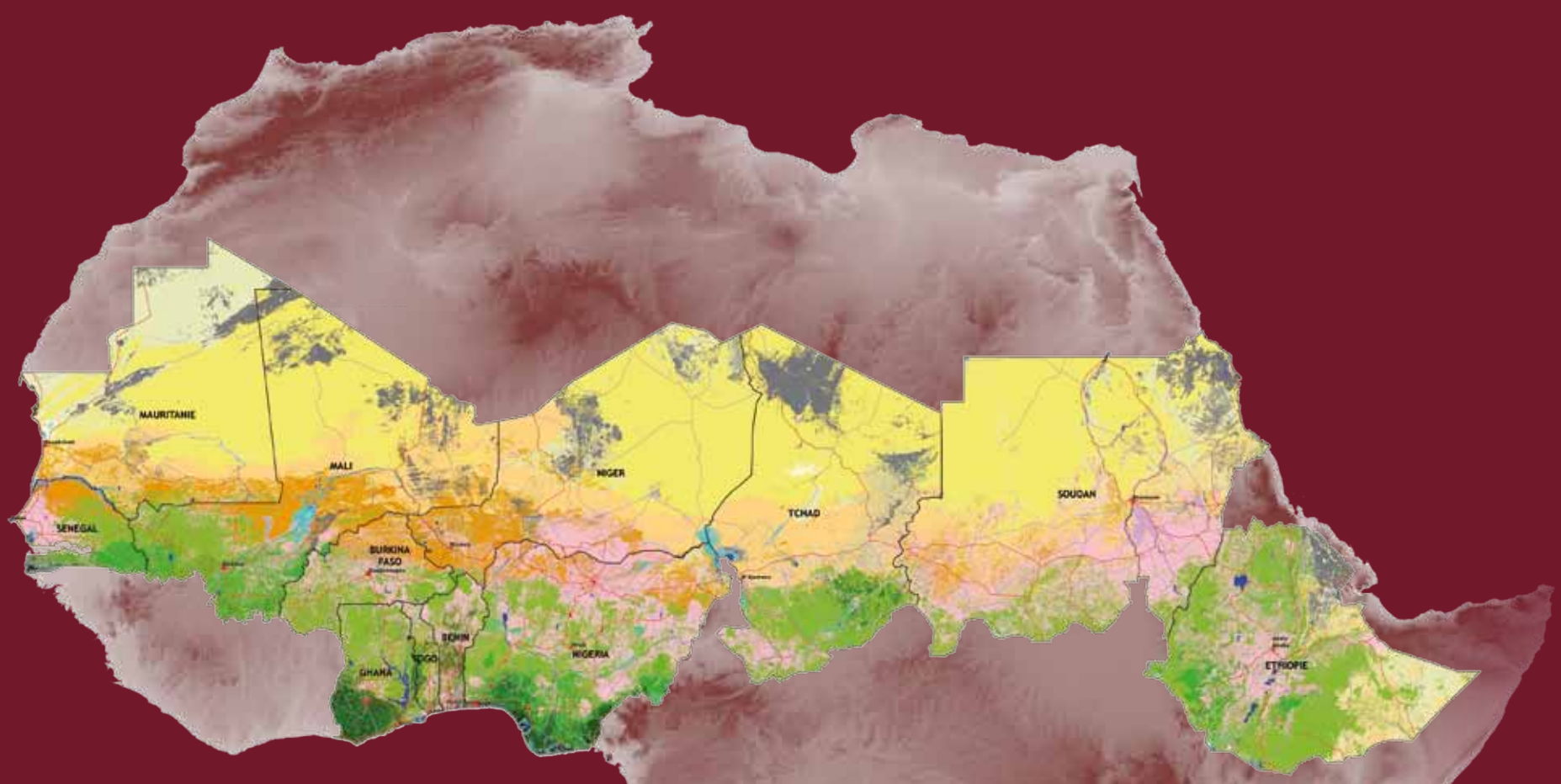
SAHARA AND SAHEL OBSERVATORY

SAHEL AND WEST AFRICA

ATLAS OF LAND COVER MAPS



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SAHARA AND SAHEL OBSERVATORY

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ATLAS OF LAND COVER MAPS

BUILDING RESILIENCE THROUGH INNOVATION, COMMUNICATION AND KNOWLEDGE SERVICES- BRICKS

BENIN, BURKINA FASO, CHAD, ETHIOPIA, GHANA, MALI, MAURITANIA, NIGER, NIGERIA, SENEGAL, SUDAN AND TOGO

January 2019

CONTRIBUTIONS

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The Sahel and West Africa - SAWAP project teams have made a substantial contribution to finalising the monograph and validating the land cover maps.

Therefore, our thanks go to:

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Cover: The cover illustrates the diversity of landscapes of the Sahel and West Africa.

FOREWORD

The Sahel and West Africa region is one of the areas on the planet which is most severely affected by aridity, land degradation and desertification. Although the twelve countries in this atlas have very different environmental characteristics, we can still find many similarities between them, particularly with regard to climate and the diversity of the landscape.

The Sahel belt ecosystems, which are significantly weakened by anthropogenic factors, are highly vulnerable to climate change, with all it may entail such as threats to goods and ecosystem services provided to the people who depend on it. Increasing food insecurity, growing pressure on natural resources (land and water) – which are already badly stretched - and the consequences of uncontrolled management may quickly result in limiting development, exacerbating instability within local populations and increasing unequal access to resources, with the predictable outcome of conflict over land use or uncontrolled migration.

Given this situation, urgent decisions and actions are needed which would be impossible without knowledge based on data and reliable information, which is ever more nuanced and more widely shared, at a national and, preferably, regional level.

The «Building Resilience through services related to innovation, communication and knowledge - BRICKS» project is supported by the Sahel and West Africa Programme - SAWAP. Funded by the World Bank and the Global Environment Facility, it involves 12 countries in the Sahel belt and aims to make available the tools, methods and data needed to develop strategies for the sustainable development of the region's land and waters, while strengthening the links between the various local, national and regional partners. The Sahara and Sahel Observatory, the Permanent Interstate Committee for drought control in the Sahel and the International Union for Conservation of Nature, have worked in partnership and mutual understanding for nearly four years to carry out this project.

The Atlas in question, which is one of the results of this joint work, covers twelve countries: Benin, Burkina Faso, Ethiopia, Ghana, Mali, Mauritania, Niger, Nigeria, Senegal, Sudan, Chad and Togo, covering an area of approximately 9.8 million km², i.e., almost one-third of the total area of Africa.

Through a set of information from the monitoring and evaluation mechanisms, this publication is humbly intended to contribute to the efforts being made by countries in the area and to facilitate the decision making process for improved management of natural resources in the region.

Unlike the Land Cover Atlas that was produced by OSS in the framework of the REPSAHEL project - Improving the Sahel populations' resilience to environmental changes, on 6 countries (Burkina Faso, Mali, Mauritania, Niger, Senegal and Chad), and developed within a national framework, this document has been designed to provide a regional vision, so as to show both the similarities, but also differences between the territories, in the hope of facilitating the implementation of regional strategies. It uses the same production techhique, the same classification techniques and the same map editing standards used for developing the regional land cover atlas from North African countries, produced by OSS as part of the MENA-DELP project - Livelihoods and desert ecosystems knowledge sharing & coordination - also financed by the World Bank and the Global Environmental Facility.

This Atlas complements the one on the Changing landscapes of West Africa (1975 -2013), produced by CILSS, with medium-resolution data and highlighting major changes in the ecosystems over the last four decades. Indeed, using 2016 Landsat TM data with 30 metres of resolution it brings a geometric precision compatible with the needs of planners and developers for planning and managing land. It covers all the Sahel zone countries of West Africa and East Africa, giving it a geographical dimension suited to the expectations of the national, regional and international partners involved in implementing the Great Green Wall of the Sahara and the Sahel Initiative.

It is available in paper format and electronic format on the BRICKS-SAWAP project website, and is aimed at the different technical services, academics, national and regional organisations interested in sustainable natural resource management, and perhaps more simply anyone concerned with the land use aspect of the environment.

Finally, we are pleased with the partnership that made this publication possible: World Bank, Global Environment Facility, national and regional partners, not forgetting all technicians in the broad sense of the term from the Sahara and Sahel Observatory, the Permanent Interstate Committee for drought control in the Sahel and the International Union for Conservation of Nature.

Together, we hope that the information available in this atlas contributes to strengthening the resilience and sustainable development of a particularly sensitive region of the African continent.

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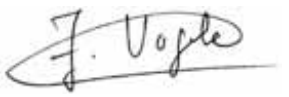

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MONOGRAPH OF THE SAHEL AND WEST AFRICAN REGION

GENERAL CONTEXT

Benin, Burkina Faso, Ethiopia, Ghana, Mali, Mauritania, Niger, Nigeria, Senegal, Sudan, Chad and Togo are countries in the warm climate zone of the planet's surface and are characterised by the alternate dry and wet seasons around the tropics of cancer. This group of countries involved in the Sahel and West Africa - SAWAP[1] programme is referred to in this atlas as "the Sahel and West Africa zone".

These territories are largely dominated by arid, semiarid and dry subhumid, environments that progress along a North-South gradient. They are subject to human activities and climatic variations due to the influence of the great Sahara and the Atlantic Ocean, which makes temperatures, rainfall distribution and wind vary throughout this area. Most of the economic activity in the area is based on the exploitation of land-based natural resources accessible to people (earth, water, biodiversity) through the practice of farming, stockfarming and, to a certain extent, the exploitation of forest products. These activities are practised within production systems which are as varied as they are complex depending on the environment, including agricultural production systems, agropastoral, sylvo-pastoral, oasis, etc.

The viability and reproducibility of these systems depends essentially on how resources are managed by people. However, for rather objective reasons pertaining, amongst others, to demographics, the political and institutional environment governing these activities and climatic variations, this resource management was not commensurate with socio-economic development needs in recent decades. This, in turn, affects production system sustainability, with all the adverse effects this entails.

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Stone barriers, Birni N'konni, Niger

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Natural vegetation, Burkina Faso

Therefore, the environmental problems of the SAWAP programme area are the result of an overuse of or mismanagement of local resources to meet the constantly increasing immediate social needs. In the absence of adequate and timely measures in terms of the political and institutional environment, a situation such as this ends up creating an imbalance between the needs in question and the productive potential of natural resources. This imbalance is exacerbated in the context of climate change. As a result, the development efforts from countries in the area face a dilemma which can only be resolved with a twofold approach, (i) developing production to meet immediate national needs (ii) maintaining and sustaining the productive base of resources i.e. **soil fertility, water and biological resources** which are the pillars of any food and non-food agricultural production.

Due to its climatic, institutional, economic and environmental context, the Sahel and West Africa region appears to be one of the most vulnerable regions in the world. The aridity and spatial and temporal variability of precipitation creates a situation that the countries concerned have integrated into their policies and socio-economic development efforts.

It is in this spirit that, in the 1970s, many countries in the region established subregional cooperation and consultation bodies in the field of the fight against the effects of drought and desertification (CILSS, INSA H, Club du Sahel, Liptako Gourma Authority, IGAD). Indeed, the degradation of land resources, water resources and biodiversity hinder the countries' socio-economic development efforts. As a result, many national programs and projects have been developed and implemented with the support of technical partners and international and bilateral financing, particularly in the areas of reforestation, agroforestry, the wood-energy economy, management of natural resources, access infrastructure, etc.

It should be noted here that studies conducted by the Interstates Committee for drought control in the Sahel - CILSS[2] and its partners in Burkina Faso, Mali, Niger, and Senegal (Edwige Botoni and Chris Reij, 2009) showed that «the major efforts in rehabilitating degraded land has increased agricultural yields,

1 Sahel and West Africa programme – SAWAP.

2 The studies in question focused on assessing the impact of investment in natural resource management and analysing the development of agriculture and the environment in the Sahel since the early 1980s.

improved food security, encouraged local groundwater recharge, increased the number of trees and their productivity, slowed down the rural exodus and so many other effects which have often been overlooked in evaluations. Such findings bear witness to the effectiveness and sustainability of the results obtained during the period in question and therefore the need for them to be widely used.

Notwithstanding the results and impact achieved over the last three decades, these efforts have fallen short of needs and require significant up-scaling, in particular because of the geographical scope of the area and its development potential, as well as the rural character of its economies which are based on the exploitation of natural resources.

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Sand dune stabilisation works, Rosso, Mauritania

Sustainable land and water management therefore remains central to environmental issues in the countries of the Sahel zone and West Africa and is an important factor in their economic growth, as well as a «key» to lifting rural populations, who represent on average 62% of the total population[3], out of poverty.

Since the ratification and entry into force of the Conventions resulting from the United Nations Conference on Environment and Development (Rio 1992), land degradation and its effects on GHG emissions and global warming, on the development of desertification phenomena, particularly in Africa, as well as on ecosystems and biodiversity, has been placed at the heart of international summits and negotiations. This has led to the establishment of financing mechanisms, including the Global Environment Facility - GEF, the Global Mechanism to Combat Desertification, the Climate Change Adaptation Fund, the Green Climate Fund, etc.

Such interventions have had a definite effect on African communities which, with the support of the international community, have multiplied initiatives in the field of sustainable land management and socio-economic development overall. This is particularly the case with the Great Green Wall Initiative for the Sahara and the Sahel (IGMVSS) of the SAWAP programme and its supporting BRICKS project[4], TERRAFRICA/NEPAD[5], etc.

I. PHYSICAL AND BIOLOGICAL CHARACTERISTICS OF THE ARID AND DESERT ECOSYSTEMS

1. Natural environment and relief

The countries of the Sahel zone and West Africa have very similar biophysical characteristics and environmental issues. The majority of these countries are in the West African sub-region (Benin, Burkina Faso, Ghana, Mali, Mauritania, Niger, Nigeria, Senegal and Togo), the rest are located in Central Africa (Chad) and East Africa (Ethiopia and Sudan).

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Chari river, Douguia, Chad

According to several authors, the Sahel zone is located, between the 200 and 600 mm isohyets stretching towards the south (OECD, 2015; Ali et al. 2008). It is a wide belt ranging from a few hundred to over a thousand kilometers from the Atlantic coast of Senegal and Mauritania to the Red Sea coast in Sudan, Eritrea and Djibouti. It is bordered to the north by the Sahara Desert and to the south by the equatorial region. In terms of relief, the area is relatively flat, broken in places by mountains north of the Sahel and in the central-eastern part of the region.

Indeed, most of the area is less than 1000 m above sea level, but the relief is rather locally contrasted, with four main sets that can be distinguished as follows:

- The Saharan border to the north which includes the mountain ranges of Adrar des Iforas (north-eastern Mali), Aïr (northern Niger) and Tibesti (extreme north of Chad), which are ancient granite massifs, eroded and with no apparent highest point;

3 This is the average rural population rate for sub-Saharan Africa in 2016: Source : https://donnees.banque- mondiale.org/indicateur/Sp.rur.tOtl.ZS.

4 The BRICKS project – Building Resilience through Innovation, Communication and Knowledge, is a project which supports the Sahel and West Africa – SAWAP programme which aims to improve access to best practice and information on monitoring the SAWAP portfolio as part of integrated management of natural resources, climate change and natural disasters.

5 NEPAD is the merger of the Millennium Partnership for the African Recovery Programme and the Omega Plan. The merger was finalized on 3 July 2001, creating the New African Initiative (NAI), which was approved by the Organization of African Union Heads of State at their Summit on 11 July 2001. The finalization of the NAI Strategic Framework on 23 October 2001 formed the New Partnership for Africa's Development (NEPAD). NEPAD is a development program with three objectives: i) to promote accelerated growth and sustainable development, ii) to eradicate widespread and extreme poverty, and iii) to end the marginalization of Africa in the globalization process.

- The intermediate (Sahel) zone further south, which consists of basins and plateaux inclining into cuestas at the edges;
- The region of the Gulf of Guinea to the south which includes plateaus with altitudes ranging between 300 and 1600 m;
- The eastern part of zone including the Horn of Africa (Ethiopia), which includes the highlands on both sides of the Great Rift Valley. Their altitudes range between 1800 and 4533 m, before gradually descending towards the lowlands of western Sudan.

2. Climate

The Sahel zone is characterized by its highly variable tropical climate in space and time according to the Köppen-Geiger[6] climate classification It is characterized by high temperatures, between 33 and 36°C, throughout the year (Hiernaux & Le Houérou, 2006, Met Office, 2010), and strong seasonal and interannual variability. The gaps are larger between night and day and can reach 10 to 15°C or more in the desert, while interannual variations south of the Sahara range between 6 and 10°C (OC DE 2008, Met Office, 2010).

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Sahel landscape in Douguia, Chad

2.1. Average rainfall and isohyets

Rainfall is determined by the intertropical front (ITF) which varies greatly from one place to another (Charlotte, 2012).). The Sahel belt to the north is characterized by a rainy season in warm weather, between July and September. Further south, particularly from the transition zone towards the Sudanian zone, the area experiences erratic rainfall, which occurs during the dry season, especially in April (known colloquially as «mango rains»). This phenomenon is more accentuated the closer you get to the Gulf of Guinea in the South (Sudano-Guinean zone) to give rise to two distinct rainy seasons alternating with two dry seasons.

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Rolling landscape in the Tigray region, Ethiopia

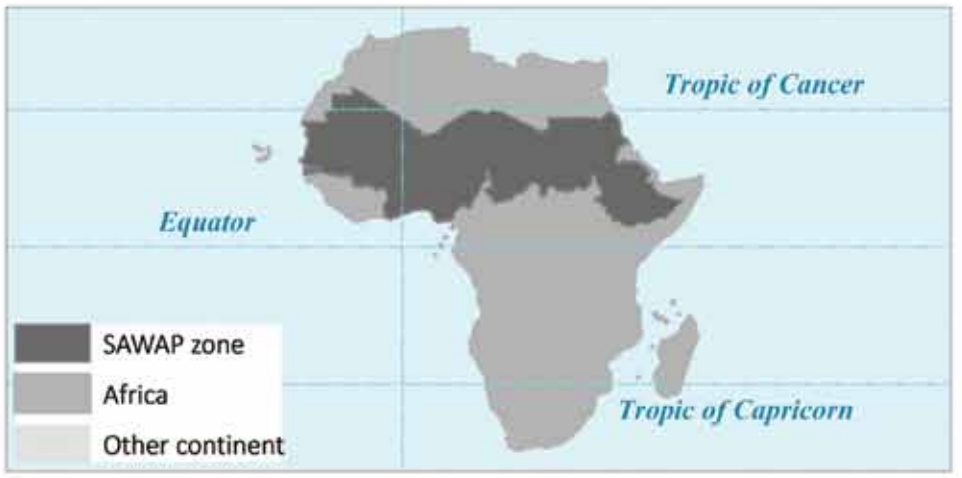
In the east of the region, in Ethiopia, rainfall is similar to rainfall in the Sahelo-Sudanian region, with a first short rainy season around March-April and a longer second rainy season that starts often around June-July. This similarity is more pronounced with the rainfall of the Sudano-Guinean zone further south and also seems to affect the diminishing rainfall pattern experienced in the Sudano-Sahelian region of West Africa since the 1950s.

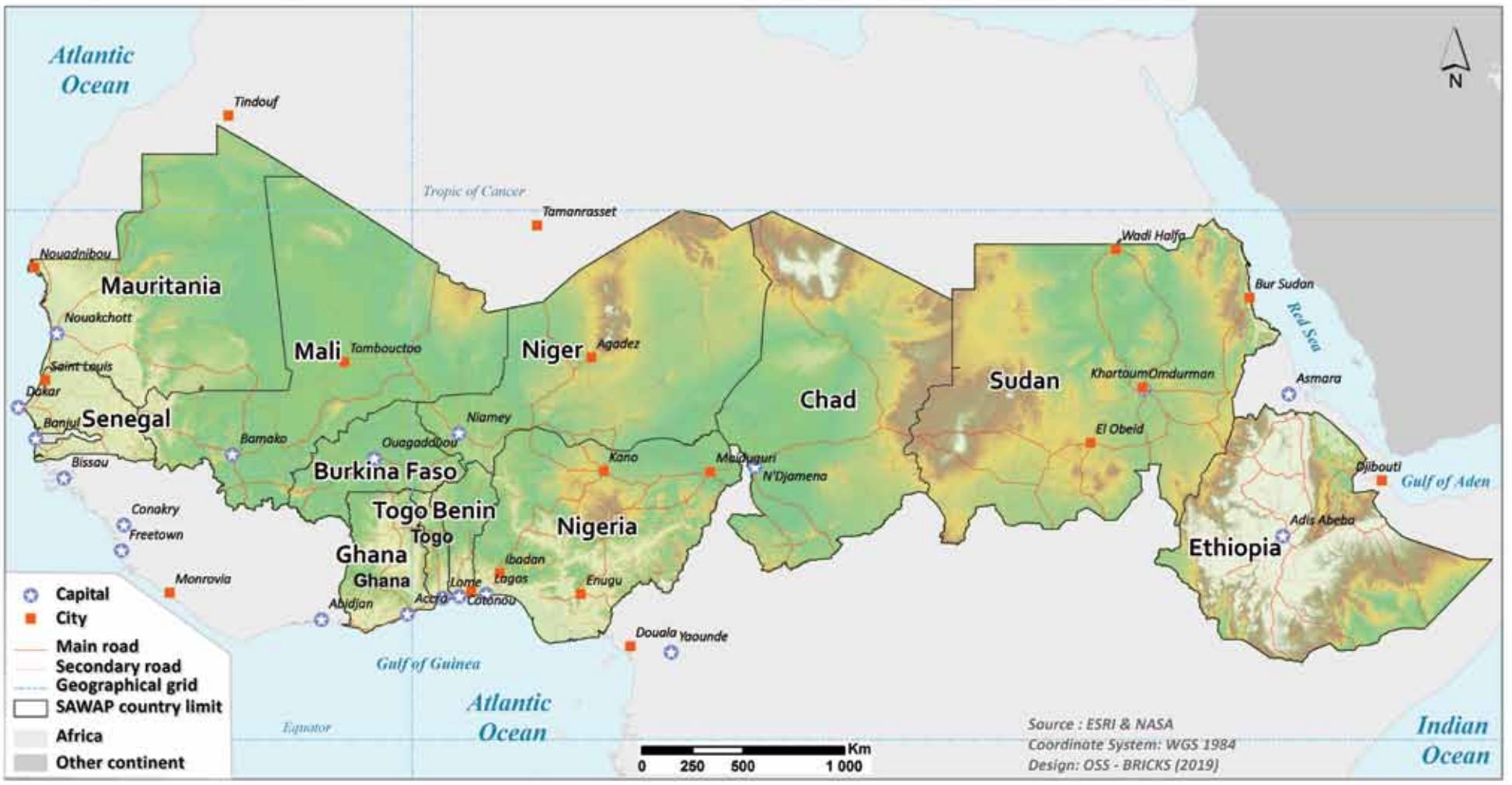
It should be noted that in the Sudano-Sahelian zone, annual rainfall experienced an average decrease of 20 - 40% between 1931-1960 and 1968-1990, compared with 15% in the tropical rainforest regions. In reality, this downward trend has translated into isohyets sliding around 150 -200 km to the south (Diouf et al., 2000).

Since the mid-1990s, there has been a return to better rainfall conditions in the area, but with inter-annual variability and increased intra-seasonal rainfall, especially in central and eastern areas (Lebel and Ali, 2009). The same trends were observed in Senegal and Burkina Faso (Saleck et al, 2011, Lodoum et al., 2009).

A recent study (Dardel, 2014) showed that the return to better rainfall conditions does not necessarily mean «regreening» the zone and a return to the initial situation. Despite the Sahel ecosystems' proven resilience to extreme climatic events on deep sandy soils, contradictory changes were observed on the part of the landscape consisting of shallow soils (increase in runoff coefficients and erosion, vegetation degradation), which could be explained by rainfall and/o changes in land use.

6 The Köppen classification system is a climate classification based on seasonal precipitation and temperature patterns. It was invented by climatologist Wladimir Peter Köppen in 1900, combining the map of world vegetation published in 1866 by Griesbach and de Candolle's division of the climate into five zones. The version presented by Rudolph Geiger in 1961 is the most commonly-used climate classification system. A very large number of climate studies and publications have adopted one of the versions of this system. The Köppen-Geiger map is still a reference today due to its frequent updates, in the fields of hydrology, geography, agriculture, biology, and climatology through research on the climate evolution. Other classifications come from this system which are more in line with the difference in biomes found such as the Trewartha classification which introduces empirical variables. These classifications are, however, less frequently used.





Map 1. Location of the Sahel and West African region

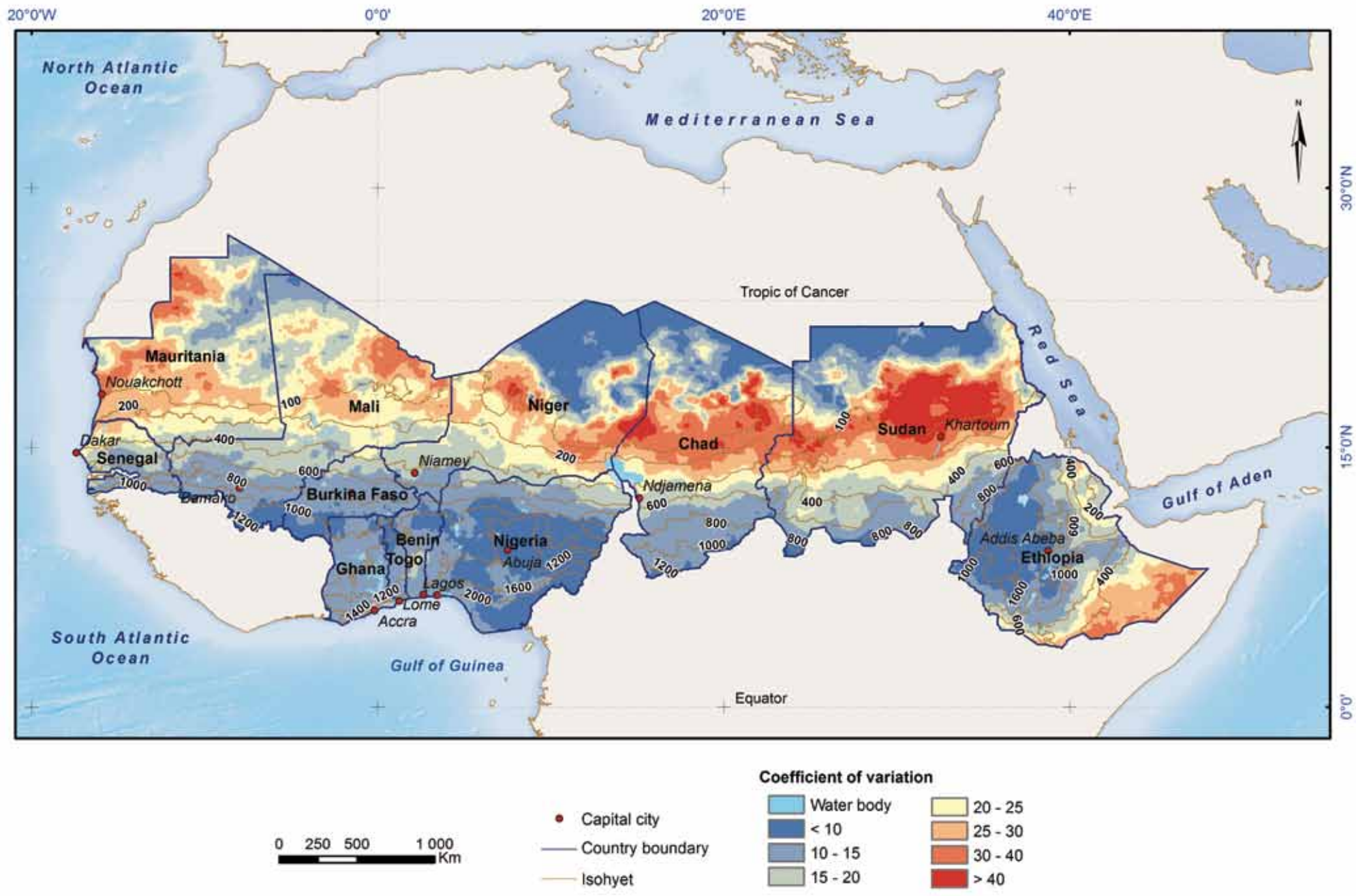
2.2. Space-time variability of rainfall

Space-time variability of rainfall is one of of the factors in climate variability.

An analysis of the annual rainfall variability map suggests two dominant situations:

- A rate of variation characterized by extensive spatial variability. High rates of variability (≥25%) are observed throughout a rather thick band following the 100-200 mm isohyet, going from eastern Mauritania to northern Sudan, while low values (<20%) are found on both sides of this band. This rather unique situation (poor variability in the desert zone) may be explained by the fact that, generally, the variability of rainfall is inversely linked to average rainfall whatever the climate. (Le Houérou, 1992 ; Scoones, 1999);
- the variation in peaks as well as the large values are in arid zones, mainly in countries like Sudan, Chad, Mauritania and, to a lesser extent, Ethiopia.

One of the biggest effects of this variability is drought which is an aggravating factor, in the long term, desertification and its litany of socio-economic problems; a situation that is exacerbated by climate change.



Map 2. Annual rainfall variability, 1981 - 2016, (OSS 2018).
Source: Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS)

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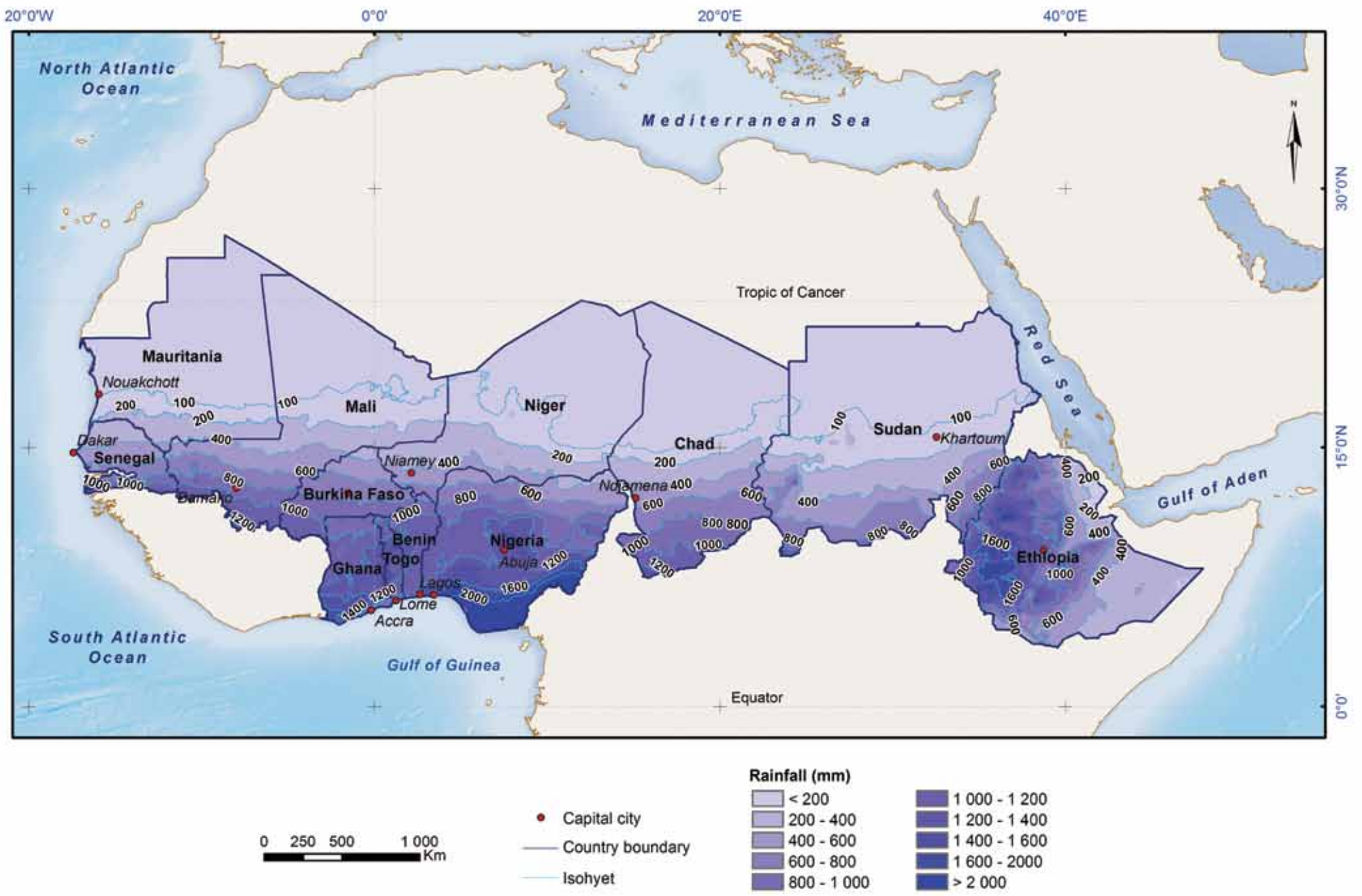
Niger river, Niamey, Niger

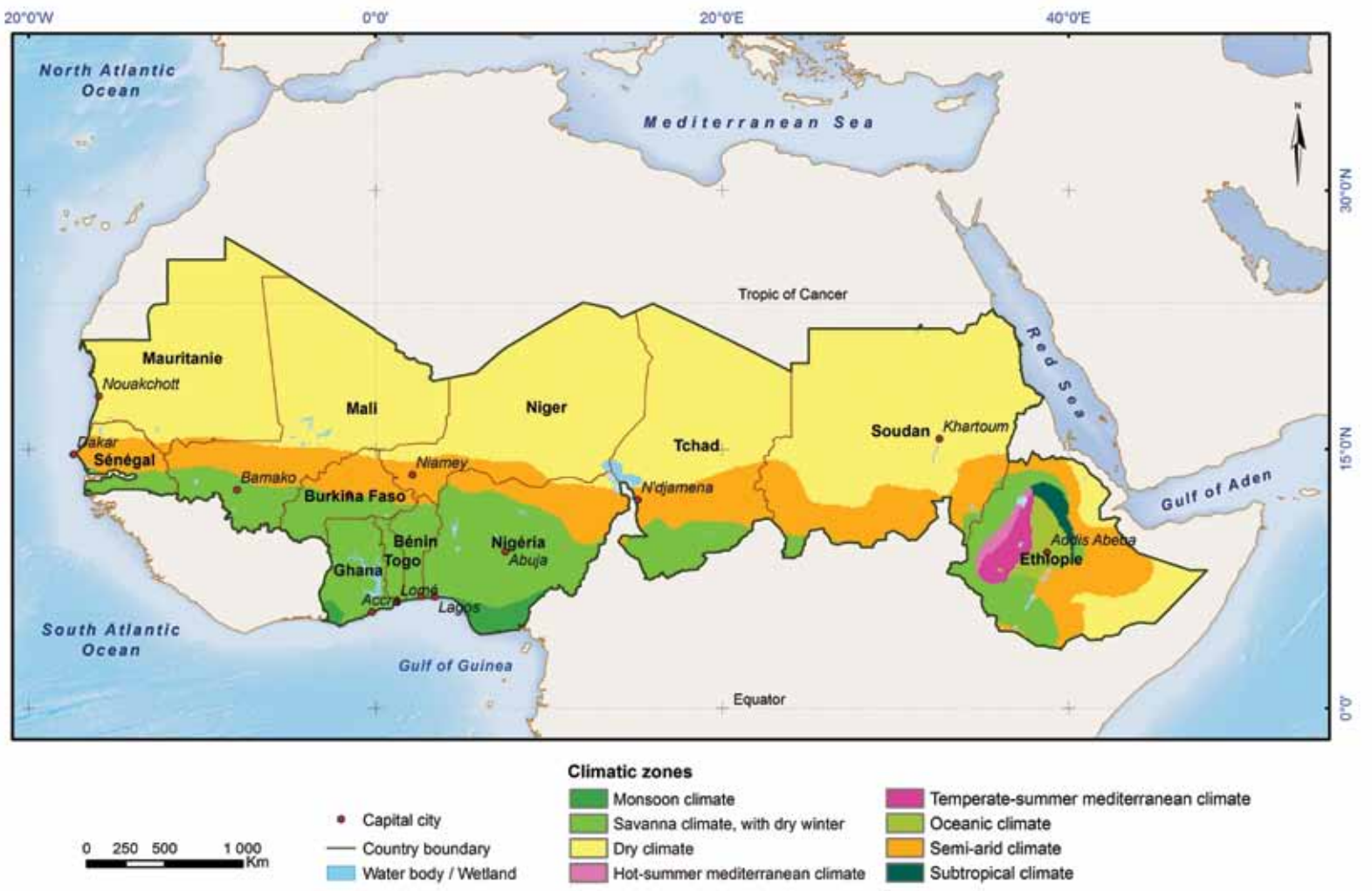


Map 3. Average annual rainfall in the Sahel region and West Africa, 1981 - 2016 (OSS 2018). Source: Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS)

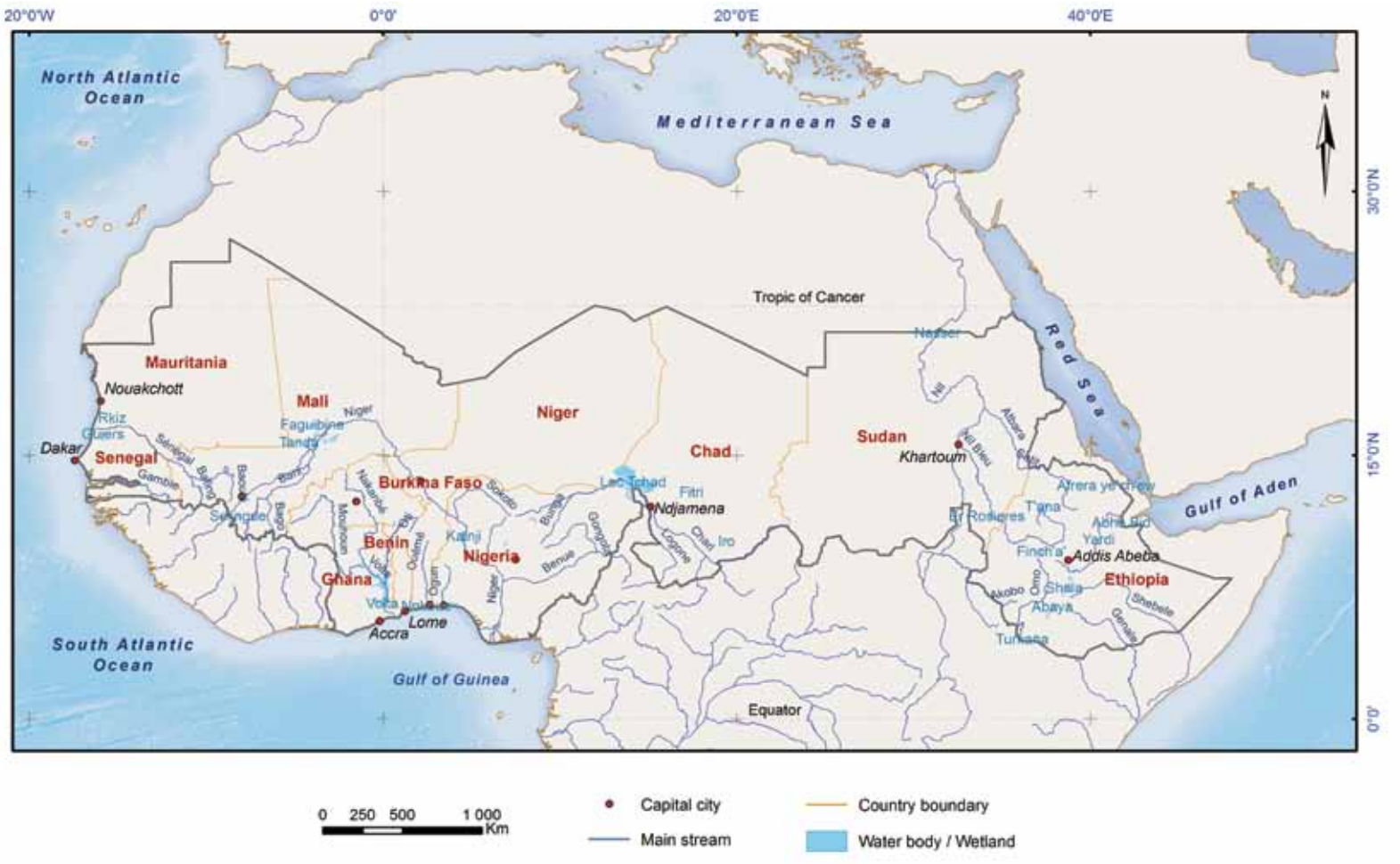
2.3. Climatic zones

The spatial distribution of precipitation was used to define the region's bioclimatic zones. In terms of rainfall, there are five different climate zones (UNEP, 2008):

- in the north, the **hyper arid** (Saharan) zone accumulates less than 200 mm of rain per year for two months (mid-July - mid-September). Vegetation is sparse and essentially consists of shrubs adapted to the climate (International Sustainability Council, 2013);
- on the southern edge of the Sahara is the **arid zone** (Sahel) where precipitation is scarce, irregular and relatively low (less than 500 mm). It is spread over a short period of the year, from June to the end of September (Stock 2004, FAO 2001);
- further south, the **dry tropical zone** (Sudan) is characterized by relatively long dry seasons, often lasting more than six months. The annual rainfall is between 600 and 1200 mm (FAO 2001), with marked inter-annual variations (Goudie, 1996);
- the **humid tropical zone** (Guinea) on the periphery of the equatorial region is prone to monsoons, rainy summers and dry winters with an average annual rainfall of around 1500 to 1800 mm (FAO 2001);
- the **highland area** of eastern Africa has its own classification because of the high altitudinal gradient and the presence of mountain flora mingling with Sudanese and Sahelian plants from West Africa. The climate therefore varies considerably depending on the regions and the altitude. Studying the illustrative map of long-term average annual rainfall shows that this part of East Africa, which covers a good part of Ethiopia, is among the wettest areas, with isohyets (lines of equal rainfall) reaching 1600 km.



Map 4. Climate zones in Sahel and West Africa (OSS, 2018).
Source: Oak Ridge National Laboratory Distributed Active Archive Center



Map 5. Hydrographic network in the Sahel and West Africa (OSS, 2018).
Source: Natural Earth, 2017 ; Lehner & Döll, GLWD, 2004

3. Water resources

The water resources in the Sahel zone are characterized by very large hydrologic systems, often shared between several countries. These systems are represented by transboundary water basins, large aquifers, lakes and wetlands (UNEP, 2010).

Transboundary water basins form an important water network covering all countries in the region. The most important are the Niger, Senegal, Volta rivers and Lake Chad network, which irrigate the Sahel. The network is completed in the east by the Upper Nile Basin (Sudan and Ethiopia), the Juba-Shabelle complex and the Awash. These basins have a considerable role to play socio-economically, especially for maintaining food security throughout the Sahel belt. In addition to these rivers, many not insignificant rivers (Comoé, Mono, Pendjar, Ouémé, Zio, Bandama, Casamance) supply the southern and central area of the region (UA-BIRA., 2012).

The area also has a wide variety of wetlands that represent a large water source for the population. They are made up of freshwater reservoirs (inland Niger delta), natural lakes such as Lake Chad (the largest African endorheic basin shared by 8 countries) and Lake Tana in Ethiopia, the main reservoir of the Blue Nile (UNEP, 2010). These resources play an undeniably important role in maintening socio-economic life and ecosystem services in the Sahel region.

This important river system is supplemented by large transboundary aquifer systems containing an abundance of renewable and non-renewable groundwater resources. Studies have shown proven interactions between aquifer systems and rivers that cross the same region, this is the case for the largest sedimentary aquifer systems in the Sahara (Iullemeden Taoudéni-Tanezrouft complex, Lake Chad Basin) and the Niger River (OSS, 2012). We can also mention the Senegal-Mauritania coastal aquifer systems (David Houdeingar, 2013), Nubian sandstone aquifers (Chad and Sudan), Upper Nile Basin (Sudan and Ethiopia), Ogaden-Juba in the Rift Valley and Awash in Ethiopia (UNEP, 2010). Because of the depth of the layers and the rigidity of some geological layers, these resources are difficult to mobilize, or even inaccessible in certain areas of the Sahel without the deployment of significant resources.

4. Soil resources

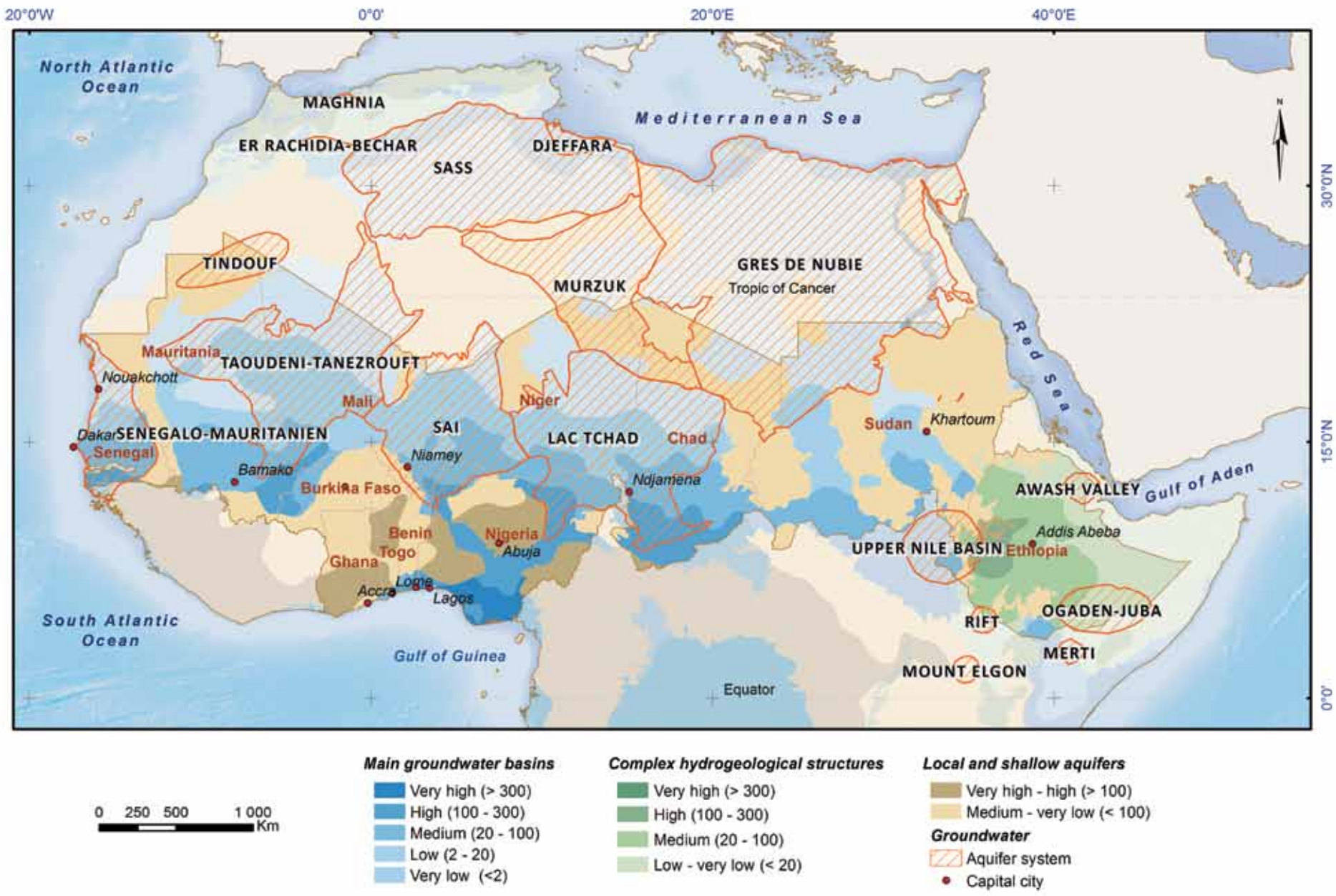
Soil cover in the Sahel is a series of large depressions (synclines) filled with erosion products from various cycles of the bedrock since the Precambrian era. Strong climatic variations during this period marked the spatial organization of the landscape and soils. This shows the complexity and variability of the Sahel environment and soils (Penning de Vries, 1982). Several studies have shown that the zone's soil cover consists of soil environments organized in morpho-pedological units, which are briefly described in the table below.

As it is linked to the climate, soil quality largely determines agricultural potential. Nearly two-thirds of land in the Sahel and Sahelo-Sudanian region is very fragile due to generally poor soil and is very susceptible to erosion. In contrast, the soils in areas south of the 10th parallel are generally richer in nitrogen and phosphorus and benefit from a tropical climate favoring the formation of a much more significant biomass than in the Sahel environment. Therefore, they have a better capacity for rebuilding the organic base and thus their fertility (OECD, 2008).

Crops in forest park, Tamale, Ghana

Main morpho-pedological units	Geographical situation	Characteristics	Type of soil/vegetation	Aptitudes/potential for use
Iron crust plateaux	Northern regions	Marked by the presence of natural rocky outcrops with localized occurrences of a thin sandy layer	Uneroded mineral soils Vegetation: «Tiger bush»	Very average agricultural potential Timber extraction areas and poor grazing in rainy season
Plateaux	More southern regions	Presence of a layer of gravel and iron crust towards the center of the plateaux, consisting of a sandy-loamy matrix which is yellowish in color	Iron-rich, hard unleached tropical soils Vegetation: open forests	Agricultural potential quite high Currently widely cultivated
Dry valleys	Southern part of the Sahel region	Massive sandy or sandy-clay deposits	Ferralitic soil characterized by a very stable microstructure which gives excellent internal drainage	Excellent farmland. These soils have a poor useful water retention, but this is strongly compensated by a depth exploitable by the roots

Table 1. Main sets of morpho-pedological units of the Sahel zone



Map 6. Groundwater resources (OSS, 2018).
Source: World-wide Hydrogeological Mapping and Assessment Programme (BGR and UNESCO)

5. Ecosystems

Due to its geographic scope and its bio-climatological diversity, the area contains a considerably rich ecosystem (forests, savannas, tiger bush, steppes, deserts, etc.), next to its wetlands and marine ecosystem.

The area has important land or marine transboundary ecosystems overlapping one or more political borders. Some have been established as protected areas and are of utmost importance in terms of safeguarding the remarkable fauna of the area and its habitats, as well as for migratory species. However, overall there are few protected areas as they represent less than 3% of national territories in most countries.

Within the western Sudanian savanna, protected ecosystems of W Park, contiguous to Benin, Burkina Faso and Niger, constitute the only major cross-border complex[7], covering 10,302 km².

Major efforts have been made recently to create protected marine areas on the west coast, from Guinea Bissau to Mauritania, in addition to the vast Banc d'Arguin National Park (Mauritania).

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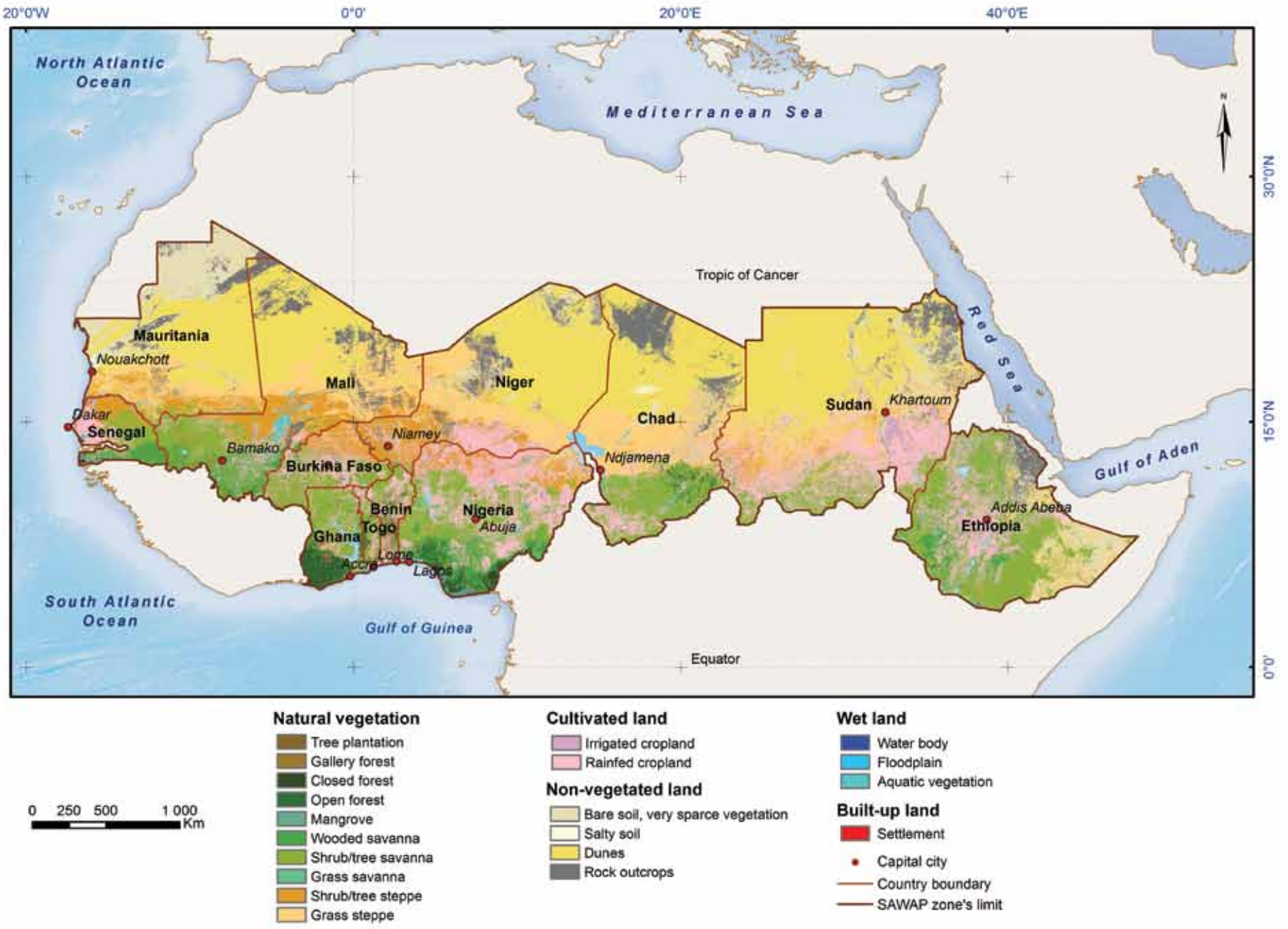
Mangrove around the Diawling National Park, Mauritania

7 Source: http://www.parc-w-benin.net/
and http://www.burkinatourism.com/parc-naturel-regional-du-W.html.



Map 7. Land cover map, data from 2015 and 2016 (OSS, 2015).
Source: Landsat 8 and OSS

In addition, the wetlands are remarkable in that they support intra-African migrations of ungulates, as well as long-distance migrations of many bird species to southern Europe and the Arctic. For example, Niger has around 1,000 wetlands that are thought to host 1.2 million waterbirds in January and February (Brouwer and Mullié, 2001).

6. Specific wealth of fauna and endemism

Despite its aridity, the Sahel region contains a great diversity of species that is undoubtedly linked to the diversity of ecosystems creating a suitable habitat for all the major taxa known to live in the tropics (Brito et al., 2014). The environmental changes which have been taking place for centuries have been at the origin of these ecosystems that contain an immeasurable number of endemic species as is the case for the Sudan Regional Center for Endemism[8]. Adapted to the environmental conditions of the area, this biodiversity is marked by spatial heterogeneity and the Upper Guinea forestone of the last hotspots of biological diversity in West Africa (Sinsin B & Kampmann D, 2010) which is home to 2 000 species of amphibians, birds and mammals (Mallon et al., 2015).

White giraffes in Kouré, Niger

8 The regional Sudanese centre for endemism covers the Sudanese area spanning from the central Senegalese coast to the West to the foot of the Ethiopian plateau to the West (White 1993).

The Sahel zone is home to endemic populations of Sahel-Saharan antelopes. Some of them, which also play an important role in seed dispersal, such as Dorcas gazelle (gazella dorcas) and white antelope (Addax nasomaculatus), are in critical danger of extinction according to the IUCN Red List of Threatened Species(Mallon et al. 2015).

In the east of the zone, the varied landscapes of the Ethiopian massif host a varied flora and fauna and are marked by strong endemism: 55% of the flora and 28% of the fauna (T. Guindeuil and J. Lesur, 2014), while wetlands, the lowlands and the large rivers that cross them, are home to many species of large mammals, reptiles and antelopes such as Swayne's hartebeest (Alcelaphus swaynei) and the Bushbuck (Tragelaphus scriptus meneliki) which are endemic to Ethiopia.

7. Specific wealth of flora, forest and agroforestry resources

In the countries of the Sahel, the heterogeneity of the climate as well as the different soil types influence the distribution of flora (WWF, 2016). Distribution of vegetation is linked to a climatic gradient, creating a series of almost parallel strips of vegetation that stretch from the southern Guinean coast with its high and well distributed rainfall throughout the year, towards the drier vegetation areas of the Sahel steppes of the Sahara Desert to the north (Thiombiano & Kampmann 2010).[9]

With regard to the region's forests[10] their size and characteristics are shown in the table below :

Plant cover	Million ha	%
Land surface	848,782	99,0%
➤ Forest	71,217	8,4%
• Primary forest	3,488	
• Other naturally regenerated forest	58,692	
• Planted forest	9,037	
➤ Wooded land[11]	102,641	12,1%
➤ Forest land[12]	15,893	1,9%
➤ Other land[13]	587,814	69,3%
Inland waters	8,63	1,0%
Total land	**857,4**	**100,0%**

Table 2. Size and characteristics of forests in the Sahel zone and West Africa in 2015. Source: FAO (FRA, 2015)

9 http://www.iucnredlist.org

10 This is forest as defined by the FAO: Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10%, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.

11 Land not defined as "Forest", spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of 5-10%, or trees able to reach these thresholds, or with a combined cover of shrubs, bushes and trees above 10 %. It does not include land that is predominantly under agricultural or urban land use.(FAO, 2015).

12 Land considered as "Other land", that is predominantly agricultural or urban lands use and has patches of tree cover that span more than 0.5 hectares with a canopy cover of more than 10% of trees able to reach a height of 5 meters at maturity. It includes both forest and non-forest tree species (FAO, 2015).

13 All land that is not classified as forest or other wooded land, includes (i) agricultural land, meadows and pastures, built-up areas, barren lands, land under permanent ice, etc. and (ii) includes all areas classified under the sub-category "Other land with tree cover" (FAO, 2015).

In addition, the delimitation of vegetation zones makes it possible to distinguish regional centers of endemism (where> 50% of the flora is endemic) in the Sudanese region as defined by White (1986) which cover an area of 3.7 million km² and which are interspersed with transition zones towards the Sahel, which in turn spans over 2.8 million km2 (White, 1983).

Each zone includes several types of vegetation (woodland, wooded land, forest land, meadow, etc.) that are distinguished by their features. The first transition zone is the major region of open forests and their appearance of degradation; the second very generally features steppe vegetation, planted with different kinds of trees, in particular thorny trees.

II. SOCIO-ECONOMIC CONTEXT

1. Demography

The resident population of the Sahel zone and West Africa was estimated at

466 million inhabitants in 2016, representing 6.3% of the world's population (IBRD, 2017), with 40% residing in Nigeria. If we exclude Nigeria, the population would be 280 million, or 3.8% of the world's population. Nigeria is concentrated at 79% on only 30% of the surface area of the region; the five Sahel zone countries with the largest land surface (Mauritania, Mali, Niger, Chad and Sudan) account for just 21% of the total population and 70% of the Sahel zone and West African area.

This population has grown from 106 million in 1960 to more than 466 million in 2016, an average annual increase of around 2.7%/year[14].

Currently, population growth rates range from 2.5% to around 4 % per year. These rates would tend to increase further, particularly due, on one hand, to a rapid decrease in the rates of infant and child mortality, combined with a lagging decrease in fertility rates and, on the other hand, to the absence of well-defined policies in this area (IBRD, 2015). However, population growth is not really a problem in itself as the region is rich in significant natural resources. Furthermore, the region presents significant room for improvement in a number of areas, including development benefiting from these significant human resources. Moreover, given the diversity of natural environments and the soil and climate conditions, the population is very unevenly distributed across the region. Indeed, the population density varies :

- between 4 and 14.5 inhabitants/km² in the Sahel region (Mauritania, Mali, Niger, Chad et Sudan) ;
- between 78 and 133 inhabitants/km² in the Inner Niger delta and along the Nile, the plateaux in the Sudanese region, the coastal areas and high plateaux of the Horn of Africa.

This situation is a reflection of (i) the limited progress of activities relating to the development and valorization of natural resources (land, water, vegetation, mineral resources, renewable energies, etc.) and (ii) limited and / or unequal development of basic infrastructure. However, it would eventually evolve along national patterns/regional planning and development programs, especially with regard to a better balance between regions.

14 Author's calculation; basic source: United Nations, Department of Economic and Social Affairs, Population Division (2014). World Urbanization Prospects.

2. Mobility and migration

The population of the region is characterized by high mobility reflected in bilateral migration. These migrations concerned 3,754,000 individuals in 2000, compared with 2,955,000 in 1990, a change of 27% over the decade[15]. This mobility was due to historical factors and the characteristics of Sahel and sub-Saharan African communities living in the area, including ethnically, linguistic, cultural and religious factors which are not necessarily reflected in the state borders.

Thus, in 2000, bilateral migrations in most countries of the zone represents a negative net migration with a total of 1,329,000 individuals mostly from West Africa. This consists of :

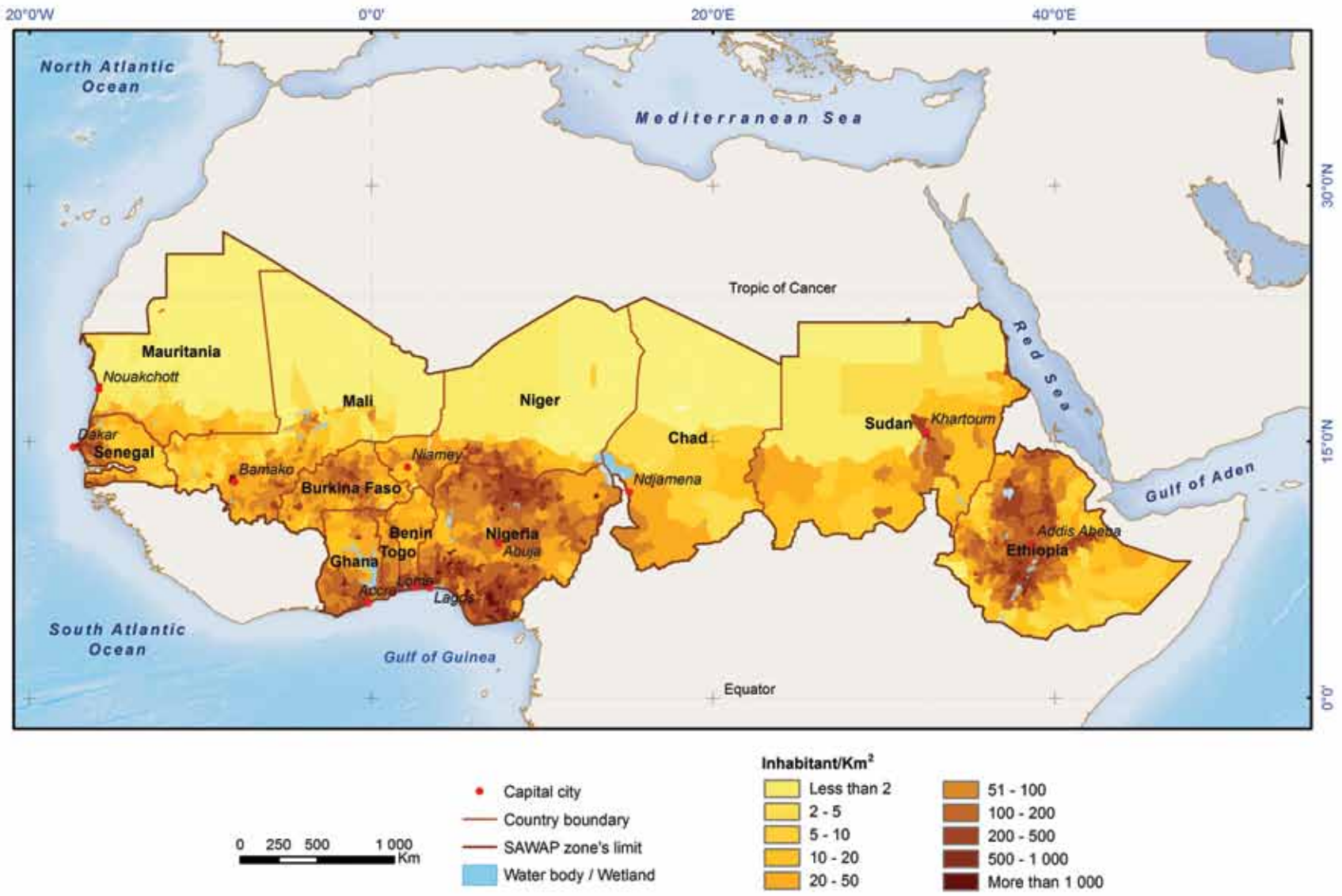
- 37.9% of bilateral migration between the Sahel countries in West Africa ;
- 1% of bilateral migration between the Sahel countries in West Africa and East Africa (Sudan and Ethiopia) ;
- 61.1% of inter-regional migration between the Sahel countries and the coastal countries on the Gulf of Guinea and central Africa (Côte d'Ivoire, Cameroun, Gabon, Republic of Congo, Democratic Republic of Congo and the Central African Republic).

3. Urbanization

Africa is experiencing one of the most rapid increases in urbanization rates in the world. Indeed, the processes of environmental degradation and desertification affecting productive natural resources in in the region are fueling and intensifying the exodus and migratory movements on one hand to the most popular rural areas and, on the other hand, to urban centers, in particular national capitals (Sadio and Bocquier, 1998; Bricas, 2008).

In the Sahel, recent trends show that the urban population which represents between 19% (Niger) and 60% (Mauritania) of the total population depending on the country has growth potential of around 4% per year. According to the «World Urbanization Prospects, 2014 Revision", the average rate of urbanization for the sub-Saharan zone would have increased from 14.8% in 1960 to 38.4% in 2016.

In addition, UN projections anticipate rates of urbanization between 50% and 74% in most countries in the region, with the exception of Ethiopia (37.6%) and Niger (35.4%).



Map 8. Population density in the Sahel region and West Africa (OSS, 2018)
Source: Center for International Earth Science Information Network (CIESIN)

15 Source: author's calculation based on the World Bank database: https://data.worldbank.org/ data-catalog/global-bilateral-migration-database. This database shows global matrices of bilateral migrant stocks spanning the period 1960-2000, disaggregated by gender and based primarily on the foreign-born concept.

Urban growth leads to an increase in demand for food products, in energy (currently provided mainly by the wood), water and services. This will result in the emergence of socio-spatial dynamics that are subject to multiple transformations physical, morphological, socio-demographic, cultural and systems. In addition, the increase in the urbanized surface is detrimental farmland, pastures and woodlands.

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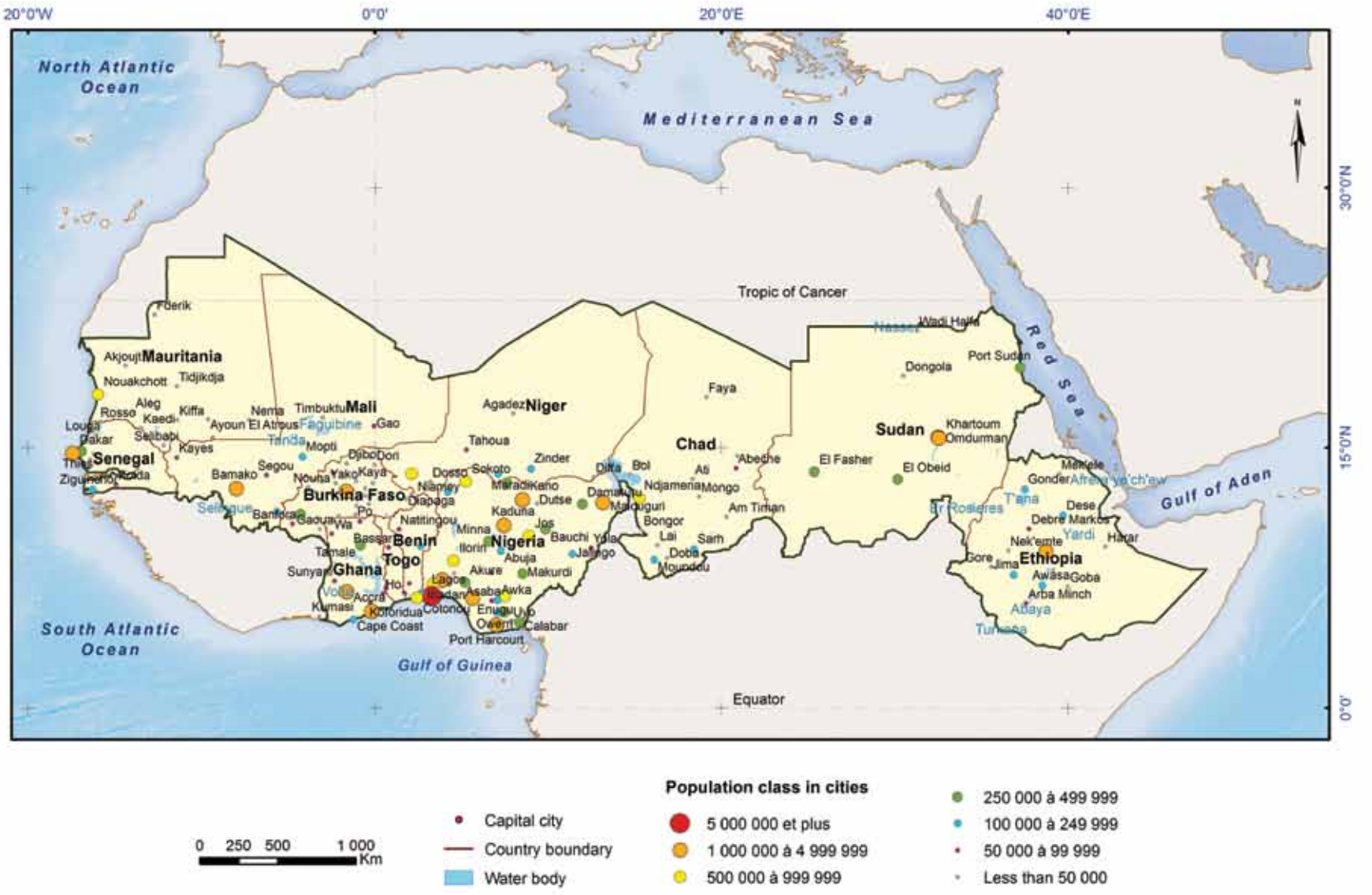
Village in the Boutilimit region, Mauritania



Map 9. Major cities in the Sahel region and West Africa (OSS, 2018). - Source: Environmental Systems Research Institute (ESRI)

III. ECONOMIC ACTIVITY

In the arid, semi-arid and sub-humid regions of Africa, which span most of the territories of Sahel region countries and West Africa, economic activity is mainly focused on exploitation and valorization of natural resources which are accessible to populations (land, water, vegetation, biodiversity), within the framework of agricultural, agro-pastoral and agroforestry production systems complexes. Such systems form the basis of livelihoods, particularly in rural areas alongside fishing, and valorization of forestry resources. These are the systems that largely determine the land use models.

Due to the strong demographic growth of the population in the region, the political and institutional environment that governs agro-forestry activities and in the absence of wealth creation and jobs in other economic sectors (secondary and tertiary), natural resources find themselves inevitably under constantly increasing anthropogenic pressure.

1. Agriculture and pastoralism

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Vegetable crops in Douguia, Chad

Agriculture and pastoralism are the most common activities in the area. This is reflected in land use where pastoral farming predominantly in terms of covered territory, even if agriculture, particularly in favorable areas (recession areas, inland delta, banks of rivers, wetlands, perimeters arranged for irrigation, etc.) is also practiced by a large section of the population. These activities can be grouped into three sets of production (Ly et al., 2010):

- pastoral systems based on transhumant pastoral livestock farming;
- mixed agro-pastoral production systems combining livestock farming pastoral and rainfed and/or flood recession agriculture;
- mixed production systems combining irrigation-based agriculture and sedentary livestock breeding.

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Pastoralism in Ferlo, Senegal

Over the last three decades, the development of agriculture in the region has undergone many transformations that have had the effect inter alia, the extension of cultivation of marginal land and/or forest-oriented areas and even grazing areas (Ibra Toure, 2015). Yet pastoralism is the most beneficial way to value such areas, both socio-economically and environmentally. It contributes largely to the national economy of the countries of the Sahel region. (40% to 60% of agricultural GDP) and is one of the most important first export sectors.

Nevertheless, it is important to point out that in recent decades, relations between the farming and pastoralist communities have often been confrontational, but that production systems are increasingly integrated (Ickowicz et al., 2012).

2. Exploitation of forest resources and its impact

In the West Africa and Sahel region, natural forests have undergone a major transformation, particularly since the 1970s. Between 1990 and 2005, forest cover decreased by 1.2 million hectares per year, which is well above the continental average. This decrease was accompanied by fragmentation of this cover, especially in the humid zone: from a closed forest to an open forest, then to wooded areas.

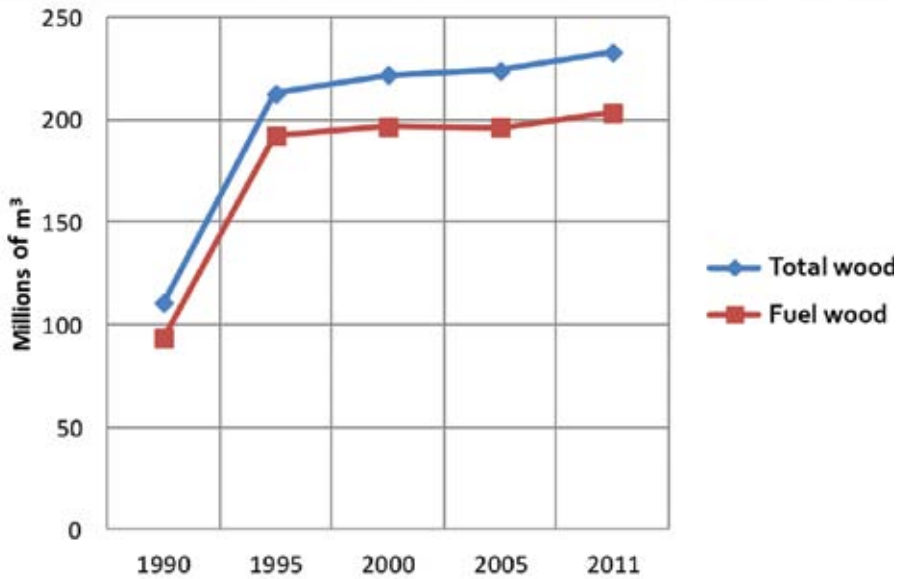


Figure 1. Evolution of volume of timber extracted from forests in the zone Sahel region and West Africa between 1990 - 2011

According to FAO estimates more than 10% of closed forests were converted into open forests between 1980 and 2000 and between 3 and 7% of fragmented forests became wooded land during this same period. The reduction in forest cover is essentially related to the conversion of forests for agriculture, logging (fuel wood and exporting raw logs), extractive operations, infrastructure development and fires (OECD, 2008). This situation which continues to prevail in the current situation is also true for the Sahel countries of Central Africa and, to a certain extent, for the countries of East Africa.

Over the last 25 years, forestry resource exploitation in the region has resulted in an overall substantial and continuous decline in areas of wooded land. The impact of this decline is changes on many levels such as: the extent of production forest, volume of timber removed, multiple-use forest, biomass stock, carbon stock, land areas burned, etc.

2.1. Deforestation et degradation of forest resources

According to the FAO (2015, 2016), the forest resources of countries in the region will have gone from almost 103 million ha in 1990 to 77 million ha in 2015, an average reduction of 1% per year over the period. Only Ghana has seen an increase in its resources with an average annual rate of 0.3%. The downward trend in dependency is projected to continue at least through the next quarter found more or less accentuated by subregions; this decrease would be:

- 1,17% per year for the West and Central Africa subregion corresponding to a reduction of over 30 000 ha per year;
- 0,72% for the East African subregion (Sudan and Ethiopia corresponding to a reduction of 11 150 ha per year .

2.2. Production forests[16]

The area of forests dedicated to production has increased from 34 million ha in 1990 to 24 million ha in 2015, thus registering a decrease of 1.14% per year on average. This decrease mainly concerns Togo (-5%) and Nigeria (-4.2), followed by Ghana (-2.9%) and Chad (-1.6%); only Ethiopia grew by 2.8% over the period.

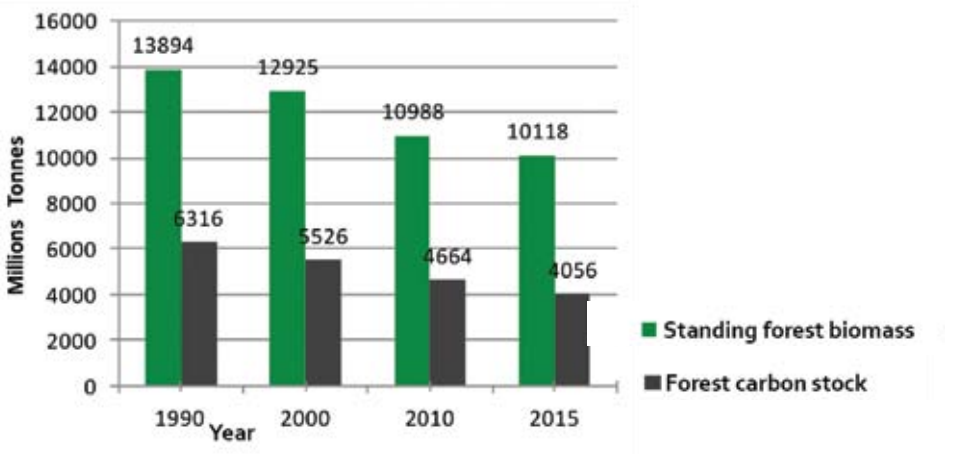


Figure 2: Evolution of living biomass and carbon stock in the forests of the Sahel zone and West Africa

2.3. Wood removal[17]

Removal of lumber and wood fuel is one of the activities which contribute, to a certain extent, to deforestation and degradation of forest resources. Figure 12 and Table 3 shows the importance and development of volume of wood removed[18] from the region's forests.

	Removal in millions of m³					Annual rate of change									
	1990	1995	2000	2005	2011	1990-1995		1995-2000		2000-2005		2005-2011		1990-2011	
						Millions m³	%	Millions m³	%	Millions m³	%	Millions m³	%	Millions m³	%
Total wood	110,81	212,88	222,16	224,14	233,18	102,07	18,4%	9,28	0,9%	1,98	0,9%	9,04	1,6%	122,37	5,3%
Fuel wood	93,69	192,57	196,6	196,4	203,63	98,88	21,1%	4,03	2,1%	-0,2	-0,1%	7,23	3,7%	109,94	5,6%

Table 3. Development of volume of timber removed from forests in the Sahel zone and West Africa between 1990 - 2011. Source: FAO, FRA 2015.

The data in this table shows an average annual increase of over 5% in the volume of wood removed from forests and wooded land over the period with a net slowdown between 1995-2005, followed by a period of regrowth in 2005, mainly regarding removal of fuel wood.

	Millions of tonnes				Annual rate of change							
	1990	2000	2010	2015	1990-2000		2000-2010		2010-2015		1990-2015	
					Millions T	%	Millions T	%	Millions T	%	Millions T	%
Standing forest biomass	13 894	12 925	10 988	10 118	-969	-0,7%	-1 937	-1,5%	-870	-1,6%	-3 776	-1,1%
Forest carbon stock	6 316	5 526	4 664	4 056	-790	-1,3%	-862	-1,6%	-608	-2,6%	-2 260	-1,4%

Table 4. Development of living forest biomass and carbon stock forests in the Sahel zone and West Africa

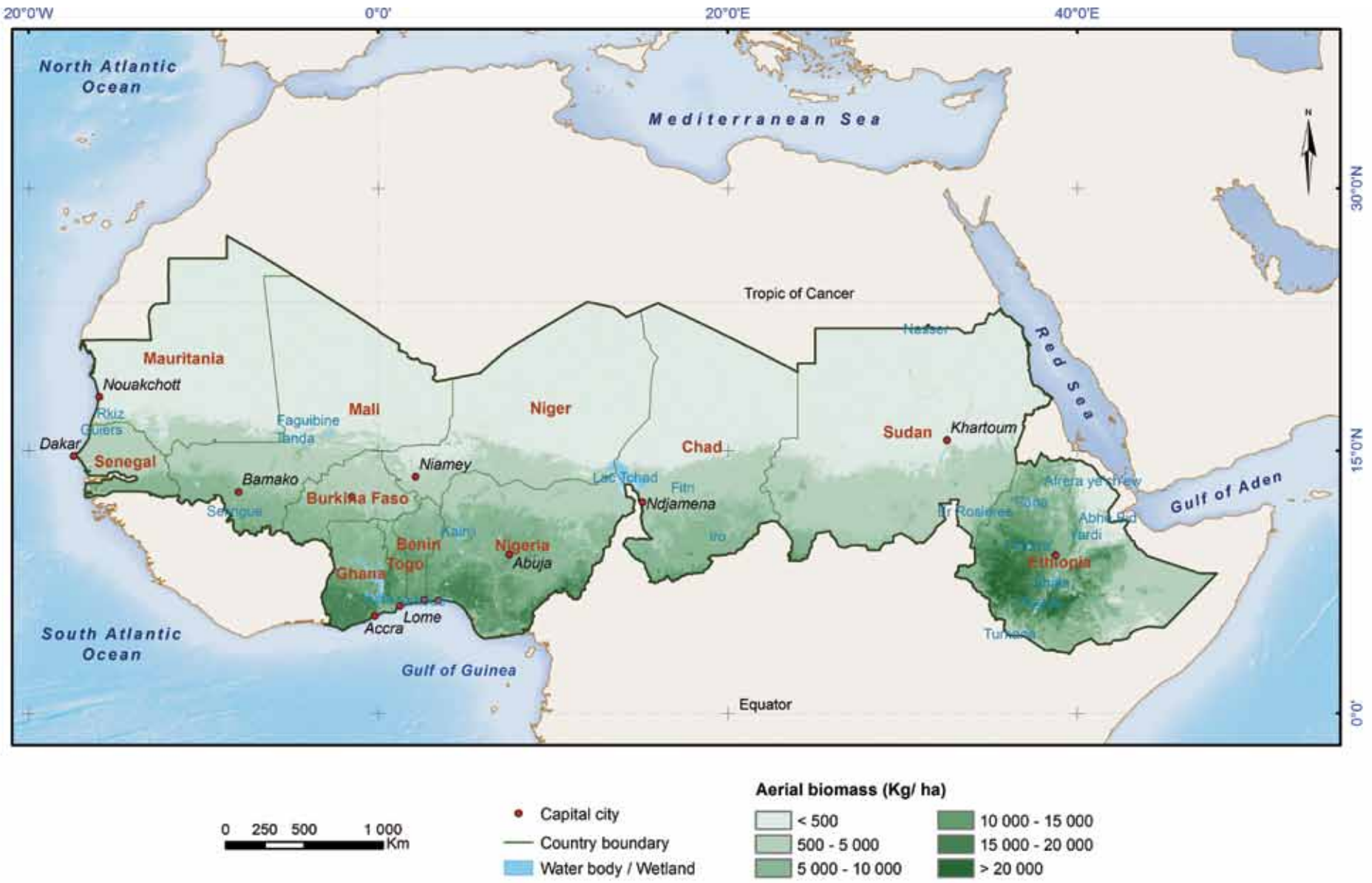
Forest areas (multiple-use, 1 000 ha)					Annual rate of change							
1990	2000	2005	2010	2015	1990-2000		2000-2010		2010-2015		1990-2015	
					1000 ha/y	%	1000 ha/y	%	1000 ha/y	%	1000 ha/y	%
15 060	12 163	11 066	9 993	9 104	-289,7	-2,4%	-217	-1,8%	-177,7	-1,8%	-238,3	-1,6%

Table 5. Change in the area of forests linked to multiple uses between 1990 and 2015

16 The data on production forests does not include Burkina Faso, Mali and Mauritania.

17 The data on wood extraction does not include Sudan.

18 This is the total number of removals of industrial roundwood and fuel wood for energy production, whether for industrial, commercial or domestic use.



Map 10a. Above-ground biomass in the Sahel zone and West Africa from 2010 - 1016 (OSS, 2018). Source: Water Productivity Open-access portal (WaPOR, FAO), MODIS (MOD17)

2.4. Standing forest biomass and forest carbon stock

Like the other factors characterizing forests, living forest biomass stock as well as carbon stock were affected by the exploitation of forest resources. Indeed, in the data available on this subject we see a decrease in these two parameters of 1.1% and 1.4% per year respectively during the period 1990-2015.

2.5. Multiple-use forests[19]

In addition to forests being cleared for cultivation and removal of wood products, some forests in the region are designated for multiple use, mainly for the production of goods, soil and water protection, biodiversity conservation and service provision (non-wood forest products, cultural use, etc.).

However, the constantly increasing anthropogenic pressure has led to overexploitation of these uses which leads to a very advanced state of degradation as well as these forests losing their multifunctionality.

According to the FAO (2015), forests which are designated for multiple use by forest-dependent people in six countries in the region (Benin, Burkina Faso, Mali, Mauritania, Niger and Senegal), have reduced from 15 million ha in 1990, to 9 million ha in 2015, recording an average rate of change of -1,6% per year. This rate varies between 0.5% per year for Mauritania and 5,3% for Mali.

3. Fishing and aquaculture

The fishery resources of the Sahel zone and West Africa contribute to meeting nutritional and food security needs, create employment and income and generate export revenue, particularly countries with a coastline (7 000 km in West Africa). From less than 300 000 tonnes in the early 1960s, in 2008, fisheries production in West African countries was estimated at over 2 million tonnes, or approximately 3.5 % of total world production. (FAO, 2014).

19 Multiple-use forest is "forest areas designated primarily for more than one purpose and where none of these alone is considered as the predominant designated function". Includes any combination of the following: production of goods, protection of soil and water, conservation of biodiversity and provision of social services and where none of these alone is considered as the predominant function.

The West African market therefore has enormous potential for net exporters such as Senegal, Gambia or Mauritania. Indeed, the major West African importers of fish products (Nigeria, Ghana, Côte d'Ivoire) can consume the total exports of other countries in the region without satisfying their own needs (Ndiaye, 2013).

In contrast to West African countries, fishing in East African countries is essentially based on internal bodies of water (rivers, lakes, reservoirs and streams) rather than the Red Sea waters. In Ethiopia and Sudan, activity remains mainly artisan, low production and is consumed locally. In Sudan, production was estimated at around 34,000 tonnes in 2012 with 29,000 tonnes from inland water catch and 5,000 tonnes from marine catch (FAO, 2014). The aquaculture sector is still nascent in most of the countries in the area (2,000 tonnes in Sudan in 2012).

4. Infrastructure and economic fabric

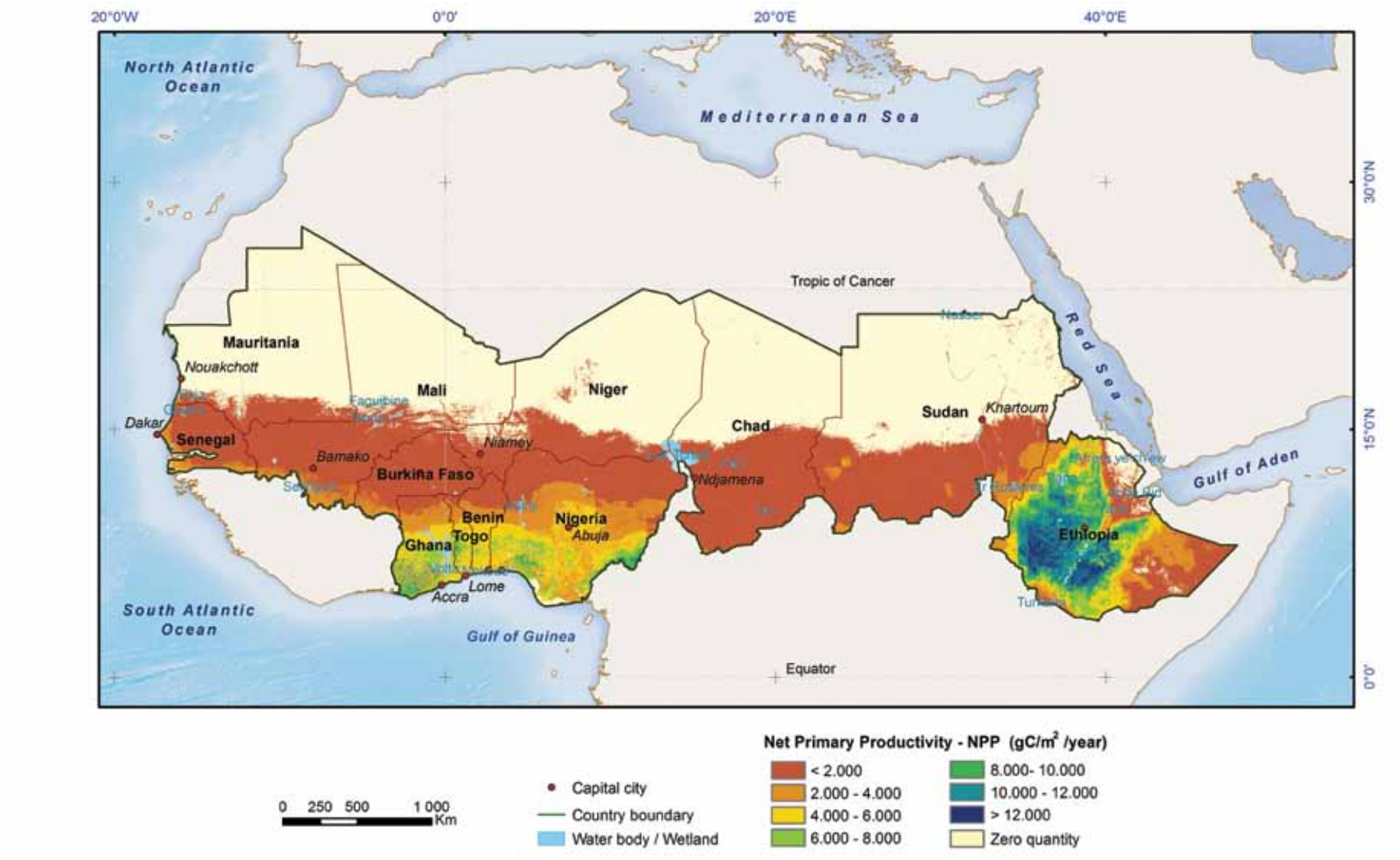
A recent study in 24 African countries20 highlights the generally appalling state of infrastructure in sub-Saharan Africa. According to this study, change and proper functioning of the infrastructures are essential for economic and agricultural performance in Africa. Indeed, by examining the different aspects of four sectors, namely electricity, water, transport and information technology and communication, the study revealed, inter alia, that :

(i) African infrastructure services are mediocre compared to global standards and have not been expanded since the 1990s. Indeed, just one in three rural Africans has access to a passable road in all seasons. Over 20% of the population in countries such as Ghana, Mauritania or Niger has to walk over 2 km to their nearest main water source. African consumers pay twice that paid elsewhere in the world for their basic services; a monthly prepaid mobile telephone package costs 12 USD in Africa, compared to 2 USD in south Asia ;

(ii) In the electricity sector, inadequate access to energy is the biggest obstacle to economic growth ;

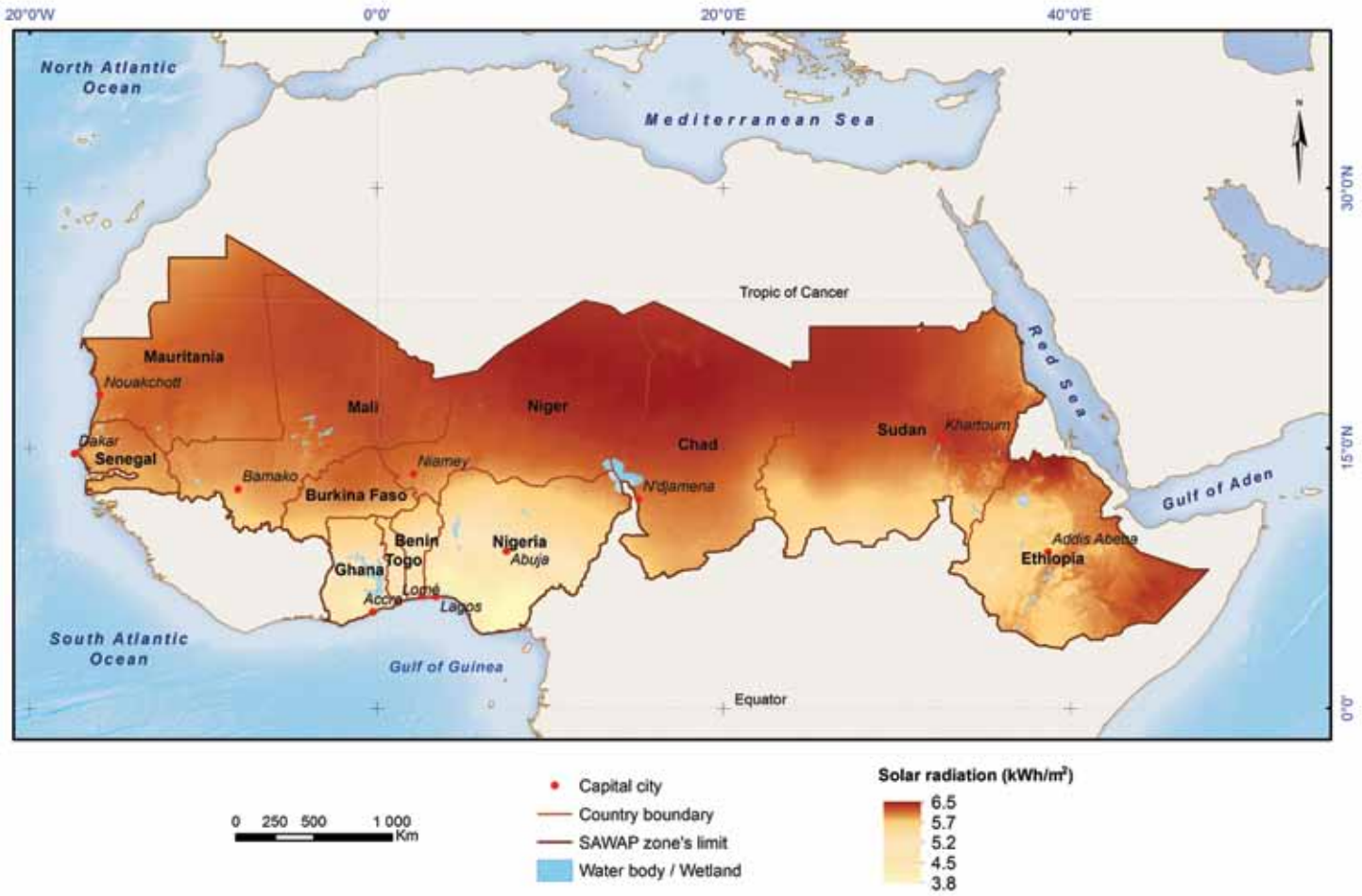
(iii) The water sector suffers from hydroclimatic variability, inadequate storage, increasing demand and a lack of cross-border cooperation. Less than 60% of the African population has access to safe drinking water and only a few countries are in the process of reaching their development objectives ;

(iv) The transport sector suffers from ineffective links between different modes of transport, declining air connectivity, poorly equipped ports, obsolete railway networks and inadequate access to roads which are passable in all seasons.

