gillett and Dr. Mesfin Tadesse, the Ethiopia Liaison Botanist of the Royal Botanic Gardens, Kew, and Dr. Inga Hedberg of Uppsala gave invaluable help in resolving some taxonomic problems in the first edition.

I also would like to thank Professor Sebsibe Demisew and Dr. Ensermu Kelbesa of the Addis Ababa University, who are the technical editors of this revised edition, and to Mr. Bo Tengnäs, advisor in the first edition and co-editor of the second version. Mr. Maundu also made significant editorial contributions.

The technical content of this book was developed through numerous discussions with farmers, pastoralists and many professionals in the field of multipurpose trees and shrubs in eastern Africa. Without the contribution of local knowledge and experience gained over the many years from rural communities, the content of this book would not be as extensive as it is.

Finally, I would like to acknowledge that no publication of this nature can be correct in every detail. The responsibility for any remaining errors or weaknesses rests entirely with me. I request readers to make use of the feedback form at the end of the book to correct any errors or to provide me with information on the content of this book.

Azene Bekele-Tesemma, PhD
Capacity Building Advisor, Eastern Africa Region, ICRAF

PART I

Introduction

Introduction

The aims of this book

The tree cover in Ethiopia continues to dwindle every year. The major reason for this resource shrinkage is the increasingly intensive use of land for crop and livestock production. Cutting down trees for fuelwood and construction materials also plays a role. About 92% of the nation's total energy comes from biomass sources, with wood and tree residues accounting for 77%. Currently, fuelwood is scarce in 75 % of the country.

Another factor affecting deforestation is failure by farmers to widely use biological measures, including planting shrubs and trees, to control soil erosion and mitigate land degradation. There are many reasons why farmers have not adopted effective soil conservation over the years. Some of the reasons are of a political nature, such as lack of land and tree tenure. Others relate to lack of information — often farmers do not farmers do not know the species best suited to their areas.

Weak extension services have also contributed. Many of the approaches and technical solutions promoted by the extension workers have not attracted farmers' interest.

Regrettably, forestry is not considered as a means by which Ethiopians can fight food insecurity. Yet forestry is the source of diversified high-value industrial commodities that can guarantee economic access to food and improve people's lives.

Due to the wide variety of agroclimatic and socio-economic conditions in Ethiopia, no uniform extension package applied nationwide can be effective. On the contrary, extension systems should engage local people in dialogue so that their local circumstances are taken into account and their wishes given priority. So far, training of foresters and agriculturalists has not provided these cadres with a sound knowledge of the wide range of tree species that can be grown in different areas and their local uses.

Forestry training has focused on industrial forestry, while agriculturalists have been trained in crop production and animal husbandry. Knowledge of how farmers use trees and how trees can be incorporated into farming systems has not been given priority. As a result, few development agents (DAs) can communicate effectively with local people, who, in turn, remain indifferent to the extension messages.

Often, in extension work, a few exotic species are promoted at the expense of rich indigenous flora of interest to communities.

Farmers and pastoralists have accumulated knowledge on the uses and characteristics of different tree species over many generations, but forestry policies and extension workers have given such local knowledge little attention. In some cases, extension workers know less about the propagation and management of locally preferred species than the local people themselves. Consequently, farmers have little respect for the extension agents and their advice when it comes to tree or shrub identification, propagation and management.

This book aims to help rectify this situation by providing information on a selection of useful tree and shrub species for the range of conditions in the 17 agroclimatic zones found in Ethiopia. The book is intended for use by staff involved in extension at all levels. It is also suitable for use in the formal education system, both in specialized training of foresters and agriculturalists as well as in high schools and teacher training colleges.

The is a practical handbook; not a botanical textbook. Therefore, efforts have been made to present the material in simple English, although it is impossible to avoid the use of some technical vocabulary when describing some of the important characteristics of the trees and shrubs listed.

A lot of information has been added to this revised edition. Seventeen agroclimatic zones are covered, up from 12 in the first edition. The number of languages covered has increased from 18 to 24.

