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GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

DISASTER PRONE AREA ATLAS BANGLADESH

KHULNA ZILA

BANGLADESH BUREAU OF STATISTICS (BBS)
STATISTICS AND INFORMATICS DIVISION (SID)
MINISTRY OF PLANNING

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Map of Bangladesh highlighting the concerned Zila

Cover (Back):

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KHULNA ZILA

June, 2021

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GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

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Foreword

Bangladesh Bureau of Statistics (BBS), the National Statistical Organization (NSO) of the country, is responsible for collecting, compiling and disseminating of statistics on population, demography, and economics as well as on other social indicators to measure the trends of the country's growth and development. Conducting Population and Housing Census is one of the core activities of BBS. Besides this, BBS conducts a lot of inter-censual survey and generate analytical reports for the users which are mainly used for planning and policy-making at the national and sub-national levels. These reports are widely used for poverty alleviation interventions and initiatives for the improvement of the people's quality of life.

Bangladesh has taken a holistic approach towards disaster management, where emphasis has been given for working together with all stakeholders to build strategic, scientific and implementation partnerships with all relevant government departments and agencies, other key non-government players including NGOs, academic and technical institutions, the private sector and development partners. The role of Government is mainly to ensure the risk reduction and comprehensive disaster management program. Giving emphasis on that, BBS took an initiative to produce disaster prone area Atlas for 15 coastal districts of the country. These Atlases will focus on the existing situation of hazards, risk and disaster proneness of the districts and at the same time, it will help visualise the vulnerability through map and statistics. The disaster prone Atlas of Khulna District is one of the output of such initiative.

However, let me take privilege to thank UNFPA for providing financial and technical support to Stat4Dev Project of BBS under which this Atlas is prepared. I would like to thank the working group comprising experts from Government of Bangladesh, Research Organizations and International Organizations for their technical backstopping in preparing the maps and the Atlas. I also would like to express my sincere thanks to officials of SID Concerned, the Director General of BBS, Project Director, Stat4Dev project and his team for their sincere efforts in successful completion of this tremendous job. Thanks are also due to the distinguished members of the Technical Committee and Report Review Committee for their valuable guidance in finalizing of the Atlas.

Dhaka: June, 2021

Muhammad Yamin Chowdhury

Director General
Bangladesh Bureau of Statistics (BBS)
Statistics and Informatics Division (SID)
Ministry of Planning
Government of the People's Republic of Bangladesh

Preface

Bangladesh Bureau of Statistics (BBS) already has entered into a new era through the enactment of *The Statistics Act, 2013*. As per this Act, BBS is mandated as the standalone agency for generating official statistics. The law has empowered BBS to provide guidance to other agencies for producing official statistics and to authenticate statistics generated by them. The Act also has given responsibility to BBS for prepareing Integrated Geographical Information System (GIS) to foster integration of GIS with statistics. According to *The Statistics Act 2013*, BBS has prepared the National Strategy for Development of Statistics (NSDS) aimed at capacity building of the nationwide use of statistics with a special focus on Environment, Climate Change and Disaster related quality statistics. Following the mandate, previously BBS published small area atlas for 64 districts in 2016-2018. Now BBS is going to prepare the disaster prone area atlas for 15 coastal districts of the country for the first time. The disaster prone area atlas of Bangladesh is a tool to enhance decision-making for reducing the economic and social impacts of natural disaster in the country. It is intended to provide a wide range policymakers with appropriate risk information in order to strengthen the capacity of the country to develop disaster risk reduction and management. It provides tool in identifying, showcasing and disseminating information to make sound decisions to enhance the planning and development process. The atlas serves as a catalyst for the holistic approach of building resilient communities. The disaster prone area Atlas of Khulna District is one of the outcome of our disaster prone area mapping exercise.

I am grateful to UNFPA for their technical and financial assistance and to the representatives of universities and research organizations for their valuable guidance in preparing the Atlas, My sincere thanks also go to Mr. Md. Akther Hossain, Project Director, Md. Maksud Hossain, Deputy Director and other colleagues of Stat4Dev Project of BBS for their relentless effort in preparing the Atlas and for bringing out this atlas. The members of the Editorial Committee deserve special thanks for their input in the technical improvement of the Atlas.

However, I think this Atlas will be useful to the policymakers, researchers and development partners to meet their demand for mapping the country. Any constructive suggestion for improvement of this report will be highly appreciated.

Dhaka: June, 2021

Mohammad Tajul Islam

Representative
UNFPA Bangladesh

Message

I am glad to know the Bangladesh Bureau of Statistics (BBS), under the Statistics and Informatics Division (SID) of the Ministry of Planning of the Government of Bangladesh, has taken the initiative of publishing the Disaster-Prone Area ATLAS prepared by the UNFPA-supported project with BBS. An ATLAS is a handy tool to identify and reveal the exact location and geophysical and socio-economic characteristics of a geographical area. I believe this Disaster-Prone ATLAS will give a clear understanding of spatial and temporal occurrences of natural calamities and will be beneficial in mitigation strategies and preparedness plans, allocation of resources for a response, and will provide the decision support system in disaster management.

UNFPA assists the national efforts at building and sustaining capacities for knowledge management and data/ statistics systems, for integrating population dynamics into national planning and monitoring systems. It commits UNFPA Bangladesh to strengthen national capacity for the production and use of age, sex and location disaggregated population data, in line with the Sustainable Development Goals (SDGs) and International Conference on Population and Development (ICPD) beyond 2014. The 2030 Agenda for Sustainable Development, adopted in 2015, has placed the highest priority on ensuring that "no one is left behind", calling on national statistical systems to disaggregate national indicators and monitor and redress inequalities as a matter of human rights. This aspiration places a high demand on national data ecosystems, and on data disaggregation by age, sex and location in particular.

Climate change is one of the greatest challenges facing humanity today. Due to its geographical location, geological and climatic conditions, Bangladesh is one of the most disaster-prone countries in the world. UNFPA is working with the Governments and other development partners to understand population dynamics better, how they affect the changing climate and how people can become resilience in the face of these changes. This disaster-prone area ATLAS has visualized through maps and statistics of the existing situation of hazard and the risk of Khulna district.

I would like to express my sincere appreciation to the Director General of BBS, Project Director, and his team for their sincere efforts in successful completion of this tedious job.

Dhaka: June, 2021

Ms. Asa Torkelsson

Project Director
Stat4Dev Project
Bangladesh Bureau of Statistics (BBS)
Statistics and Informatics Division (SID)
Ministry of Planning

Acknowledgement

I am delighted to acknowledge the active role of officials concerned in undertaking the exercise for preparation of Disaster Prone Area Atlas. It is worth-mentioning that the staff members of BBS have professionally and successfully completed the Atlas by overcoming all the challenges.

I would like to express my humble gratitude and thanks to Mr. Mohammad Yamin Chowdhury, Secretary, Statistics and Informatics Division (SID), Mr. Mohammad Tajul Islam, Director General, Bangladesh Bureau of Statistics, Ms Mahmuda Akhter, Ex. Additional Secretary (Informatics), Statistics and Informatics Division (SID), Mr. Ghose Subobrata, Ex. Deputy Director General, Bangladesh Bureau of Statistics for their valuable suggestions, patient guidance and all-out support for completion of the disaster prone area atlas.

Thanks to UNFPA Bangladesh for their generous support to BBS for conducting National Population Census and other outputs, like preparing disaster prone area maps, using census data for the very meaningful use by different government and non-government agencies.

Particularly I am grateful to Mr. Md. Maksud Hossain, Deputy Director and other Stat4Dev project's officials who were the active members of this Atlas team.

I have the pleasure to express my deepest gratitude to Mr. Rezaul Roni, Associate Professor, Department of Geography and Environment, Jahangirnagar University and who gave their full effort in preparing this Atlas. My great appreciation is due to the members of the project management team of stat4Dev project for their relentless efforts in this exercise.

I am deeply indebted to various stakeholders and agencies concerned who always provided their valuable suggestions and comments for successful completion of the Atlas and data collection from field.

Hope, users and readers will continue to forward their suggestion and comments for further improvement of those documents.

Dhaka: June, 2021

Md. Akther Hossain

Acronyms

ADPC	Asian Disaster Preparedness Center
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
BMD	Bangladesh Meteorological Department
BWDB	Bangladesh Water Development Board
DRR	Disaster Risk Reduction
GIS	Geographic Information System
MoL	Ministry of Land
NGO	Non-governmental Organization
NSDS	National Strategy for Development of Statistics
SoB	Survey of Bangladesh
SWIR	Short Wave Infrared
UN	United Nations
WHO	World Health Organization

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Chapter 1

Introduction

1.1 Background

Bangladesh is broadly distinguished as one of the most susceptible countries of the world to climate change. In addition it is one of the most vulnerable countries of the world in terms of natural and anthropogenic hazards. As per the World Risk Report 2015, Bangladesh has been identified as the sixth most natural disaster-prone country among 173 countries in the world. The geography and climate have made the country vulnerable to different meteorological, hydrological and geological hazards. Natural hazards are a direct result of increased rainfall in the monsoon season, rising sea levels from climate change, and tropical cyclones. The occurrences of natural disasters in the nation are supposed to increase because of climate change. Each disaster brings about devastating effects on the nation's agriculture, water supply, food resources, health and shelter. It is predicted that the effects of climate change, in the future, will generate more than 20 million climate refugees. Bangladesh is among the countries most predisposed to extensive flooding, tornados and destructive cyclones. Additionally, the water in Bangladesh is frequently contaminated with arsenic due to flooding and the high arsenic contents in the soil. It is estimated that nearly 77 million people in Bangladesh are exposed to toxic arsenic from drinking water (WHO, 2000).

Bangladesh Bureau of Statistics (BBS) already has been entered into a new era through the enactment of the Statistical Act 2013. As per the Act BBS is mandated as the stand-alone agency for generating official statistics. The law has empowered BBS to guide other agencies for producing official statistics and also to authenticate statistics generated by them. Consequently, BBS has prepared the National Strategy for Development of Statistics (NSDS) aimed at capacity building of the nationwide use of statistics as well as Environment, Climate Change and Disaster-related quality statistics.

1.2 Objectives

As a consequence of the above NSDS, BBS is going to prepare 15 coastal districts disaster-prone area atlas based on field verification and updating GIS map with other related information. Each disaster-prone area atlas will represent a single district and existing situations of hazard and risk are visualized through maps and statistics.

1.3 Scope of the work

Geographically, the survey was conducted to the entire district for the selected 15 coastal districts area. A mauza/ Mahallah list containing the dominant disaster information for all the 15 districts were created to prepare the risk map. The risk analysis was done at the extent of both the national and local levels. It will focus on the main disaster namely flood, salinity, storm surge, excess rainfall, cyclone, thunderstorm and windstorm.

1.4 About the national disaster Atlas

The main deliverable of the project is the district-specific disaster-prone area atlas. The atlas contains general information about the demographic and climatic characteristics of a specific district. It describes the main elements at risk and the hazard profile of the local level based on settlements. The information was collected from the local level community and

compiled to construct the maps. It contains an analysis of the risk and vulnerability of the district. The disaster-prone area atlas of Bangladesh is a tool to enhance decision-making to reduce the economic and social impacts of natural hazards in the country. It is intended to provide a wide range of decision-makers and policymakers with appropriate risk information to strengthen the capacity of the country to develop strategic risk management strategies. It provides an excellent tool in identifying, showcasing and disseminating important information needed to make timely and sound technical decisions to enhance the development process. The atlas catalyzes the holistic approach of building resilient communities.

1.5 Expected benefits to the Nation

At the end of this Atlas, a lot of information on disaster and risks will be available and be able to define the disaster profile of specific districts of Bangladesh. Such a disaster risk profile will help to better coordinate all disaster management related initiatives proactively at national and local levels, leading to the reduction of disaster risk for all.

1.6 Key stakeholders

The National Disaster Atlas is intended to benefit a range of stakeholders and potential users. Mainly, the key decision/policy-makers will be able to ensure policymaking and decisions are based on robust risk information. The atlas will benefit donors and development partners by informing them of their respective project formulation and design and risk-proofing development interventions. It will also ensure risk-informed planning by Planners in the government institutions, non-government organizations and the private sector. Besides, the academe is one of the expected beneficiaries and users of the atlas specifically as a basis or reference for further researches and academic papers. Moreover, the private sector will also benefit from the atlas as its findings could guide them in disaster risk proofing their investments. The humanitarian actors could also utilize the atlas as a guide in identifying hazard-safe areas where humanitarian interventions are placed and implemented. The Districts and the local communities will by and large be the main beneficiaries and users of the atlas.

As herein listed, these stakeholders were grouped into ministries, governmental institutions, regional organizations, and international organizations (including UN Agencies and NGOs). Some of the other stakeholders, particularly the regional organizations, participated in the project by providing data required in the assessment including thematic inputs in the use of software, and modeling, including the development of the methodology and analysis.

1.7 Key concepts and definitions

Disaster.

According to the Disaster Management Act, 2012, 'Disaster' means any such incidents mentioned below created by nature or human or created due to climate change and its massiveness and devastation cause such damage to cattle, birds and fisheries including life, livelihood, normal life, resources, assets of community and the environment of the damaged area or create such level of hassle to that community whose own resources, capability and efficiency is not sufficient to deal this and relief and any kind of assistance is needed to deal that situation, such as: - (a) Cyclone, northwester, tornado, sea high tides, abnormal tides, earthquake, tsunami, excessive rains, shortfall of rains, flood, erosion of river, erosion of coastal area, drought, excessive salinity, excessive pollution of arsenic, building slide, landslide, hill slide, gushing water from hills, hailstorm, heat wave, cold wave, long term water logging etc.; (b) Explosion, fire, capsize of vessel, massive train and road accident, chemical and nuclear radiation, pilferage of oil or gas, or any mass destruction incident; (c) Disease causing pandemic, such as pandemic influenza, bird flue, anthrax, diarrhea, cholera, etc.; (d) Harmful microorganism, poisonous materials and infection of life active object including infection by bio based or biological infectious object; (e) Ineffectiveness or damage of essential service or disaster protection infrastructure; and (f) Any unnatural incident or a misfortune causing massive life loss and damage.

Disaster risk

The potential disaster losses in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time. The definition of disaster risk reflects the concept of disasters as the outcome of continuously present conditions of risk. Disaster risk comprises different types of potential losses, which are often difficult to quantify. Nevertheless, with knowledge of the prevailing hazards and the patterns of population and socio-economic development, disaster risks can be assessed and mapped, in broad terms at least.

Disaster risk reduction

Disaster Risk Reduction (DRR) is the development and application of policies and practices that minimize risks to vulnerabilities and disasters, applies to manage and /or responding to current disaster risks.

Early warning system

It is a major element of disaster risk reduction. It prevents the loss of life and reduces the economic and material impact of disasters. To be effective, early warning systems need to actively involve the communities at risk, facilitate public education and awareness of risks, effectively disseminate alerts and warnings and ensure the constant state of preparedness (Ibid).

Exposure

People, property, systems, or other elements present in hazard zones that are thereby subjected to potential losses. Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest.

Hazard

'Hazard' means any unnatural incident which is created by natural law, due to technical faults or by humans and as a result brings down the normal lifestyle of people into danger and risk through occurring devastation and create sorrows and sufferings including devastating and irreparable damages to necessary items to maintain livelihood (The Disaster Management Act, 2012).

Natural hazard

Natural process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Natural hazards are a sub-set of all hazards. The term is used to describe actual hazard events as well as the latent hazard conditions that may give rise to future events. Natural hazard events can be characterized by their magnitude or intensity, speed of onset, duration, and area of extent. For example, earthquakes have short durations and usually affect a relatively small region, whereas droughts are slow to develop and fade away and often affect large regions. In some cases, hazards may be coupled, as in the flood caused by a hurricane or the tsunami that is created by an earthquake.

Resilience

The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions. The resilience of a community concerning potential hazard events is determined by the degree to which the community has the necessary resources and is capable of organizing itself both before and during times of need.

Return period

A return period, also known as a recurrence interval or repeat interval, is an estimate of the likelihood of an event to occur. It is a statistical measurement typically based on historical data denoting the average recurrence interval over an extended period. The theoretical period is the inverse of the probability that the event will be exceeded in any other year. For example, a 25-year flood has a 1/25 = 0.25 or 25% chance of being exceeded in any one year. Despite the

connotations of the name "return period", it does not mean that a 25-year flood will happen regularly every 25 years or only once in 25 years (Wikipedia, 2015).