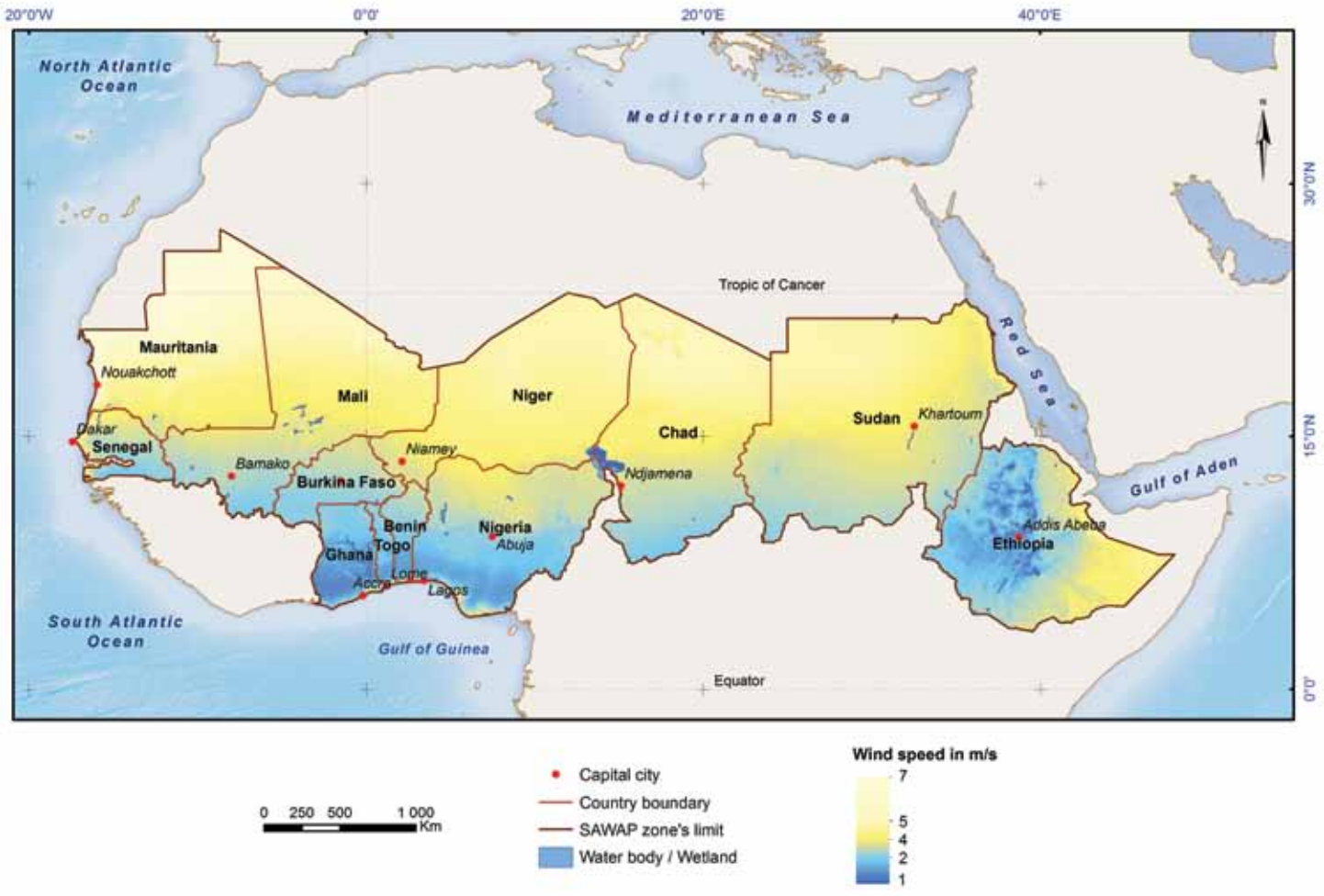


Map 10b. Net Primary Productivity in the Sahel zone and West Africa from 2000 - 2014 (OSS, 2017). Source: Water Productivity Open-access portal (WaPOR, FAO), MODIS (MOD17)

20 Infrastructures africaines, une transformation impérative. A joint publication between the French Agency for Development (AFD) and the World Bank, 2010 (https://www.afd.fr/fr/infrastructures-africaines-une-transformation-imperative).



Map 11. Solar power potential in the Sahel and West African countries (OSS, 2018). Source: Worldclim-v2



Map 12. Wind power potential in the Sahel and West African countries (OSS, 2018). Source : Worldclim-v2

In this context, some key institutions, including the African Union Commission (AUC), the New Partnership for Africa's Development (NEPAD) and the African Development Bank jointly created, in 2010, the Programme for Infrastructure Development in Africa (PIDA) for the period 2011 to 2040. PIDA, which aims to identify and prioritize Africa's key needs in the area of infrastructure so as to support development and reduce poverty, has defined four priority sectors for this investment: energy, transport, water and sanitation and information and communication technologies.

In addition, according to the African Development Report (AfDB, 2015), there are significant disparities between the different sub-regions in the infrastructure development, particularly between North Africa and sub-Saharan Africa, as well as between the countries of sub-Saharan Africa.

	2013	2014	2015	2016
Northern Africa	63,8	56,24	59,85	60,28
Southern Africa	35,15	33,34	34,54	35,53
West Africa	16,26	17,46	18,55	18,79
Central Africa	15,7	15,8	16,59	16,65
Eastern Africa	11,58	13,85	14,61	14,68

Table 6. Development of Africa Infrastructure Development Index in the different sub-regions of the continent (AfDB, 2016)

According to the Africa Infrastructure Development Index (AIDI[21]) established by AfDB (2016), the situation has generally improved for all

countries in recent years. However, it is information technologies and communication that emerge as the main driver of AIDI improvements. Specifically :

(i) in the transport and electricity sectors, which require a much higher level of investment, growth was not big enough to influence the index and have an impact on individual country rankings ;

(ii) in the water sector, progress made is still well below the United Nations Sustainable Development Goals (SDGs).This needs to be urgently addressed given the huge impact this sector has on the quality of life of people and its links with other sectors such as health, especially in rural areas. Indeed, in about half of the countries on the African continent, less than 35% of the population has access to improved sanitation facilities and less than 76% have access to improved water sources.

5. Mining and energy resources

5.1. Mining resources

The Sahel zone is currently experiencing a new economic era based on extractive industries. Indeed, based on current knowledge, its sub-soil turns out to be rich in gold, uranium, bauxite, iron, phosphate, diamond or even manganese (OECD, 2008) and, to some extent, in oil. However, this mineral wealth, which remains undervalued, is far from reflecting the possible mining and energy potential of the area, due to the fact that they remain largely under-explored.

In addition, high international prices have strengthened the momentum given worldwide to mineral exploration (in particular gold, base metals and diamond). Thus, investment has gone from less than 2 billion USD in 2002 to more than 7 billion USD in 2007, of which almost 20% is focused on the African continent (Antil A. 2014). However, this acceleration of investment appears to have benefited countries in central and southern Africa (DR Congo, South Africa, Angola, Zambia, Zimbabwe, Namibia and Botswana) much more than the countries in the Sahel zone and West Africa. This situation is probably explained by the fact that the regulatory and institutional framework for mining activities was less conducive in the so-called Sahel countries than in these countries in central and southern Africa where there are long traditions of exploitation of mining areas.

In addition, most of the new explorations carried out in the zone revealed new potential for oil and gas production (Chad, Mauritania, Niger), but the volumes extracted are often low. In addition, the works and explorations carried out over the last decade (i) show that the area contains many indicators of presence of a vast range of minerals and (ii) probably suggestive of future development of new sources of uranium (the third Imouraren mine in Niger), iron (eastern Senegal), gold (Mali, Ghana and Burkina Faso), even phosphate (Kaedi in Mauritania).

5.2. Renewable energy

Energy consumption in the countries of the zone is generally very low, resulting in the lowest level of GHG emissions in the world with average emissions of 0.39 $MtCO_2$ per capita[22] per year in 2016 against an average of 1.087 $MtCO_2$ per capita per year for the African continent and a world average of 4.91 $MtCO_2$/inhabitant per year (I4CE, 2017). This situation is explained by the fact that the region draws most of its energy (domestic) - about 80% - from its biomass, which still has a significant effect on the deforestation currently being experienced in sub-Saharan Africa.

According to the FAO (FRA, 2015), the biomass stock in forests and other wooded land in 2015 in the region, excluding Togo, would reach more than 16 000 million tonnes with an average of 291 T/ha for forests and 39 T/ha for wooded land[23].

In addition, the Sahel zone has significant potential for developing new and renewable energies. Indeed, it enjoys significant amounts of sunshine which is a considerable potential:

- In terms of raw energy, with potential average sunshine of 4 to 6 kWh/m²/day (OECD, 2008) ;
- In terms of productivity of plant species, which strongly supports different methods of agricultural production.

In addition, the Sahel-Saharan coastline, located where the Sahara meets the Atlantic Ocean, is influenced by the climate of the Sahara and ocean effects, giving rise to a zone of global energy transfer.

21 The AIDI is based on four major components: (i) transport; (ii) electricity ; (iii) ICT and (iv) water and sanitation. These components are broken down into 9 indicators having a direct or indirect impact on productivity and economic growth.

22 Source : http://www.globalcarbonatlas.org/en/cO2-emissions

23 For Ethiopia, stock was estimated on the basis of forest area and wooded areas and the average stock/ha calculated for the other countries except Togo (data not available) .

Generated over the Sahara's hot surfaces, daily thermal air streams are superimposed to the ocean's trade wind system creating one of the biggest winds in the world. The best sites for installing large-scale wind turbine generators are therefore located in the coastal zone between Dakar and Nouadhibou, as well as in the Cape Verde islands, where a pilot project was implemented during the 1980s (1982-1989) with the support of UNSO and the Danish government. This exceptional wind power has even caught the attention of investors for a large-scale electricity generation project (Sahara Wind project) that could supply Europe (OECD, 2008).

POTENTIAL, STRENGTHS AND PRESSURE

I. DEVELOPMENT POTENTIAL AND STRENGTHS

1. Natural wealth

Natural resources in the Sahel zone countries and West Africa are the foundation of most of the productive activities and have significant and varied potential, as well as important assets for their socio-economic development. Certainly, many authors view the climate of the Sahel zone as a constraint, in particular because of serious hazards that may be present there (droughts, floods, extreme heat, scorching sun, dust clouds, etc.). However, the climate in its different components (precipitation, temperature, sunshine, wind), is **an important resource for development**.

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Ackee or Blighia sapida – exotic fruit

2. Demography and human resources

According to «World population prospects, 2017 Revision[24]», the population of the countries in the Sahel zone and West Africa is expected to grow from 480.5 million inhabitants in 2017, to 663 million inhabitants in 2030 and double in 2050 with a billion inhabitants. The number of young people under 20 will double as a result and the youth dependency ratio[25] will remain one of the highest in the world, which could lead to impoverishment of the population, especially in the absence of sustained economic growth.

Such a demographic change could foster the development of a larger market for trade and commerce, new opportunities for specialization of the economy as well as the improvement of added value. This is the case for the semi-arid regions of the Sahel zone and West Africa where an increase in population density will result in reducing the costs associated with delivering public services (education, health care, water/sanitation, communications and security).

However, so that the higher population density does not lead to increased competition for natural resources (land, water and biodiversity) which would lead to a dwindling of the resource base, or even conflict, **public policy could focus on creating new livelihoods more related to human and physical capital than natural capital,** particularly through programs investing in infrastructure, education and training, and in creating an enabling and encouraging framework for developing **domestic and foreign private investment.**

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Preparing and selling fish, Burkina Faso

3. Agriculture, livestock farming and pastoralism

In most countries in the Sahel zone, production systems have not really experienced any significant or timely improvement since they became independent. This situation has been exacerbated mainly by environmental crises experienced in the region over the last three decades, including recurring drought. While some changes in the field of irrigation, infrastructure and regional cooperation have contributed to the region's socio-economic development the measures for adjustment taken to date in the context of the different development programs related to sustainable management of natural resources, especially since the advent of UNCED (Rio de Janeiro, 1992), have not yet achieved enough critical mass to produce a considerable effect.

24 https://esa.un.org/unpd/wpp/publications/Files/WPP2017_KeyFindings.pdf

25 This ratio is the ratio of the number of young people compared to the number of people of working age.

AGRICULTURAL PRODUCTION SYSTEMS LAND DEGRADATION AND DESERTIFICATION

Like any system, an agricultural production system can be defined as a set of interrelated elements that interact to contribute to a result which, in this case, is food production. These elements are:

(i) **environmental factors** that are summed up in the ecosystem, which constitutes the physical support of the production system, and is characterized by a number of non-variable factors, at least on the scale of human life, such as geology, pedology, climatic variables, etc., which determine a certain natural potential of energy production and some stability ;

(ii) **human factors environmental factors** that are summed up in the ecosystem, which constitutes the physical support of the production system, and is characterized by a number of non-variable factors, at least on the scale of human life, such as geology, pedology, climatic variables, etc., which determine a certain natural potential of energy production and some stability ;

(iii) **the political and institutional environment** within which the human element develops, encompassing policies/strategies, regulation and institutions, which govern the behavior of the latter, in particular with regard to its relations with its community in order to compete in the production process.

Then we add the international environment **to these three factors,** with international agreements and conventions, the global economy, etc., which may have, under certain conditions, a direct and/or indirect influence on the other three elements.

That being so, a given agricultural production system, in **a given limited space** (e.g. slash-and-burn agriculture) that meets needs and which is in perfect balance with its environment at a given time, will inevitably conflict with this same environment at a later date, if certain changes are not made. This is due **to the inevitable inequality which progressively develops between the non-variable factors in the natural environment and the variable factors in the human environment**[26]. Indeed, in the absence of any intervention or measures, a production system strikes a balance which is inferior to the initial balance.

So, for example, a pastoral zone in a semi-arid region that is overgrazed or over-cultivated because of the increasing pressure of man and his herd is degraded and may no longer meet needs if no rational planning and management is undertaken and if there is no other alternative source of livelihood. Conversely, an irrigation project in a semi-arid rain-fed area will allow production systems to move to a situation of greater equality generating more production and more jobs.

Therefore, any production system which experiences a breakdown in equality ceases to reproduce and itself becomes a factor in the degradation of the environment in all its physical (ecological, environmental) and social (migration, exodus) dimensions.

This situation means that the current production systems still have considerable room for improvement in terms of adapting and improving, both quantitatively and qualitatively, as well as an important potential for change in agricultural and livestock systems, particularly in areas such as:

- The development of irrigation-based agriculture: the current situation shows that «only 20% of the irrigation potential of the Sahel countries has been developed, in addition to the fact that a quarter of the existing irrigation systems are in a state of disrepair[27] » (IBRD, 2013). The situation can be compared with that of the countries in the Horn of Africa with rates of mobilization for irrigation potential of 11% for Sudan (FAO, 2012) and 32% for Ethiopia (FAO, 2015) ;
- Developing and up-scaling proven SLM practices and developments as well as integrating trees into degraded landscapes for protection and production purposes ;
- Forest landscape restoration or integrated management of landscapes which is a relatively recent approach, but which is widely used in other semi-arid regions of the world, and could be easily adapted in the area ;
- Improved pastoral farming systems which can become more productive, more profitable and more resilient with regard to climatic variability, in particular by implementing a regional approach given that there are a large number of cross-border issues such as trade, animal diseases, policy alignment.

CONDITIONS FOR MOBILIZATION OF POTENTIAL FOR CHANGE IN AGRICULTURAL AND LIVESTOCK SYSTEMS

Achieving the potential for change (mentioned above) involves many different stages of adjustment relating to the political and institutional framework governing production activities, in particular in the following areas:

(i) sectoral and sub-sectoral strategies;

(ii) price policies ;

(iii) capacity building at different levels ;

(iv) taking into account environmental internalities and externalities in development activities.

4. Forest and rangeland ecosystem services

In addition to fodder and wood products (lumber and wood fuel), forests and range provide an array of non-woody products, wild fruits, condiments, leaves and grains, game, aromatic and medicinal plants, etc.) which play a vital role, whether direct or indirect, in food security and nutritional equality in rural areas. They also contribute to food resiliency and the adaptation of Sahel people in crisis situations. (Sanogo D. and Nieyidouba L., 2017).

26 Imbalance can arise from a variety of factors. For example, limited space in the case of slash and burn agriculture has led to shortened fallow periods, meaning the system cannot respond to the need to address declining land fertility and crop yields. In other cases, such as that of the almost exclusive production of peanuts in the groundnut basin in Senegal during the 1970s, this is the demographic pressure, the reduction in fallow periods and the insufficiency, or even absence, of land fertilization, which has led to depletion of soil which has become very susceptible to erosion with the destruction of plant cover, drying up of water points etc., which affected the balance of production systems in place.
In other cases, inappropriate prices of exchange rate policies have caused a deterioration in production systems.

27 http://www.banquemondiale.org/fr/news/opinion/2013/10/28/more-irrigation-and-pastoralism-could-transform-africa-s-sahel-region

Hence, the region faces a crucial challenge to maintain and restore forest and rangeland ecosystem services including (i) improving management and (ii) lifting barriers to valorization of NTFPs (improved understanding of them and their classification, genetic improvement, domestication, etc.).

©N'deye Fatou Mar - OSS

Wood fuel, near Accra, Ghana

5. National and cross-border ecosystem services

Ecosystem services in watersheds (production and water purification, land protection, protection of biodiversity, etc.) in the countries of the region remain largely unknown, in particular with regard to their economic values. Evaluating these services should make it possible in the medium term to implement **payment systems for ecosystem services (PES) at a national and/or sub-regional** level to mobilize additional resources that will be earmarked for integrated protection and development of the region's ecosystems.

6. The reduction of GHG emissions and forestry and agricultural carbon sequestration

The considerable extent of agricultural, pastoral and forest land in the countries of the Sahel zone and West Africa, represents an important factor which, under certain conditions, would allow us to make a considerable contribution to reducing GHG through carbon sequestration in soil and biomass. These conditions lie in the **gradual mobilization of progress in agricultural, agropastoral and pastoral** production systems as well as exploitation of forest resources through:

- Development of SLM practices on an appropriate scale for agricultural land and rangeland ;
- The introduction of sustainable forest management involving all relevant stakeholders, including local people, and within the framework of appropriate co-management processes ;
- Integrated development and management of watersheds in the framework of regional programs.

7. Valorization of landscapes through ecotourism, agrotourism and cultural tourism

Tourism in the Sahel and West Africa region faces many challenges. While, on a global scale, tourism accounts for 10.4% of GDP and one in 10 jobs (UNWTO), it is below average generally in countries of the zone, with the exception of Senegal. Like the whole African continent, the tourism sector has been growing steadily for several years. The many strengths of the Sahel zone and West Africa, however, remain largely under-exploited.

At present, the potential of the region is immense: the diversity of the above- mentioned landscapes (desert, coasts, forests, savannah), often within the same country, can help develop tourism through discovering a region away from the mainstays of worldwide travel.

Geographical and natural diversity goes hand in hand with varied cultural diversity with a rich heritage and traditions kept alive by people whose hospitality is one of their finest qualities.

©Karim Bello - OSS

Bahar Dar falls, Ethiopia

However, tourism is struggling to take off in most countries in the zone for various reasons. Security issues mean that many countries are discouraging their citizens from taking their vacation in the Sahel belt (Dambo, Waziri Mato and Moutari Mum, 2014). On the other hand, the isolated geographical situation of many countries in the zone as well as the lack of infrastructure and air links limits access to the area, even for internal flights on the continent (World Bank). In addition, the entry requirements (visas) are often a limiting factor, though are in the process of being improved, for example, the recent launch of the African passport or the fact that the majority of African countries are relaxing or increasingly removing more requirements for African nationals, with the aim of encouraging tourism and internal travel (75% of African travelers in sub-Saharan Africa by 2021 according to the World Bank) (Visa Openness Index).

On the other hand, protected areas and natural plant and animal resources are currently threatened by strong anthropogenic pressure, whilst at the same time being one of the main drivers of tourism development in the region. One example is a study carried out by the David Sheldrick Wildlife Trust measuring the economic benefits of the presence of an elephant in a territory, which would mean 1.6 million USD for travel agencies, airlines and the local economy. Also, to preserve their heritage and meet the many challenges of tourism development in the region, 9 of the 12 countries in the Sahel zone and West Africa, have recently signed the African Charter for Sustainable and Responsible Tourism at COP 22 in Marrakech (OMT).

8. Biodiversity, expertise, traditional knowledge and practices linked to biodiversity

The characteristics of the biodiversity of the countries in the Sahel zone and West Africa are such that they exhibit remarkable endemism because of the diversity of its ecosystems under different bioclimatic stages. In addition, enriched by the ethnic and cultural diversity of its people, biodiversity is supported by the rich heritage in the fields of expertise, traditional knowledge and its associated practices.

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Commiphora africana, Diawling National Park, Mauritania

9. New and renewable energy resources

Given their geo-climatic situations, the countries of the Sahel zone and West Africa have an almost invaluable renewable energy potential, in particular, in order of importance, solar power, biomass power, wind power and hydroelectric power Although it is not evenly distributed over the territory of the region, the progressive mobilization of this potential would be able to:

Serve as a basis for **developing a green, resilient economy** at both national and sub-regional levels ;

- Minimize the constraints related to dispersal across the space of human settlements and production areas that could be provided with energy ;
- Contribute to protecting the global environment through mitigating GHG emissions.

II. PRESSURES

> *« ... Africa is one of the continents most vulnerable to climate change and climate variability, a situation that is exacerbated by the interaction of multiple stresses occurring at various levels and by low adaptive capacity »*
>
> IPCC AR4, 2007

1. Climate pressure

The Sahel zone is one of the regions in the world where climatic variability is felt the most. According to the 2014 IPCC report, the increase in temperatures over the past 50 years has been marked by an increase of 2°C. Anomalies (deviations from the mean) recorded in temperature were significantly higher during the period 1995-2010 compared to the period 1979-1994. Relative to rainfall in the Sahel region, they are characterized by their extreme seasonal and decadal variability. During the 20th century, the Sahel region experienced a relative increase in rainfall until 1950 where a sharp decrease of 15 to 30%, with a clear break between 1968 and 1973, was recorded.

This trend resulted in isohyets shifting 200 km to the south and accelerating the aridification process in the area's climate (Niang I. et al, 2014). Based on analysis of precipitation trends during the period 1901 - 2000, a study carried out by the «Met Office Hadley Centre» was able to highlight three climate «hotspot» zones in the Sahel: the first in the western region (Senegal and Mauritania), the second between Mali and Niger and the third in the eastern part of Ethiopia and stretching north to Sudan (Philipp Heinrigs, 2010).

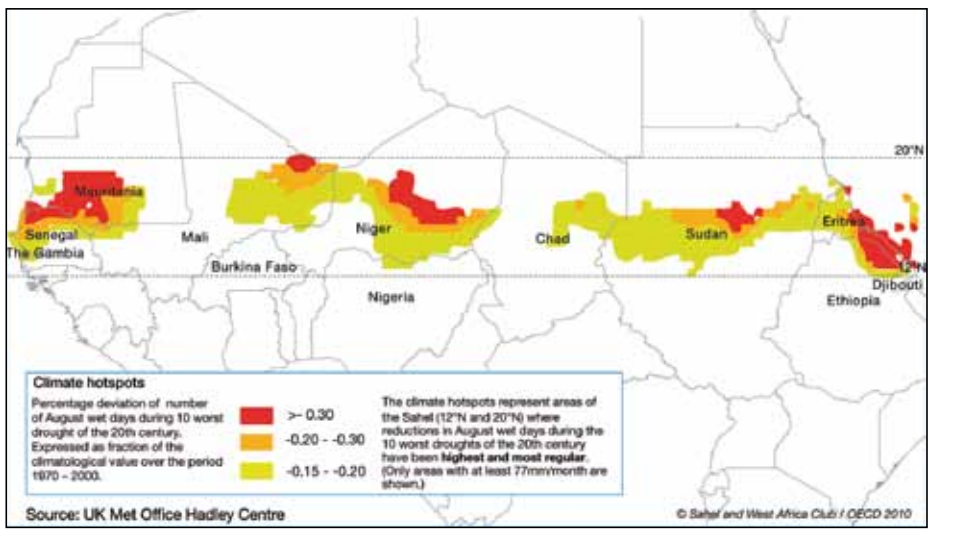


Figure 3 : Climate hotspots in the Sahel zone

Trends towards increasing temperatures and decreasing rainfall are, according to the IPCC moderate climate scenarios, likely to become more accentuated in the coming decades. The scenarios (SRES A2[28] and B1[29]) predict an increase in temperature in both East and West Africa. With respect to rainfall, the forecasts are more uncertain, but they indicate a reduction in rainfall in West

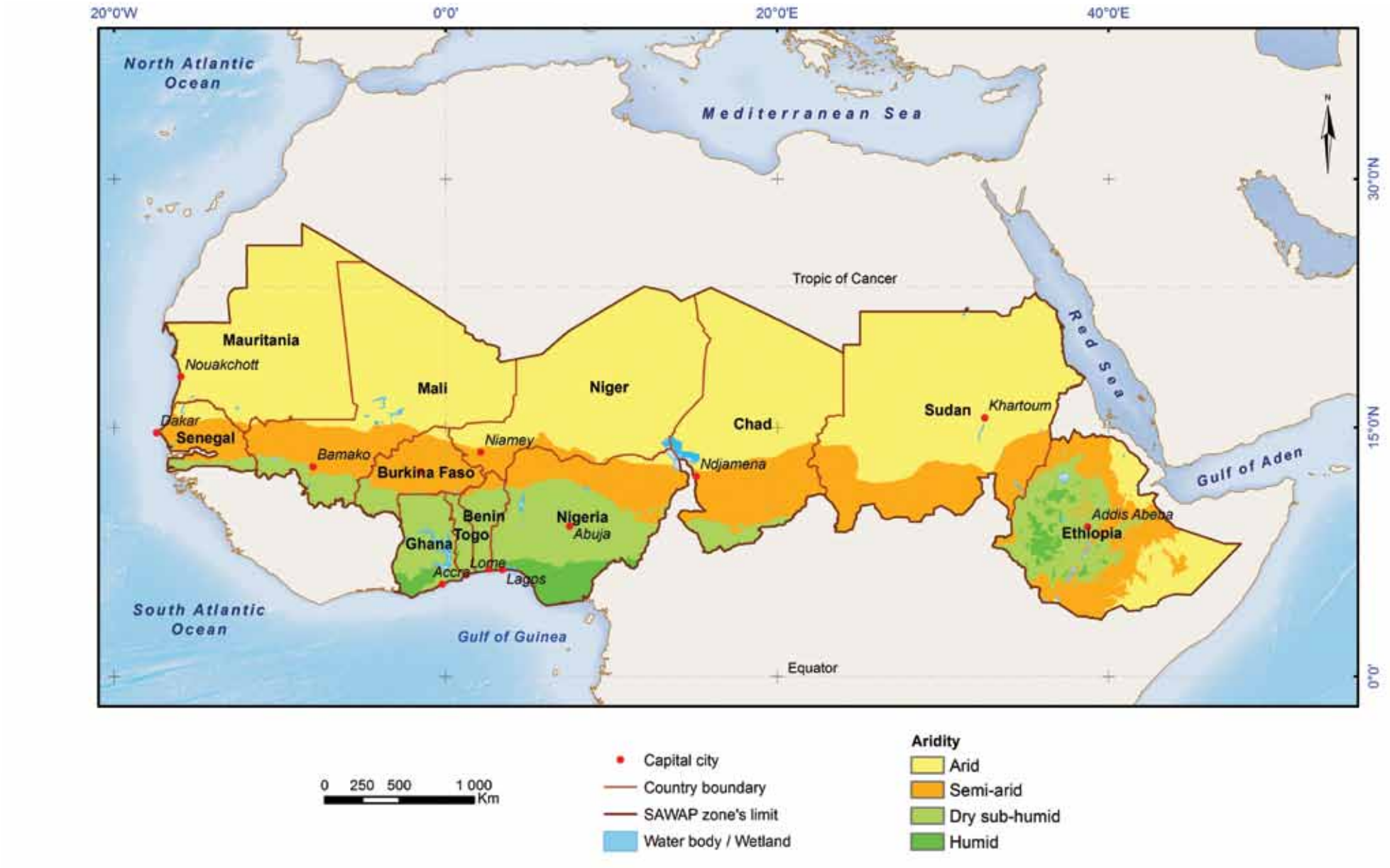
28 See footnote on page 31.

29 The story and family in scenario B1 describes a convergent world with the same global population, which culminates in the middle of the century and then declines as in scenario A1 but with a rapid change in economic structures towards an economy based on service and information economy, with a reduction in material intensity and the establishment of clean and resource efficient technologies. The focus is on global solutions to economic, social and environmental sustainability, including improving equity, but without additional climate initiatives.

Africa and a likely rise in rainfall and extreme rainfall in East Africa (Regional Environmental Change, 2017).

Subject to the antagonistic influence of the great Sahara to the north and the trade winds to south, the climate of the Sahel zone is largely determined by the Intertropical Front (ITF). Seasonal changes in the location of the ITF drastically affect rainfall in the countries of the region, resulting in alternating prolonged, frequent wet and dry seasons. As a result, the aridity and the space–time variability of precipitation in the Sahel zone is a constant feature which the countries concerned must tackle within the context of their policies and socio-economic development efforts, especially when we know that their economies are focused on exploiting and valorization of natural resources accessible to the population (land resources, water resources, vegetation, biodiversity, etc.).

Aridity prevails in the northern half of the Sahel zone and West Africa above the 17th parallel north with an index value characterizing an arid climate; the rest of the space is shared between semi-arid, sub-humid and humid climates along a north-south gradient that reflects rainfall.



Map 13. Aridity index in the Sahel zone and West Africa (OSS 2018).
Source: Consultative Group for International Agricultural Research (CGIAR)

2. Human pressure

Since the 1970s, especially following the great drought of 1968- 1973 in the Sahel, which decimated livestock, agriculture in the Sahel region has undergone many changes and upheavals, in particular the sedentarization of pastoralists who have converted to farming. This led to croplands being expanded to the detriment of marginal lands, designated forestry and pastoral zones, and even fallows compromising their role in soil regeneration (Ibra Touré, 2015 and John F. May and Jean-Pierre Guengant, 2014). Moreover, the absence of any significant change in extensive traditional agricultural production systems has exacerbated such upheavals.

Subsequently, in response to these special conditions and for the purpose of reconstituting its livestock, a large part of the population gradually returned to pastoralism and/or agropastoralism.

Although this activity represents a solution for adapting to unequal space and time distribution of pastoral and hydraulic resources, it remains a no less risky activity, which is very vulnerable to climate change and which is a source of land pressure and conflict with farmers (Bruno Hellendorff, 2012). So, in 2010, out of the 171 million inhabitants of the region's arid zones dependent on agriculture, about 26 million were pastoralists, 105 million agro-pastoralists and 40 million farmers (IBRD, 2015).

These upheavals also affected the forest resources which experienced deforestation and degradation as a result of cropland expansion, excessive removal of wood, forest fires, etc.

On another level, the fishery resources have not escaped human pressure especially in the West African coasts that have been subject to over exploitation due to the intensification and modification of practices, especially by foreign companies. Fisheries agreements signed between the countries with these companies are intended, inter alia, to regulate their use in order for small coastal farmers to maintain their level of production.

In East Africa, on the other hand, population growth has been such that the intensification of fishing activities has led to excessive over-exploitation of inland water fish resources.

The rampant urbanization witnessed in recent decades is another significant aspect and represents a threat to natural resources. Indeed, the rate of urbanization in the Sahel zone countries, which was the lowest in the world in 1950, has since grown exponentially, from 2% to 25% in 2010 (OECD/SWAC, 2014).

This increase is due to migratory movements accompanied generally by a diversification of activities, particularly in the tertiary and service sectors, thus making it possible, to a certain extent, to alleviate rural poverty, but whilst also creating new social and environmental challenges.

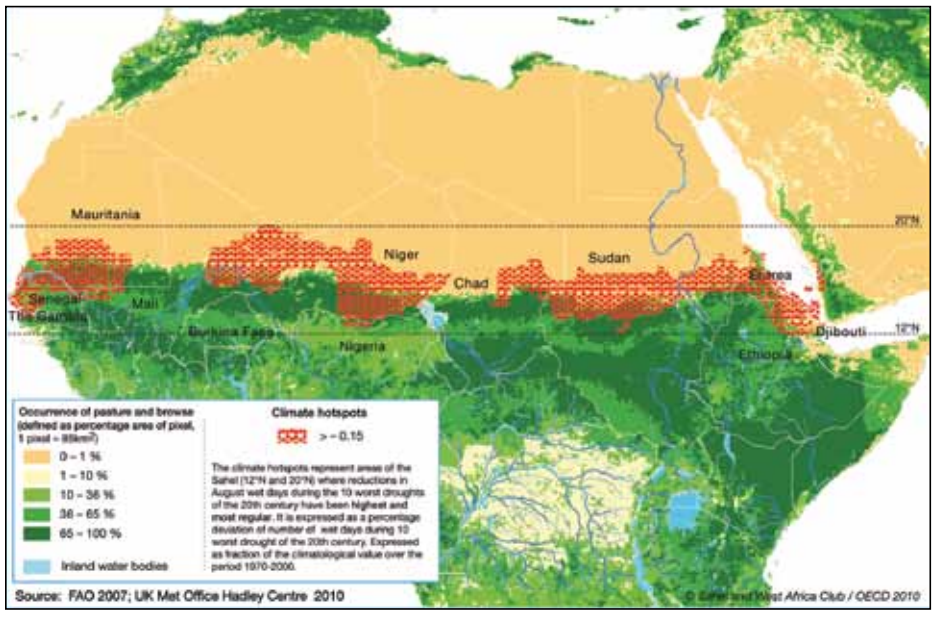
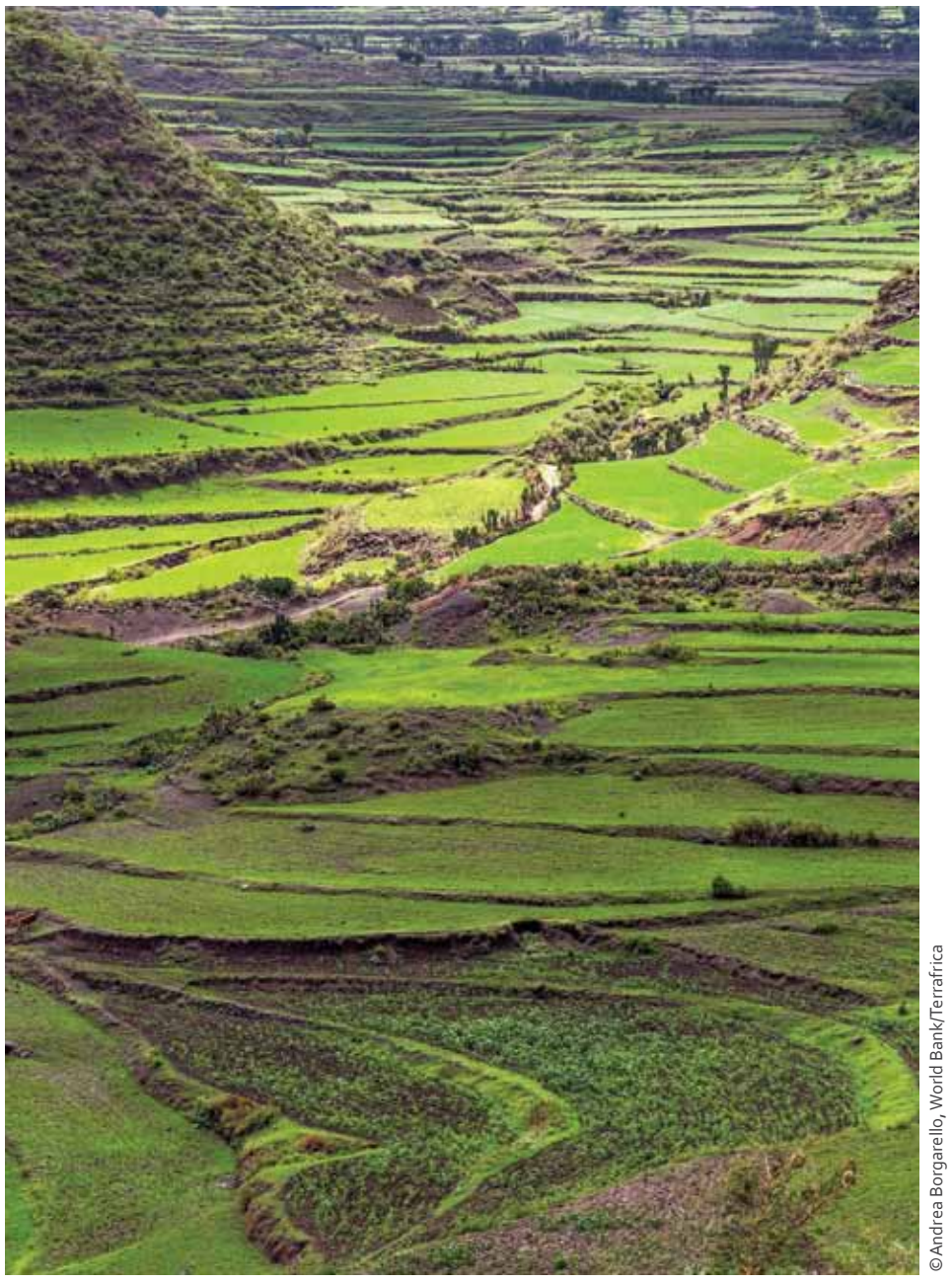


Figure 4. Grazing land and climate " hotspots "



Terraced crops, Ethiopia

©Andrea Borgarello, World Bank/Terrafrica

III. ENVIRONMENTAL CHALLENGES IN THE SAHEL ZONE AND WEST AFRICA

1. Managing urbanization

The crucial challenges of rapidly growing urban agglomerations in the region are to be found in particular in appropriate and timely planning the development of urban expansion, in particular with regard to :

- Provision of basic social services (drinking water, sanitation, safety/health, education, social protection, etc.) ;
- Basic infrastructure and provision of public services (communication, public transport, etc.) ;
- Management and valorization of solid waste and wastewater ;

They are also to be found in establishing an environment which supports:

- The capitalization of human resources through encouraging private initiative and innovation, particularly in the field of services ;
- Encouraging local authorities to invest in promising industries.

2. Addressing conflict over water resources

Climate disturbances on a global level have had a profound impact on the water supply available in the Sahel region. In recent years, the transitional semi-arid eco-region has faced major and persistent challenges as a result of the adverse effects of climate change, irregular rainfall and recurring drought. This situation has resulted in reduced harvests, as well as increasing pressure on the groundwater resources that are the main source of water for many people in the Sahel region. As a result, water resources are over-exploited recording a decrease in quantity and quality (IAEA, 2013).

Transboundary water resources (rivers, lakes and aquifers) in the Sahel region tend to become a source of tension, creating difficulties in terms of development and management. Indeed, the increasing demand for water and the proliferation of irrigation and hydroelectric projects represent the source of potential conflict between countries sharing watersheds (UNESCO, 2017)[30]. In addition to the issues related to water availability and management, countries in the Sahel zone are facing difficulty accessing drinking water, in particular due to insufficient infrastructure and the limited capacity for mobilization, capitalization and management of this resource (IBRD, 2014).

3. Curbing loss of biodiversity

Vigorous population growth, climate change and the development and expansion of human activities are the main drivers of declining biodiversity in the Sahel. In West Africa, we see (i) the expansion of cropland to the detriment of rangeland designated for marginal agricultural use, but which represent high quality resources for pastoralist activities and wild animals, (ii) excessive cutting of natural vegetation for different domestic uses (Edouard G. Bonkoungou, undated).

Such changes have led to the fragmentation of meadows and a profound disruption of the traditional pastoralist system based on mobility, as well as the survival of wildlife in these areas. In East Africa, the encroachment of human settlements on protected areas and pastoral areas off reserves for cultivation has become a primary concern[31].

Three main trends are observed in sub-Saharan Africa :

- A decline in plant cover with an expansion of around 15% of desertified areas ;
- An increase of around 57% of agricultural land to the detriment of natural vegetation ;
- A net decrease in woody vegetation in West Africa compared to a slight increase in East Africa (Niang I et al., 2014).

In addition, a study by Gonzalez et al. in 2012 highlighted changes in the structures of the different ecosystems of the countriesin the Sahel zone as a result of climate change. The following was noted (i) a southward movement of the Sahel and Sudanian savannas, (ii) a decline in vegetation density in Senegal and (iii) a decline in specific wealth of flora in Mauritania, Mali, Burkina Faso, Niger and Chad. The IPCC 2014 report states that these changes in the distribution of biomes will have a serious impact on wildlife (Niang I et al.2014).

4. Tackling poverty and vulnerability with regard to the effects of drought, desertification and climate change

The humanitarian crises caused by the devastating droughts that have ravaged the Sahel and Horn of Africa in recent years have centered the debate on the question of development and **chronic vulnerability of a large number of people living** in the arid areas of sub-Saharan Africa. Indeed, more than 200 million inhabitants *(see Table 7)* in these zones make a living from farming (IBRD, 2015), most of whom :

- Are exposed to climatic shocks, particularly drought, which can decimate their income, destroy their assets, and plunge them into a cycle of poverty from which it is difficult to escape ;
- Have limited abilities to mitigate the effects of drought and other shocks after they appear, especially in the absence of other alternative sources of income.

Thus, most of these people are vulnerable to the effects of drought and desertification, effects that are more or less accentuated by climate change over time. This vulnerability is determined by the combination of three groups of factors, namely :

(i) Soil degradation: the productivity and sustainability of production systems currently prevailing in arid zones (farming and pastoralism) are sensitive to many of the factors that make up GLADIS soil quality indices[32], so that the extent of the land is very degraded in arid zones and the negative trends observed in many places are of real concern ;

(ii) Access to infrastructure: the isolation of countries in the Sahel zone is a reality, even for countries like Senegal and Mauritania which have a coastline. A significant part of the national territories is very poorly served by communication infrastructures, which results, amongst other things, in high transport costs which affect, to some extent, the viability of production systems ;

30 WWAP (World Program for Water Resources Assessment). 2016. United Nations World Report on development of water resources 2016: water and employment. Paris, UNESCO.

31 http://new.unep.org/dewa/Africa/publications/aeo-1/223.htm

32 These are indices established by the Semi-Arid Soil Degradation Assessment Project (LADA - Land Degradation) Assessment in Drylands Project) funded by GEF and implemented by UNEP between 2006 and 2011, based on the Global Land Degradation Information System (GLADIS) to assess the state and evolution of soil quality on the basis of four biophysical parameters (biomass, biodiversity, soils, and water).

(iii) The politico-economic factors that are often at the root of :

- unequal distribution of social services, in particular human health and education services, because of the relative dispersal across the space of human settlements and low population density; education is a means to facilitate the diversification of livelihoods and resilience to crises. The disparities observed in the coverage of social services not due to lack of interest or demand on the part of communities in the arid zones, but to the lack of public services ;
- economic constraints: low agricultural productivity in arid areas is compounded by the lack of economic incentives to invest in the sector. With production scattered over vast stretches of land, poorly structured and inefficient value chains and fragmented and often contradictory farming policies, farming in arid zones faces a number of economic constraints and trade-offs.

	Population *(Millions of habitants)*	Dependent on farming:			
		Farming	Pastoralism	Farming & livestock	Total
Arid zones	247,7	39,5	26,2	105,5	171,2
• East Africa	92,2	17,6	12,7	34,3	64,7
• West Africa	155,5	21,9	13,5	71,1	106,5
Non-arid zones	269	57,3	13	125,4	195,7
• East Africa	109,6	20,8	4,4	53,1	78,2
• West Africa	159,4	36,5	8,6	72,3	117,5
Total	516,7	96,8	39,3	230,8	366,9

Table 7. Estimated population dependent on farming in sub-Saharan Africa in 2010. Source: IBRD, 2015

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Irrigated rice paddies and plots, Rosso, Mauritania

4. THE IMPACT OF CLIMATE AND HUMAN PRESSURES

1. Changes in land use

The pressures mentioned above are the main driving factors in changes in land use in the zone. Indeed, a review of available data on land use over the past decades shows considerable changes that are reflected mainly in (i) the expansion of farmland, (ii) the expansion of human settlements (iii) the reduction of forest areas, savanna, wooded lands and equivalent.

Main class of land cover	Surface area in km²			Average annual change (%)
	1975	2000	2013	
Farming/cropland	553 696	878 544	1 165 720	2,30%
Forests, wooded land and equivalent	2 171 692	1 922 992	1 695 972	-0,50%
Savannah	1 587 980	142 3604	1 248 284	-0,40%
Body of water, humid zones, flooded plains	152 596	152 872	155 180	0,04%
Sand/dune areas	103 276	136 344	152 188	1,00%
Human settlements	15 172	24 588	36 412	2,90%

Table 8. Change in land use in West African countries between 1975 -2013 Source: Land Use and Land Cover Trends in West Africa

Moreover, if we look at the countries below individually, this data shows that the increase in cropland would have developed as follows :

Expansion of croplands (%)	Country
< 1%	Senegal
2 - 3%	Niger, Nigeria
3- 4%	Mali, Ghana
4 - 5%	Burkina Faso, Chad
5 - 6%	Benin
6 - 7%	Mauritania, Togo

Table 9. Average annual rate of cropland expansion in West African countries between 1975 and 2013 Source: Land Use and Land Cover Trends in West Africa.

2. 2. Land degradation and desertification

Agricultural production systems in sub-Saharan regions have been undergoing changes for a few decades under the constraint of socio-economic changes (population growth, change in modes of consumption and production patterns, globalization of trade, rural exodus, etc.) or environmental changes (persistent drought, climate changes).

Such a situation ultimately affects the properties of natural resources, including soils, biological functioning and dynamics of organic matter, thus leading to the appearance of desertification.

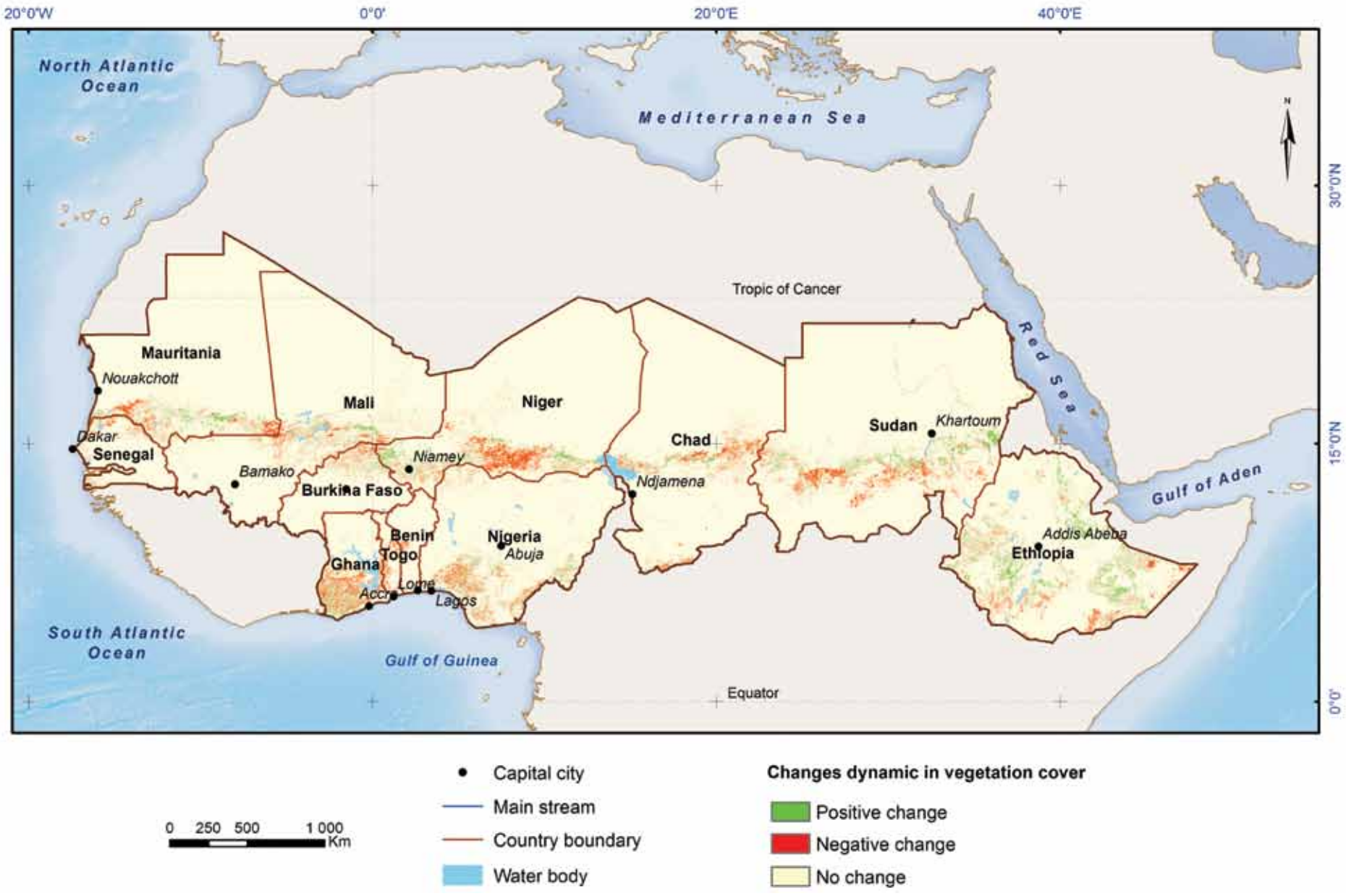
Desertification in the countries of the Sahel zone and West Africa has been estimated by the Desertification Sensitivity Index (ISD) based on the ME DALUS approach (Mediterranean Desertification and Land Use) which combines 4 sub-indices, namely: the soil quality index, the the quality of the vegetation, the climate quality index and the quality of human activities index (see Map 15).

Looking at the map, we can see that :

- most of the Sahel and West Africa zone is in an arid climate, or about 1/3 of the area, is actually susceptible to desertification ;
- other areas, albeit less important, located in the semiarid and dry subhumid climate, are moderately susceptible.

This situation reflects the reality and the dynamics of the desertification phenomena even if, on the other hand, we note that a significant part of the zone corresponding to about 2/3 of the southern zone of the Sahel and West Africa program is barely affected by or even avoids desertification.

> *The United Nations Convention on the fight against desertification states that desertification refers to land degradation in arid, semi-arid and dry subhumid areas as a result of various factors, including climatic variation and human activities. It is characterized by an overall decline in rainfall, degradation of natural resources and loss of soil fertility, resulting in migrations in badly affected areas.*



Map 14. Changes in land use in the Sahel zone and West Africa (OSS 2018).
Data Source: European Space Agency (ESA) and OSS

In the Sahel region, which is characterized by its aridity, soils are in general poorly structured, sandy, not very fertile and very fragile, with some exceptions in mountainous areas (the Ethiopian andosols, the more siliceous soils of Fouta Djalon) (Descroix L. and Diedhiou A., 2012). As a result, soils are subject to desertification after prolonged droughts and intense human activity, which has led to land degradation in this region. Many areas have been identified as «ecologically critical zones» due to erosion, loss of soil fertility and the resulting degradation of plant cover (Jeffrey D. Vitale, John G. Lee, 2005).

In the sub-Saharan region in particular, land degradation has severely affected the steppes with a degradation rate estimated in 2014 at 40%, as well as forest land and cropland with a degradation rate of 26% and 12%[33]. The resulting loss of food production is about 6% higher than the world average (Jeffrey D. Vitale, John G. Lee, 2005).

Land degradation and desertification result in an increase in GHG emissions following the destruction of soil organic matter, causing significant feedback consequences for the global climate system. Indeed, in dry regions, it is estimated that 300 million tonnes of carbon, or about 4% of total emissions worldwide, are released into the atmosphere each year because of desertification (MEA, 2005). This situation could get worse unless action is taken to combat land degradation.

ANSWERS TO ENVIRONMENTAL ISSUES AND SUSTAINABLE DEVELOPMENT PERSPECTIVES IN THE CONTEXT OF CLIMATE CHANGE

I. THE EMERGENCE OF THE CONCEPT AND PRACTICE OF «SLWM» AS A GLOBAL RESPONSE TO LAND DEGRADATION ISSUES

Sustainable Land and Water Management (SLWM) is a concept that is in the process of being agreed in terms of restoration or rehabilitation of degraded lands. It refers to a wide range of approaches that, in synergy, improve productivity, conserve biodiversity and promote the resilience of production systems and ecosystems. Aside from the fact that they make a substantial contribution to mitigating GHG emissions, SLWM practices are essential for meeting the objectives of the UN Convention on combating desertification, which should help achieve SDG 15 «Life on Land», adopted in September 2015 by the United Nations General Assembly, in particular, target 15.3 on achieving Land Degradation Neutrality (LDN).

SLWM practices and those developed in the Sudano-Sahelian region include agroforestry, protection of soil and water, biological fixation of structures, assisted natural regeneration managed by farmers with multi-purpose agro-purpose agro-forestry species, restoration of degraded lands, sustainable agriculture with low external input and fallow land.

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Half moon technique, Niger

II. PRIORITIES AND PERSPECTIVES IN THE SHORT AND MEDIUM TERM

1. Farming: adapting cropping systems and techniques

This adaptation will have to go through the improvement in productivity of production systems and the stability of livelihood strategies based on agricultural and natural resources to ensure their sustainability, and :

- Gradually maximize development potential of irrigation-based agriculture and rehabilitation of existing irrigation infrastructures; this must be accompanied by the implementation of agro-industrial centres or units depending on production volume ;
- Develop SLWM through dissemination and upscaling already proven techniques and practices in the context of support projects and programs such as the SAWAP program and other appropriate technologies (agro-ecology, organic farming, agroforestry, integrated pest management, organic fertilization of soil, etc.) ;
- Integrated ecosystem management and restoration of degraded forest by integrating trees into the landscape (agroforestry); indeed, an assessment of the experiences of the 1980s had shown that including trees in cropping systems, particularly through assisted natural regeneration (ANR) in crop fields (Faidherbia albida) and other actions relating to the dune stabilization in the Niayes in Senegal, had the greatest impact both socio-economically and environmentally (Edwige Botoni and Chris Reij, 2009).
- Improve cultivated genetic resources and the capitalization of genetic resources of wild crop relatives through the creation and/or appropriate breeding, domestication of wild species and/or improving their performance.

33 Le, Q.B. Nkonya, E., & Mirzabaev, A. (2014) Biomass productivity-based mapping of global land degradation hotspots. ZEF-Discussion Papers on Development Policy No. 193. University of Bonn

Map 15. Desertification sensitivity index for the Sahel and West Africa zone

2. Livestock and pastoralism: adaptation and improvement of farming systems and techniques

Adaptation and improvement of farming systems and techniques must :

- Introduce sustainable management of pastoral resources which should enable improved productivity and resilience of farming systems and increased production of meat, milk and hides ;
- Improve herd mobility by ensuring adequate and fair access to water and pasture throughout the year and improving security in pastoral areas ;
- Support improvement in farming techniques, including grouping births, as well as specialized zones: birth zones, fattening and export areas ;
- Promote small farms, especially around urban areas, as well as breeding small wild species (cane rats, quail...).
- Promote the inclusion of livestock farming into the regional market by promoting complementarities between the Sahel zones (production zones) and coastal areas (consumption zones) in terms of animal products.

3. Biodiversity of forest and pastoral resources

Perspectives in this area are emerging in the strengthened implementation of National Biodiversity Strategies and Action Plans, in particular with regard to :

- Processing non-wood forest products that will contribute directly and/or indirectly to food security and nutritional resilience of rural populations locally ;
- The establishment of sub-regional and regional programs related to scientific knowledge and characterizing the constituent elements of biodiversity (ecosystems, species, genes) ;
- The development and adoption of harmonized national frameworks and action plans for implementing the Nagoya Protocol on Access to Genetic Resources and traditional expertise and associated knowledge and the equitable sharing of benefits (APA) while emphasizing opportunities for sub-regional cooperation.

4. Clarification of and securing individual and collective land rights

Despite the different biophysical, socio-cultural contexts of the countries in the Sahel zone and West Africa, it is well known that securing rural actors remains a near-universal challenge in that it is a determining factor for social peace and the motivation to invest in sustainable land and forest management, the definition and implementation of resilience strategies within communities and ecosystems as well as mitigating climate change. The tree structure of land issues involves ramifications including questions such as :

- land use planning in its rural dimension to provide a spatial framework for coherent, concerted and integrated intervention ;
- securing collective and individual property rights ;
- the development of an appropriate legal and institutional environment consistent with local socio-cultural substrates.

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Cattle breeding in Ferlo, Senegal

In most countries in the Sahel zone and West Africa, significant effort has been made to look at this issue of land security from different angles, particularly in terms of reorganizing policies and legislation for greater conciliation with specific national contexts, decentralization and developing technical and institutional capacity at central and deconcentrated and decentralized levels.

However, all of these initiatives require synergistic support from all stakeholders for sustainable and more productive management of natural capital from the perspective of sustainable food security for all.

5. Supporting the development of value chains

The establishment of agricultural, livestock, forest products and agricultural inputs sectors is to be encouraged and supported. And this, in various forms of partnership: Public-Private, Private-Private (Producers-economic operators) or Public-Public. These sectors will include :

- High consumption agricultural products, particularly around irrigation-based farming where agro-industrial units or centres could be set up depending on production volumes ;
- Pastoral livestock products (meat, milk, hides) ;
- Woody forest products (wood fuel, charcoal) ;
- Agricultural and livestock inputs (equipment, agricultural services, animal health services, etc.).

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Valorization the fruits of the Doum palm, Tillabery, Niger

6. Risk Management in the Agricultural Sector and improving emergency preparedness

Due to the ever-present and varied risks inherent in the climate, institutional, economic and environmental context to which farming systems in the Sahel zone are exposed (drought, flood, crop pests, etc.), we must promote long-term structural solutions to improve agricultural sector resilience, particularly through:

- Strengthening cross-sectoral information and early warning systems for global management of resources, emergency preparedness ;
- The design and implementation of a comprehensive management strategy for agricultural risks that will require sustained financial investments and that will put more emphasis on long-term risk management rather than a short-term response to the crisis[34] .

7. Developing the green economy

Prospects in this area will come from the creation of the foundations for mobilizing potential in the field of new and renewable energy contributing to the sustainable development of the countries concerned, including:

- Conducting the necessary studies and assessments for developing action plans (national/sub-regional) to mobilize and promote existing potential;
- Identifying institutional arrangements and business plans to be provided for the implementation of the different elements of the action plans;
- Preparing a plan for implementing the adopted action plans and tools for their monitoring and evaluation.

34 Martien Van Nieuwkoop et al. Transformer l'agriculture au Sahel, comment y parvenir? Africa region, sustainable development. The World Bank.

III. LONG-TERM PROSPECTS AND PRIORITIES

To facilitate transformational change, long-term measures must complement the short and medium-term measures to improve productivity and stability of livelihood strategies based on agricultural and natural resources and to ensure their sustainability. To that end, public policies should encourage investment:

- In human capital, especially in education and professional training, health and nutrition, as well as family planning ;
- In physical capital, including transport infrastructure, communications and housing (in cities).

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Ghana's SAWAP project team in the field

IV. SPECIAL CONSIDERATIONS ON THE ROLES AND RESPONSIBILITIES OF NON-STATE ACTORS

The public authorities must play a leading role in managing the future transformation for mobilizing existing potential. In order to do this, they will need the collaboration and involvement of the private sector and civil society as well as the productive cooperation of technical and financial partners:

1. The private sector includes :

- On the one hand, farmers, agro-pastoralists and pastoralists; they will mainly have to contribute to the investment in the continued intensification of their production systems of which they are the primary beneficiaries ;
- On the other hand, other economic operators: they may contribute to investment in value chains related to agro-pastoral production, as well as in other sectors/fields of activity in industry and services. They will help to support the intensification of agricultural systems by creating jobs related to promoting natural resources, as well as outside the production zones, thereby helping to reduce possible underemployment in production zones and to relieve pressure on natural resources.

2. Civil society organizations will have an important role to play in facilitating the changes in behavior and attitude of their fellow citizens, by raising their awareness of the reasons and the need to develop traditional models of land use, as well as acting as a mediator in local conflicts caused by competition for natural resources.

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Shea butter processing women's cooperative, Ghana

3. The technical and financial partners for development: can contribute to investment by means of :

- Facilitating intensification of farming systems in vulnerable areas, mainly through supporting the implementation of relevant policies ;
- Human capital (human resources) and physical capital mainly through appropriate technology transfer and support for implementing policies to support the improvement of social health services, family planning and education ;
- Physical capital, in particular through supporting the establishment of actions to develop and manage natural resources, as well as facilitating/ catalyzing foreign investment.

THE « SAHEL AND WEST AFRICA PROGRAM - SAWAP »

CONTEXTE

The **Sahel and West Africa Program (SAWAP)**, financed by the World Bank (WB) and the Global Environment Facility (GEF), aims to solve problems related to natural resource management in twelve sub-Saharan African countries **(Benin, Burkina Faso, Chad, Ethiopia, Ghana, Mali, Mauritania, Niger, Nigeria, Senegal, Sudan and Togo)**.

It is the Bank's main support for the Great Green Wall for the Sahara and the Sahel Initiative (GGWSSI). Aim of the program SAWAP is about expanding the sustainable management of land and water resources in targeted areas and in vulnerable climatic zones in the above-mentioned countries. SAWAP also contributes to the TerrAfrica project financed by the Bank and the NEPAD-AU. TerrAfrica's partners such as the World Bank, IFAD, FAO, UNDP and NEPAD have given their support to countries, with a view to preparing multi-sector investment plans for sustainable land management actions.

The SAWAP program is composed of thirteen projects: twelve national projects on various issues and themes relating largely to Sustainable Land and Water Management (SLWM), and a regional project on «Building Resilience Through Innovation Communication and Knowledge Services», called BRICKS.

The SAWAP program is composed of thirteen projects : **twelve national projects** on various issues and themes relating largely to Sustainable Land and Water Management (SLWM), and **a regional project** on « Building Resilience Through Innovation Communication and Knowledge Services », called BRICKS.

The GGWSSI was initially conceived as a means of combating desertification and poverty, starting by establishing a green belt of plant species of economic value and adaptive to drought, over an average width of 15 km, spanning 7,675 km from Senegal to Djibouti. This vision has gradually materialized into a patchwork of actions and multi-sectoral interventions to conserve and protect natural resources for the purpose of combating poverty.

THE REGIONAL PROJECT ON « BUILDING RESILIENCE THROUGH INNOVATION, COMMUNICATION AND KNOWLEDGE SERVICES - BRICKS »

BRICKS is a regional project aimed at consolidating the SAWAP program with the main objective of facilitating the identification of regional and global innovation and promoting them through effective communication, knowledge management and monitoring and evaluation. Indeed, it also supports twelve national SAWAP projects to stimulate discussion on best practice and successful experiences for common actions by the twelve countries, but also to document the program's performance through an effective monitoring and evaluation system.

The BRICKS project is implemented by three regional centers of excellence: CILSS (Permanent Inter-State Committee for Drought Control in the Sahel, based in Ouagadougou-Burkina Faso), the OSS (Observatory of the Sahara and Sahel, based in Tunis, Tunisia) and IUCN (International Union for Conservation of Nature based in Ouagadougou - Burkina Faso).

Carrying out the activities with a view to achieving the objectives set led to the establishment of ad hoc working groups by CILSS, OSS and IUCN. Collaborations have been initiated and strengthened to support the 12 countries with different areas of interest, involving management of land, water, biodiversity, forests, climate and risks of natural disasters.

The patchwork of activities undertaken over four years (2014-2018) contributed to strengthening links and complementarities between the institutions. The drive of the BRICKS project actors allowed solid foundations to be laid for its implementation in terms of organization, methodologies, approaches, partnerships and collaborations.

©CILSS

SAWAP conference, at the African Union Headquarters, Addis Ababa, Ethiopia

The annual «SAWAP Conferences», the regular organization of regional meetings bringing together the twelve countries and agencies implementing the project, as well as national workshops on specific themes, provided the opportunity to discuss and train national partners involved in monitoring and evaluation, making use of the tools and geospatial applications, best practice in managing land, communication, etc...

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GIS Training and Remote Sensing Workshop-SAWAP Project, Addis Ababa, Ethiopia

Beneficiaries and actors of the regional project

The direct beneficiaries of the BRICKS regional project are the national project teams and the three agencies implementing the project (CILSS,OSS and IUCN). These agencies have many resources; their knowledge of sustainable forest management and management of sustainable ecosystems and communication have been strengthened, so that in return they can ensure knowledge transfer to promote South-South Learning, as well as joint training.

Agencies implementing the BRICKS project

CILSS - Regional coordination, management and dissemination of good practice

CILSS, with its technical branches, the **AGRHYMET** Regional Center (AGRrometeorology, HYdrology, METeorology) in Niger, and InSah (Institut du Sahel) in Mali, provides regional coordination to the BRICKS project and is responsible in particular for identifying good practice in the Sahel and West African region. More than 350 examples of good practice in sustainable land management have been identified and around 20 of them, which are of major interest in eight themes, have been highlighted and disseminated by leaflet, in particular via the portal dedicated to the SAWAP program (sawap.net), as well as through the different social networks. They are also distributed by sharing knowledge and experience through lectures and study trips organized around themes of interest to the national SAWAP projects. In addition, CILSS provides small grants to competitive regional innovations in the form of technical assistance to enable the development of communication tools, in collaboration with IUCN.

IUCN - Biodiversity and communication strategies OSS - Monitoring and Evaluation of the Project Portfolio

IUCN, with its Central and West Africa Program (PACO) provides a better understanding of the central role biodiversity plays in the area of the Great Green Wall and within the SAWAP program in order to promote and strengthen its inclusion in policies and strategies in said program. In collaboration with CILSS and OSS, it has ensured the development and implementation of a communication strategy for the program, and, inter alia, set up and consolidated a functional regional network committee of communicators and journalists from the BRICKS project, supporting communication efforts and benefiting from capacity building action. In addition, it has ensured capacity building in the knowledge management of communication experts in the SAWAP projects, as well as associate journalists, through training workshops and the provision of tools to improve the impact of information disseminated to target audiences.

OSS - Monitoring and Evaluating the Project Portfolio

OSS, with its experience in monitoring and evaluation and in developing geospatial tools and services, has ensured the implementation of the element concerning monitoring the SAWAP project portfolio. In this context, activities have been structured along several branches mainly on :

- The construction of multi-scale databases dedicated to GIS and monitoring and evaluation ;
- The establishment of a Geoportal and a monitoring and evaluation platform ;
- Support and capacity building in the national SAWAP program teams ;
- Conducting regional studies, including this Atlas on land cover, and mapping sites on themes of interest for monitoring and evaluating the SAWAP project.

Efforts made in terms of implementing these fields of activity have led to the establishment of a range of products and services which are useful and appreciated by national projects.

The monitoring and evaluation system designed by OSS, in collaboration with its partners, including CILSS, IUCN, the World Bank and the GEF, includes 7 indicators, including **4 Key Performance Indicators** (KPIs) for Project Development Objectives (PDO)and **3 Intermediate Outcome Indicators** (IOIs) proposed by the monitoring and evaluation working group, set up for this purpose, and validated by the twelve SAWAP countries. An online platform has been set up to enable countries to directly provide the necessary data for updating the indicators, and to enable the OSS to analyze progress achieved and the impact recorded.

The four key indicators are:

- Increase in areas benefiting from sustainable land and water management practices ;
- Change in plant cover in the areas targeted compared to the baseline ;
- Targeted institutions with increased adaptive capacity to reduce risks and cope with climate variability ;
- Change in carbon accumulation rates in biomass and in soils.

NATIONAL SAWAP PROJECTS

BENIN

Protection of forest ecosystems and local development

Forest and Adjacent Lands Management Project (PGFTR) / Ministry of Environment, Habitat and Urbanism

The Forest and Adjacent Lands Management Project (PGFTR) was implemented by the State of Benin in 2006 to curb the deforestation that is eroding the 19 forests classified by the program at a rate of 100,000 ha/year. To counter this, the program aims to set up a number of activities, also touching on areas to be conserved only on their periphery, with direct links to the population.

The project first aimed to rehabilitate the infrastructure of the forest parks and provide funding for technical equipment to enable surveillance activities in forest reserves. Within these reserves, the forest boundaries must be properly established, in order to be able to start activities to restore degraded areas, rehabilitate old plantations and improve agroforestry and rangeland management. Species designated for creating lumber must be planted over the entire area of intervention.

Outside these areas, rural timber markets have been set up, as well as technical support for farmers near forests. Income-generating activities (e.g. production of honey or garri) and community micro-projects have also been launched, with the aim of reducing pressure on people living in neighboring forests. Finally, a trust fund for long-term funding of recurring national park costs in the northern savannah has been proposed.

In terms of key performance indicators, Benin is making notable progress with its effective implementation of the 19 planned management plans, as well as exceeding the objectives of lands benefiting from sustainable management as well as exceeding the number of expected beneficiaries.

BURKINA FASO

Capacity building among local actors, supply of basic equipment and sustainable land management

Second National Land Management Program, phase 3 (PNGT2-3) / Ministry of Agriculture and Hydraulic Developments

The Burkina Faso SAWAP project comes from the Second National Program of Land Management (PGNT2), launched in 2001. Currently in its third phase (PGNT2-3), in the process of being implemented, the Ministry of Agriculture and Hydraulic Facilities (MAAH) wanted to continue its support to communities, including providing land service facilities and the capacity to promote the land security of local actors and support natural resource management policies. This support must be able to secure investment in local development programs ensuring that they effectively integrate the sustainable management issues mentioned.

Burkina Faso has far exceeded the area originally planned for sustainable land management: the final target was revised in the interim from 15,000 ha to 220,000 ha, which has almost been reached now. The same goes for the number of direct beneficiaries of 3,304,770 people, a target reached at 165%. In addition, 467 institutions dealing with civil society organizations or public services have been equipped with adaptive capacity.

CHAD

Support for developing agricultural production

Emergency Project Supporting Agricultural Production in Chad (PAPAT) / Ministry of Production, Irrigation and Agricultural Equipment

Given the very low productivity of agriculture in Chad, restricted by difficult climatic conditions and the lack of market stability and the political situation, as well as weak producer organisations, the World Bank and the Government of Chad have agreed to combine the grants from the Global Environment Facility and the Least Developed Countries Fund to put in place an emergency support project for agricultural production (PAPAT). The goal is to support rural communities and producer organizations so that they can increase the production of targeted plant and animal species in the project areas while developing sustainable land and water management practices in ecosystems vulnerable to the climate. This involves the purchase of 128 tonnes of seeds and 2,800 tons of animal feed, which will be distributed free of charge to 23,500 small-scale farmers and breeders in the areas most affected by drought.

They will be trained to use them, and sub-projects aimed at promoting SLWM practices will be funded in order to maintain the impact of this emergency aid.

Chad's indicators show that it has significantly exceeded its targets, which can be explained on the one hand by the effective implementation of planned actions but on the other hand, by initially undervaluing the areas to be restored. The same applies to the number of beneficiaries, basically anticipated via the producer groups: they have been overtaken because the government has chosen to fund infrastructure for associations in certain regions, which has contributed to a significant increase in the number of beneficiaries in relation to the initial target.

ETHIOPIA

Integrated development of landscapes and watersheds to reduce land degradation and improve their productivity

Sustainable Land Management Project, Second Phase (SLMP 2) / Ministry of Agriculture

Ethiopia is facing serious problems in terms of land degradation, particularly through erosion phenomena, and as such has put in place important means of restoration in its second phase of the sustainable land management project (SLMP-2).

Watershed management has been adopted, local and national institutions (administrations, research, etc.) have benefited from a strengthened ability

to disseminate and implement multiple measures and environmental management techniques needed for soil restoration.

Local development plans have been implemented, as well as a proactive poverty reduction policy. This innovative policy has been developed in the regions of Oromia, Amhara, the nations in the South, the Tigray and Benishangul-Gumuz. It consisted in allocating plots of land to young people with no land in return for their commitment to establishing viable practices on these lands, thus allowing a return to sustainable production and an increase in carbon storage on a national scale. Over 15,000 young people have benefited from the initiative and the aim is to extend it to the rest of the country.

©Zena Afework Demissie - SAWAP Ethiopia

SAWAP project area of intervention, Ethiopia

Ethiopia is making steady progress in achieving its objectives in terms of indicators, which are significant in view of the size of the country and and its potential. It has reached 63% of the 910,000 ha set out in SLM, and 77% of the expected beneficiaries of 2 152 000 people. More than 5,000 institutions have benefited from capacity building to reduce risks and to tackle climate variability, i.e. 110% of the new target revised upwards. This training has not yet been fully reflected in the natural resource management plans, which reach 1312 out of the 2313 planned, and on carbon accumulation rates (6% of the target).

GHANA

Improving soil fertility and maintaining biodiversity in the savannah watersheds in the North

Sustainable Land and Water Management Project (SLWMP) / Ministry of Environment, Science, Technology and Innovation

Savannah zones in northern Ghana are lagging behind the rest of the country, a delay which is accentuated by the recurring natural disasters such as floods. To mitigate this situation, via the Sustainable Land and Water Management Project (SLWMP), the country has focused its efforts on disseminating sustainable land and water management practices, especially by exploiting the use of rainwater.

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SAWAP project area of intervention, Ghana

The Savannah Development Authority (SADA), the local districts and communities have benefited from increased skills in terms of watershed management and have benefited from financial support to help farmers to develop appropriate SLWM practices themselves. Finally, monitoring and evaluation activities were also funded to ensure the practices adopted are durable and replicable. Ghana needs to make further progress towards achieving the targets set in terms of KPI with the majority today around 60%.

MALI

Building resilience to climate change through the management of natural resources

Natural Resource Management and Climate Change Project (PGRNCC) / Ministry of the Environment, Sanitation and Sustainable Development

Mali, a country in the Sahel zone with an area of 1 241 138 km2 with low plant cover, is strongly affected by the damaging consequences of human practices (bushfires, slash-and-burn farming, archaic land clearing, agricultural nomadism, overgrazing, etc.) and climate change (rainfall and climatic variability, temperature rise, etc.) with the knock-on effects of escalation of drought, silting and/or rivers drying up, degradation of cropland, loss of biodiversity, etc.

Thus, to limit the impact of climate hazards on people and natural resources, Mali has initiated the PGRNCC to implement several activities to (i) support vulnerable communities to improve their resilience to climate risks and hazards, (ii) to promote increased adoption of SLWM practices and (iii) to improve plant cover in the target areas. Activities promoting SLWM practices, promoting the management of environmental information, revising local

development plans to ensure they take into account community management of natural resources, have been carried out.

In addition, income-generating activities (IGAs) are funded to enable people to diversify their income, meaning they no longer have to depend primarily on natural resources. Examples include the development of sheep and beef fattening activities, which reduce pressure on forests while providing additional income.

Local communities and their decision-makers have also been made aware of the different challenges posed by climate change and adaptation options, particularly with regard to socio-economic activities and the various SLWM practices that can be implemented to tackle them.

The project in Mali has already achieved its objectives in terms of the project's direct beneficiaries. However, other indicators lag behind in terms of reaching the final targets, including the expected target of 10,748 ha of land benefiting from sustainable land management practices.

MAURITANIA

Restoring landscapes through regenerating gum arabic to improve community resilience

Sustainable Land, Water and Forest Management Project (SLWMP) / Ministry of the Environment and Sustainable Development

Mauritania's SLWM project, launched in January 2016, aims to restore gum arabic production in the south of the country, at the Senegalese border. The project is intended to revitalize landscapes and people who have experienced drought, because gum Arabic is highly sought-after worldwide by the food, pharmaceutical or cosmetic industries.

In addition to the financial benefits of developing the sector, the project must enable the dissemination of knowledge related to good plantation land management, as well as the monitoring of ecosystem services that can supply the gum producing species, in particular Acacia senegal and Acacia seyal. As they are very adapted to their arid environment, these species enable the mobilization of water resources and nutrients that is beneficial to soils. In addition, they belong to the Fabaceae family, meaning they associate with nitrogen-fixing Rhizobium bacteria, which enriches the soil with nitrogen and benefits other neighboring plant species, thus increasing soil cover. Acacias also provide lumber or wood for heating, as well as fodder for livestock.

Activities have just been launched for the SAWAP Mauritania project and we cannot yet appreciate their achievements. A plantation of gum trees (Acacia senegal) is planned across 59 sites with a combined total of 11,390 hectares.

NIGER

Ensuring food security through the resilience of ecosystems and the diversification of agricultural production by local people

Community Action Program (PAC3) / Ministry of Agriculture, Animal Husbandry

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SAWAP project area of intervention, Tillabey, Niger

In 2003, Niger set up a Community Action Program through the World Bank and the GEF with the aim of sustainably reducing the poverty and improving local governance, giving communities and local governments the means to improve management of natural resources and ecosystems, and to increase levels of health, education and food security to stimulate economic growth. Phase 3 of this program (PAC -3) is to build capacity within the different administrative bodies: ministries, local authorities, communes, so that they can respond more quickly and effectively to a crisis.

A local investment fund has been proposed to support the local primary sector (agro-sylvo-pastoralism, fisheries), to maintain the existing infrastructures and improve SLM practices and support small income-generating activity projects.

A Bio-Carbon Initiative component aimed at carbon sequestration and gum arabic production is funded throughout the Program implementation process (CAP 1, PAC 2 and PAC 3). Having gone through the audit phase, the Program assessment report is currently in the validation stage. Niger has far exceeded its planned targets in terms of beneficiaries and SLWM areas, with more than 550,000 beneficiaries reached out of the 300,000 expected and 87,683 ha restored compared to the 60,000 planned. More than 2,700 institutional representatives have taken part in capacity-building activities.

NIGERIA

Reducing vulnerability of soil to erosion in targeted sub-watersheds

Erosion and Watershed Management Project (NEWMAP) / Federal Ministry of the Environment

Nigeria faces serious gully problems caused by heavy rainfall and the sedimentary nature of soils made worse by bad anthropogenic practices (overgrazing, deforestation, mining activities). The NEWMAP project therefore supports preventive and corrective actions related to erosion, both at an administrative (monitoring and evaluation, planning, knowledge management) and technical (watershed management, crisis prevention, adoption of SLWM practices) level.

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SAWAP project area of intervention, Nigeria

The different expected impacts of the project are first of an end to the destruction of infrastructures washed away by landslides (roads, houses, markets). In addition, preventive SLWM practices applied should see an increase in agricultural productivity, and stabilize soil, which avoids river silting, making it easier to access better quality water. Finally, restored plant cover will benefit local wildlife, but will also improve local microclimates, making them more humid. It will also play a role in carbon storage.

In terms of indicators, 14 Ministries, Departments and Agencies (MDA) are currently involved in implementing the NEWMAP project with the aim of reducing and tackling climate variability. Development plans are implemented gradually (19/30) but SLWM practices have not yet been put in place. In terms of beneficiaries, the target has been exceeded by far because there are numerous indirect beneficiaries of the project (protected infrastructures).

SENEGAL

Inclusive and sustainable development of agricultural sectors

Inclusive and Sustainable Development Project of Agribusiness in Senegal (PDIDAS) / Ministry of Agriculture and Rural Equipment

In Senegal, the PDIDAS project (Inclusive and Sustainable Development Project of Agribusiness in Senegal) made it possible to provide investors with more than 20,000 ha of productive land, twice as much as originally planned. These lands have been defined and demarcated after a long consultation process with local people, which has allowed around 40,000 people to become involved in the project, 50 investors and about 500 different administrative authorities (mayors, state services, councillors).

The project includes the construction of irrigation (5000 ha in the Ngalam Valley and 5000 ha around Lake Guiers) and post-harvest infrastructures (shops storage and packaging, access roads, etc.), hydro-agricultural facilities, support for local initiatives through non-repayable grants, allowing small farmers to be integrated into new sectors and value chains.

The anticipated benefits are 100,000 tons of horticultural products marketed on the national and international market for a value of 60 billion FCFA, 10 billion of which are sold by small farmers. More than 9,500 jobs must be created, including 6,600 for women and 7,500 from big investors. The 10,680 direct beneficiaries planned include 6,900 women, 200 SMEs in various activities across the value chain, 800 smallholder farmers and 180 farmers with medium-sized farms. Communities were also made aware of the issueswith SLWM, which concerns 7 classified forests and 2 nature reserves. To date, only half of the 10,000 ha anticipated by key performance indicator No. 1 actually benefits from SLWM practices, and 1,520 beneficiaries have so far been identified, out of the planned 10,680.

SUDAN

Supporting national structures in disseminating and evaluating sustainable management practices

Sustainable Natural Resources Management Project (SSNRMP) / Ministry of the Environment, Forests and Physical Development

Sudan's Sustainable Natural Resources Management Project (SSNRMP) aims to set up several simultaneous stages to be able to develop SLWM practices. On the one hand, Sudan conducted diagnostic studies to identify institutional, technical, administrative, financial and training needs and put in place a capacity-building plan for key ministries and institutions specializing in the fields of forest, livestock, grazing and wildlife, research and extension. These studies analyze the state of land degradation and biodiversity as well as evaluating the current body of laws and regulations in order to determine their effectiveness and relevance in the context of implementing SLWM practices, in addition other two studies were carried out to support SLWM the first one is Communication Strategy and second one is Prosopis chilensis Management (Exotic invader species in Sudan).

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SAWAP project area of intervention, Sudan

On the other hand, financial support has been provided for research centers and extension services, as well as for technical assistance for projects developing sustainable livelihoods within communities. The project also includes rehabilitation and restoration of forest ecosystems, as well as support for sustainable pasture management activities. According to figures received on December 2018, Sudan has achieved its targets in terms of indicators, with about 94% of the 50,000 beneficiaries and 107% of the 104,000 ha of land in the anticipated SLWM. Most natural resource management plans have been put in place (6/7).

TOGO

Managing and preventing natural disasters and their effects on the land

Integrated Disaster and Land Management Project (IUPMP) / Ministry of Agriculture, Livestock and Fisheries Development

Togo has suffered recurring natural disasters for several years, including severe floods. They cause enormous damage, for example, loss of human life, destruction of homes, infrastructures and works, devastation of fields and crops. In terms of the environment, each year floods are responsible for the loss of hundreds of hectares of forest and savannah thus disrupting animal habitats and the reproductive cycle of some reptiles. Based on the National Strategy for Reducing the Risk of Natural Disasters of Togo (SNRRCN), the Integrated Management of Disasters and Land project aims to build the capacity of some targeted institutions to manage the flood risk and degradation of land in targeted urban and rural areas. This project involves training at national, regional and local levels to raise awareness within institutions, and establish communication campaigns on the risks linked to looding and soil degradation. Preventive systems have been funded, for example water reservoirs and drainage trenches which should enable floods to be controlled. These developments greatly benefit women, many of whom have been paid for building them, and who no longer need to relocate their agricultural production when flooding occurs. In addition, the new activities developed (agriculture, fish farming in the basins) enable income to be diversified and thusreduce the pressure on natural resources, especially forestry, and restore the ecosystem services they provide. Additionally, a national flood warning system has been implemented to be able to respond quickly and effectively to flood risk.

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SAWAP project area of intervention, Togo

Togo has exceeded the planned targets: 1680 ha of SLWM out of the 1,200 targeted, and 2,650,000 beneficiaries compared to the expected 2,500,000. Likewise, the institutions have been strengthened and SLWM practices have been effectively disseminated (105 institutions out of 95 targeted and 8 out of 5 planned).

METHODOLOGY AND VALIDATION PROCESS OF THE LAND COVER MAP

The standard classification and characterization of land cover units to improve knowledge of the state of natural resources constitutes a first step in implementing land preservation activities and sustainable land management. This knowledge is crucial for more informed decision-making and in supporting the planning process. Despite the strong demand for this type of information in most countries, data is usually lacking, out of date or poorly distributed. In addition, the problems associated with harmonizing classification legends and systems present an obstacle to the use and promotion of land cover maps, including comparability across space and time.

In view of this, the BRICKS project has set as one of its objectives, the development of land cover maps for the 12 countries in the SAWAP program by adopting harmonized approaches and standardized techniques. Just like the achievements in other OSS member countries, the land cover mapping of the area was created by adopting a participative approach involving relevant national partners and OSS experts.

METHODOLOGY

The mapping methodology used is based on analysing and processing earth-observation data. It combines two techniques :

- ***Automatic multi-date classification*** of multispectral Landsat images at 30 m resolution. Coverage of the entire area of activity with Landsat-8 OLI images was used. For each scene, two images (one per season: dry/rainy) taken during the period November 2015 - August 2016 were processed. The use of several images per scene made it possible to achieve enhanced thematic precision. In total, more than 960 images were acquired and used.
- ***Photo-interpretation*** for the grouping of classes generated by automatic classification. Very high-resolution images available on Google Earth have identified the classes of land cover, according to the previously defined legend. Other data and additional ancillary information from thematic maps, from specific reports, databases, expert reports, etc. were able to be used to complete, refine and validate the final mapping product. The following data in particular has been used during the finalization and validation of the map :
- ***GlobCover, 2010*** (European Space Agency, ESA and Catholic University of Louvain)
- ***GlobCover30, 2010*** (the Institute of Remote Sensing and Digital Earth-RADI), Chinese Academy of Sciences – CAS)
- ***Global Urban Footprint*** (GUF) 2015 (German aerospace center – DI).

TECHNICAL SPECIFICATIONS AND VALIDATION

Defining the legend and the technical specifications of the map was carried out collectively with the national partners involved and meets the expectations of the different national programs in relation to management of natural resources. It combines the limits of the technique and data used, on the one hand, and the needs of users, on the other hand. With a view to standardization and harmonization, a legend created from 20 classes was developed on the basis of the FAO's Land Cover Classification System (LCCS), which is an international standard on the subject.

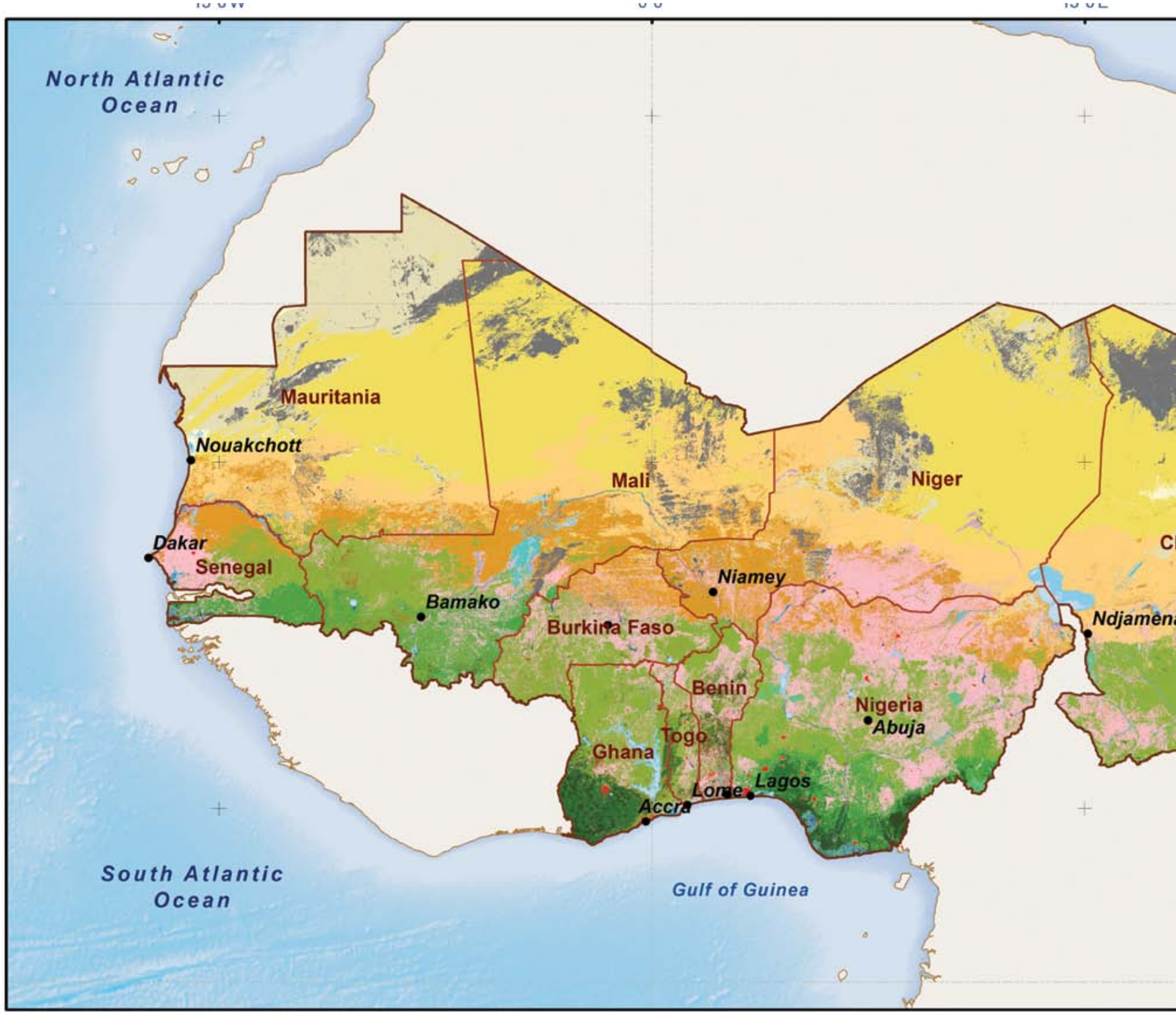
A compilation of map clippings has been published in paper format and made available to key national partners for validation. The map was thus finalized by integrating the comments and remarks from national experts.