There are, however, still large gaps in the information provided, especially in newly added species for which only basic information was gathered.

Criteria for selection of the species

There are well over 6,600 higher plant species in Ethiopia, including 22 that are threatened, and it would have been impossible to include them all in this handbook. The present selection is a compromise representing the most important species as indicated by farmers contacted in Amhara, Tigray, Oromia, Southern peoples, Gambella, Benshangul Guuz Harrari, Dire Dawa, Afar, Somali and Addis Ababa regional states (see map of administrative regions on pages 10 and 11) and the author's experience.

Species were also selected based on their occurrence in crop, grazing or communal land as well as on the knowledge of farmers, pastoralists and extension workers interviewed by the main author. The fact that a species has been found to be useful does not necessarily mean that it must be planted. For many species, particularly in drier lowland areas, protection of natural regrowth may in fact be a more effective and cheaper way to ensure long-term survival.

A few species such as the oil-rich *Jatropha curcas* and many that are good for timber are included because of their industrial value and potential to become investment projects in which farmers can be involved as outgrowers.

We have included indigenous and exotic species. For exotic species, we indicate if the tree has been naturalized.

The species selected are almost all trees, but a number of large and small shrubs are also included. There are, however, a few exceptions. Tall grasses such as *Arundinaria alpina*, *Oxytenanthera abyssinica*, *Arundo donax* and *Olyra latifolia* have been included, as well as the tree fern *Cyathea manniana*, the climbers *Rhoicissus* spp., scramblers such as *Phytolacca dodecandra*, the giant herb of the banana family *Ensete ventricosum* and the economically significant herb *Aloe vera*.

In the selection are fruit species such as *Citrus medica*, *Citrus aurantifolia*, *Casimiroa edulis* and *Malus domestica*.

The large woody *Euphorbia* species are unusual in their family but are also included here because they are useful and well known in Africa.

We hope that subsequent editions of the book will cover more species as our knowledge and contacts with the rural communities grow.

How to use this book

General usage instructions

This book can be used in a number of ways and it is largely up to the user to find out how best to use it in his or her particular situation. A few hints will be given here.

In extension, the book can be used to identify trees and for information on different species. In the field, local people may often indicate that a certain species is useful and know its name. Using the local name as an entry point, the extension worker can identify the corresponding species name indicated in the section on Vernacular Names. After finding the corresponding scientific name, he or she can then compare the criteria of the species in the field with the identification criteria indicated in Part III of this book. If the criteria match, the extension agent now informs farmers on the possible uses of the species, methods of propagation and management requirements.

If the vernacular name does not appear in the list, another option is to search directly for the species in Part III. In this case, the extension agent should try to identify the species from the description, drawings and photographs. If the text in the description is difficult to understand, a study of the illustrated glossary of botanical terms (page 48) should help.

On other occasions, local communities may simply indicate the various uses that they want to get from the tree or shrub they would like to plant. Then, they may require that the extension agent gives them various options of species they can grow. In this case, the extension agent can select suitable species from the table summarising uses in part IV.

In other situations, users may simply want to find out more information on a known species. In this case, they should search in the alphabetical species list in Part III.

Another situation may be when an extension worker wants to know which species could do well in an area. In this case, the first step is to identify the agroclimatic zone. If data on rainfall and altitude are available, it is easy to identify the zone from the table on page 9. If the altitude and rainfall figures are not known, observations on the natural vegetation, crops and soil type can be matched with those in the table. Once the agroclimatic zone is identified, the list of suitable species for each agroclimatic zone (page 38) can be identified by referring to the section on that lists species by agroclimatic zone in Part II.

It is also good for the extension agents to look around and try to see which species are actually growing and how well they are doing. If the countryside is bare, it is recommended that they study protected forests near churches and preserved areas in towns and villages as they are normally rich in species. Once a relevant list of potential species has

been made and verified with the help of local people, the extension worker should learn more about the species, for instance, their vernacular names, uses, propagation and management, by studying the information provided in Part III. This, together with the information on uses in Part IV, should give the extension worker enough knowledge to gain him or her the confidence of the local people.