Risk

Risk means hazards, factors of dangers and the possible harmful situation created due to the internal process of the environment or assembling and capability. (The Disaster Management Act, 2012)

Risk analysis

The process to comprehend the nature of risk and to determine the level of risk (ISO 31010).

Risk assessment

A methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend. Risk assessments (and associated risk mapping) include a review of the technical characteristics of hazards such as their location, intensity, frequency and probability; the analysis of exposure and vulnerability including the physical, social, health, economic and environmental dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities in respect to likely risk scenarios. This series of activities is sometimes known as a risk analysis process.

Vulnerability

Vulnerability means any such existing socio-economic, geographical and environmental condition of any community, which may make the expected capability of the community vulnerable, weak, unskilled and limited to adapt to the effect of natural or human-created hazard or any adverse reaction (The Disaster Management Act, 2012).

Natural Disaster

A natural disaster is a major adverse event resulting from natural processes of the Earth; examples include cyclones, drought, floods, erosion, volcanic eruptions, earthquakes, tsunamis, and other geologic processes. A natural disaster can cause loss of life or property loss and damages, and typically leaves some economic loss and damages, the severity of which depends on the affected population's resilience, or ability to recover. Following is the description of some of the natural disasters (with their code number) in Bangladesh.

Drought

Bangladesh faces unpredictable drought hazard in the dry monsoon due to inadequate and uneven rainfall. It varies from place to place, however, and the north western region of Bangladesh suffers most from the drought almost regularly in a two-year cycle. It is unusual dryness of the soil, resulting in crop failure and shortage of water for other usage, caused by significantly lower rainfall than average over a prolonged period. Hot dry winds, shortage of water, high temperature and consequent evaporation of moisture from the ground can contribute to conditions of drought. This may have initiated the process of desertification in those districts where the affected areas maintain high temperatures, non-availability of surface water due to drying out of water sources, crops die out and there is a crisis of fodder as well. For people who are directly dependent on rainwater, drought is a big problem (Disaster Related Statistics, BBS, 2015).

Flood

Flood is one of the major natural disasters in Bangladesh. In general, the normal inundation of flood-free areas by water caused by excessive rain and spillage from the overflown riverbanks is called a flood. Floods bring about immense havoc to the lives of the people. Flooding is a natural phenomenon in Bangladesh and occurs on an annual basis. The rivers are huge by global standards and can inundate over 30% of the landmass at a time. Bangladesh is prone to serious and chronic flooding. Even in an average year, 18% of the landmass is inundated and previous floods have affected 75% of the country (as in 1988). 75% of the country is below 10m above sea level and 80% is classified as floodplain as Bangladesh is principally the delta region of South Asia's great rivers. Bangladesh floods regularly, recent notable and catastrophic floods have occurred in 1988, 2004, 2007 and 2010. Floods cause erosion of chars (islands) by flooding rivers, cause landlessness amongst Bangladesh's poor; environmental refugees, loss of property, lives, epidemic, other water-borne diseases, lack of drinking water, loss of agricultural land and crops, communication disruption are some of the major effects of this natural disaster (Disaster Related Statistics, BBS, 2015).

Water Logging

Bangladesh's high vulnerability to frequently occurring natural disasters is known worldwide, a lesser-known new phenomenon - water logging - has been disrupting the livelihoods of people during the past two decades. The phenomenon involves the deterioration of drainage conditions in several southern coastal rivers leading to temporary to permanent inundation of floodplains along those rivers, causing enormous difficulties towards maintaining livelihoods and disrupting land-based productive systems including crops. The problem has become severe in the southwestern parts of Bangladesh, especially along the Kapataksma river system covering parts of Jashore, Khulna and Satkhira districts. Waterlogging is also becoming an issue in the central southern Noakhali district, where gradual chocking of the Noakhali rivulet (i.e., khal) has given rise to temporary waterlogging every year (Disaster Related Statistics, BBS, 2015).

Cyclone

A large-scale closed circulation system in the atmosphere with low barometric pressure and strong winds that rotate counter clockwise in the northern hemisphere and clockwise in the southern hemisphere. The system is referred to as a cyclone in the Indian Ocean and South Pacific, hurricane in the western Atlantic and eastern Pacific and typhoon in the western Pacific. Cyclones are the most devastating of natural disasters. Generally, the disasters faced by the coastal areas are related to tides, river flows and weather conditions leading to cyclonic winds. A major hazard that occurs in the coastal areas is mostly due to weather conditions associated with depressions of varying severity. The hazards due to cyclones are associated with elements such as depressions, cyclone surges, the effect of wind speed, hazard areas, etc. High winds cause rough conditions and high waves during the time of depression over the sea and cause damage and loss throughout the land they pass over. In Bangladesh, the main cause of damage and loss is the severe cyclonic storm with Hurricane intensity. In Bangladesh, most of the cyclones occur during the pre-monsoon (April/ May/ early-June) and post-monsoon (late-September/ October/ November) period. The pre-monsoon period is the sowing or broadcasting season for Aus rice and the post-monsoon season is the harvesting season for Aman rice in the coastal areas. Hence, the impact of cyclones is severe in terms of economic loss, as well as the loss of lives and property (Disaster Related Statistics, BBS, 2015).

Tornado

The two transitional periods between southwest and northeast monsoons over the Indian sub-continent are characterized by local severe storms. The transitional periods are usually referred to as pre-monsoon (March-May), and post-monsoon (October-November). It is the pre-monsoon period when most of the abnormal rainfall or drought conditions frequently occur in different parts of Bangladesh. Also, there are severe local seasonal storms, popularly known as nor' westers (kalbaishakhi). Severe nor'westers are generally associated with tornadoes. Tornadoes are embedded within a mother's thundercloud and move along the direction of the squall of the mother storm. The frequency of devastating nor'westers usually reaches the maximum in April, while a few occur in May and the minimum in March. Nor'westers and tornadoes are more frequent in the afternoon (Disaster Related Statistics, 2015).

Storm/Tidal Surge

Storms are caused by atmospheric disturbance involving perturbations of the prevailing pressure and wind fields, on scales ranging from tornadoes (1 km across) to extra-tropical cyclones (2000-3000 km across). This causes a rise in sea level that result in the inundation of areas along coastlines. The movement of ocean and sea currents, winds and major storms causes these phenomena (Disaster Related Statistics, 2015).

Thunderstorm

A thunderstorm, also known as an electrical storm, a lightning storm, or a thundershower, is a type of storm characterized by the presence of lightning and its acoustic effect on the Earth's atmosphere known as thunder. Thunderstorms occur

in association with a type of cloud known as a cumulonimbus. They are usually accompanied by strong winds, heavy rain and sometimes hail, or, in contrast, no precipitation at all. Thunderstorms result from the rapid upward movement of warm, moist air. They can occur inside warm, moist air masses and at fronts. As the warm, moist air moves upward, it cools, condenses, and forms cumulonimbus clouds that can reach heights of over 20 km (12.45 miles). As the rising air reaches its dew point, water droplets and ice form and begins to fall through the clouds towards the Earth's surface. As the droplets fall, they collide with other droplets and become larger. The falling droplets create a downdraft of cold air and moisture that spreads out at the Earth's surface, causing the strong winds commonly associated with thunderstorms, and occasional fog (Disaster Related Statistics, 2015).

River/Coastal Erosion

A combination of natural processes, including weathering, dissolution, abrasion, corrosion, and transportation, by which material is worn away from the earth's surface. The energy in a river causes erosion. The bed and banks can be eroded making it wider, deeper and longer. River erosion and submerging of the coastal lands are the natural phenomena being one of the main natural disasters. River and coastal erosion cause much more destruction to the socioeconomic mechanism than any other natural disaster. Loss of life may not happen due to erosion but it makes people undone. It causes massive financial loss and damages. The immense pressure of the downwards tide, current force and twirl, waves and tides, storm, tidal surges, lack of trees on the riverbank causes erosion to the coastal islands every year. The collision between downwards current of freshwater and uprising sea level creates strong twirling that causes erosion to the coast. Moreover, due to combined sudden flood, heavy rain, and downwards freshwaters causes a collision to the riverbank and cause erosion to the riverbanks and coastal areas. Deforestation and lack of plantation in the riverbanks and coastal areas are also complemented by riverbank and coastal erosion (Disaster Related Statistics, 2015).

Landslide

Landslides are a complex-disaster phenomenon that can be caused by earthquakes, volcanic eruptions, heavy rainfall (typhoons, hurricanes), sustained rainfall, heavy snowmelt, unregulated anthropogenic developments, mining, and others. In Bangladesh, landslides are mostly triggered by heavy rainfall. However, underlying causes of landslide include deforestation, hill cutting, unregulated development work, etc. Moreover, poverty and landlessness force poor people to live in risky hill-slopes. However, recently landslide has emerged as a major hazard, particularly after the Chattogram Landslide 2007. Due to heavy rainfall from 10 -11 June 2007, landslides and collapsed walls caused widespread damages in six areas of Chattogram city and different Upazilas of the District (Disaster Related Statistics, 2015).

Salinity

Saline water intrusion is mostly seasonal in Bangladesh; in winter months, the saline front begins to penetrate inland, and the affected areas rise sharply from 10 percent in the monsoon to over 40 percent in the dry season. Coastal districts such as Satkhira, Khulna, Bagerhat, Barguna, Patuakhali, Barishal are the victims of salinity intrusion. Agricultural production,

fisheries, livestock, and mangrove forests are affected by higher salinity in the dry season. It is observed that the dry flow trend has declined as a result of which sea flow (saline water) is traveling far inside the country resulting in contamination both in surface and groundwater. The population of pure freshwater fish species decline and species that are more tolerant survive and dominate changing the composition of the ecosystem and affecting the livelihoods of the people dependent on the freshwater resources (Disaster Related Statistics, 2015).

Hailstorm

Hailstorm is a very curious geographical and climatic phenomenon. A hailstorm is named such, because during the storm, hail or balls of ice fall in huge quantities on the Earth. It is nothing but irregular lumps or balls of ice. The specialty of a hailstorm is that both hail, i.e. balls of ice, and rainwater fall during the storm, at the same time. The hailstorms are not exactly storms but are a side effect of a much bigger storm, the thunderstorm. This phenomenon originates from thunderclouds that are known as Cumulonimbus clouds. When the existing temperature of a mass of air currents falls rapidly over decreasing altitude, it results in a hailstorm. The hailstones are formed due to the process of freezing and grow over time. They are carried by the updrafts or the air currents moving in the upward direction until they become large for these currents to continue carrying them. Hailstones must have at least 3/4 inch of diameter to become severe and cause a substantial amount of damage and loss to life and property. Being a nature's phenomenon and a type of natural disaster, hailstorms are unavoidable. The impact of hailstones can cause widespread damage and loss to vulnerable plants, crops, infrastructure and equipment that is stored outside. Hailstones have the potential to destroy animals and human life upon impact if strong enough (Disaster Related Statistics, 2015).

1.8 Data and Map sources

The development of a comprehensive disaster risk profile requires foremost a good understanding of the general context and background of the country. Accordingly, a wide range of data has been collected. These data were organized in a dataset and converted into GIS formats. The data includes administrative entities, population, infrastructure, buildings and settlement, livelihood, health, education, elevation and topography and land use countrywide. It is important to note that the data availability constitutes a main challenge and constraint for the preparation of this atlas. The following table contains the sources of data, their content along with type and format.

Table 1.1: Database Inventory

S/N	Type of data	Format	Content	Source
1	Topographic Maps	Image	Images covering the specific area produced in 2010	SoB
2	Land Cover Map	GIS Shapefiles	Land use land cover information	MoL

3	Education facilities location	GPS locations	Specific locations and other related information	BBS
4	Health facilities location	GPS locations	Specific locations and other related information	BBS
5	Administrative boundary	GIS Shapefiles	Admin boundary with Geocode	BBS
6	River Network	GIS Shapefiles	Detail river network with the name	BWDW
7	Meteorological data	Spreadsheet	Daily Temperature, Rainfall, Humidity with station location's latitude and longitude	BMD
8	Demographic data	Spreadsheet	mauza specific Various demographic related data	BBS
9	Soil salinity	Point-based GIS shape files	Salinity measurement for the specific location of the study area	BARC
10	Disaster information	Spreadsheets	Various disaster and damage related information	BBS

Chapter 2

Methodological Framework for Hazard and Risk Assessment

2.1 Understanding country situation and baseline data compilation

The risk assessment process was an extensive inventory and compilation of existing data and information related to hazards and elements at risk. It involves an understanding of the country's disaster risk management framework, practices and institutional set-up. It entails collection of baseline data of the country such as administrative boundaries, infrastructure, socioeconomic data (e.g. demographics, poverty index, employment, agriculture, etc.), spatial data (e.g. Digital Elevation Model, geology, soil, land cover, land use, road network, etc.) and meteorological data (e.g. rainfall, temperature, etc.). The process also includes collection of historical disaster events and damages and losses they caused. The collected data are compiled and structured in different datasets according to its nature, format and contents. Subsequently, the datasets are integrated in the Geographical Information System (GIS) platform and processed into maps and spatial formats. Some of the baseline data are presented in figures and tables. These maps, figures and tables are presented in chapter 3.

2.2 List of disaster and disaster calendar

Each district has different hazards occurred in different times. To identify the different hazards in particular district one questionnaire form was produced to collect the data from field and compiled together.

Table 2.1: The table shows the disaster calendar of the Khulna district.

Upazila Name	Disaster Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Batiaghata	Coastal Flood												
	Cyclone												
	Excess Rainfall												
	Heavy Fog												
	River Erosion												
	Thunderstorm												
	Windstorm												
Dacope	Coastal Flood												
	Cyclone												
	Excess Rainfall												
	River Erosion												
	Thunderstorm												
	Windstorm												

Upazila Name	Disaster Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dighalia	Coastal Flood												
	Cyclone												
	Thunderstorm												
	Windstorm												
Dumuria	Coastal Flood												
	Cyclone												
	Excess Rainfall												
	Thunderstorm												
	Windstorm												
Koyra	Coastal Flood												
	Cyclone												
	Excess Rainfall												
	River Erosion												
	Windstorm												
Paikgachha	Coastal Flood												
	Cyclone												
	Excess Rainfall												
	River Erosion												
	Thunderstorm												
Phultala	Cyclone												
	Excess Rainfall												
	Thunderstorm												
	Windstorm												
Rupsha	Coastal Flood												
	Cyclone												
	Excess Rainfall												
	Thunderstorm												
Terokhada	Cyclone												
	Coastal Flood												
	Thunderstorm												

2.3 Hazard assessment and mapping

Hazard assessment and mapping is the first step of the risk assessment process. It involves characterizing the hazards in terms of its spatial distribution, frequency and intensity. It covers eight major hazards that are prevalent in Khulna district namely, cyclone, excess rainfall, flood, river erosion, thunderstorm, tidal bore, water logging and windstorm. The hazard maps identify the hazard-prone areas, describe the physical characteristics of the hazards and characterize the hazards in terms of magnitude, frequency, duration, extent, intensity and probability. The hazard assessment and mapping phase also entails building of plausible scenarios for each hazard and developing hazard intensity maps.

2.4 Exposure assessment

Identifying and assessing the elements at risk is the next step in the risk assessment process. Exposure assessment is an intermediate stage of risk assessment, which links the hazard assessment with the targeted elements under consideration for the risk assessment (ADPC, 2013). The elements at risks in this study, also labelled as sectors of activity, are population, building, critical facilities such as health and education facilities, infrastructure (e.g. roads) and agriculture. Exposure was quantified and expressed as the number of disaster affect the community (or human lives).