The scale and map clippings adopted are in line with those of the world topographical map at 1: 1 000 000 for better use of clippings in national programs and development projects. Each clipping was divided into two parts (North and South).

For practical considerations (size and format), the clippings were edited on a scale of 1:1 250 000. Clippings that cover desert areas with very low plant cover were merged and edited on a reduced scale (1:2 500 000). The scale of the map determines the minimum size of the mappable objects (minimum mapping unit - MMU).

The area of the smallest mapped unit chosen is 50 hectares, with the exception of urban, agricultural and water classes, which will have an MMU of 25 hectares. World Geodetic System WGS 84 and Universal Projection Traverse of Mercator MMU (Fuseaux 28-38) were adopted for all cards presented in the Atlas.

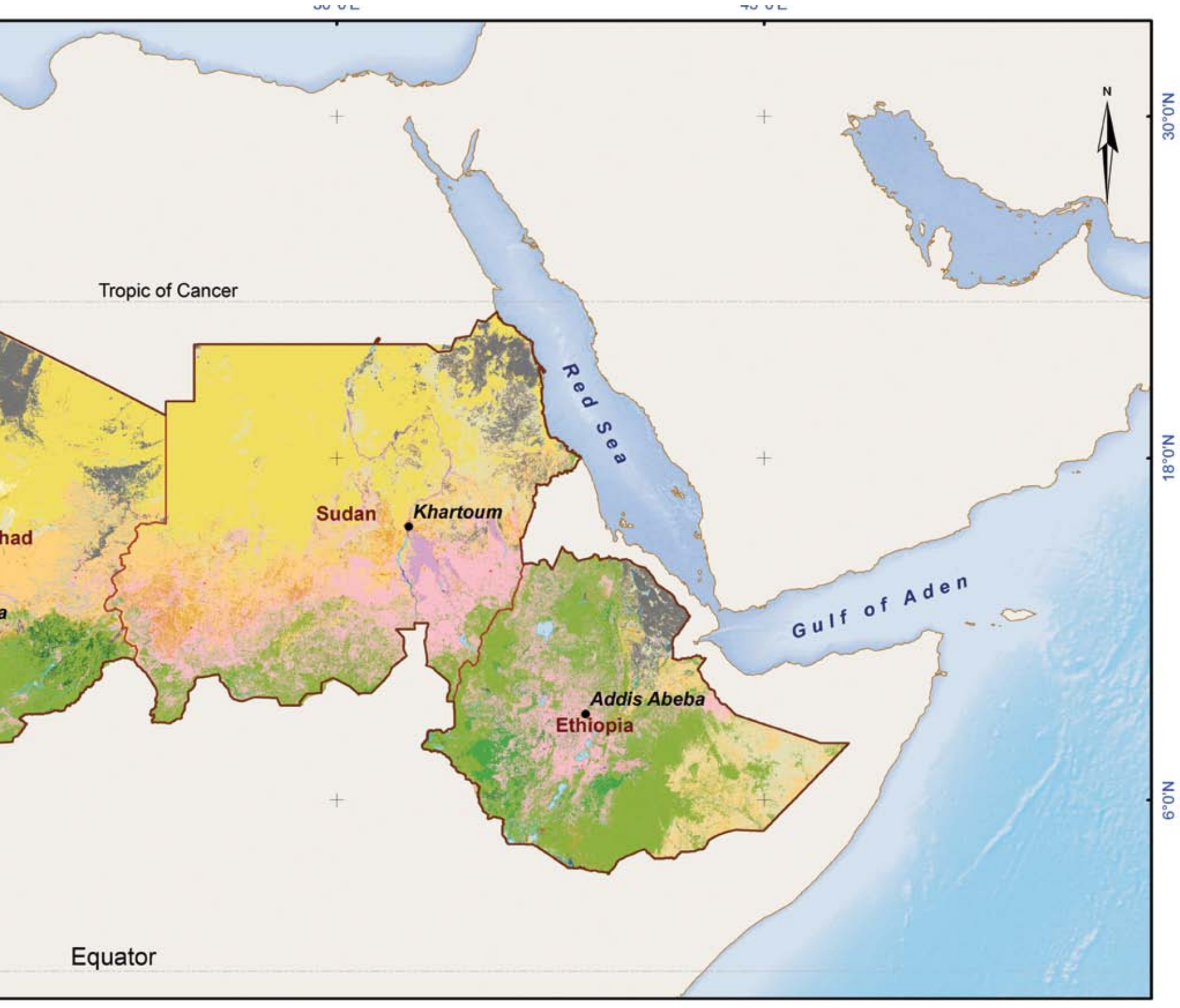
LAND COVER MAP



0 250 500 1 000 Km

Natural vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub/tree savanna
- Grass savanna
- Shrub/tree steppe
- Grass steppe


30°0'N
18°0'N
0°0'N
N
Tropic of Cancer
Equator
Red Sea
Gulf of Aden
Sudan
Khartoum
Addis Abeba
Ethiopia
Cultivated land
Irrigated cropland
Rainfed cropland
Non-vegetated land
Bare soil, very sparce vegetation
Salty soil
Dunes
Rock outcrops
Wet land
Water body
Floodplain
Aquatic vegetation
Built-up land
Settlement
Capital city
Country boundary
SAWAP zone's limit

PHOTOS ILLUSTRATING LAND COVER MAP LEGEND

NATURAL VEGETATION

TREE PLANTATION

Land planted with species for reforestation, intended, among other things, to protect, restore and produce wood and oil. Example: Eucalyptus plantation, Filao (in Senegal) and oil palm in Togo, Ghana and Benin.

GALLERY FOREST

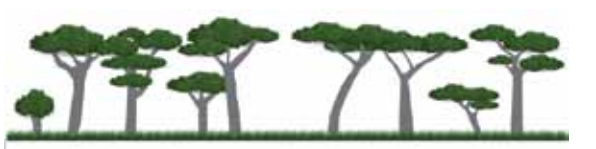
Closed dense forest formations that support water courses in regions of open formation and savannah in favor of the moisture they maintain plant formation relatively closed (75 - 100% soil capping by tree and shrub crowns), evergreen or semi-deciduous, along a water course or enclosed valley.

CLOSED FOREST

Dense forest formation where trees touch or where there is high cover. It consists of several layers with a dense canopy and crowns that interlock.

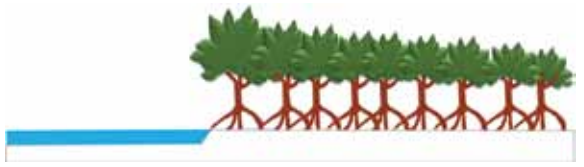
WOODED SAVANNA

Open colony with small- and medium-sized trees with crowns which are often joined, with the entire canopy largely filtering light; on the ground, grasses are sparse and can be mixed with other suffrutescent or herbaceous plants. It consists primarily of trees with a normally straight trunk, with the crowns of woody plants covering between 50% and 75% of the floor.



MANGROVE

Forest formation under main dependence of soil around brackish waters and formed mainly of mangroves. It is characteristic of the coastal intertidal zone of lagoon and mudflat coastline in the intertropical zone with tree and shrubs species which tolerate salt water (species of the genus Rhizophora and Avicennia).



WOODED SAVANNA

Trees and shrubs forming a clear canopy allowing light to filter through. It corresponds to a plant formation characterized by the presence of a continuous herbaceous stratum, at least 80 cm high, dotted with mainly deciduous trees and shrubs. The rate of ground cover from the crowns of trees and shrubs is between 25% and 50%. Shrubs are usually low – branchy and with twisted trunks. Woody plants are generally deciduous and tolerant to fire.

SHRUB/TREE SAVANNA

Woody plants represented almost exclusively by shrubs and bushes, scattered across the continuous grassy carpet.

GRASS SAVANNA

Trees and shrubs ordinarily absent (less than 10% cover) Confusion with shrub savanna remains important and field information is essential to make the distinction.

SHRUB/TREE WOODED STEPPE

Class encompassing shrub steppe with parts of treed steppes (steppe with trees).

GRASS STEPPE

Sparse grassland without trees or shrubs.

CULTIVATED LAND

IRRIGATED CROPLAND

Crops whose development depends on an artificial water supply (sprinkling, submersion, drip, etc.) Examples: rice, sugar cane, maize and market gardening.

RAINFED CROPLAND

Crops whose development is depends entirely on rainfall. Example: millet, sorghum, maize, peanut, cowpea, fonio, etc.

BARE LAND

BARREN SOIL OR VERY SPARSE VEGETATION

Areas totally devoid of vegetation.

SALTY SOIL

Generally sandy area with very low plant cover and high salinity. (For example Tann in Senegal)

SAND DUNES

An area of relief the shape of which is due to the piling up of sand.

ROCK OUTCROPS

Scree, cliff, rocks, rocky outcrops and lava are included in this class.

WETLAND

W

PERMANENT WATER BODY

Natural and artificial bodies of water. Primarily lakes, temporary or permanent ponds and temporary or permanent watercourses.

FLOOD PLAIN

Flat expanse of land which is periodically flooded.

WATER-MEADOW

Grassy formation growing on a soil base covered in a sustainable way, but not necessarily permanent, by a layer of open water, of variable depth in space and time. Water meadow on standing or running water.

BUILT-UP LAND

SETTLEMENT

Territorial entity of variable size, generally inhabited by a human settlement (village, town, etc.)

NB : all definitions of the 20 land-cover classes are extracted from the OSS land cover atlas (Burkina Faso, Senegal, Mali, Niger, Mauritania) and the profiles draw on the CILSS atlas of West Africa.

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75	NF-37-N	GEBEIT-N	195
76	NF-31-S	FORT LAPERRINE-S	196
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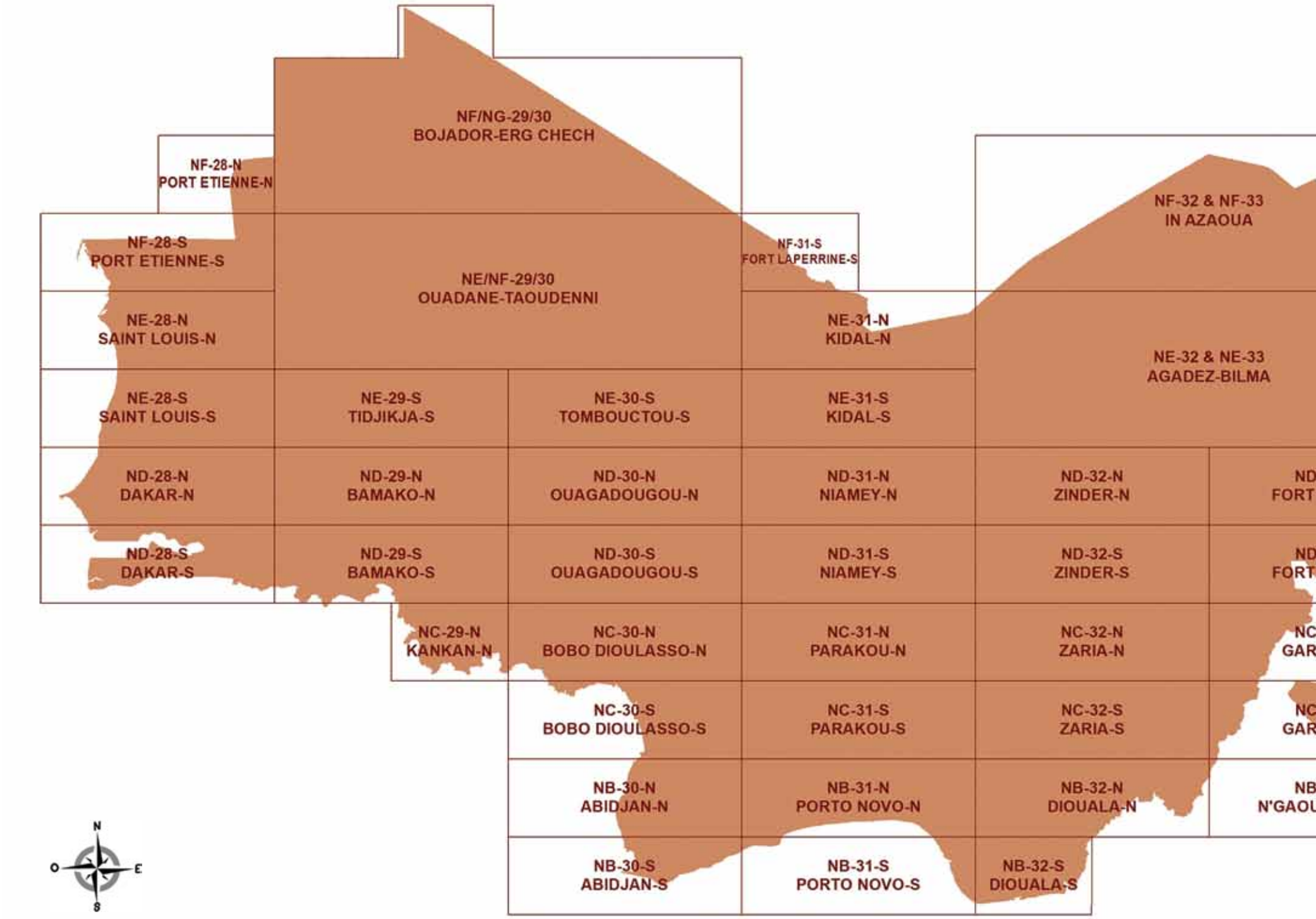
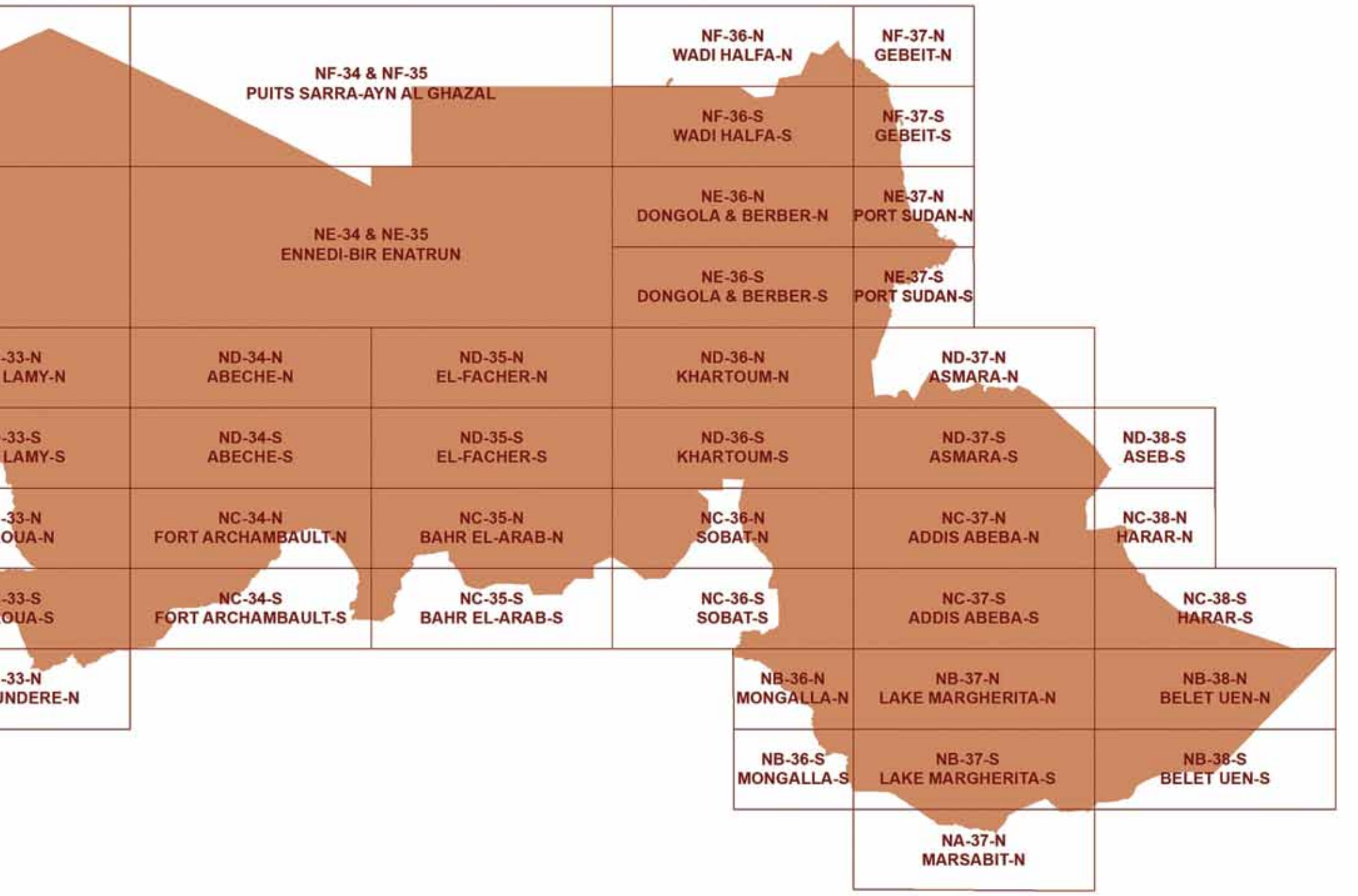
LAND COVER MAPS INDEX



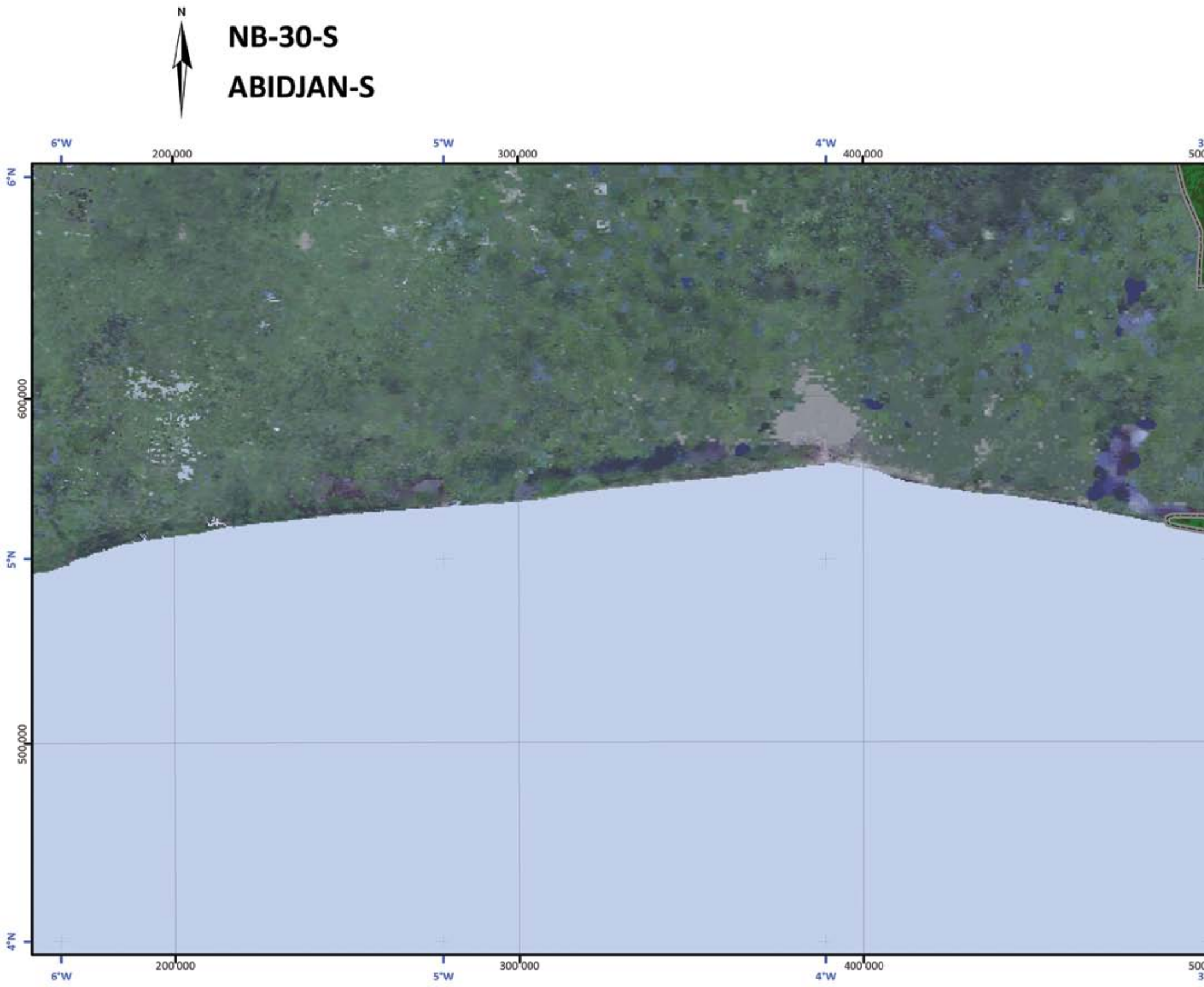


The scale and map index used are in line with those of the global topographic map at 1:1 000 000 thereby allowing for a better utilization of these map sheets in national development programs and projects. Each map has been divided into two parts (North and South). For practical reasons (size and format), the maps have been edited at a scale of 1:1 250 000. Map sheets covering desert zones with very sparse plant cover have been combined and edited at a reduced scale (1:2 500 000).

The map index is given in the form of a grid, indicating the names of the map sheets. To consult the map sheets, please refer to the alphabetical index of map sheets by page number (page 53).

NB-30-S

ABIDJAN-S

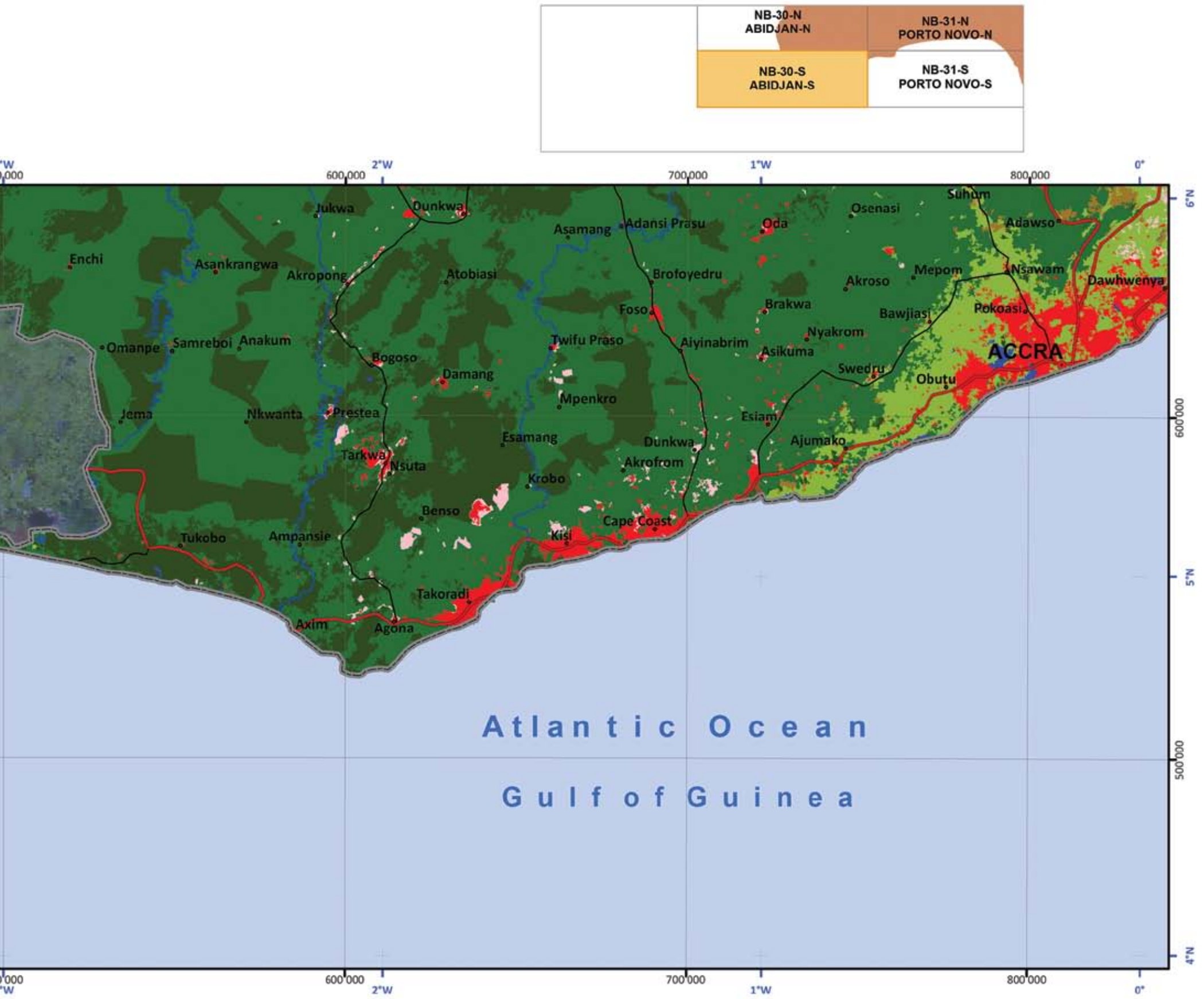


Scale 1: 1 250 000

The map is in the World Geodetic System (WGS84) and UTM projection (zone 30).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

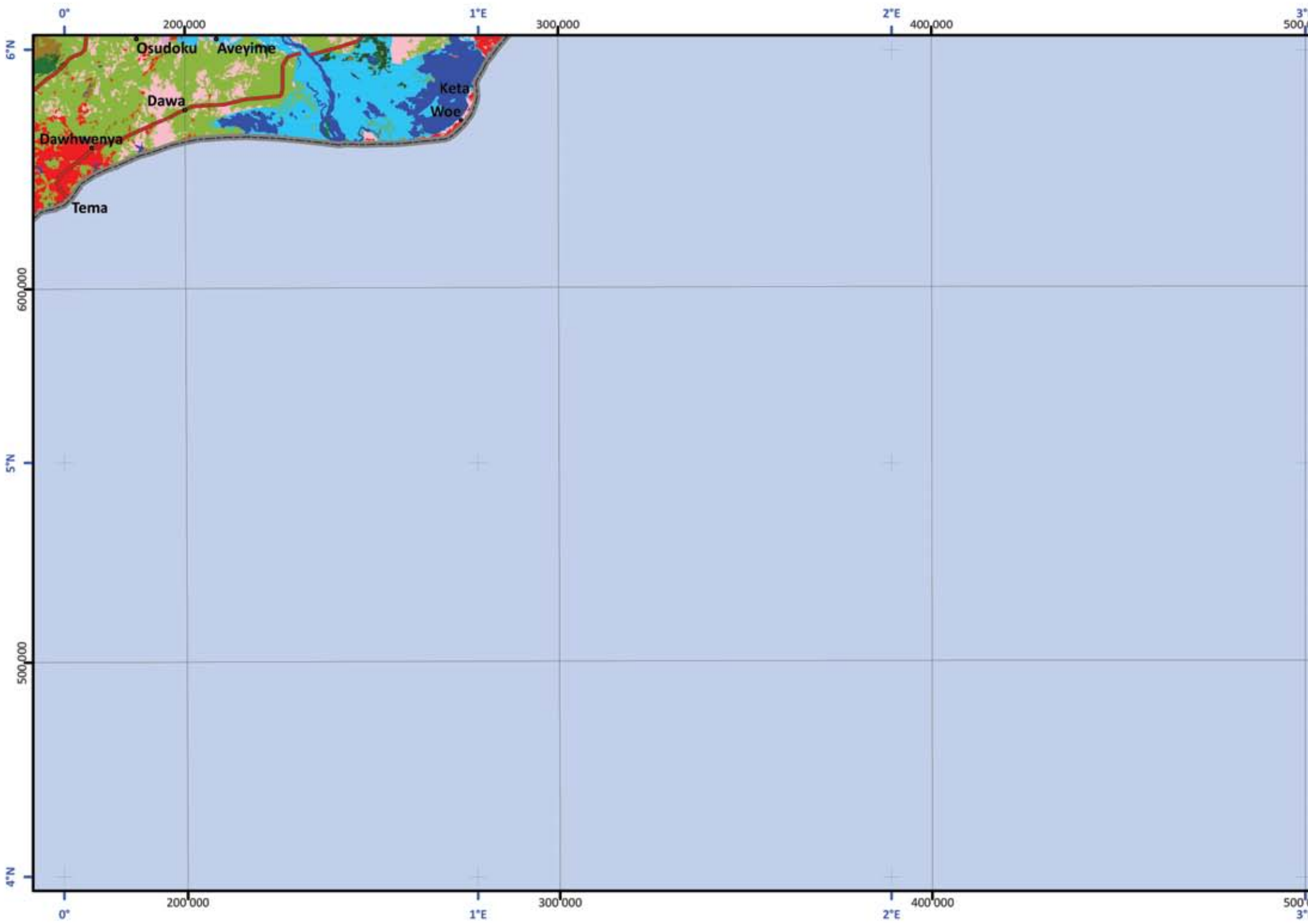
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NB-31-S

PORTO NOVO-S

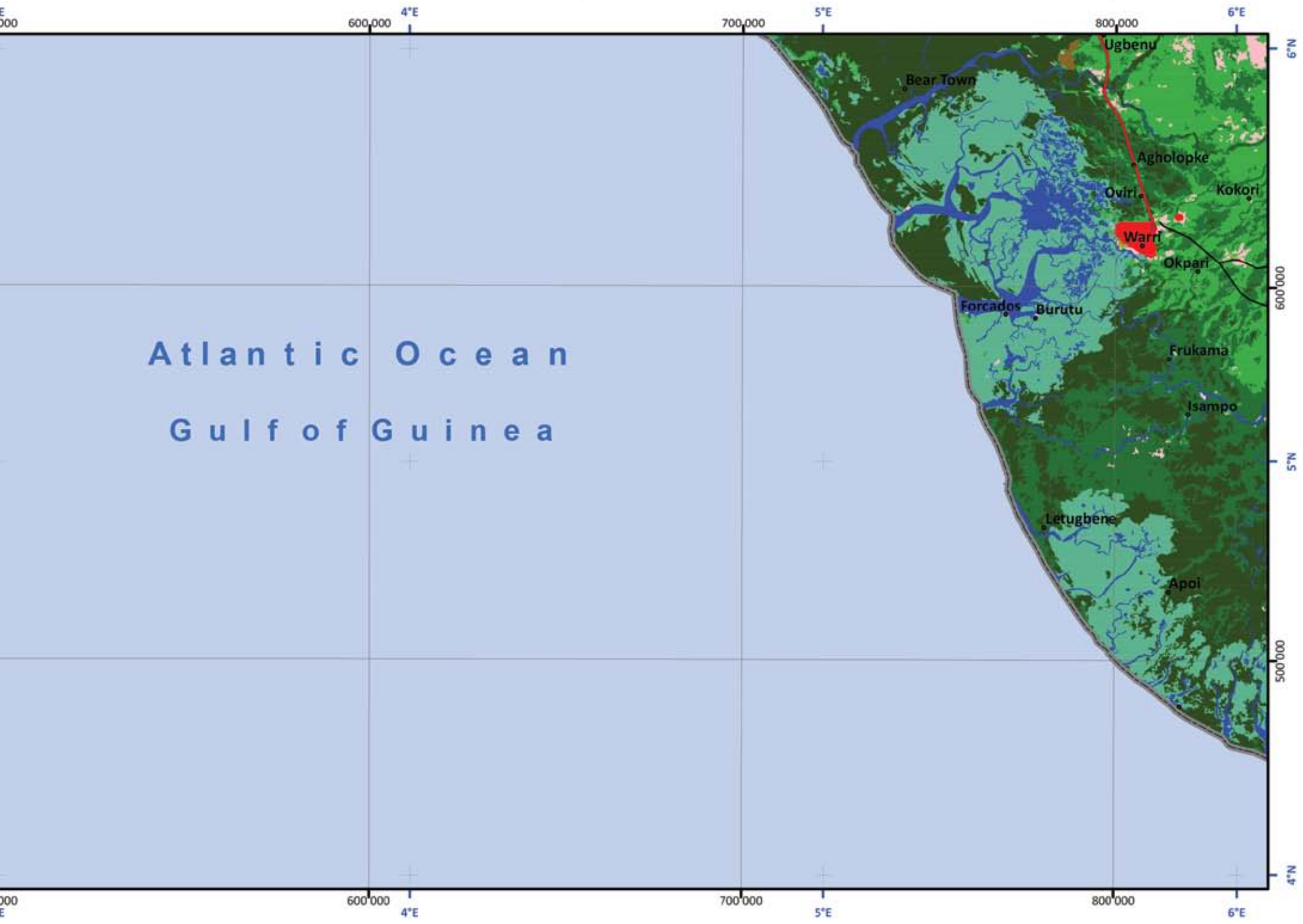


Scale 1: 1 250 000

The map is in the World Geodetic System (WGS84) and UTM projection (zone 31).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

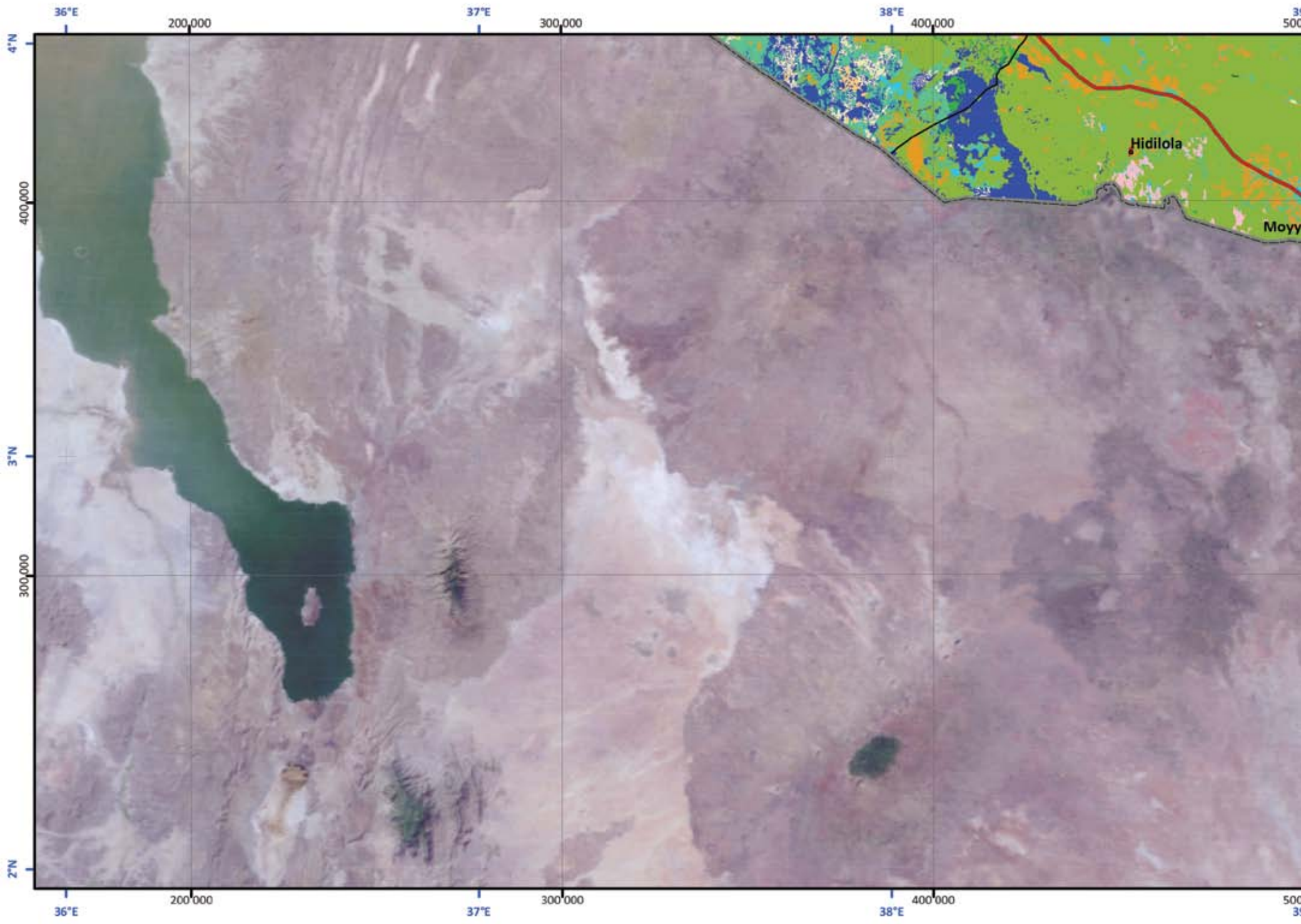
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NA-37-N

MARSABIT-N



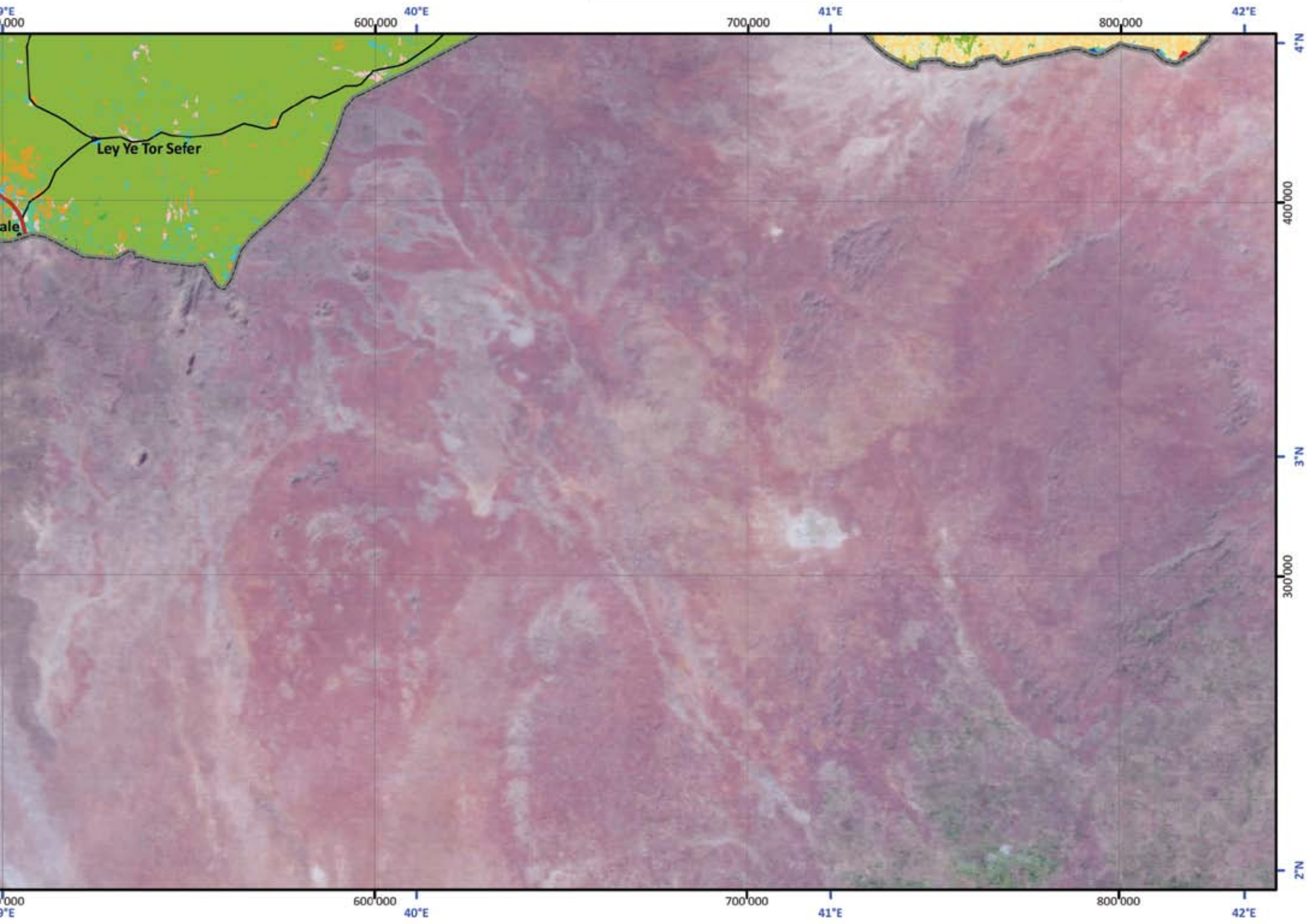
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 37).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

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- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

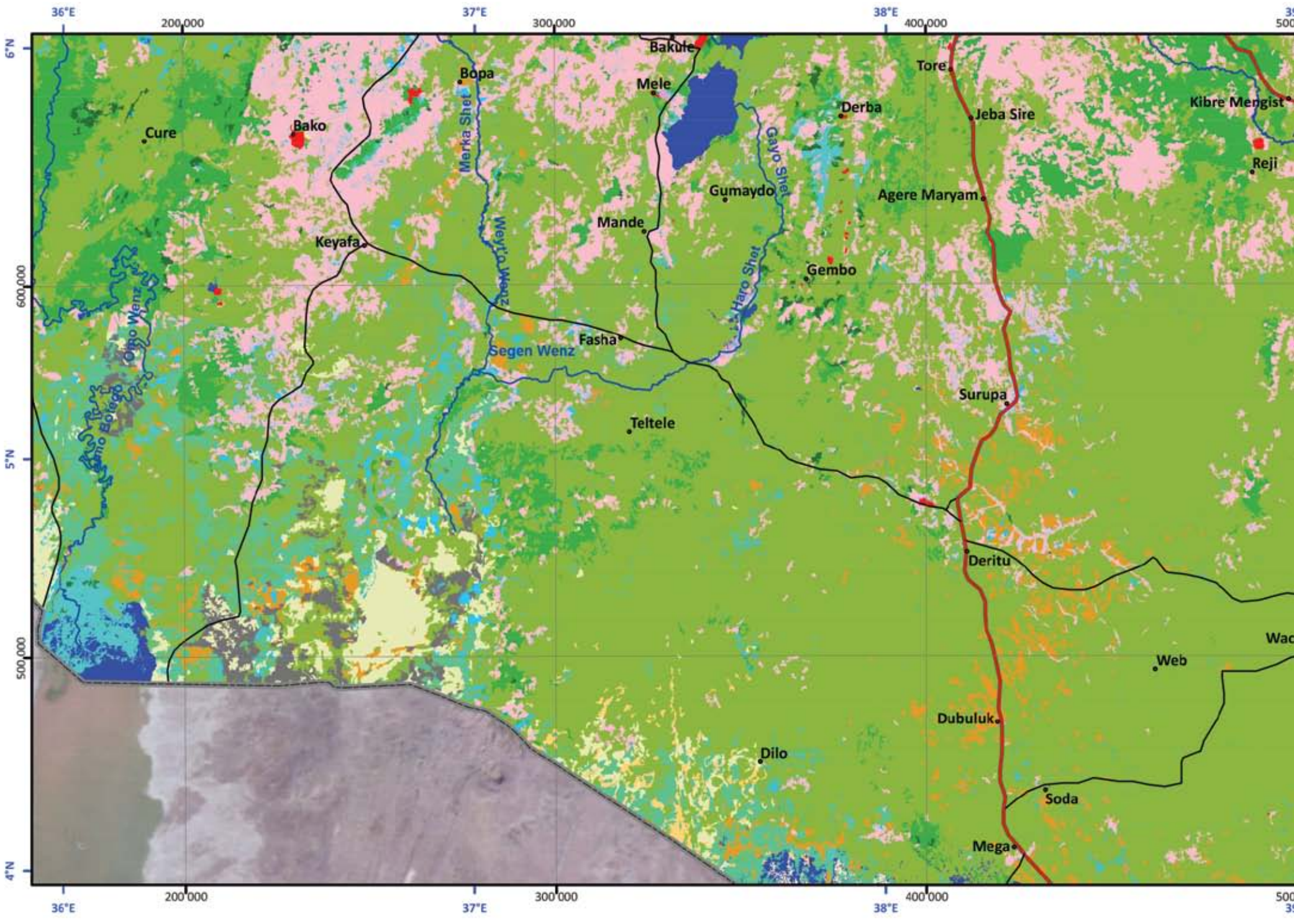
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NB-37-S

LAKE MARGHERITA-S



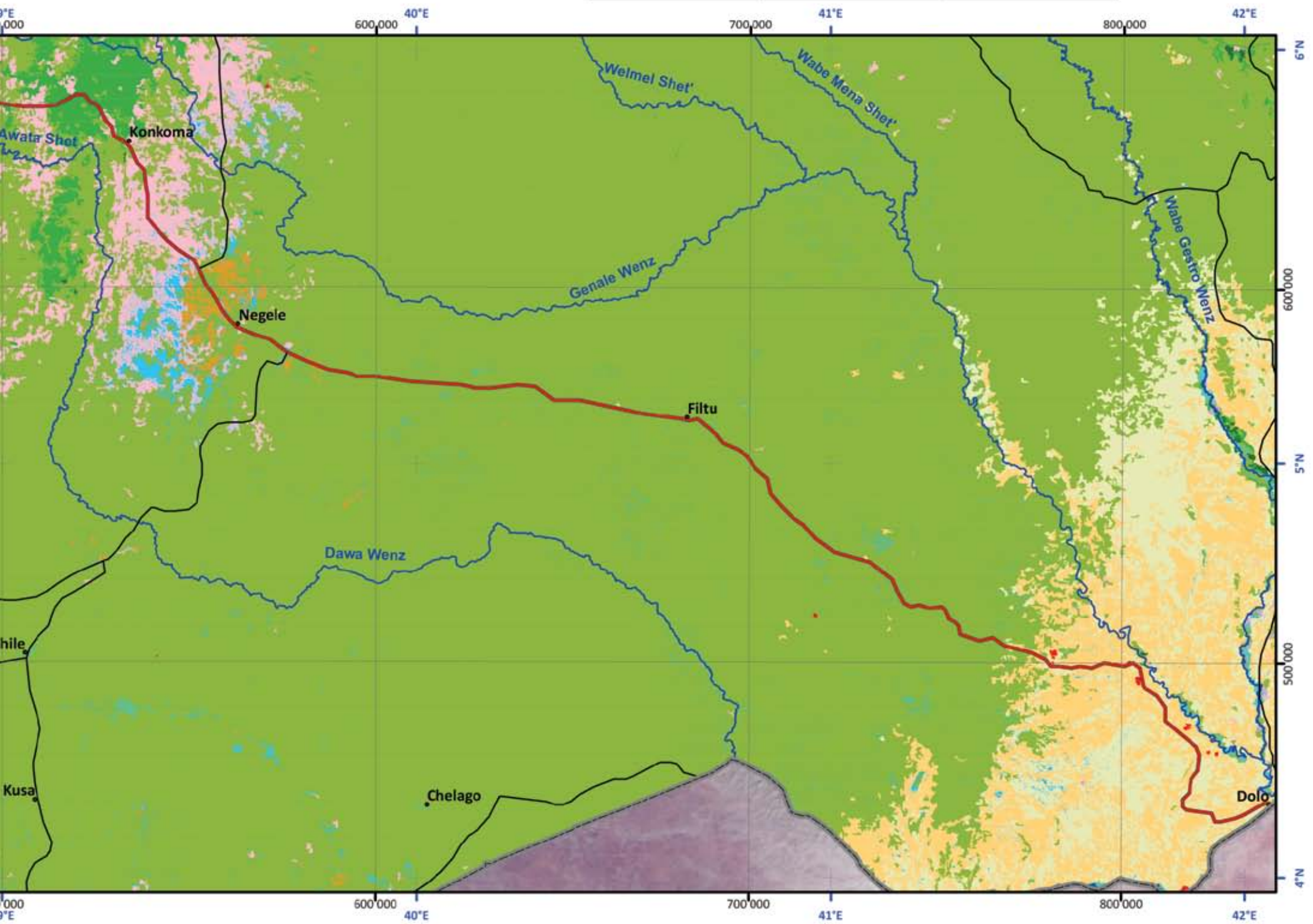
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 37).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



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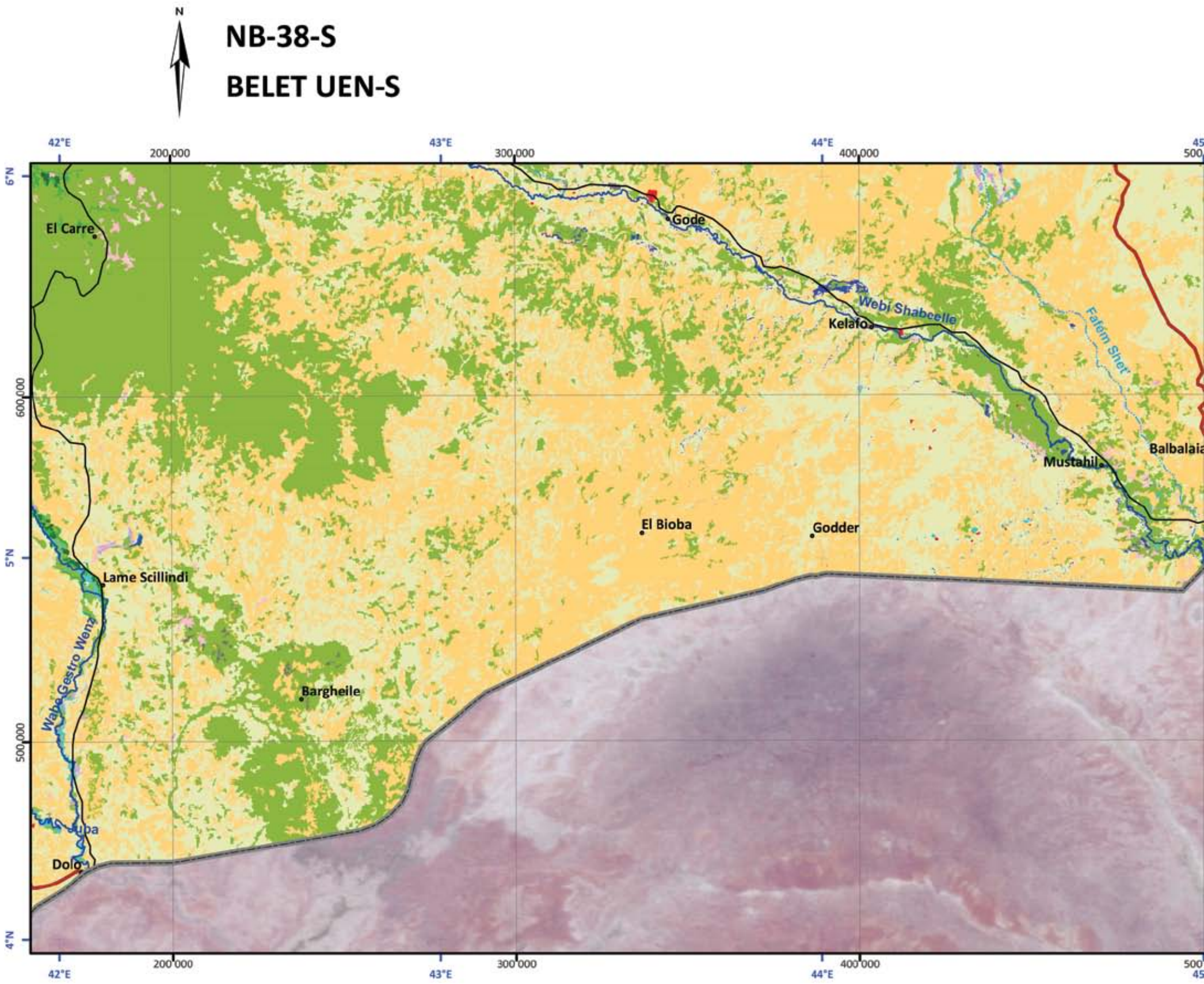
- Primary road
- Secondary road
- National capital
- City or Town

NB-38-S

BELET UEN-S



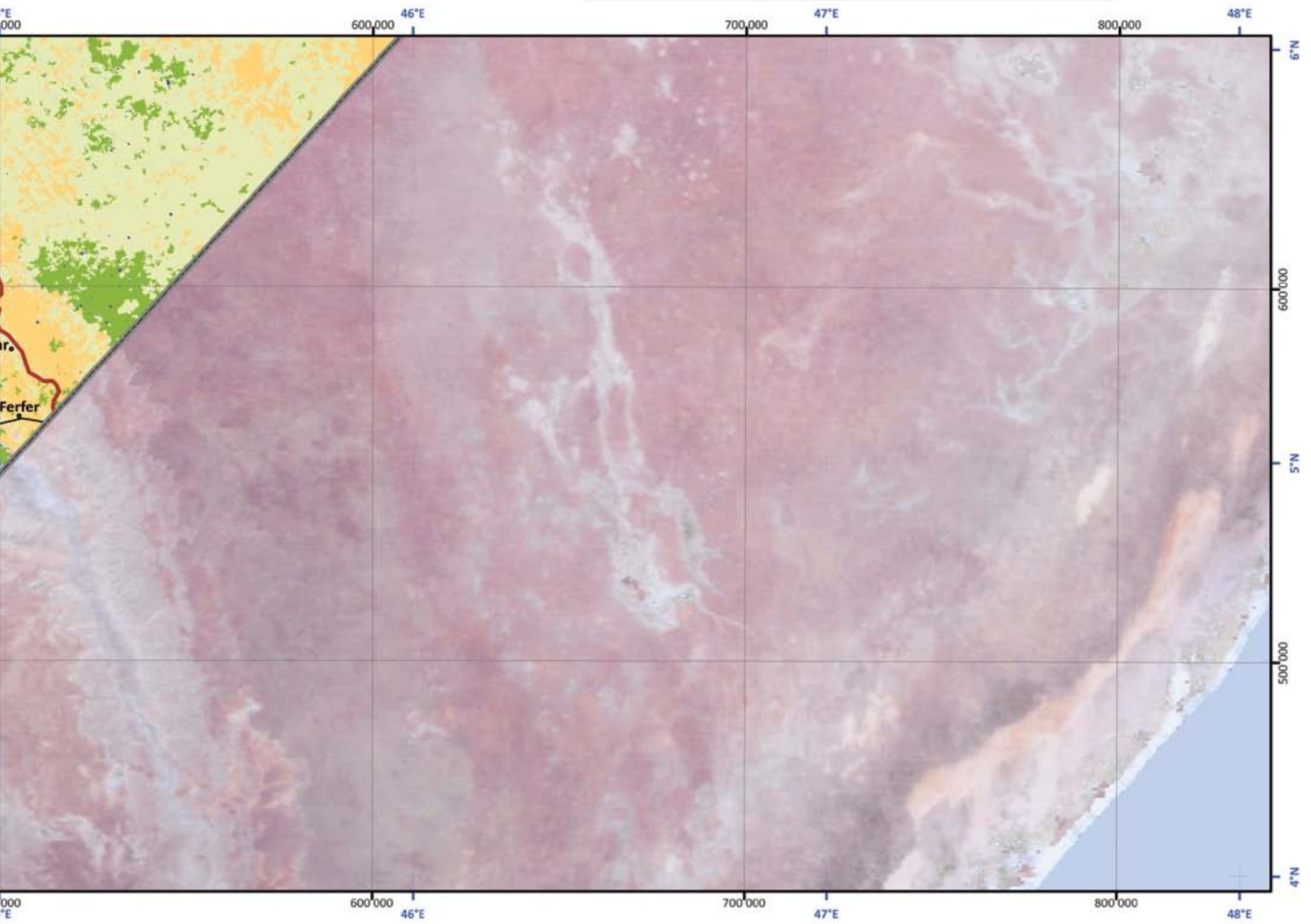
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 38).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

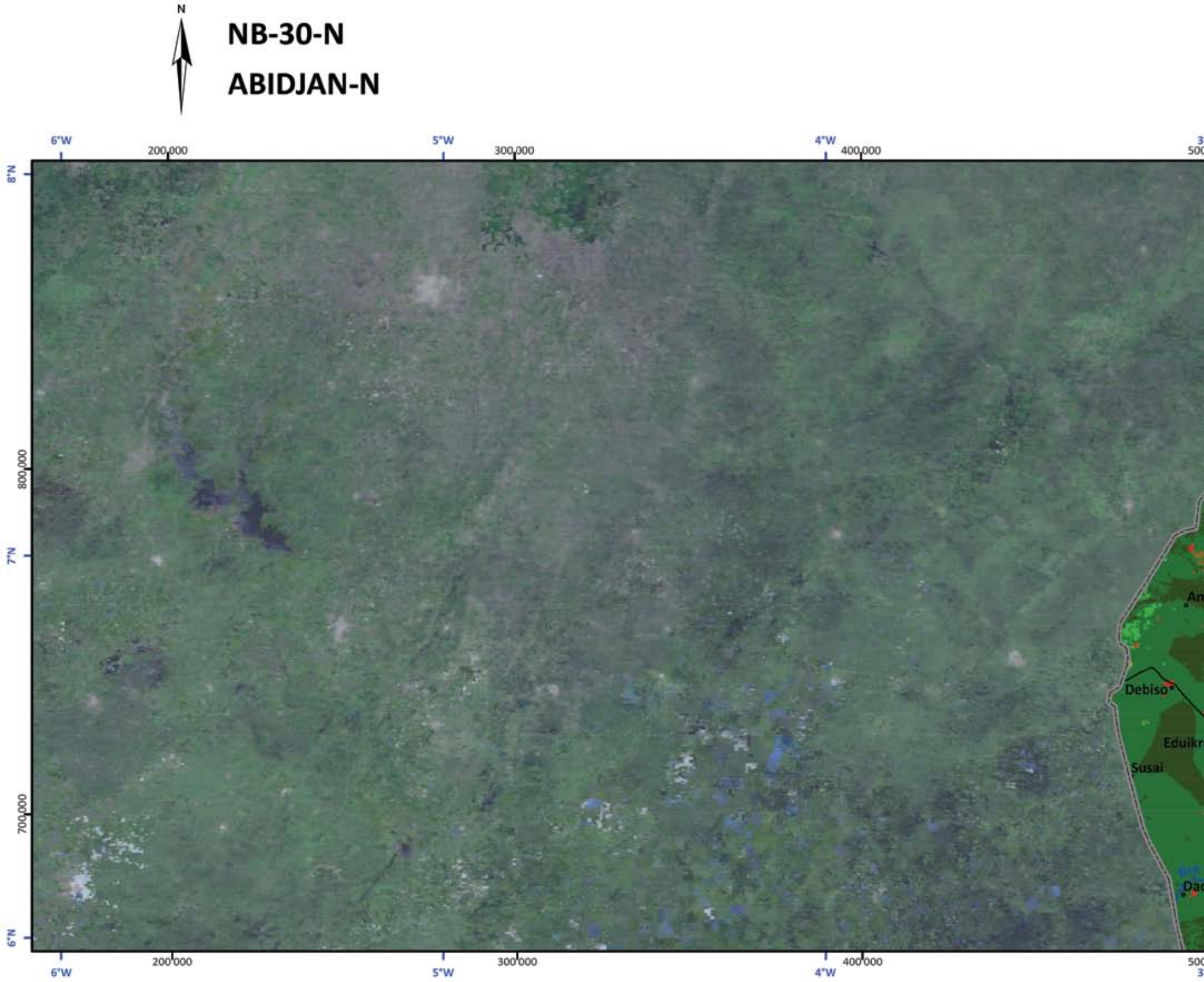
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NB-30-N

ABIDJAN-N



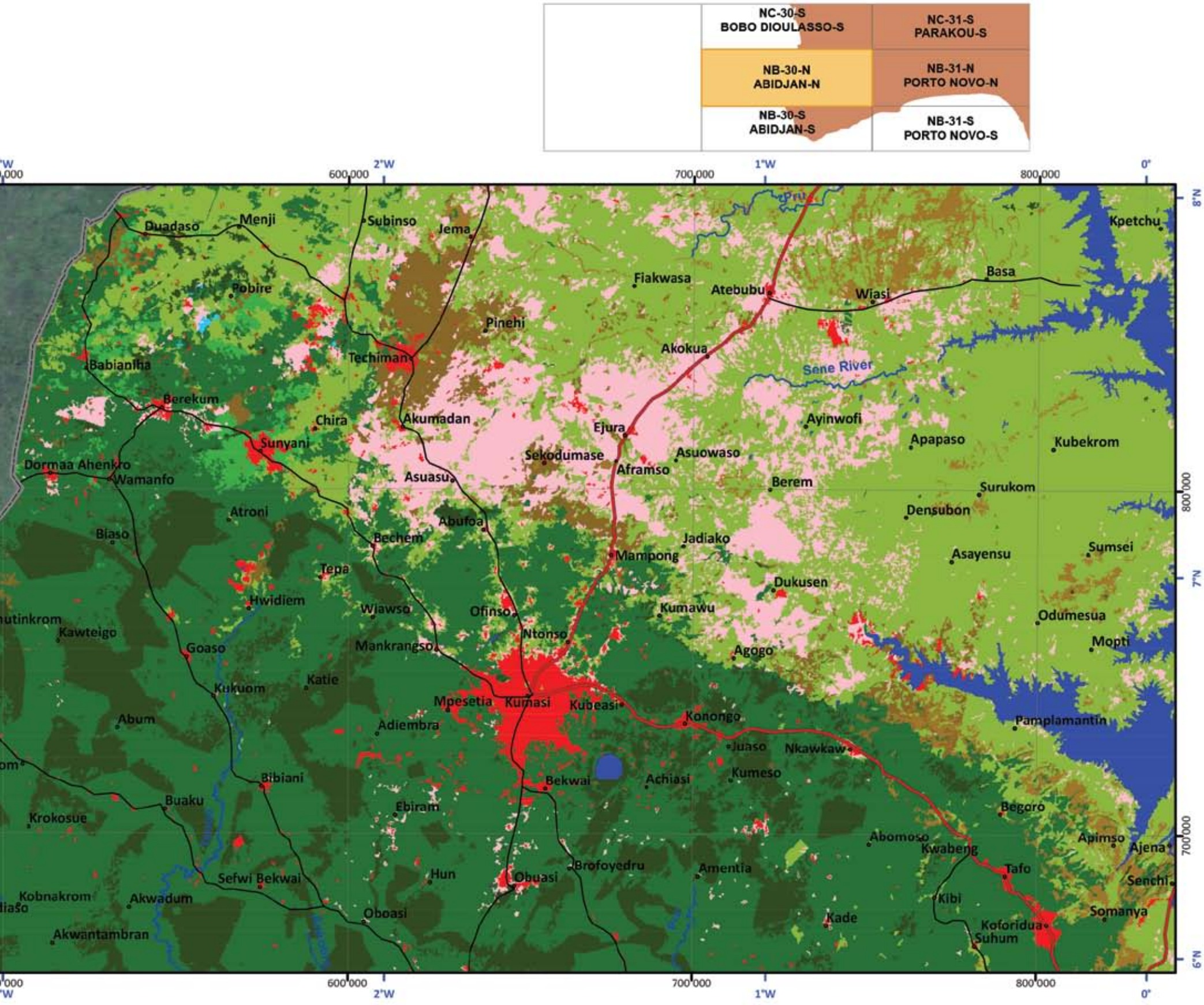
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 30).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain Aquatic vegetation

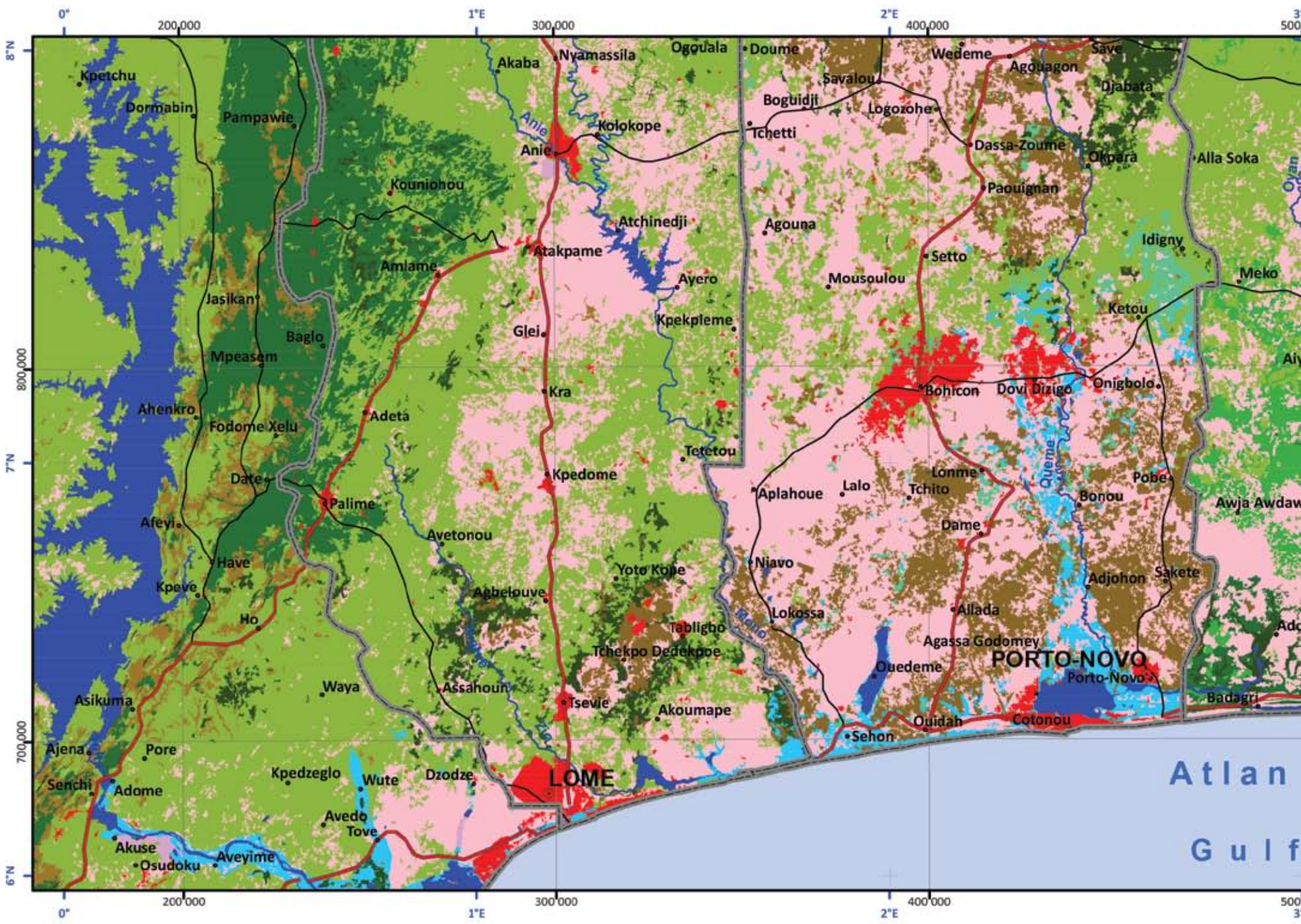
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NB-31-N

PORTO NOVO-N



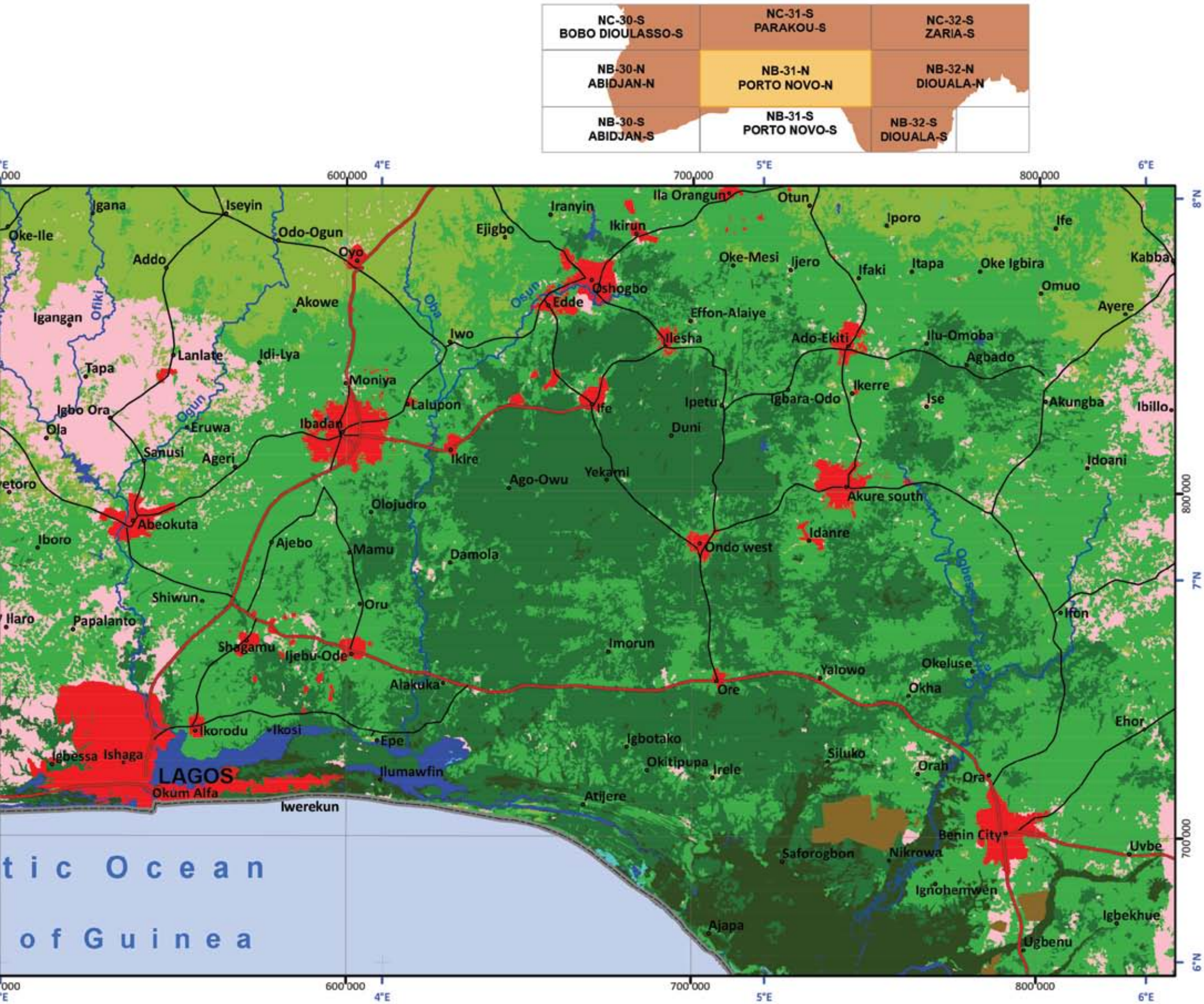
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 31).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

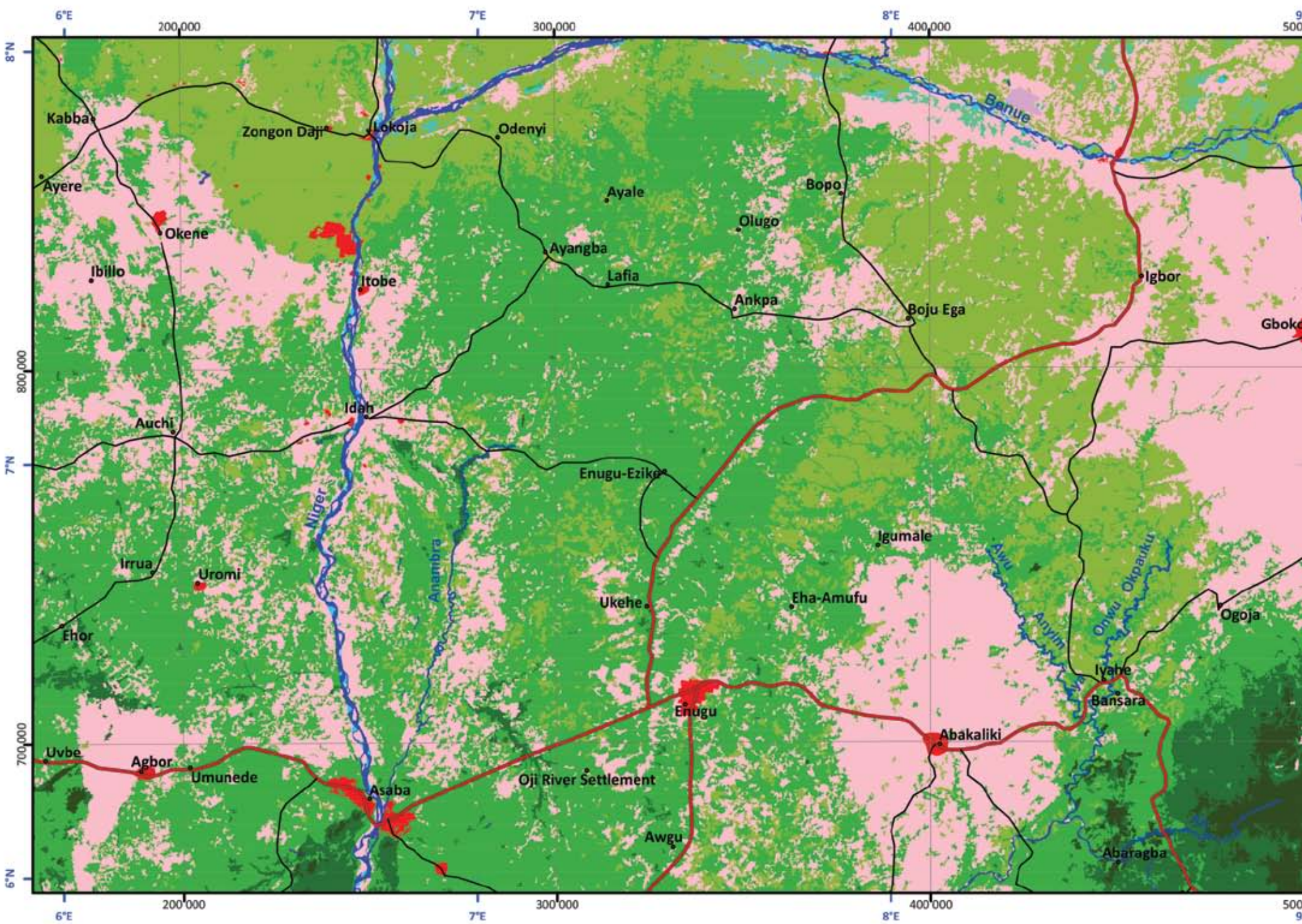
- Water body
- Floodplain
- Aquatic vegetation

Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NB-32-N
DIOUALA-N



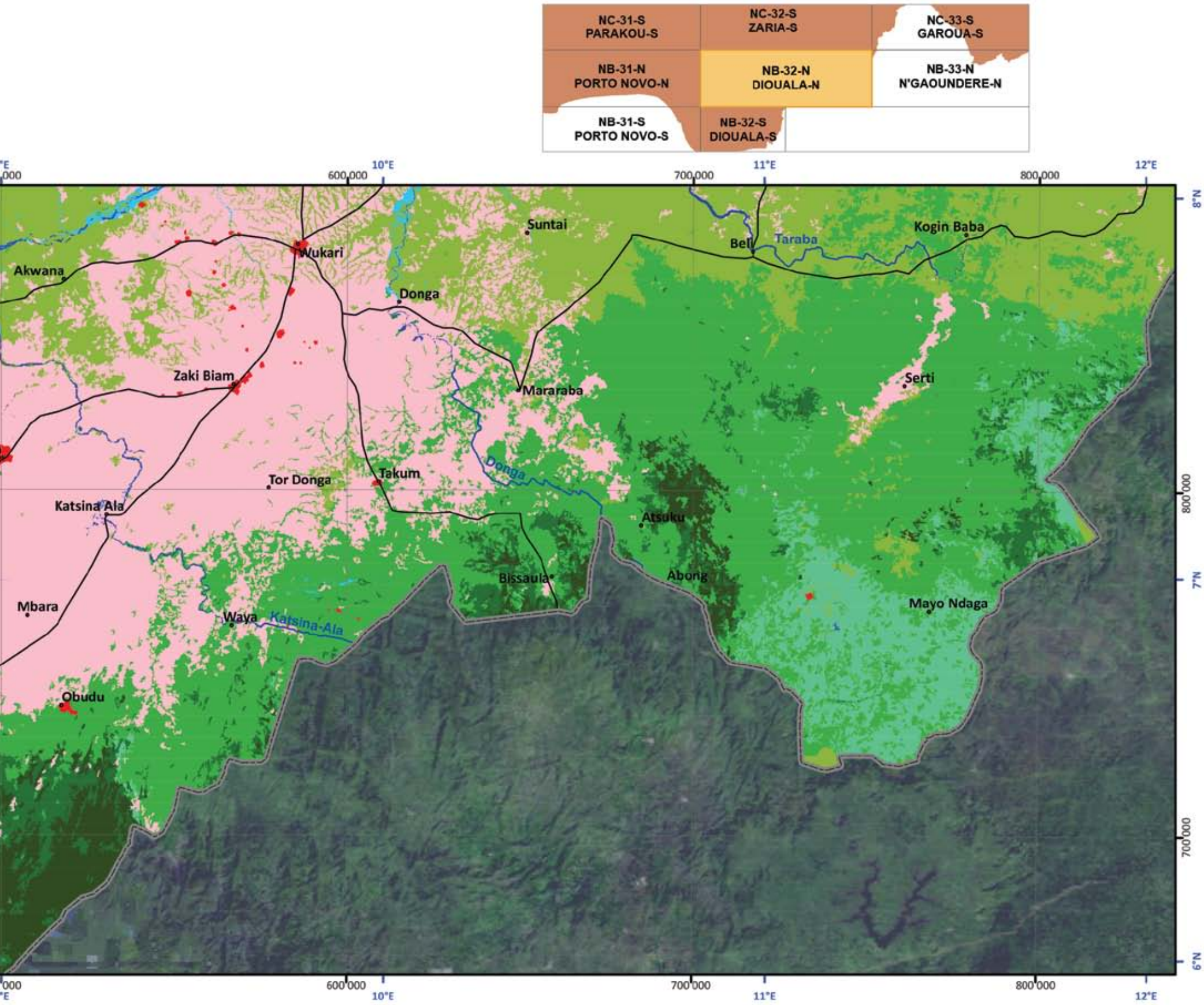
Scale 1: 1 250 000

Km
0 20 40 60 80 100

The map is in the World Geodetic System (WGS84) and UTM projection (zone 32).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NB-33-N

N'GAOUNDERE-N

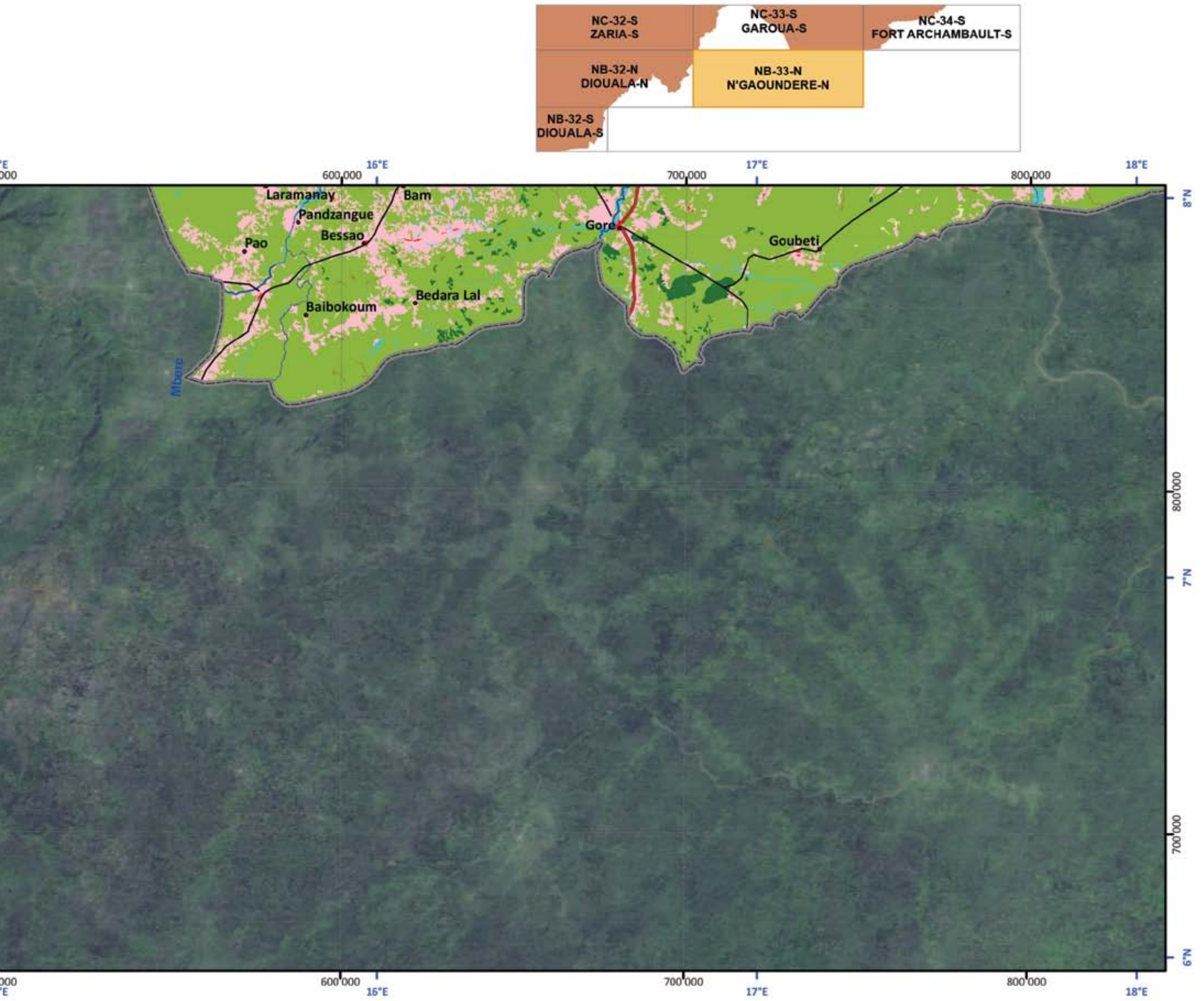
Scale 1: 1 250 000

Km
0 20 40 60 80 100

The map is in the World Geodetic System (WGS84) and UTM projection (zone 33).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

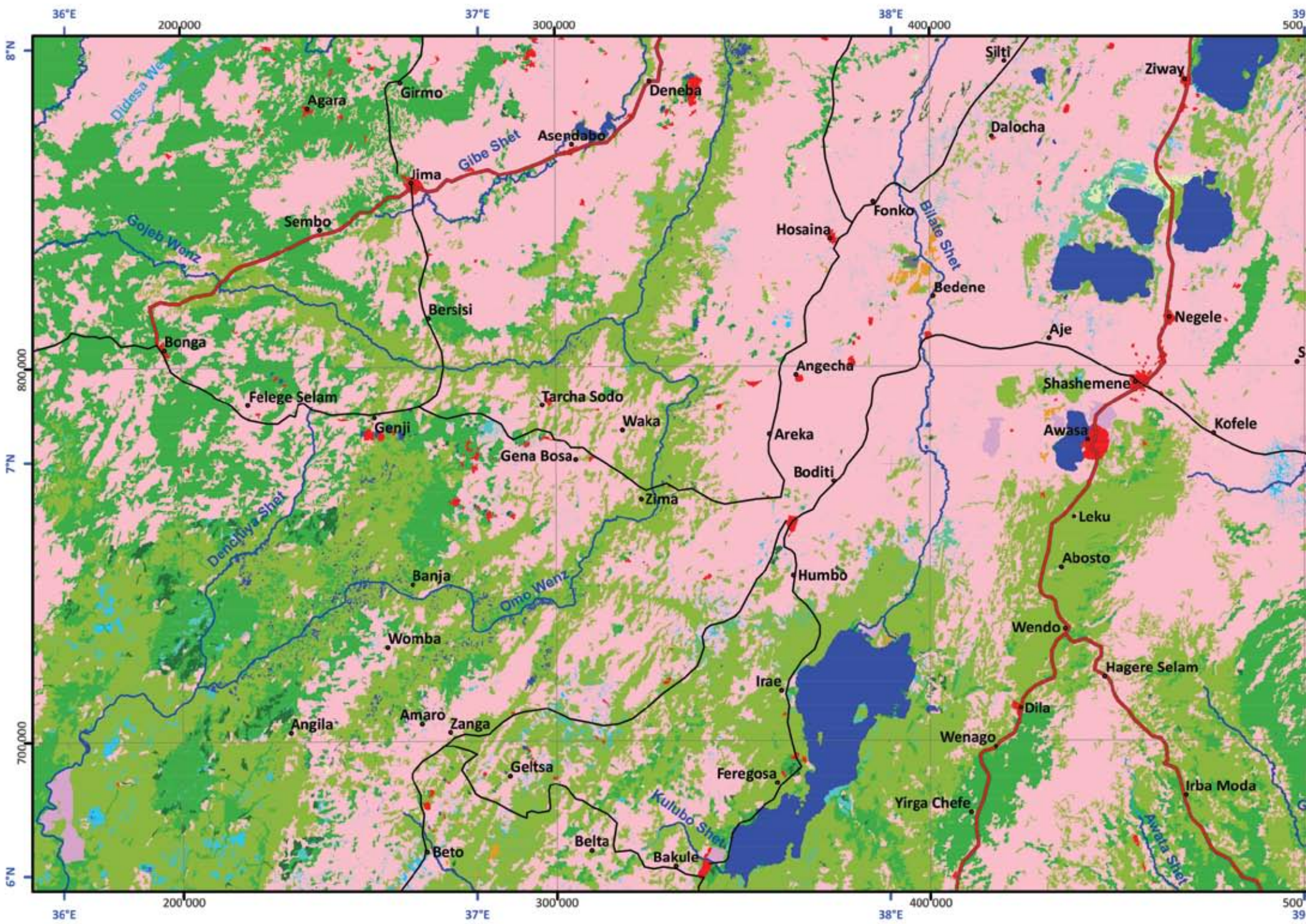
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NB-37-N

LAKE MARGHERITA-N



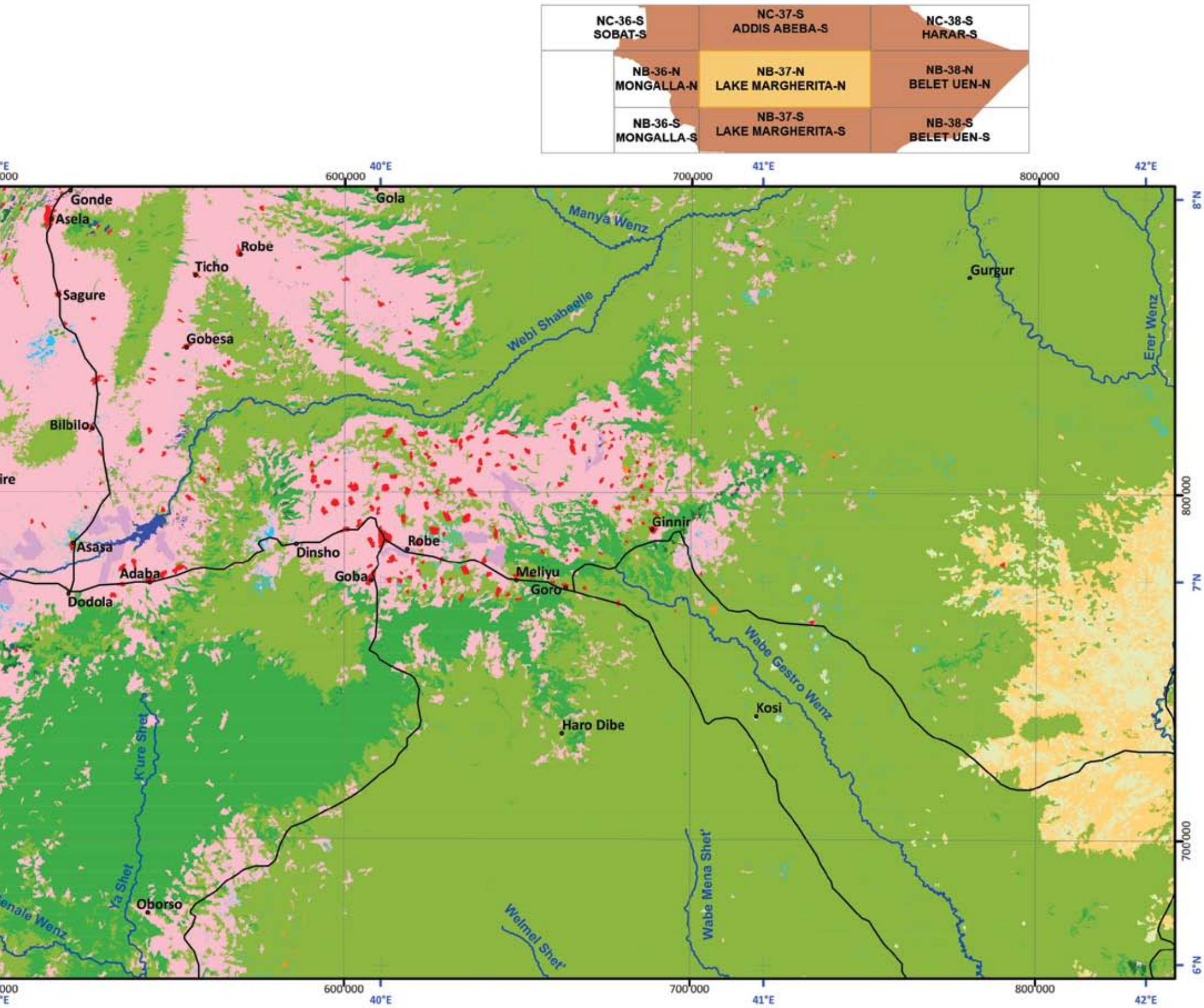
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 37).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

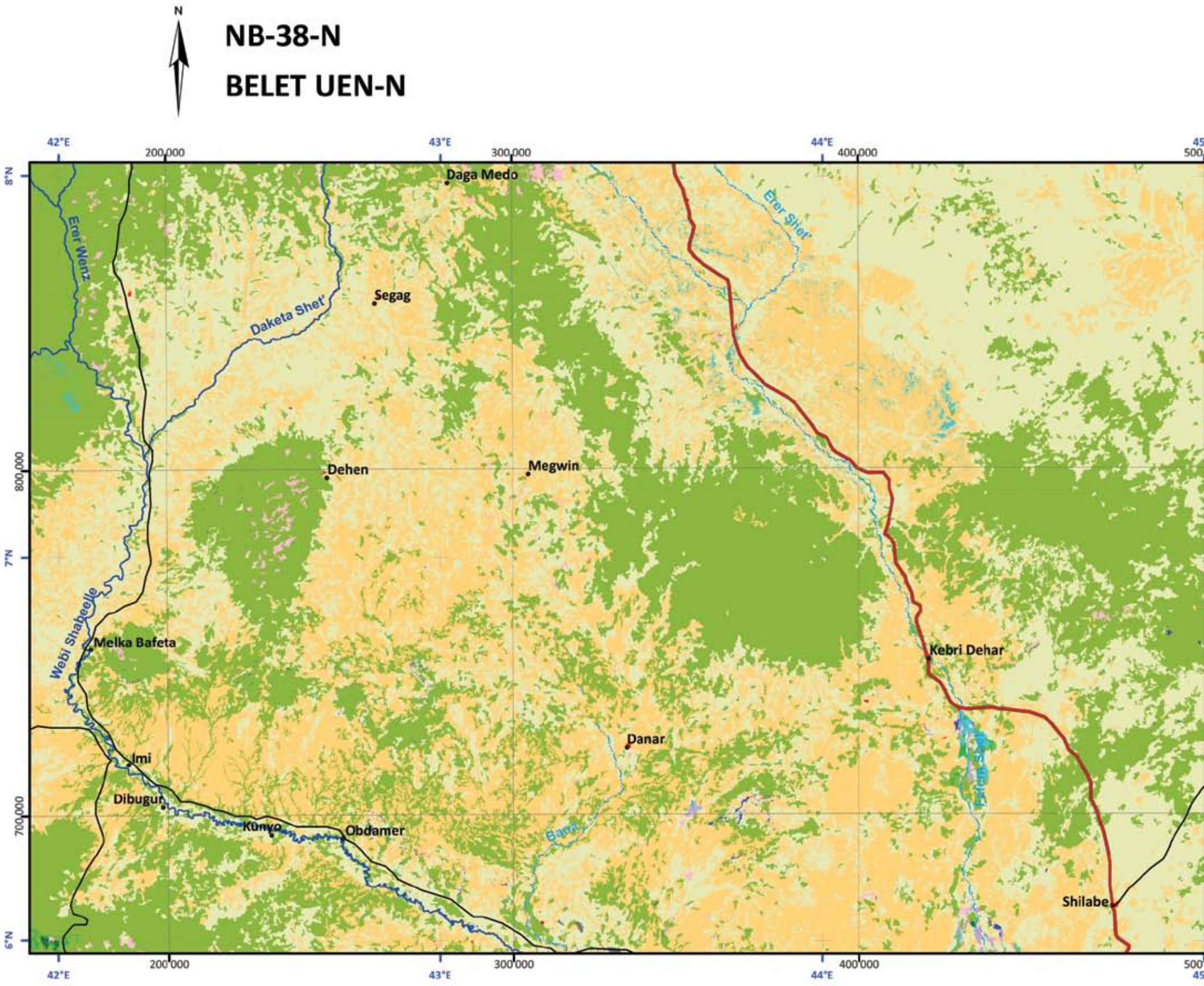
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NB-38-N