In high schools and teacher training colleges, the staff and students can use this book:

- To identify types of trees suitable for different purposes in their environmental education fieldwork.
- As a resource document to demonstrate how seed germination time could be reduced by using suitable seed treatment methods.
- As a resource book for information on how to raise tree seedlings of different species.
- As a reference book for teaching about the environment in subjects such as geography, biology, agriculture, and home science.

In the technical training of foresters and agriculturalists, the book can be used as a resource in studies of forest botany, agroforestry, silviculture and related subjects. Similar use may be possible in selected subjects at university level.

The species descriptions

Vernacular names

The English or scientific names of trees are usually not the names farmers and pastoralists use. Farmers' choice of species is often expressed in their local (vernacular) language. Even though Amharic, Ethiopia's national language is widely understood, there is no single language that is commonly used by all the nation's people. Therefore, it was decided to include as many vernacular languages as possible, 24.

Vernacular names are given in the Part II and again in Part III, where each species is discussed in detail. Knowledge of local names is essential for any person discussing trees with the people of a given area. There are two limitations to the usefulness of these names. Firstly, there are no standard spellings as these are based on phonetic interpretations of the names. Secondly, names may vary because of the existence of several dialects of the same language in different areas.

We request any reader finding errors or omissions in vernacular names to send us this information.

The following abbreviations of local languages have been used in the text:

Afargna (Af), Agewgna (Ag), Agnuakgna (Agn), Amargna (Am), Borenagna (Br), Bertagna (Brt), English (Eng), Gamogna (Ga), Gimirigna (Gm), Gumuzgna (Gmz), Guragigna (Gr), Haderigna (Hd), Kefgna (Kf), Kembatgna (Km), Konsogna (Ks), Mejengrgna (Mjr), Nuyergna (Nur), Oromugna (Or), Sahogna (Sh), Shinashgna (Shn), Sidamigna (Sd), Somaligna (Sm), Tigrigna (Tg), and Wolaytgna (Wt).

Ecology

Under the ecology heading, information is given on the occurrence of each species in the various agroclimatic zones, the altitude range, niches in the landscape, soil preference, drought resistance and other important ecological factors.

Ethiopia is extremely heterogeneous ecologically. This diversity has been classified in a number of different ways by various authorities. However, we have used the agroclimatic zone classification indicated by Azene Bekele-Tesemma and Hakan Sjhölm (2005) and reproduced on page 9.

Unlike the previous version of this book, this revised edition indicates trees and shrubs useful for all the currently known 17 agroclimatic zones of Ethiopia. The distribution map of these agroclimatic zones is included for ease of reference.

The list of species under "Species by Agroclimatic Zones" is useful to extension workers who would like to identify the plants that are suitable for their specific areas.

However, a species being listed under a given agroclimatic zone does not necessarily mean that it will grow well throughout that zone. Neither does it mean that it is limited to that agroclimatic zone either. Therefore, one must refer to the more detailed information given under each species in Part III.

Uses

Uses, both as products and services, have been listed for each species in the summary table in Part IV. It should be noted that the information reflects "reported" uses — mainly what the rural people claim to use these plants for as cited in first-hand information or in literature.

It was not possible to verify all such reports and statements. Sometimes uses vary from one community to another and from one area to the next. Thus, it is always a good idea to verify uses when discussing any of the listed plants with the local people. In some instances, the reports originated from outside Ethiopia. Although it was not always possible to verify the usage in Ethiopia, we still included the potential uses.

It should also be noted that a single tree or shrub cannot be grown for all the potential uses at the same time. On the contrary, management of a particular tree often aims at optimising a specific product or service.

On medicinal uses, it is worth mentioning that herbal medicine requires skilled practitioners. Therefore, although medicinal uses have been indicated, this does not mean that anyone should start using them without first consulting experienced and knowledgeable people.