Table 2.2: Elements considered in the assessment for each hazard

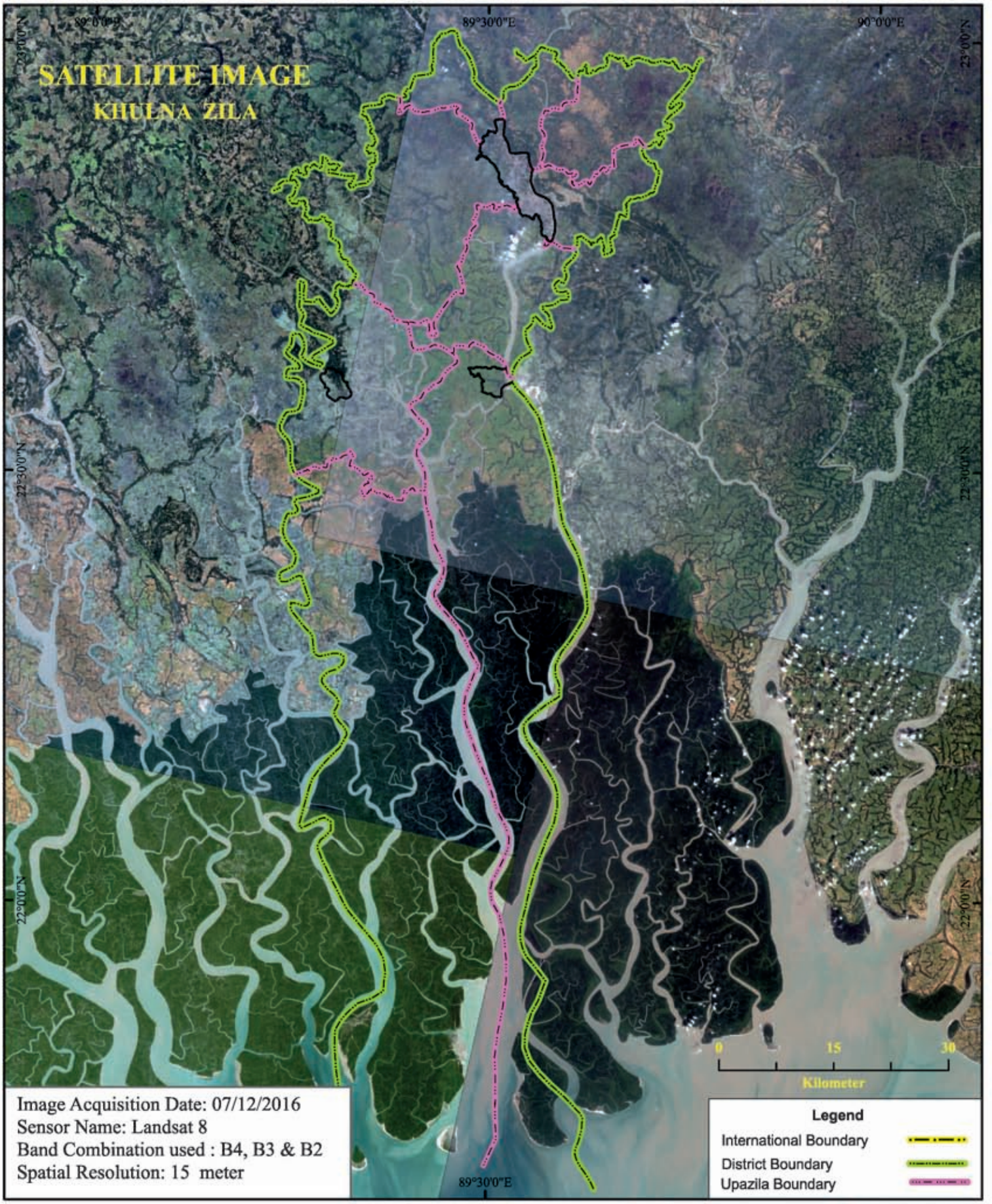
Type	Population	Settlement
Coastal Flood	√	√
Windstorm	√	√
Thunderstorm	√	√
Cyclone	√	√
Excess Rainfall	√	√
Strom surge/Tidal bore	√	√
Water logging	√	√
Tornado	√	√

The exposure assessment is aimed at creating a national database of elements at risks. It qualifies the elements located in hazard-prone areas. The goal is to develop a comprehensive profile of elements at risk and analysis of their exposure to various natural hazards. The analysis is carried out based on available data.

2.5 Satellite Imagery and processing

The cloud free multi-spectral Sentinel-2 images of 21 February 2020 were downloaded for better visualization. The Sentinel-2 image has 13 bands with 16-bit radiometric resolution and the spatial resolution was 10 meter. The most familiar Agriculture (B11, B8, B2) indices was used to detect the land-water boundary and agricultural land as well. The agriculture band combination uses SWIR-1 (B11), near-infrared (B8), and blue (B2). It is mostly used to monitor the health of crops because of how it uses short-wave and near-infrared. Both these bands are particularly good at highlighting dense vegetation that appears as dark green. The details of the images are given below:

Satellite Imagery and processing



Stat4Dev Project, 2021

Chapter 3

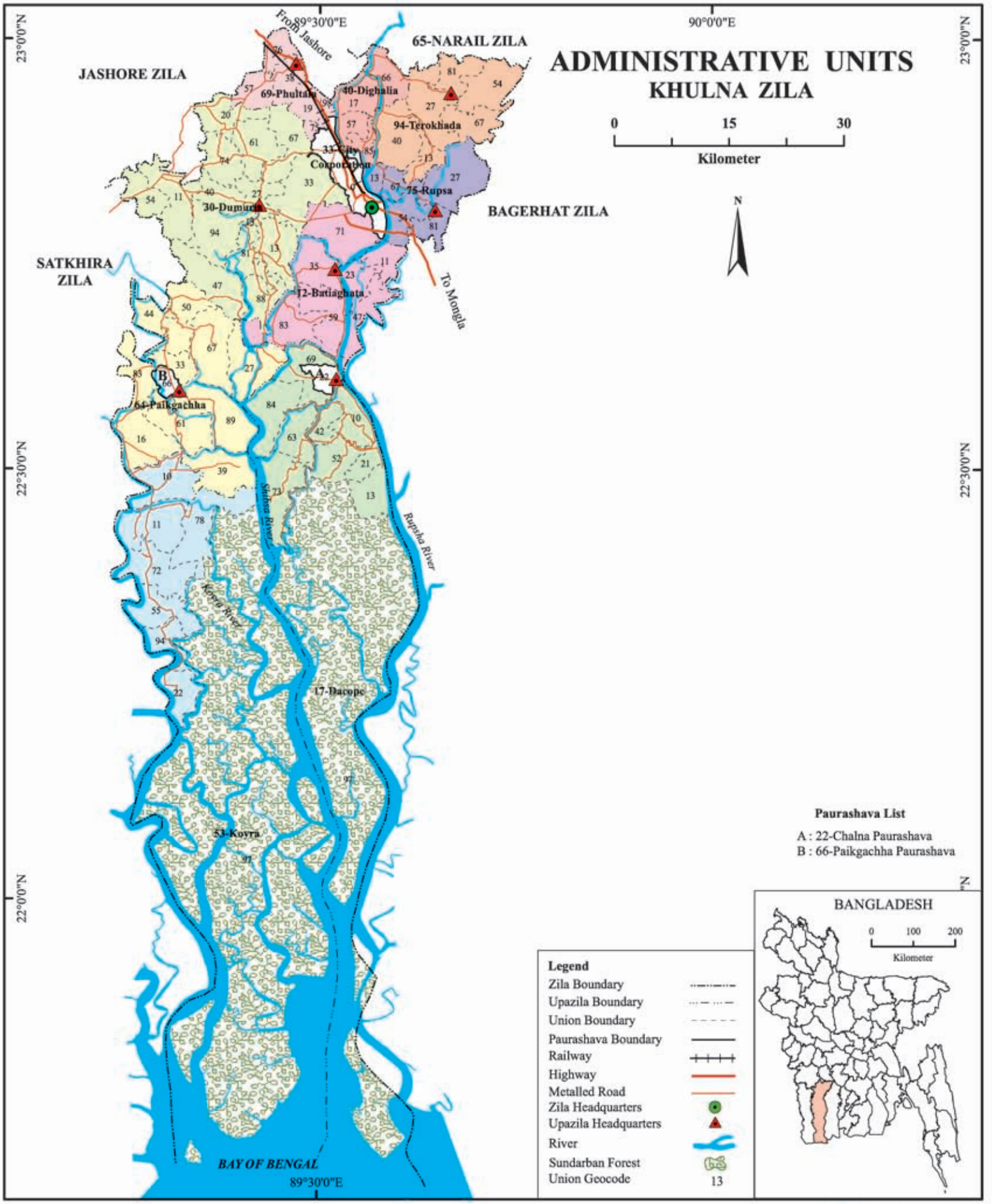
Basic Data and Base Maps of Khulna District

3.1 Geography and administrative division

Khulna district (zila) was established in 1882. It is situated between 22°12 and 23°59 north latitudes and between 89°14' and 89°45 east longitudes. The district is bounded on the north by Jashore and Narail districts, on the east by Bagerhat district, on the south by the Bay of Bengal and on the west by Satkhira district. The total area of the district is 4389.11 sq km. of which 607.80 sq km is riverine and 2028.22 sq km. is under forest. Khulna district constitutes 2.97% of the area of the country. In respect of area, it ranks 1st among the 10 districts in Khulna division and 4th among the 64 districts of the country.

The district headquarter is located in Khulna City Corporation. There are 9 upazilas, 5 thanas (Police Station), 67 unions, 49 wards, 695 mauzas and 204 mahallas in the district.

Geography and Administrative Division



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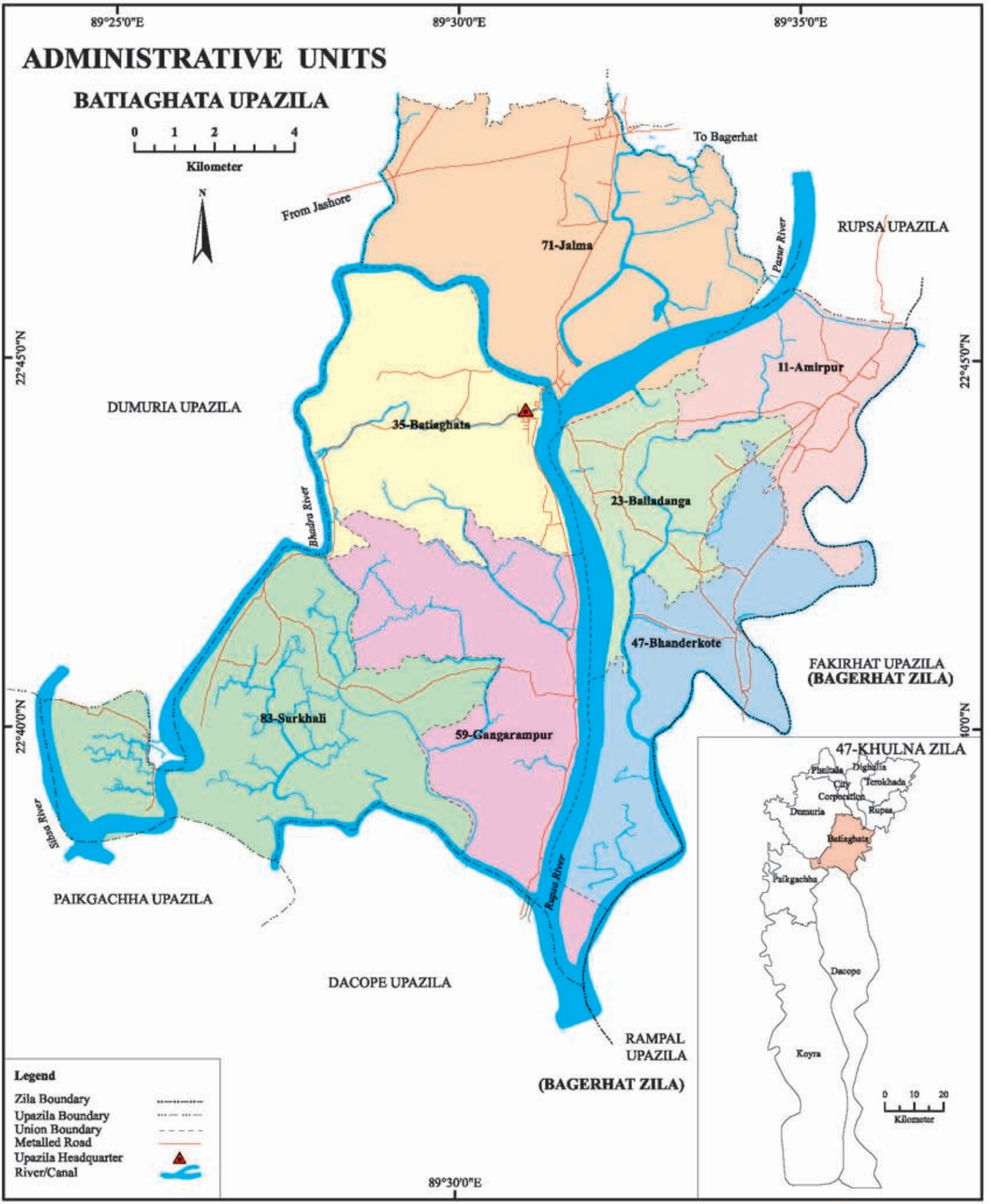

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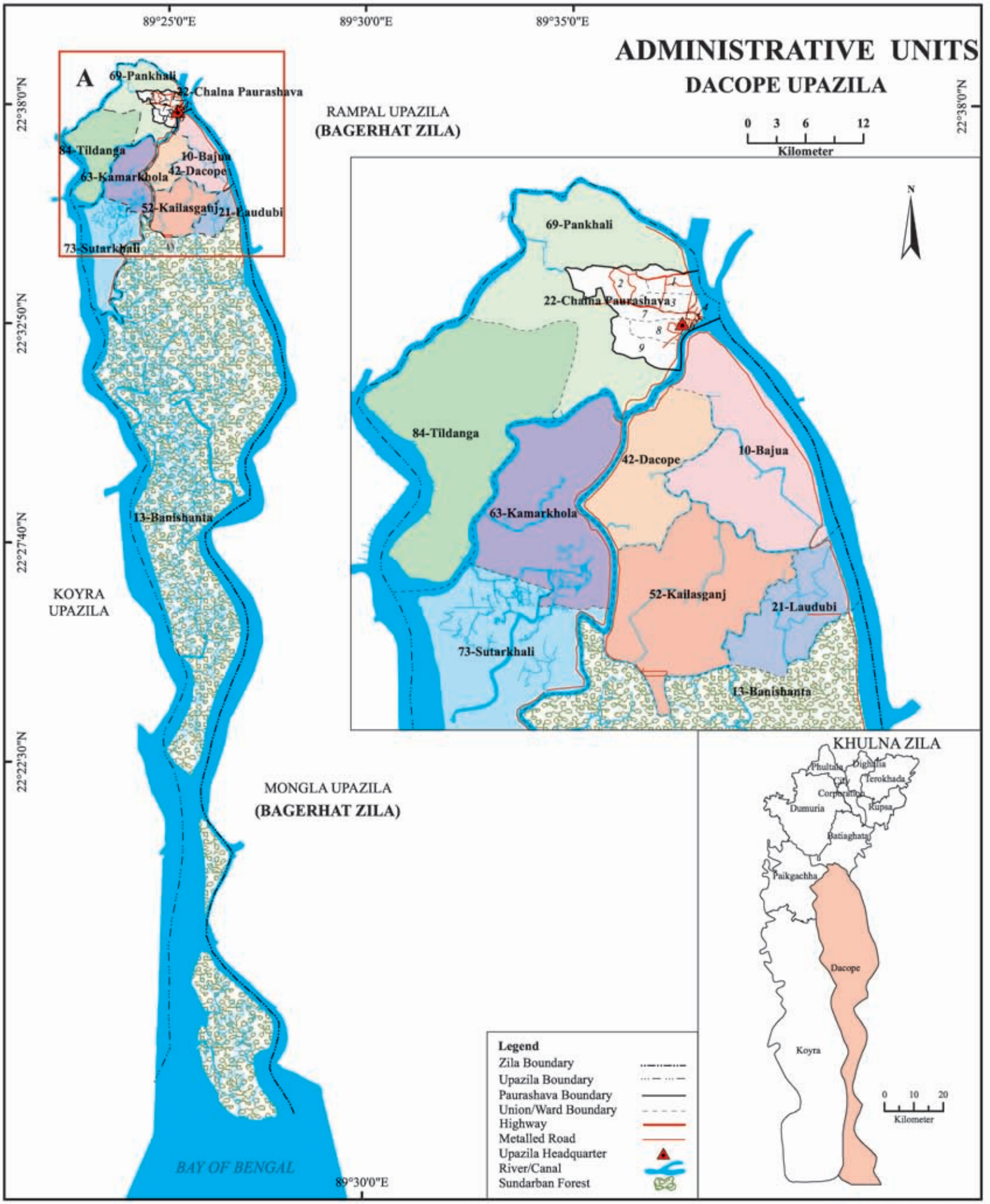