BELET UEN-N



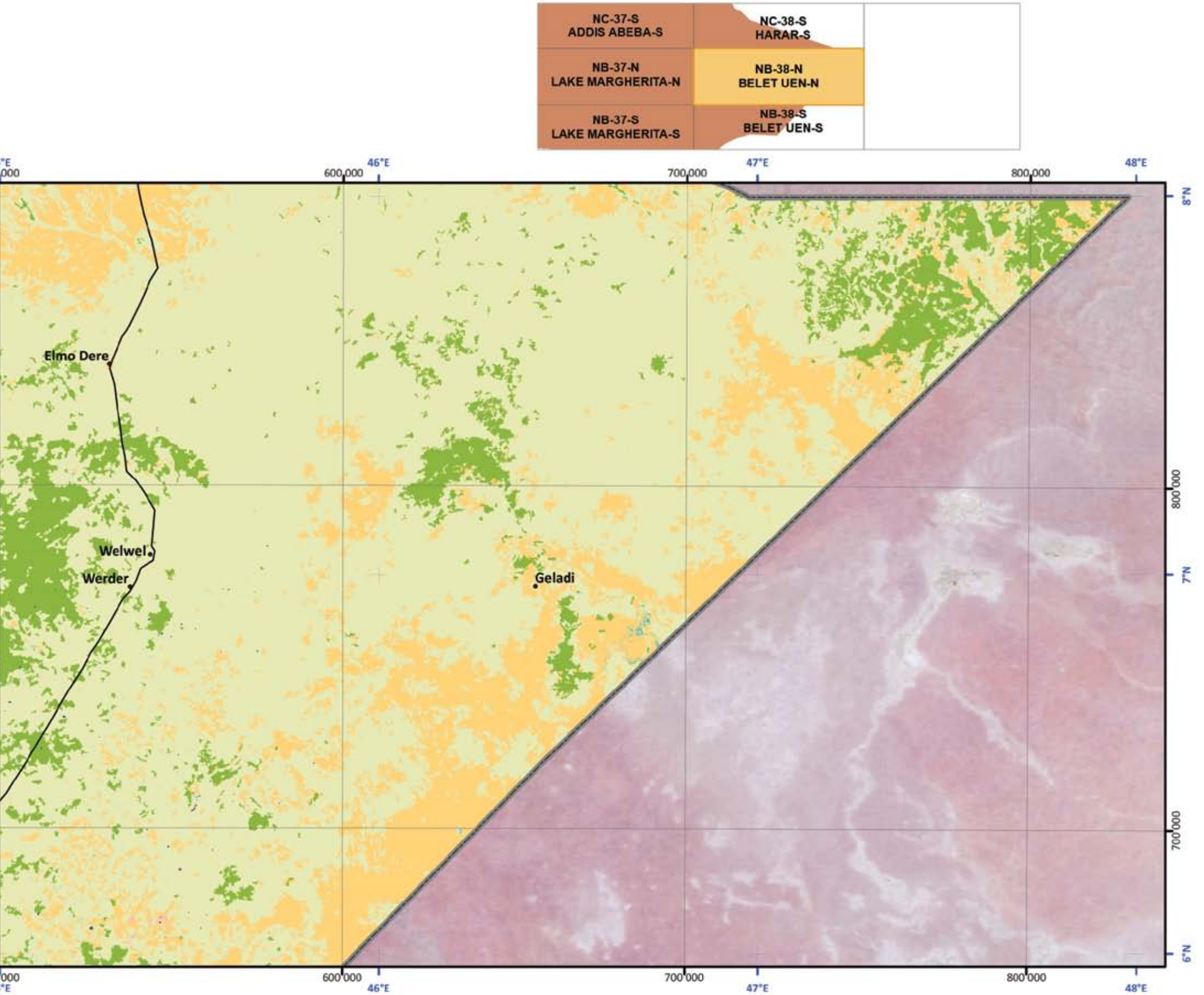
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 38).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

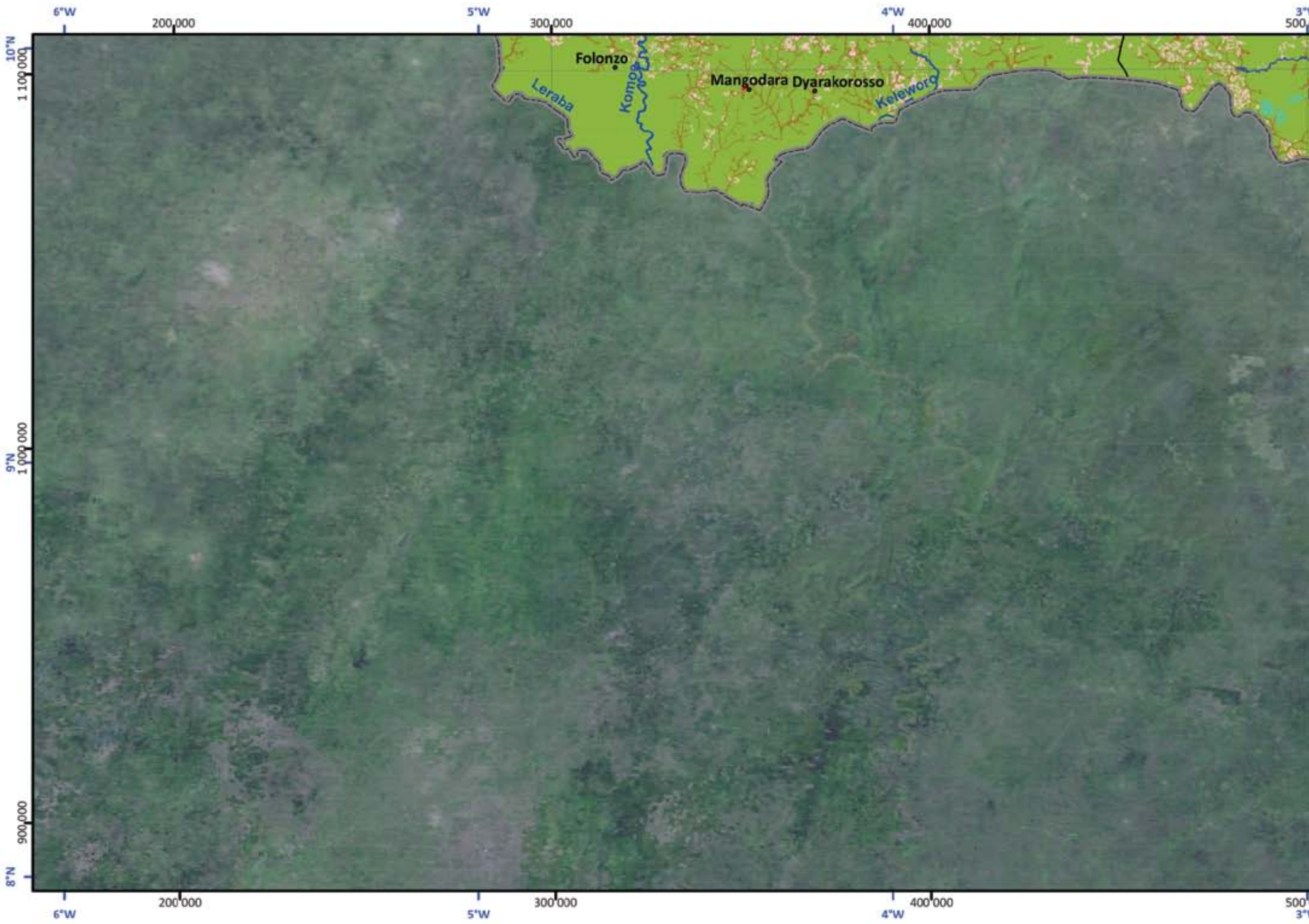
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NC-30-S

BOBO DIOULASSO-S



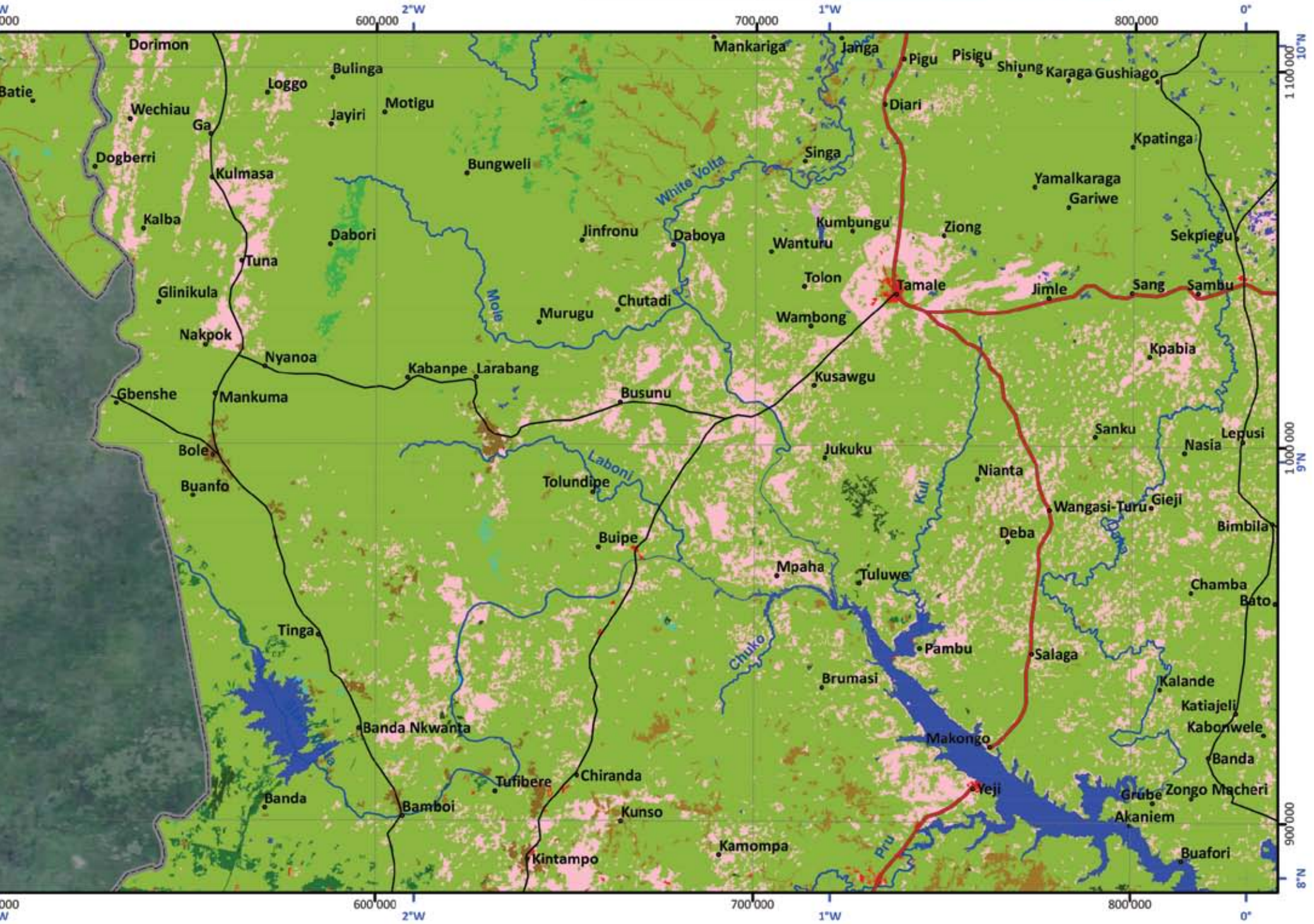
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 30).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

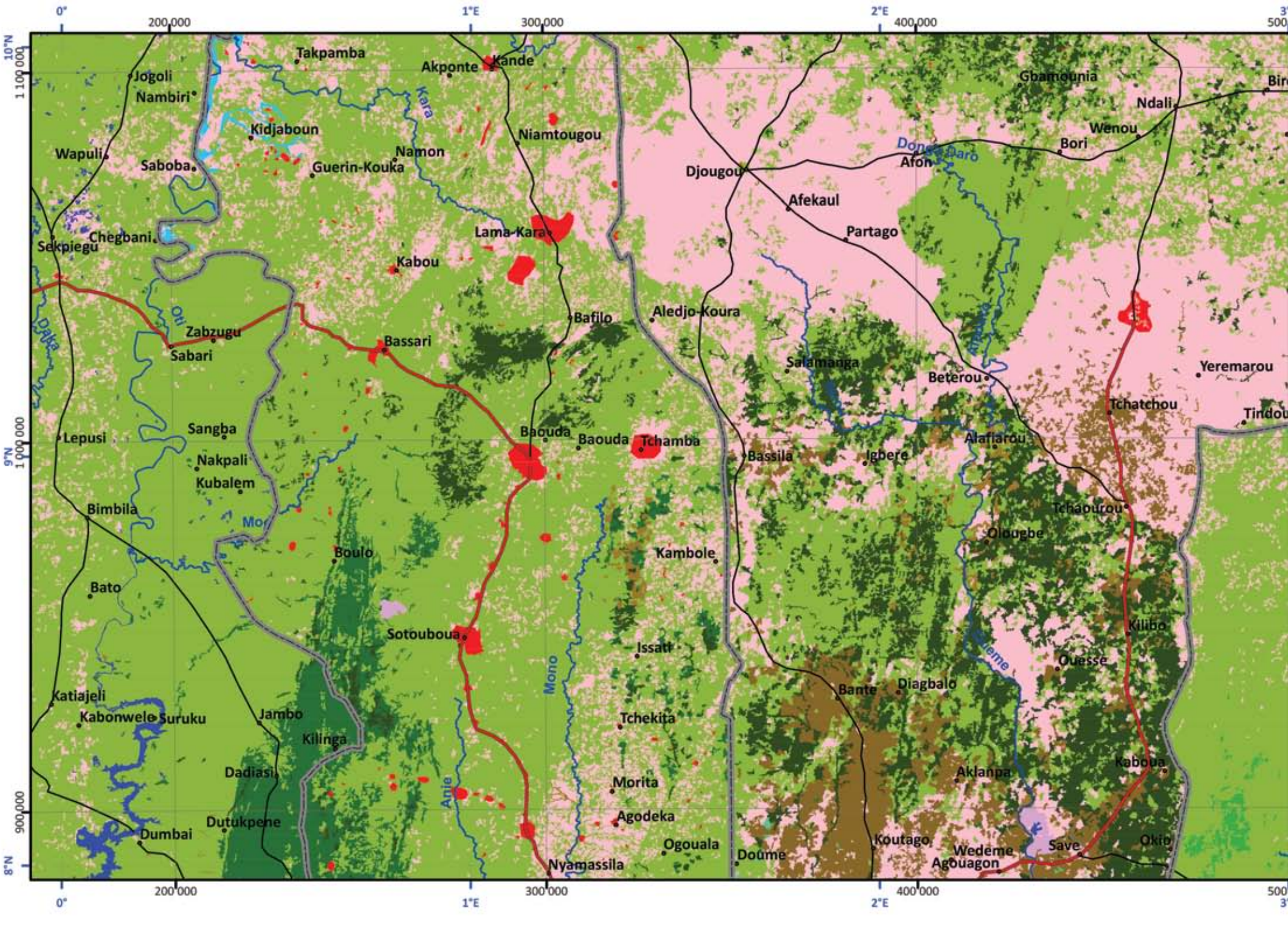
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NC-31-S

PARAKOU-S



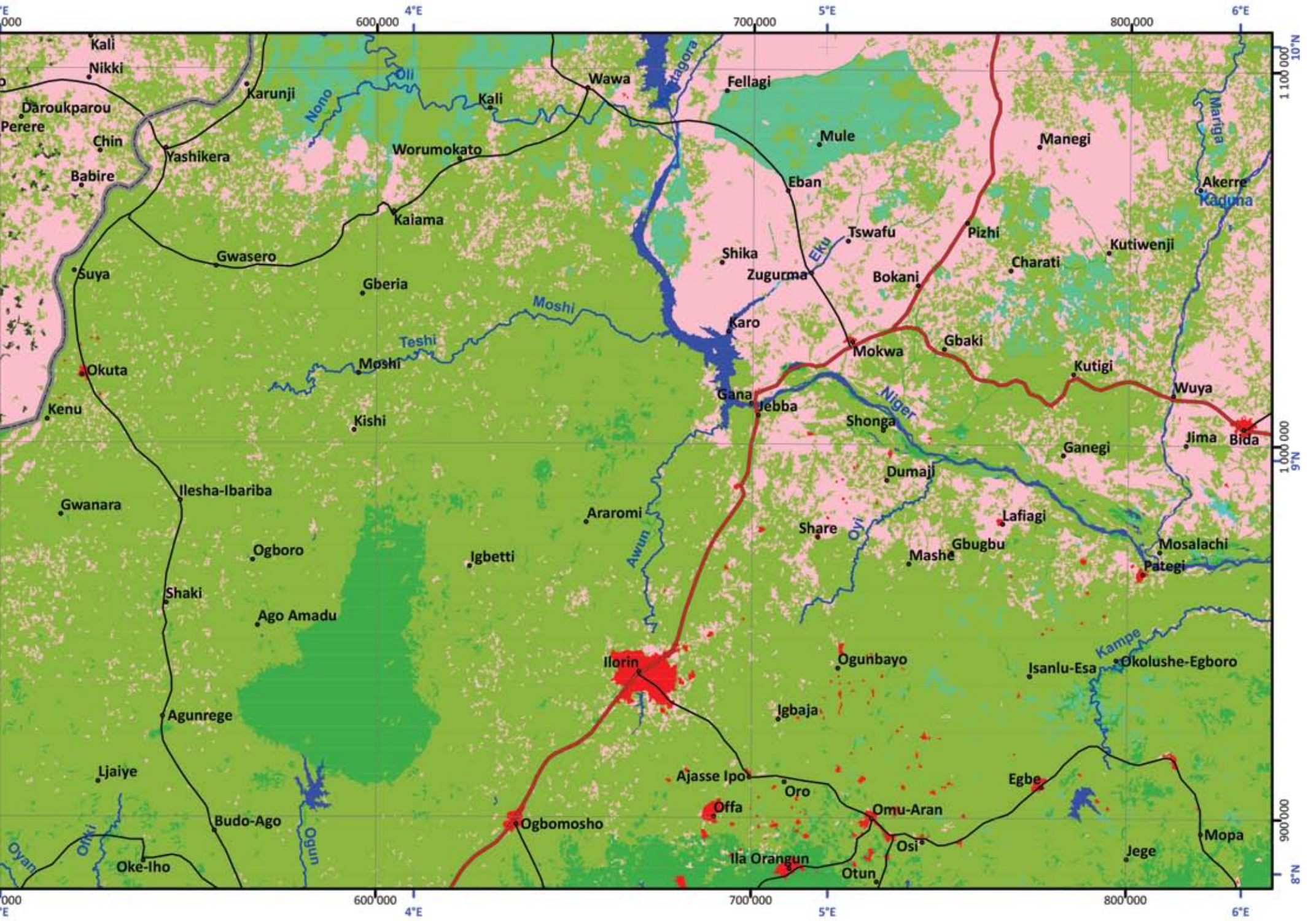
Scale 1: 1 250 000

The map is in the World Geodetic System (WGS84) and UTM projection (zone 31).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NC-30-N BOBO DIOULASSO-N	NC-31-N PARAKOU-N	NC-32-N ZARIA-N
NC-30-S BOBO DIOULASSO-S	NC-31-S PARAKOU-S	NC-32-S ZARIA-S
NB-30-N ABIDJAN-N	NB-31-N PORTO NOVO-N	NB-32-N DIOUALA-N



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

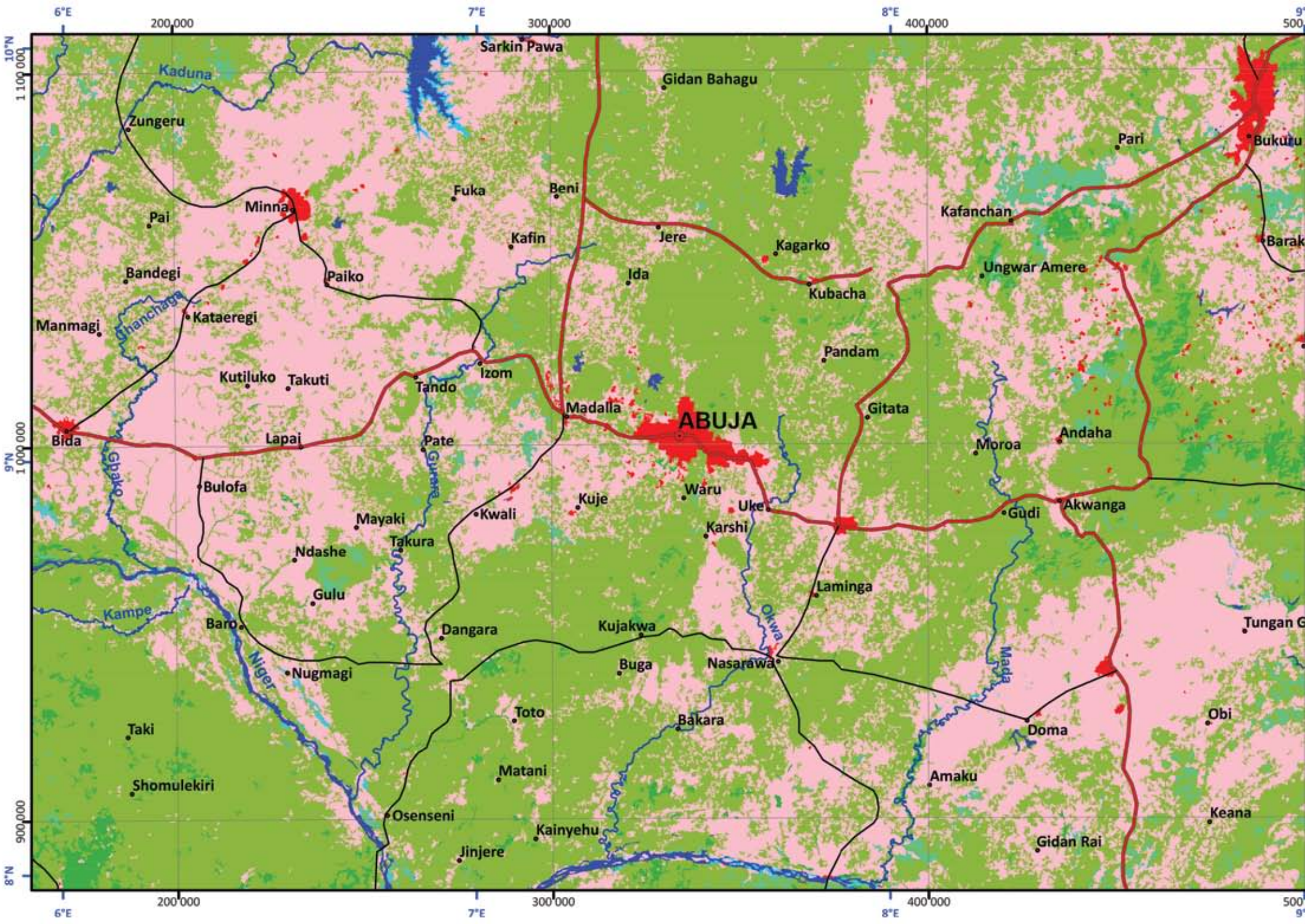
- Water body
- Floodplain
- Aquatic vegetation

Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NC-32-S
ZARIA-S



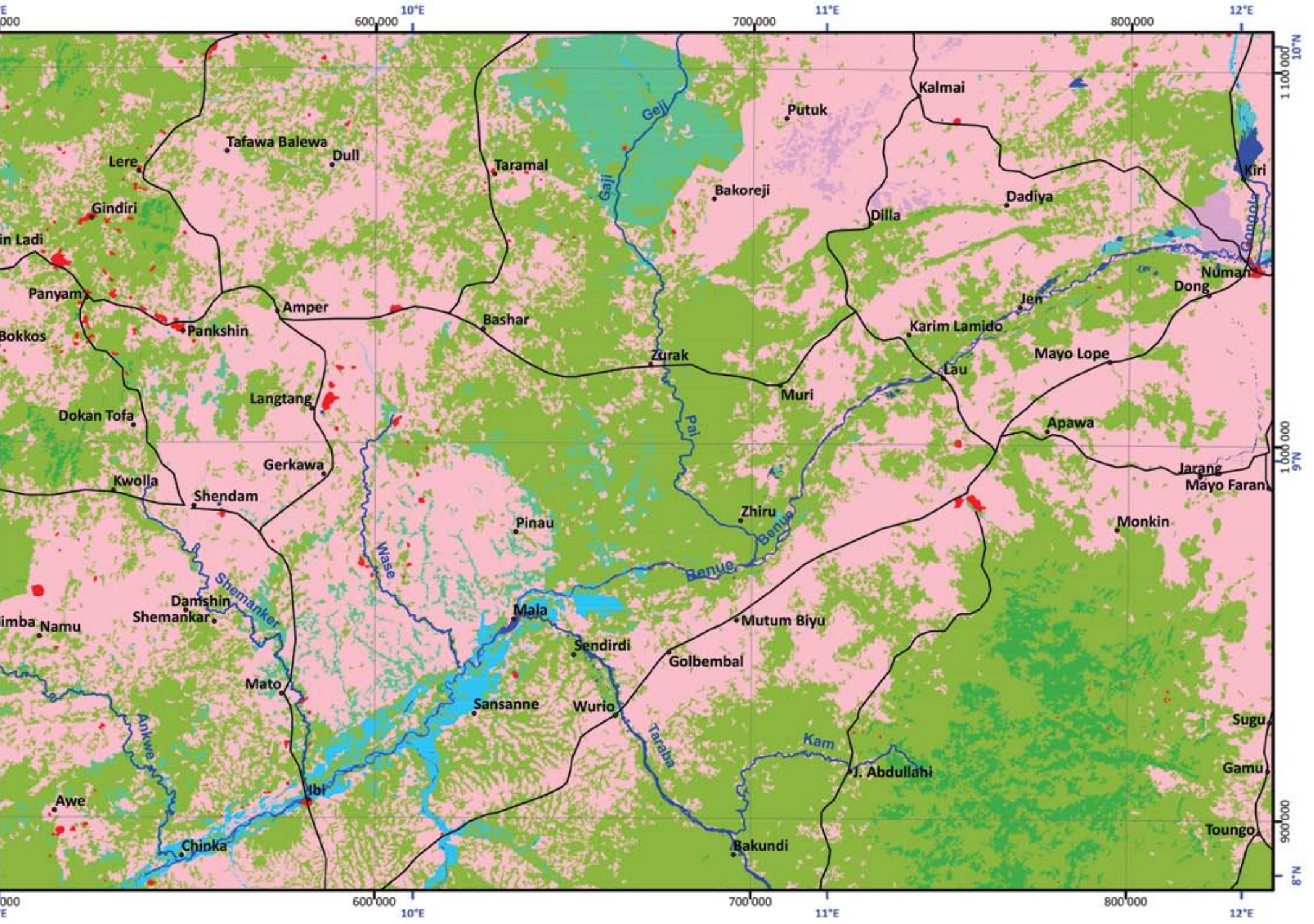
Scale 1: 1 250 000

The map is in the World Geodetic System (WGS84) and UTM projection (zone 32).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NC-31-N PARAKOU-N	NC-32-N ZARIA-N	NC-33-N GAROUA-N
NC-31-S PARAKOU-S	NC-32-S ZARIA-S	NC-33-S GAROUA-S
NB-31-N PORTO NOVO-N	NB-32-N DIOUALA-N	NB-33-N N'GAOUNDERE-N



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

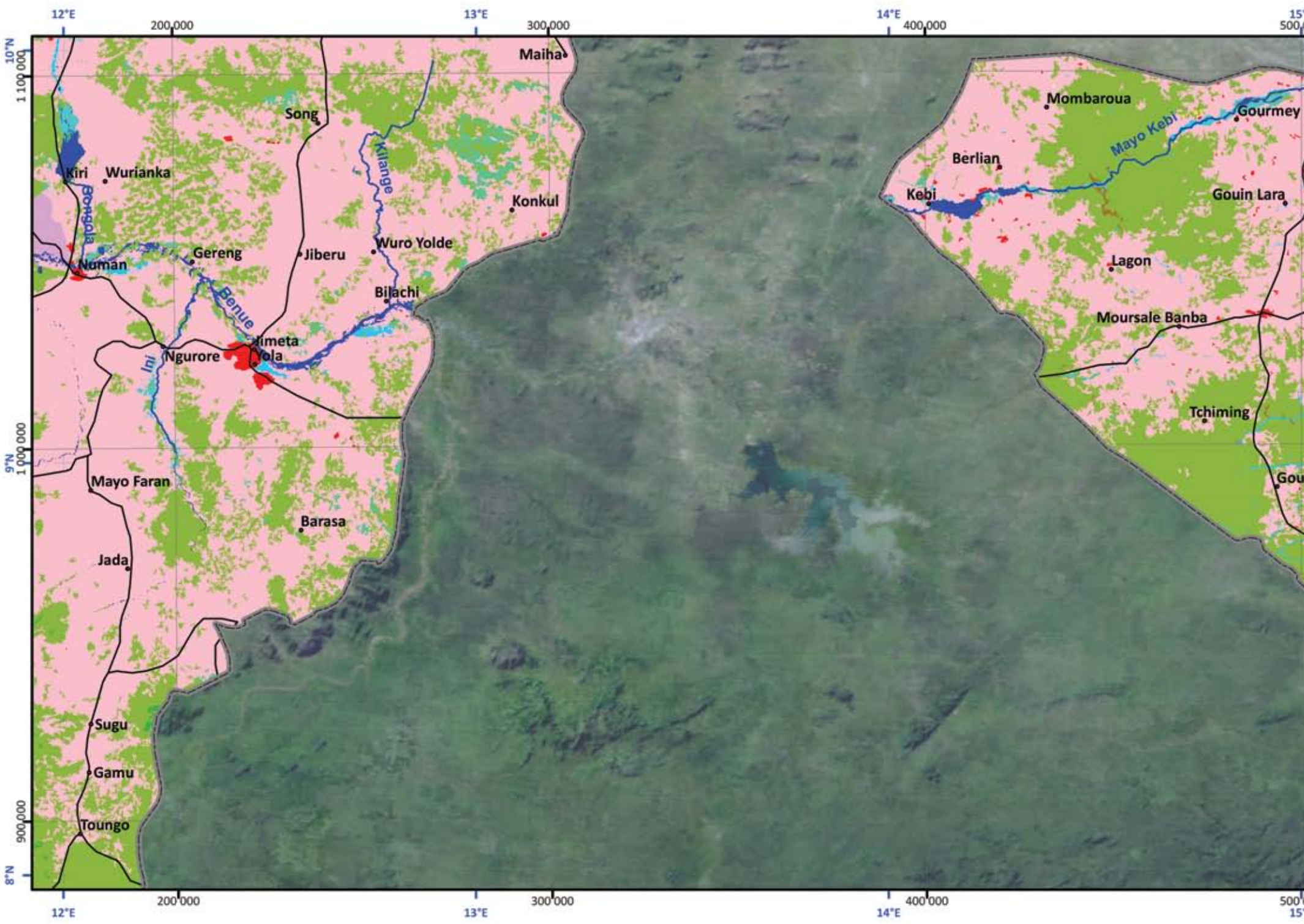
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NC-33-S

GAROUA-S



Scale 1: 1 250 000

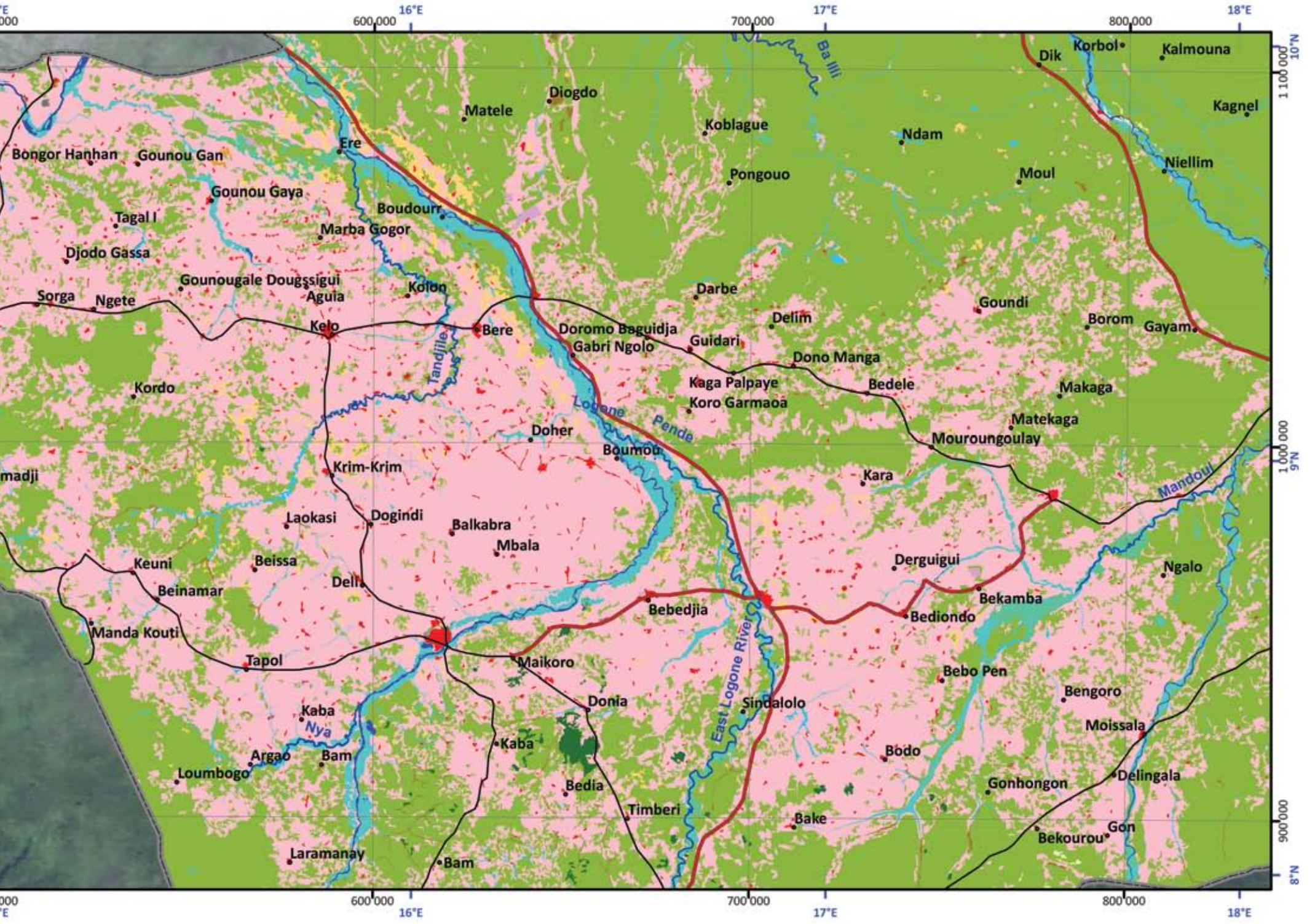
Km
0 20 40 60 80 100

The map is in the World Geodetic System (WGS84) and UTM projection (zone 33).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NC-32-N ZARIA-N	NC-33-N GAROUA-N	NC-34-N FORT ARCHAMBAULT-N
NC-32-S ZARIA-S	NC-33-S GAROUA-S	NC-34-S FORT ARCHAMBAULT-S
NB-32-N DIOUALA-N	NB-33-N N'GAOUNDERE-N	



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

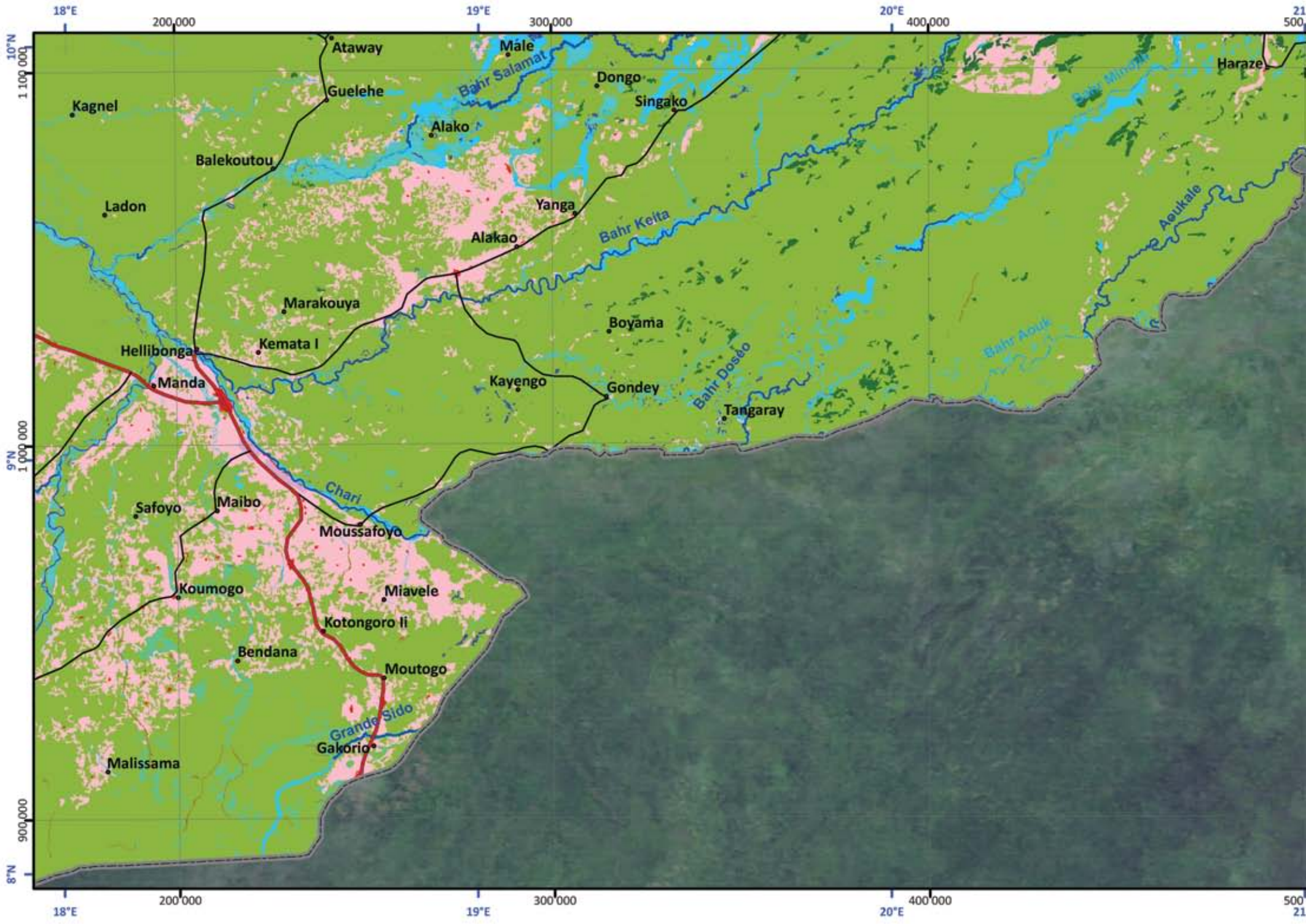
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NC-34-S

FORT ARCHAMBAULT-S



Scale 1: 1 250 000

Km
0 20 40 60 80 100

The map is in the World Geodetic System (WGS84) and UTM projection (zone 34).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

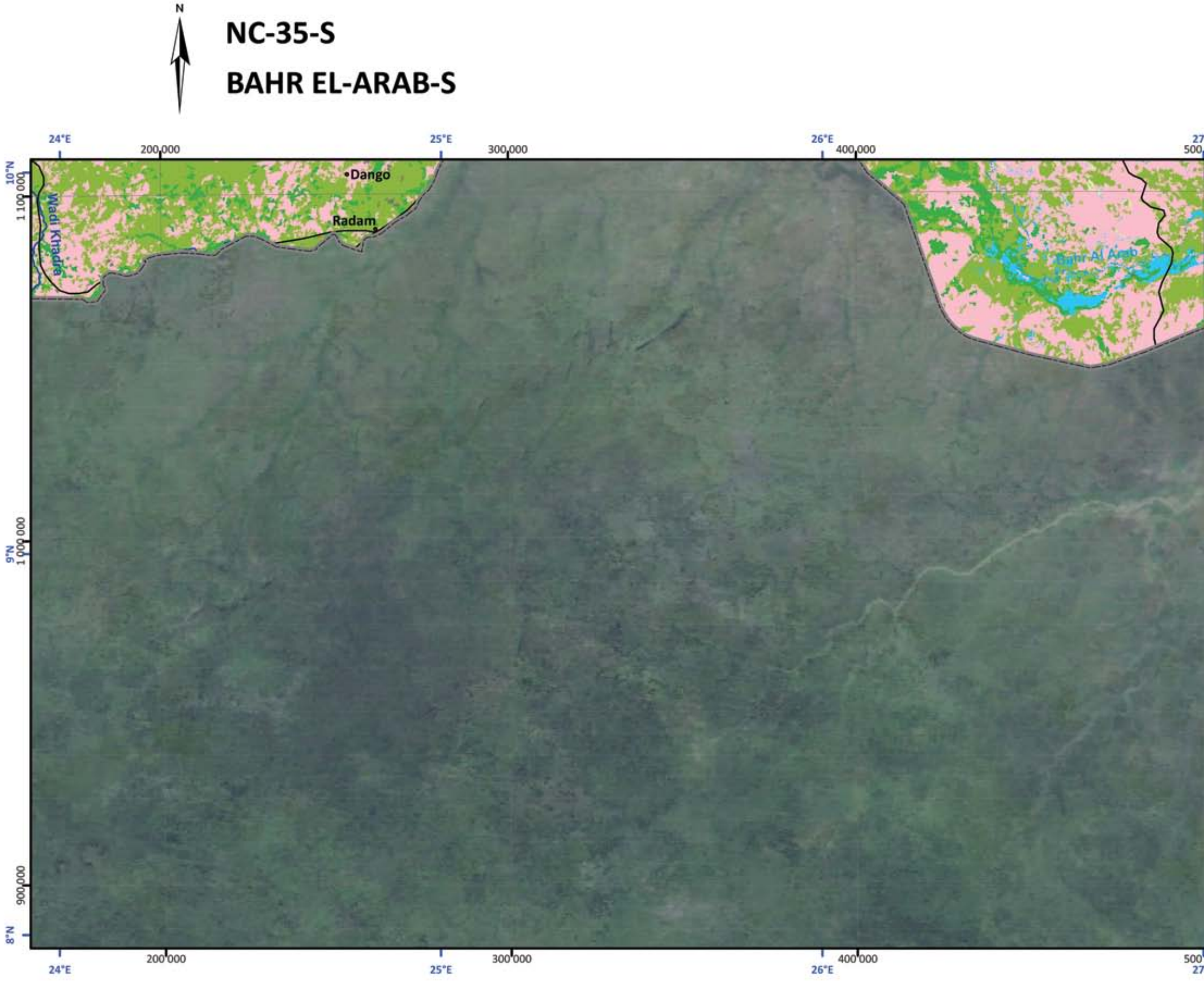
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NC-35-S

BAHR EL-ARAB-S



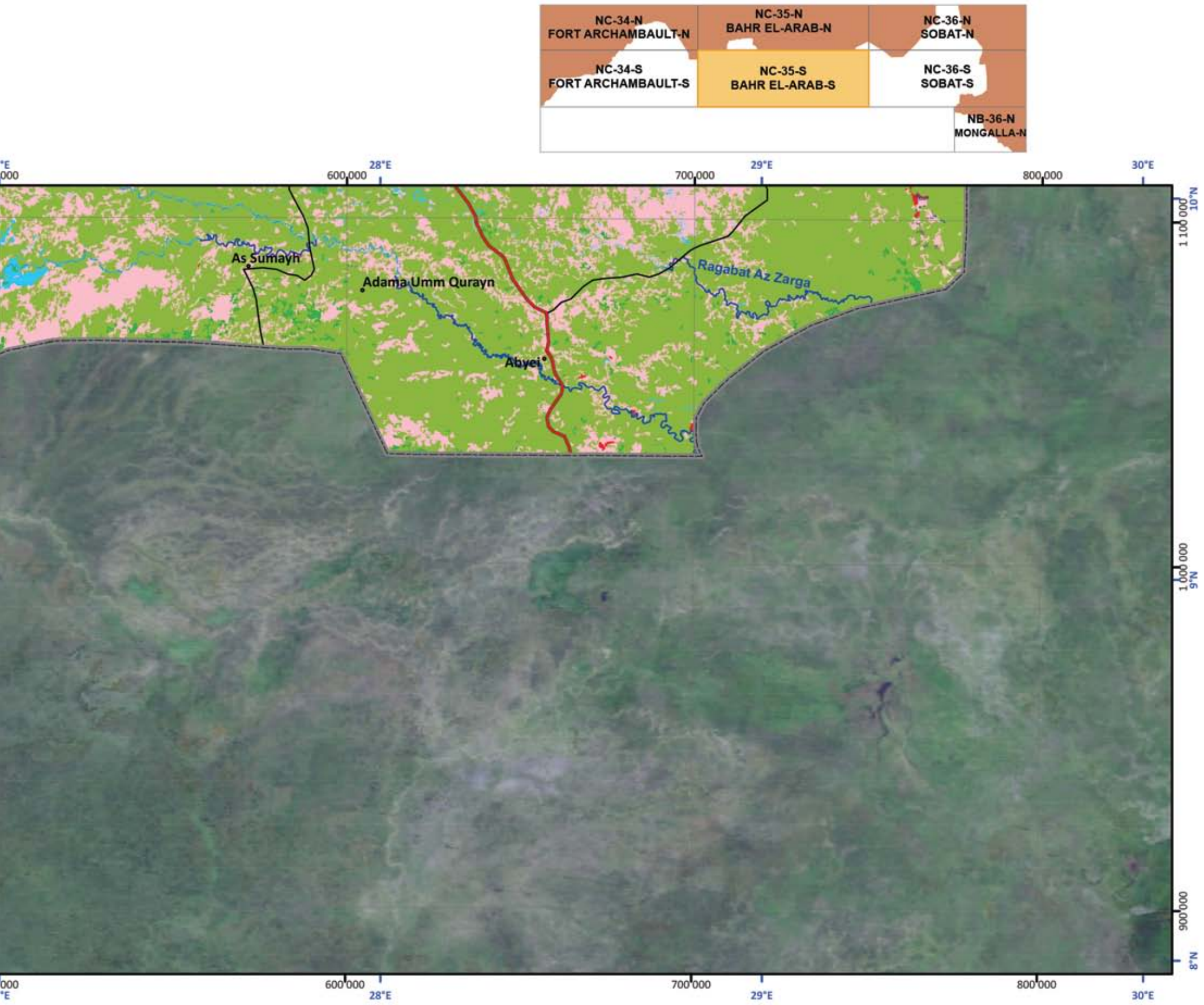
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 35).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

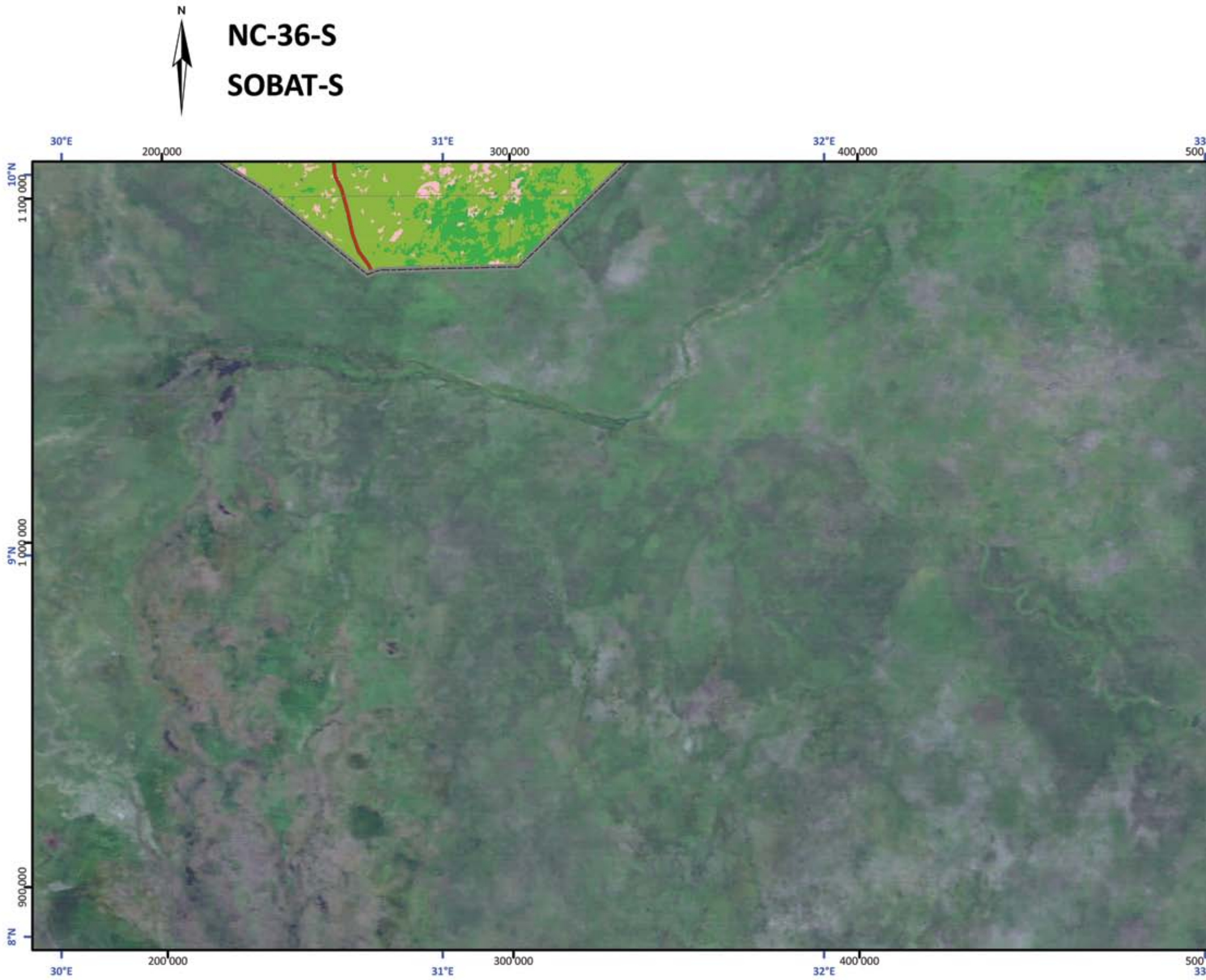
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NC-36-S

SOBAT-S



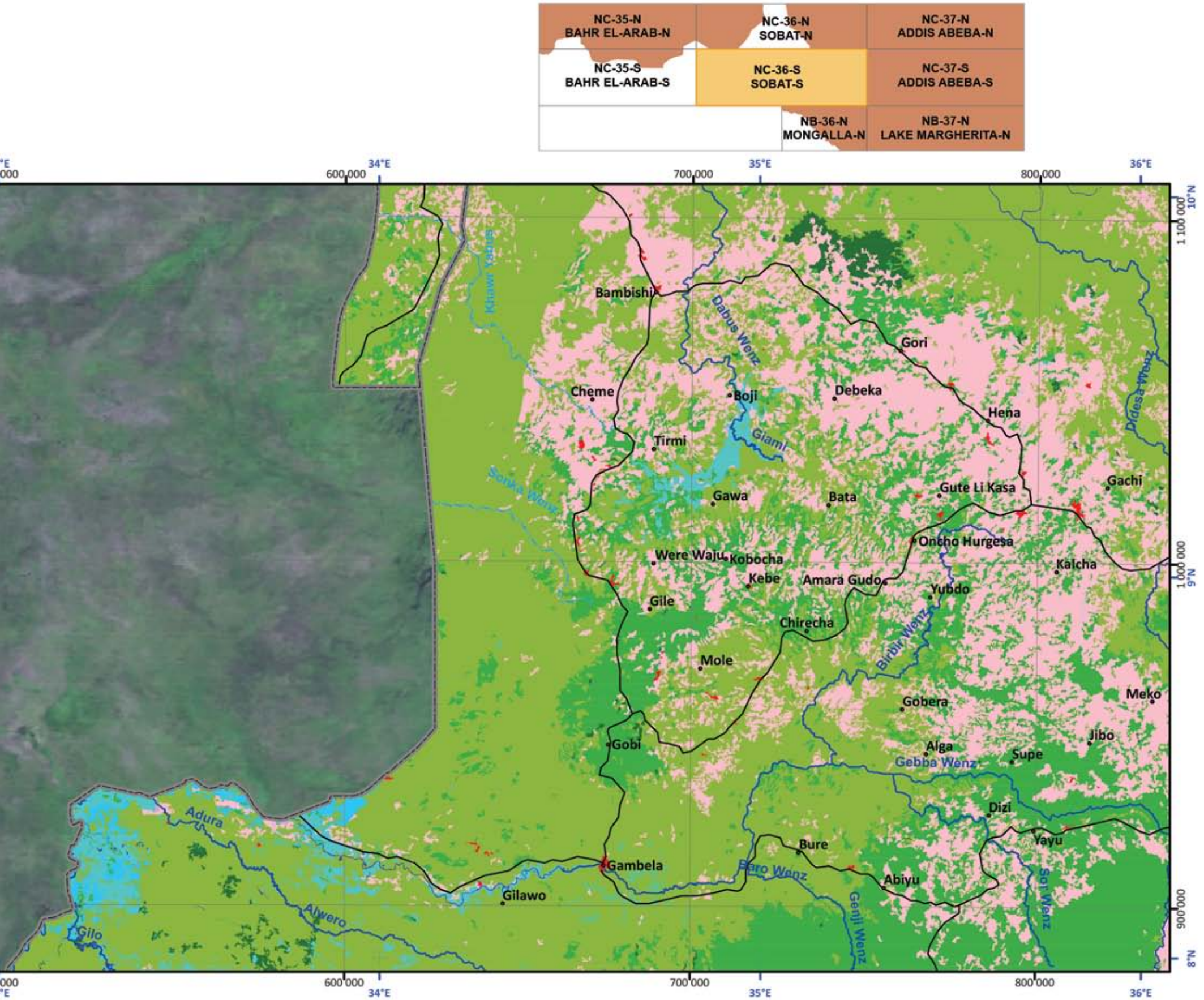
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 36).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

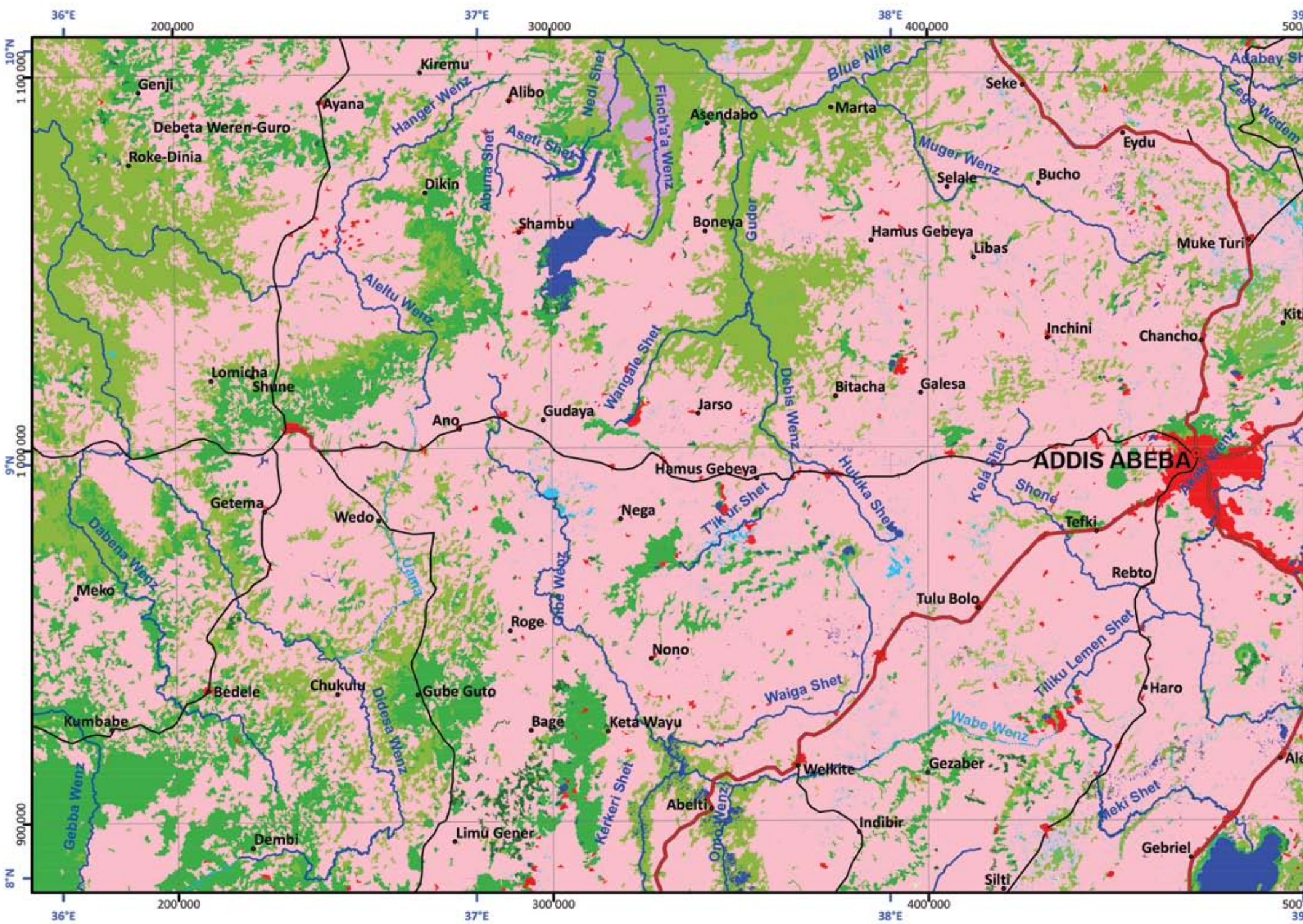
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NC-37-S

ADDIS ABEBA-S



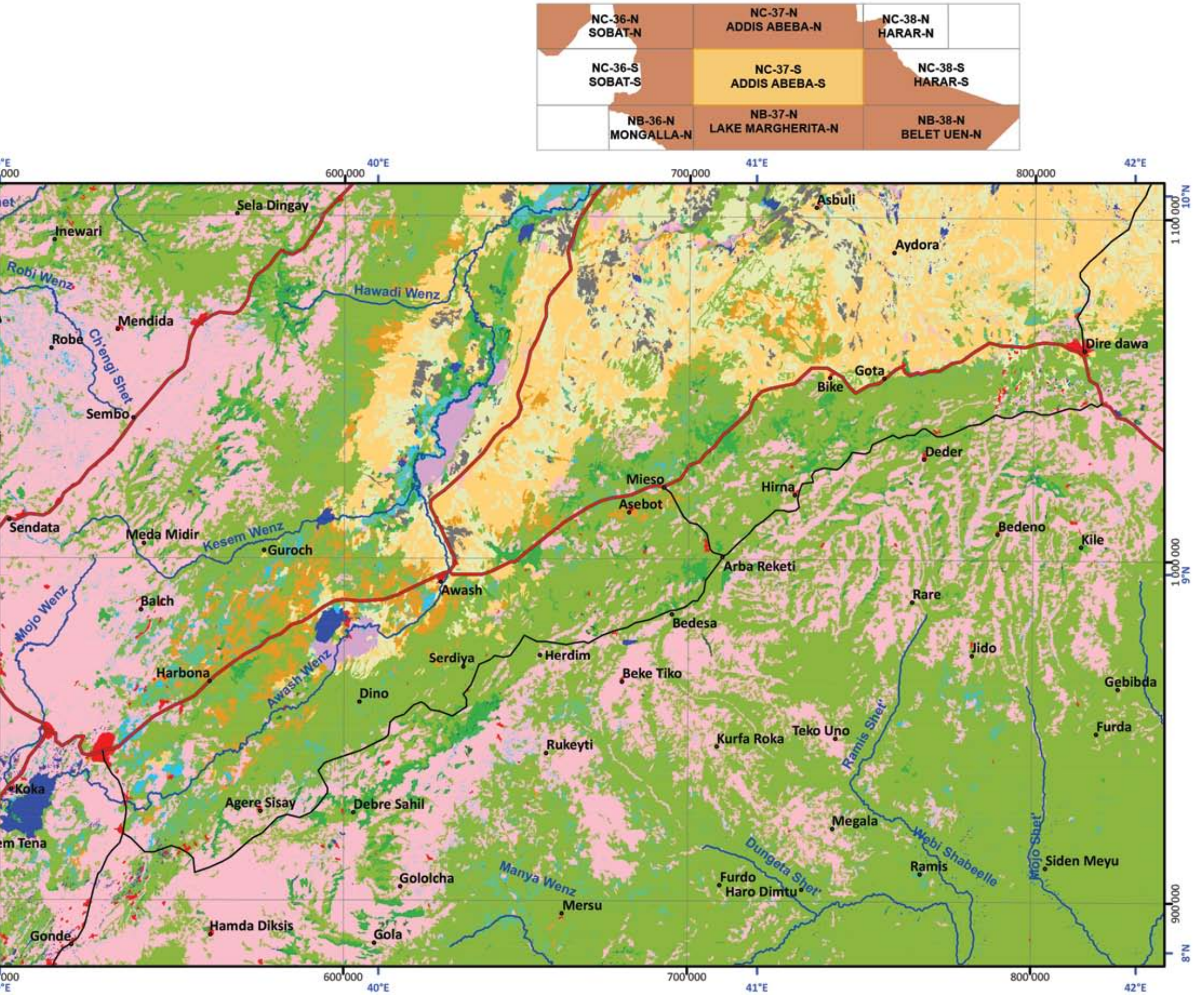
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 37).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

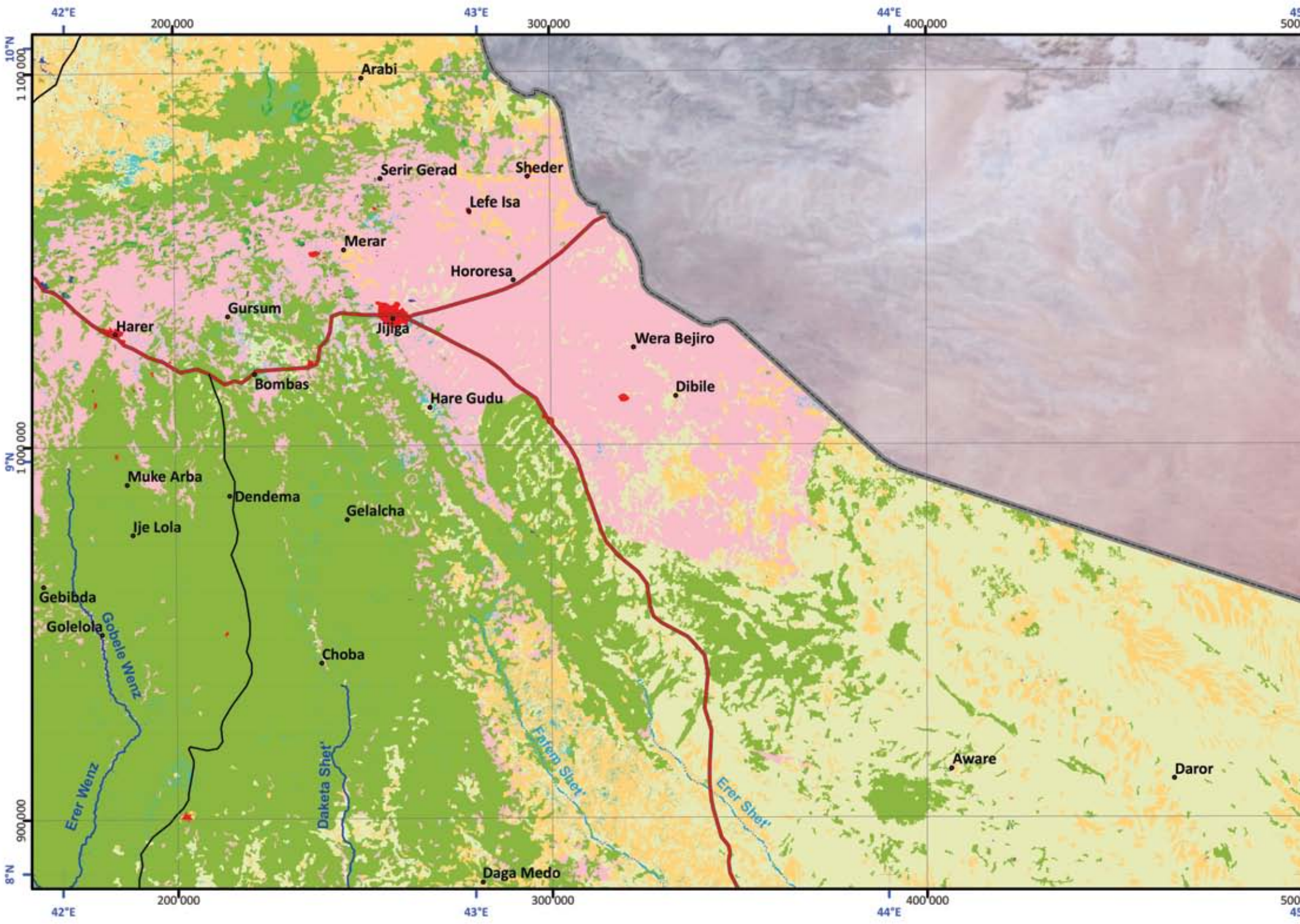
- Water body
- Floodplain
- Aquatic vegetation

Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NC-38-S
HARAR-S



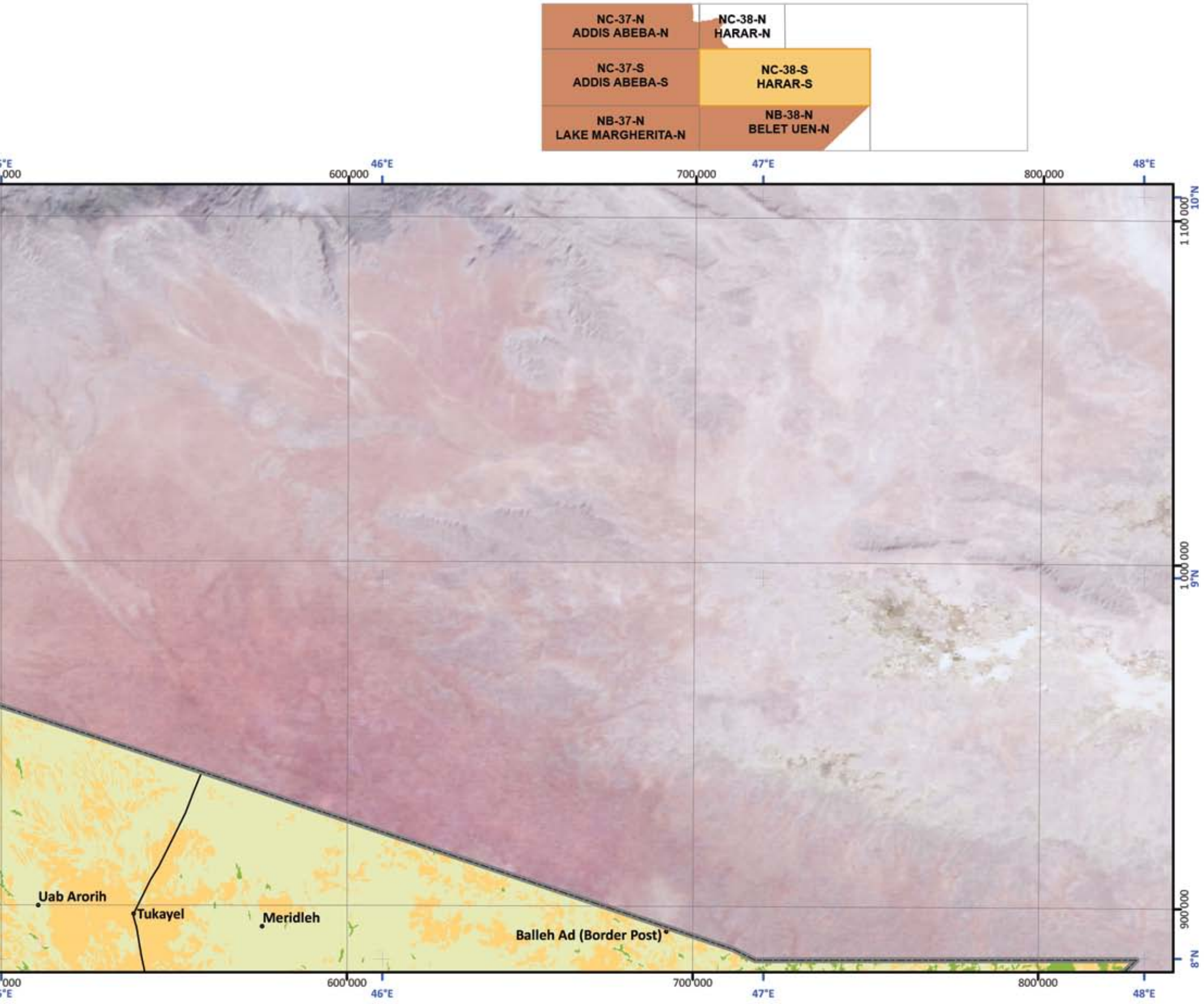
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 38).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

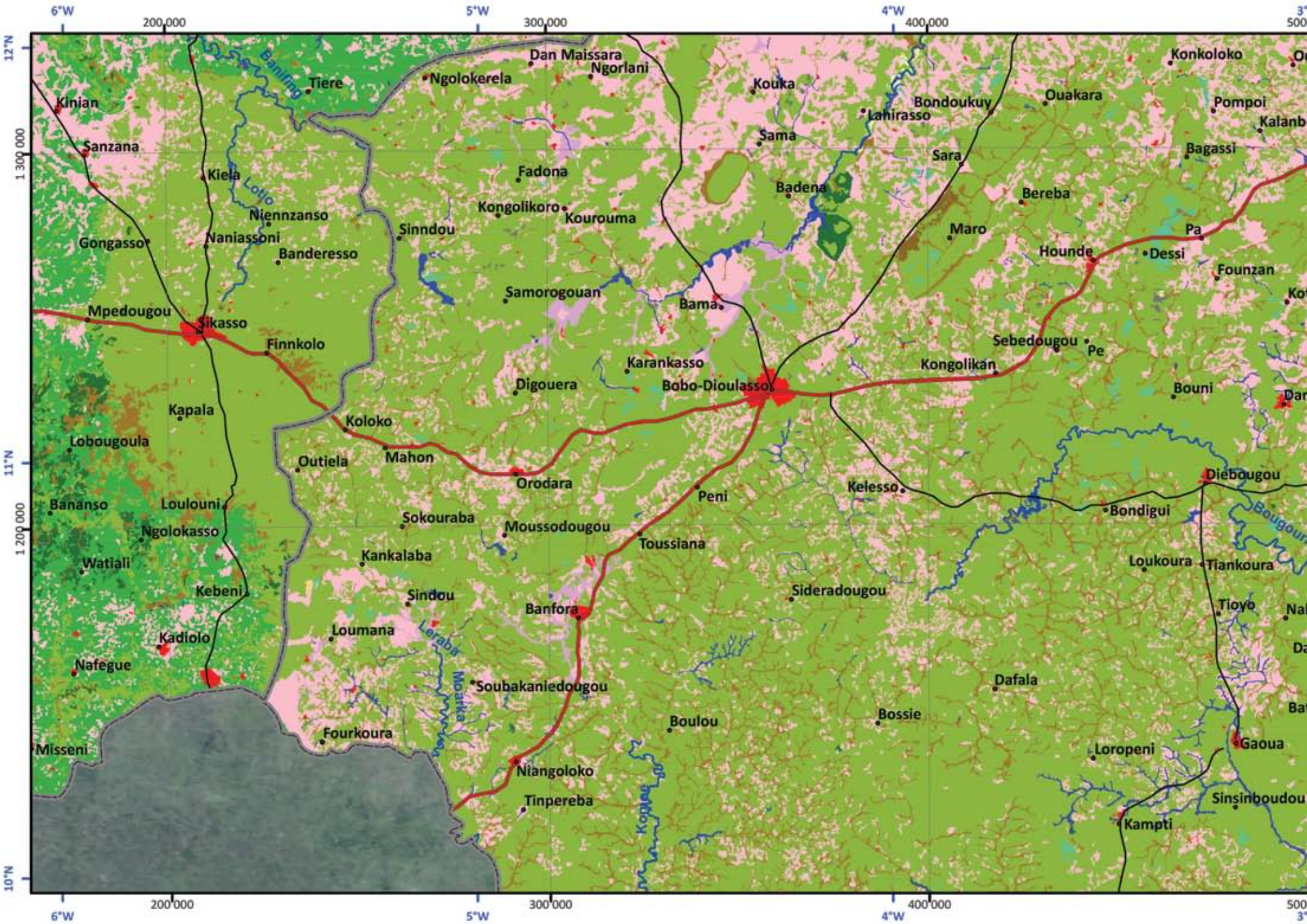
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NC-30-N

BOBO DIOULASSO-N



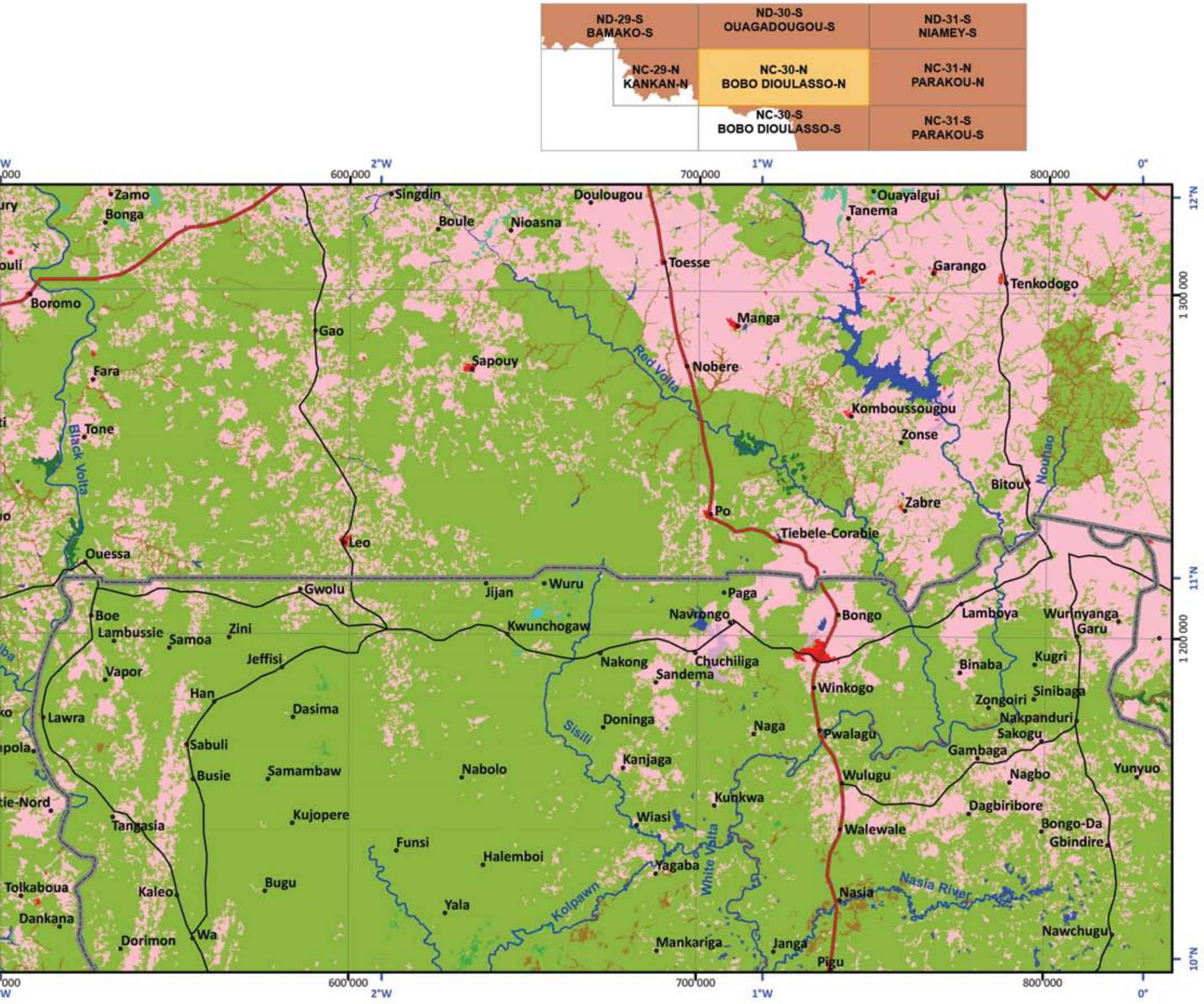
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 30).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

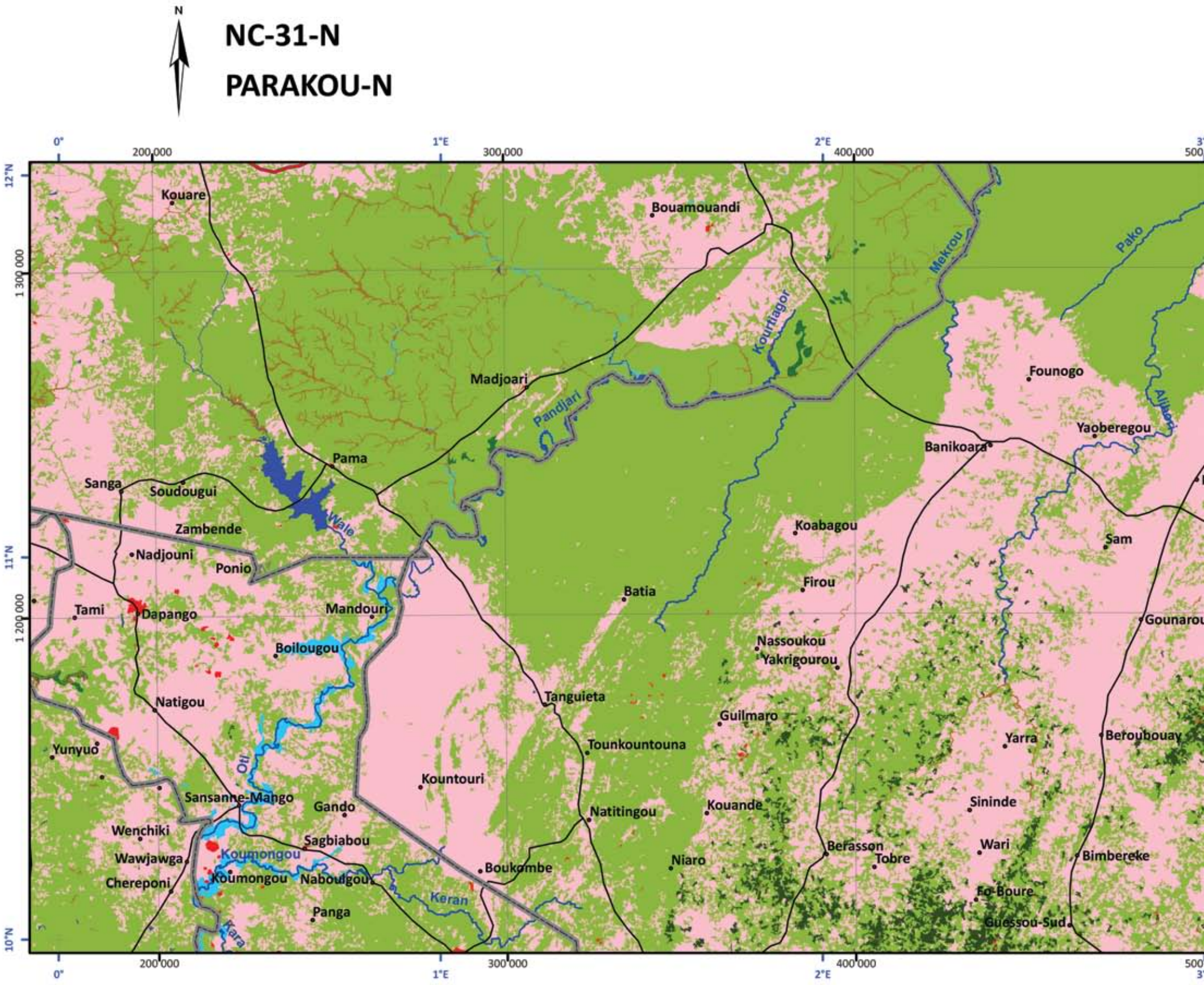
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NC-31-N

PARAKOU-N



Scale 1: 1 250 000

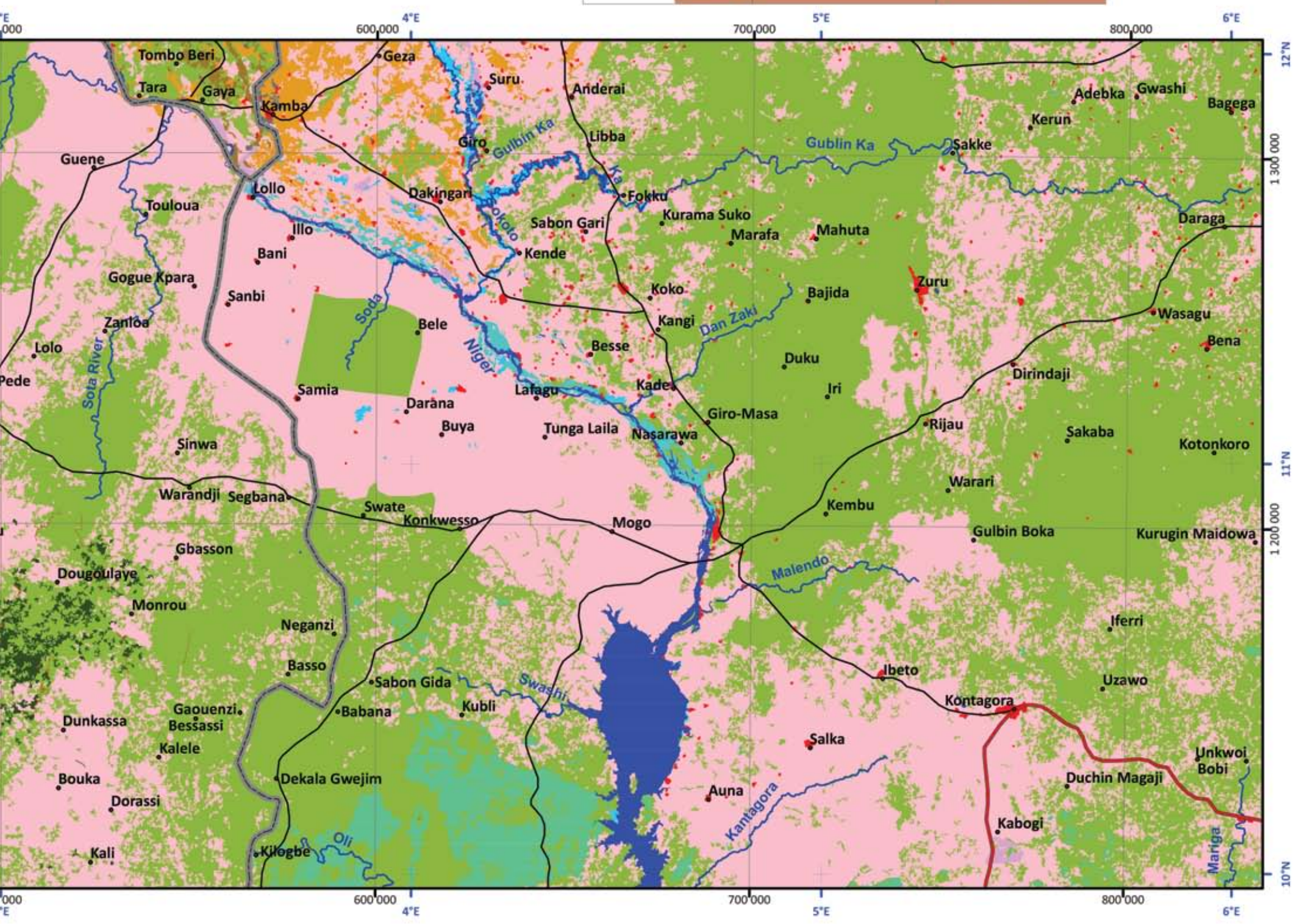
0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 31).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

ND-30-S OUAGADOUGOU-S	ND-31-S NIAMEY-S	ND-32-S ZINDER-S
NC-30-N BOBO DIOULASSO-N	NC-31-N PARAKOU-N	NC-32-N ZARIA-N
NC-30-S BOBO DIOULASSO-S	NC-31-S PARAKOU-S	NC-32-S ZARIA-S



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

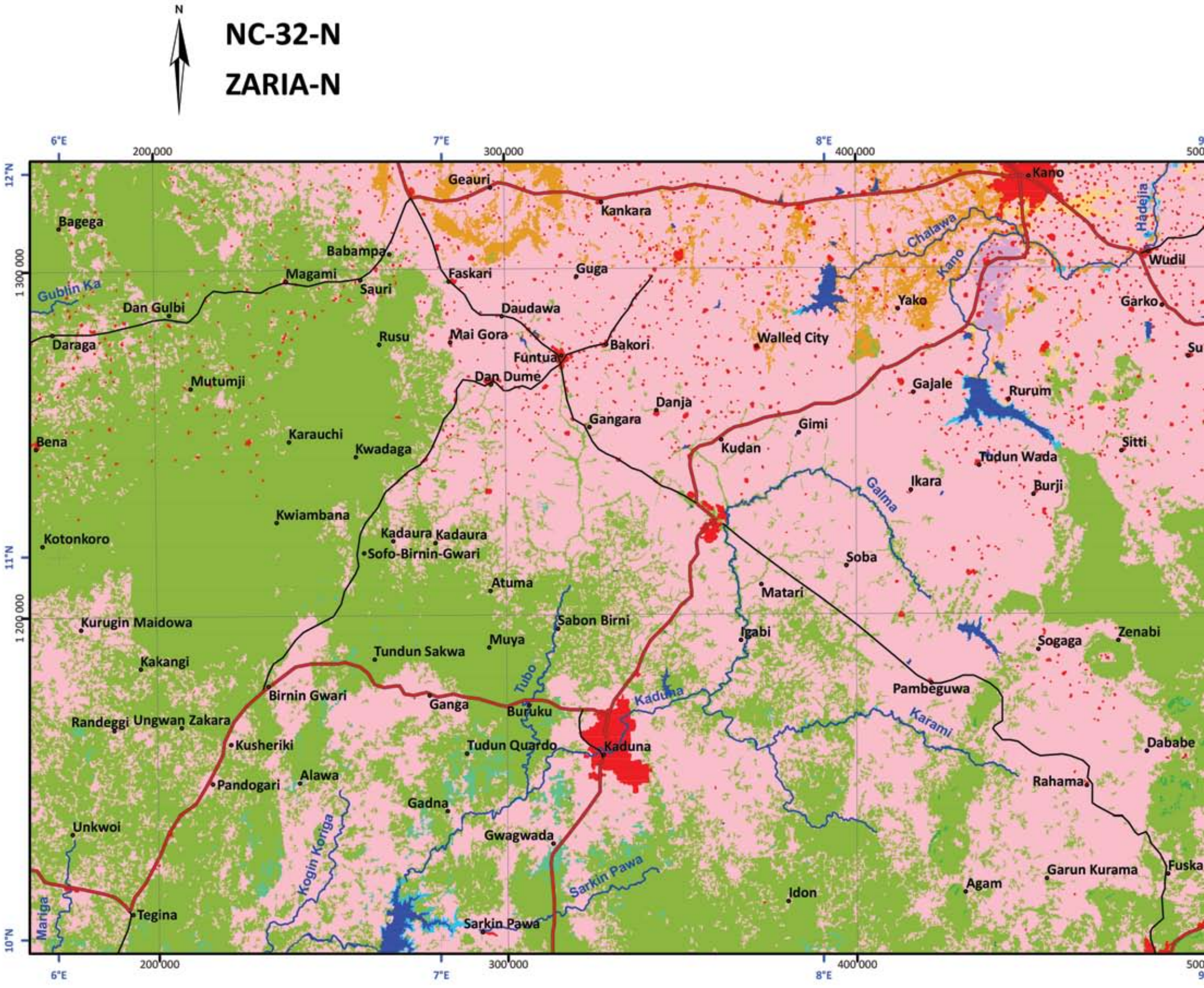
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NC-32-N

ZARIA-N

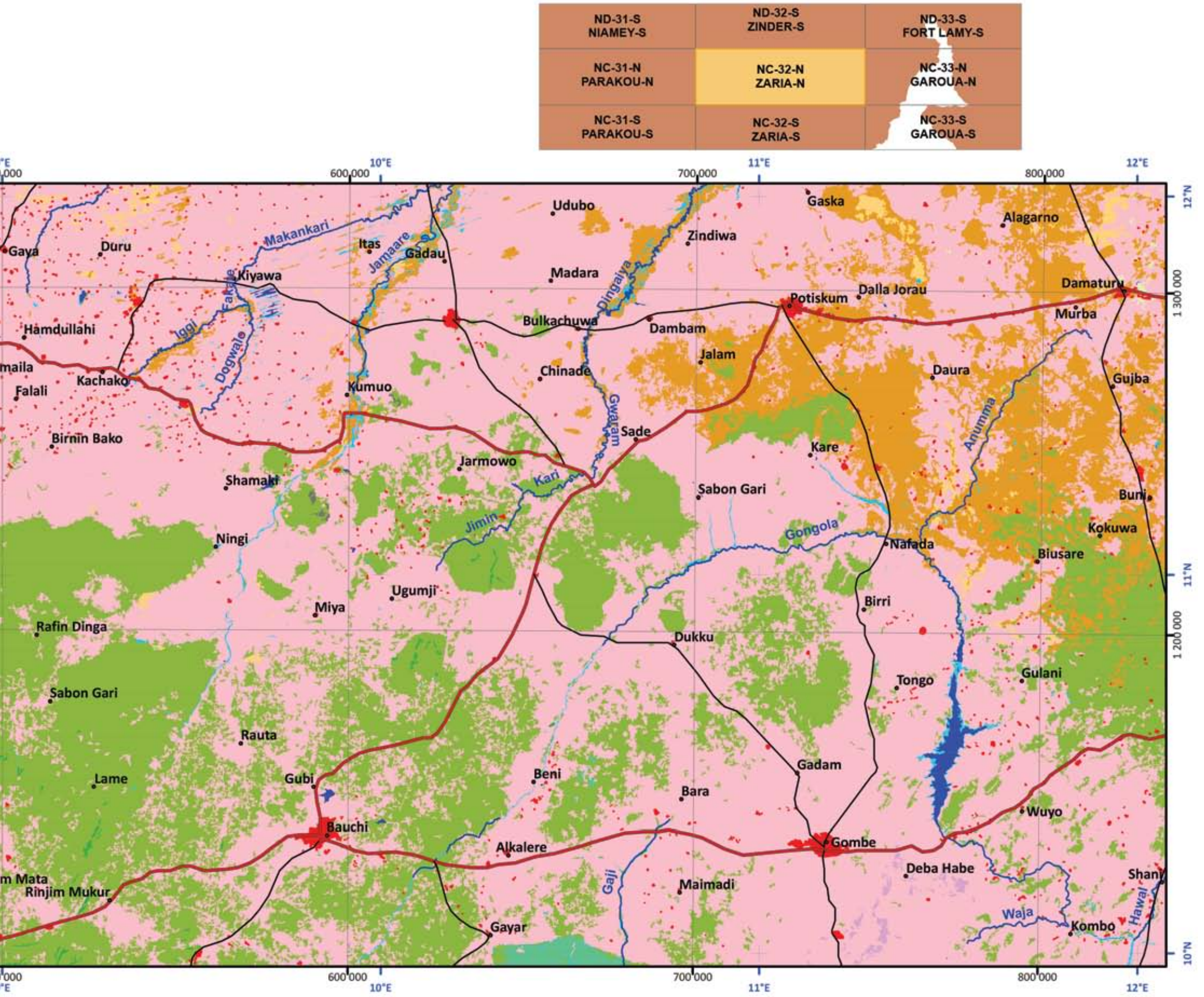


Scale 1: 1 250 000

The map is in the World Geodetic System (WGS84) and UTM projection (zone 32).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