Description

When a farmer requires a tree for a particular use, proper identification of that tree is of the greatest importance. The descriptions in this manual focus first on the general appearance of the tree and then the bark, leaves, flowers and fruit. On the page opposite each description are line drawings that

complement the text. With a few exceptions, in this revised version, colour photos of trees or their parts are included to make identification easier. The use of specialized botanical terminology has been kept to a minimum. Before beginning to use the text to identify a plant, the reader should refer to the illustrated glossary on page 48.

It must be noted that there can be great variation in tree size and shape as well as in many other plant characteristics depending on the site where it is found. Therefore, the text sometimes indicates the range of variation that can be expected. However, certain features define that plant species alone. Size and scale are also indicated in the text, but in many illustrations of typical mature trees, an adult person is drawn beside the tree to indicate the scale.

Propagation

Whenever information on suitable propagation methods is available it has been included. "Seedlings" indicates that a relevant propagation method is raising seedlings in some sort of nursery, either on-farm or in a central or group nursery. "Wildings" indicates that it is known that farmers propagate a certain species by collecting and transplanting wildings to a desired place on their farms, or that this is one means of propagating the plant.

"Direct sowing at site" means that a species can be propagated by direct sowing of seed at the desired site, and "cuttings" means propagation by cuttings is recommended. Cuttings is a more common vegetative multiplication technique, while budding and grafting are mentioned for fruit trees. Coppicing resembles propagation but it is actually a management practice. Hence, coppicing ability is given under "management". The same applies for use of root suckers.

Seed information

Most trees and shrubs are propagated using seed. Information is given on the number of seeds per kilogram, seed storage and simple treatment before sowing (if required).

Storage of seeds should generally be avoided for most species. In this manual, the storage periods indicated are not precise. This is deliberate because loss of seed viability is a gradual process, the speed depending on many factors, but mainly the storage conditions. Hence, only approximate indications of acceptable storage periods can be given. If seeds are to be stored for some time, it is always best to keep them in a cool, dry and insect-free place. Properly dried seeds can be stored in air-tight containers, such as sealed bottles or tins.

Information on seeds for many of the species preferred by farmers is unavailable. In these cases, the user should find out the details locally.

Management

Different management techniques allow tree growers to optimise tree and shrub products or services. Management techniques may also be applied to reduce negative effects of the presence of trees and shrubs, such as the shading effect on adjacent crops.

The most common management practices are pruning of roots and branches, coppicing, lopping and pollarding. Whenever a certain management technique is known to be feasible for a certain species, it is indicated. Information on the growth rate is also provided under this heading.

All young trees grow fast and are more likely to survive if properly weeded and, if necessary, thinned. Since such general management requirements apply to all species, they have not been indicated in the detailed information on each species.

Remarks

Any other useful or interesting information that does not fall into the above categories is included under "remarks".