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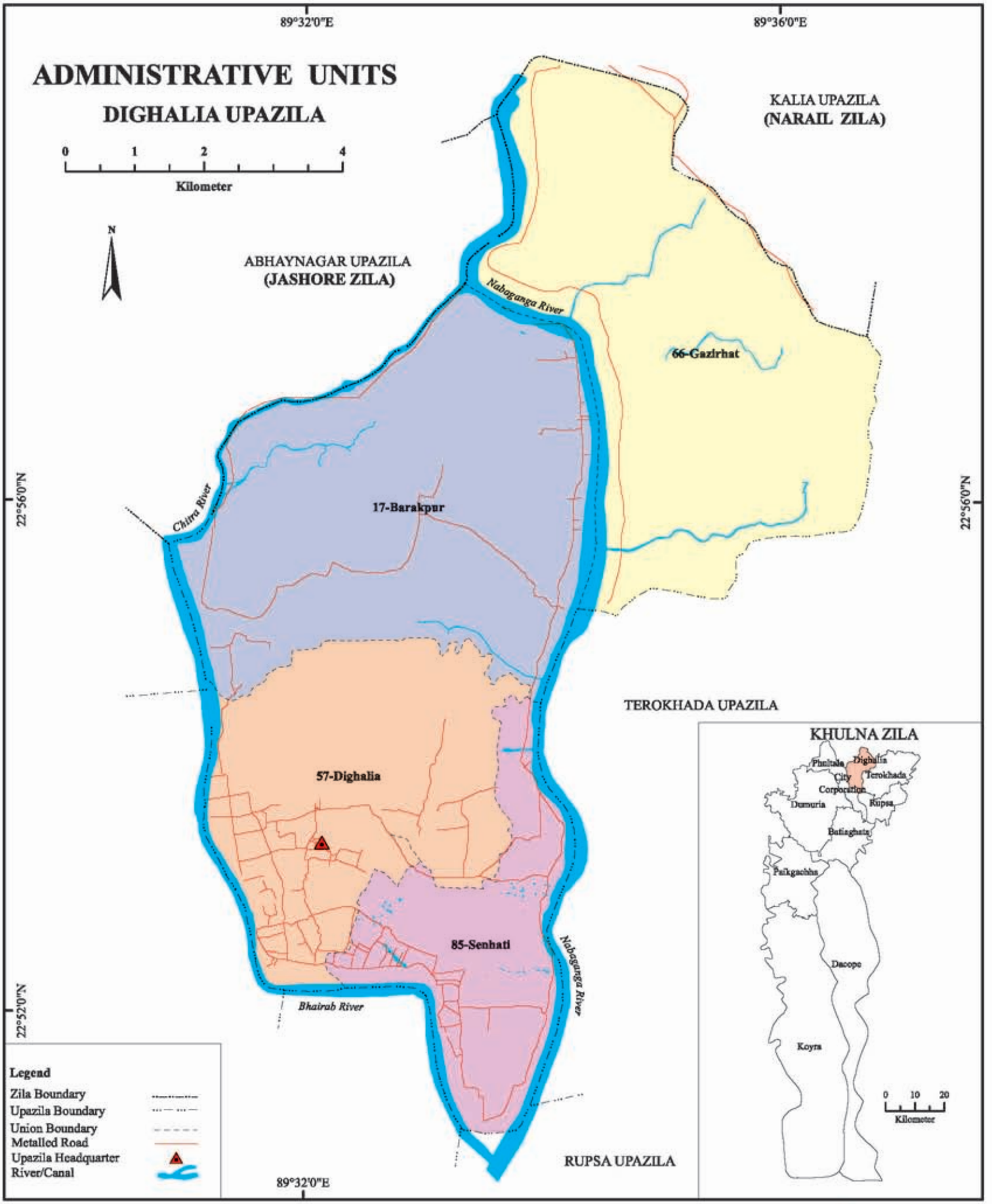

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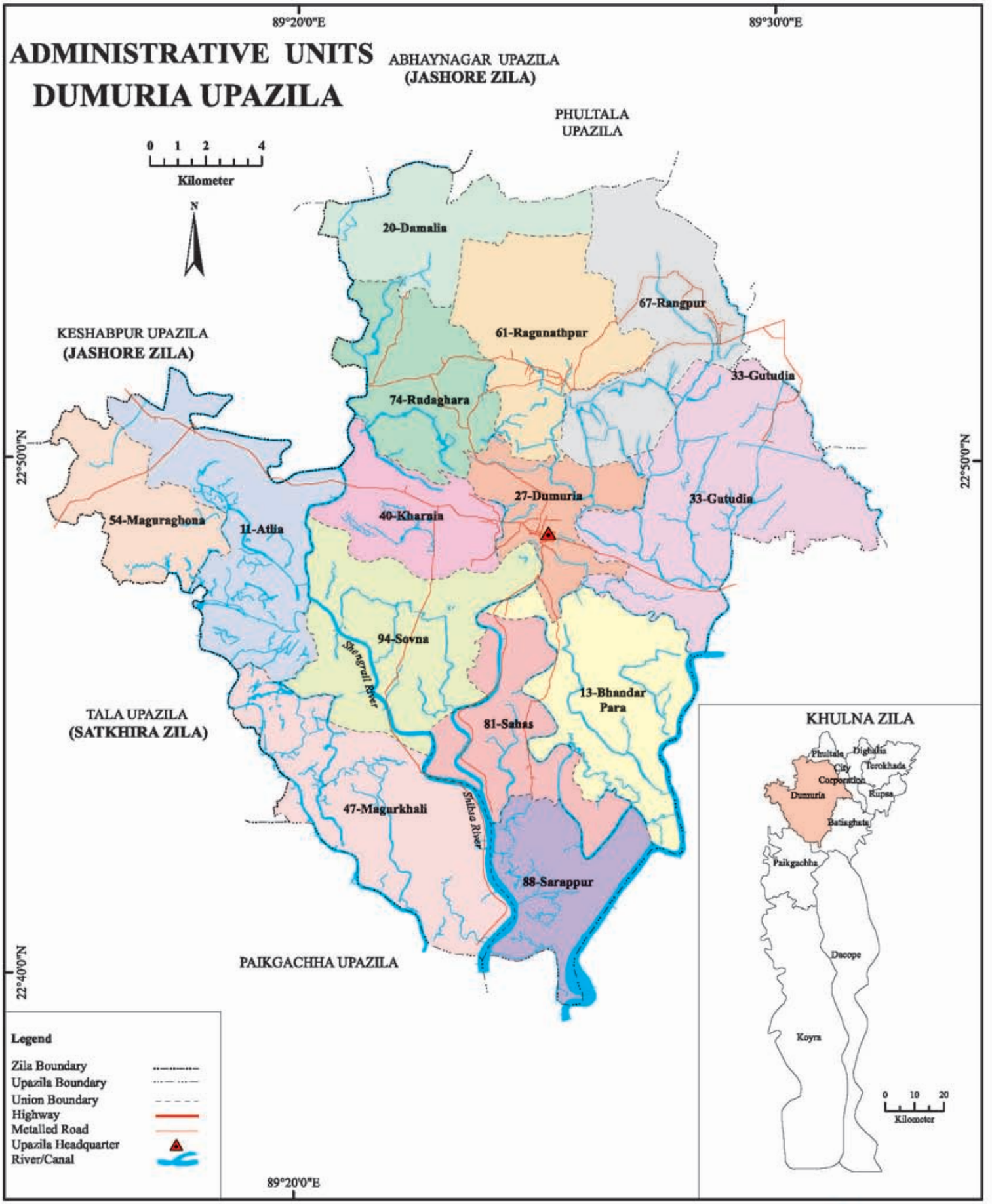

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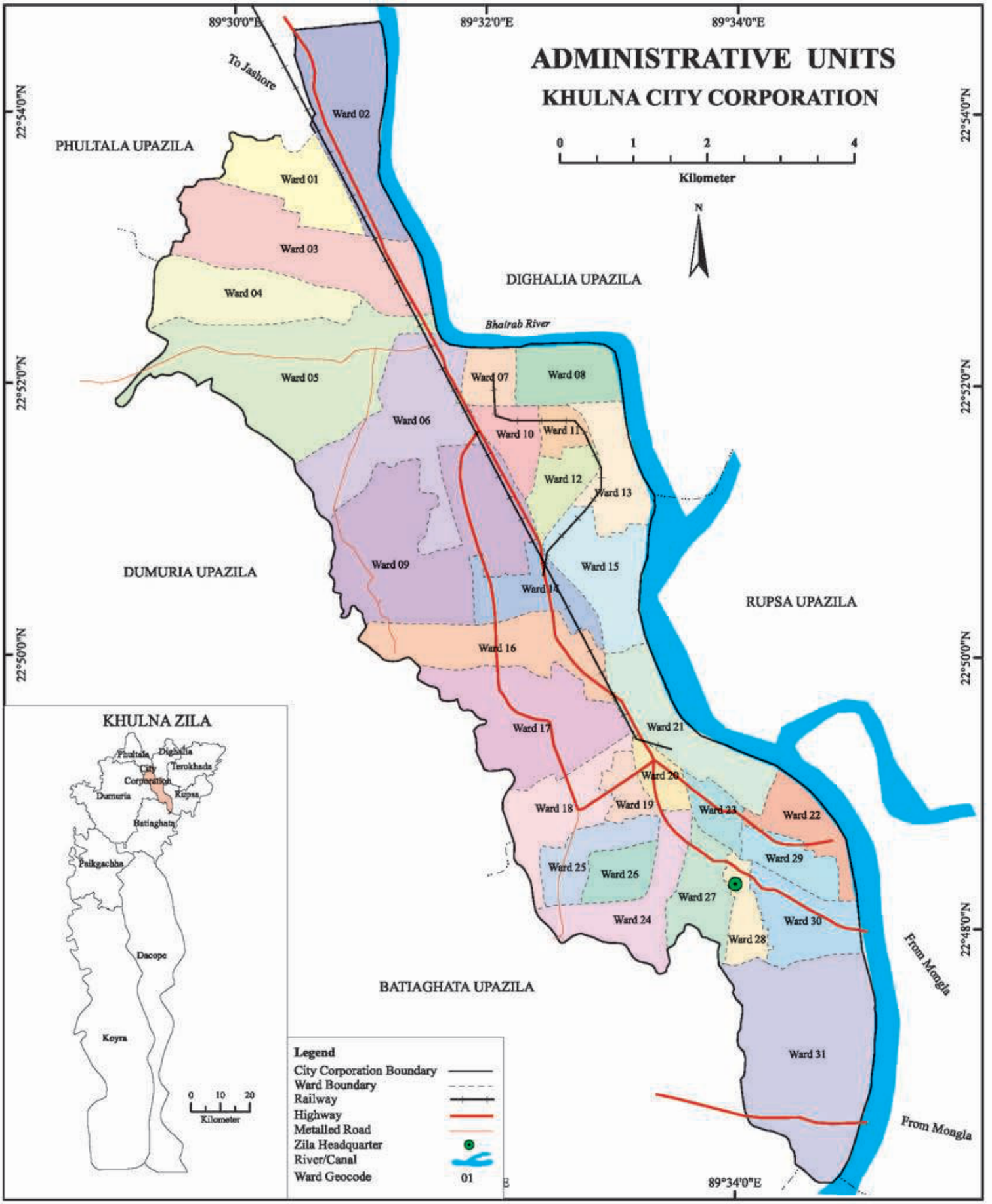

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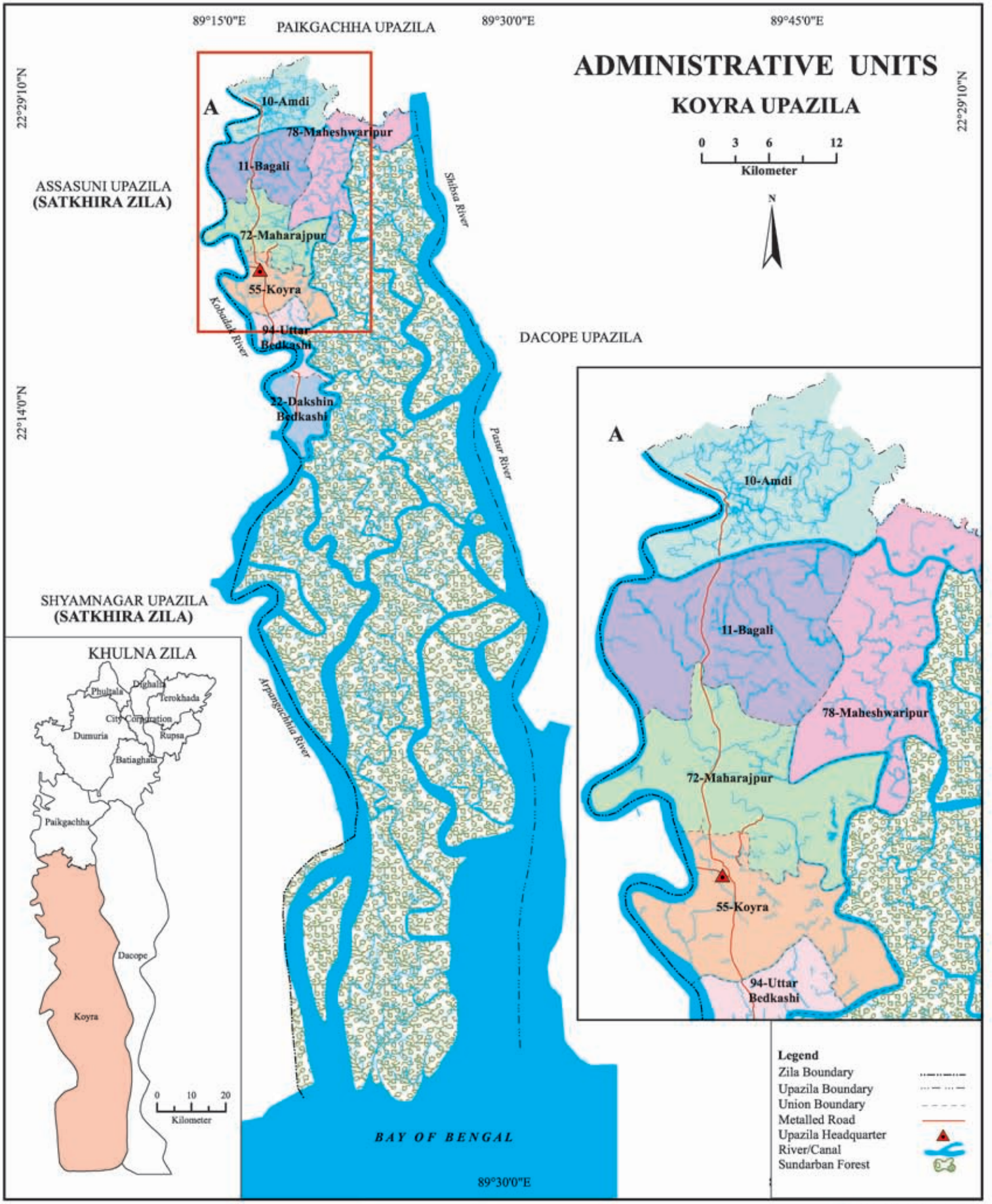