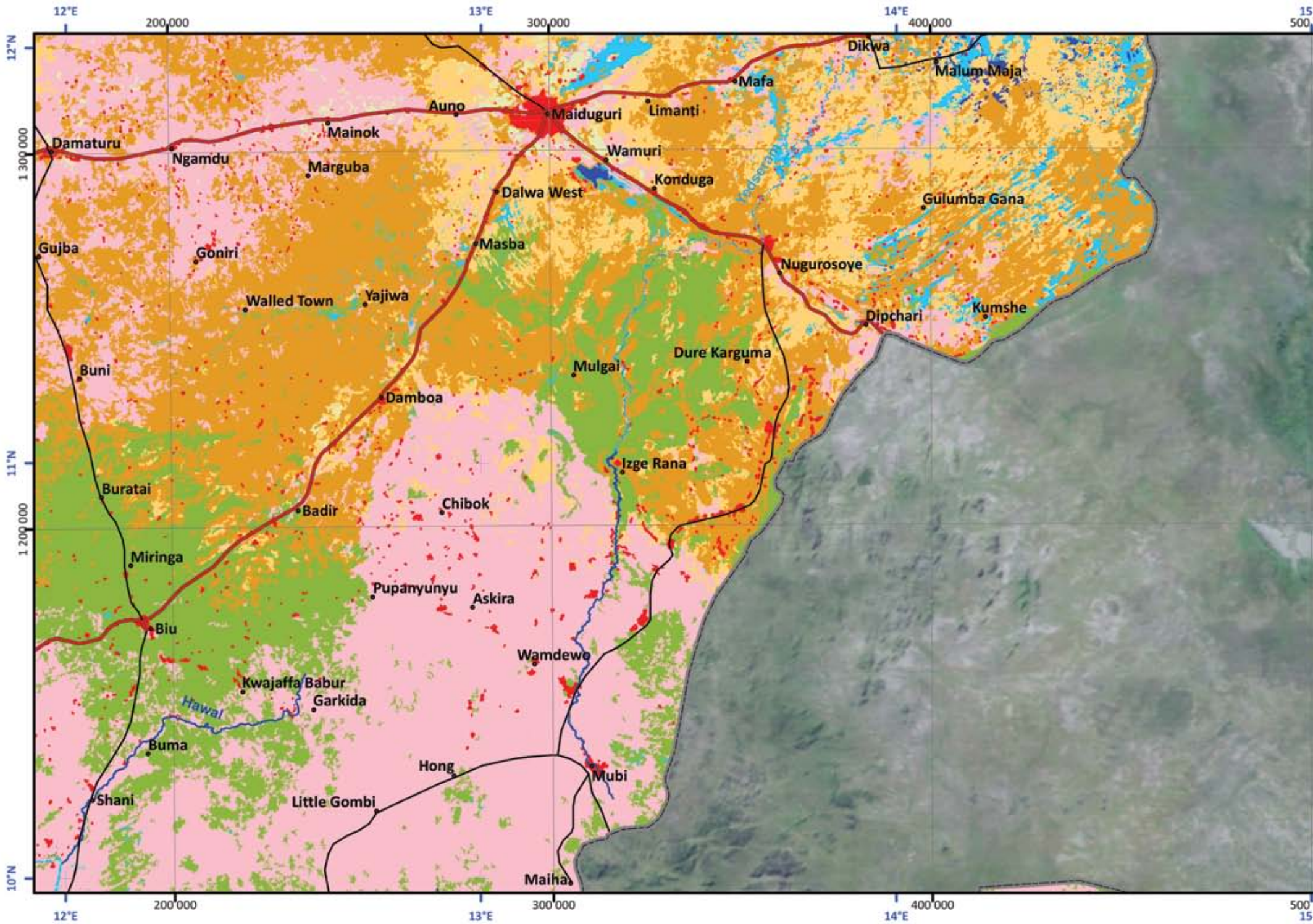
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NC-33-N

GAROUA-N



Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 33).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

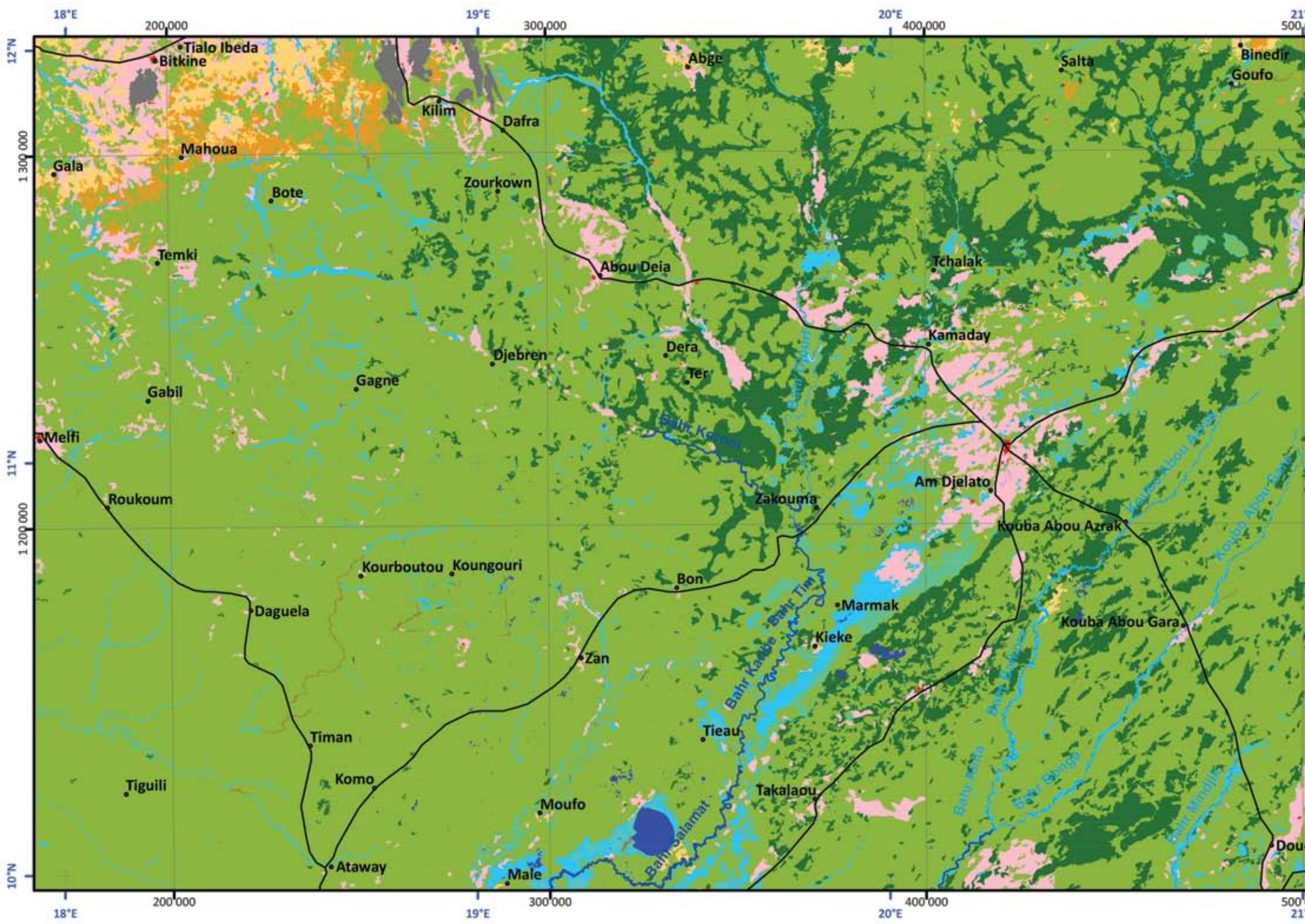
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NC-34-N

FORT ARCHAMBAULT-N



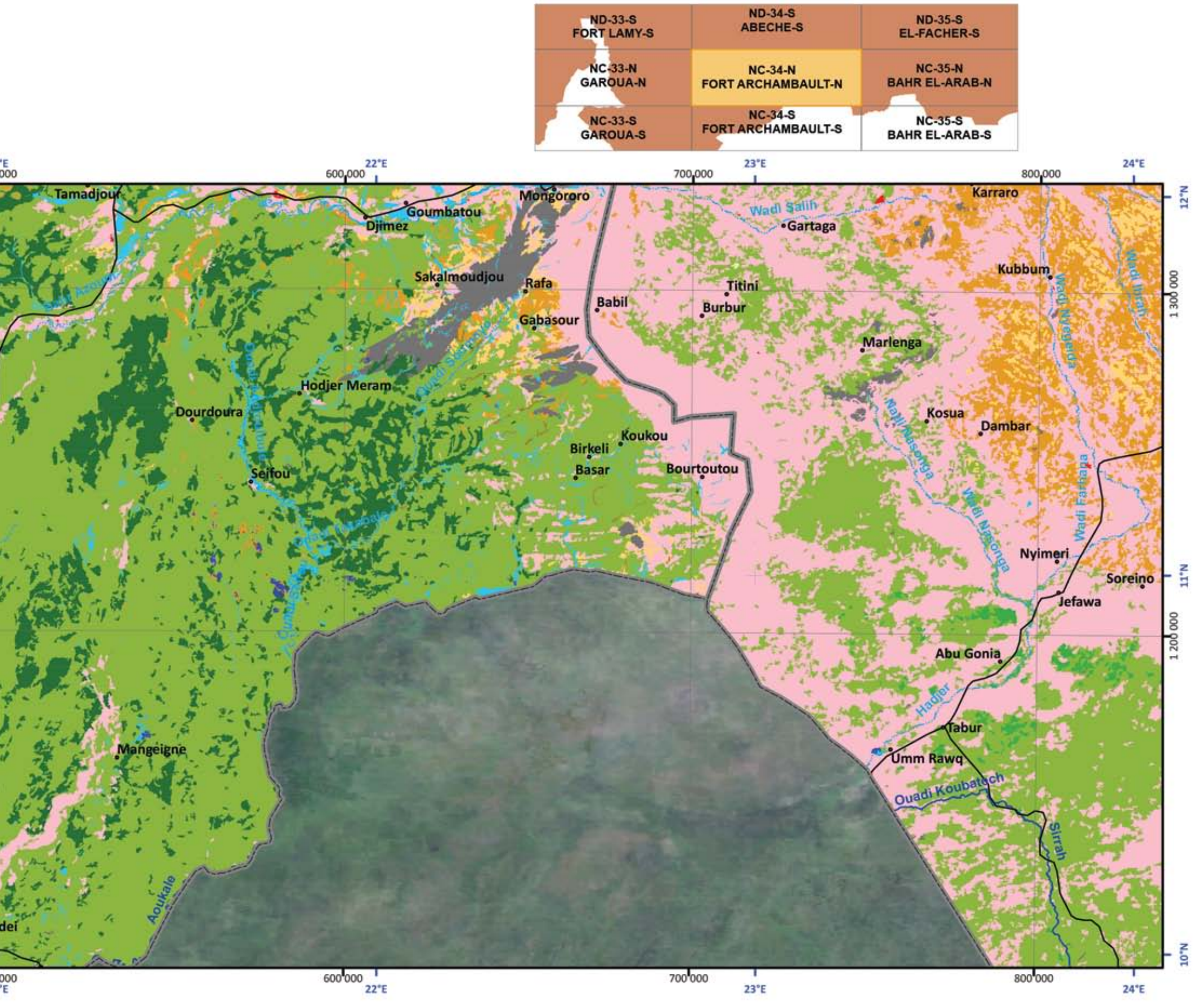
Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

Scale 1: 1 250 000

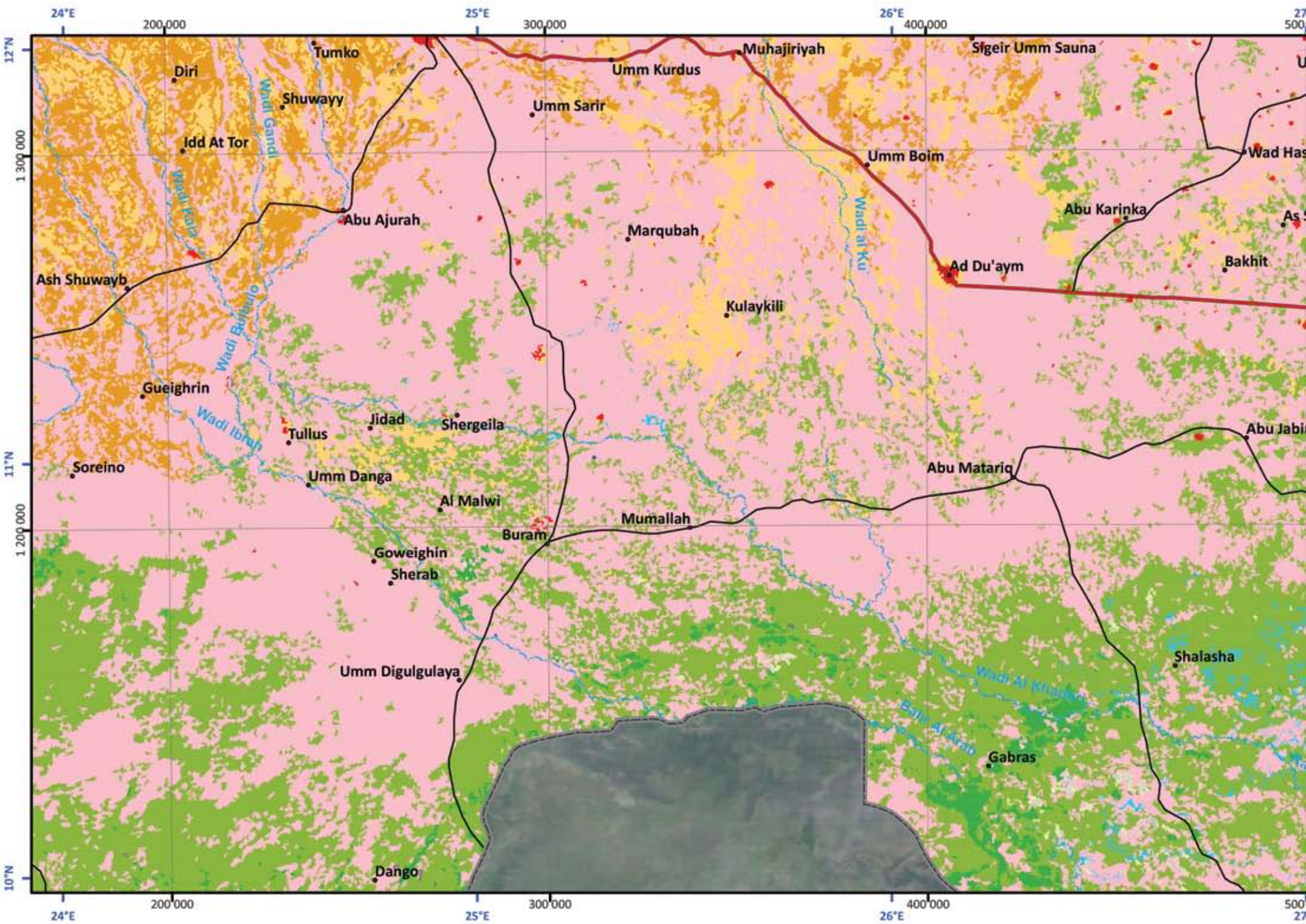
0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 34).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.


ND-33-S
FORT LAMY-S
ND-34-S
ABECHE-S
ND-35-S
EL-FACHER-S
NC-33-N
GAROUA-N
NC-34-N
FORT ARCHAMBAULT-N
NC-35-N
BAHR EL-ARAB-N
NC-33-S
GAROUA-S
NC-34-S
FORT ARCHAMBAULT-S
NC-35-S
BAHR EL-ARAB-S
22°E
600,000
23°E
700,000
24°E
800,000
12°N
1 300 000
11°N
1 200 000
10°N
Tamadjour
Goumbatou
Djimez
Mongororo
Karraro
Wadi Salih
Gartaga
Kubbum
Wadi Nyegaida
Wadi Irah
Sakalmoudjou
Rafa
Titini
Babil
Burbur
Gabasour
Marlenga
Hodjer Meram
Dourdoura
Kosua
Dambar
Wadi Nasonga
Koukou
Birkeli
Basar
Bourtoutou
Seifou
Nyimeri
Soreino
Jefawa
Wadi Farhana
Abu Gonia
Hadjer
Tabur
Umm Rawq
Ouadi Koubatech
Sirrah
Mangeigne
Aoukalé
Cultivated Land
Irrigated cropland
Rainfed cropland
Bare Land
Barren soil or very sparse vegetation
Salty soil
Sand dunes
Rock outcrops
Wetland
Water body
Floodplain
Aquatic vegetation
Built-up Land
Settlement
River
Perennial stream
Intermittent stream
Primary road
Secondary road
National capital
City or Town

NC-35-N

BAHR EL-ARAB-N



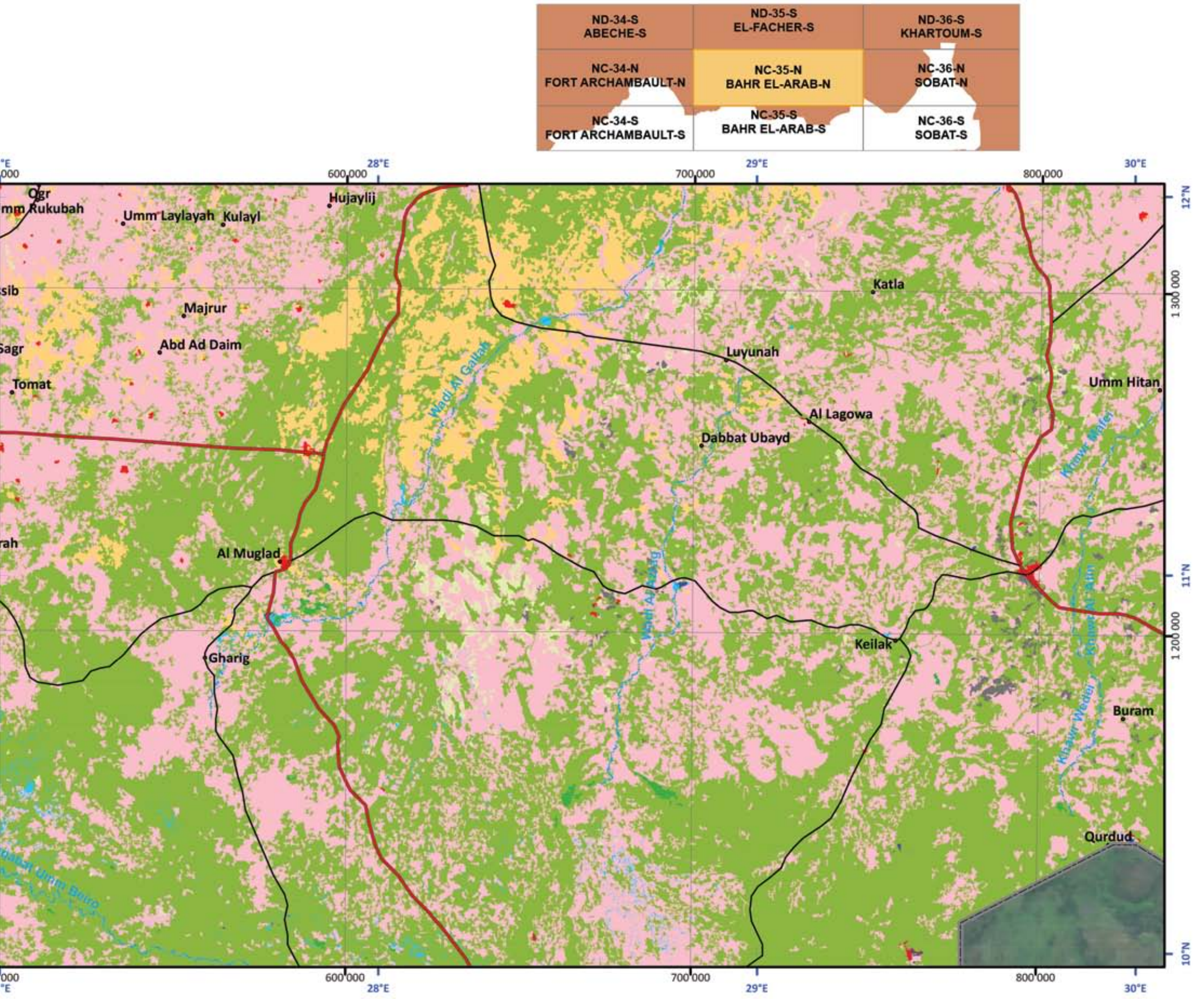
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 35).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

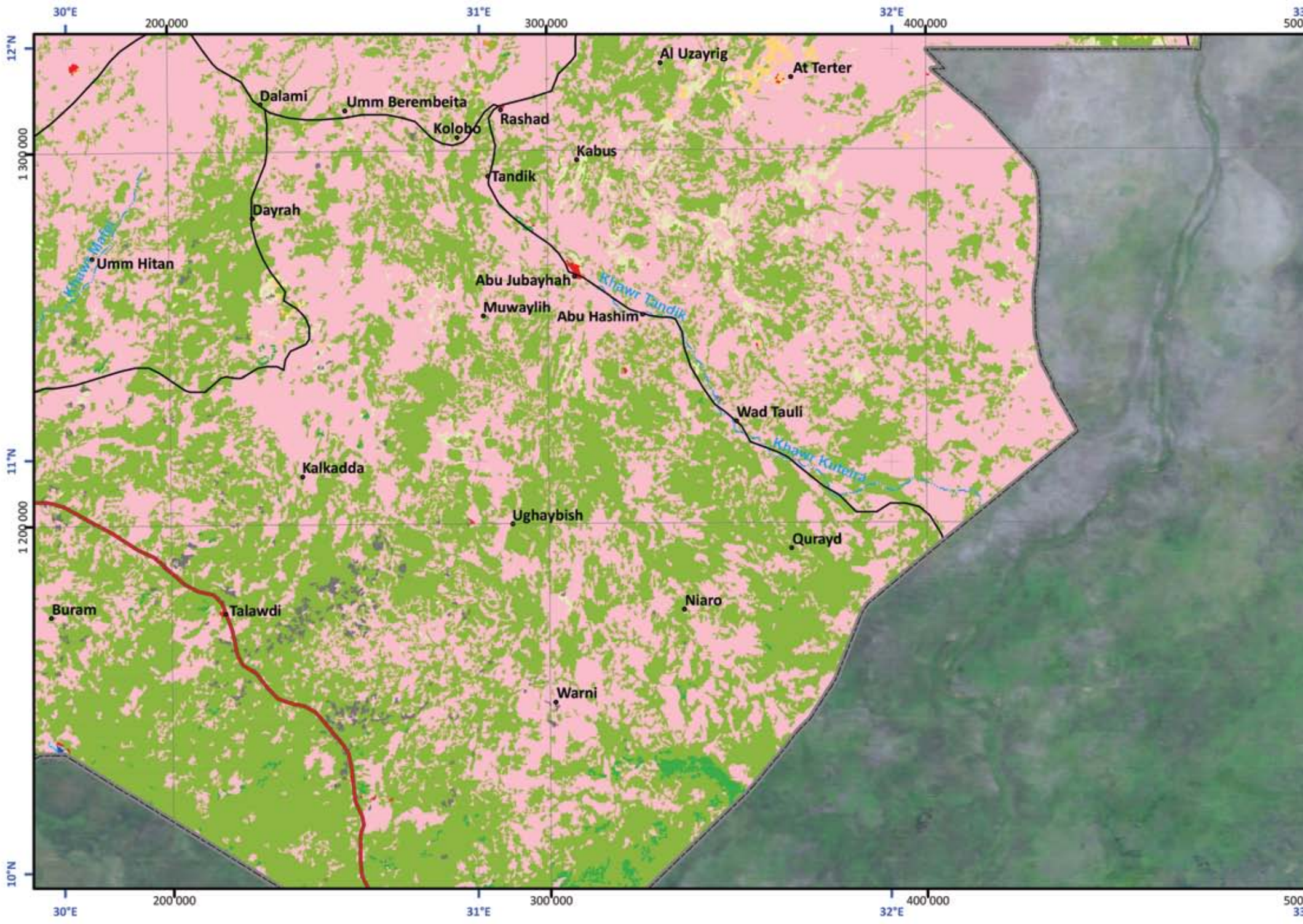
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NC-36-N

SOBAT-N



Scale 1: 1 250 000

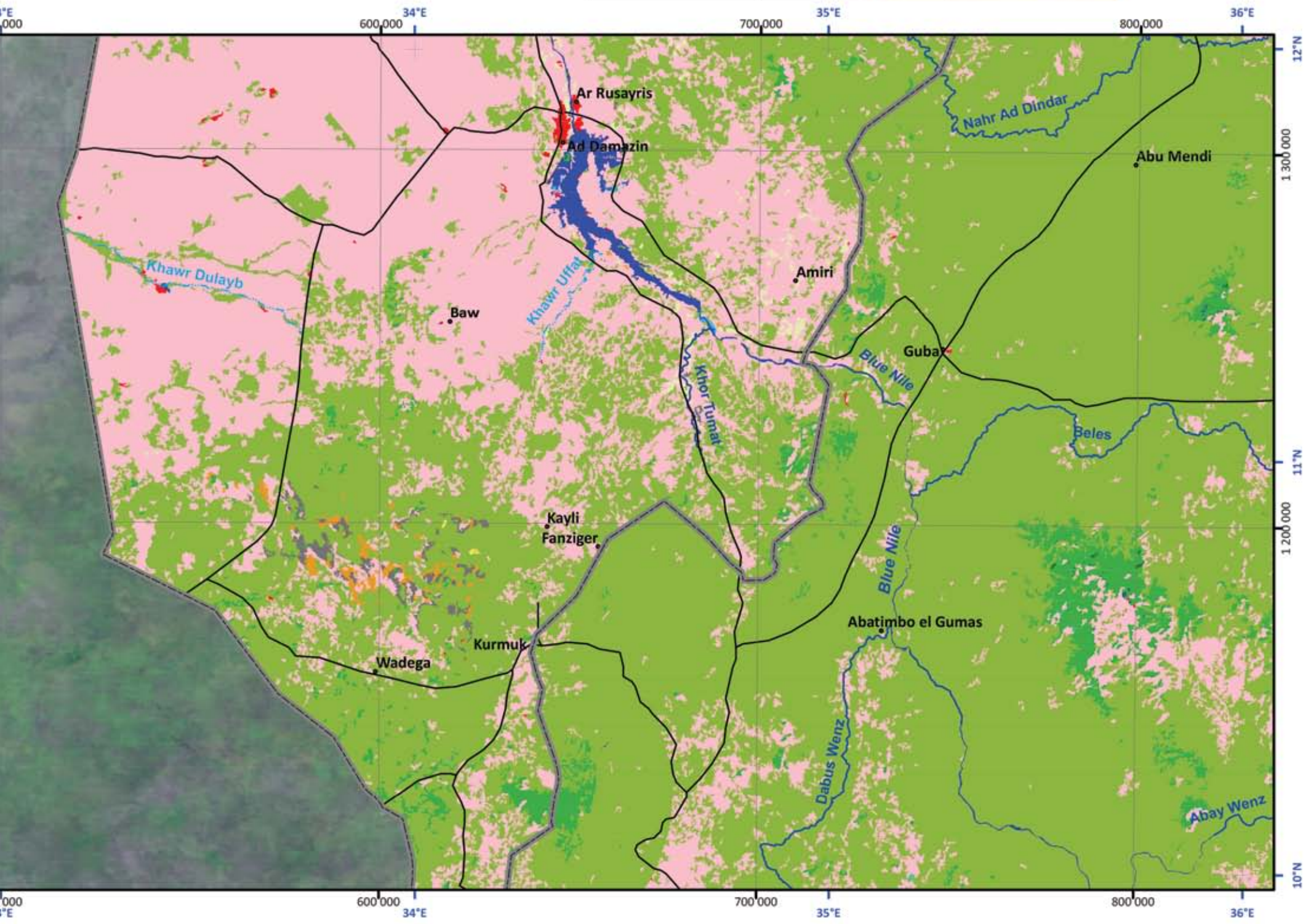
Km
0 20 40 60 80 100

The map is in the World Geodetic System (WGS84) and UTM projection (zone 36).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

ND-35-S EL-FACHER-S	ND-36-S KHARTOUM-S	ND-37-S ASMARA-S
NC-35-N BAHR EL-ARAB-N	NC-36-N SOBAT-N	NC-37-N ADDIS ABEBA-N
NC-35-S BAHR EL-ARAB-S	NC-36-S SOBAT-S	NC-37-S ADDIS ABEBA-S



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

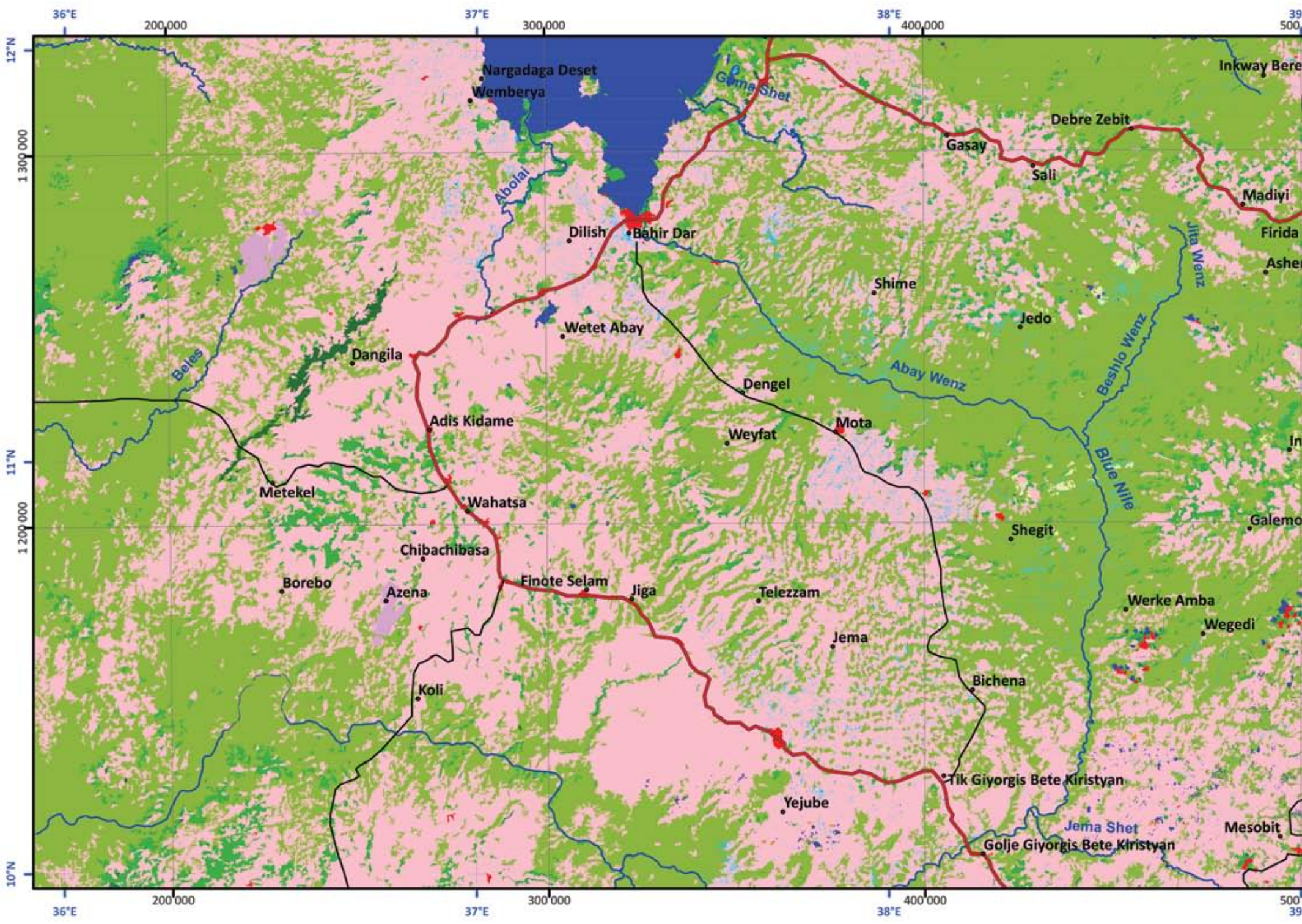
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NC-37-N

ADDIS ABEBA-N

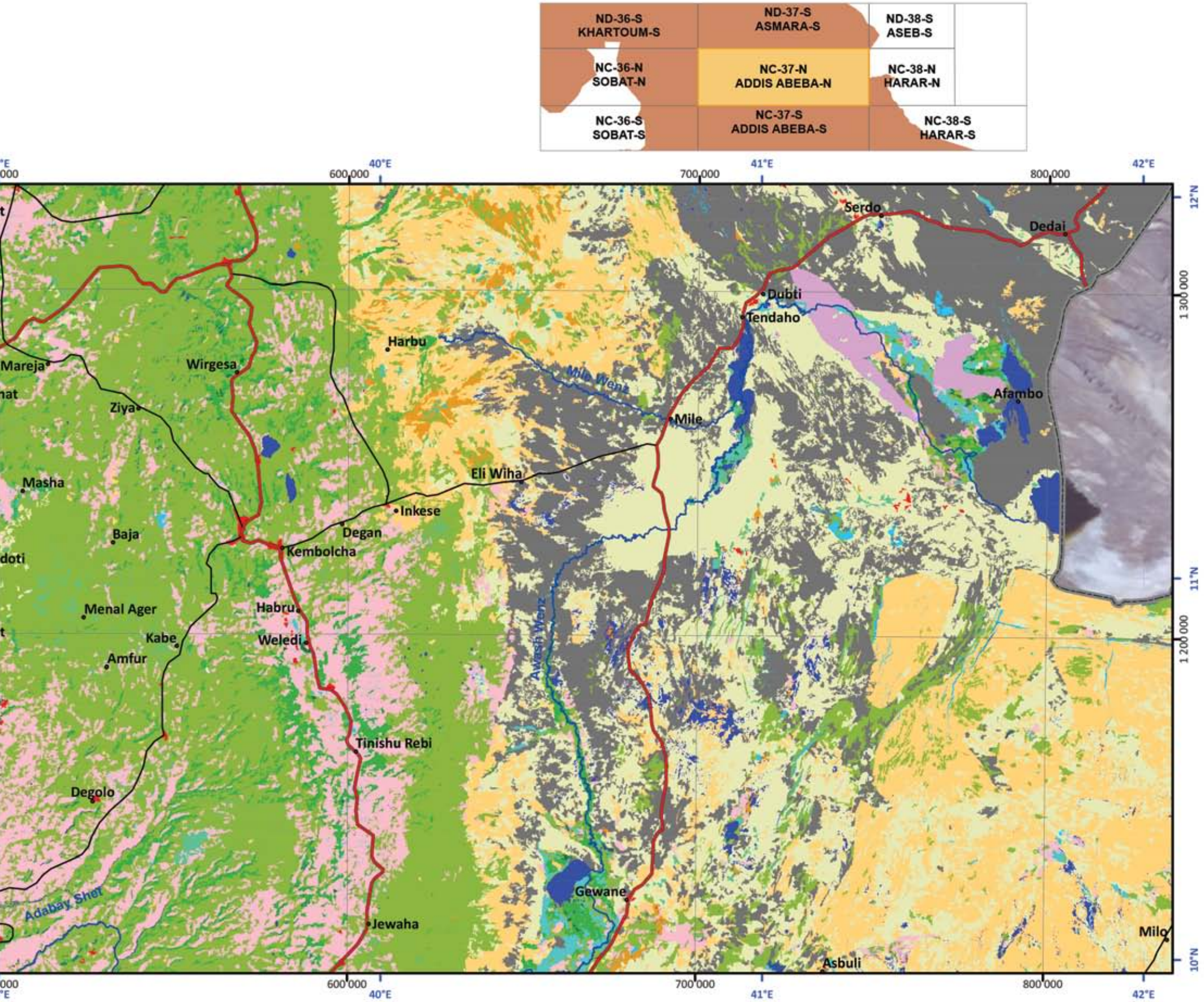


Scale 1: 1 250 000

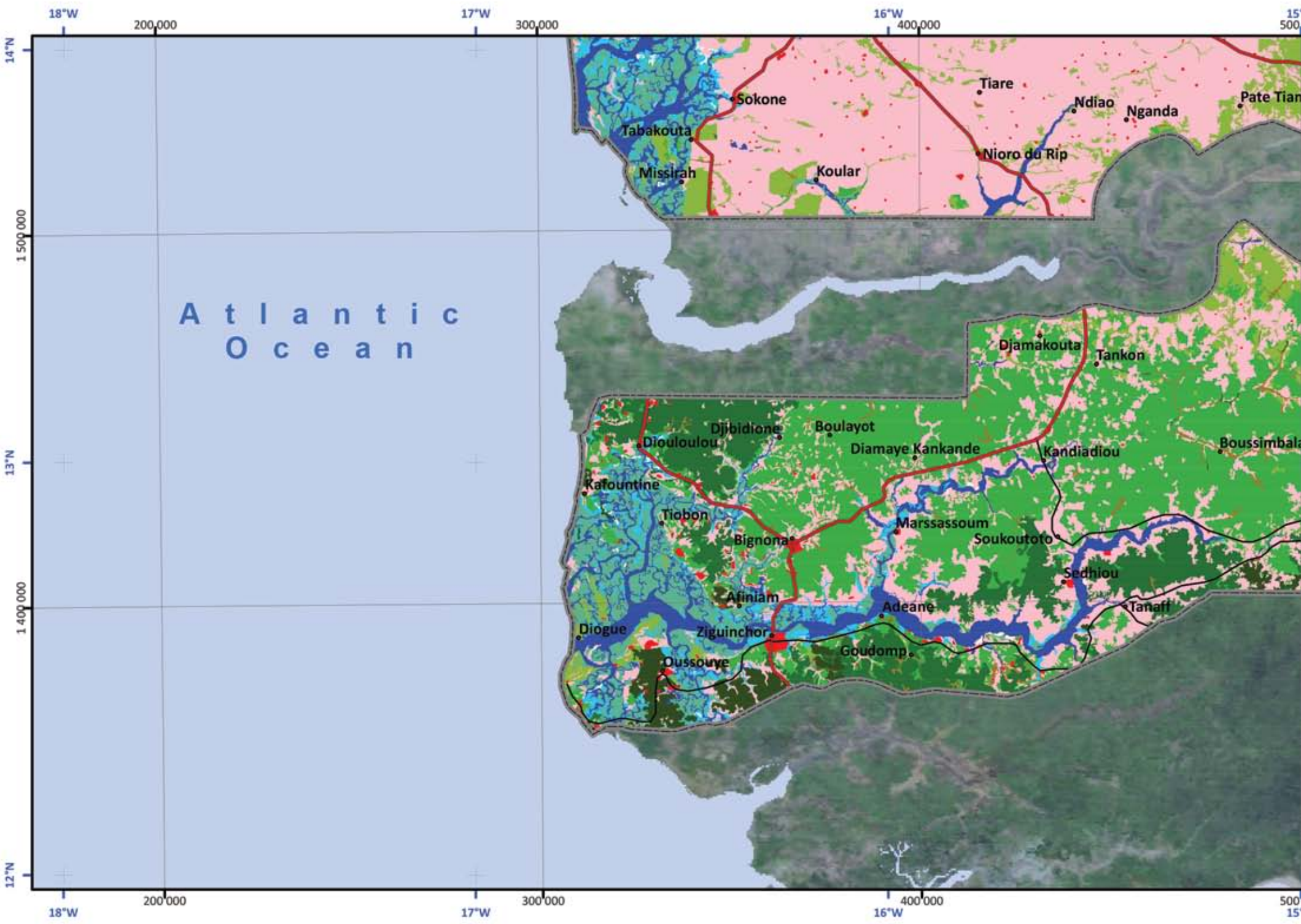
The map is in the World Geodetic System (WGS84) and UTM projection (zone 37).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe


ND-36-S
KHARTOUM-S
ND-37-S
ASMARA-S
ND-38-S
ASEB-S
NC-36-N
SOBAT-N
NC-37-N
ADDIS ABEBA-N
NC-38-N
HARAR-N
NC-36-S
SOBAT-S
NC-37-S
ADDIS ABEBA-S
NC-38-S
HARAR-S
40°E
600,000
41°E
700,000
42°E
800,000
12°N
1 300 000
11°N
1 200 000
10°N
Serdo
Dedai
Dubti
Tendaho
Harbu
Wirgesa
Mareja
Ziya
Mile Wenz
Mile
Afambo
Eli Wiha
Masha
Inkese
Degan
Baja
Kembolcha
Menal Ager
Habru
Weledi
Kabe
Amfur
Awash Wenz
Tinishu Rebi
Degolo
Adabay Sher
Jewaha
Gewane
Asbuli
Milo
Cultivated Land
Irrigated cropland
Rainfed cropland
Bare Land
Barren soil or very sparse vegetation
Salty soil
Sand dunes
Rock outcrops
Wetland
Water body
Floodplain
Aquatic vegetation
Built-up Land
Settlement
River
Perennial stream
Intermittent stream
Primary road
Secondary road
National capital
City or Town

ND-28-S
DAKAR-S



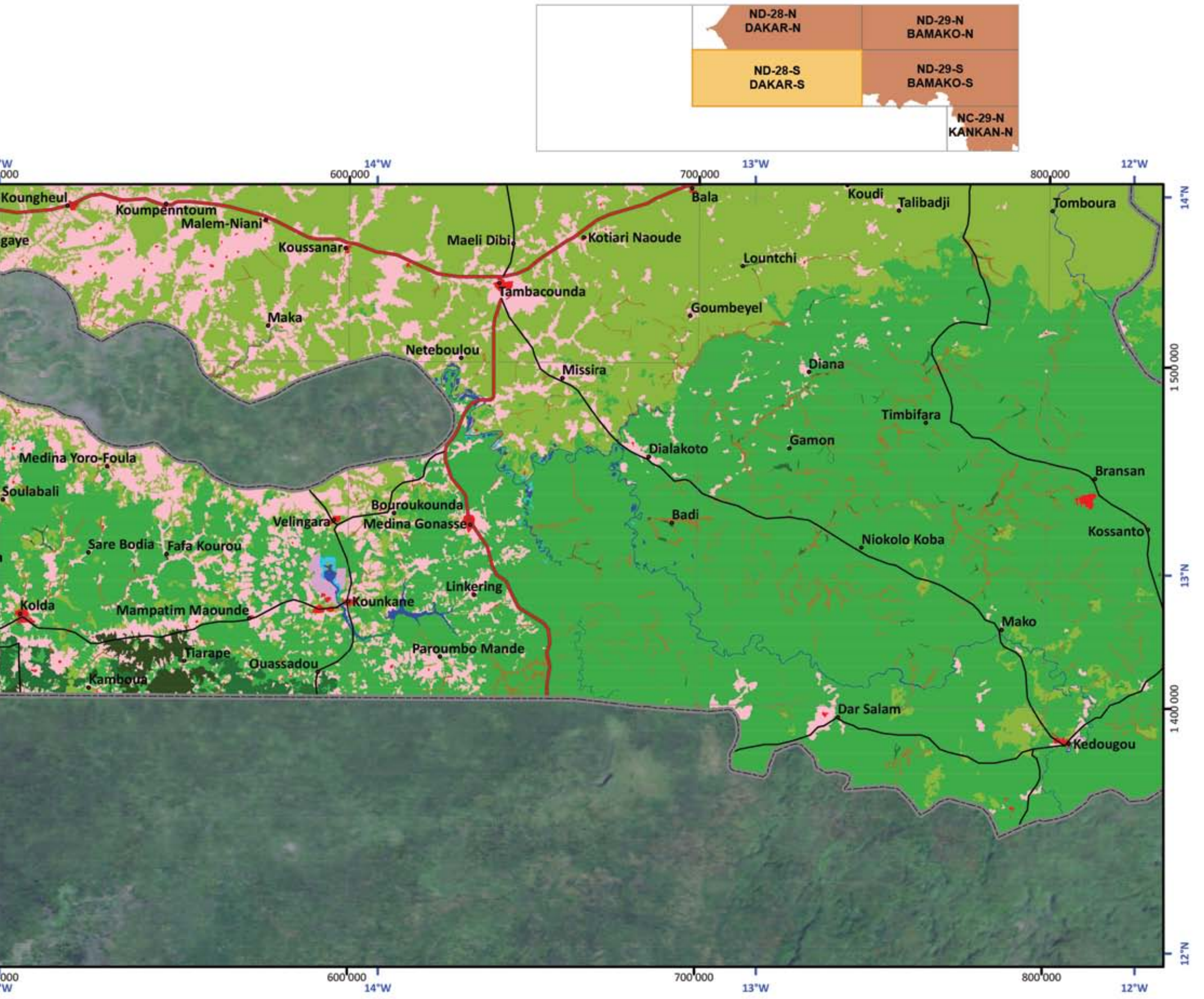
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 28).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

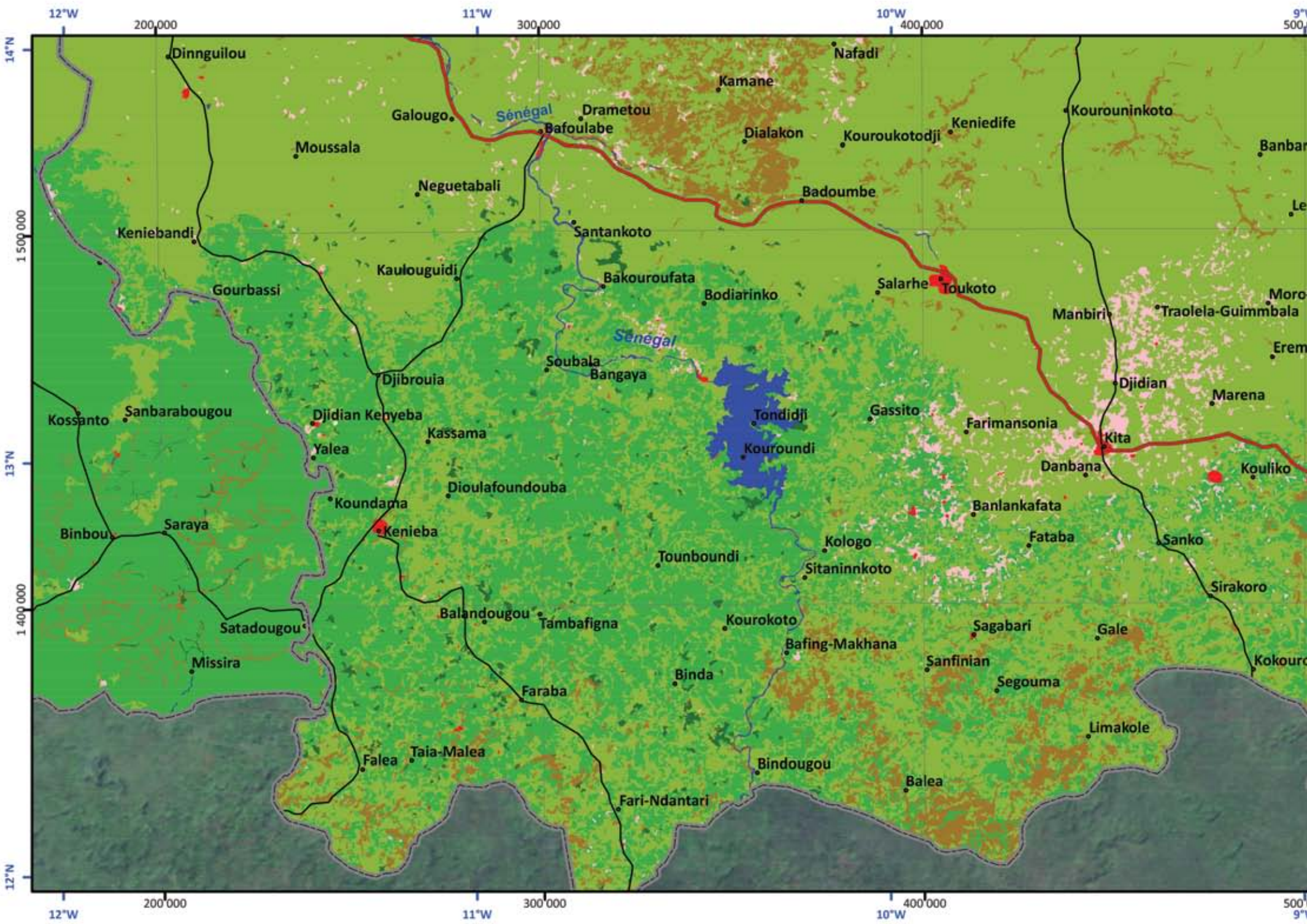
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-29-S

BAMAKO-S



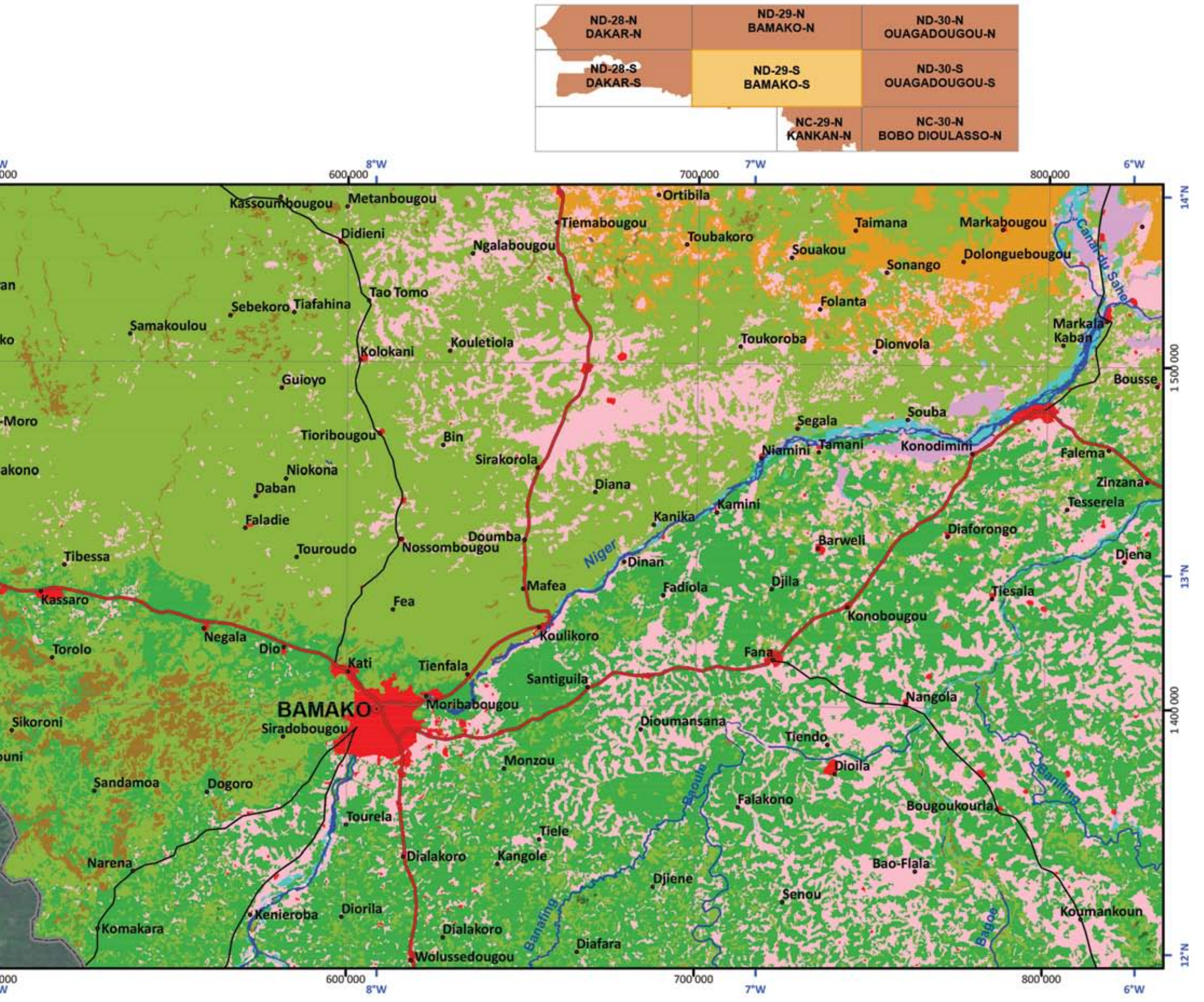
Scale 1: 1 250 000

Km
0 20 40 60 80 100

The map is in the World Geodetic System (WGS84) and UTM projection (zone 29).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

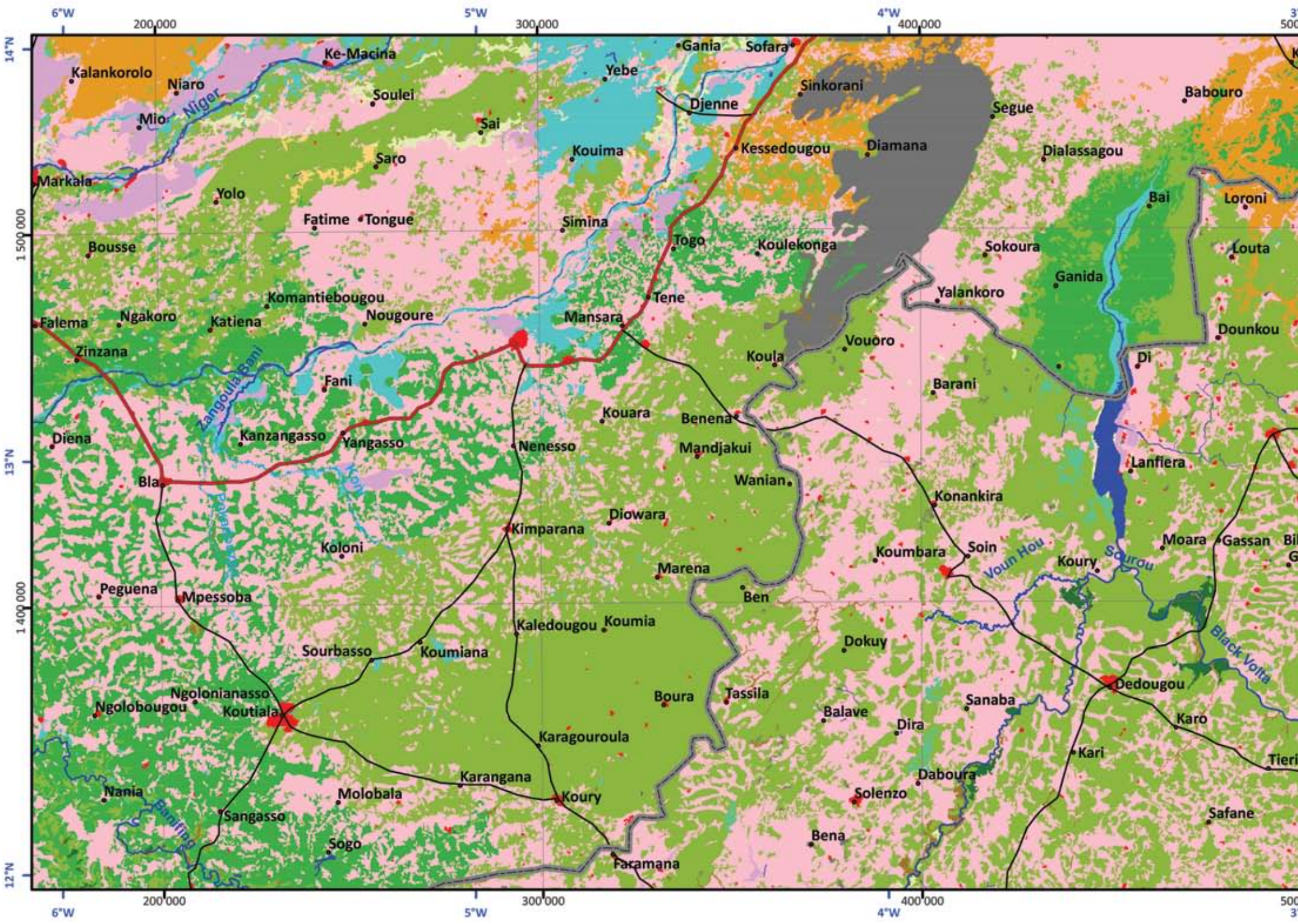
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-30-S

OUAGADOUGOU-S



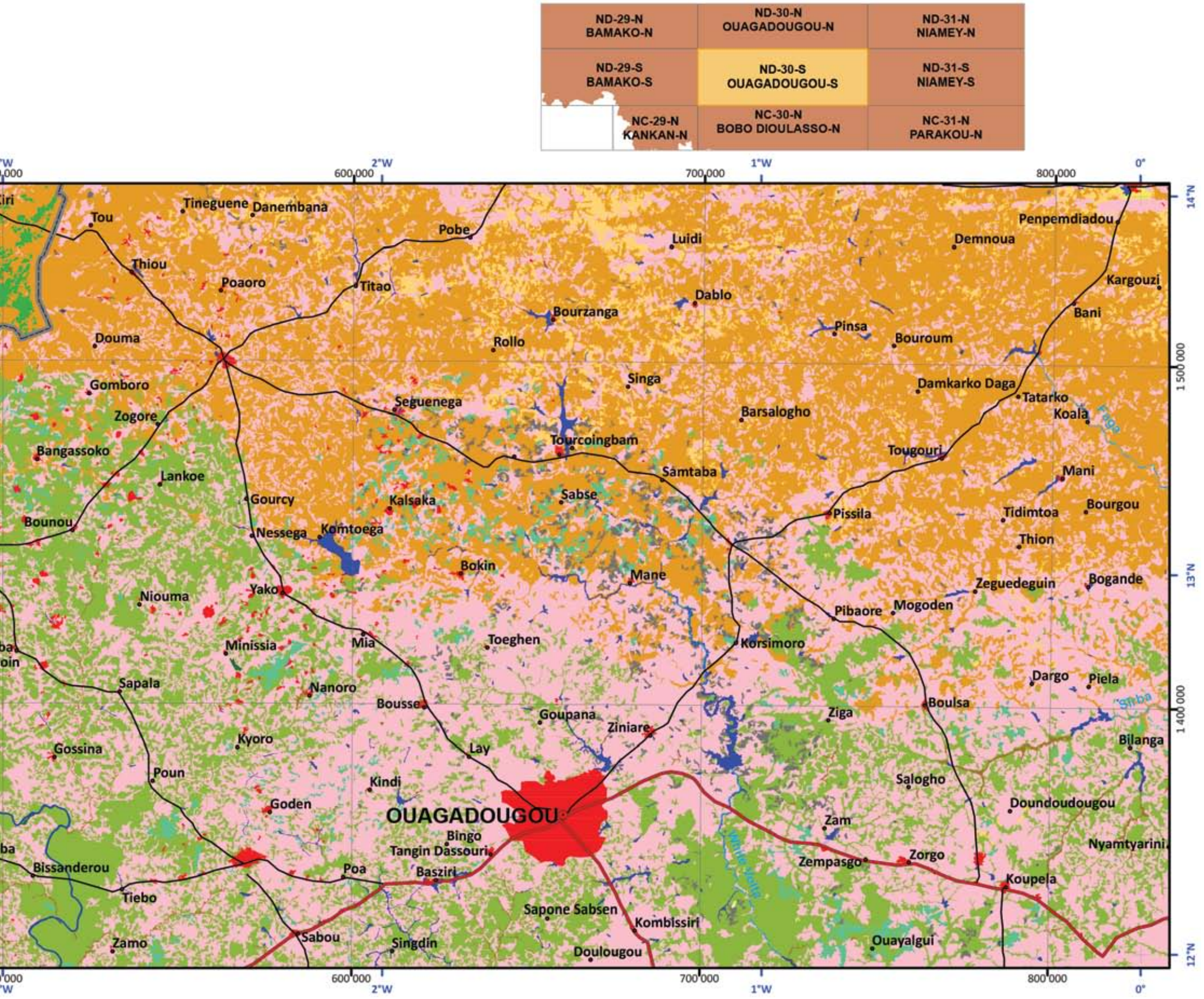
Scale 1: 1 250 000

Km
0 20 40 60 80 100

The map is in the World Geodetic System (WGS84) and UTM projection (zone 30).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

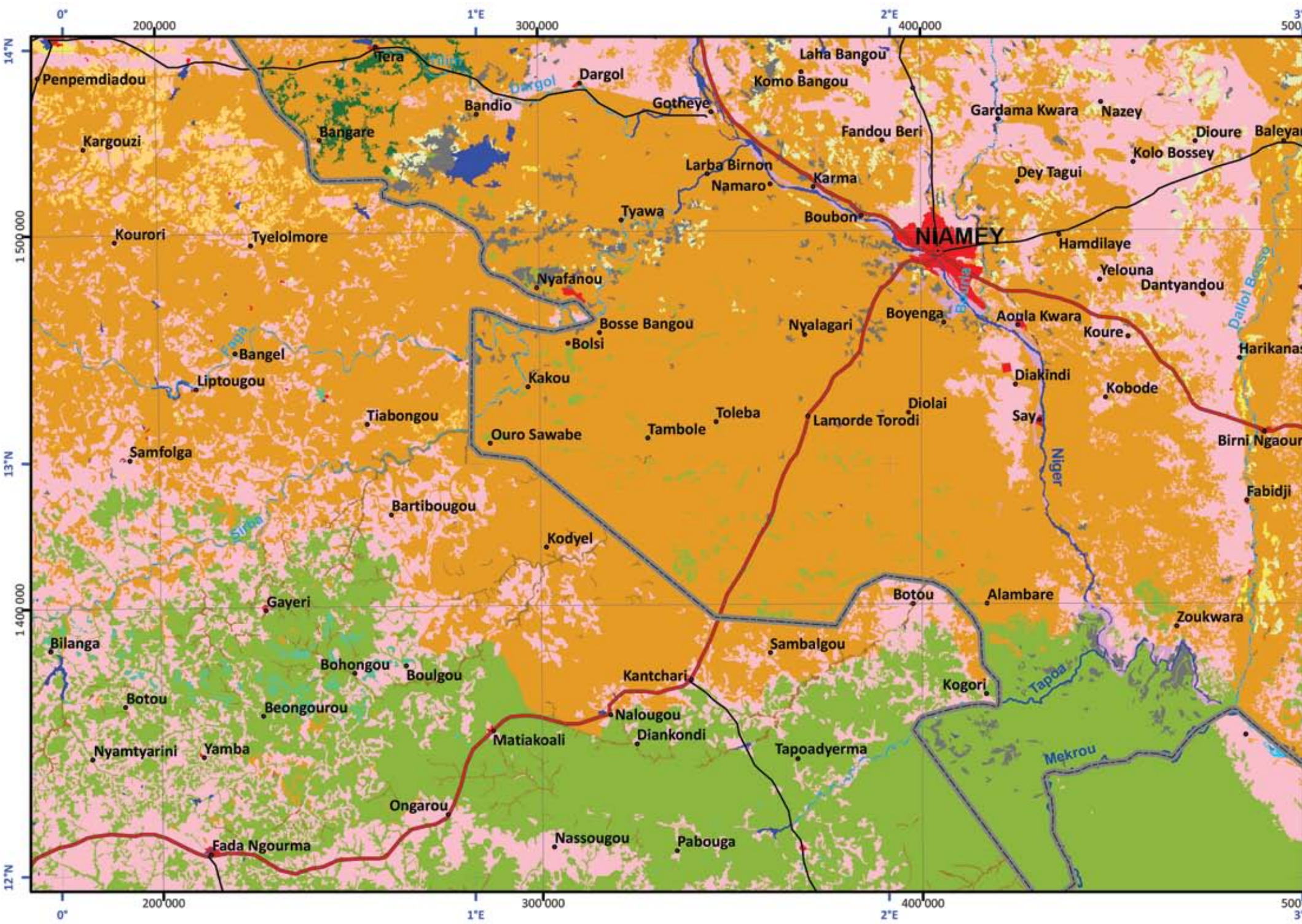
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-31-S

NIAMEY-S



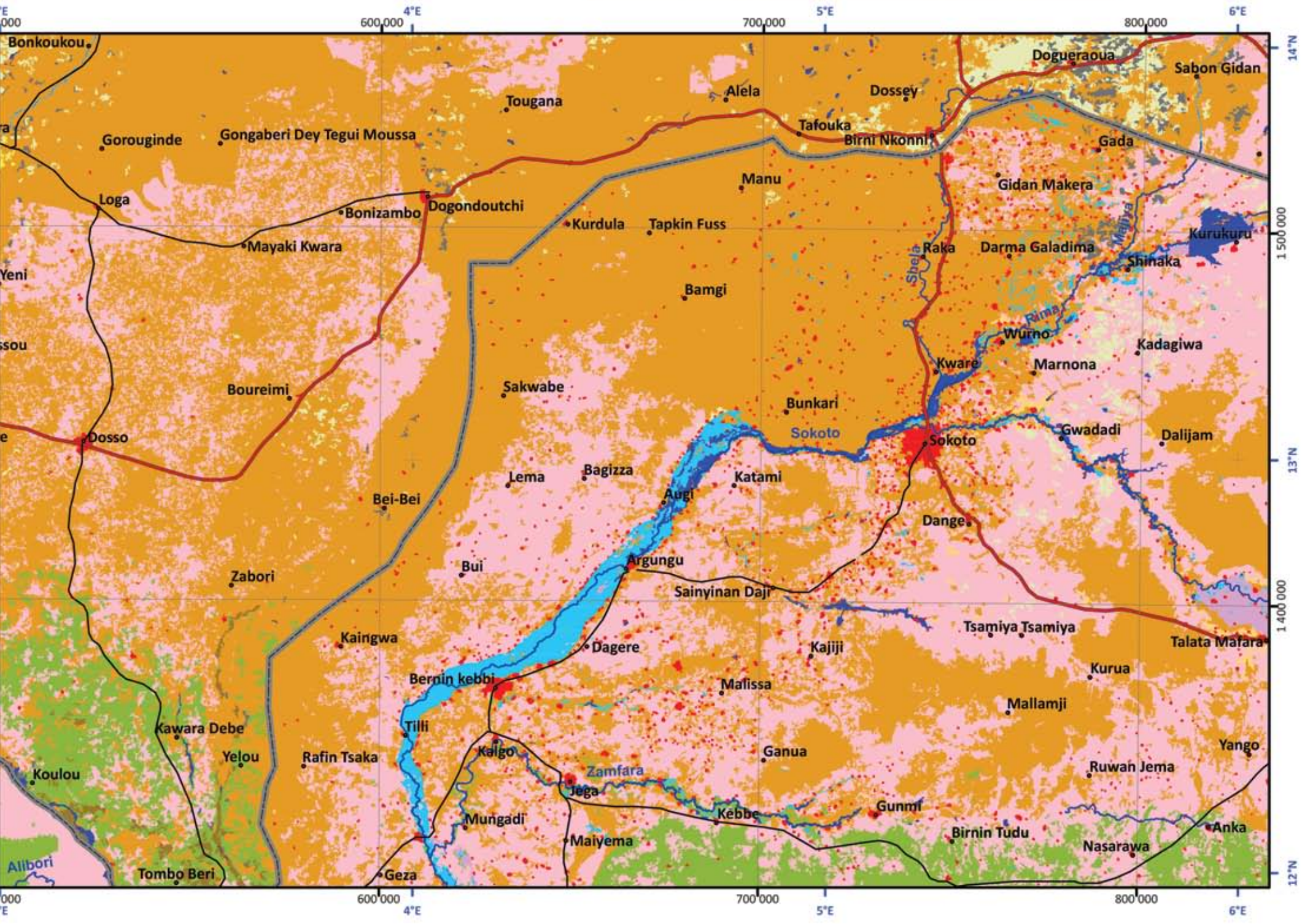
Scale 1: 1 250 000

The map is in the World Geodetic System (WGS84) and UTM projection (zone 31).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

ND-30-N OUAGADOUGOU-N	ND-31-N NIAMEY-N	ND-32-N ZINDER-N
ND-30-S OUAGADOUGOU-S	ND-31-S NIAMEY-S	ND-32-S ZINDER-S
NC-30-N BOBO DIOULASSO-N	NC-31-N PARAKOU-N	NC-32-N ZARIA-N



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

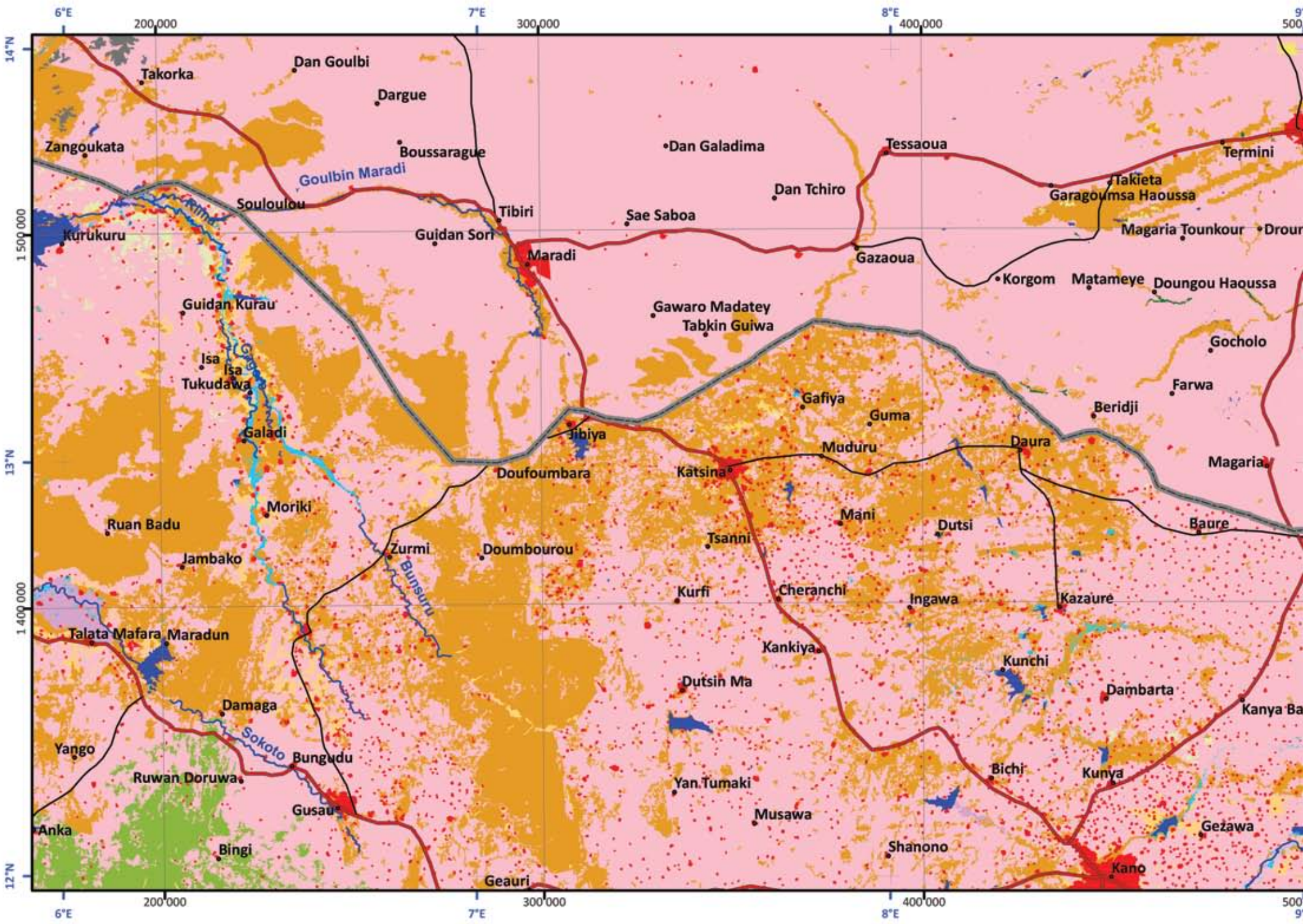
- Water body
- Floodplain
- Aquatic vegetation

Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-32-S
ZINDER-S



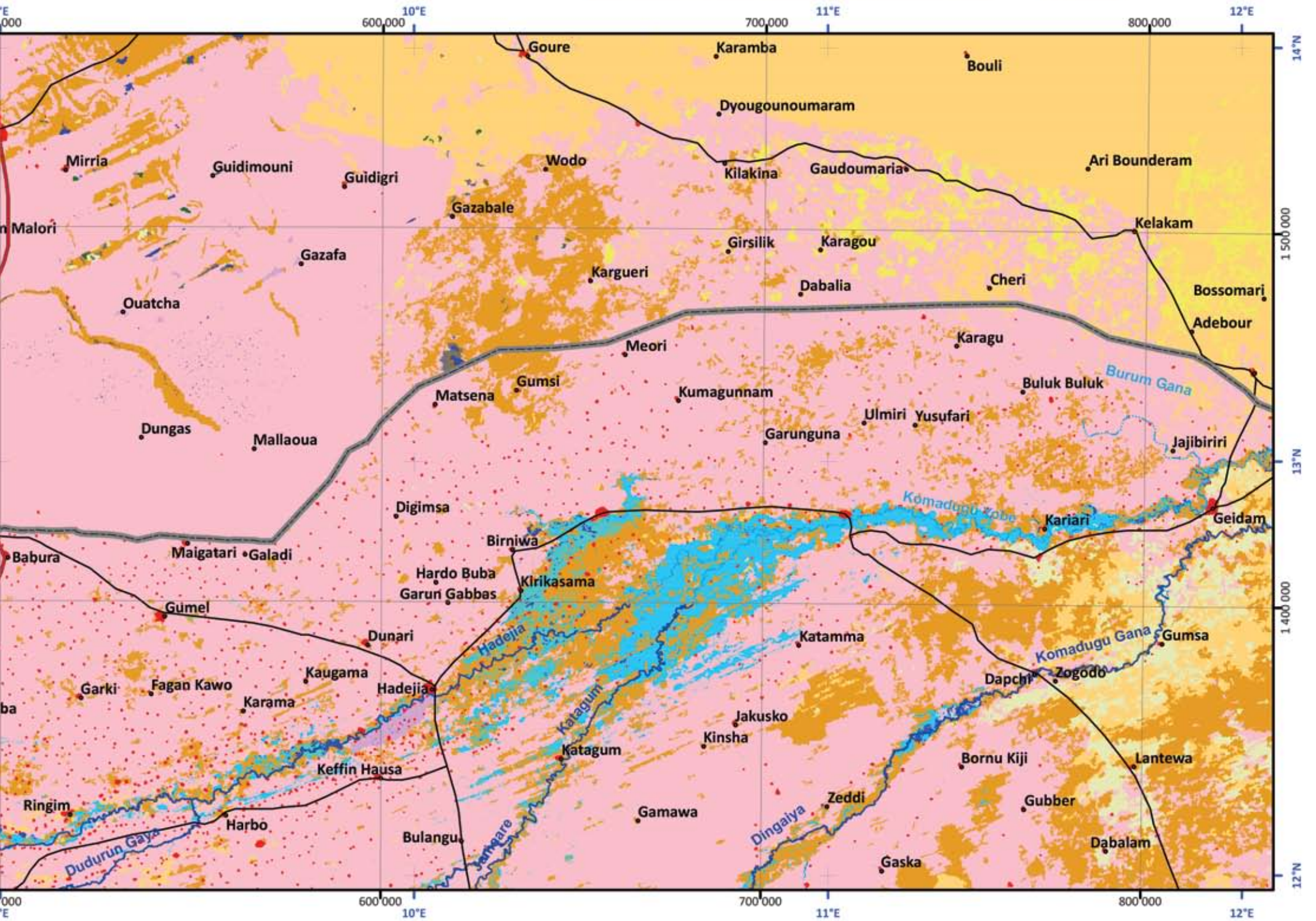
Scale 1: 1 250 000

The map is in the World Geodetic System (WGS84) and UTM projection (zone 32).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

ND-31-N NIAMEY-N	ND-32-N ZINDER-N	ND-33-N FORT LAMY-N
ND-31-S NIAMEY-S	ND-32-S ZINDER-S	ND-33-S FORT LAMY-S
NC-31-N PARAKOU-N	NC-32-N ZARIA-N	NC-33-N GAROUA-N



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

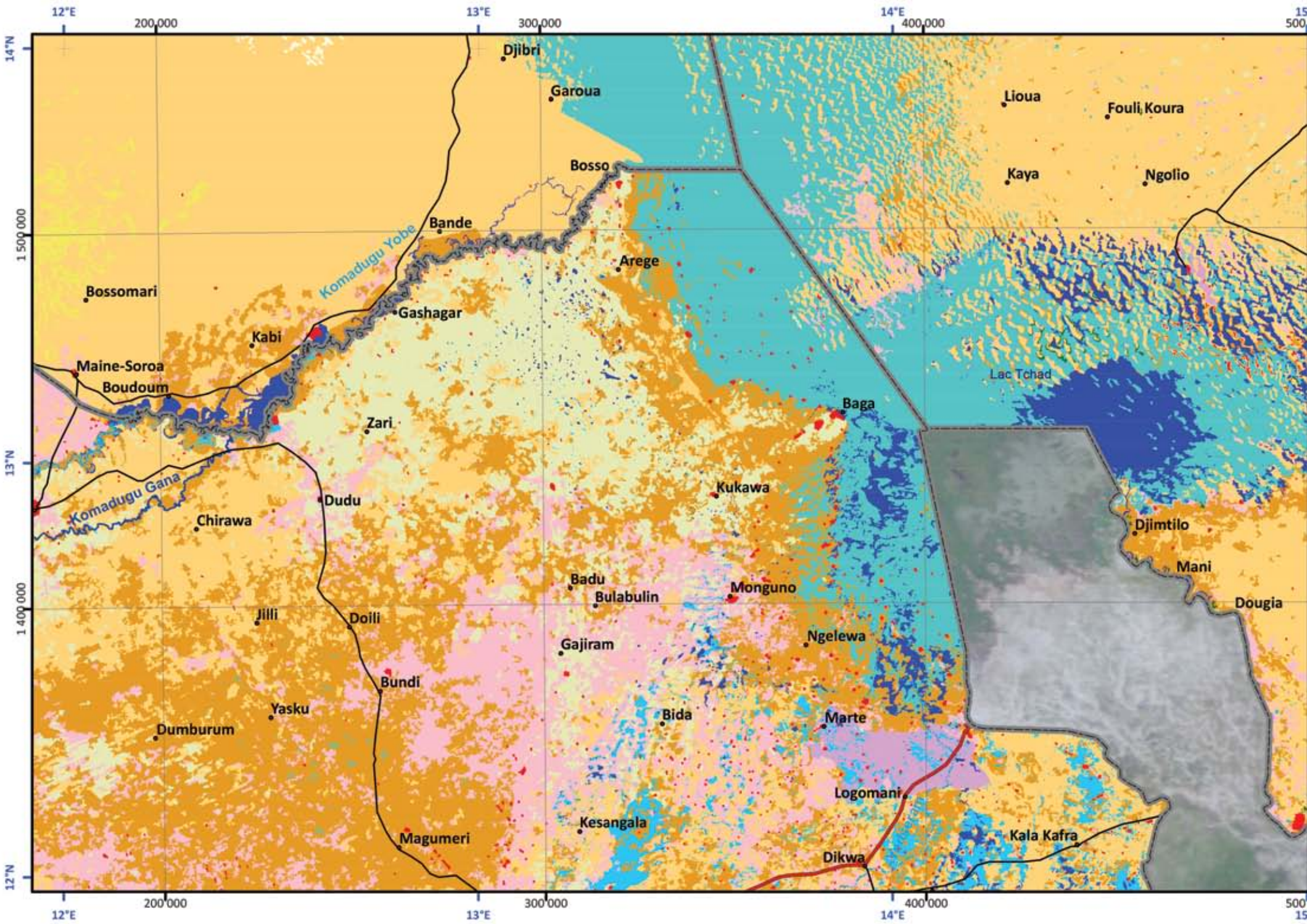
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-33-S

FORT LAMY-S



Natural Vegetation

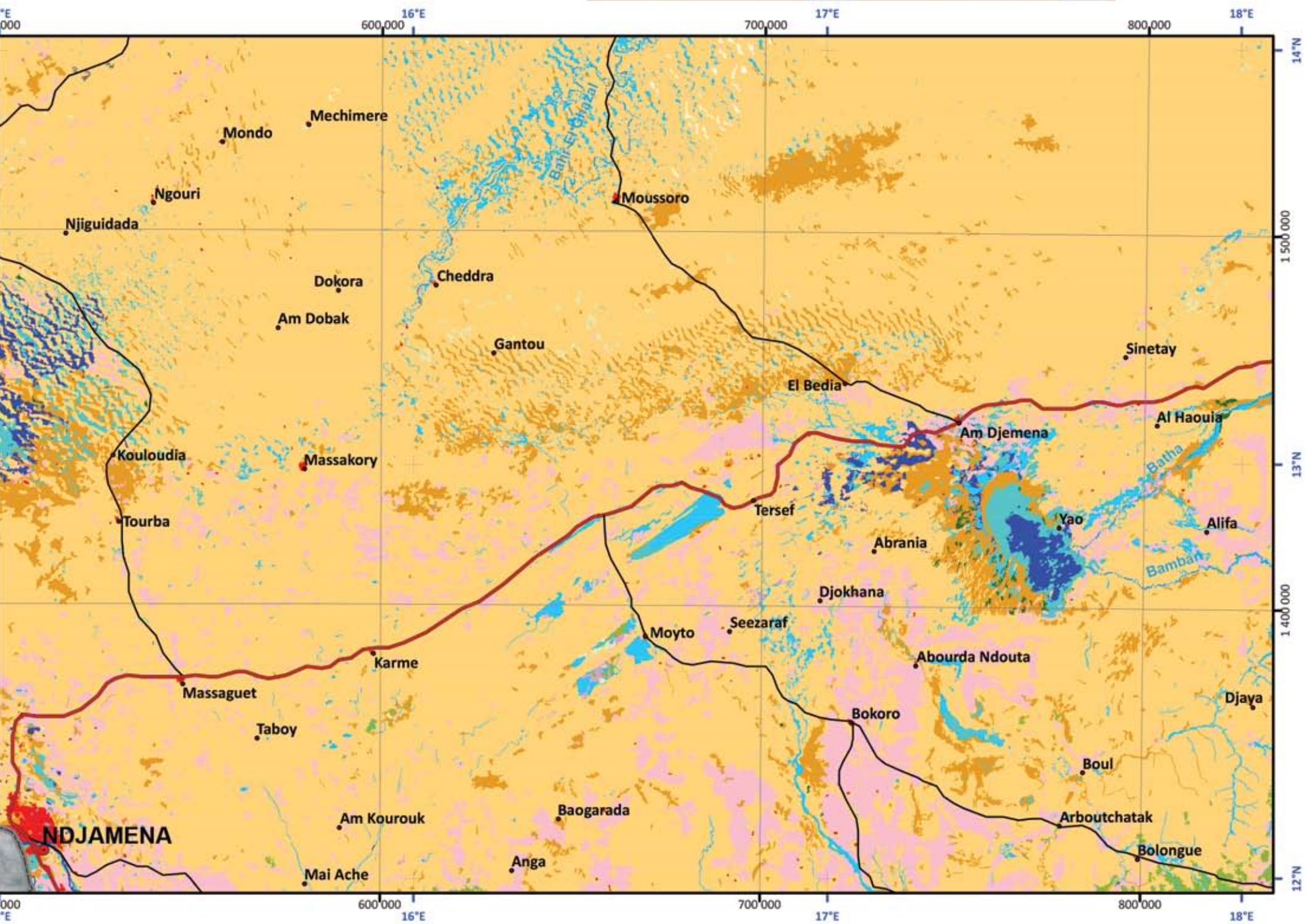
- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 33).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

ND-32-N ZINDER-N	ND-33-N FORT LAMY-N	ND-34-N ABECHE-N
ND-32-S ZINDER-S	ND-33-S FORT LAMY-S	ND-34-S ABECHE-S
NC-32-N ZARIA-N	NC-33-N GAROUA-N	NC-34-N FORT ARCHAMBAULT-N



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-34-S

ABECHE-S

Scale 1: 1 250 000

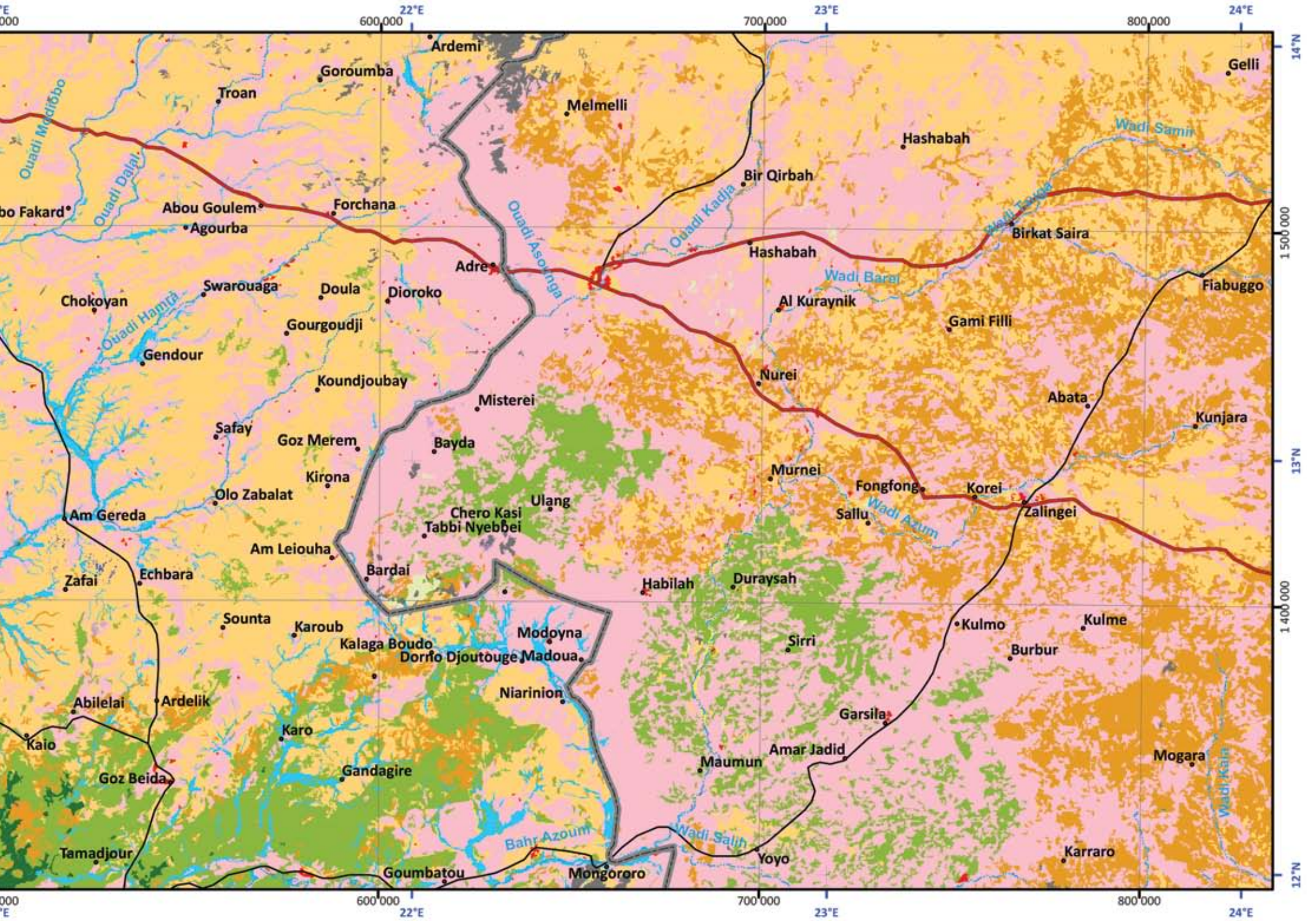
Km
0 20 40 60 80 100

The map is in the World Geodetic System (WGS84) and UTM projection (zone 34).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

ND-33-N FORT LAMY-N	ND-34-N ABECHE-N	ND-35-N EL-FACHER-N
ND-33-S FORT LAMY-S	ND-34-S ABECHE-S	ND-35-S EL-FACHER-S
NC-33-N GAROUA-N	NC-34-N FORT ARCHAMBAULT-N	NC-35-N BAHR EL-ARAB-N



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

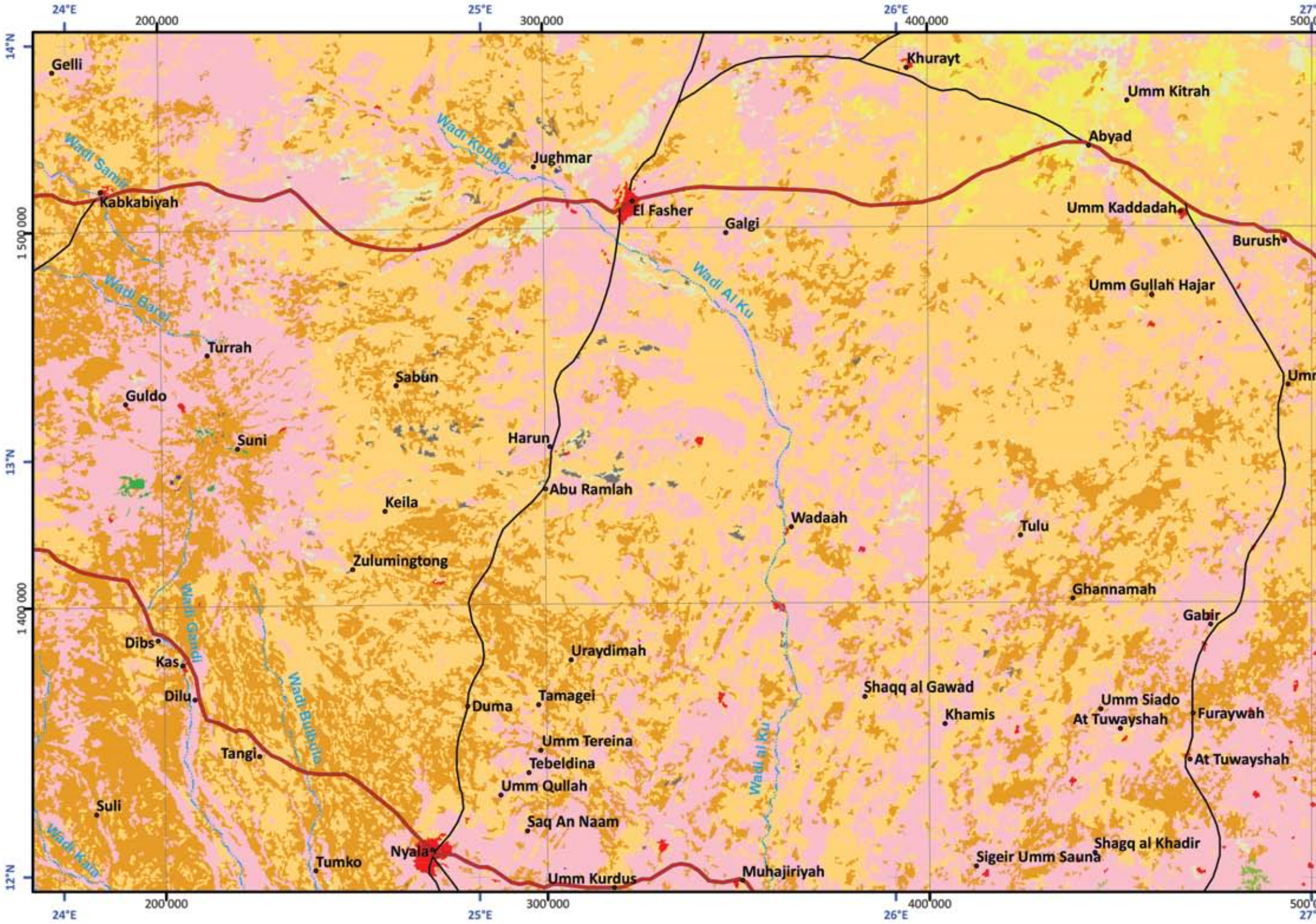
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-35-S