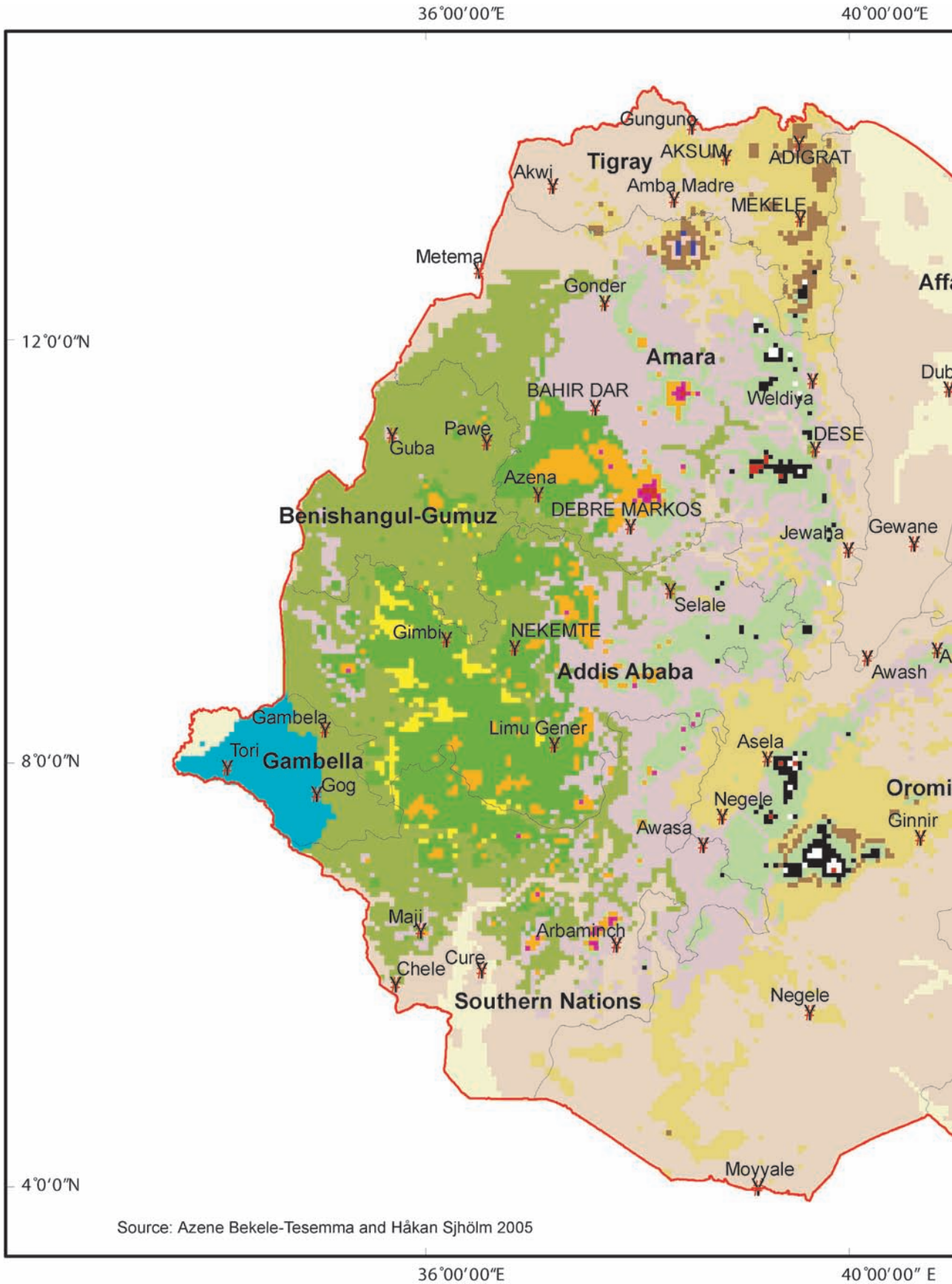
Agroclimatic zones considered

1. DRY BEREHA = Dry Hot-lowlands
2. MOIST BEREHA = Moist Hot-lowlands
3. DRY KOLLA = Dry Lowlands
4. MOIST KOLLA= Moist Lowlands
5. WET KOLLA = Wet Lowlands
6. DRY WEYNA DEGA = Dry Mid-highlands
7. MOIST WEYNA DEGA= Moist Mid-highlands
8. WET WEYNA DEGA= Wet Mid-highlands
9. DRY DEGA = Dry Highlands
10. MOIST DEGA = Moist Highlands
11. WET DEGA = Wet Highlands
12. DRY WURCH = Dry Frost zones
13. MOIST WURCH = Moist Frost zones
14. WET WURCH = Wet Frost Zones
15. DRY ALPINE WURCH = Dry Alpina-frost Zones
16. MOIST ALPINE WURCH = Moist Alpina-frost zones
17. WET ALPINE WURCH = Wet Alpina-frost zone