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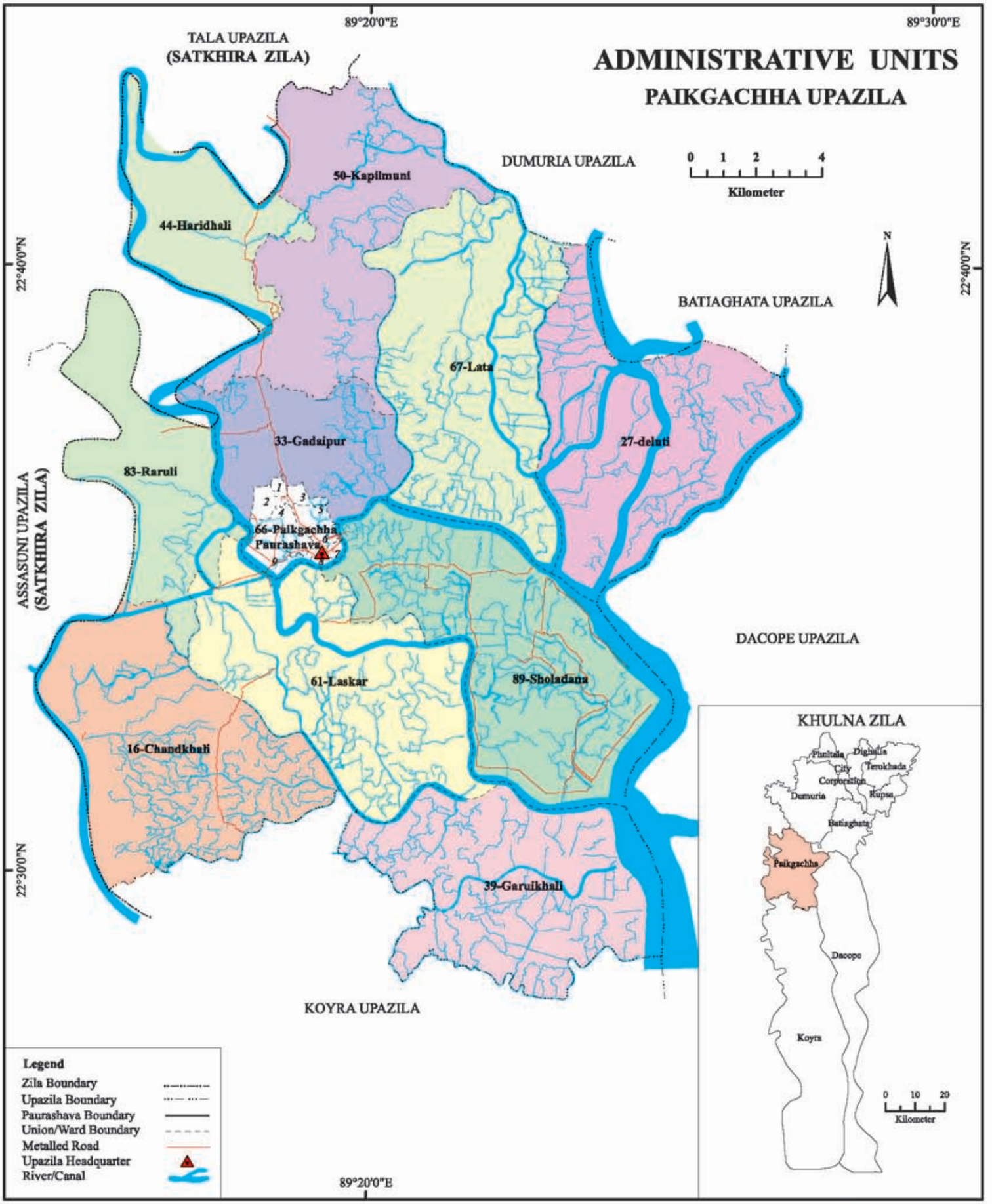

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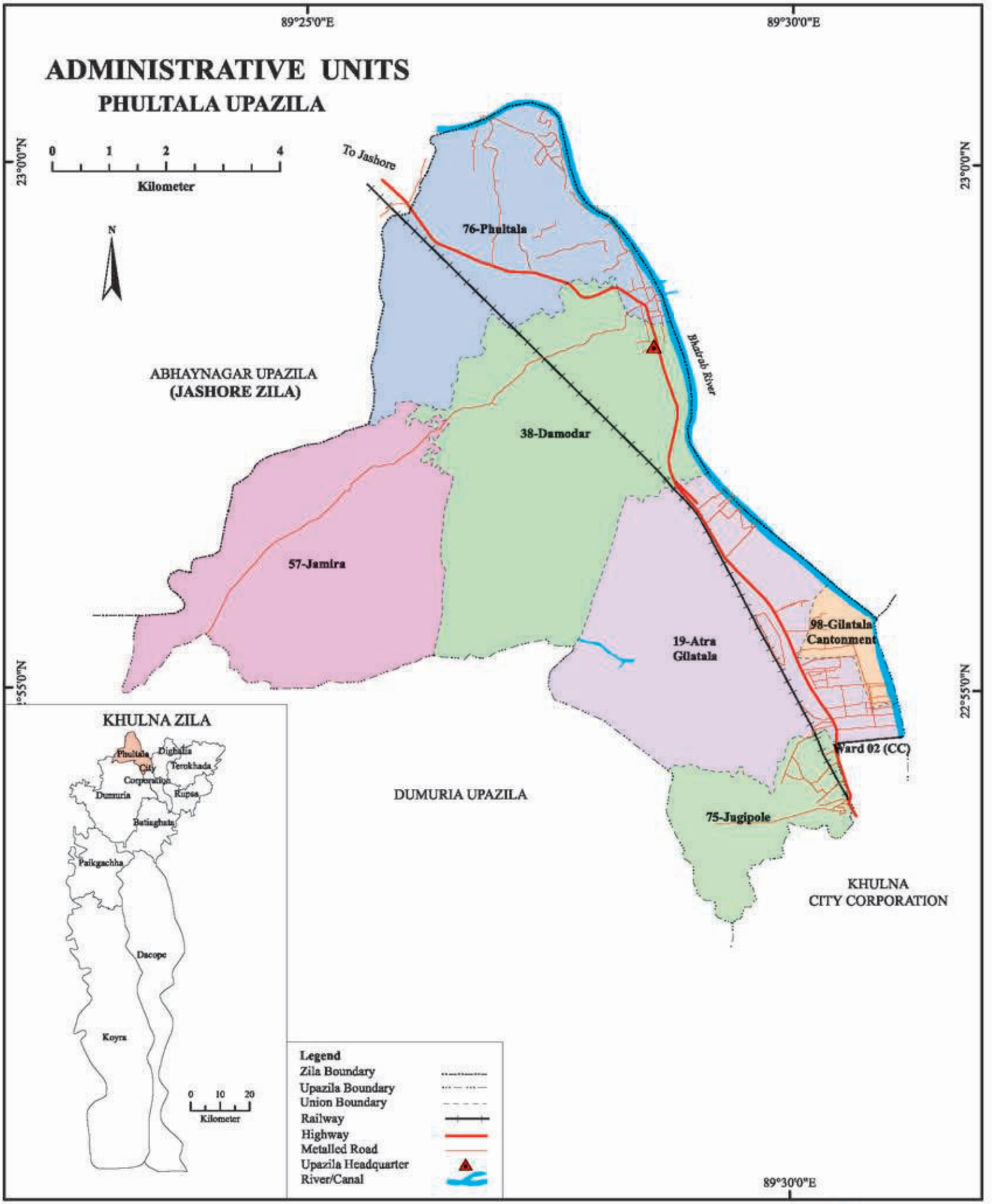

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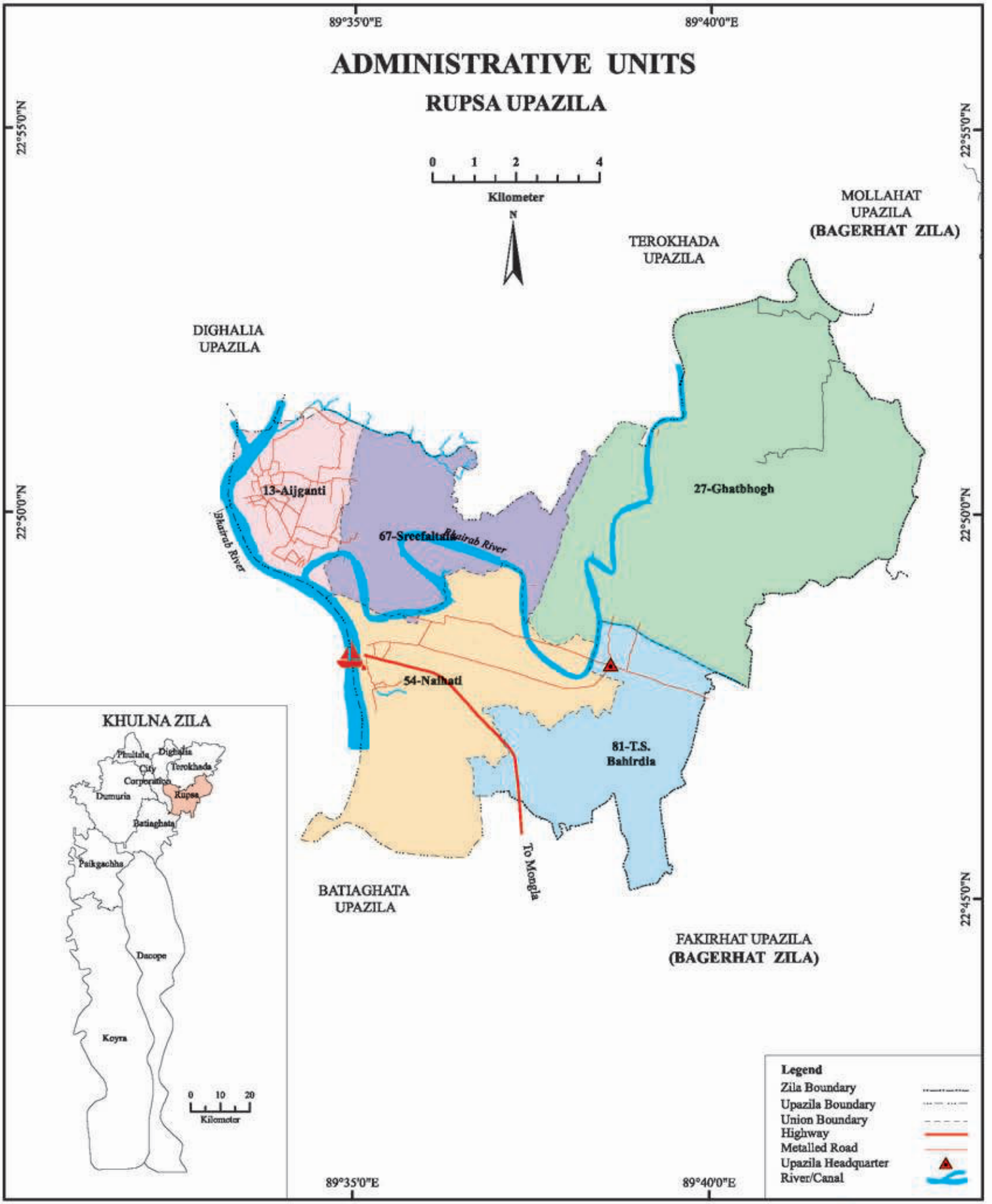

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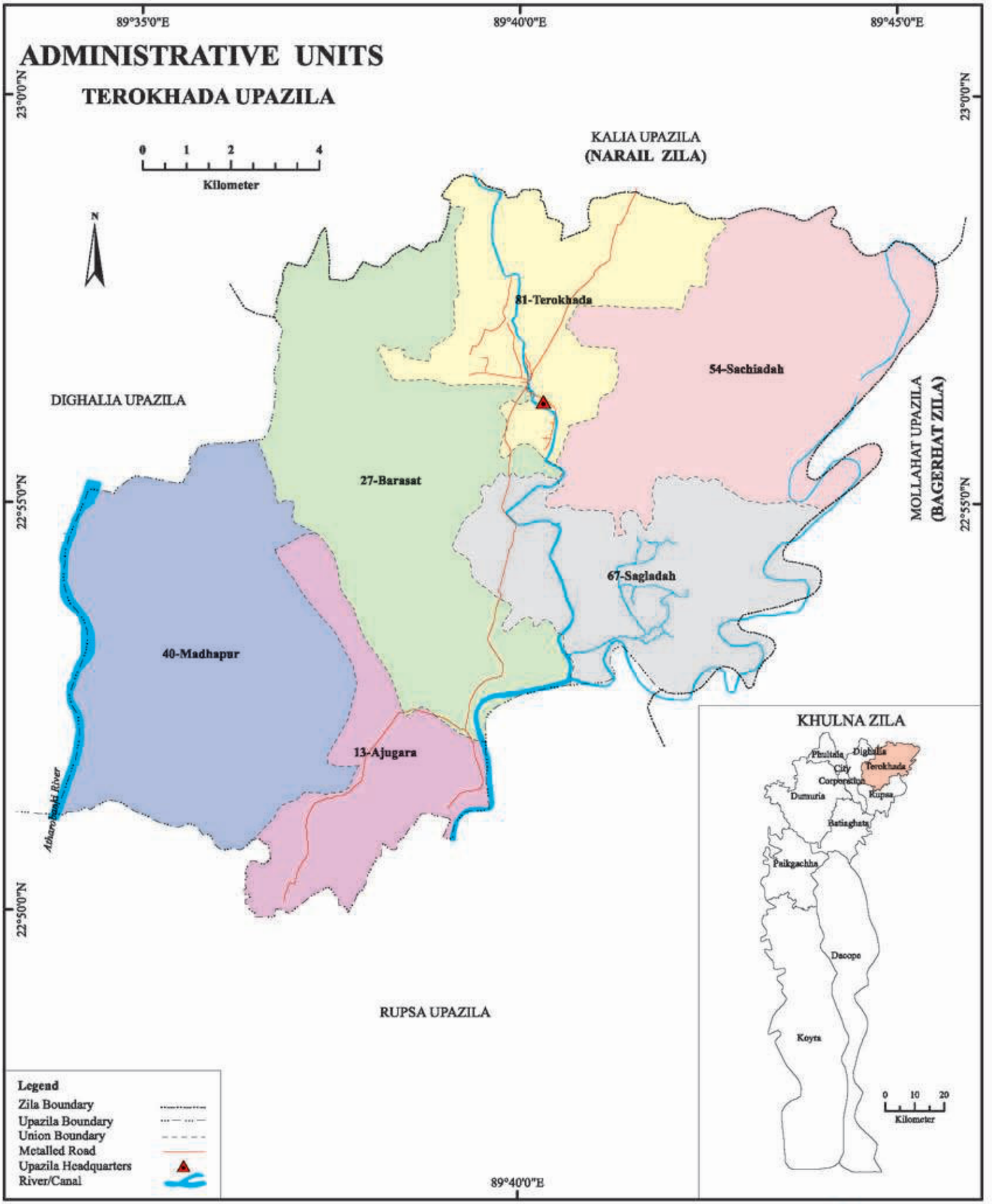

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3.2 Households

The total number of households of Khulna district, as enumerated in the Population and Housing Census 2011, is 547347 of which 183911 (33.60%) are in urban area and 363436 (66.40%) in rural area. The type of household shows that there are 540504 (98.75%) general (dwelling), 612 (0.11%) institutional and 6231 (1.14%) other households in the district. General household by residence is presented in Table 3.1 for the last five consecutive censuses. It is observed that the percentage changes of general household during the decade 2001-2011 are 11.08% in the district, (-) 32.62% in urban area and 63.23% in rural area. It is seen in the table that the total general households have been increasing since 1974 in the district. But the rural area shows a fall in 1981 after which an increasing trend is noticed till 2011 with a diminishing rate of contribution to the total household of the district since 1981 to 2001.

On the other hand, urban households show an increasing trend both in the total household and in the rate of contribution since 1974 to 2001. The increasing trend for urban households reflect the pattern of migration from rural to urban area. The upward trend of urban general household over the period registered of 91.62% during 1974-1981 suggesting a very rapid urbanization in Khulna district. The urbanization, though exhibits a downward slide 42.27% over the decade 1981-1991 but it has gone up to 43.67% in the decade 1991-2001 and again a huge downward slope of (-) 32.62% during decade 2001-2011.This downward slope of (-) 32.62% is attributed to the definitional change of urban area in 2011. The rural household recorded the highest 63.23% expansion during 2001-2011 as compared to 24.38% in 1991-2001 and 7.62% in 1981-1991.