EL-FACHER-S



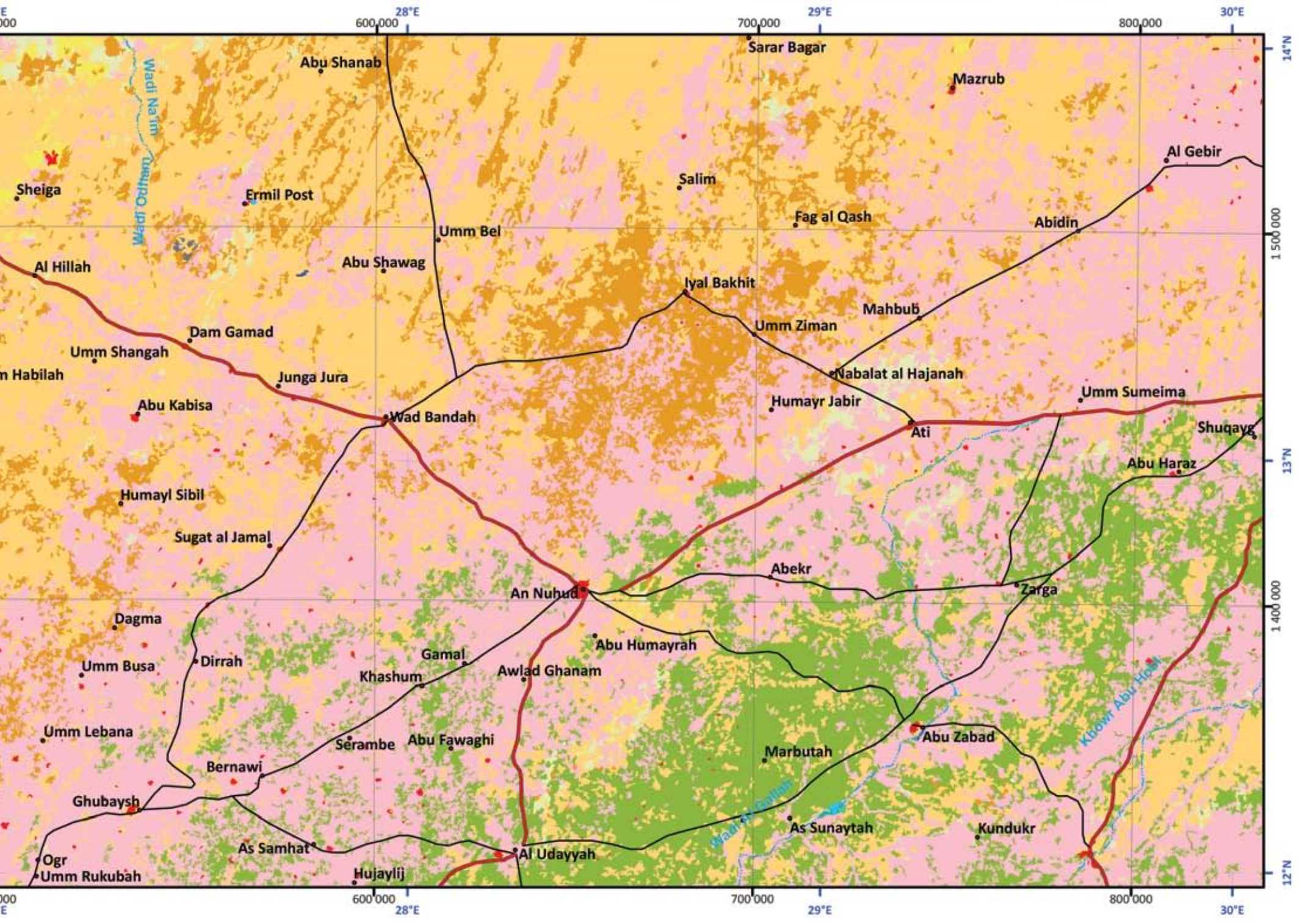
Scale 1: 1 250 000

The map is in the World Geodetic System (WGS84) and UTM projection (zone 35).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

ND-34-N ABECHE-N	ND-35-N EL-FACHER-N	ND-36-N KHARTOUM-N
ND-34-S ABECHE-S	ND-35-S EL-FACHER-S	ND-36-S KHARTOUM-S
NC-34-N FORT ARCHAMBAULT-N	NC-35-N BAHR EL-ARAB-N	NC-36-N SOBAT-N



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

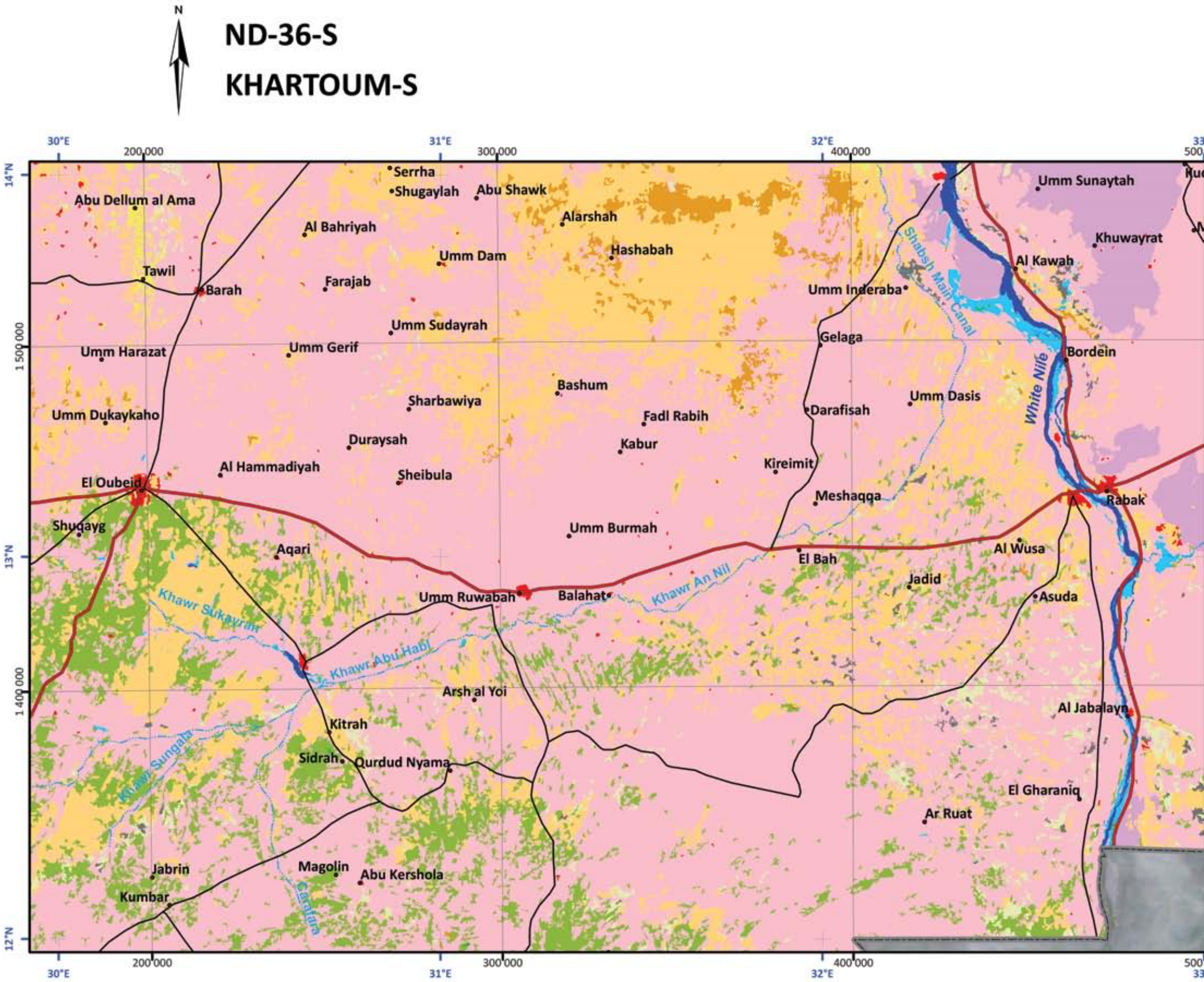
- Water body
- Floodplain
- Aquatic vegetation

Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-36-S
KHARTOUM-S

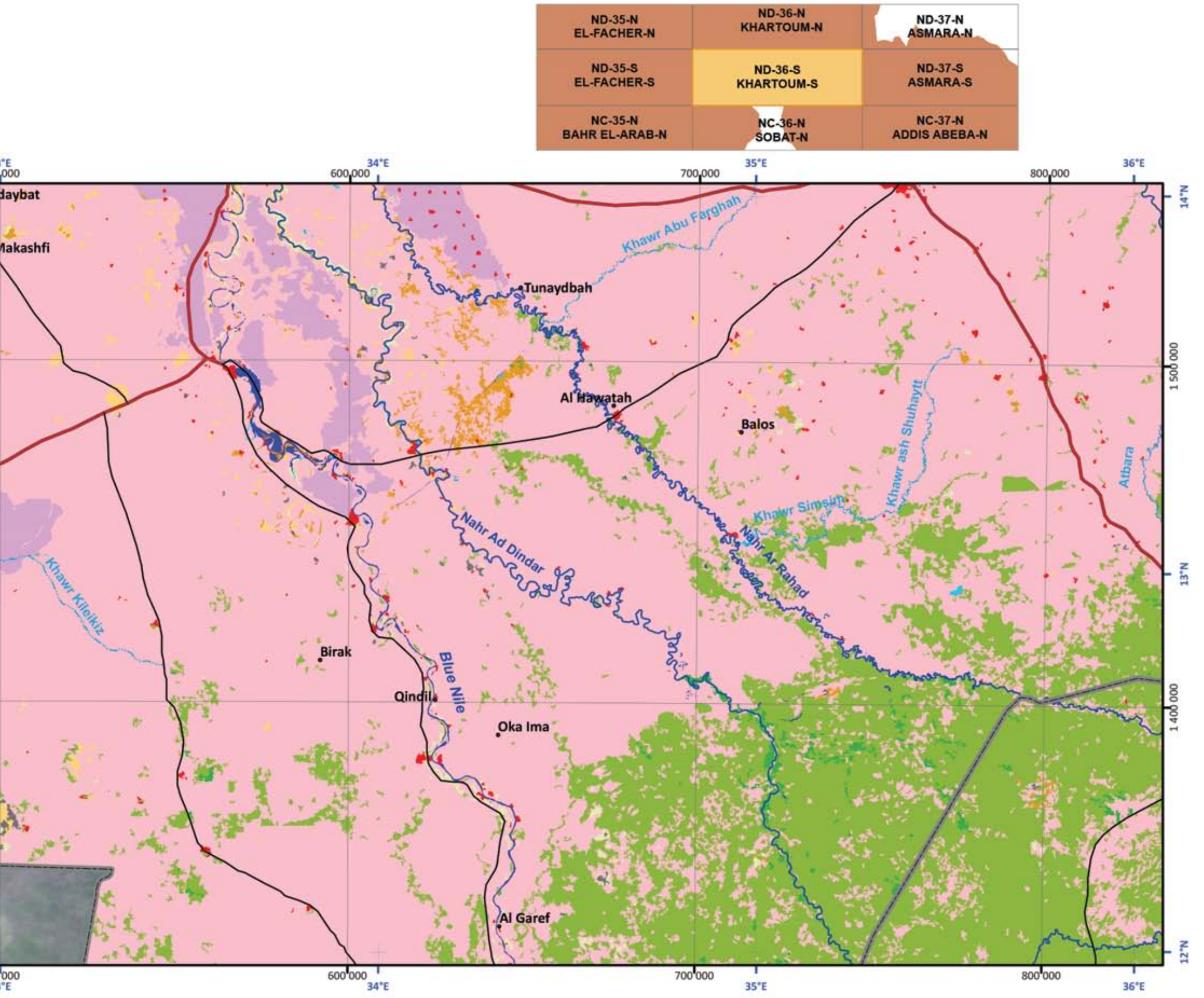


Scale 1: 1 250 000

The map is in the World Geodetic System (WGS84) and UTM projection (zone 36).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

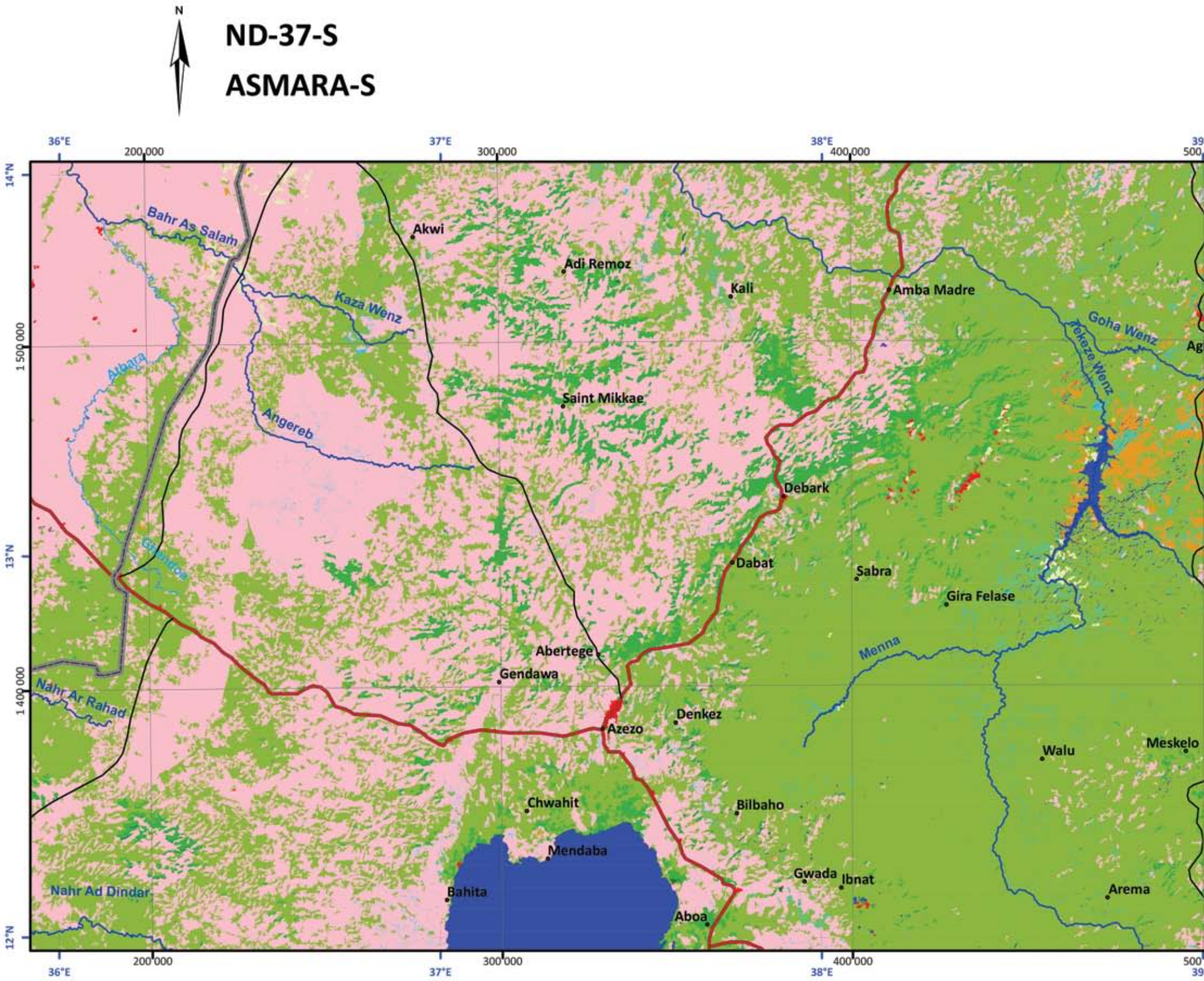
- Water body
- Floodplain
- Aquatic vegetation

Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-37-S
ASMARA-S



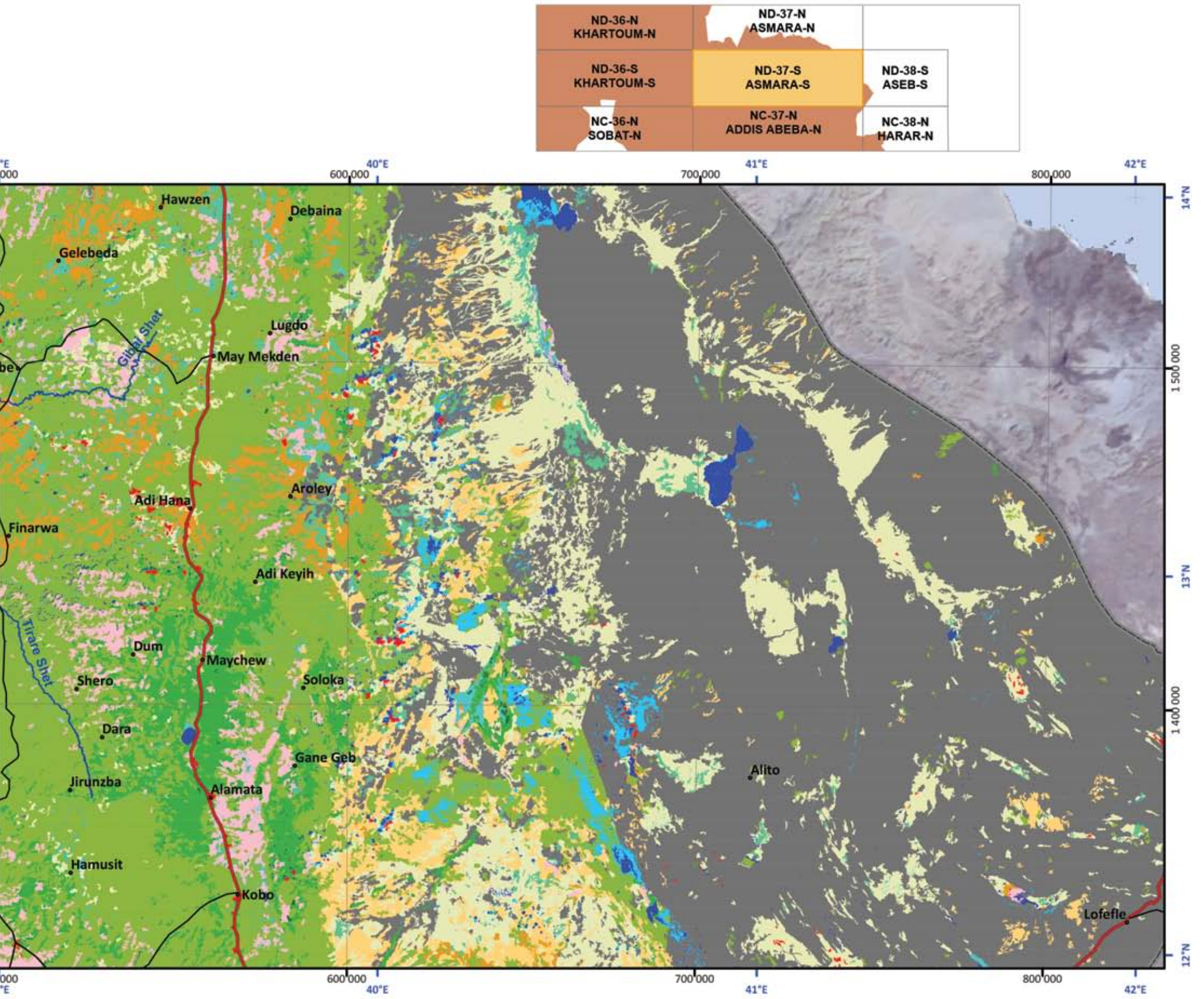
Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 37).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

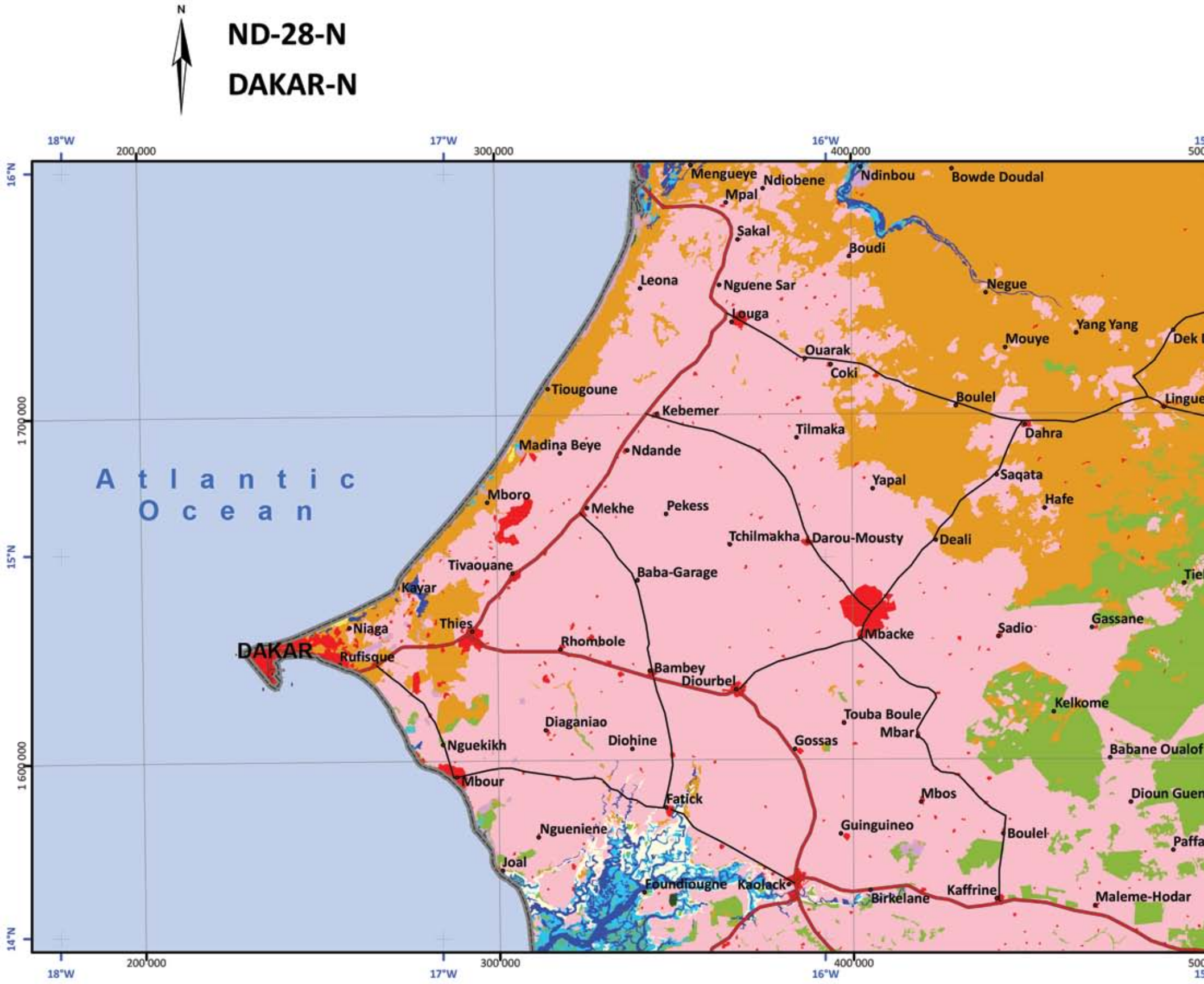
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-28-N

DAKAR-N

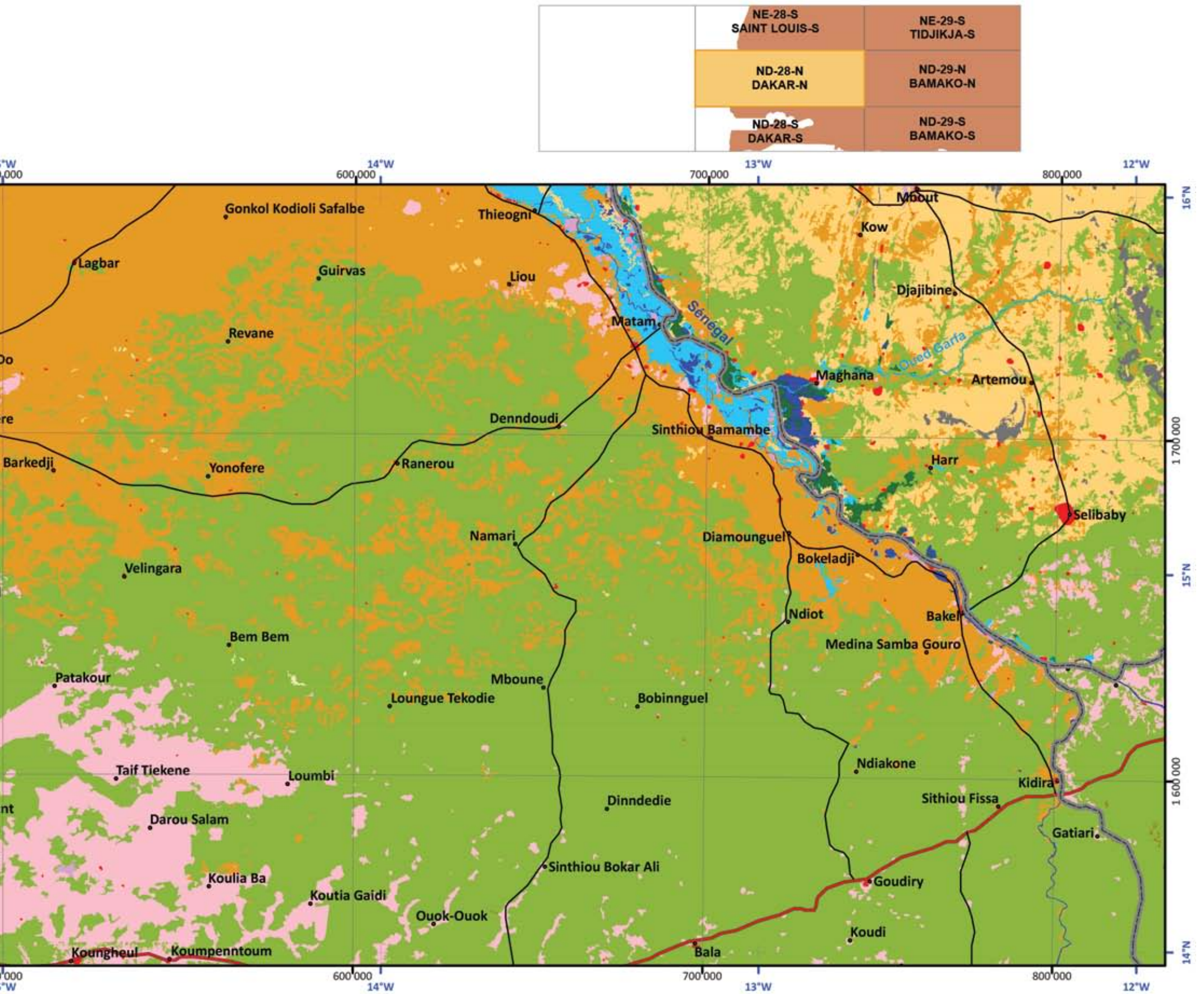


Scale 1: 1 250 000

The map is in the World Geodetic System (WGS84) and UTM projection (zone 28).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

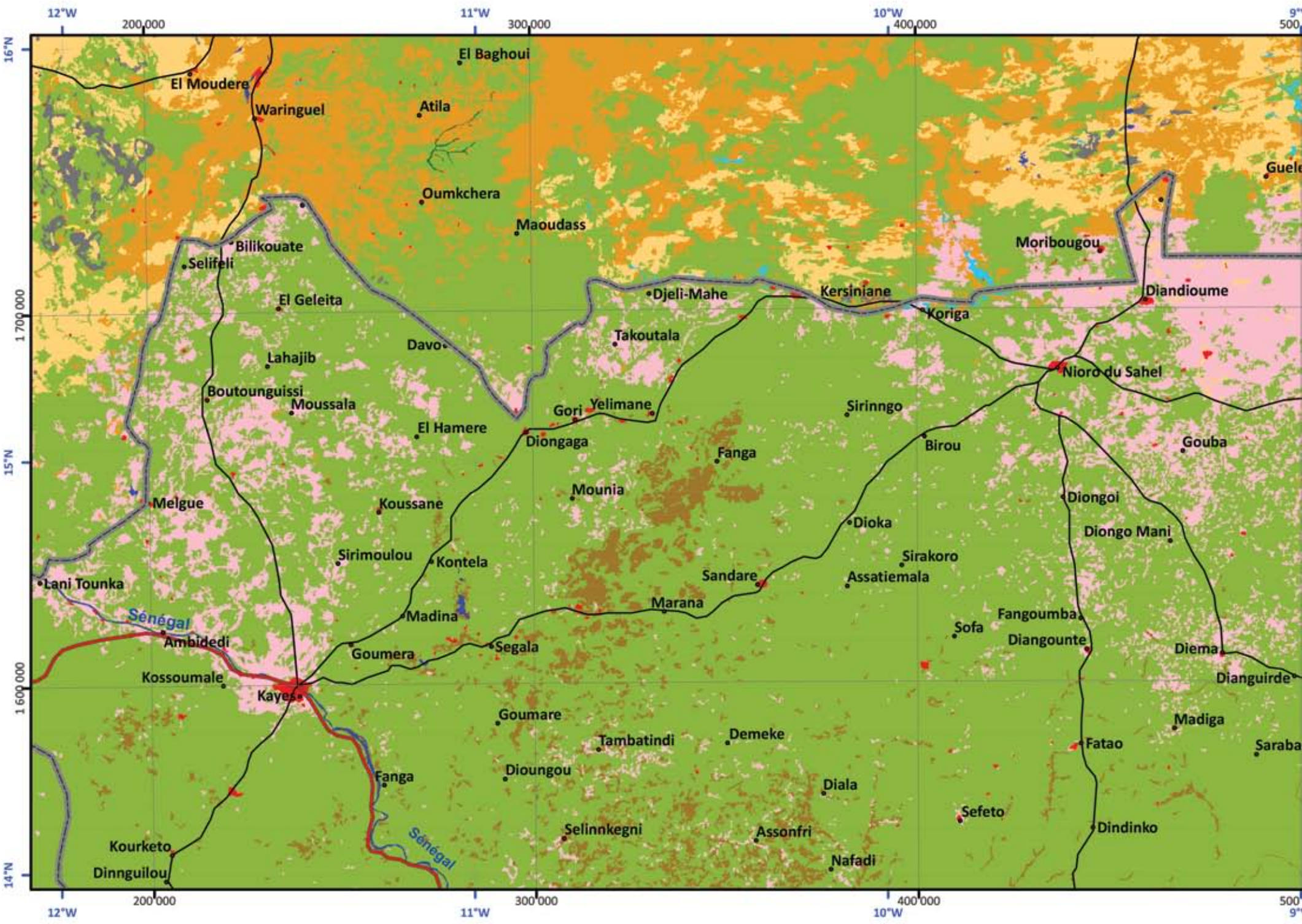
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-29-N

BAMAKO-N



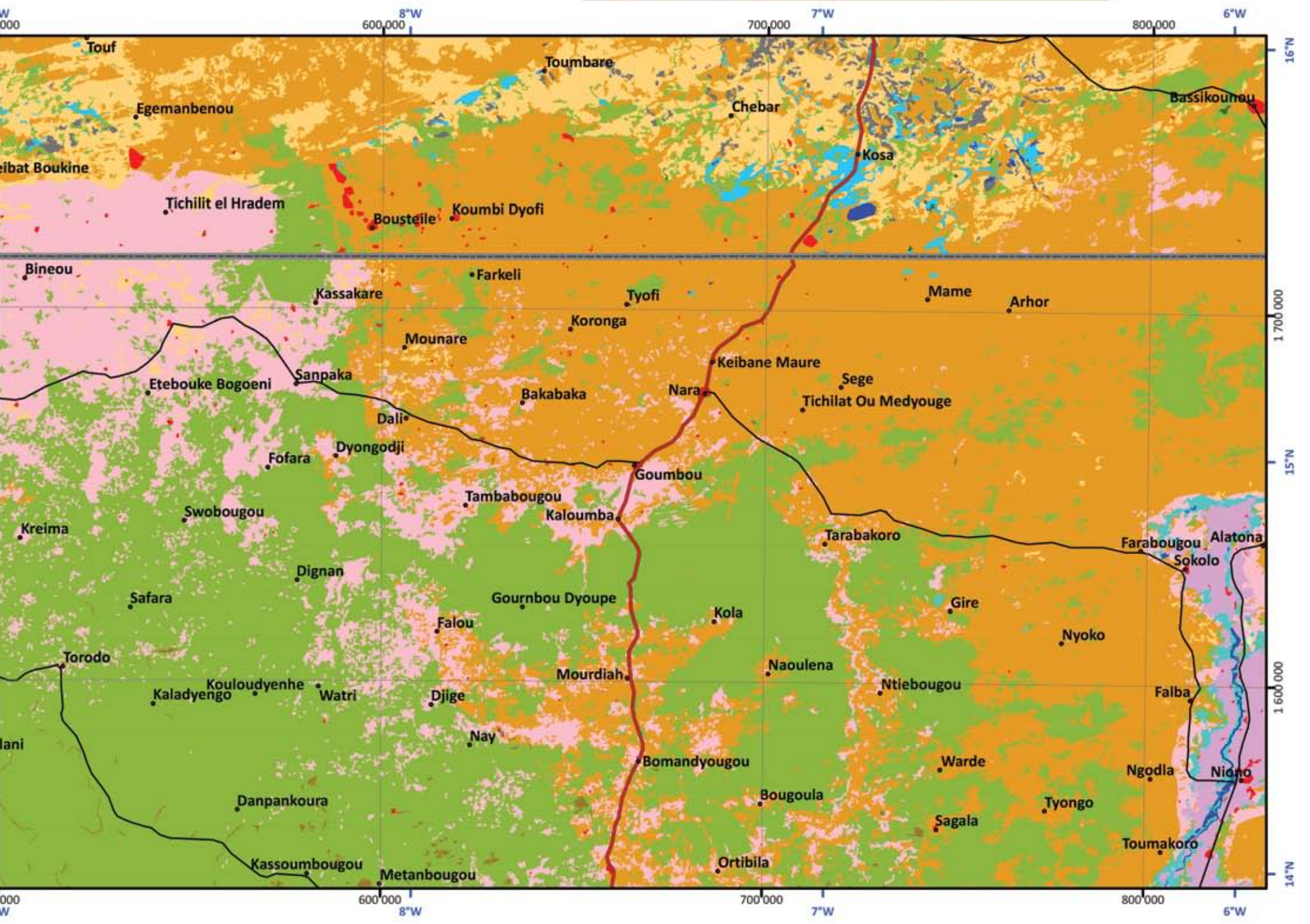
Scale 1: 1 250 000

The map is in the World Geodetic System (WGS84) and UTM projection (zone 29).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NE-28-S SAINT LOUIS-S	NE-29-S TIDJIKJA-S	NE-30-S TOMBOUCTOU-S
ND-28-N DAKAR-N	ND-29-N BAMAKO-N	ND-30-N OUAGADOUGOU-N
ND-28-S DAKAR-S	ND-29-S BAMAKO-S	ND-30-S OUAGADOUGOU-S



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

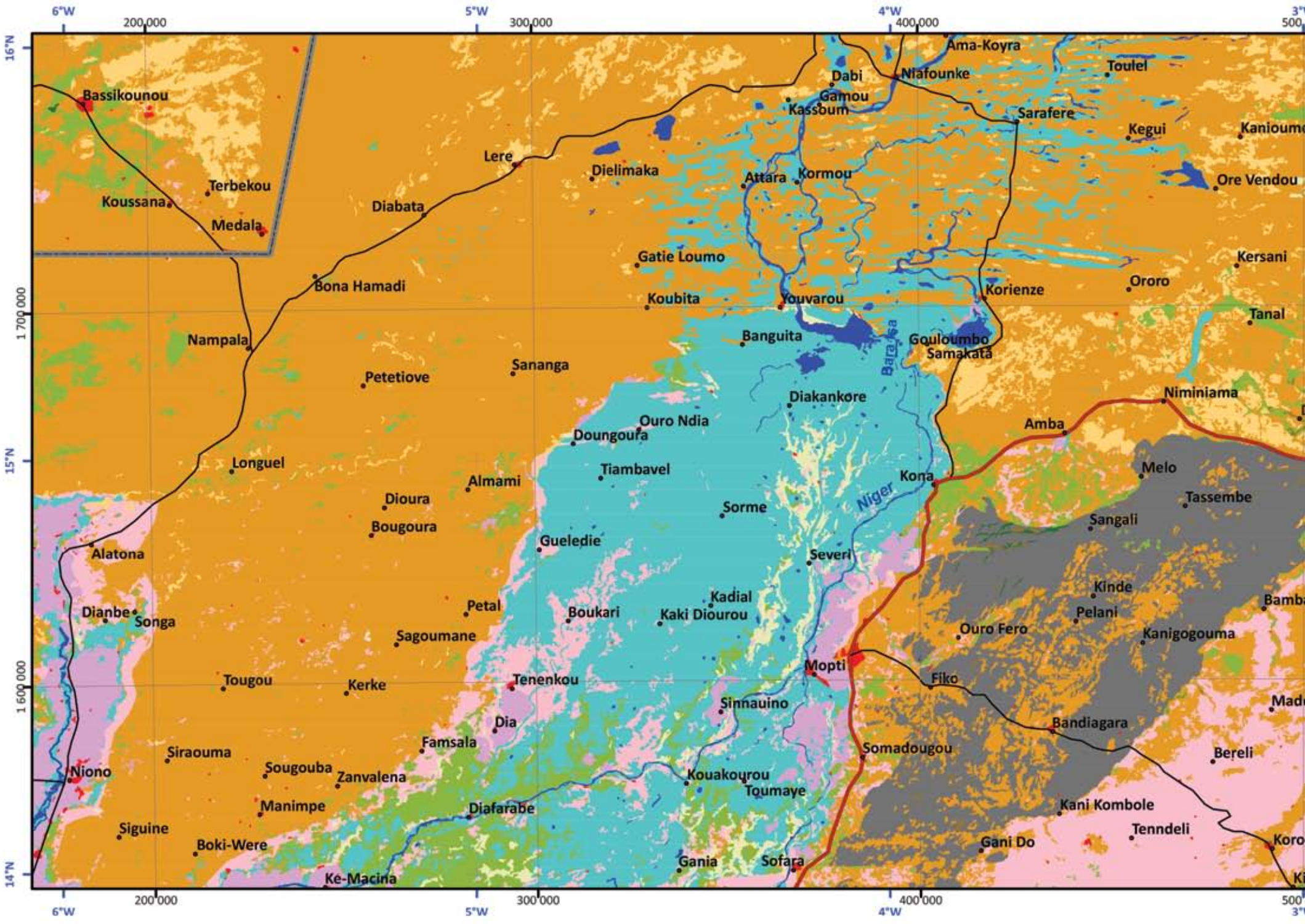
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-30-N

OUAGADOUGOU-N



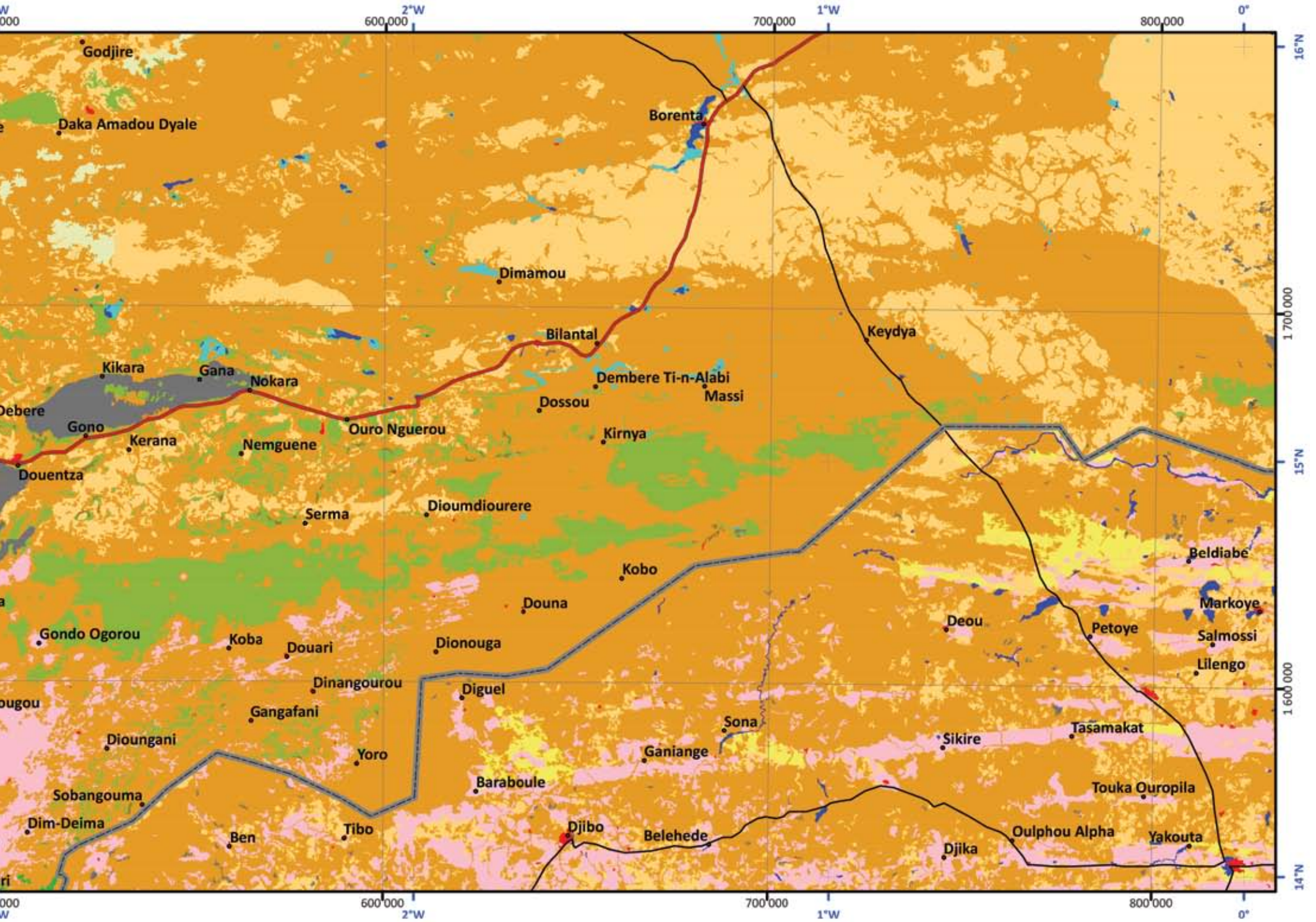
Scale 1: 1 250 000

The map is in the World Geodetic System (WGS84) and UTM projection (zone 30).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NE-29-S TIDJIKJA-S	NE-30-S TOMBOUCTOU-S	NE-31-S KIDAL-S
ND-29-N BAMAKO-N	ND-30-N OUAGADOUGOU-N	ND-31-N NIAMEY-N
ND-29-S BAMAKO-S	ND-30-S OUAGADOUGOU-S	ND-31-S NIAMEY-S



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

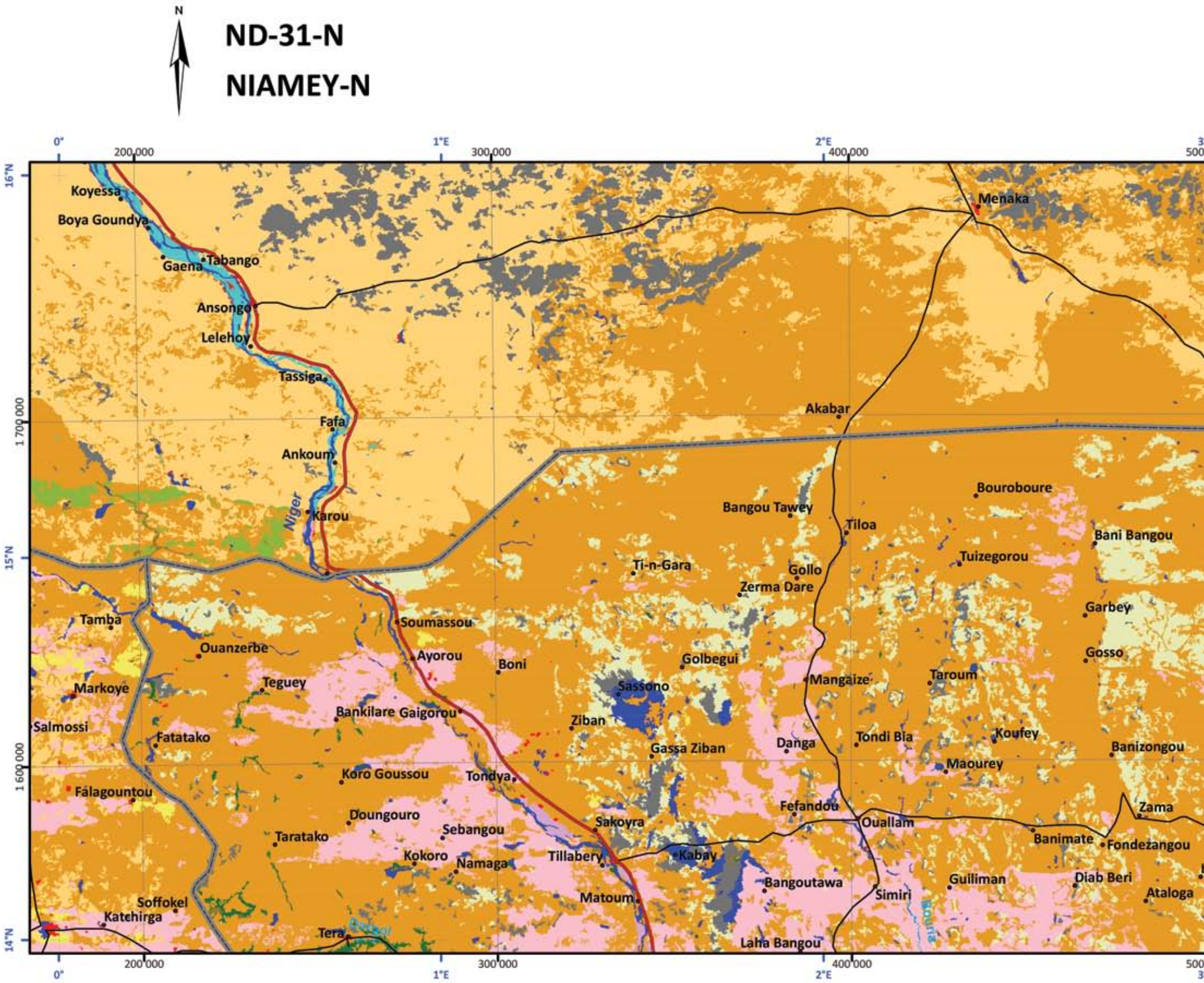
- Water body
- Floodplain
- Aquatic vegetation

Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-31-N
NIAMEY-N



Natural Vegetation

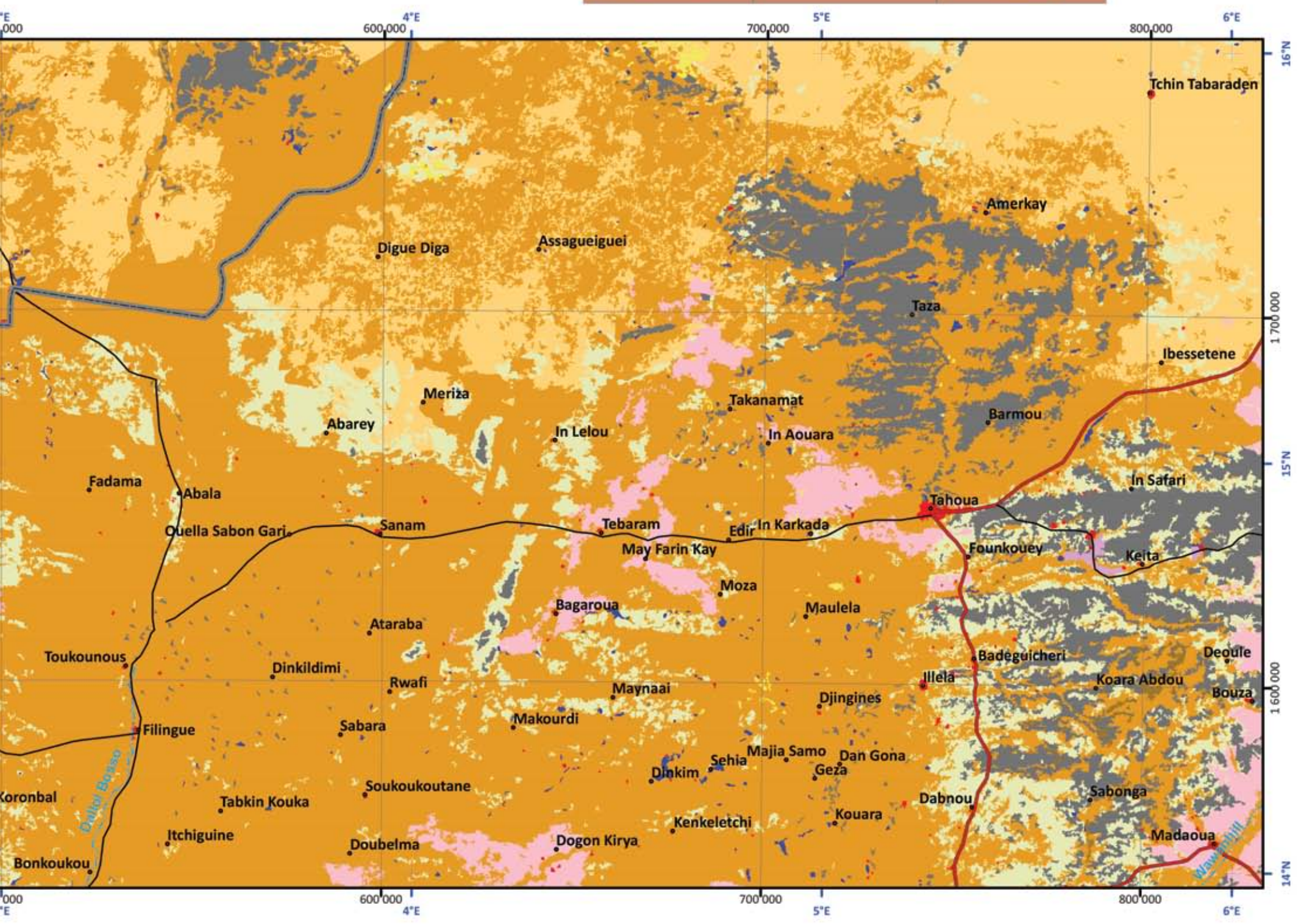
- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 31).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

NE-30-S TOMBOUCTOU-S	NE-31-S KIDAL-S	NE-32 & NE-33 AGADEZ-BILMA
ND-30-N OUAGADOUGOU-N	ND-31-N NIAMEY-N	ND-32-N ZINDER-N
ND-30-S OUAGADOUGOU-S	ND-31-S NIAMEY-S	ND-32-S ZINDER-S



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

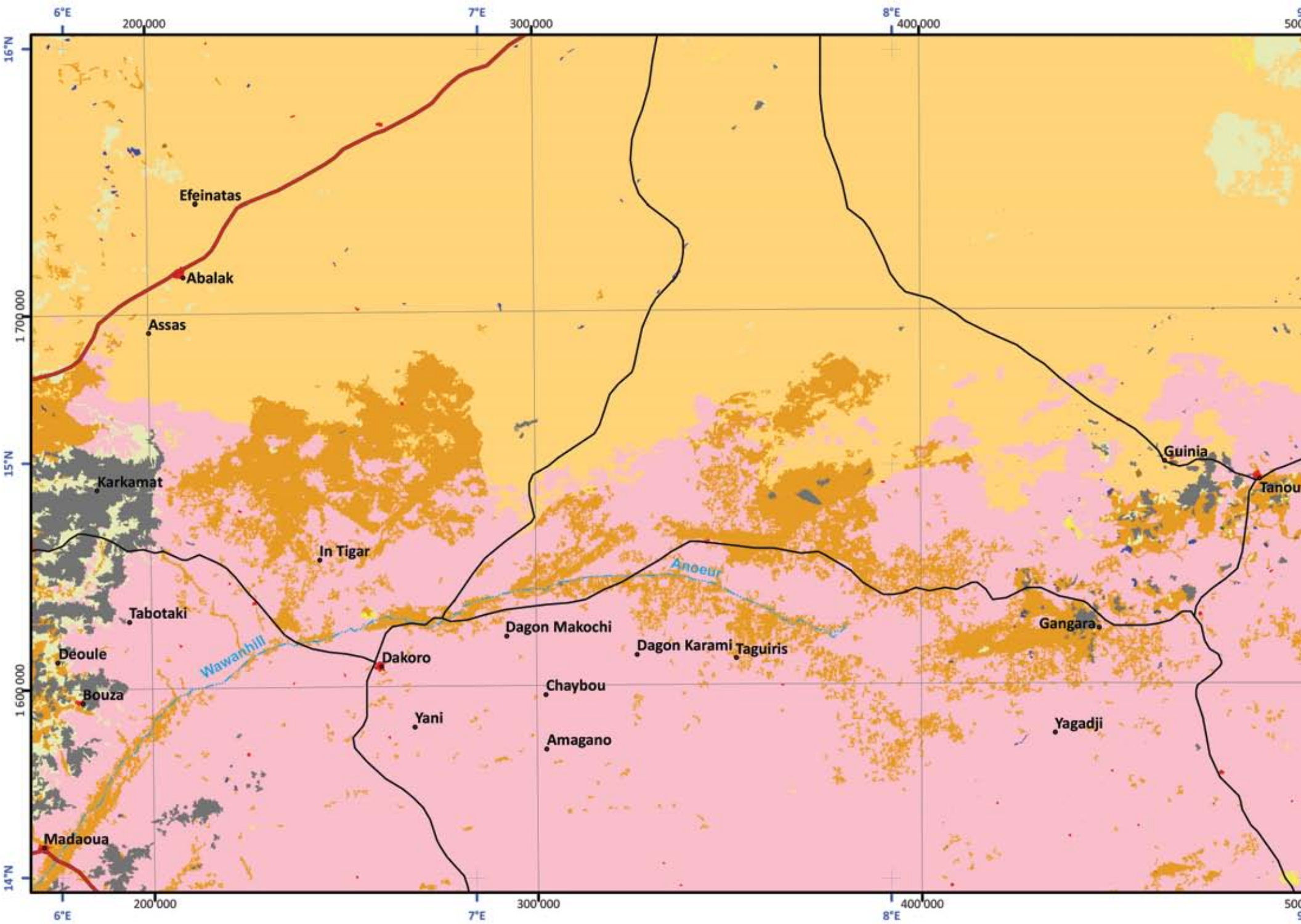
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-32-N

ZINDER-N



Scale 1: 1 250 000

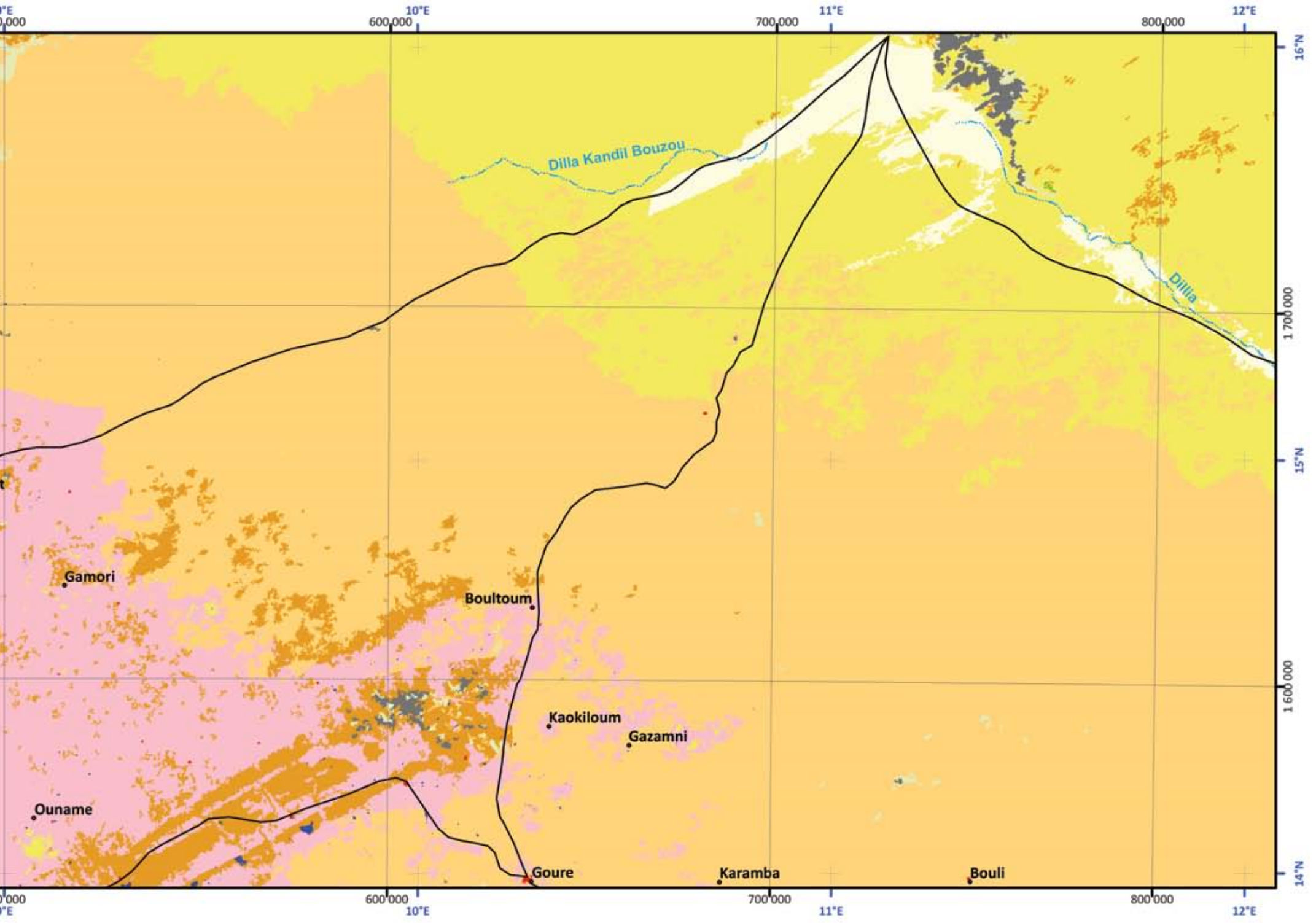
0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 32).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NE-31-S KIDAL-S	NE-32 & NE-33 AGADEZ-BILMA	
ND-31-N NIAMEY-N	ND-32-N ZINDER-N	ND-33-N FORT LAMY-N
ND-31-S NIAMEY-S	ND-32-S ZINDER-S	ND-33-S FORT LAMY-S



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

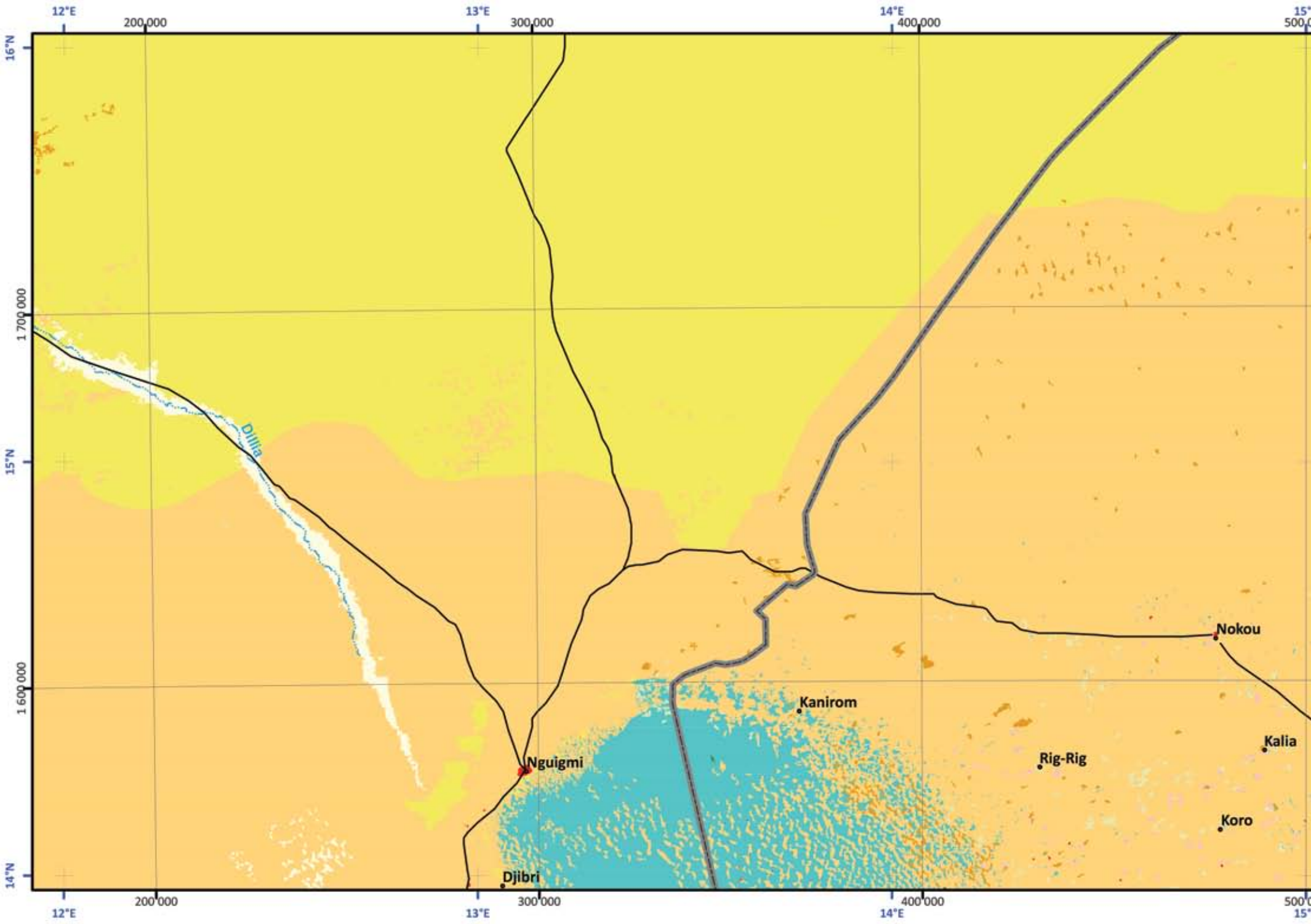
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-33-N

FORT LAMY-N



Scale 1: 1 250 000

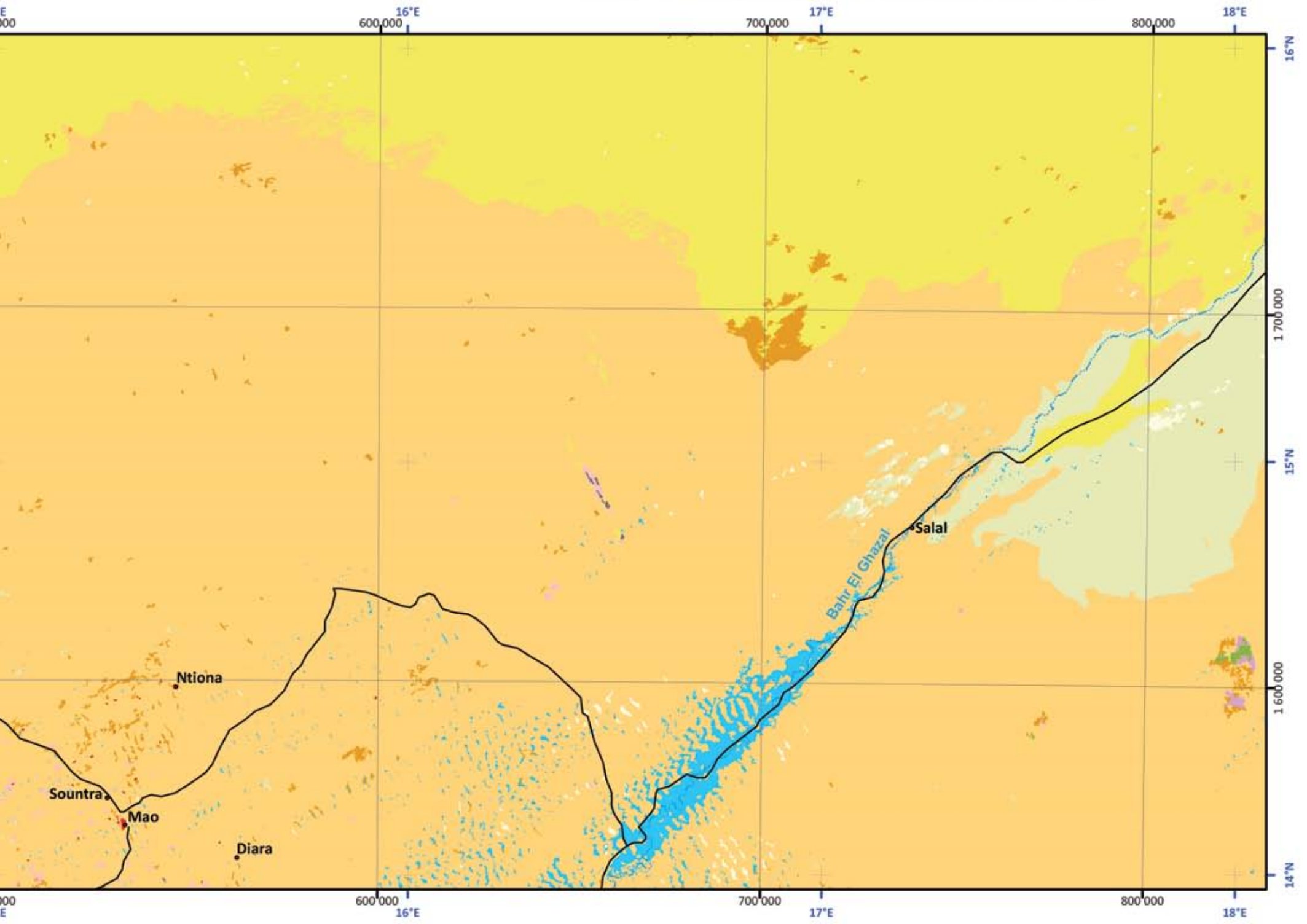
0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 33).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NE-32 & NE-33 AGADEZ-BILMA		NE-34 & NE-35 ENNEDI-BIR ENATRUN
ND-32-N ZINDER-N	ND-33-N FORT LAMY-N	ND-34-N ABECHE-N
ND-32-S ZINDER-S	ND-33-S FORT LAMY-S	ND-34-S ABECHE-S



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

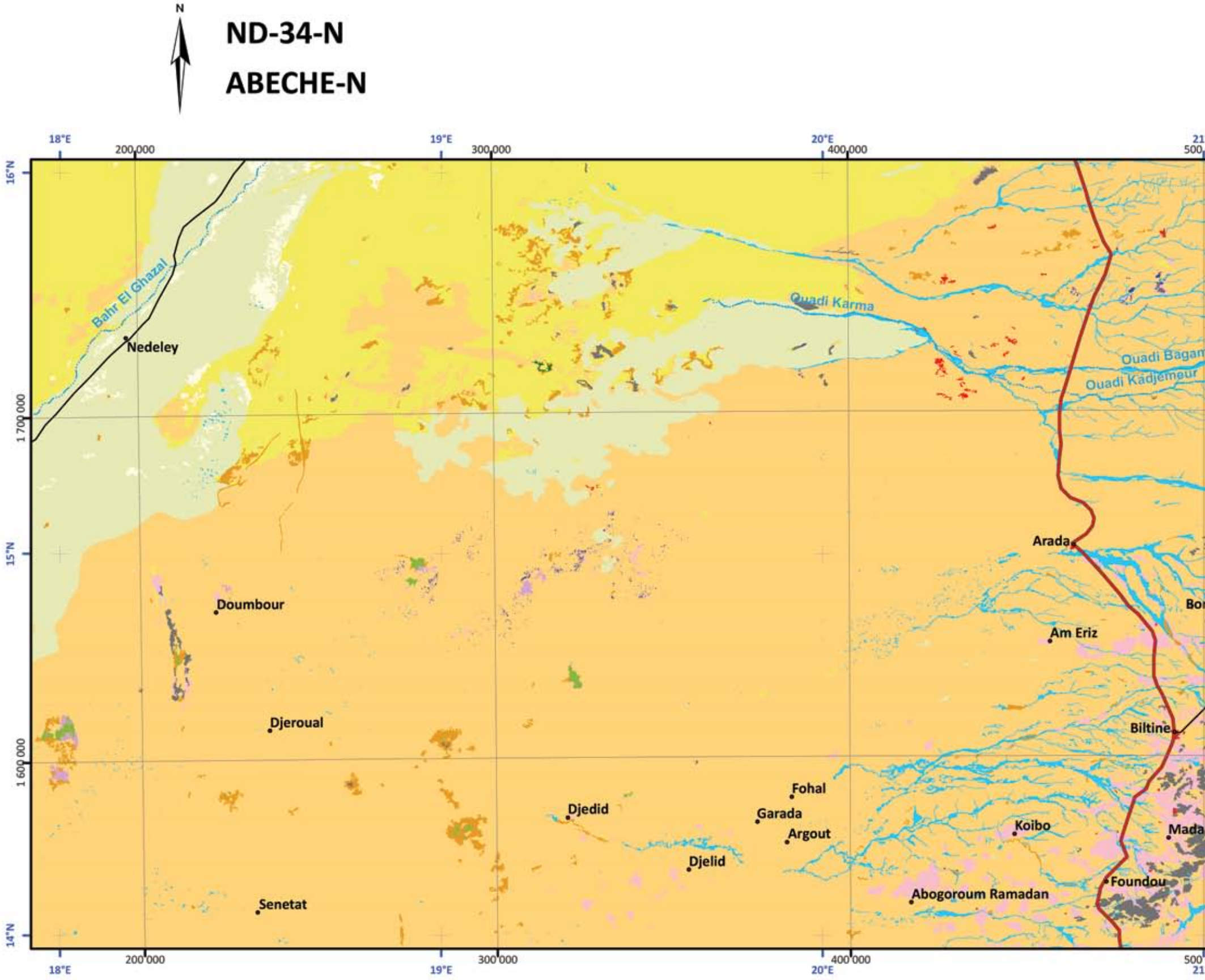
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-34-N

ABECHE-N



Scale 1: 1 250 000

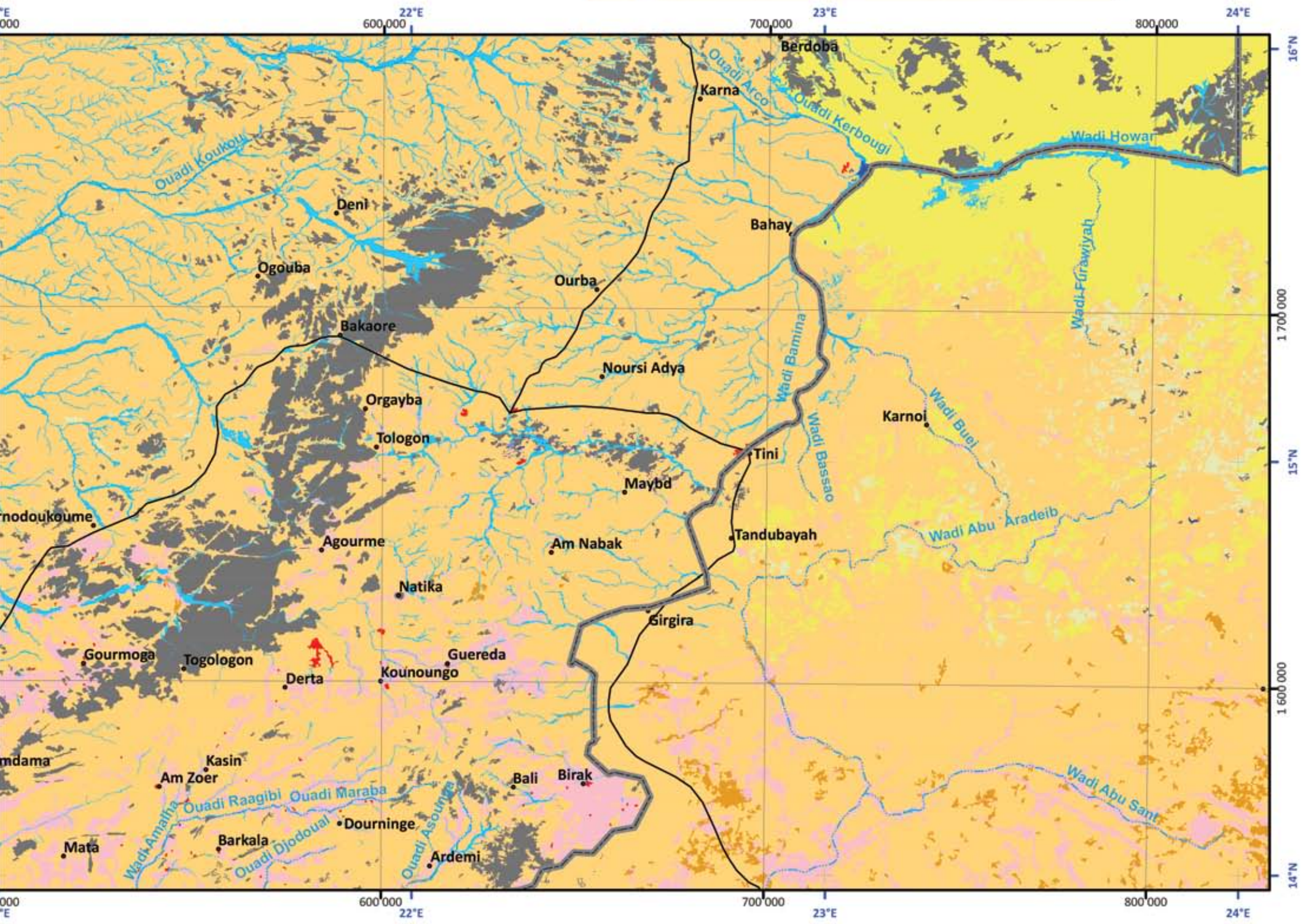
Km 0 20 40 60 80 100

The map is in the World Geodetic System (WGS84) and UTM projection (zone 34).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NE-32 & NE-33 AGADEZ-BILMA	NE-34 & NE-35 ENNEDI-BIR ENATRUN	
ND-33-N FORT LAMY-N	ND-34-N ABECHE-N	ND-35-N EL-FACHER-N
ND-33-S FORT LAMY-S	ND-34-S ABECHE-S	ND-35-S EL-FACHER-S



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

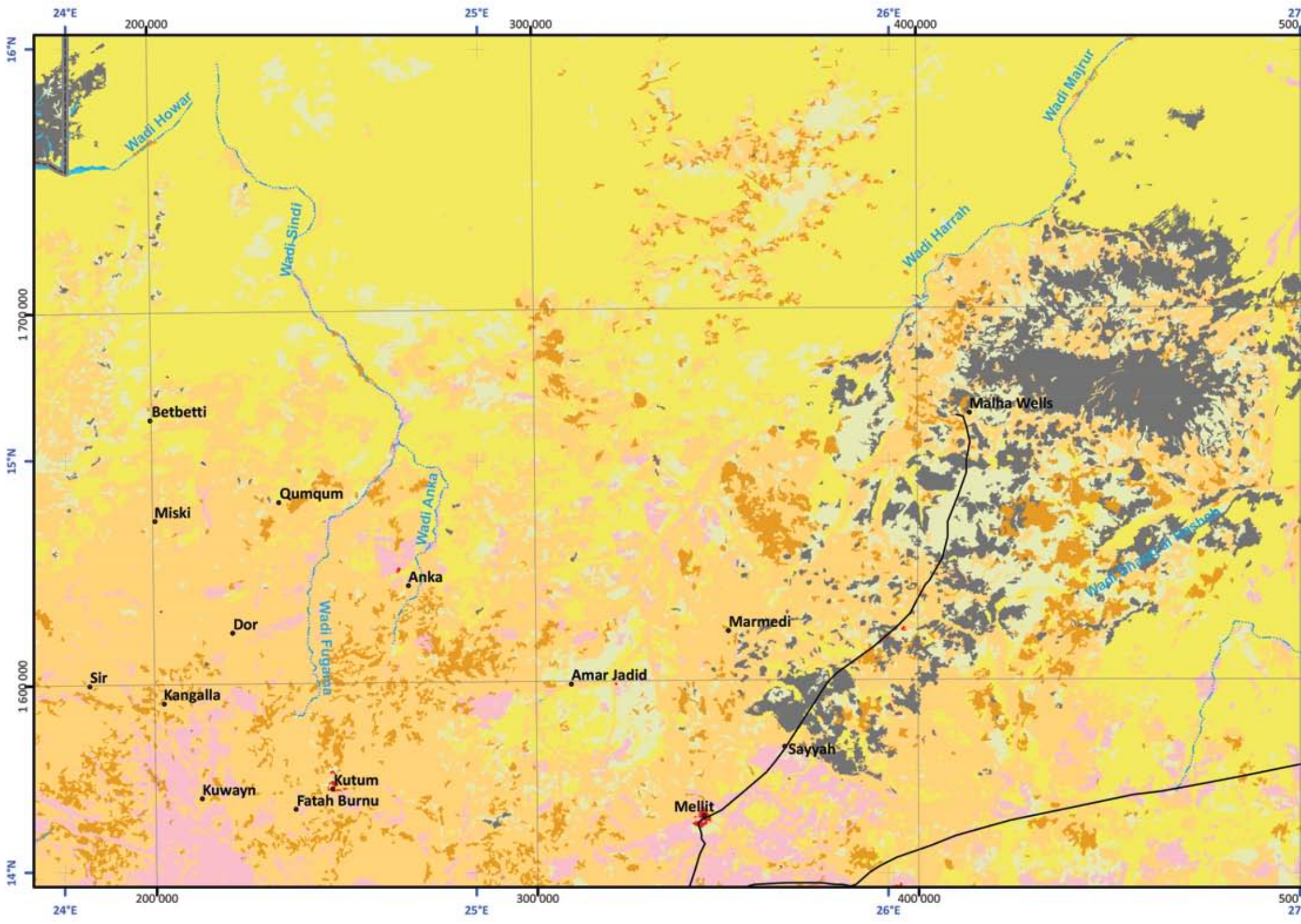
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-35-N

EL-FACHER-N



Scale 1: 1 250 000

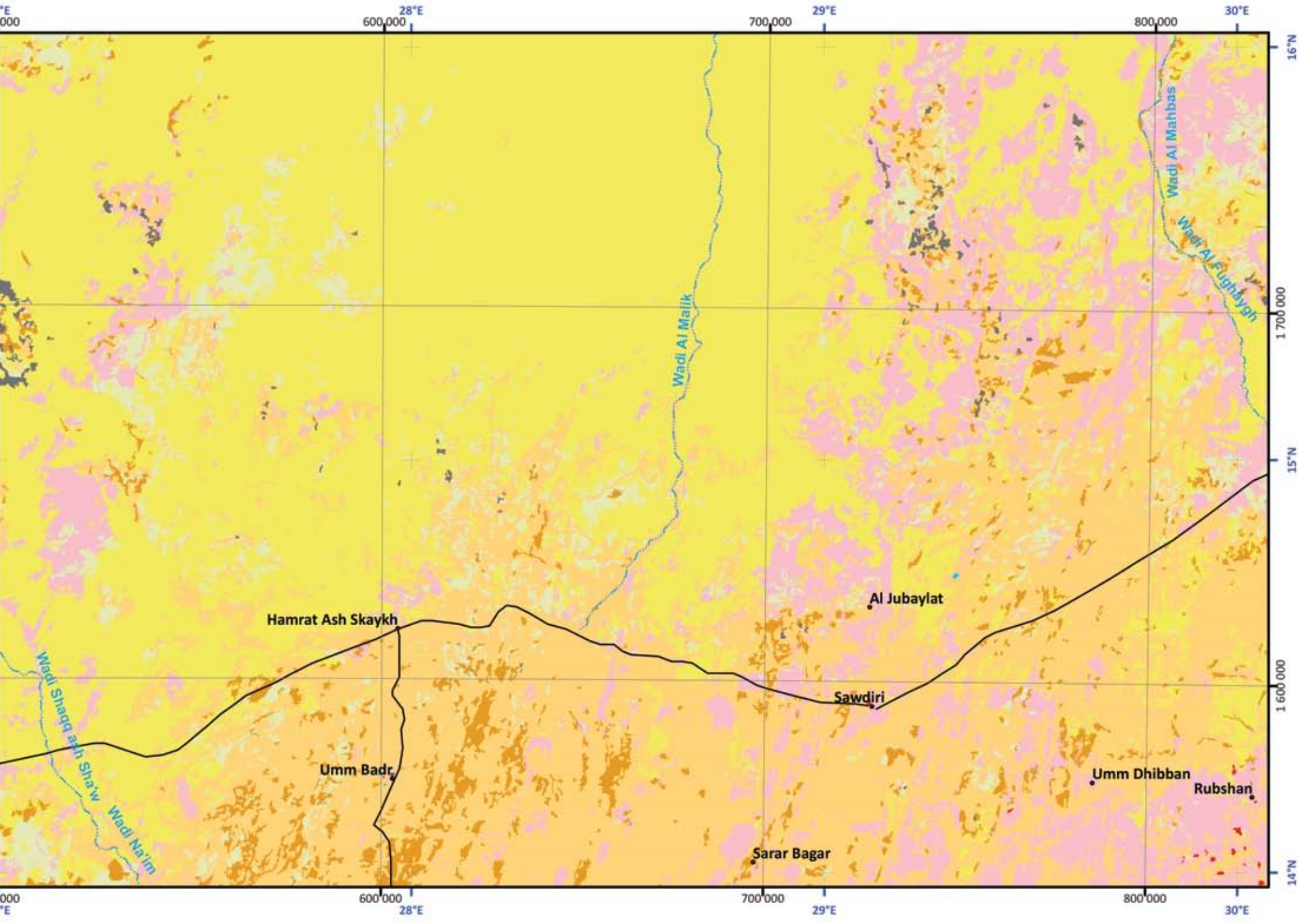
Km
0 20 40 60 80 100

The map is in the World Geodetic System (WGS84) and UTM projection (zone 35).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NE-34 & NE-35 ENNEDI-BIR ENATRUN		NE-36-S DONGOLA & BERBER-S
ND-34-N ABECHE-N	ND-35-N EL-FACHER-N	ND-36-N KHARTOUM-N
ND-34-S ABECHE-S	ND-35-S EL-FACHER-S	ND-36-S KHARTOUM-S



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

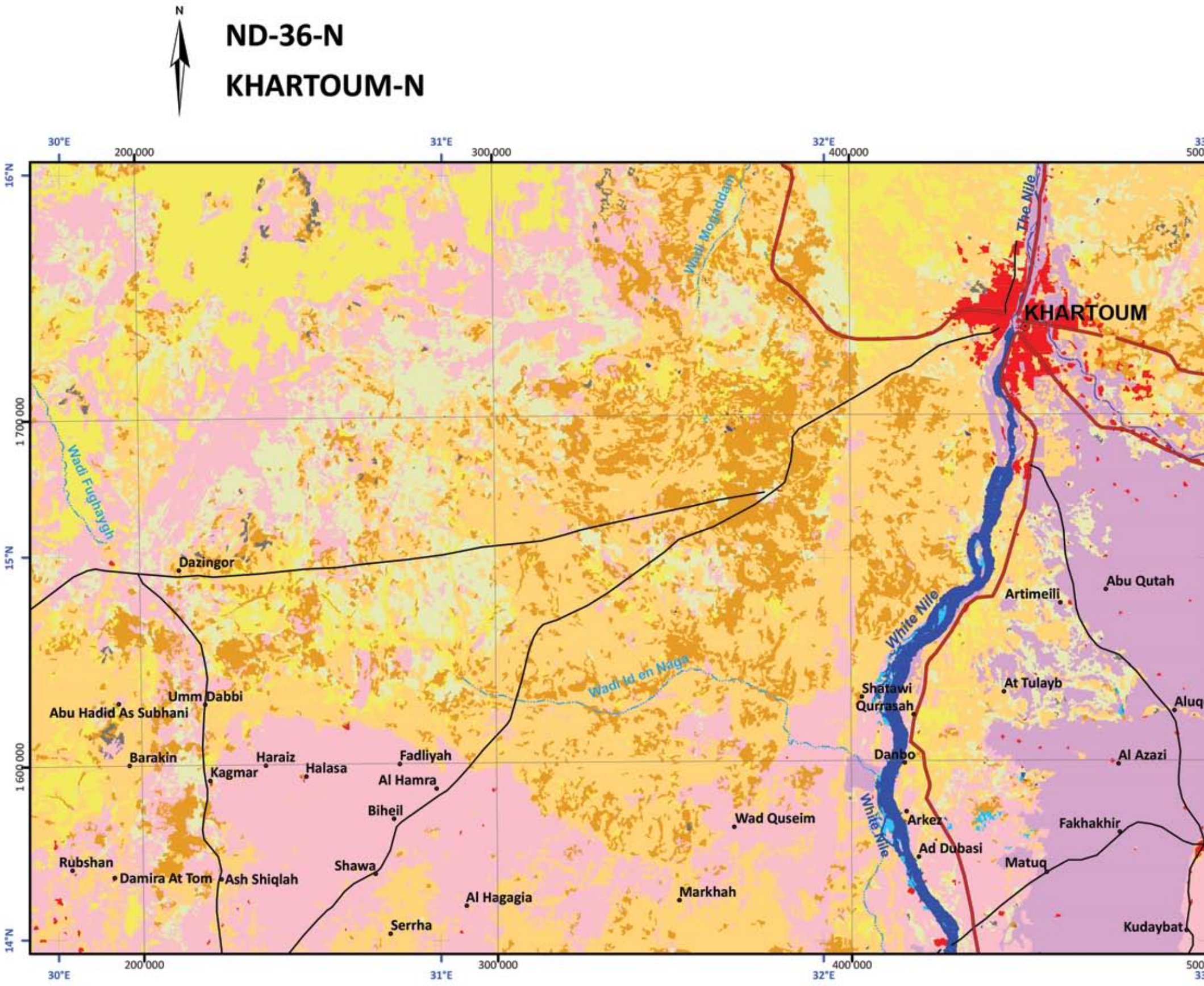
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-36-N

KHARTOUM-N



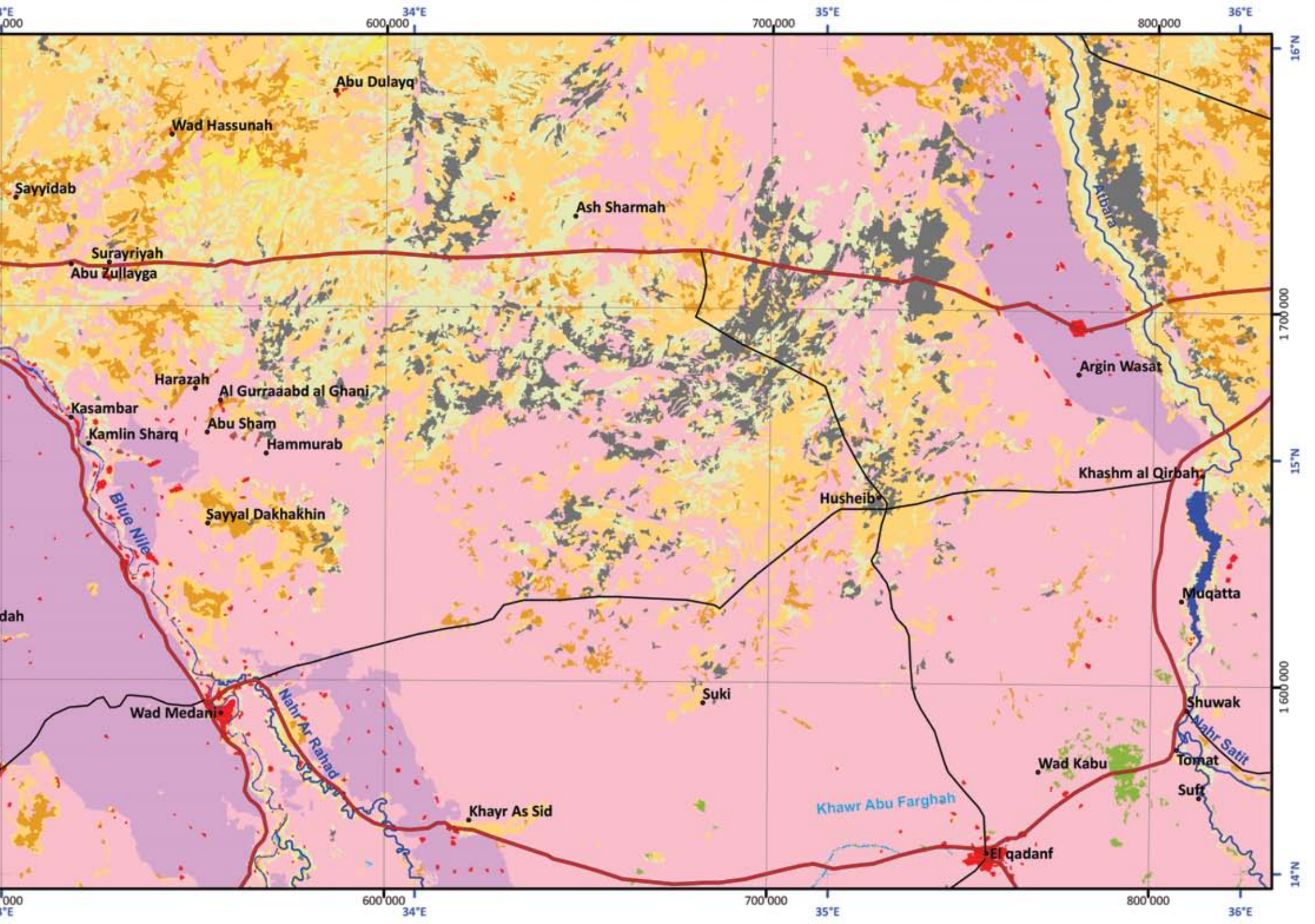
Scale 1: 1 250 000

The map is in the World Geodetic System (WGS84) and UTM projection (zone 36).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NE-34 & NE-35 ENNEDI-BIR ENATRUN	NE-36-S DONGOLA & BERBER-S	NE-37-S PORT SUDAN-S
ND-35-N EL-FACHER-N	ND-36-N KHARTOUM-N	ND-37-N ASMARA-N
ND-35-S EL-FACHER-S	ND-36-S KHARTOUM-S	ND-37-S ASMARA-S