> 3700 asl	DRY ALPINE WURCH A: None (dry and too cold) C: None S: Black soils, degraded T: lichens, *Hypericum quartinianum, Hypericum roeperianum*	MOIST ALPINE WURCH A: None (frost limit) C: None S: Dark black soils, shallow T: *Hypericum quartinianum, Hypericum roeperianum*	WET ALPINE WURCH A: None (too cold and too wet) C: None S: Dark black soils, deep T: Grasses, *Hypericum quartinianum, Hypericum roeperianum*
>3200-3700 m above sea level	DRY WURCH A: Only barley, single cropping per year C: Drainage none S: Gray soils, degraded T: *Erica* species	MOIST WURCH A: Only barley, single cropping per year C: Drainage rare S: Black soils, degraded T: *Erica, Hypericum*	WET WURCH A: Only barley. 2 crops per year C: Wide-spread drainage ditches S: Black soils, highly degraded T: *Erica*, *Hypericum*
>2300-3200 m above sea level	DRY DEGA A: Barley, wheat and pulses C: Traditional moisture conservation measures eg. furrow with tie-ridges S: Gray to brownish gray soils T: *Olea europaea*	MOIST DEGA A: Barley, wheat and pulses C: Few traditional terracing S: Brown clay soils T: *Juniperus procera*, *Hagenia abyssinica, Podocarpus falcatus*	WET DEGA A: Barley, wheat, Nug, pulses, 2 crops/ year C: Wide spread drainage ditches S; dark brown clay soils T: *Juniperus procera, Hagenia, Podocarpus falcatus*
>1500- 2300 m above sea level	DRY WEYNA DEGA A: Wheat, tef, rarely maize C: Terracing wide spread S: Light brown yellow soils T: Acacia savannah	MOIST WEYNA DEGA A: Maize, sorghum, tef, enset (rare), wheat, Nug, Dagussa, barley. C: Traditional terracing S: Red brown soils T: *Acacia, Cordia africana*	WET WEYNA DEGA A: Tef, maize, enset (in West parts), Nug, barley C: Wide spread drainage S: Red clay soils, deeply weathered, Gullies frequent T: *Acacia, Cordia*
500 - 1500 m above sea level	DRY KOLLA A: Sorghum rarely, tef, C: Water retention terraces S: Yellow sandy soils T: Acacia bushes and trees	MOIST KOLLA A: Sorghum, rarely tef, Nug, Dagussa, C: Widespread terracing S: Yellow silty soils T: *Acacia, Erythrina, Cordia, Ficus*	WET KOLLA A: Mango, taro, sugar cane, maize, coffee, citrus. C: Ditches frequent S: red clay soils. Highly oxidized. T: *Milicia excelsa, Cyathea manniana*
< 500 m above sea level	DRY BEREHA A: possible only with irrigation C: Wind erosion frequent S: Aridsol, rigosols, silty and sandy. T: *Acacia senegal, Acacia bussei, Tamarix aphyla*	MOIST BEREHA A: Seasonal rain-fed agriculture possible C: Burning grasses common, No wind erosion due to cover of tall grasses S: Silty and clayey, mainly black, T: *Ziziphus pubescens, Antiaris toxicaria*	
ANNUAL PPt	< 900 mm	900 mm - 1400 mm	> 1400 mm
Rainfall in millimetres			

A : Main crop **C : Traditional soil conservation** **S : Soil on slopes** **T : Natural trees and other vegetation**