Table 3.1: General households by residence of khulna district, 1974 – 2011

Residence	2011		2001		1991		1981		1974	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
District	547347	100.00	486611	100.00	362636	100.00	295252	100.00	242083	100.00
Urban	183911	31.01	264793	54.42	184304	50.82	129546	43.88	67606	27.93
Rural	363436	66.99	221818	45.58	178332	49.18	165706	56.12	174477	72.07

Source: Zila Report, Population and Housing Census 2011, BBS.

3.3 Population

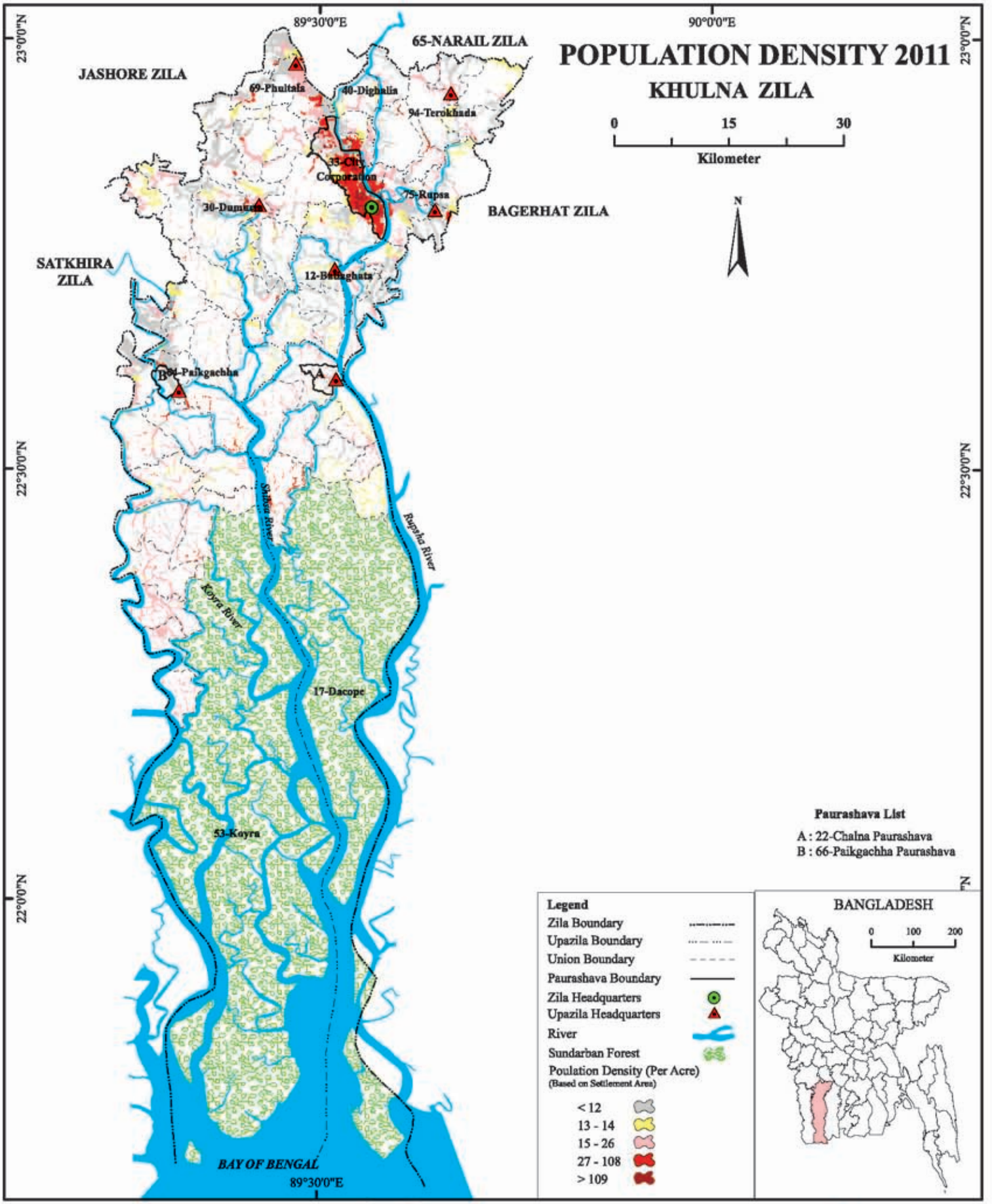
The total population of the district, as enumerated in 2011 census, is 2318527 of which 777588 (33.54%) constitute urban population and the remaining 1540939 (66.46%) constitute rural population. It is observed that the total population of rural area has been increasing since 1991 but the percent contribution to the total population by rural area has been showing a little decreasing trend since 1981 to 2001. On the contrary, in urban area both the total population and percent contribution show an increasing trend till 2001 after which the population and the rates have gone down in 2011. This particular situation which has appeared in Table 3.2 is mainly attributed to the definitional change of urban area in 2011 census.

Table 3.2: General distribution of characteristics of population of Khulna district, 1981-2011

Residence	2011		2001		1991		1981	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Zila	2318527	100.00	2378971	100.00	2010643	100.00	1771101	100.00
Urban	777588	33.54	1284208	53.98	1007255	50.10	748728	42.27
Rural	1540939	66.46	1094763	46.02	1003388	49.90	1022375	57.73

Source: Zila Report, Population and Housing Census 2011, BBS.

Population and Households



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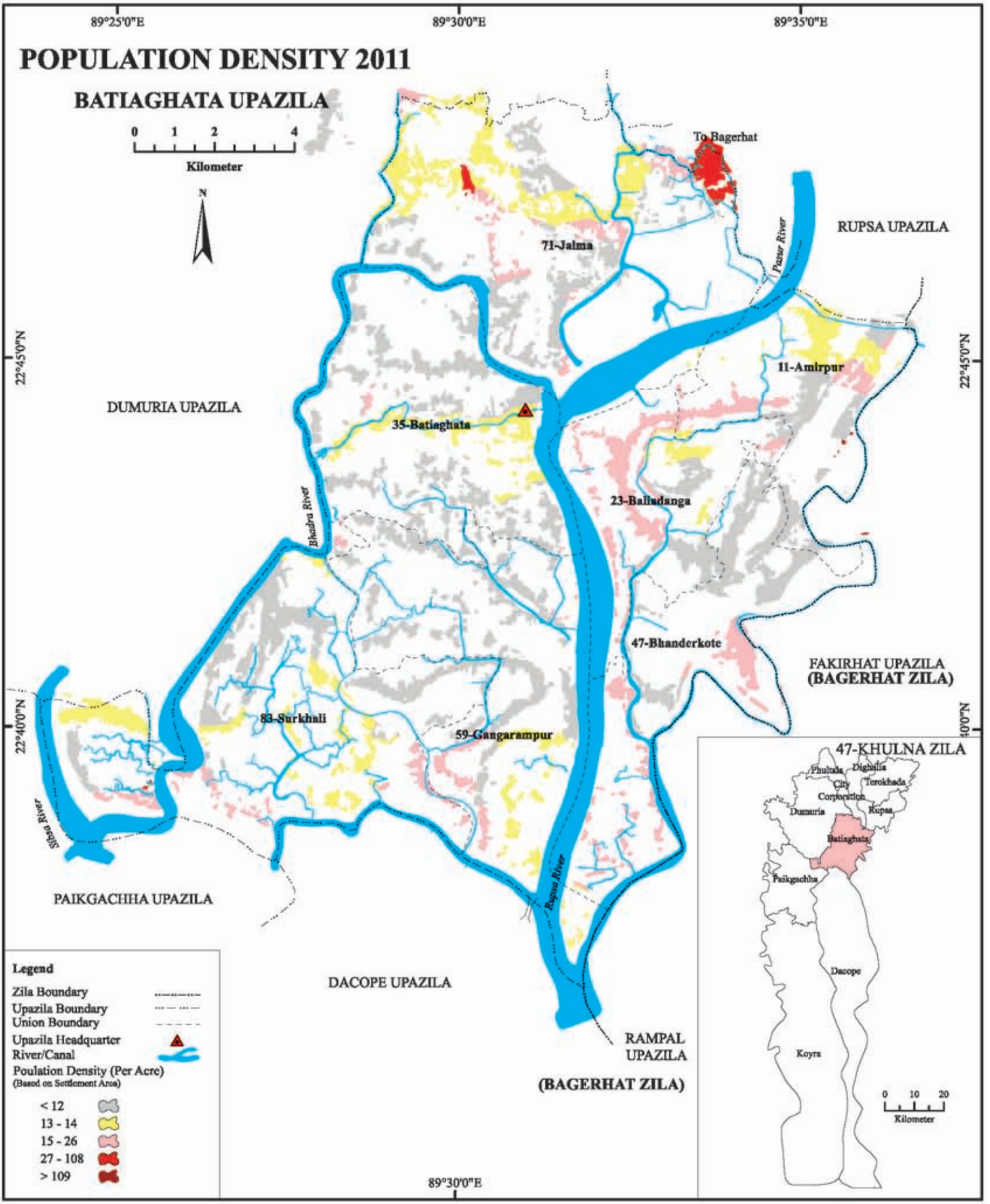

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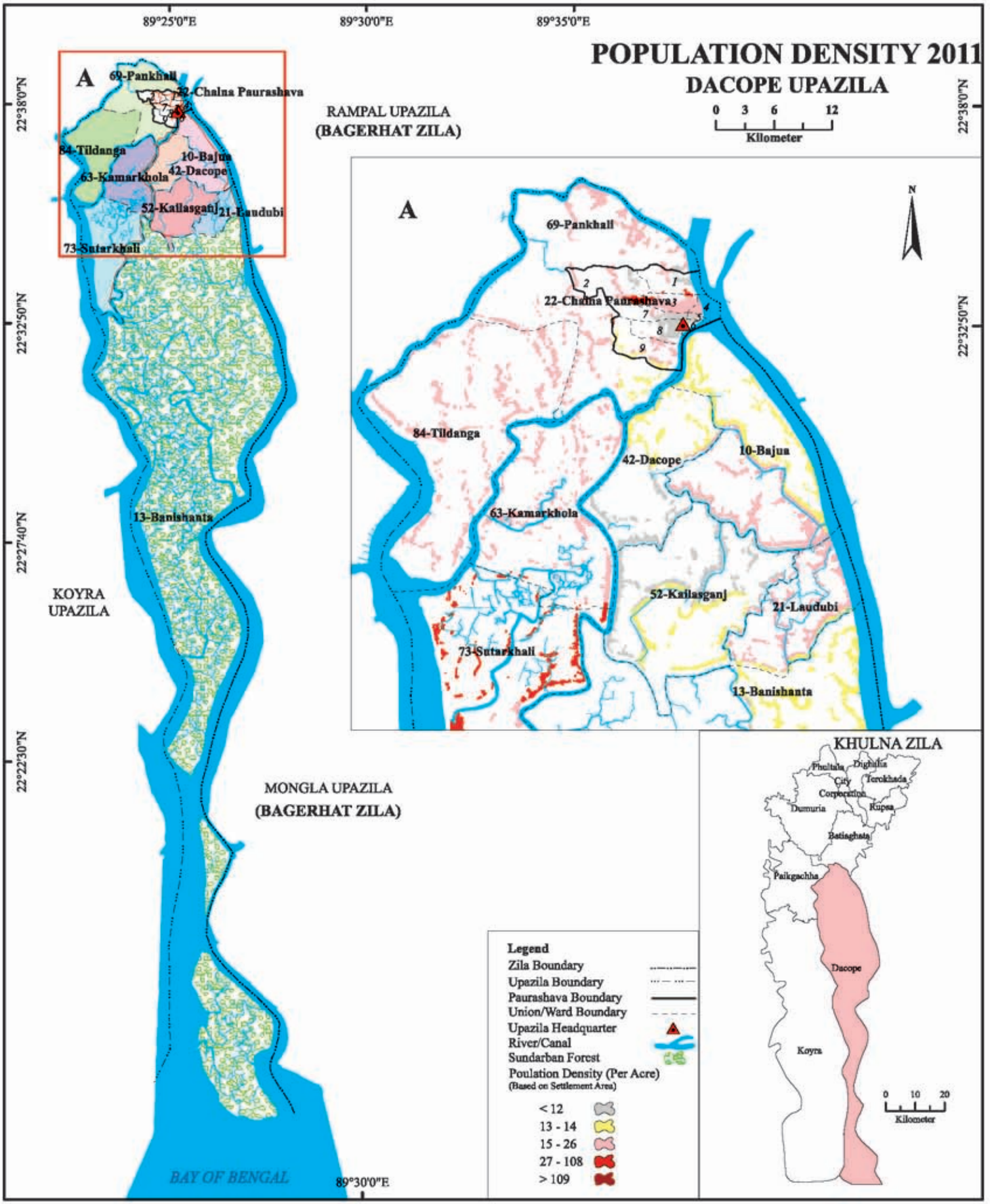

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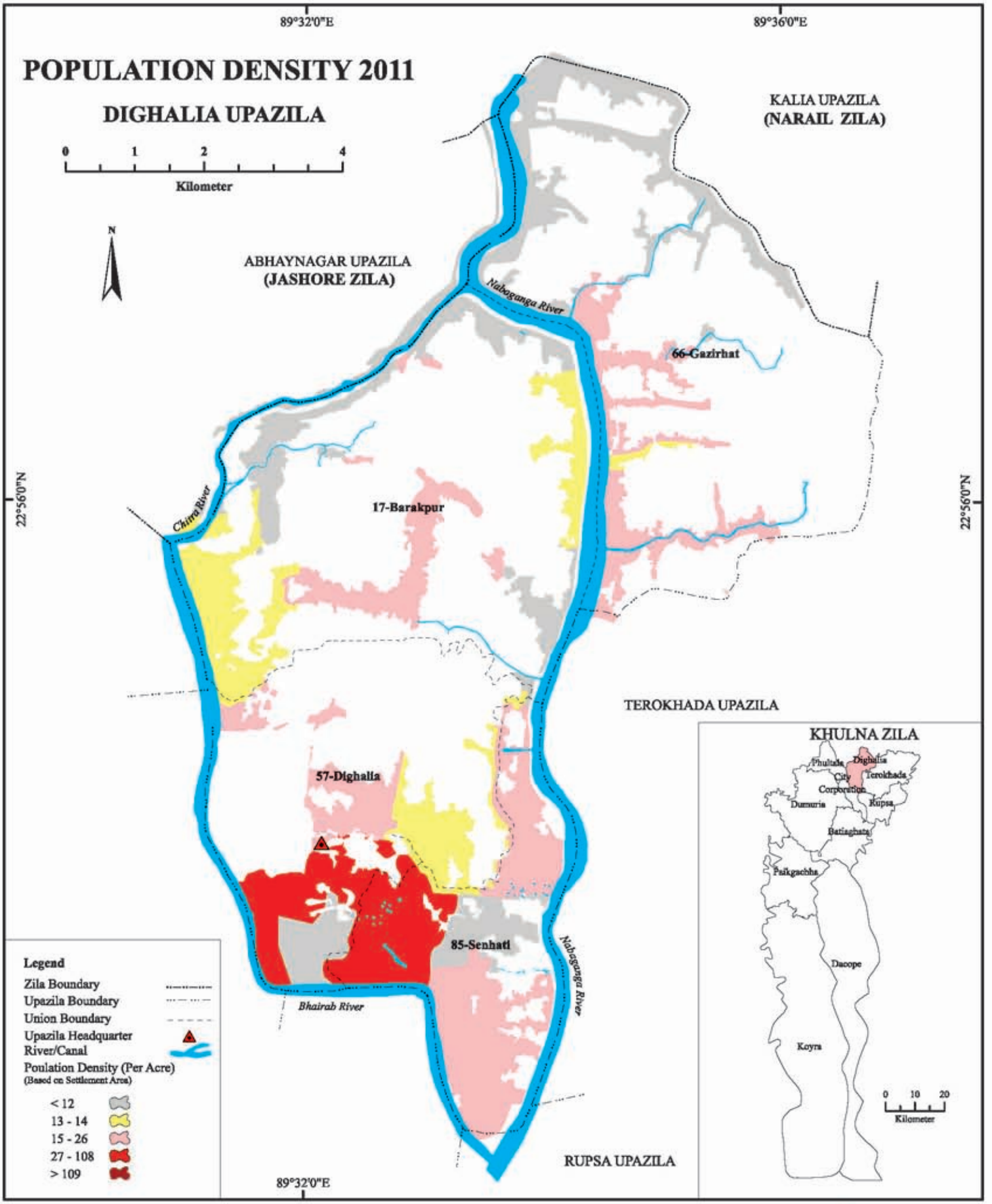