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

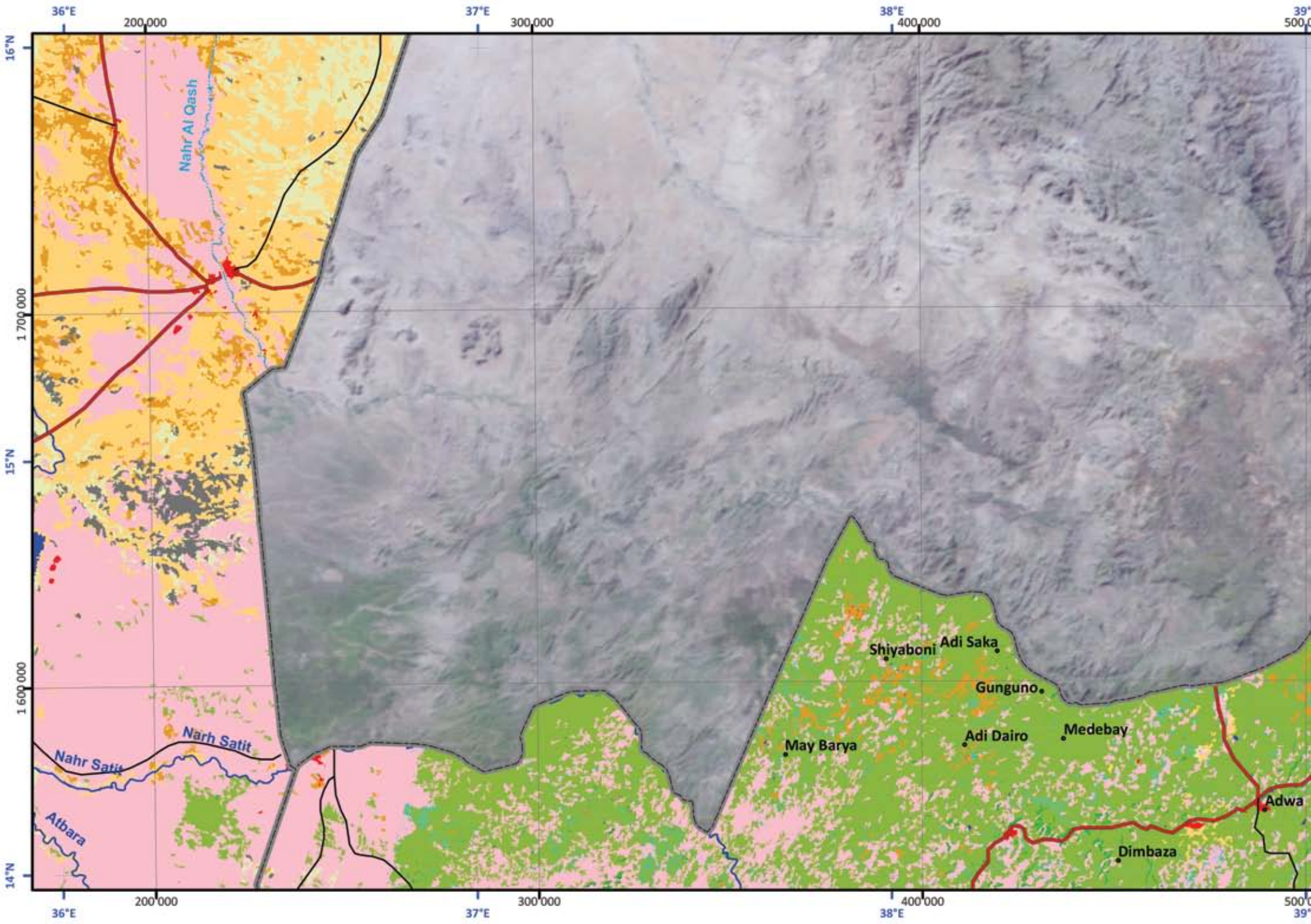
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-37-N

ASMARA-N



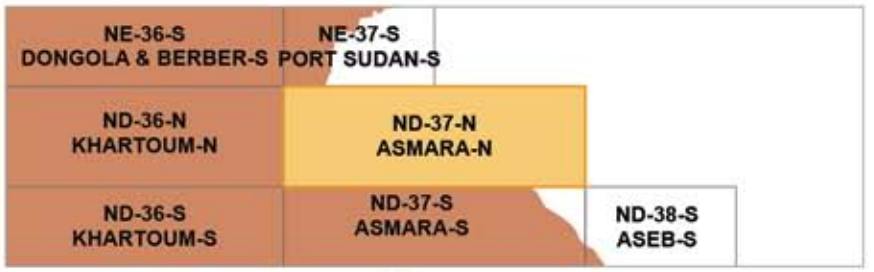
Scale 1: 1 250 000

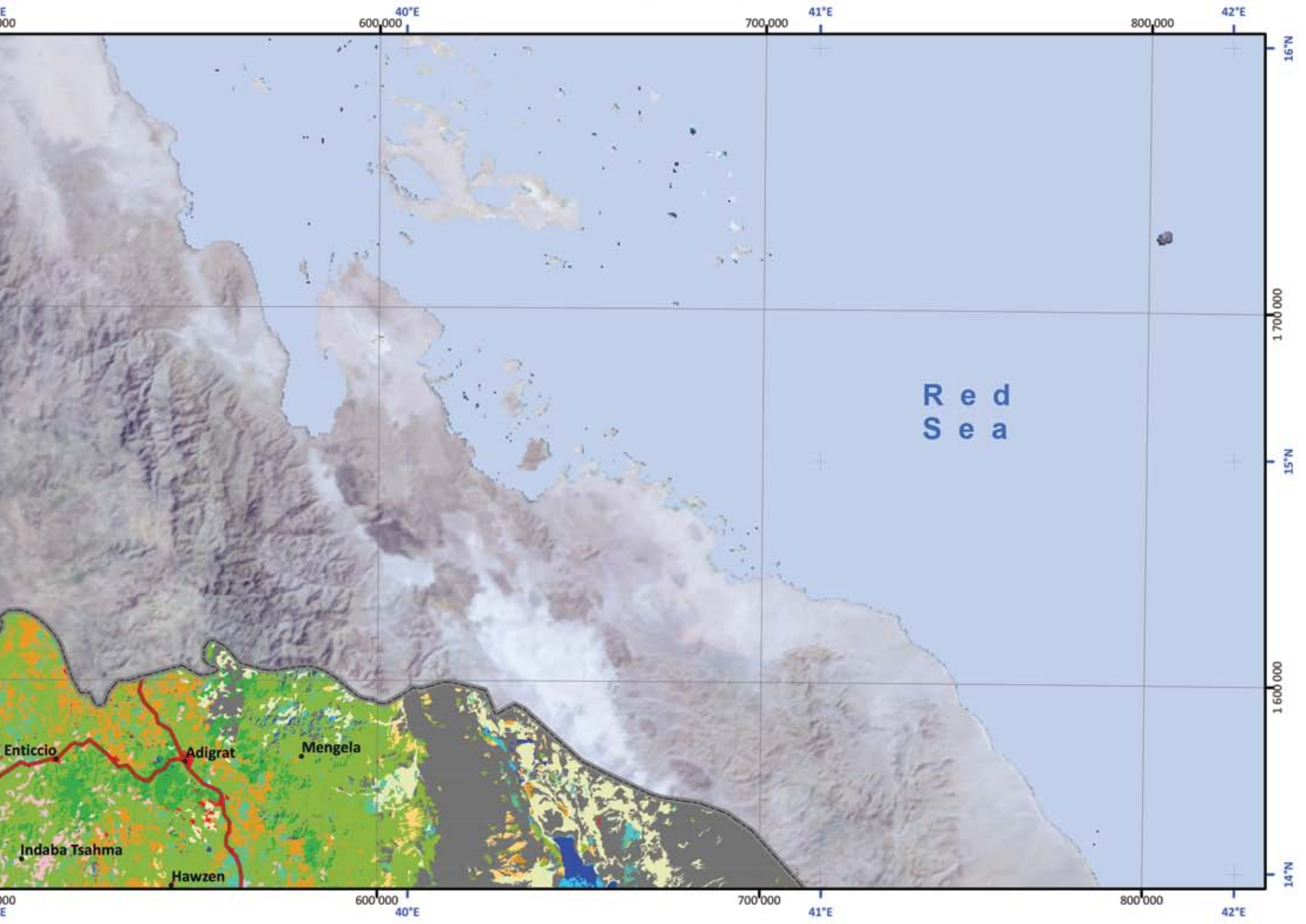
0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 37).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe





Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

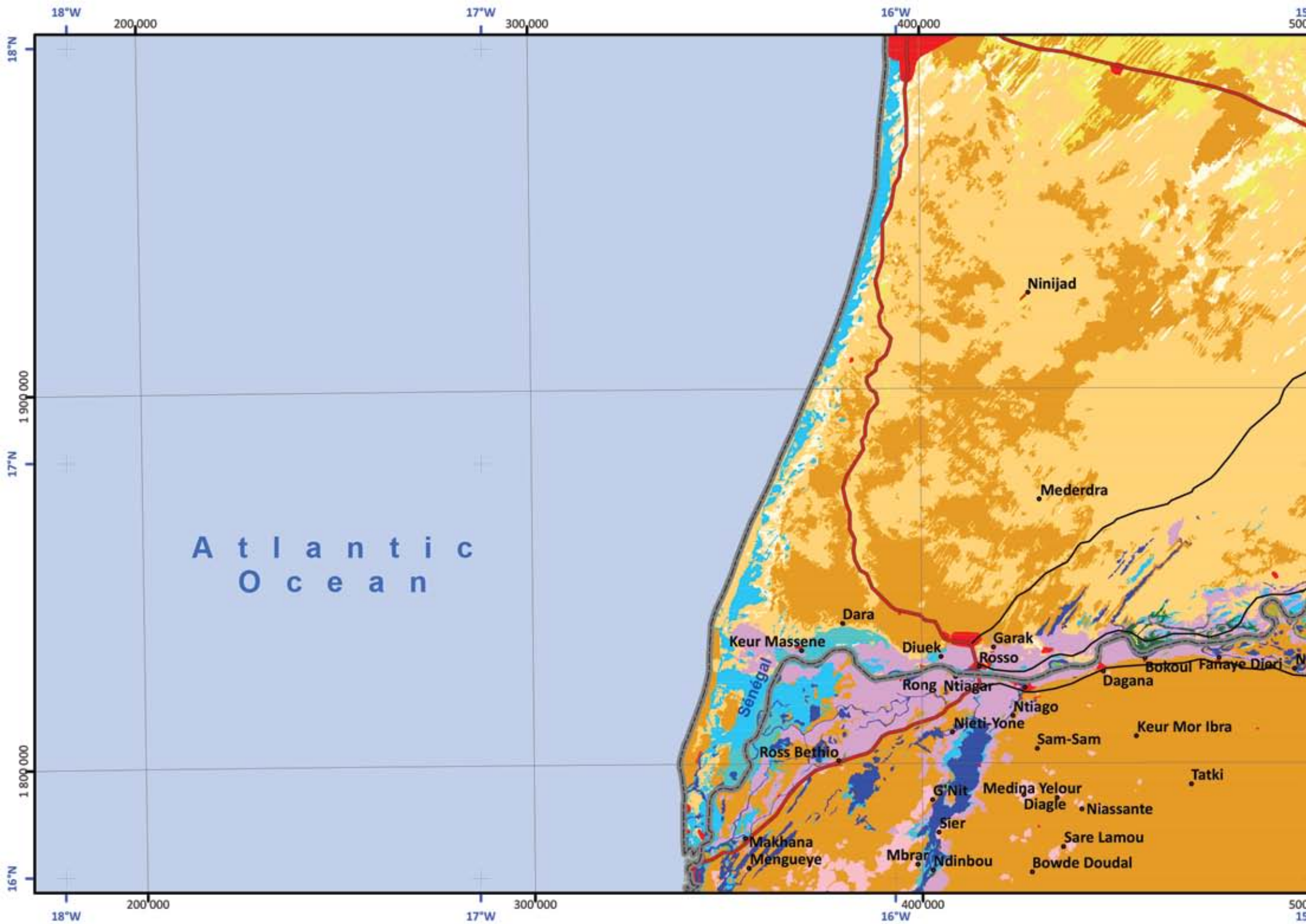
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NE-28-S

SAINT LOUIS-S



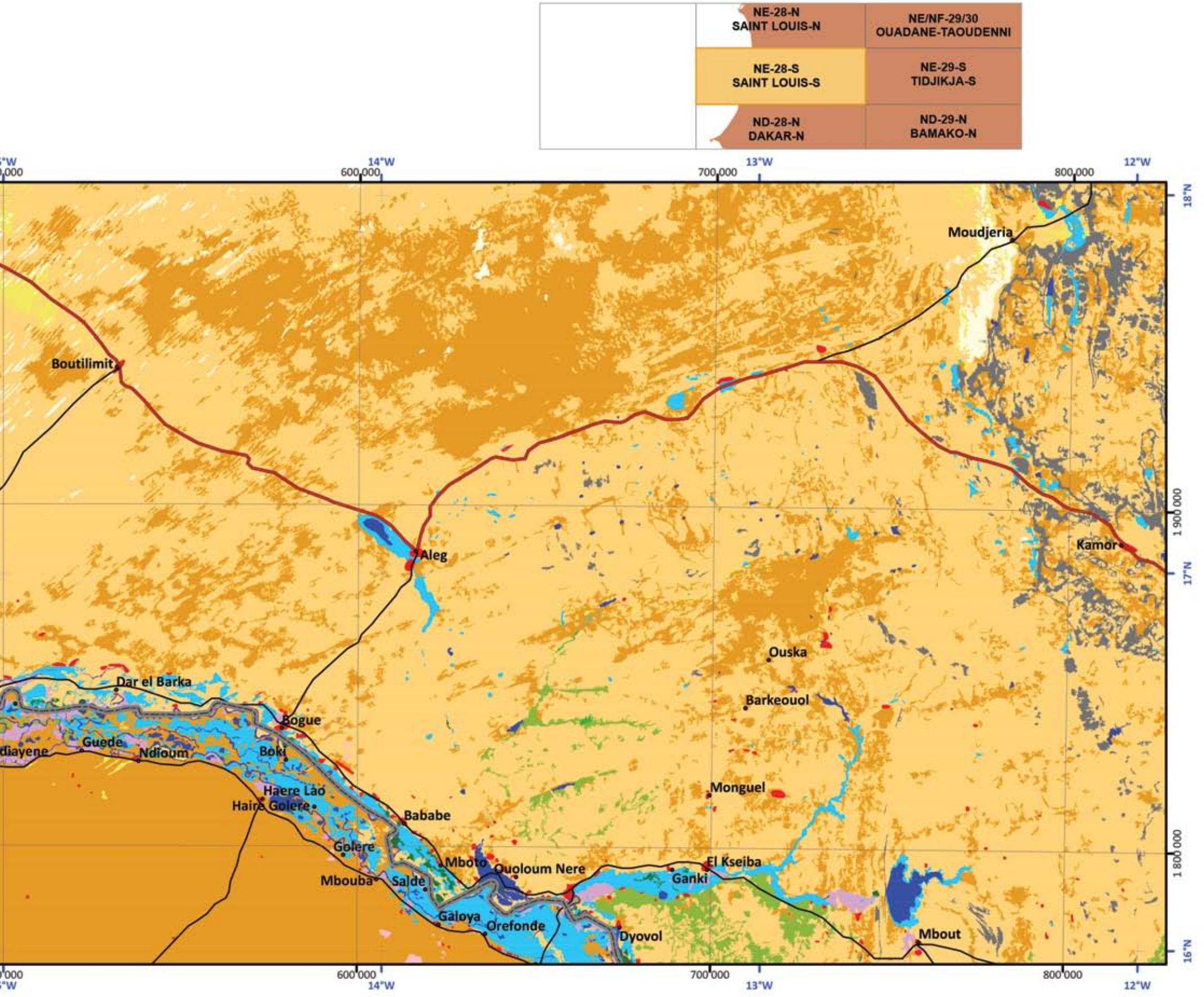
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 28).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

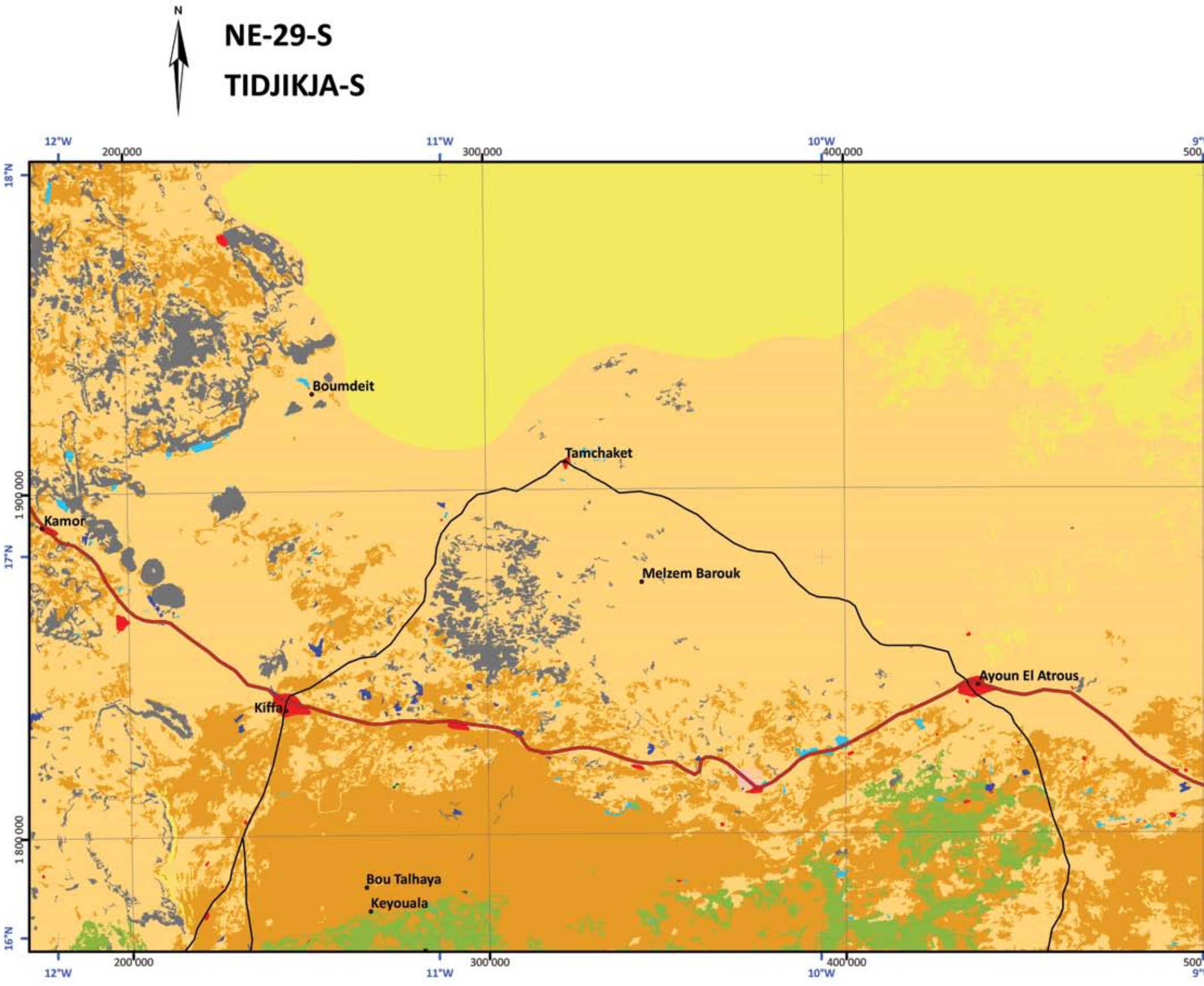
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NE-29-S

TIDJIKJA-S



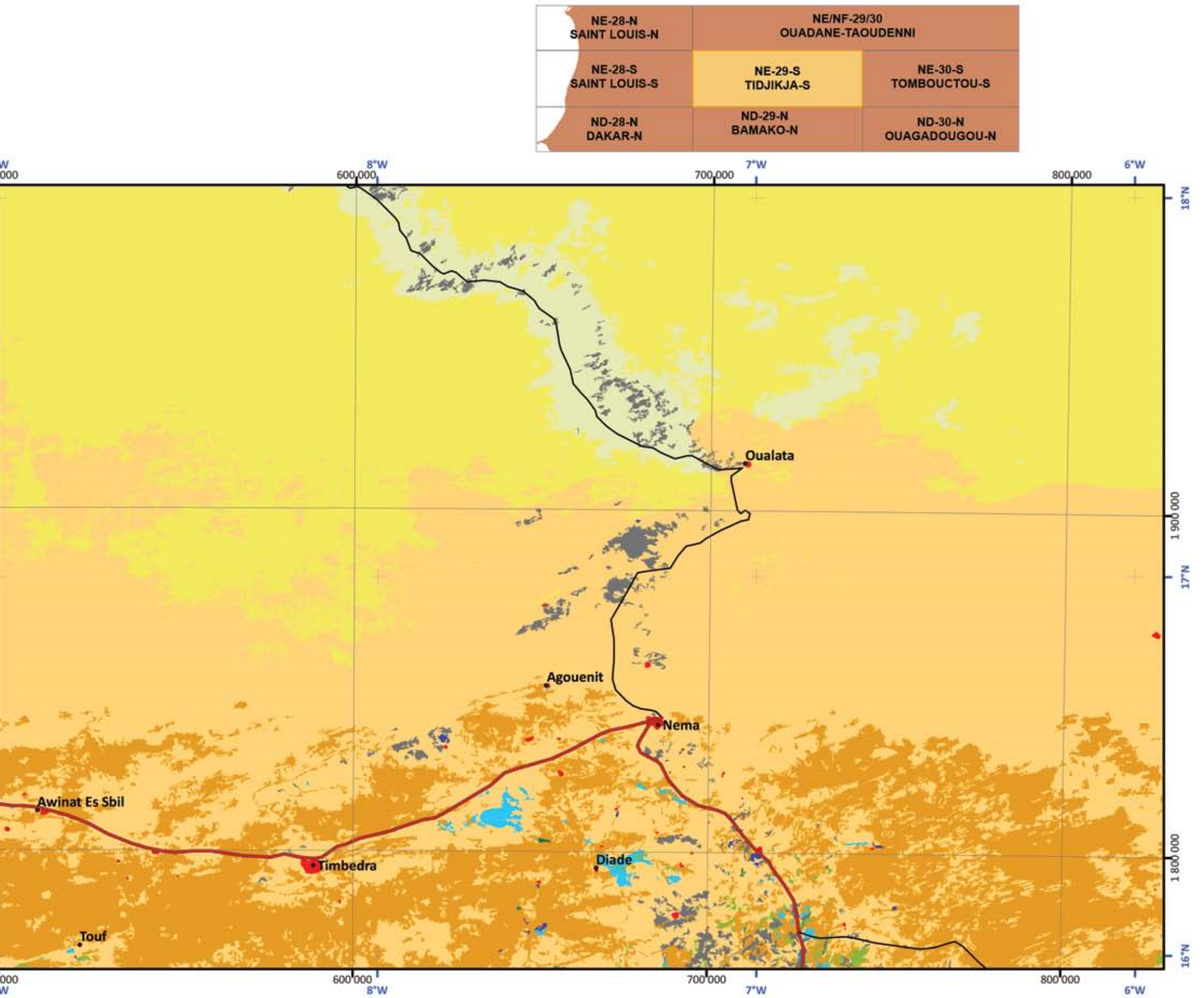
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 29).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

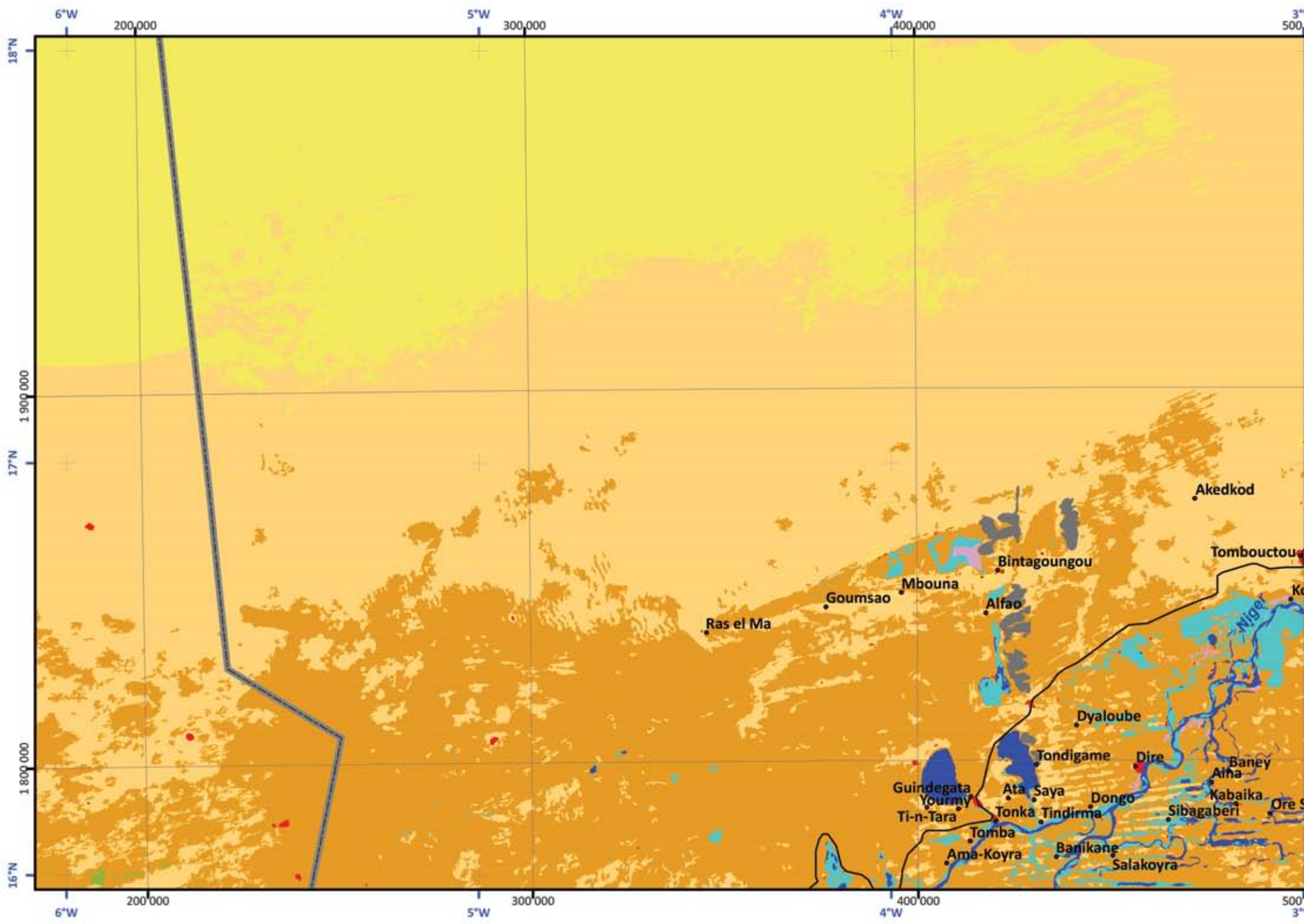
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NE-30-S

TOMBOUCTOU-S



Scale 1: 1 250 000

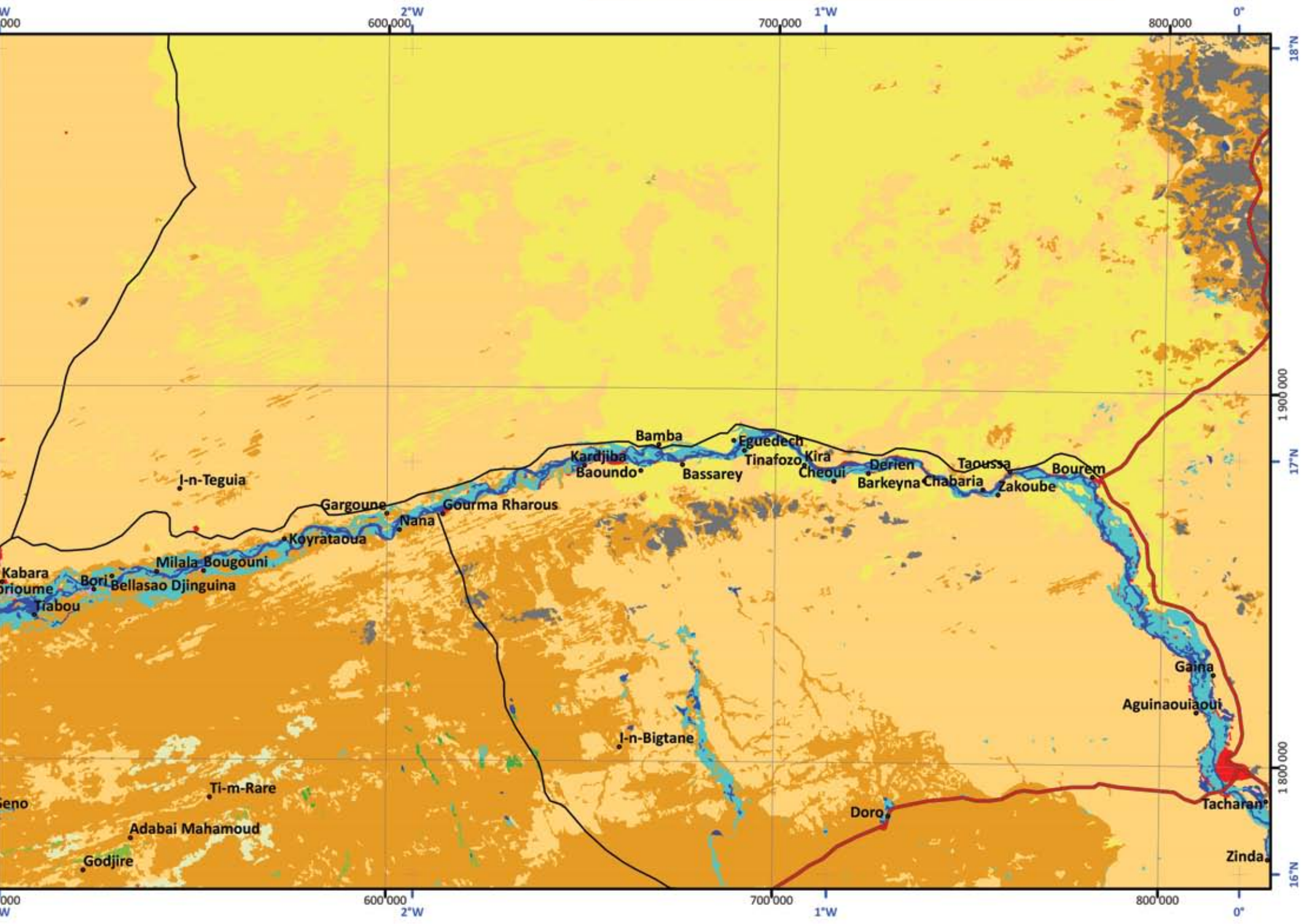
0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 30).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NE/NF-29/30 OUADANE-TAOUDENNI		NE-31-N KIDAL-N
NE-29-S TIDJIKJA-S	NE-30-S TOMBOUCTOU-S	NE-31-S KIDAL-S
ND-29-N BAMAKO-N	ND-30-N OUAGADOUGOU-N	ND-31-N NIAMEY-N



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

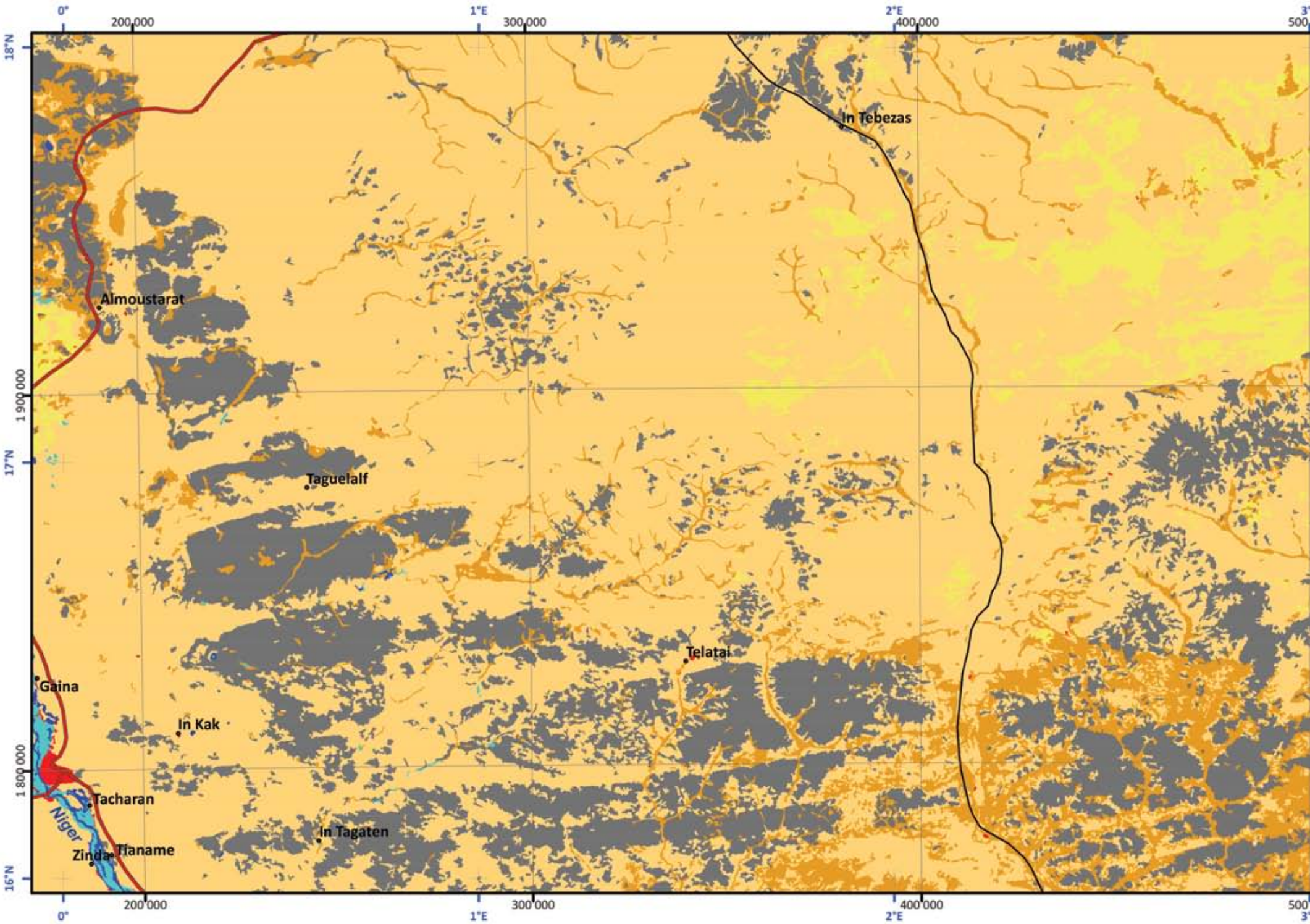
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NE-31-S

KIDAL-S



Scale 1: 1 250 000

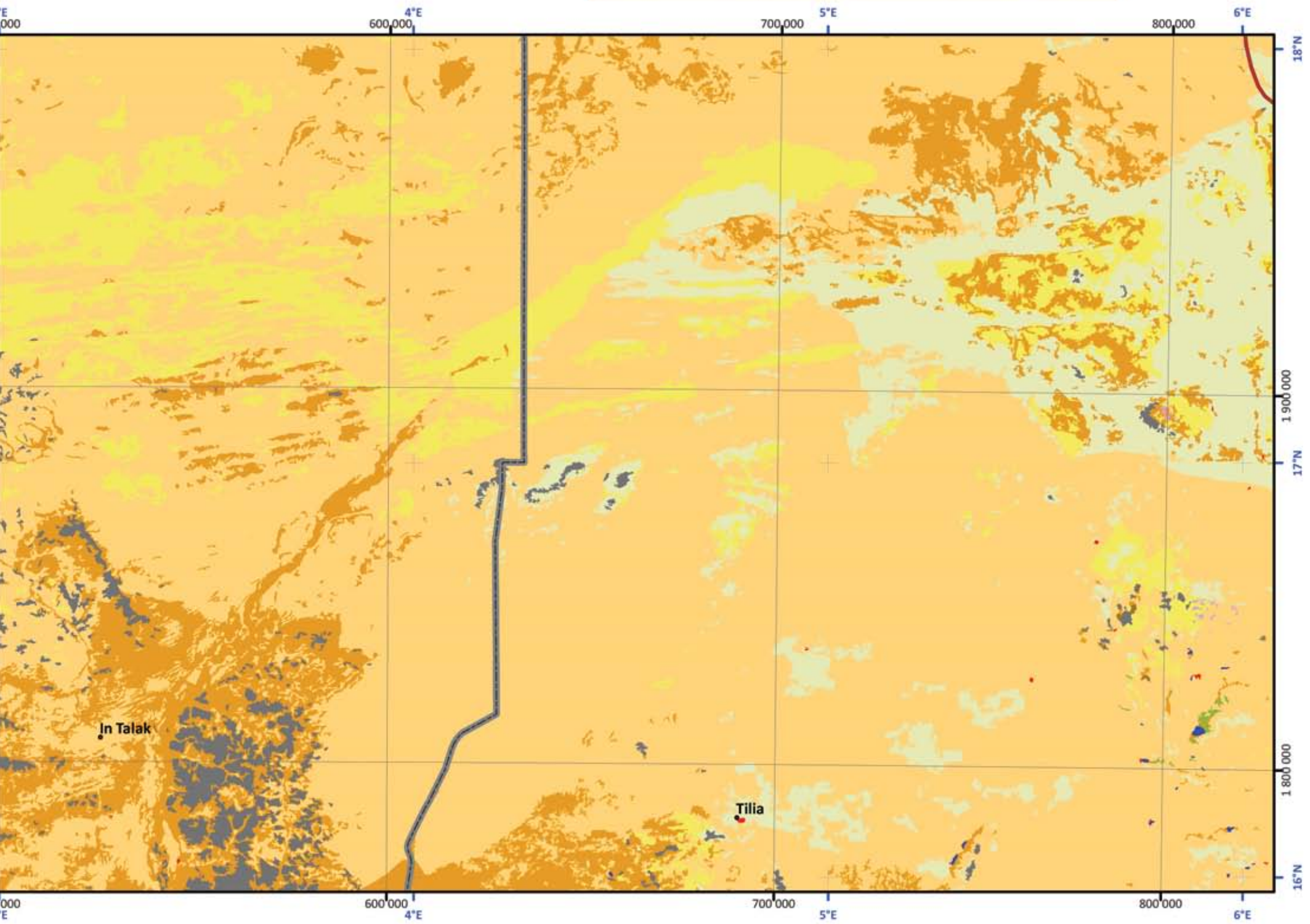
0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 31).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NE/NF-29/30 OUADANE-TAOUDENNI	NE-31-N KIDAL-N	NE-32 & NE-33 AGADEZ-BILMA
NE-30-S TOMBOUCTOU-S	NE-31-S KIDAL-S	
ND-30-N OUAGADOUGOU-N	ND-31-N NIAMEY-N	ND-32-N ZINDER-N



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

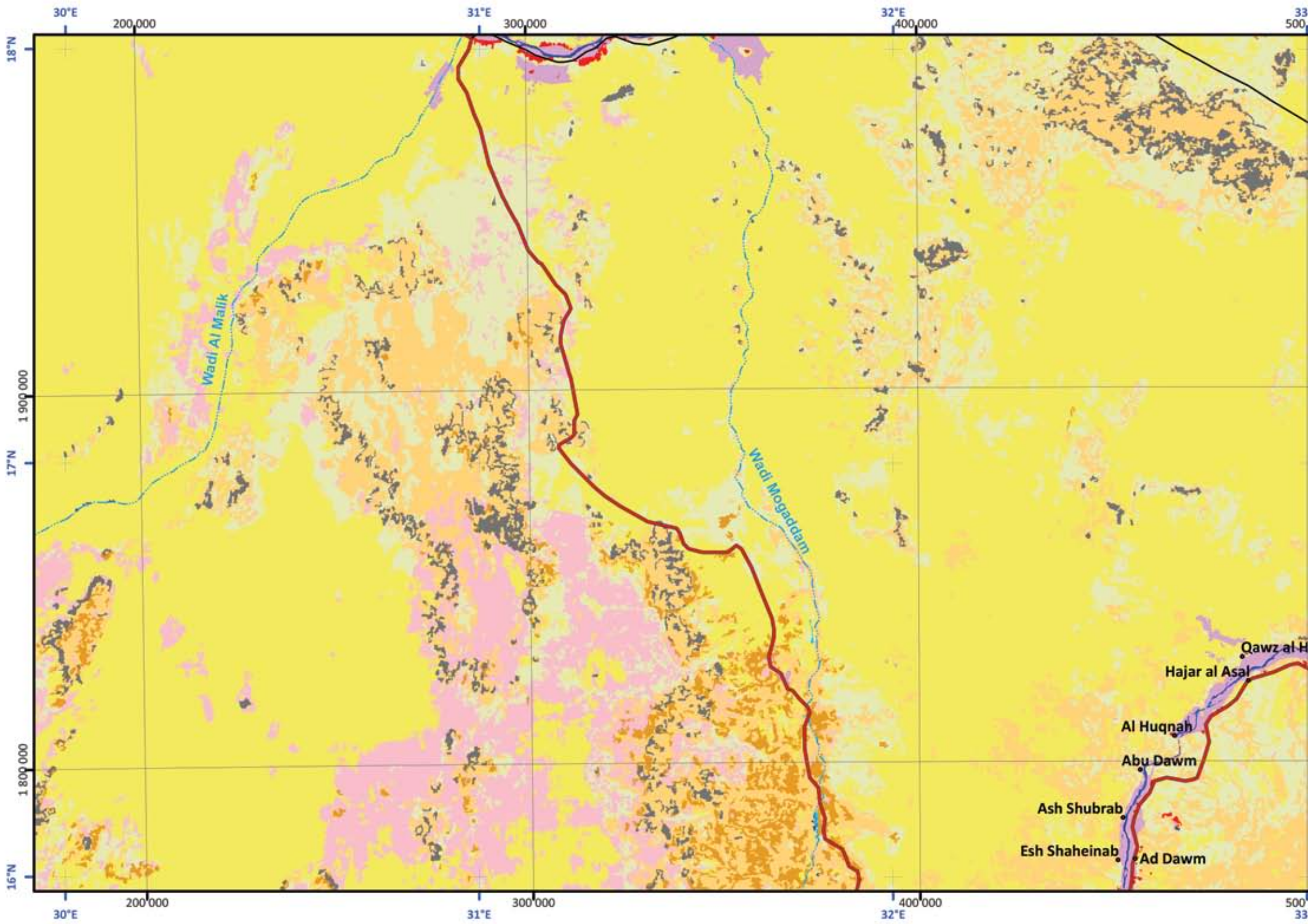
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NE-36-S

DONGOLA & BERBER-S



Scale 1: 1 250 000

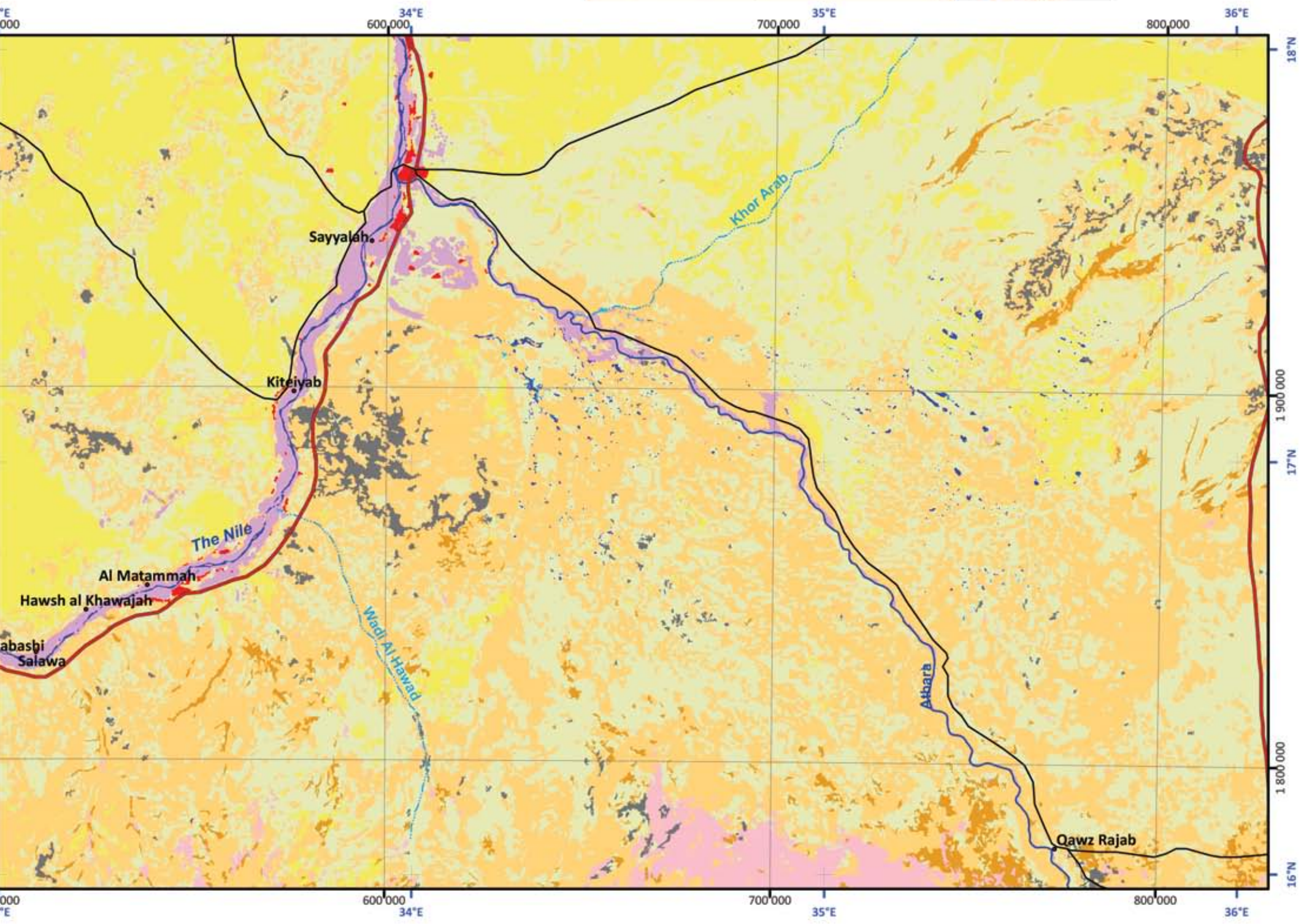
0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 36).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NE-34 & NE-35 ENNEDI-BIR ENATRUN	NE-36-N DONGOLA & BERBER-N	NE-37-N PORT SUDAN-N
	NE-36-S DONGOLA & BERBER-S	NE-37-S PORT SUDAN-S
ND-35-N EL-FACHER-N	ND-36-N KHARTOUM-N	ND-37-N ASMARA-N



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

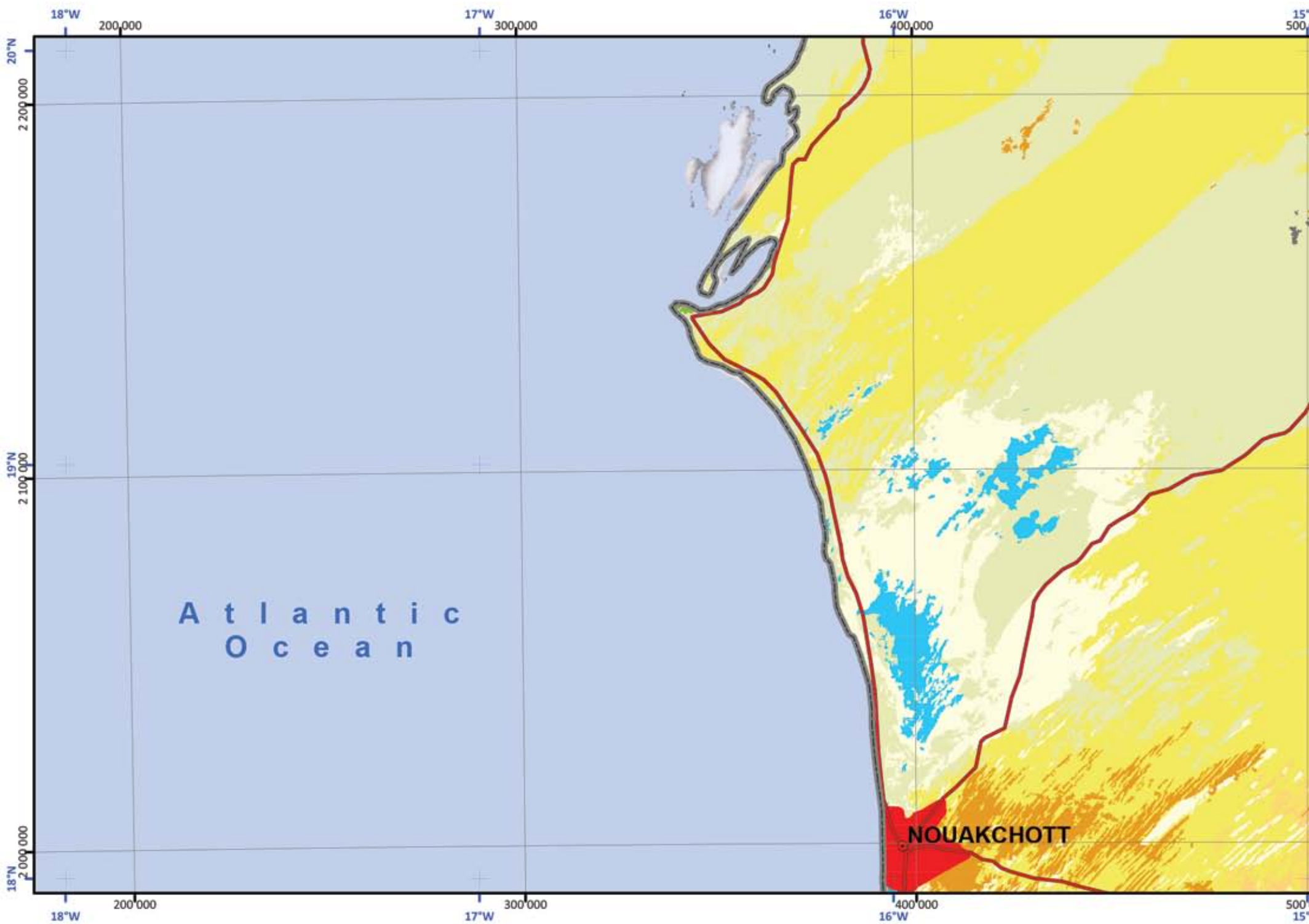
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NE-28-N

SAINT LOUIS-N



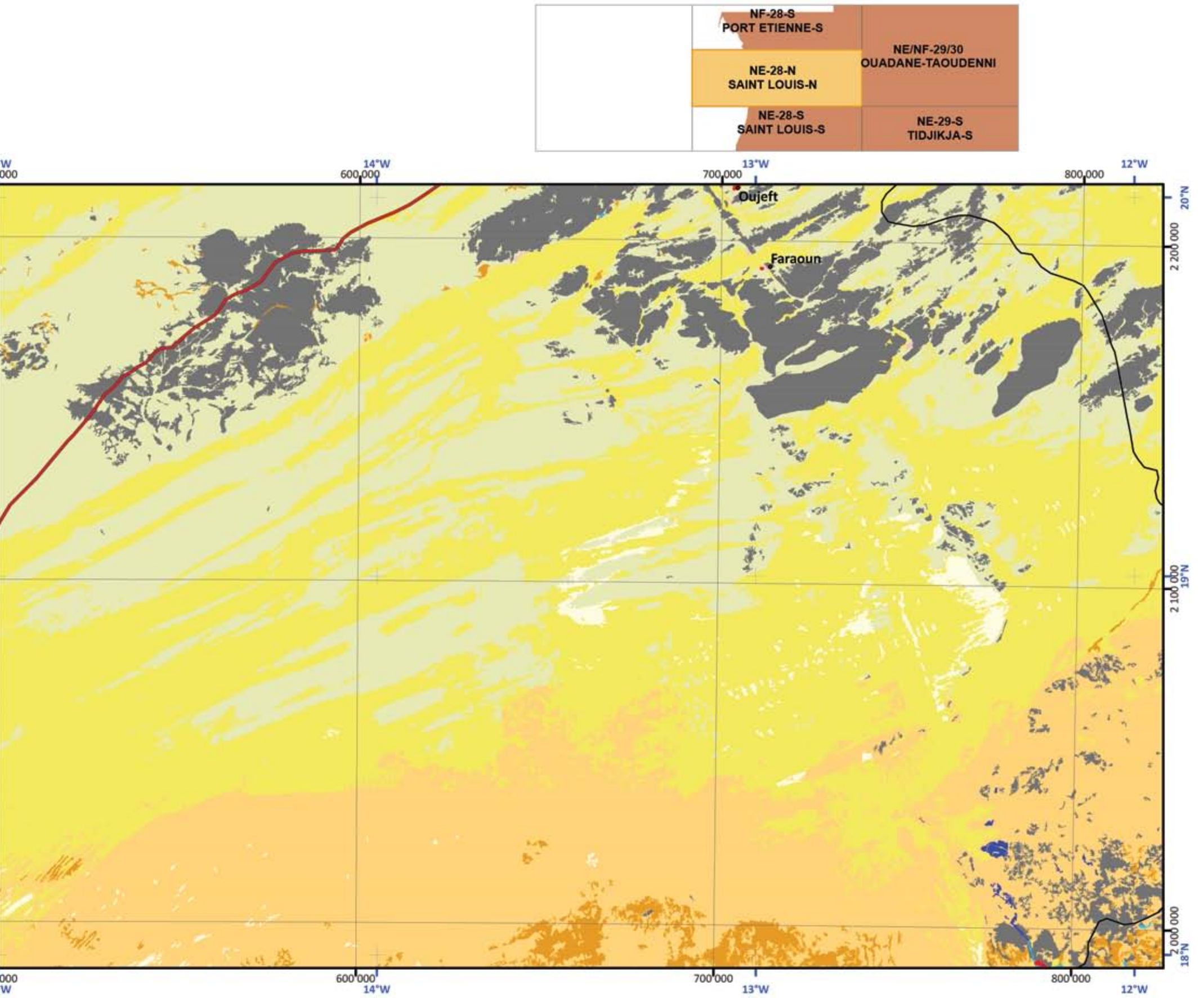
Scale 1: 1 250 000

Km
0 20 40 60 80 100

The map is in the World Geodetic System (WGS84) and UTM projection (zone 28).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

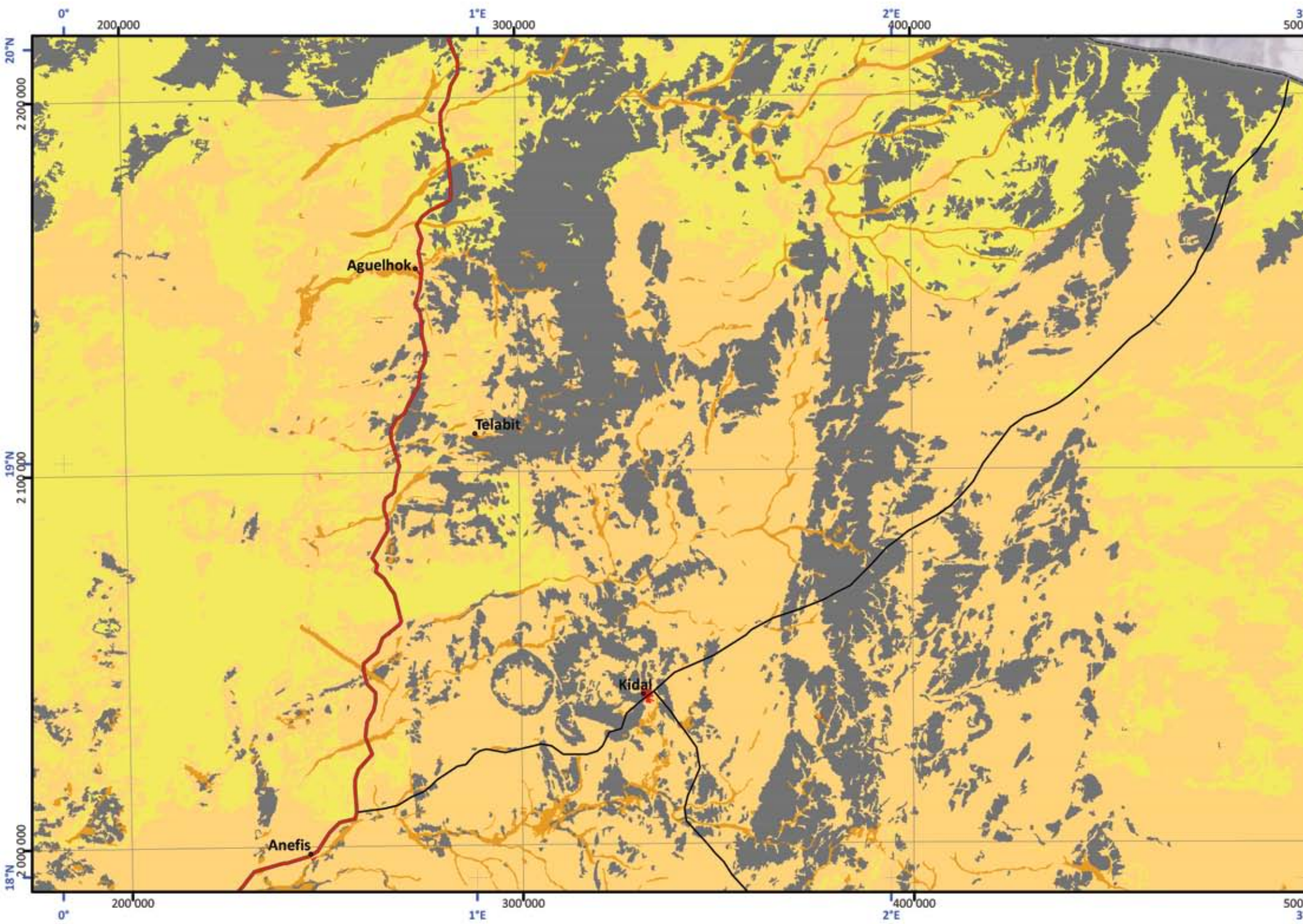
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NE-31-N

KIDAL-N



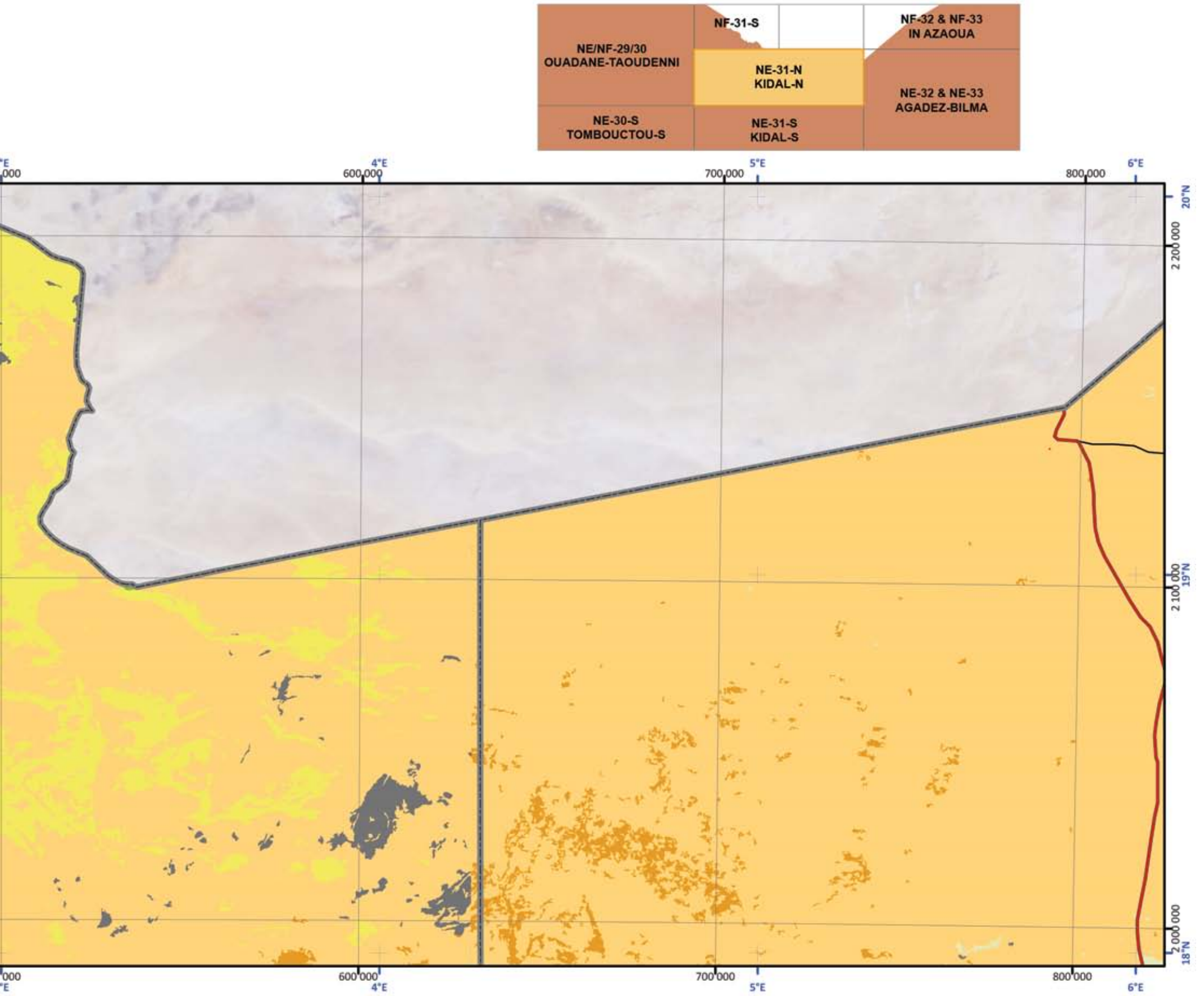
Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 31).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

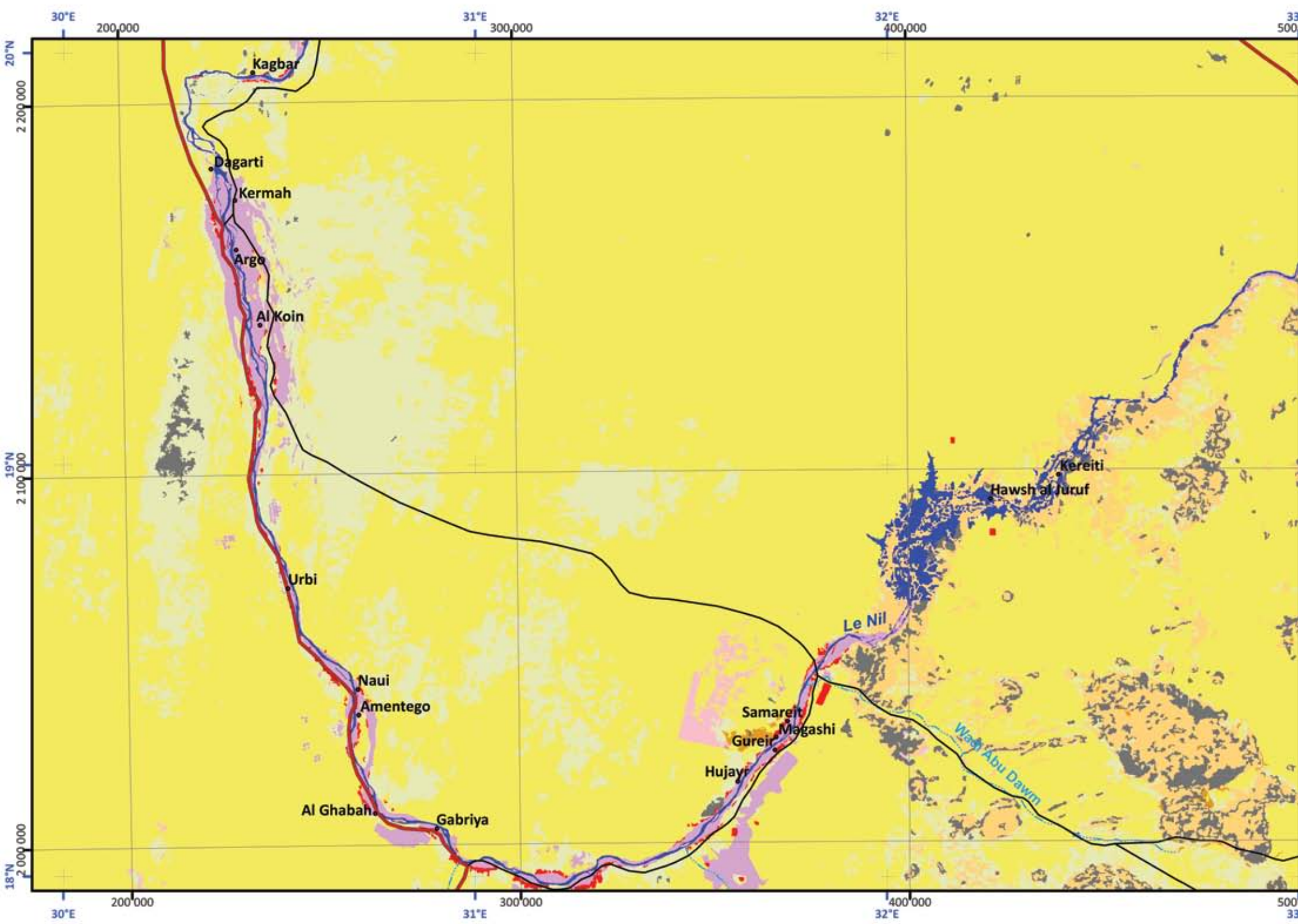
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NE-36-N

DONGOLA & BERBER-N



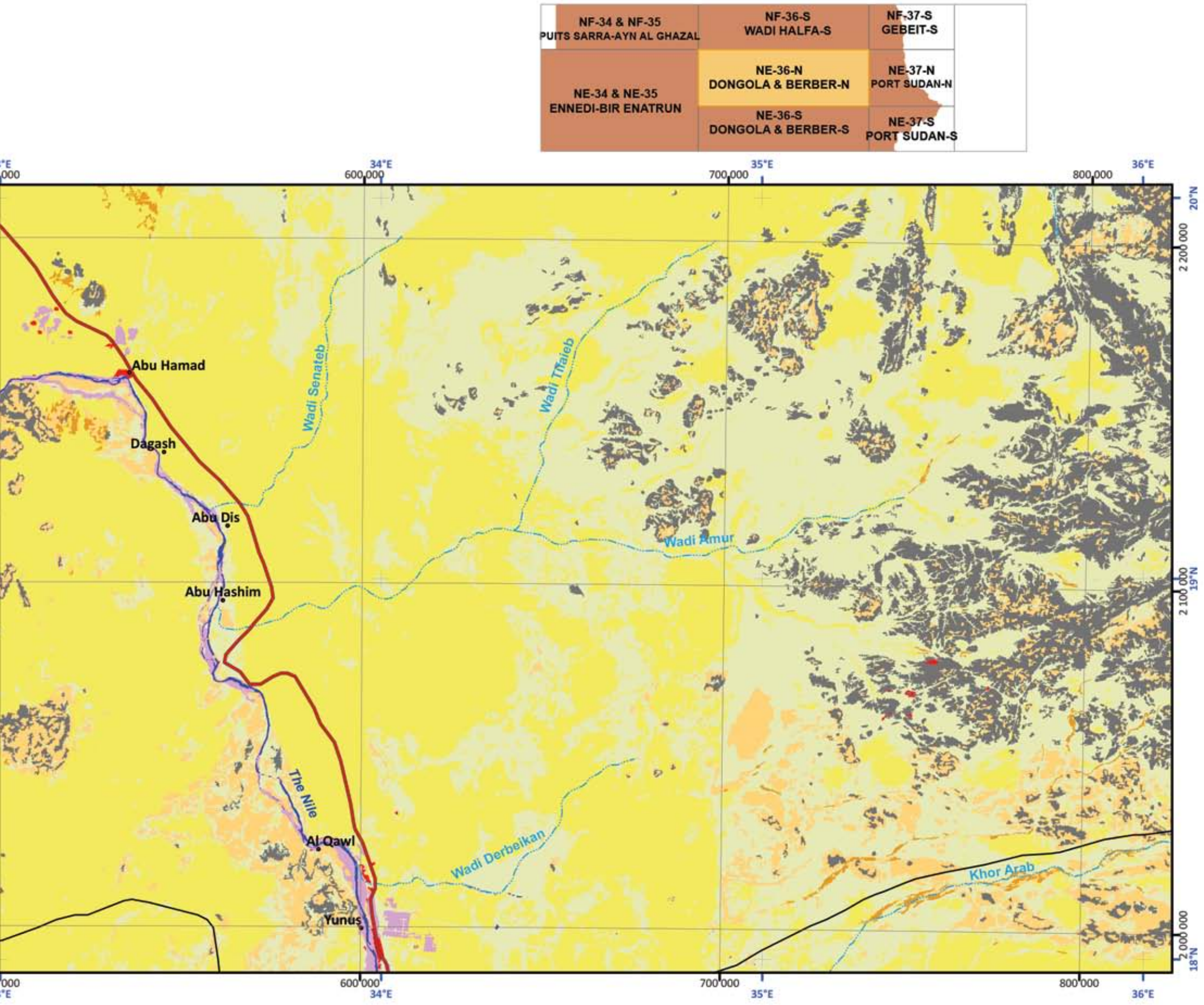
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 36).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

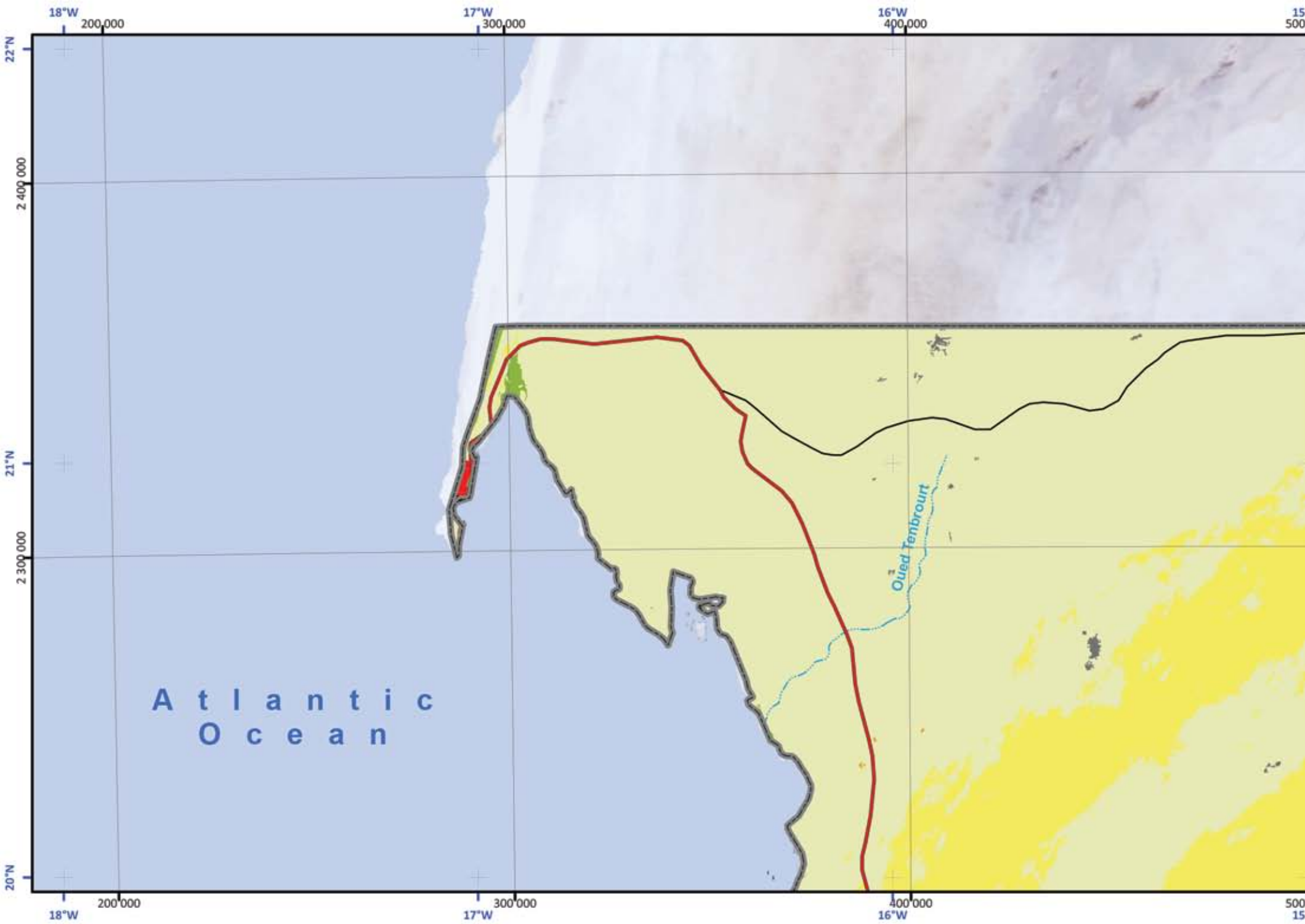
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NF-28-S

PORT ETIENNE-S

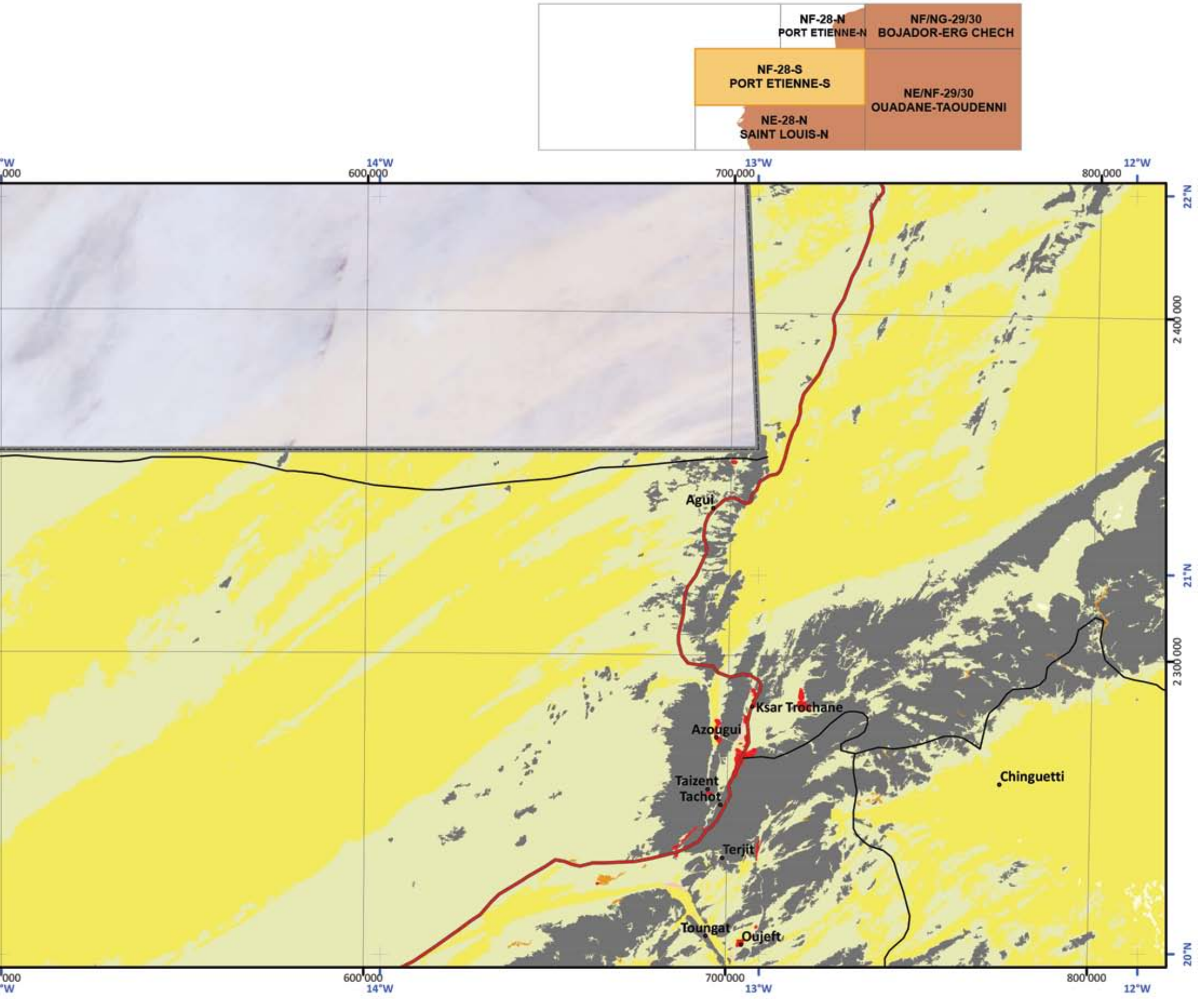


Scale 1: 1 250 000

The map is in the World Geodetic System (WGS84) and UTM projection (zone 28).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

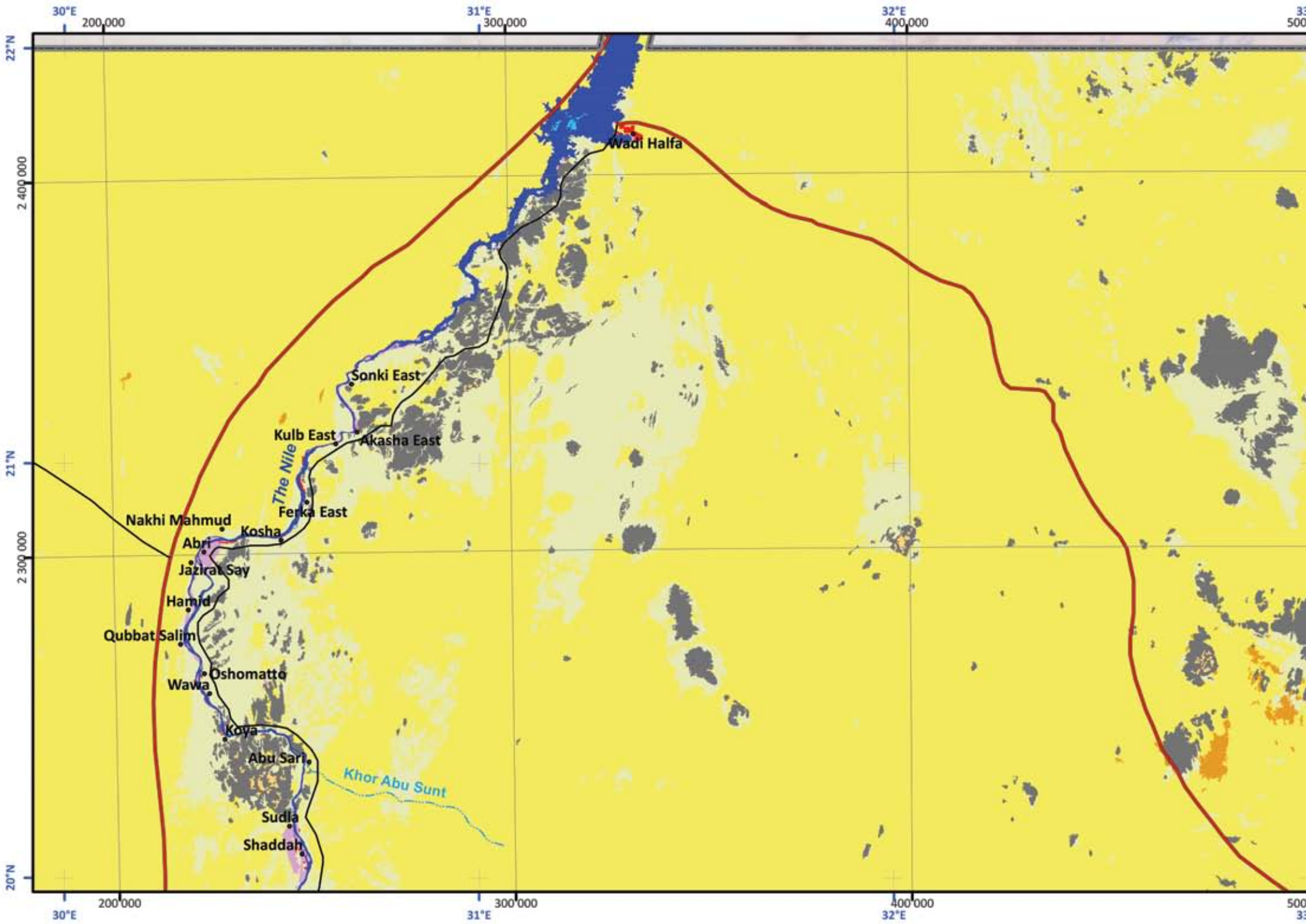
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NF-36-S

WADI HALFA-S



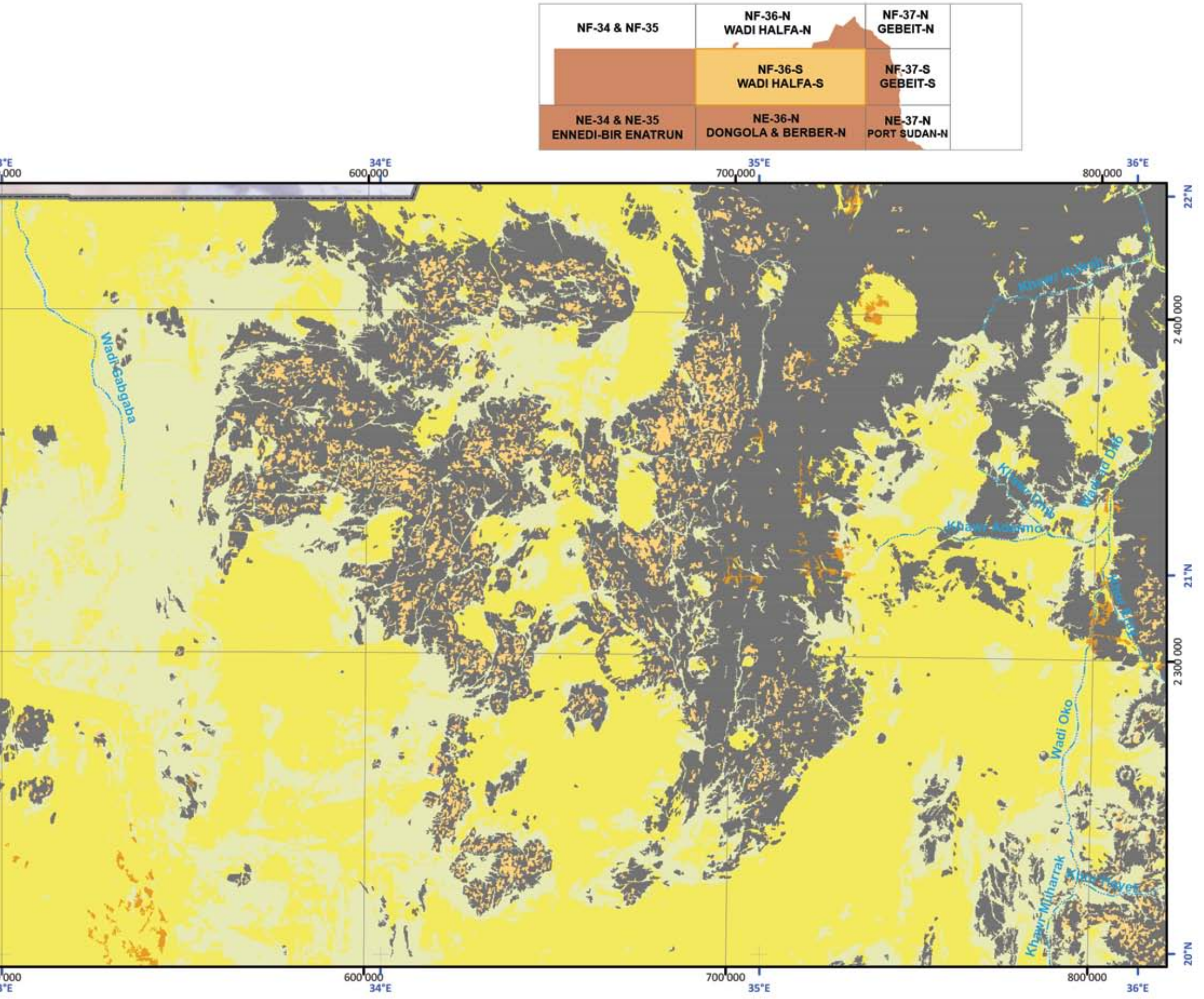
Scale 1: 1 250 000

0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 36).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

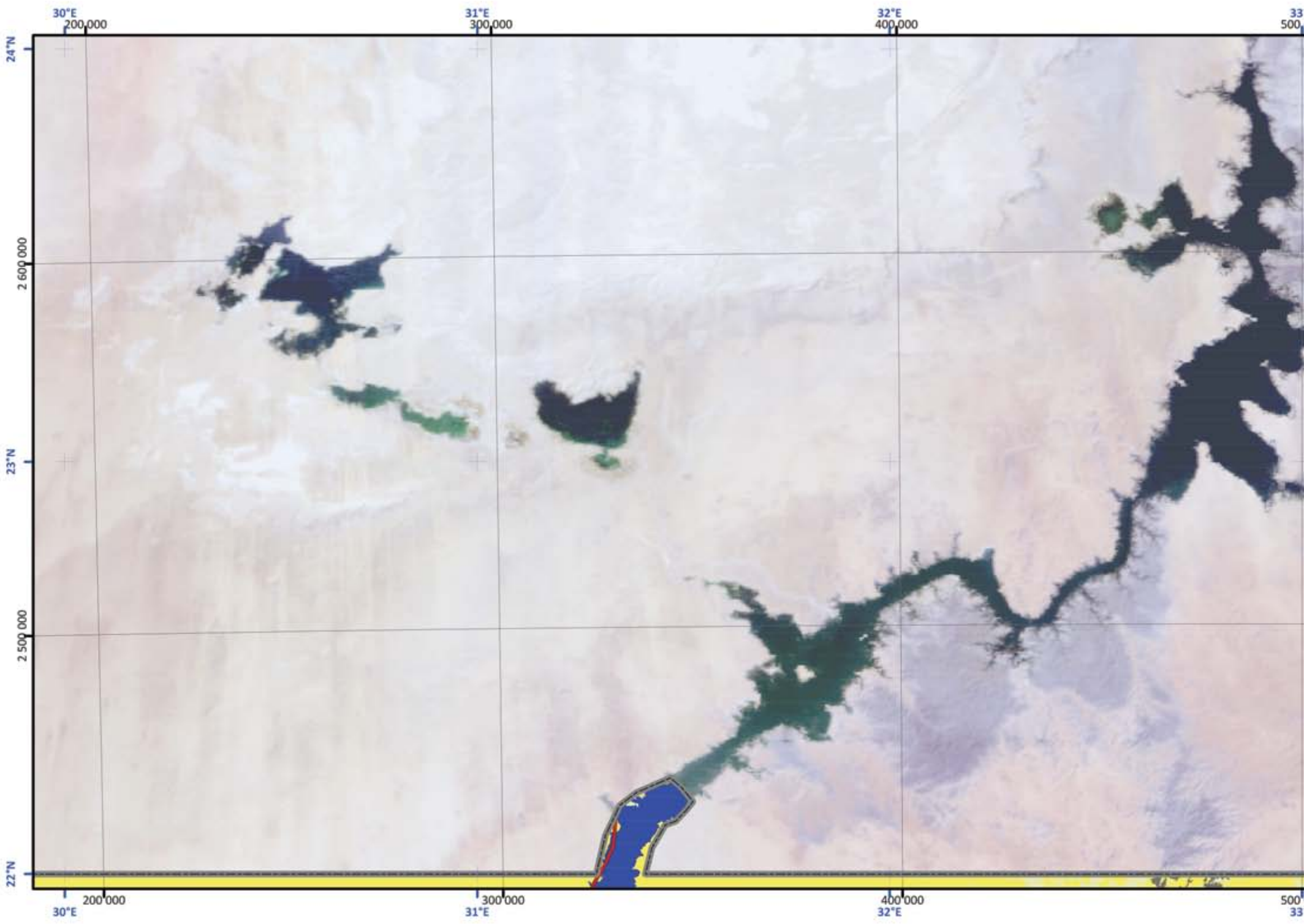
Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe


NF-34 & NF-35
NF-36-N
WADI HALFA-N
NF-37-N
GEBEIT-N
NF-36-S
WADI HALFA-S
NF-37-S
GEBEIT-S
NE-34 & NE-35
ENNEDI-BIR ENATRUN
NE-36-N
DONGOLA & BERBER-N
NE-37-N
PORT SUDAN-N
34°E
600,000
35°E
700,000
36°E
800,000
22°N
2 400 000
21°N
2 300 000
20°N
Wadi Gabgaba
Khawr Al Malik
Khawr Dihb
Wadi Id Dihb
Khawr Adamma
Wadi Oko
Khawr Miharrak
Khawr Gash
Cultivated Land
Irrigated cropland
Rainfed cropland
Bare Land
Barren soil or very sparse vegetation
Salty soil
Sand dunes
Rock outcrops
Wetland
Water body
Floodplain
Aquatic vegetation
Built-up Land
Settlement
River
Perennial stream
Intermittent stream
Primary road
Secondary road
National capital
City or Town

NF-36-N

WADI HALFA-N



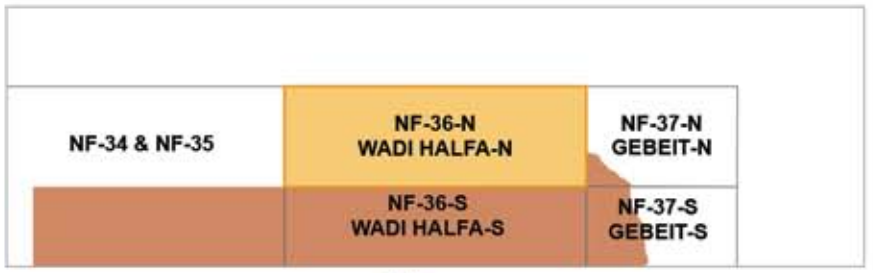
Scale 1: 1 250 000

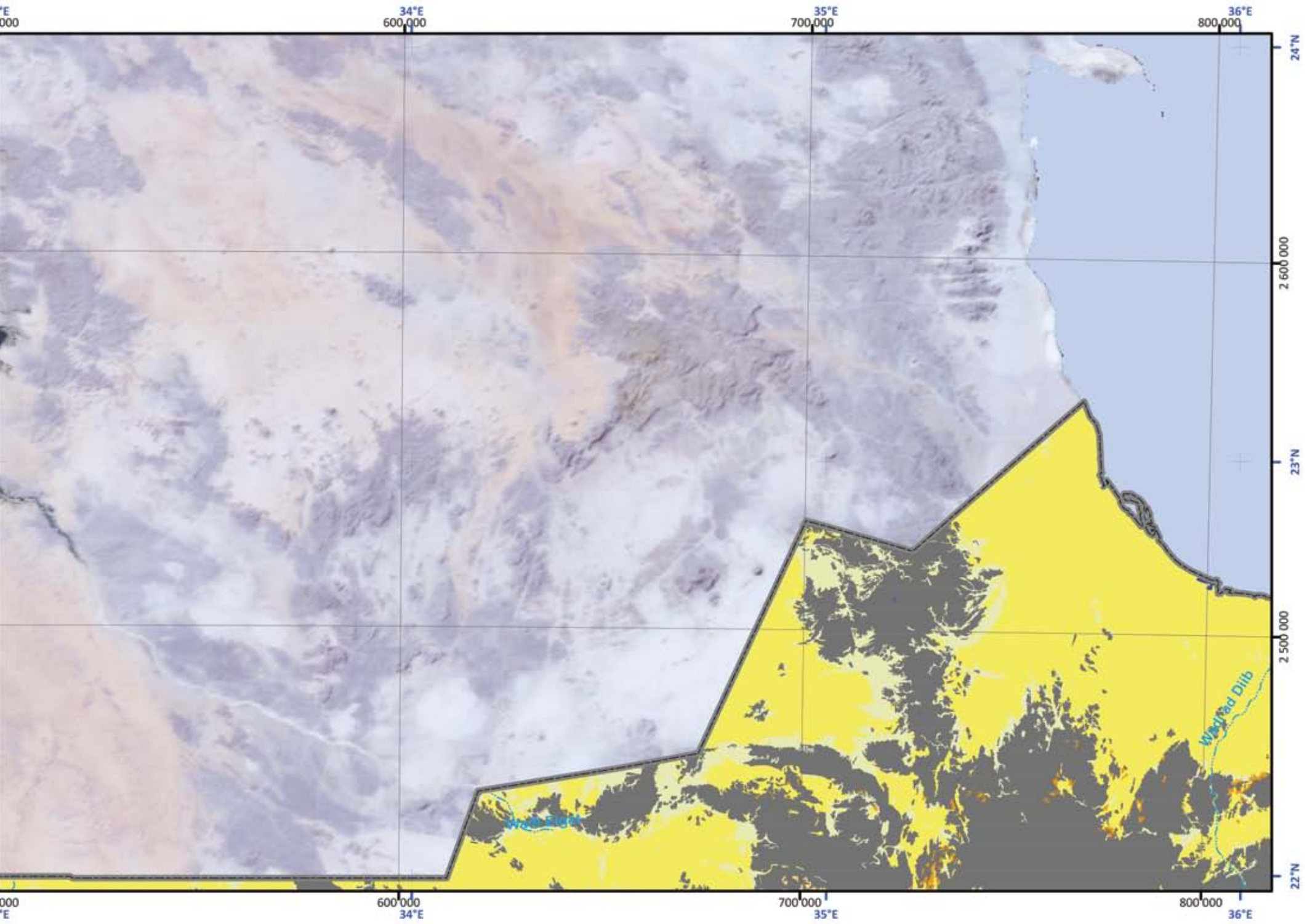
0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 36).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe





Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

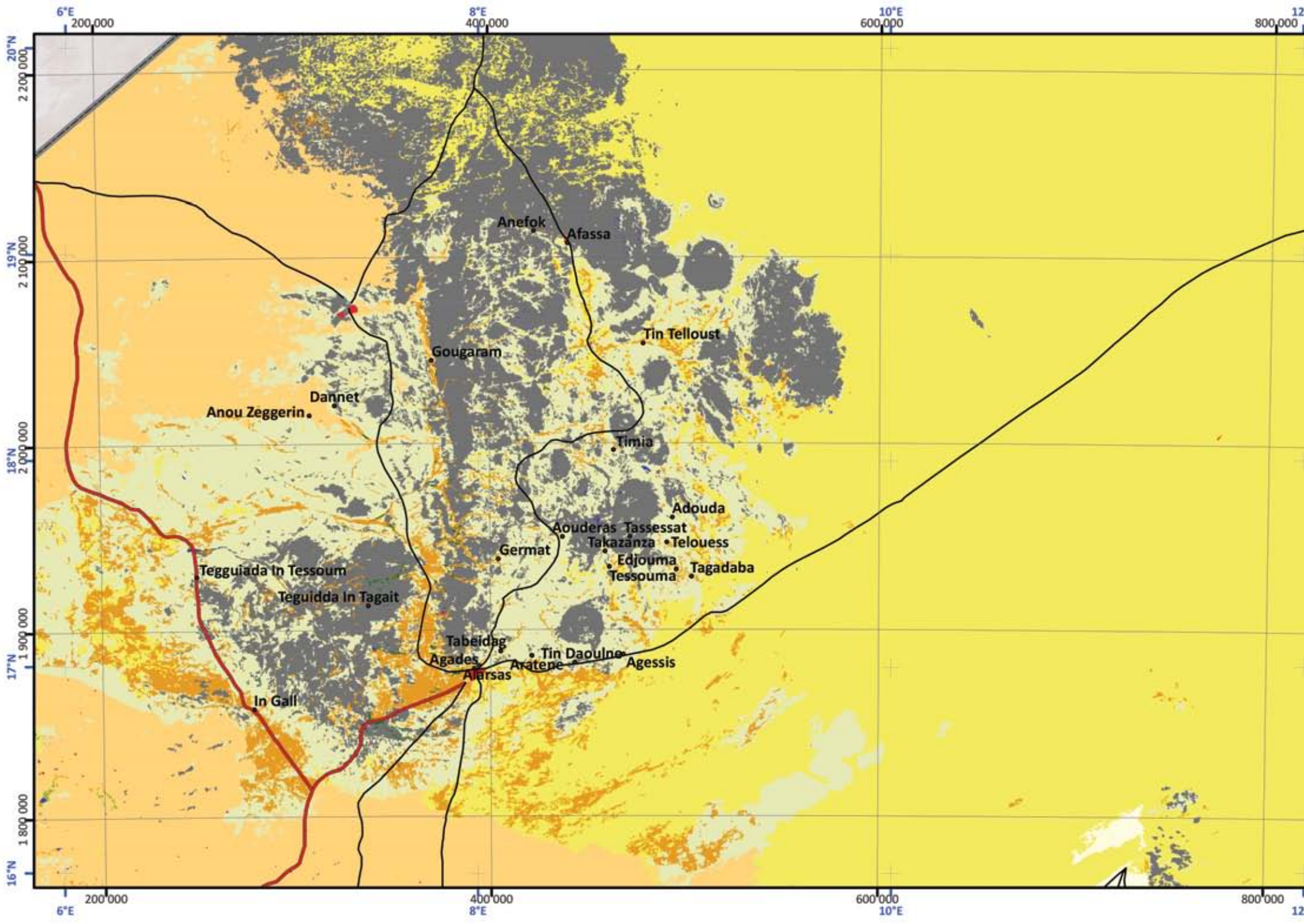
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NE-32 & NE-33

AGADEZ-BILMA

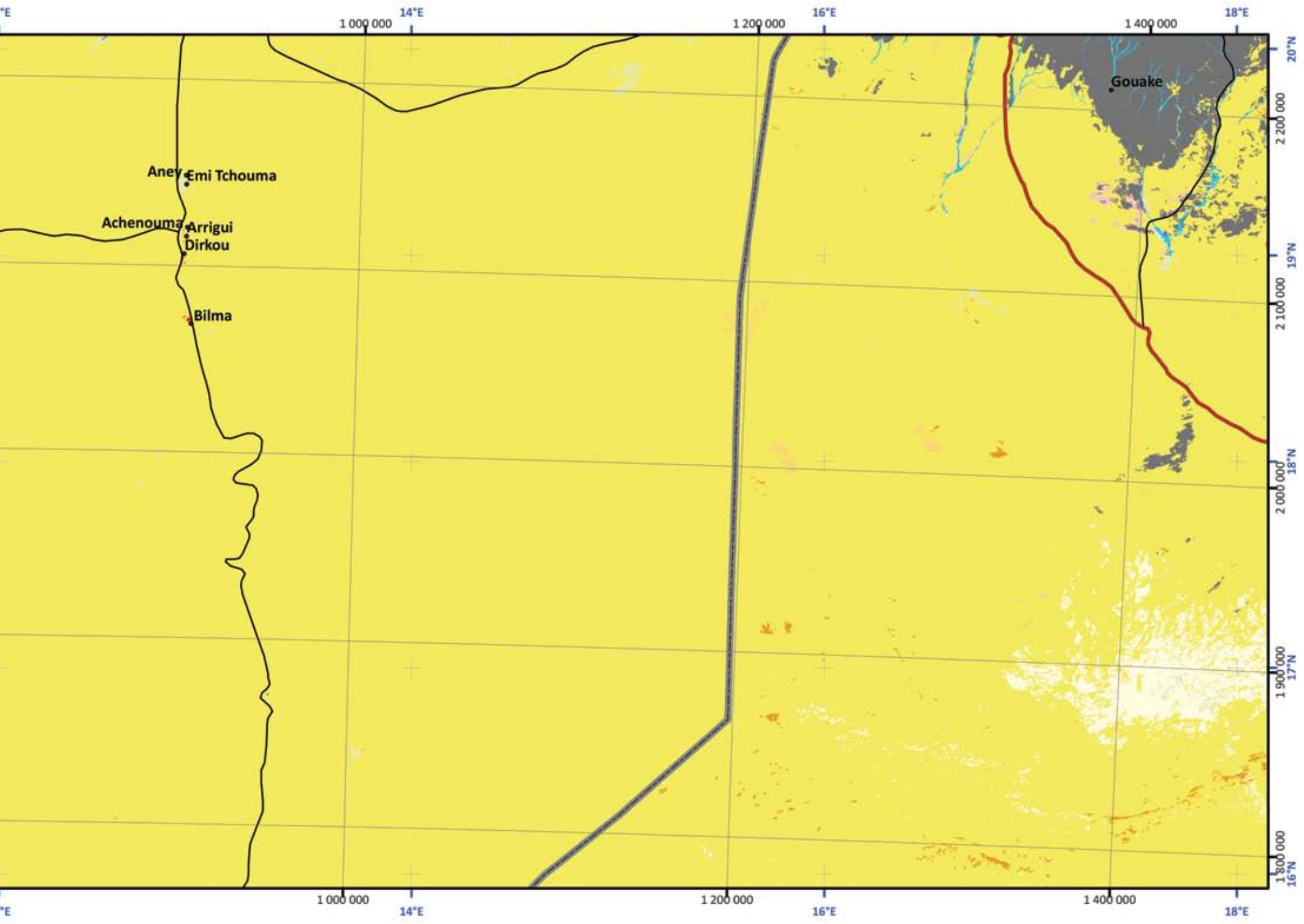


Scale 1: 2 500 000

The map is in the World Geodetic System (WGS84) and UTM projection (zone 32).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

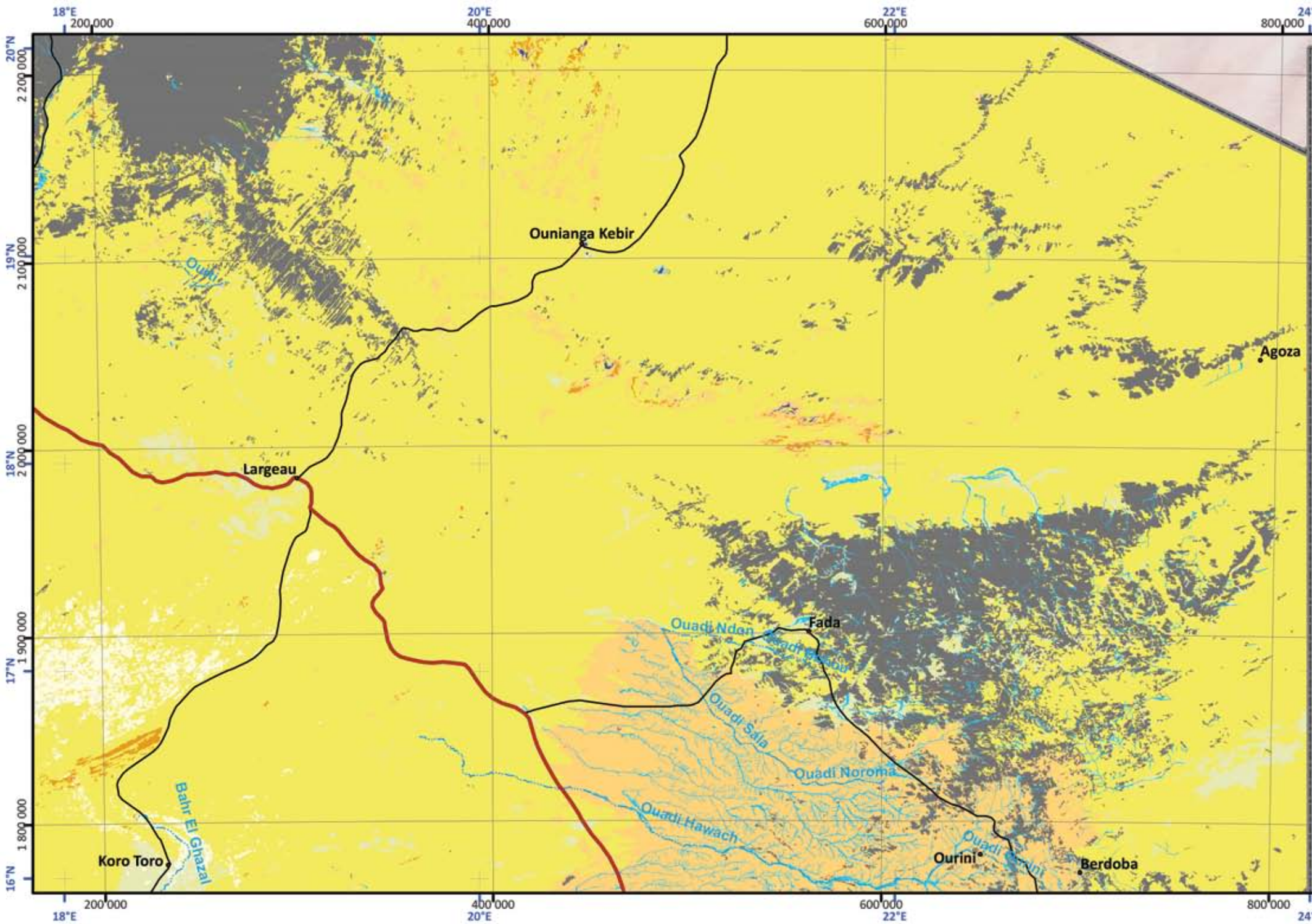
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NE-34 & NE-35

ENNEDI-BIR ENATRUN



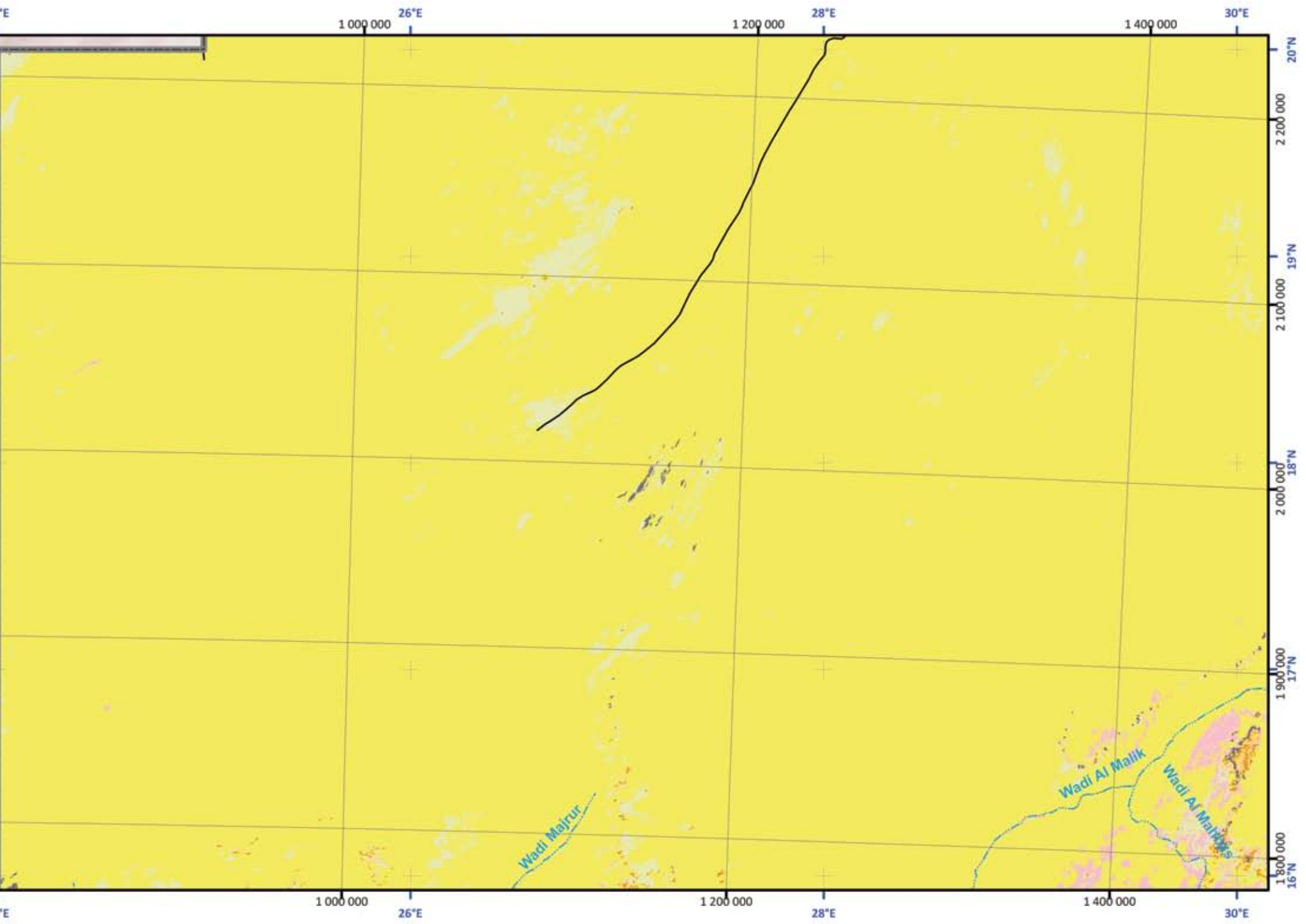
Scale 1: 2 500 000

0 40 80 120 160 200 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 34).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

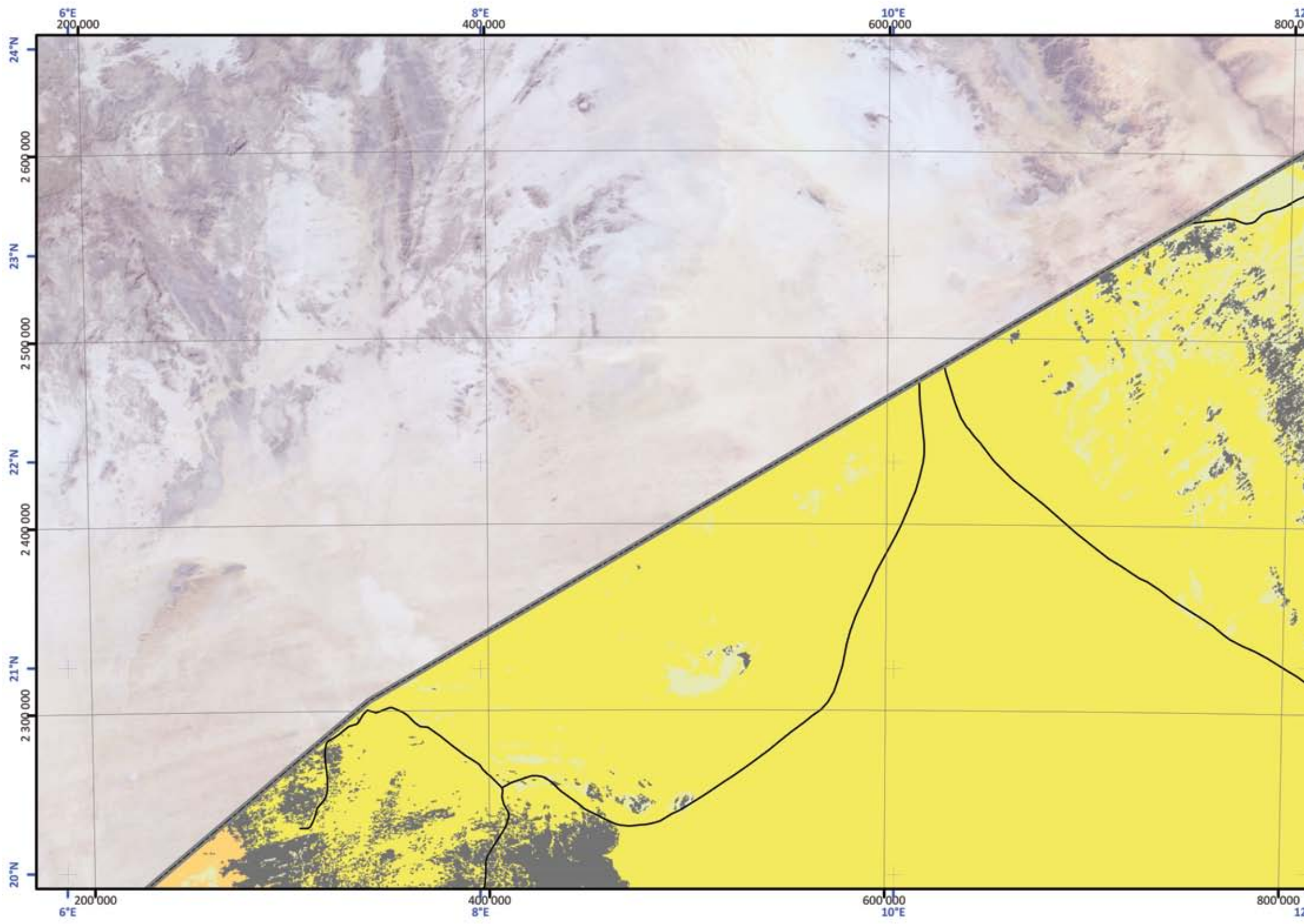
- Water body
- Floodplain
- Aquatic vegetation

Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NF-32 & NF-33
IN AZAOUA



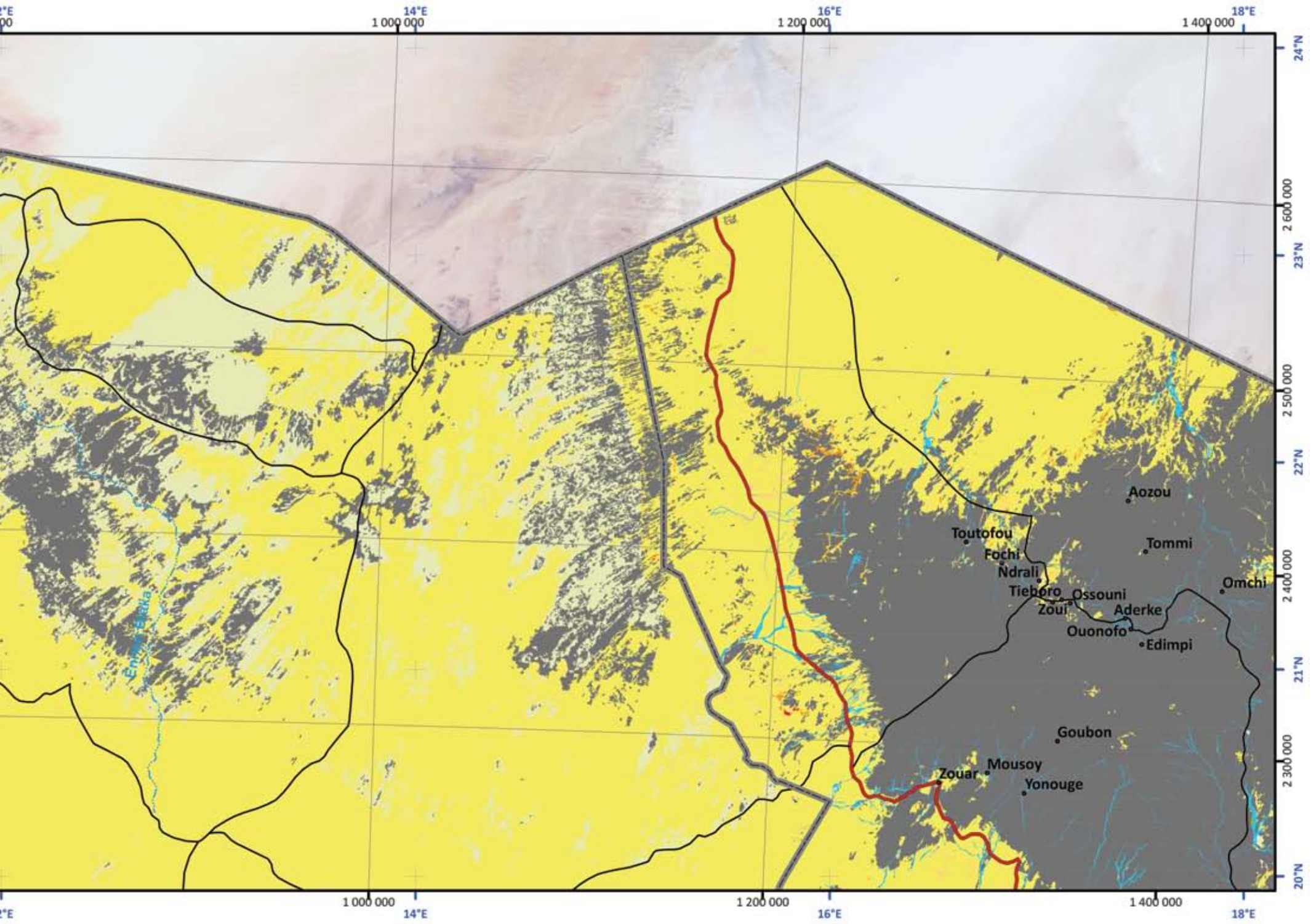
Scale 1: 2 500 000

0 40 80 120 160 200 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 32).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

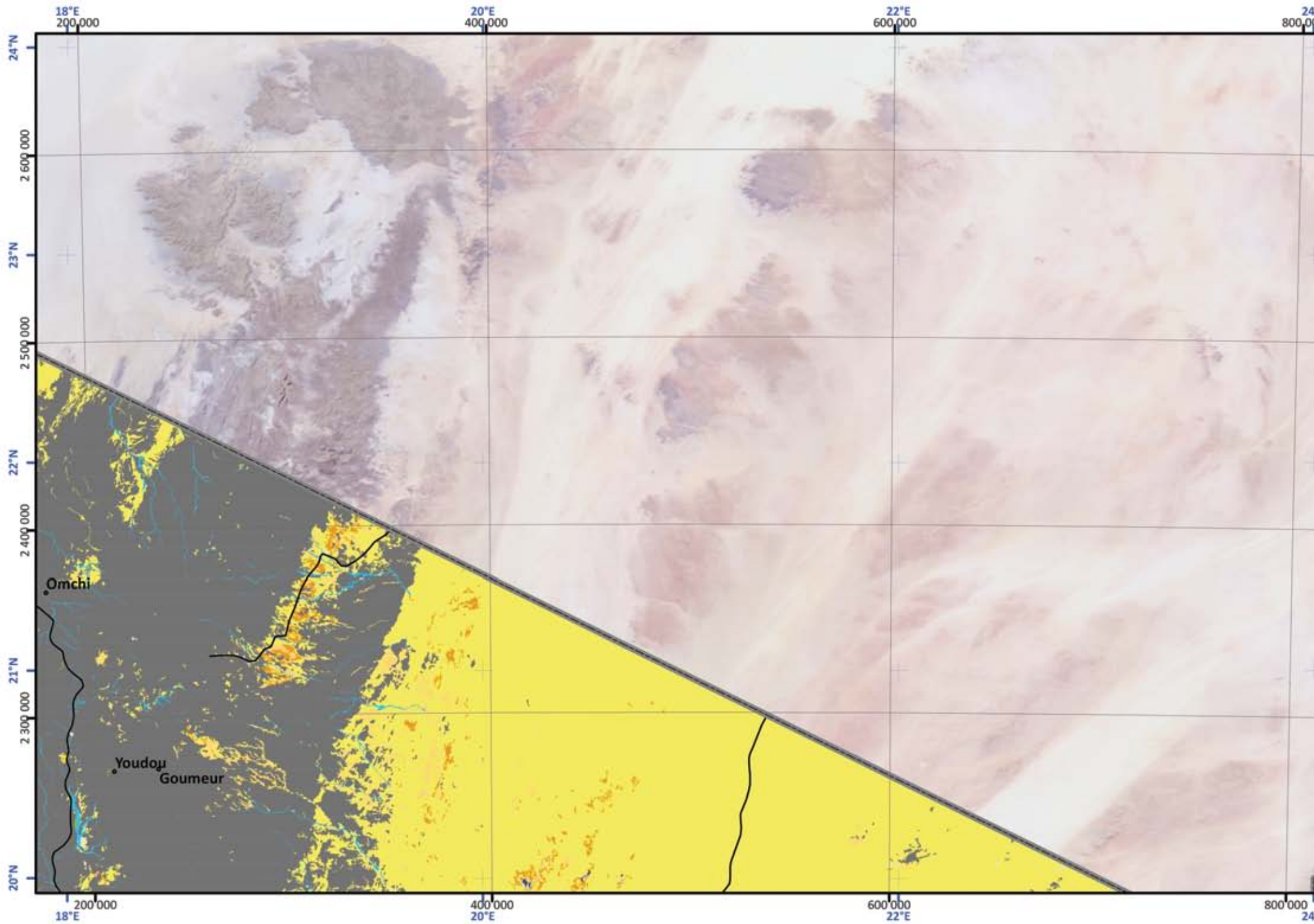
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NF-34 & NF-35

PUITS SARRA-AYN AL GHAZAL



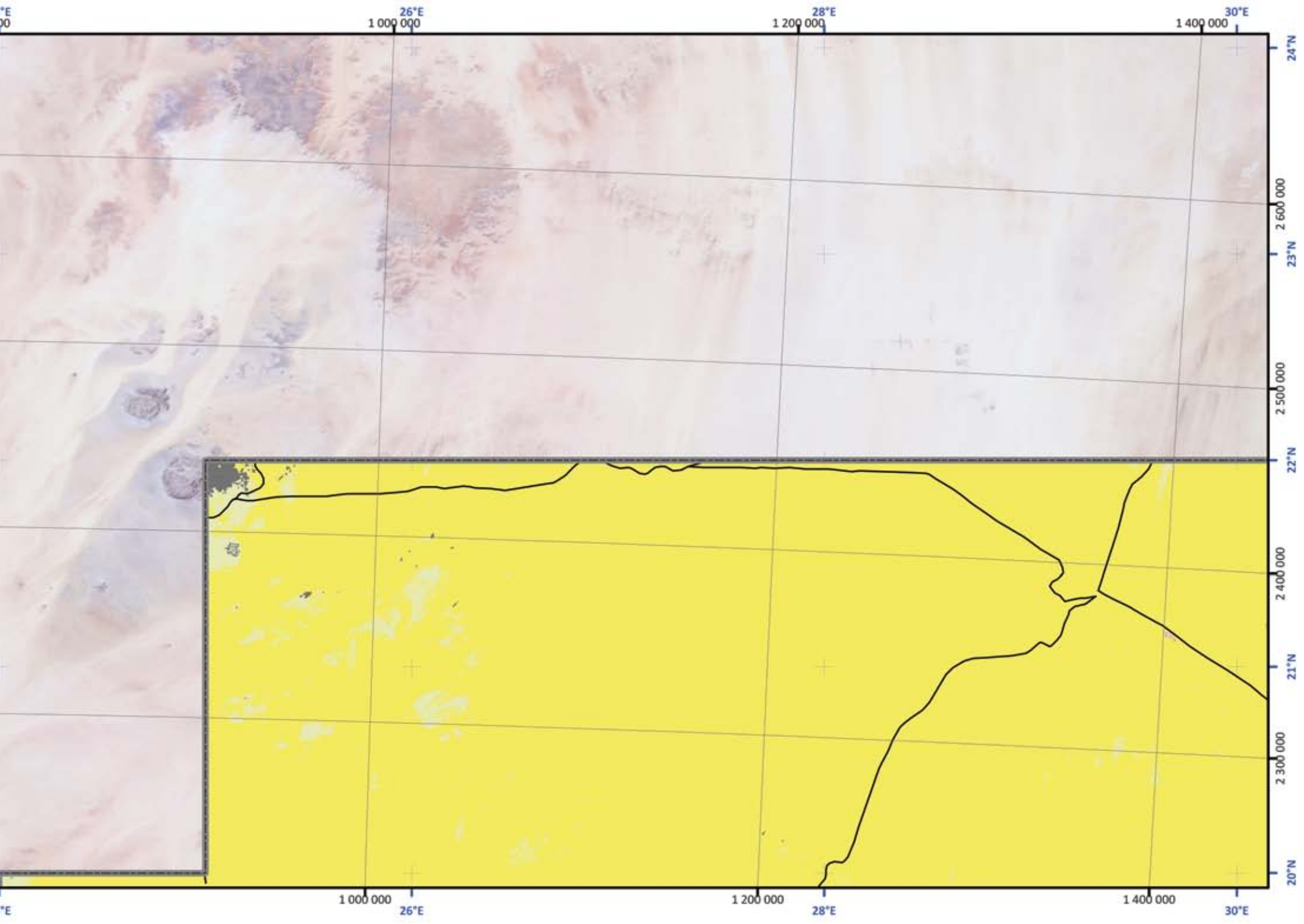
Scale 1: 2 500 000

0 40 80 120 160 200 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 34).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

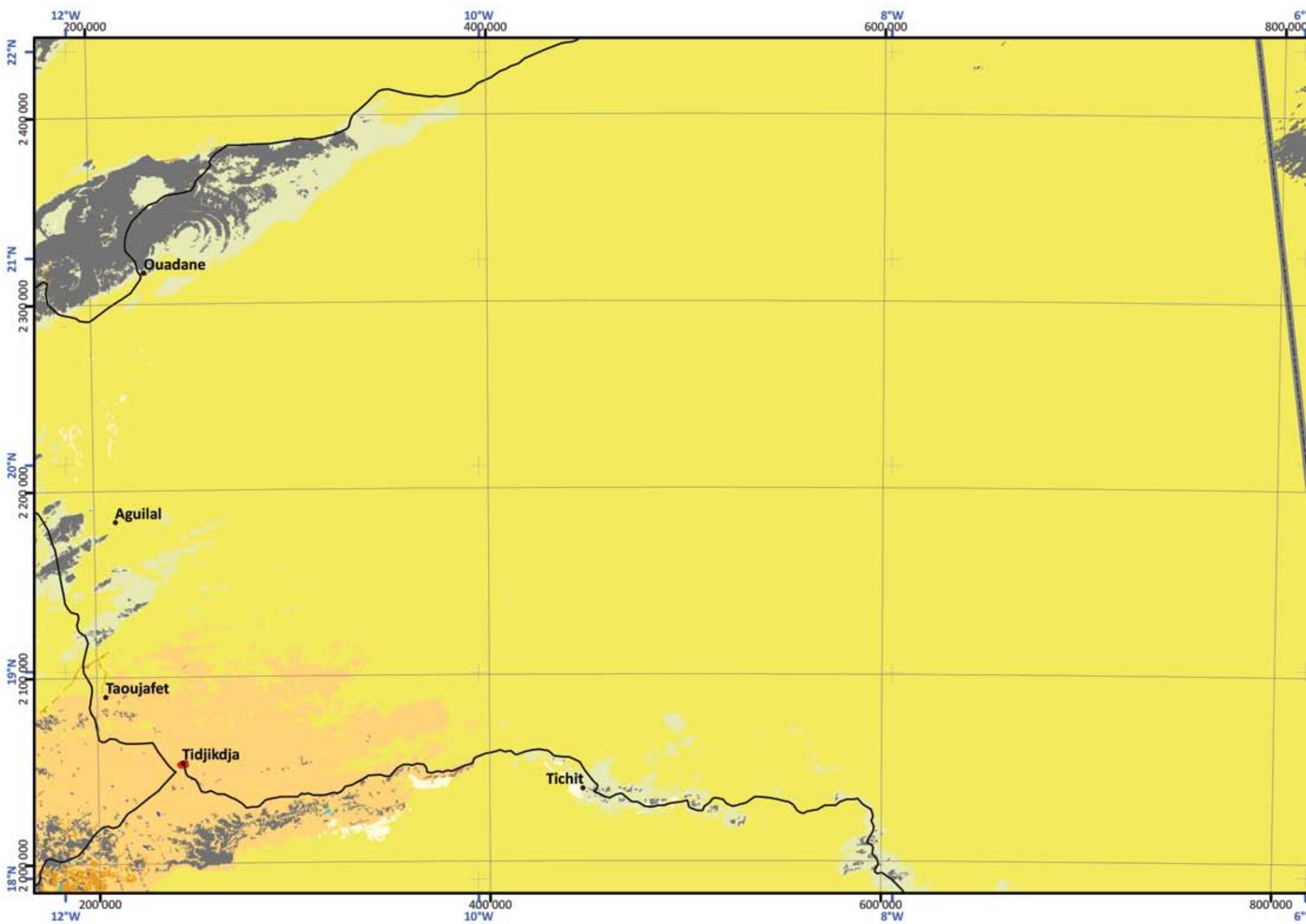
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NE/NF-29/30

OUADANE-TAOUDENNI



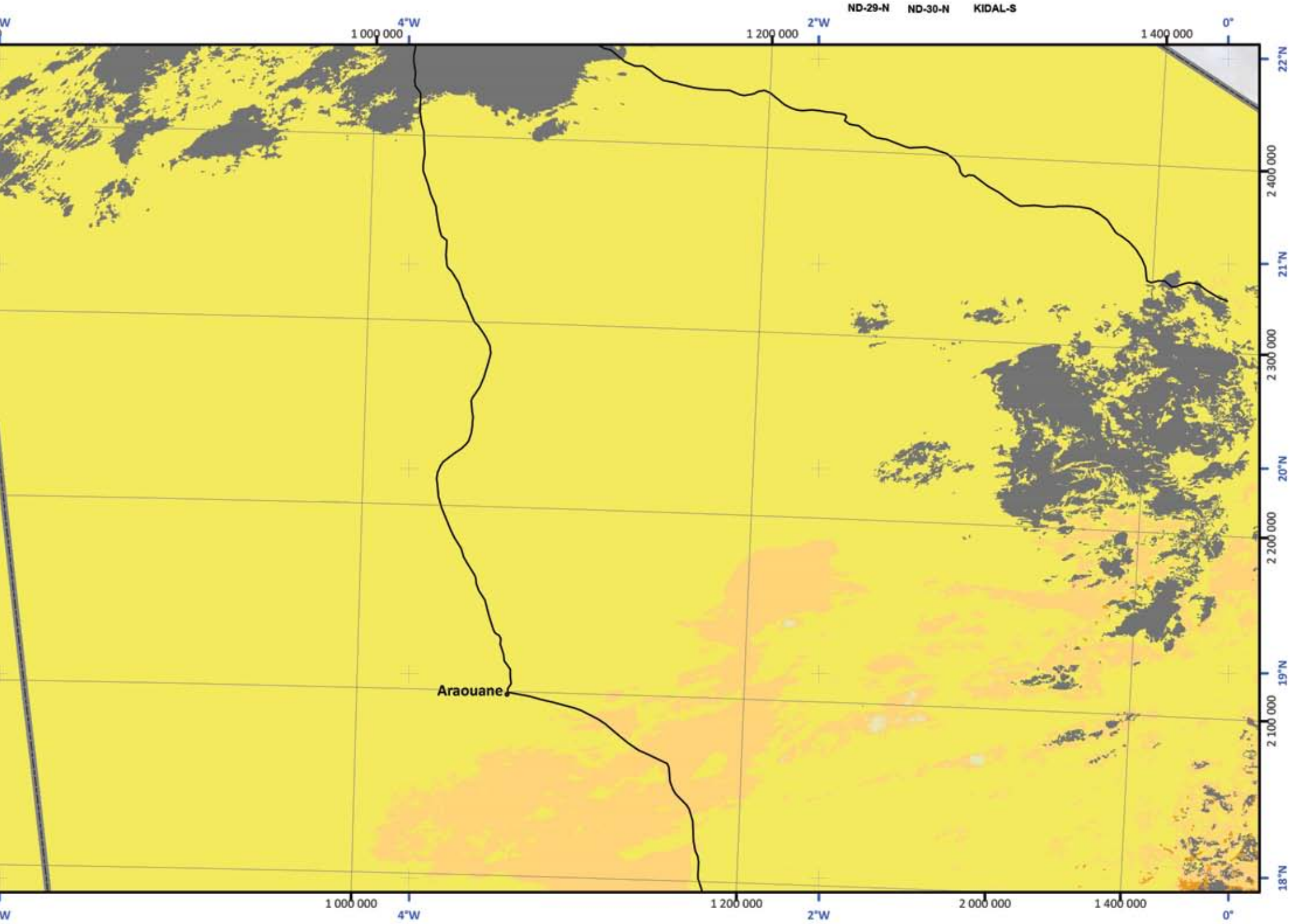
Scale 1: 2 500 000

0 40 80 120 160 200 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 29).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

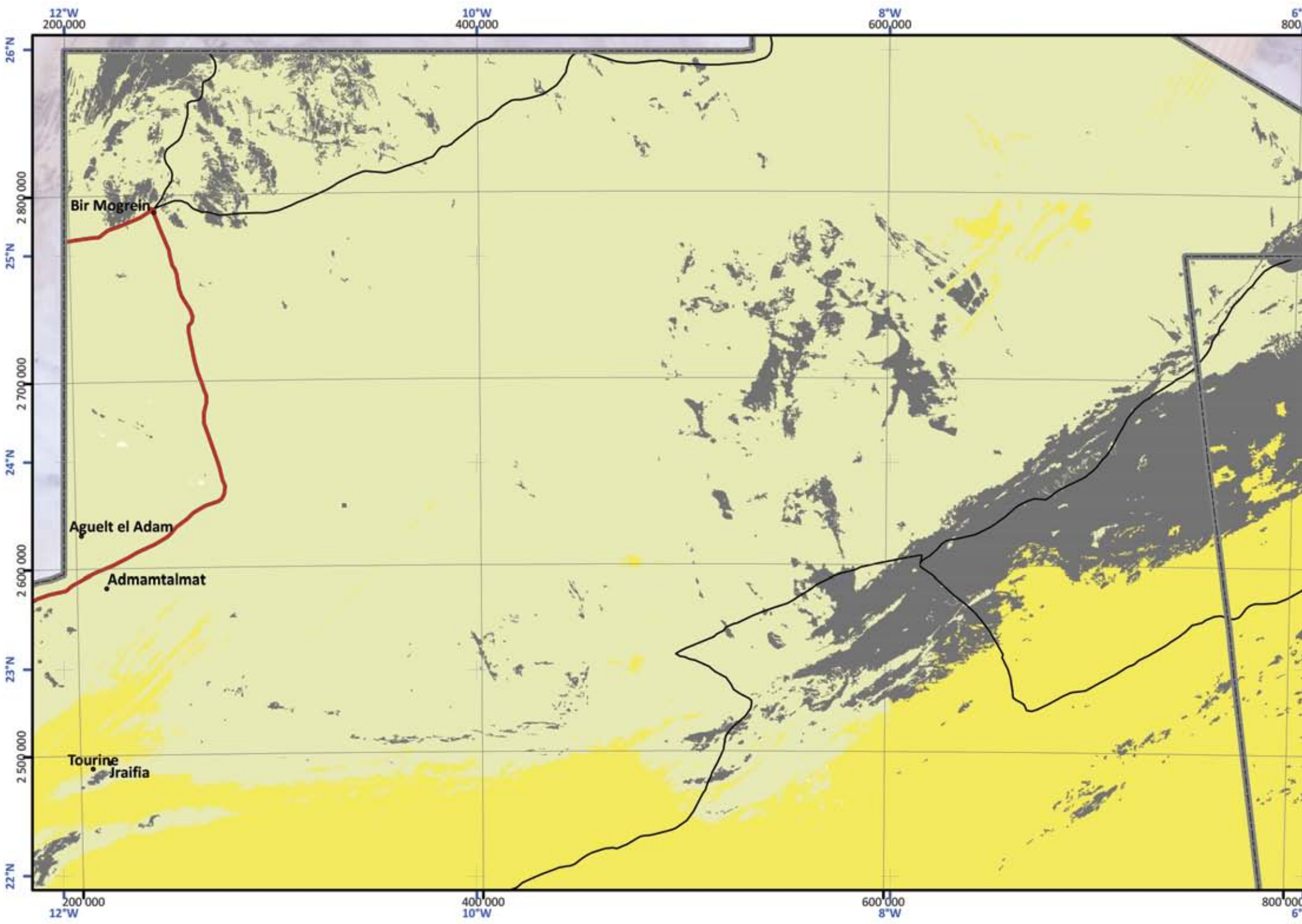
- Water body
- Floodplain
- Aquatic vegetation

Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NF/NG-29/30
BOJADOR-ERG CHECH



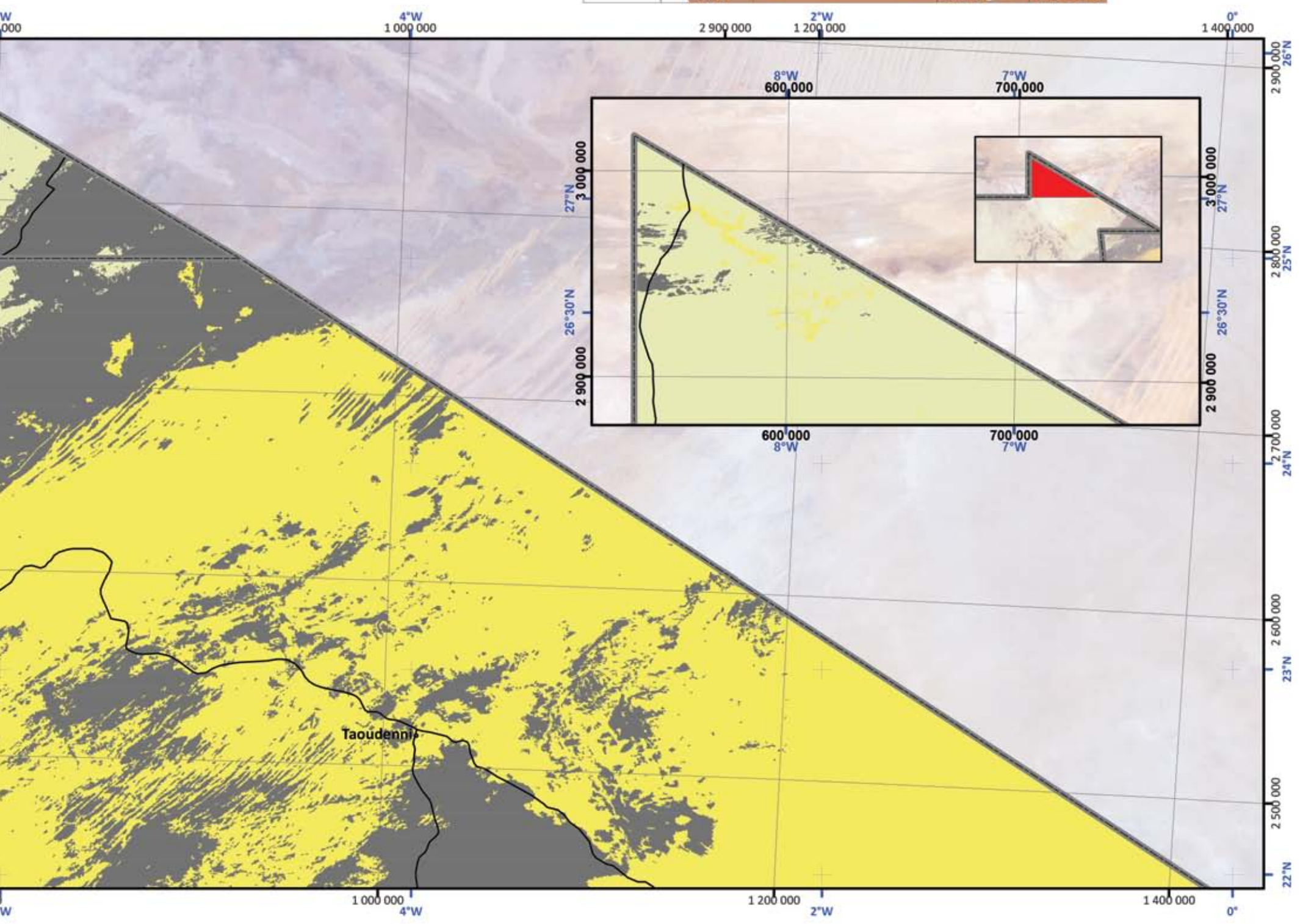
Scale 1: 2 500 000

0 40 80 120 160 200 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 29).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

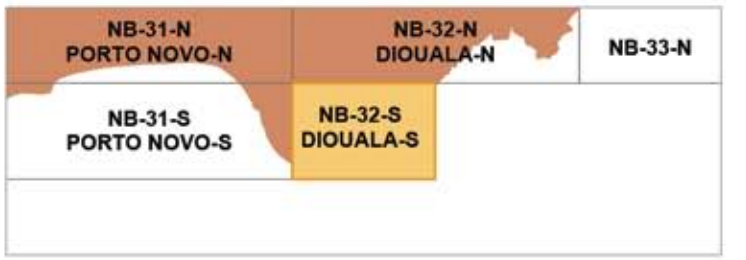
- Water body
- Floodplain
- Aquatic vegetation

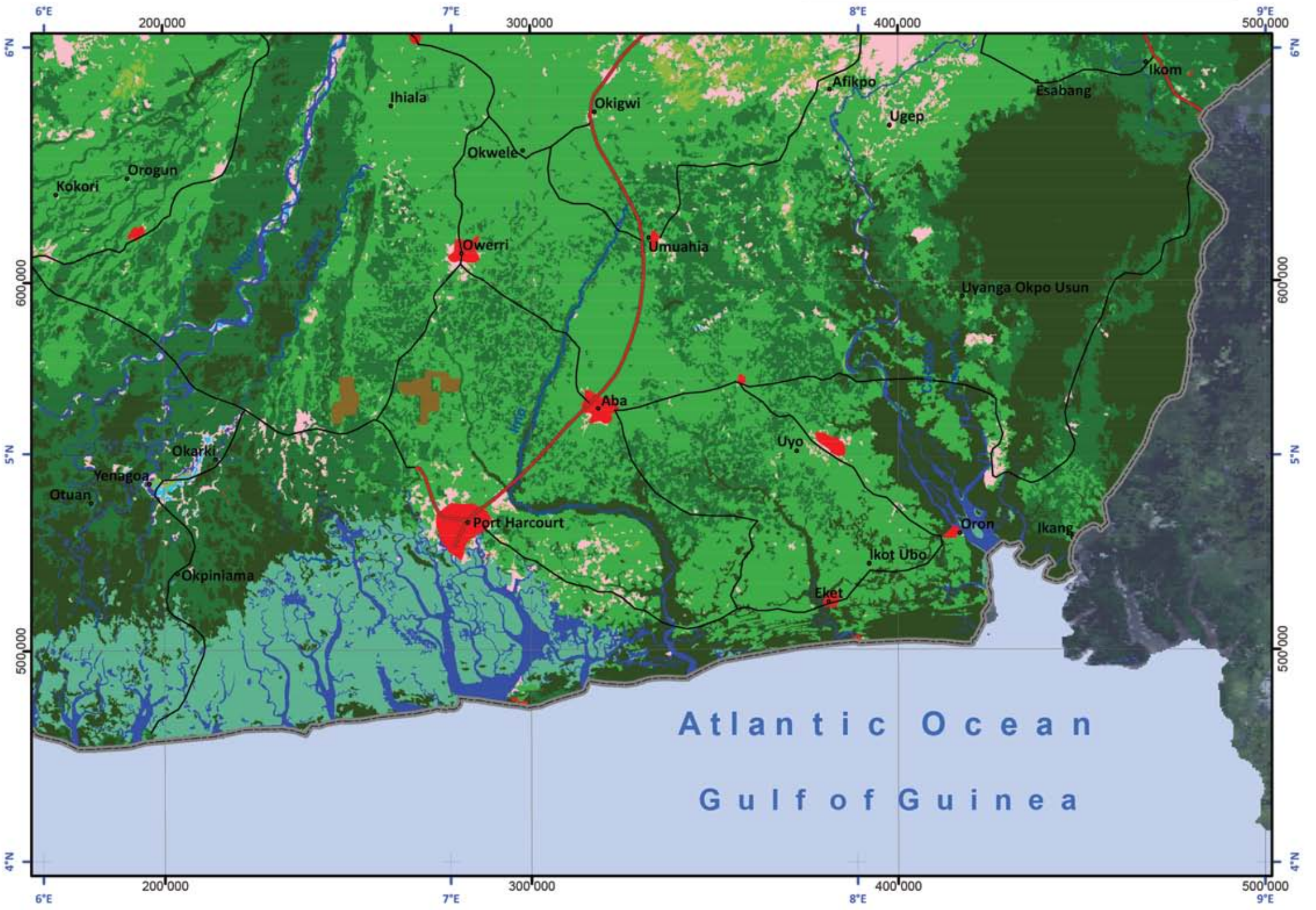
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NB-32-S
DIOUALA-S





Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

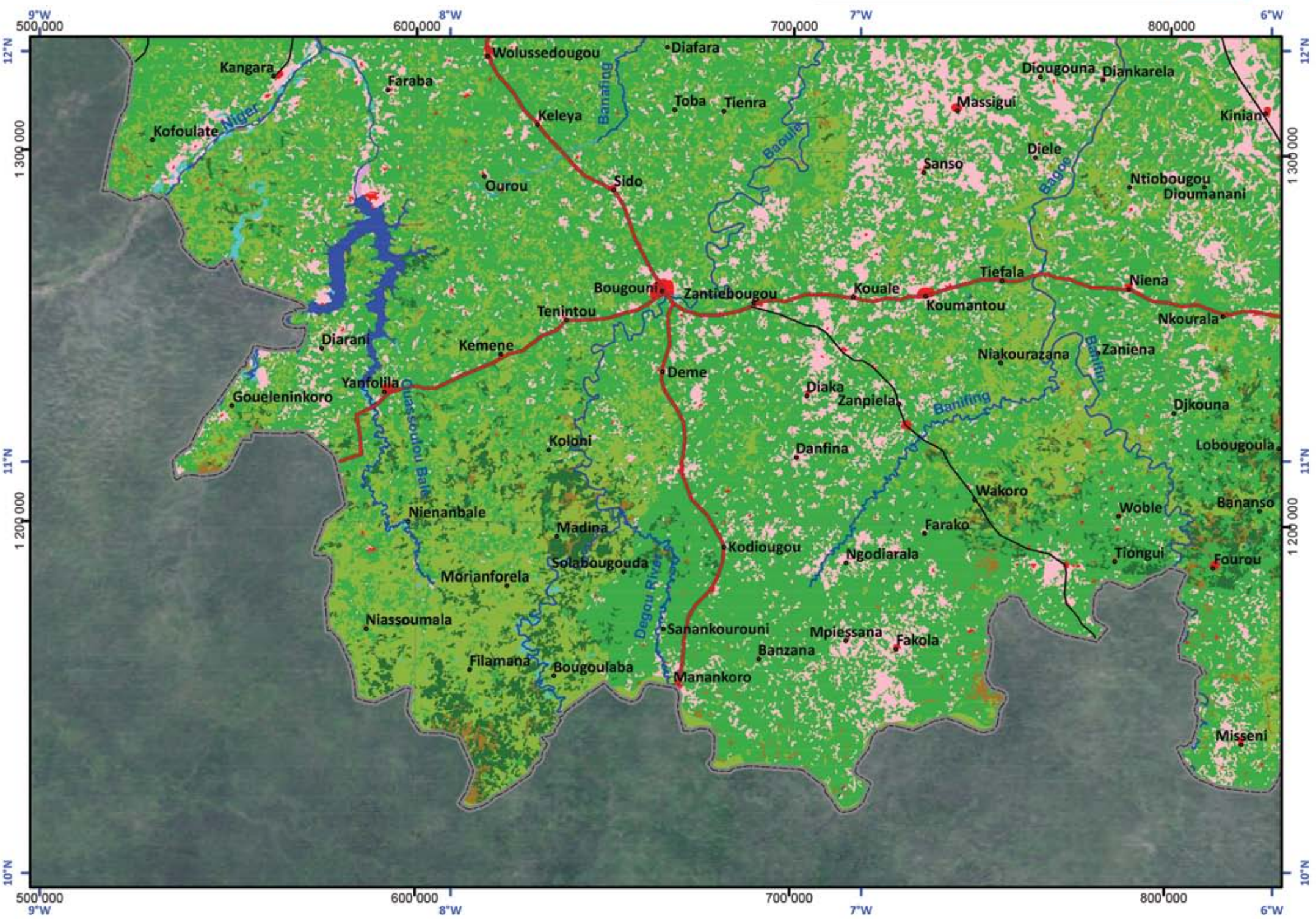
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NC-29-N

KANKAN-N



Scale 1: 1 250 000

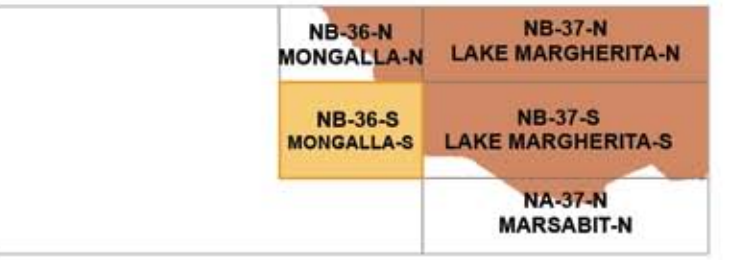
Km
0 20 40 60 80 100

The map is in the World Geodetic System (WGS84) and UTM projection (zone 29).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NB-36-S
MONGALLA-S



N

33°E 500,000 | 34°E 600,000 | 35°E 700,000 | 36°E 800,000

6°N | 600,000 | 5°N | 500,000 | 4°N

Bambu

Chele

Kibish Sliot

Omo Wenz

Kibish Sliot

Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

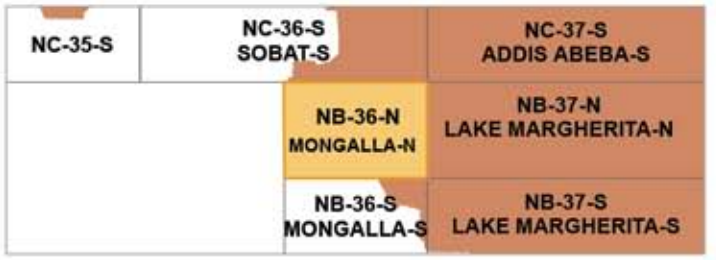
Built-up Land

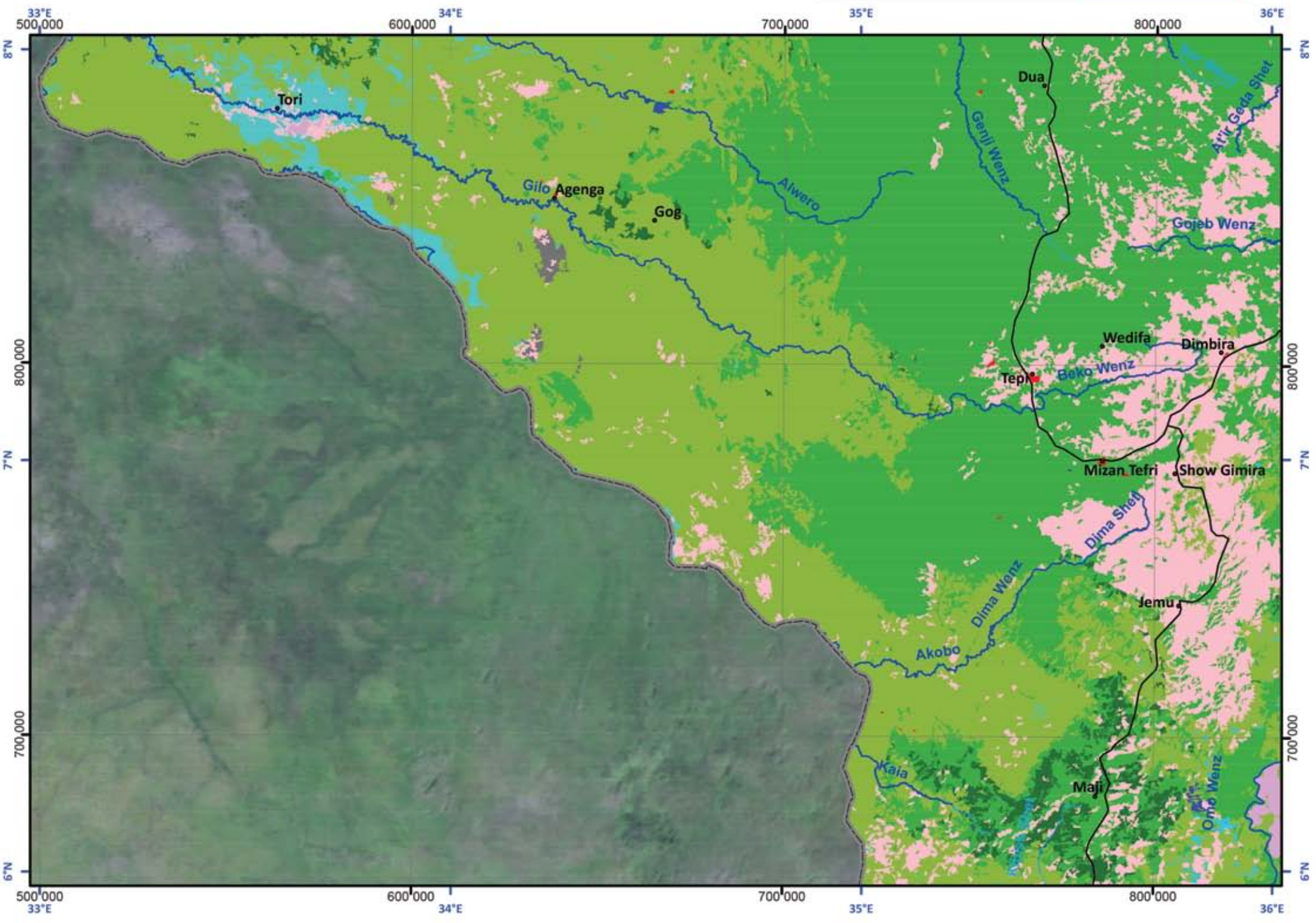
- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NB-36-N

MONGALLA-N





Scale 1: 1 250 000

Km
0 20 40 60 80 100

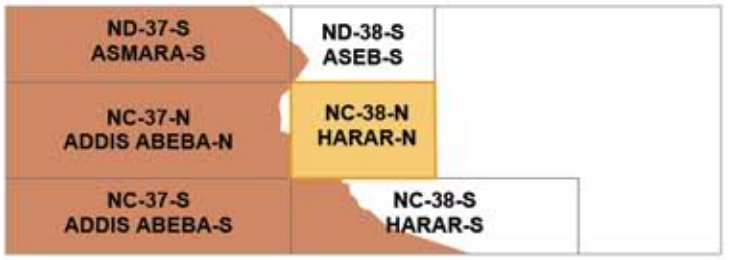
The map is in the World Geodetic System (WGS84) and UTM projection (zone 36).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

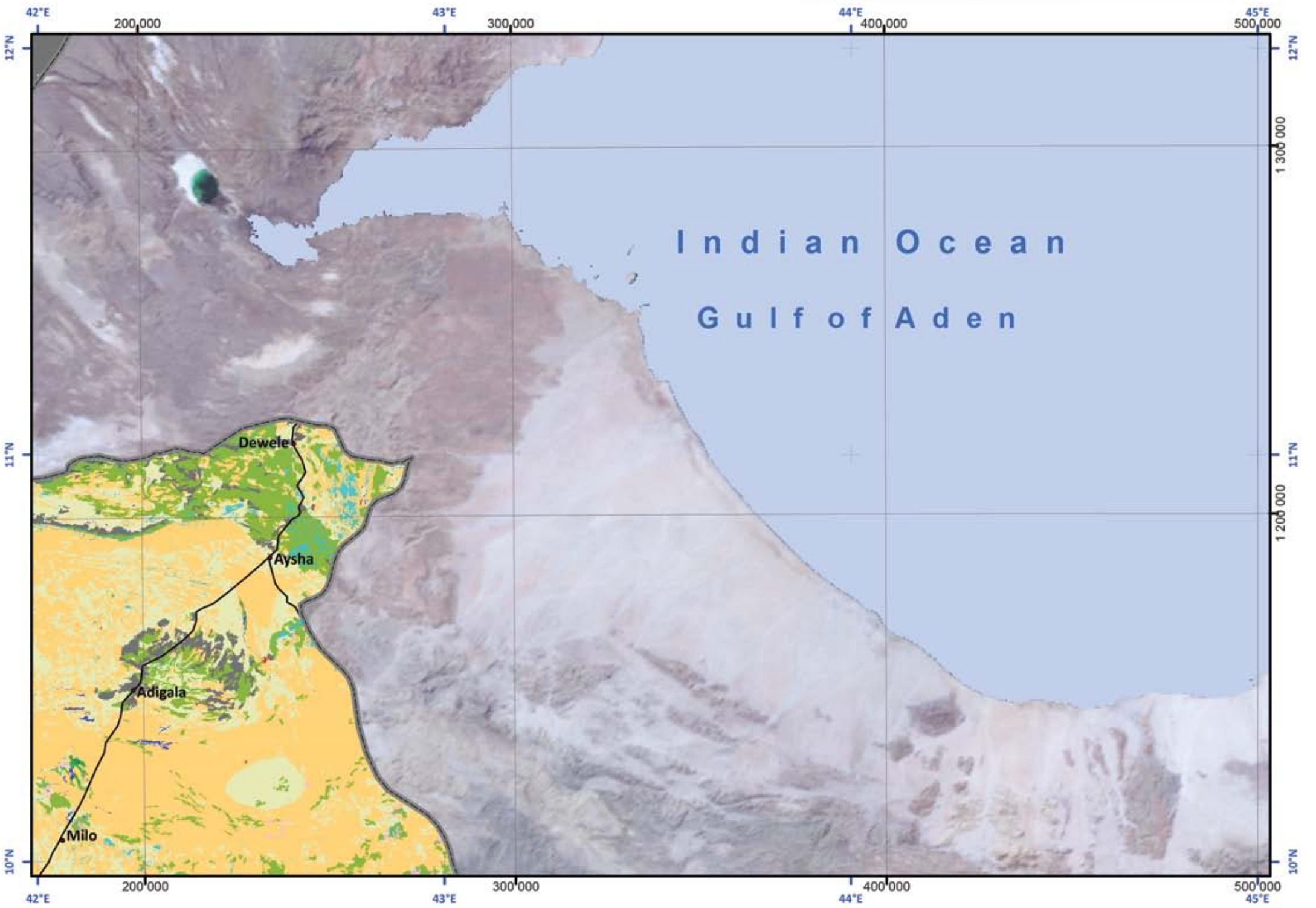
Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NC-38-N

HARAR-N





Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

ND-38-S
ASEB-S

Scale 1: 1 250 000

Km
0 20 40 60 80 100

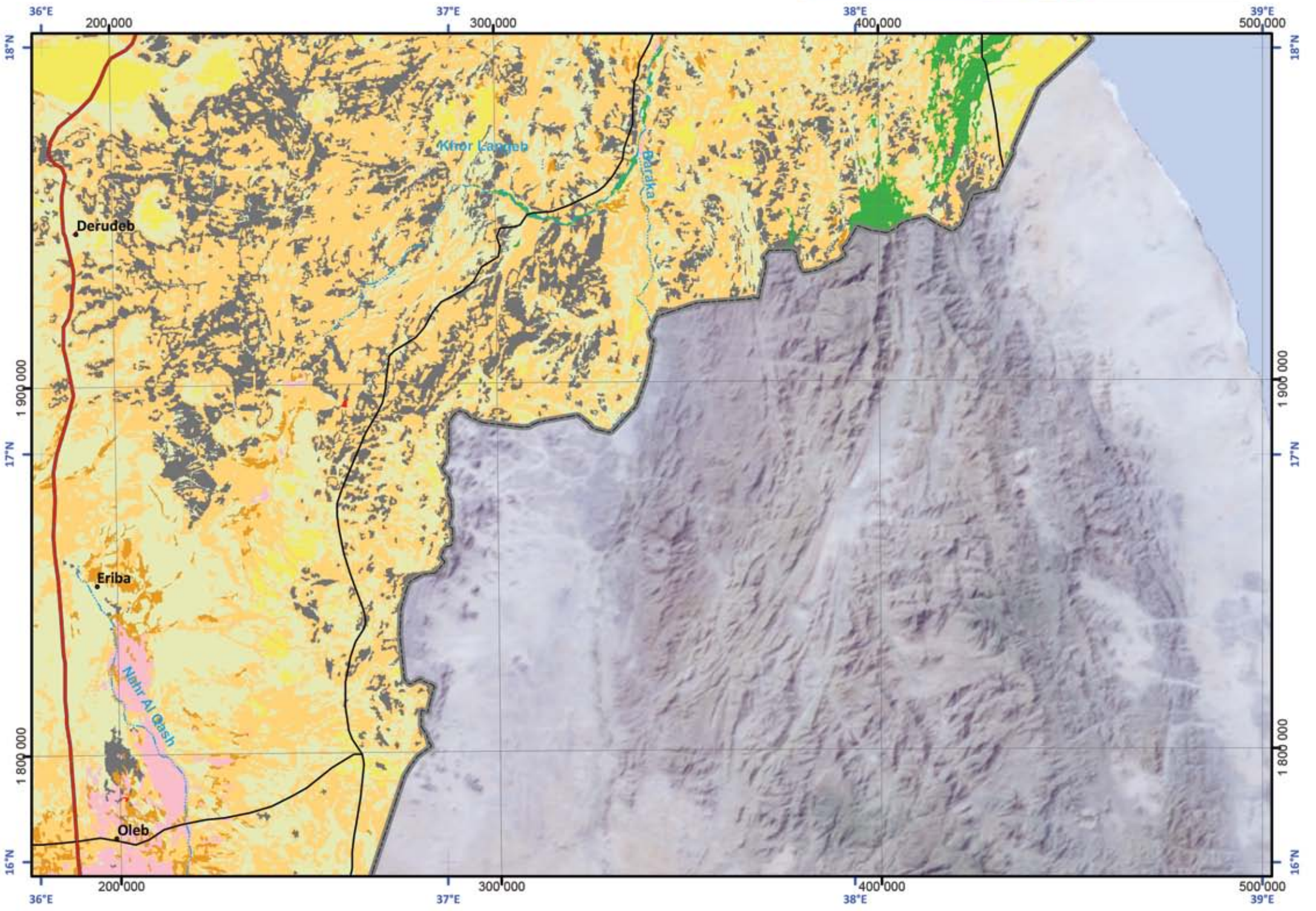
The map is in the World Geodetic System (WGS84) and UTM projection (zone 38).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NE-37-S

PORT SUDAN-S



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

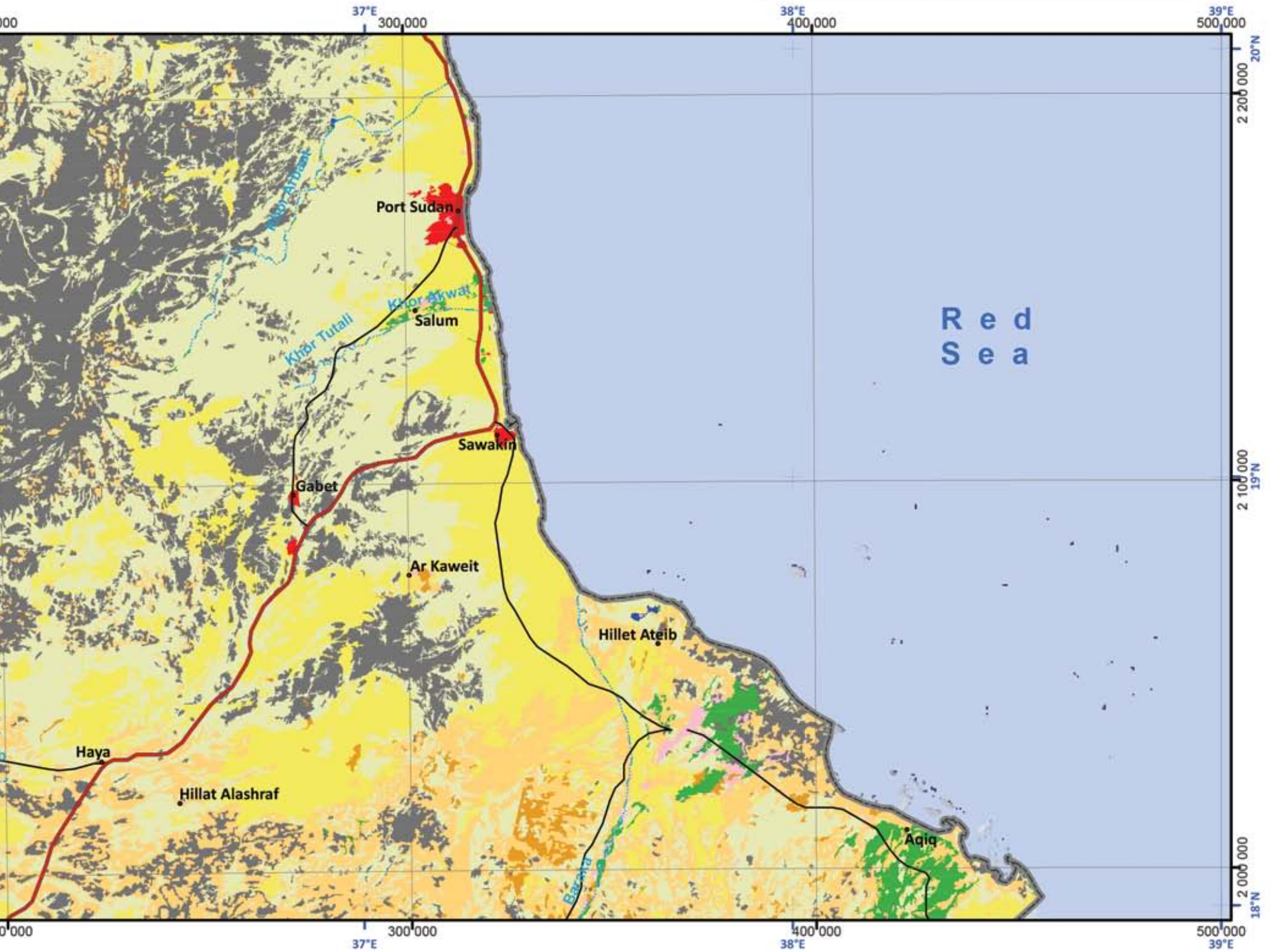
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NE-37-N

PORT SUDAN-N



Scale 1: 1 250 000

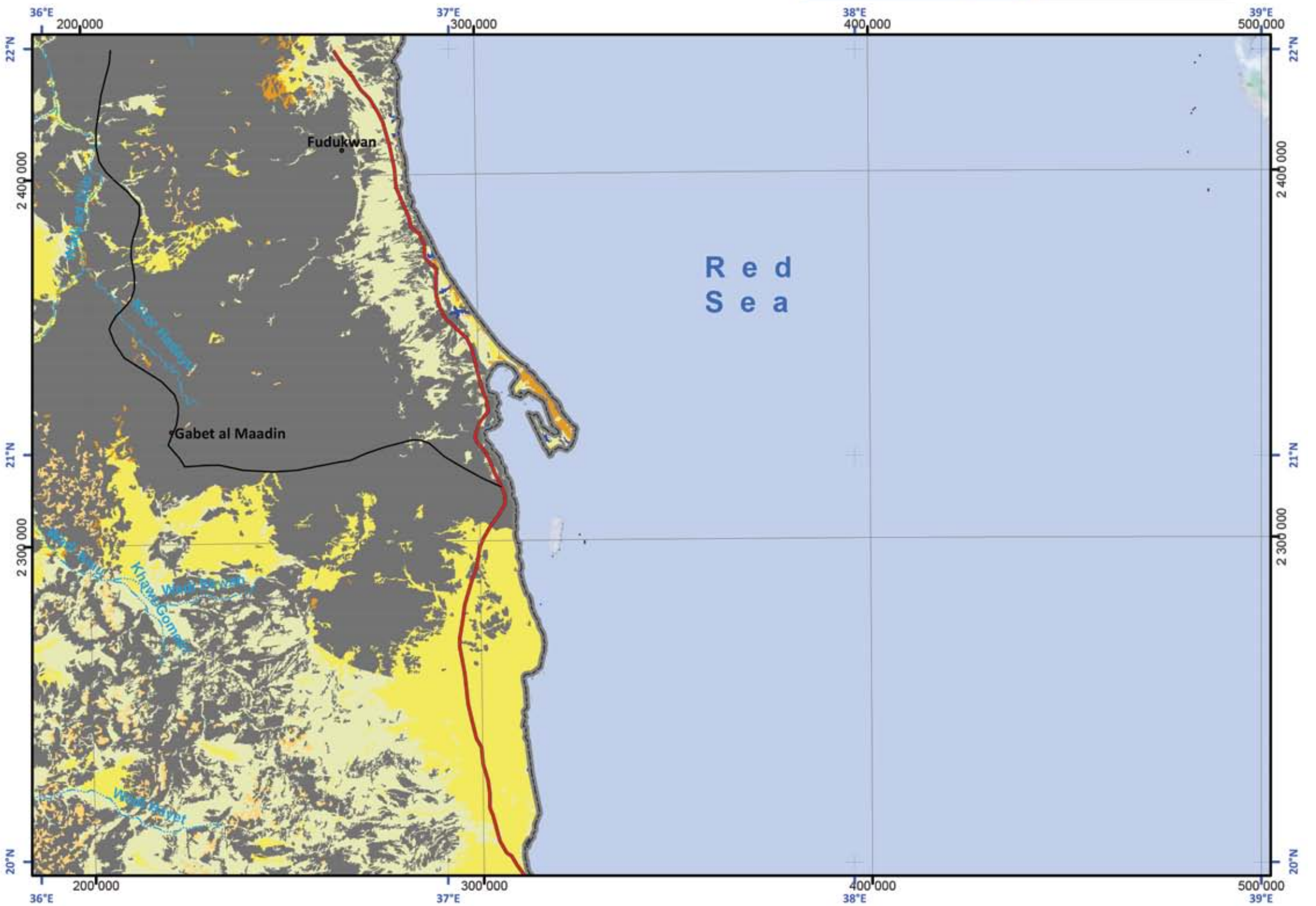
0 20 40 60 80 100 Km

The map is in the World Geodetic System (WGS84) and UTM projection (zone 37).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NF-37-S
GEBEIT-S



Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

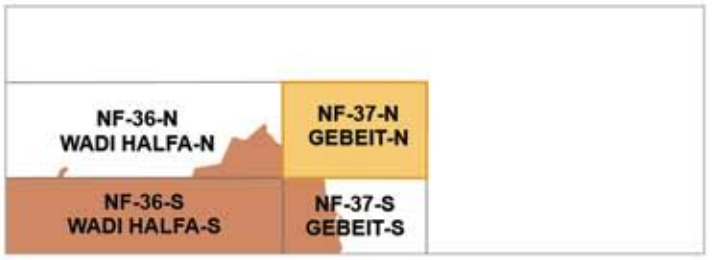
- Water body
- Floodplain
- Aquatic vegetation

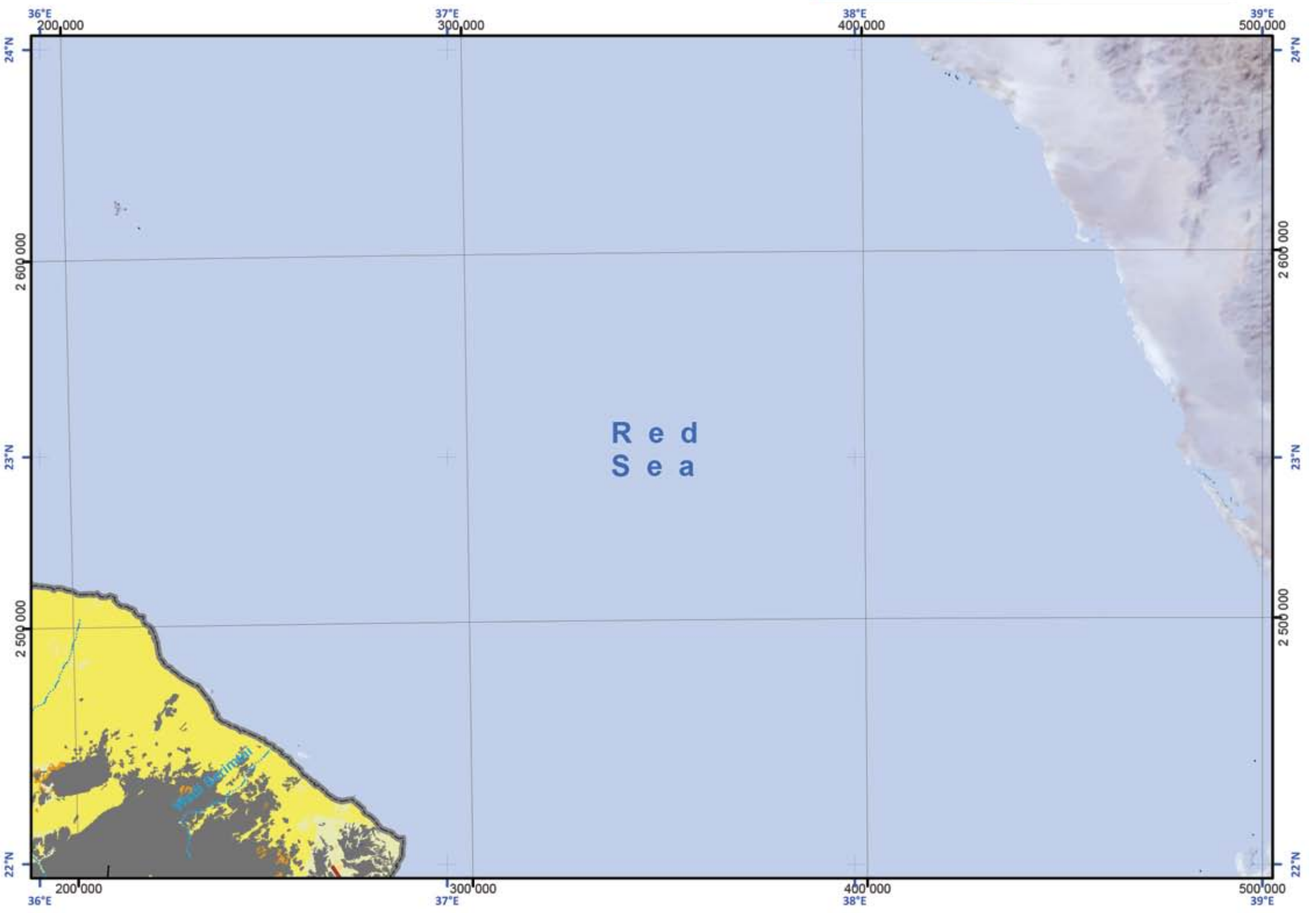
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NF-37-N
GEBEIT-N





Scale 1: 1 250 000

0 20 40 60 80 100 Km

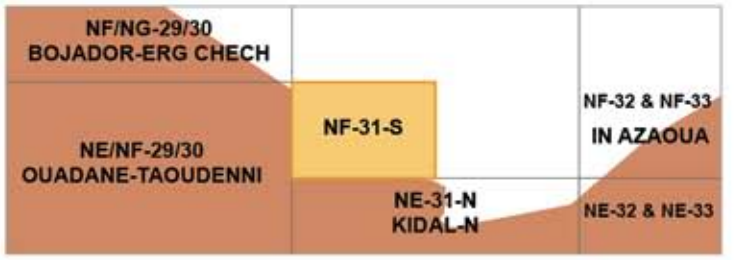
The map is in the World Geodetic System (WGS84) and UTM projection (zone 37).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

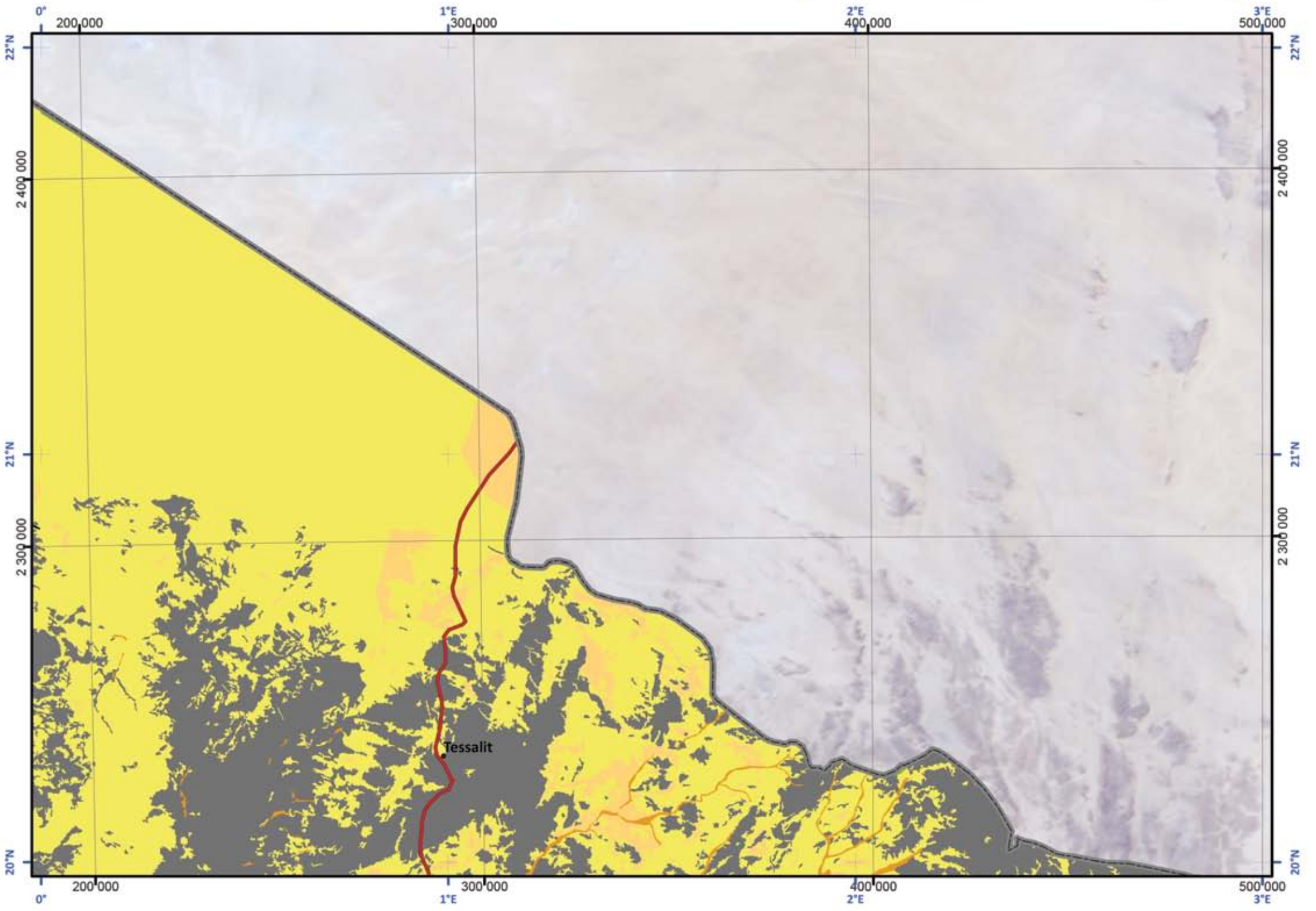
Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

NF-31-S

FORT LAPERRINE-S





Cultivated Land

- Irrigated cropland
- Rainfed cropland

Bare Land

- Barren soil or very sparse vegetation
- Salty soil
- Sand dunes
- Rock outcrops

Wetland

- Water body
- Floodplain
- Aquatic vegetation

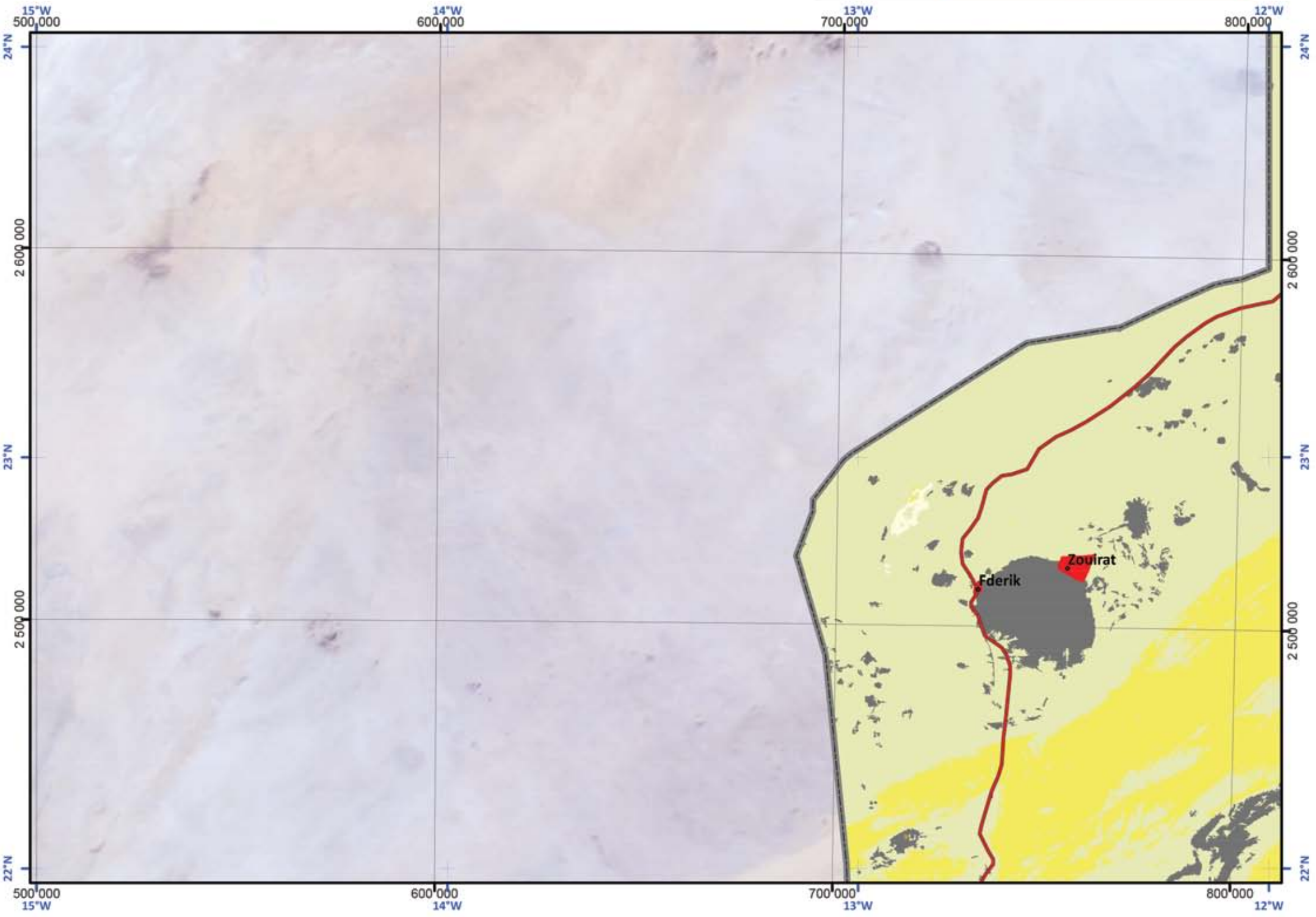
Built-up Land

- Settlement

- River
- Perennial stream
- Intermittent stream
- Primary road
- Secondary road
- National capital
- City or Town

NF-28-N

PORT ETIENNE-N



Scale 1: 1 250 000

Km
0 20 40 60 80 100

The map is in the World Geodetic System (WGS84) and UTM projection (zone 28).
The black grid represents the metric coordinates.
The blue ticks represent the Geographical coordinates.

Natural Vegetation

- Tree plantation
- Gallery forest
- Closed forest
- Open forest
- Mangrove
- Wooded savanna
- Shrub / Tree savanna
- Grass savanna
- Shrub / Tree steppe
- Grass steppe

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ABBREVIATIONS AND ACRONYMS

AfDB	African Development Bank
AIDI	Africa Infrastructure Development Index
AU	African Union
AUC	African Union Commission
BRICKS	Building Resilience through Innovation, Communication, and Knowledge Services
CEDEAO	Communauté économique des états de l'afrique de l'ouest
CILSS	Permanent Interstate Committee for drought control in the Sahel
ECOWAS	Economic Community of West African States
FAO	Food and agriculture Organization of the United Nations
FIT	Front Inter Tropical
GEF	Global Environment Facility
GGWI	Great Green Wall Initiative
GHG	GreenHouse Gas
GIS	Geographic Information System
IBRD	International Bank for Reconstruction and Development
IGA	Income-Generating Activity
IGAD	Intergovernmental Authority on Development
INSAH	Institut du Sahel
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
KPIs	Key Performance Indicators
LDN	Land Degradation Neutrality
MtCO2	Million tonnes of CO2
NEPAD	New Partnership for Africa's Development
NTFP	Non-Timber Forest Products
OECD	Organization for Economic Co-operation and Development
OSS	Sahara and Sahel Observatory
PACO	Central and West Africa Program
PIDA	Programme for Infrastructure Development in Africa
SADA	Savannah Development Authority
SAWAP	Sahel and West Africa Program
SDGs	Sustainable Development Goals
SLWM	Sustainable Land and Water Management
TFP	Technical and Financial Partners
UE	European Union
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNSO	United Nations Sudano-Sahelian Office
WB	World Bank
WTO	World Tourism Organization

ATLAS PRESENTATION

This regional atlas of land cover maps is meant to serve as a planning and decision-making tool in support of the Great Green Wall Initiative. It is intended for decision makers, development partners and the public audience. It was designed on the basis of satellite data of 30 meters resolution and covering 12 countries concerned by the Sahel and West Africa program - SAWAP (Benin, Burkina Faso, Chad, Ethiopia, Ghana, Mali, Mauritania, Niger, Nigeria, Senegal, Sudan, and Togo).

Through the cartography of land cover and the thematic synthesis describing the biophysical and socio-economic environment of the region, this product highlights the potentialities and assets of the Sahel and West African regions, while demonstrating their vulnerability and threats to the natural resources.

The reader could also find illustrations of the main ecosystems and their strategic role in socio-economic development and transboundary cooperation, to face global climate change.

This publication is the result of close collaboration between OSS, CILSS, IUCN and the relevant technical departments within countries of the region, in the framework of the «Building Resilience through Innovation, Communication and Knowledge Services - BRICKS» project.

All data and maps used are available on the OSS website at the following link: www.oss-online.org/fr/publications.

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