Source: Azene Bekele-Tesemma,and Håkan Sjhölm. 2005. **PPT : Precipitation**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DEBRE MARKOS
Benishangul-Gumuz
Jewaha
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Gimbi
NEKEMTE
Addis Ababa
Awash
Gambela
Limu Gener
Asela
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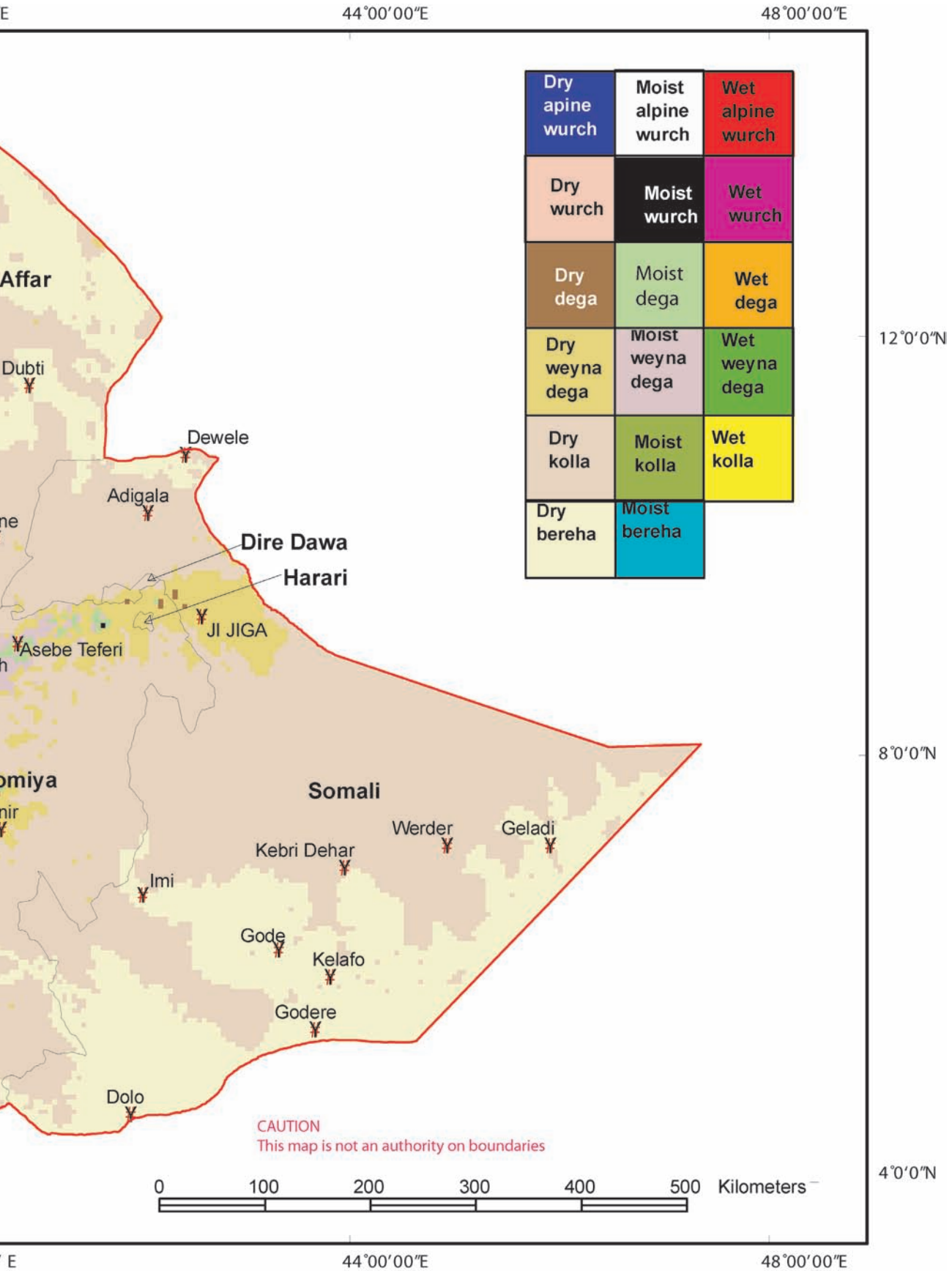