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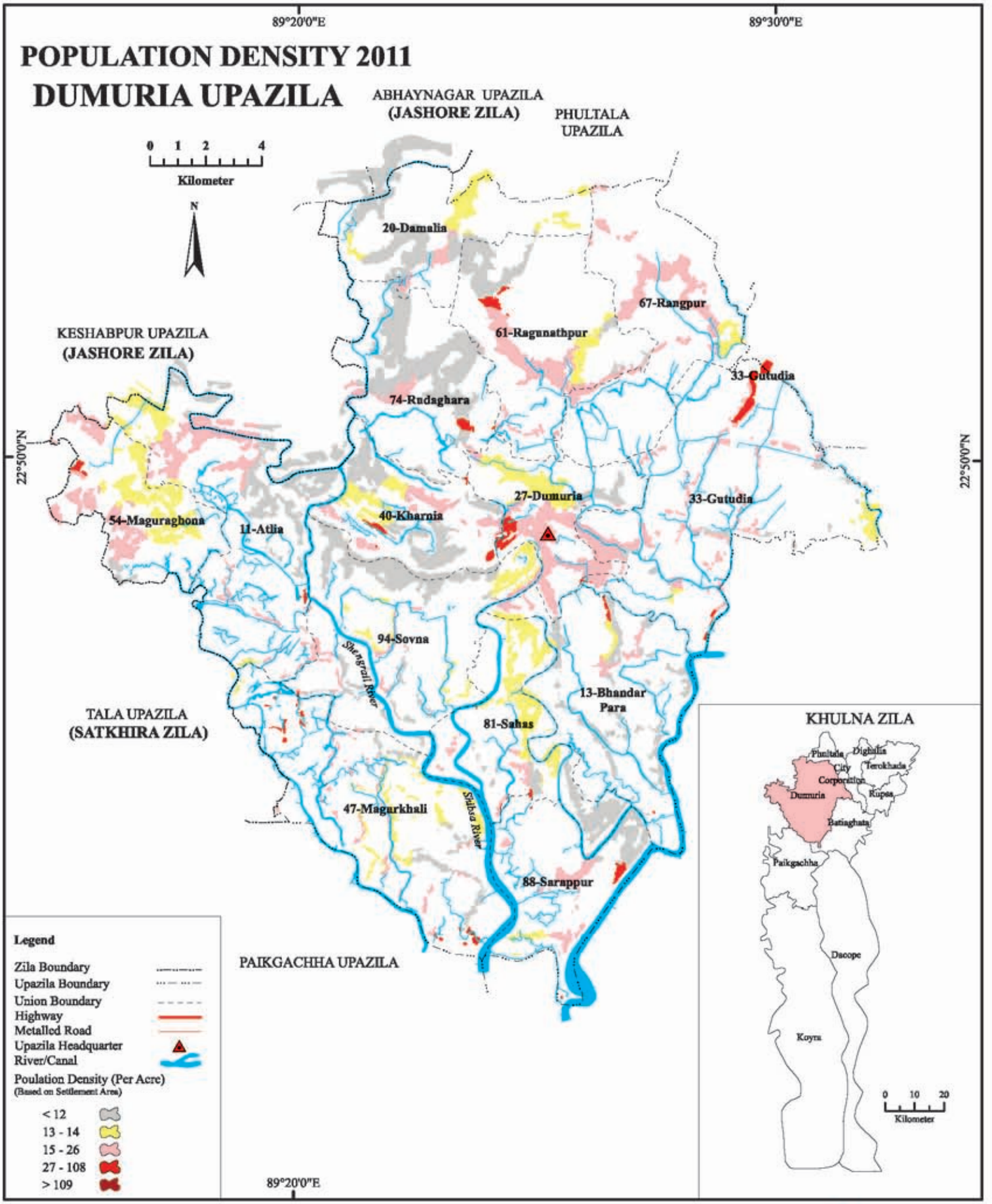

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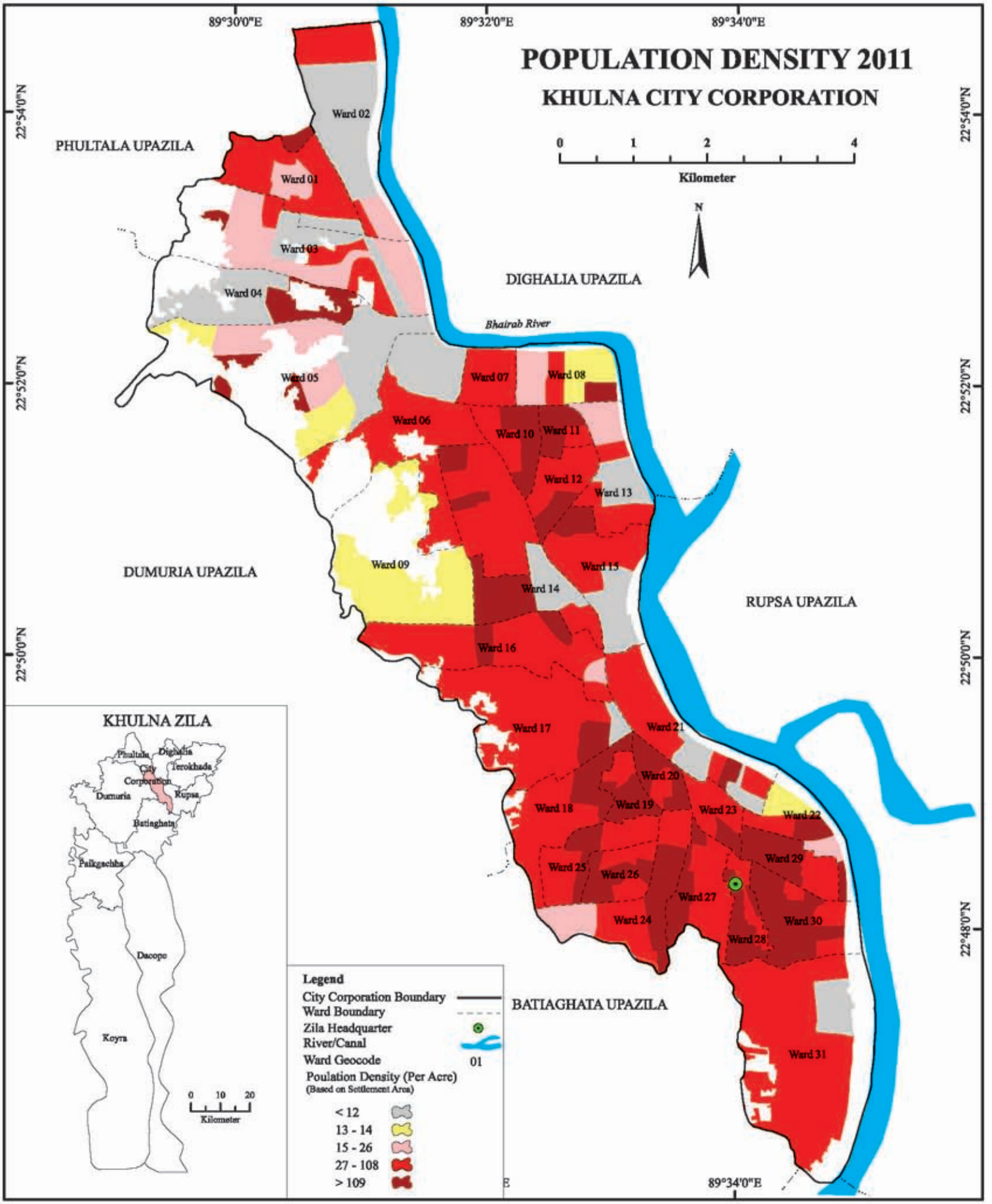

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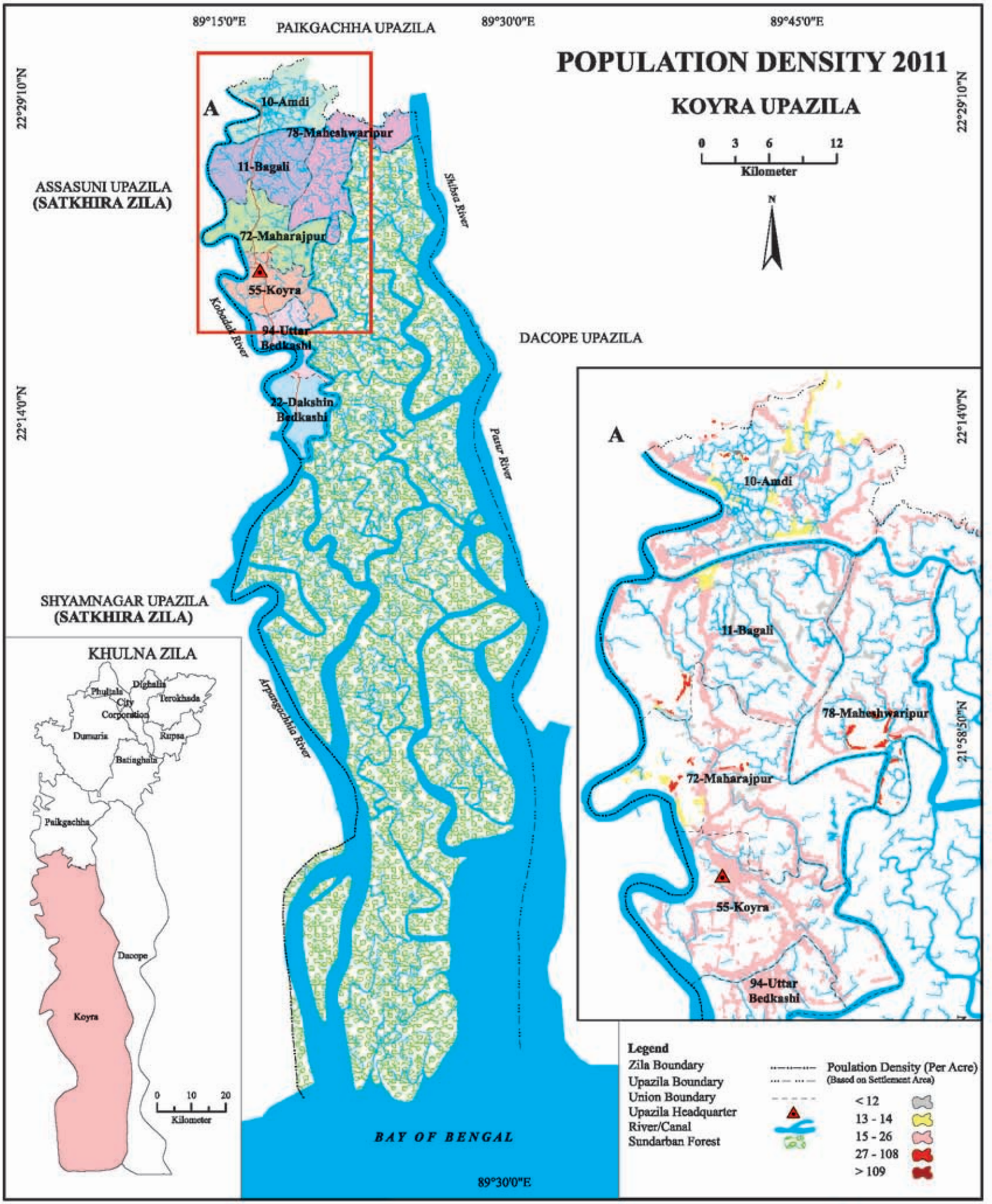

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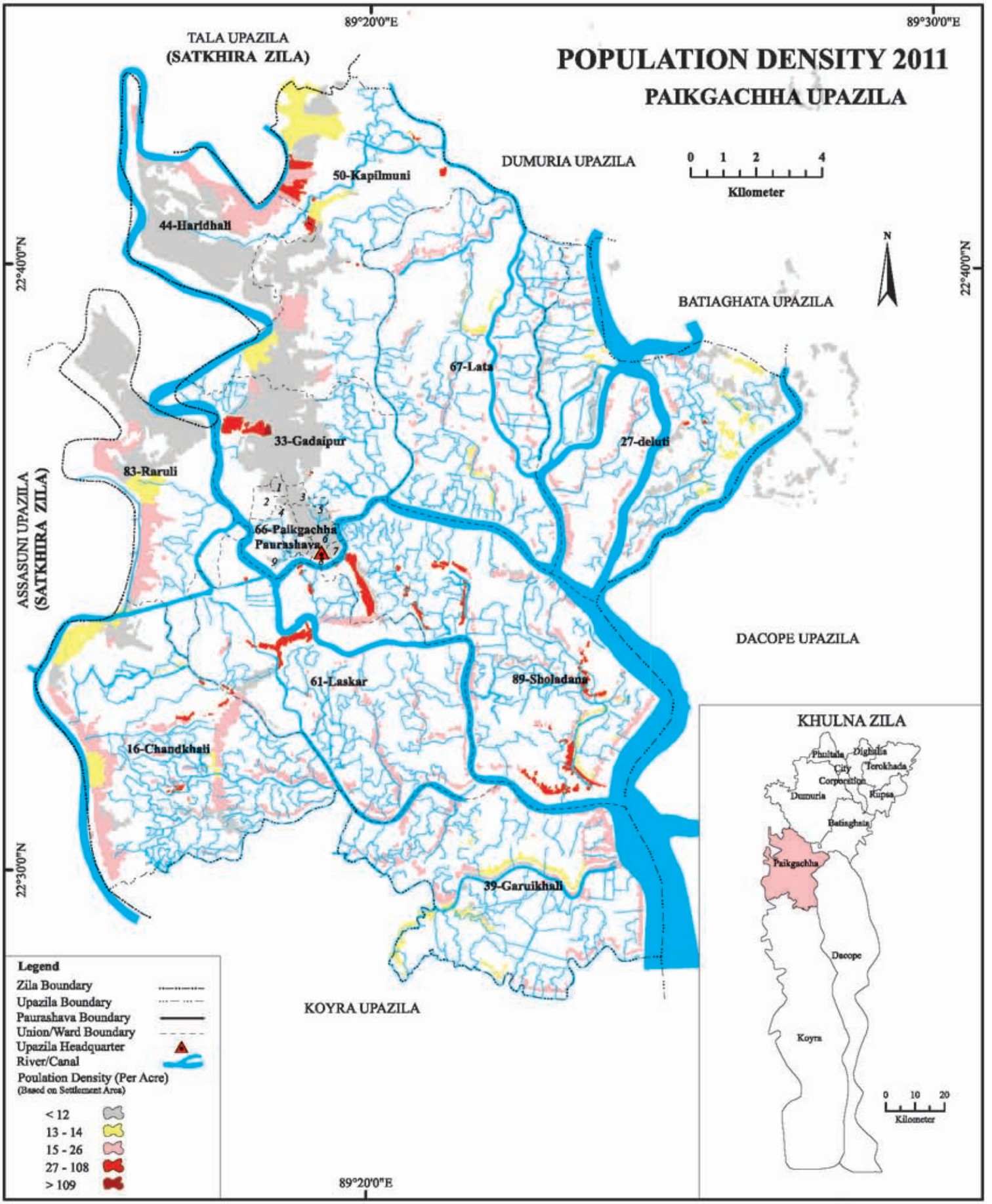