Chele
Southern Nations
Negele
Moyyale
Source: Azene Bekele-Tesemma and Håkan Sjhölm 2005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This map is not an authority on boundaries
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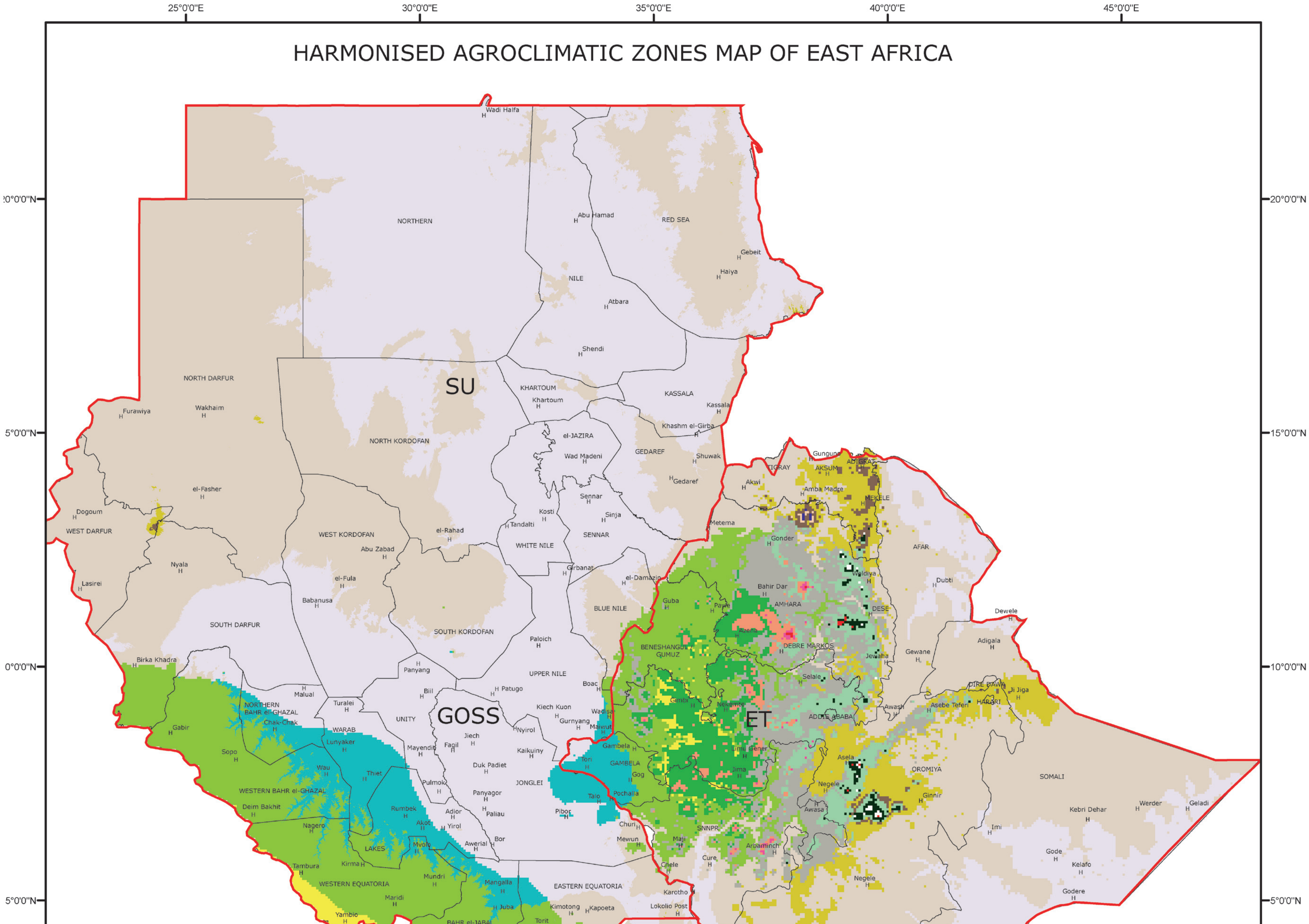
Kilometers

HARMONISED AGROCLIMATIC ZONES MAP OF EAST AFRICA



Source: Azene Bekele-Tesemma 2007