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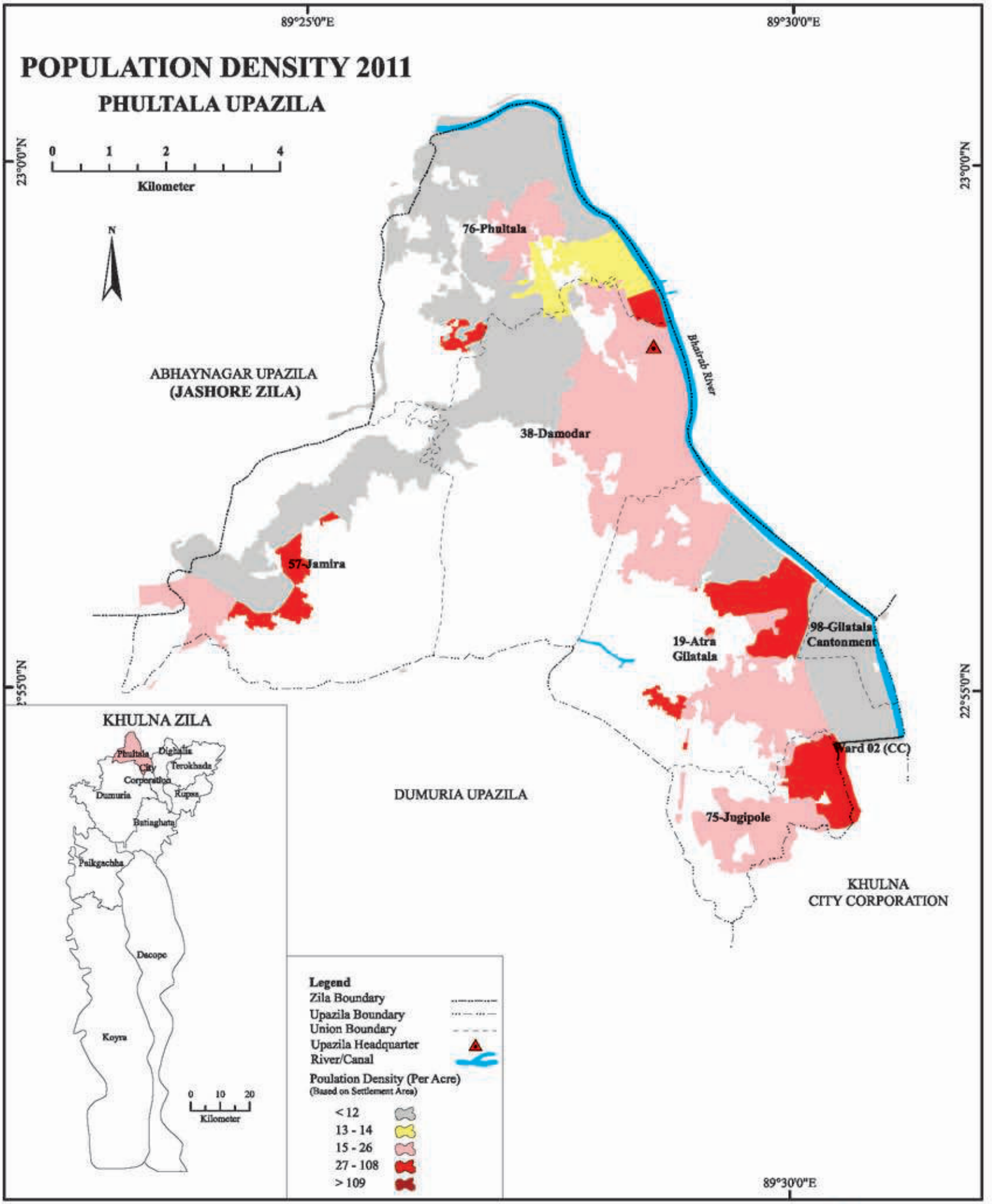

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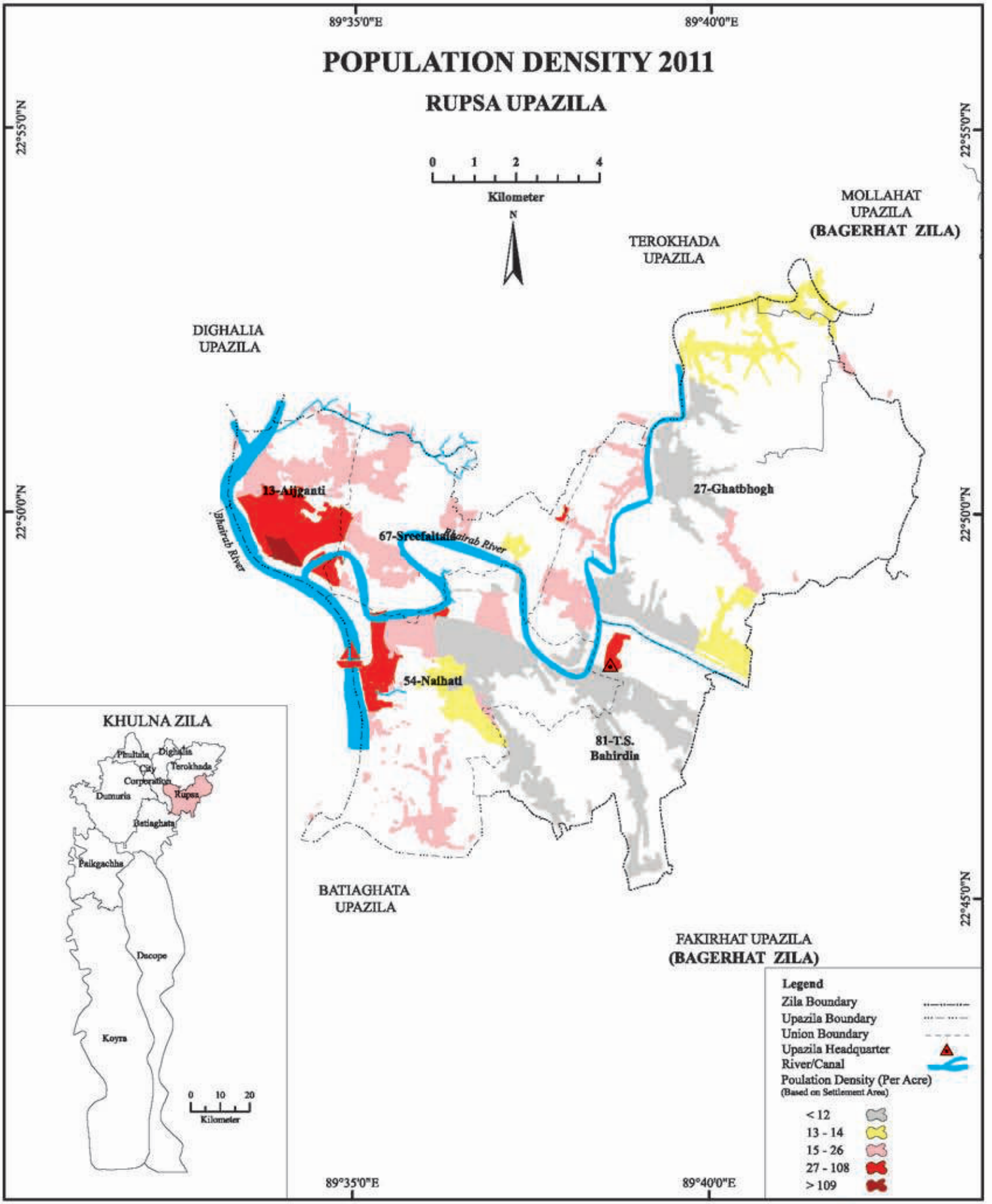

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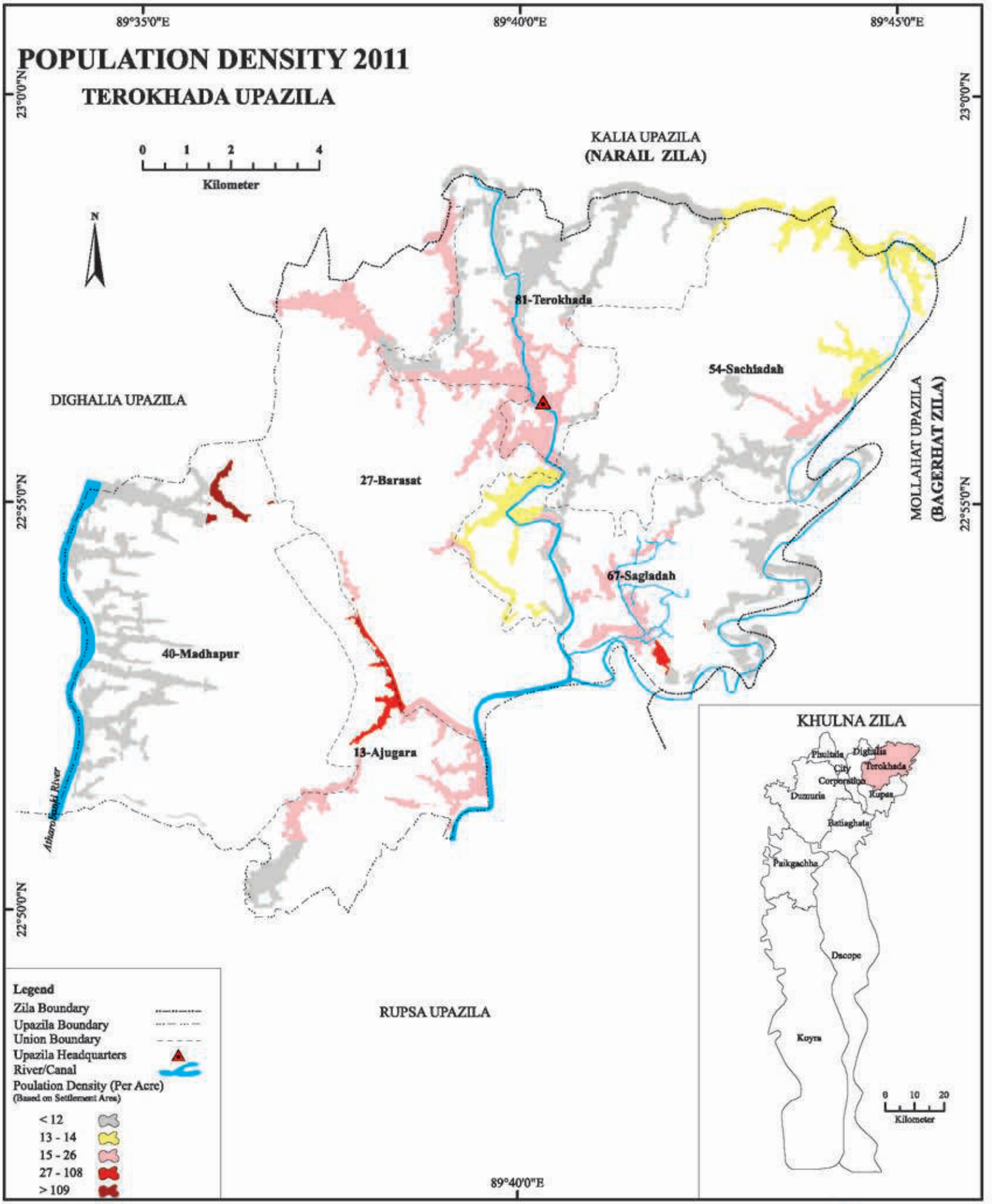


Stat4Dev Project, 2021

3.4 Climate

The district has a hot summer and a mild winter. The summer begins from the middle of April and continues till the middle of June. The winter starts from November and continues till February. According to the Meteorological Department Report of 2011, the monthly average maximum temperature rises up to 31.1°C during the month of May. The monthly average minimum temperature falls down to 21.8°C in the month of January. The level of humidity rises to 89 percent in the month of July which commences from the middle of June and continues till the end of September. The rainfall is generally heavy in the month from June to September. Annual rainfall recorded in 2011 was 162.3 mm.

Table 3.3 : General Climatic characteristics of the Khulna district.

Data Type	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
District Normal Max Temp	Celsius	25.6	28.5	33.1	34.6	34.3	32.9	31.8	31.8	32.1	32.1	29.9	26.5
Country Normal Max Temp	Celsius	25.2	27.8	31.6	33.2	32.9	31.9	31.1	31.4	31.5	31.5	29.5	26.4

Source: Bangladesh Meteorological Department

3.5 Land cover

In Khulna district, the total land area covers 45.58% of total district area, where Dumuria is the largest upazila (22% of total land area).

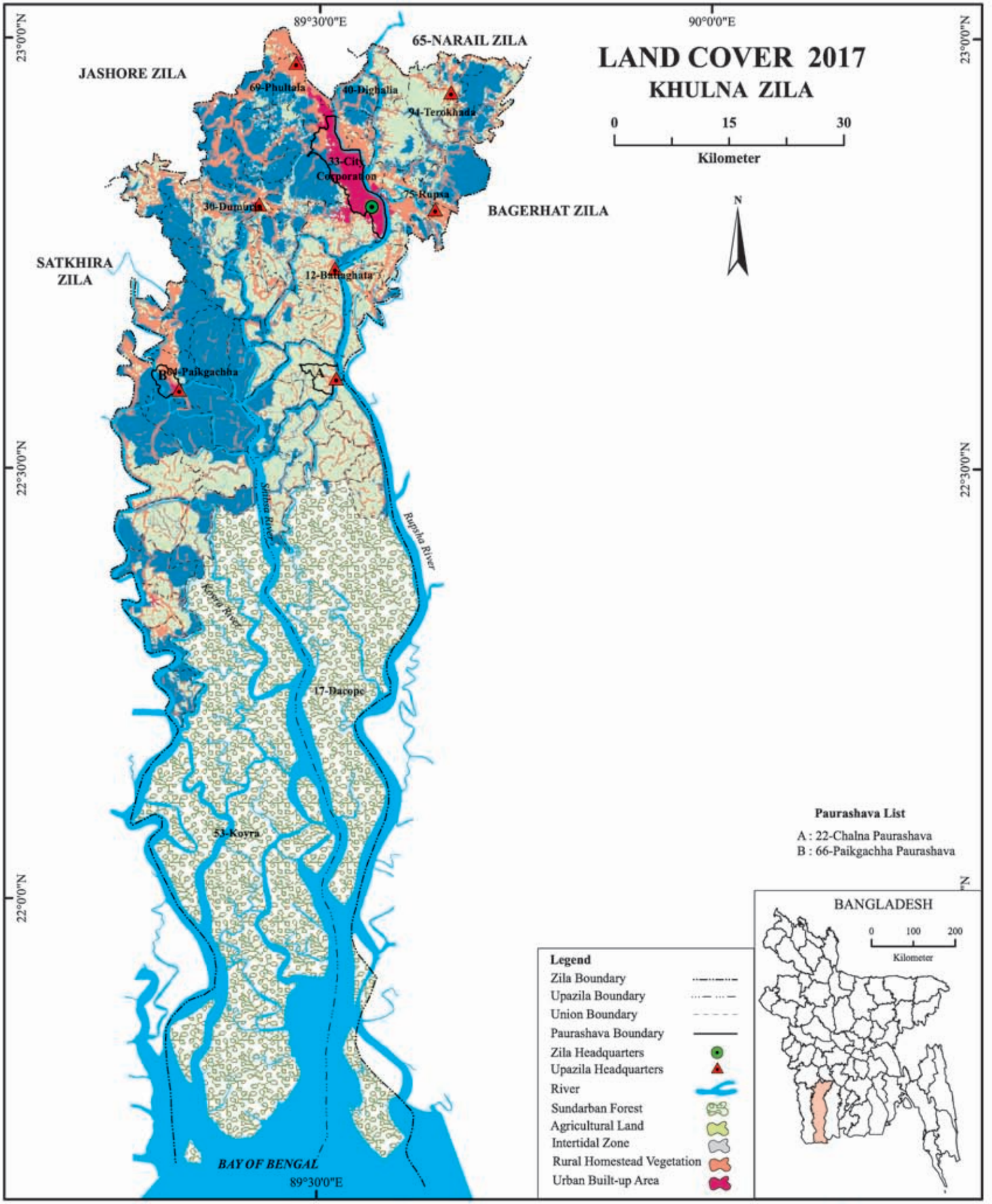
Table 3.4: Land area distribution to different upazilas of Khulna district (in sq km)

Upazila	Total area	Land area	Reserve forest	Riverine area
Batiaghata	248.31	211.19	0	24.03
Dacope	991.56	286.01	494.68	210.87
Dighalia	77.16	73.69	0	3.47
Dumuria	454.23	440.4	0	4.69
Khulna City Corporation	64.78	64.76	0	0.024
Koyra	1775.40	260.56	1512.36	2.47
Paikgachha	411.19	304.08	21.18	79.78
Phultala	56.83	56.83	0	0

Rupsa	120.15	117.73	0	2.47
Terokhada	189.49	185.11	0	280
Total	4389.10	2000.36	2028.22	607.804

Source: District Statistics, 2011, BBS

Land Cover
Area Map



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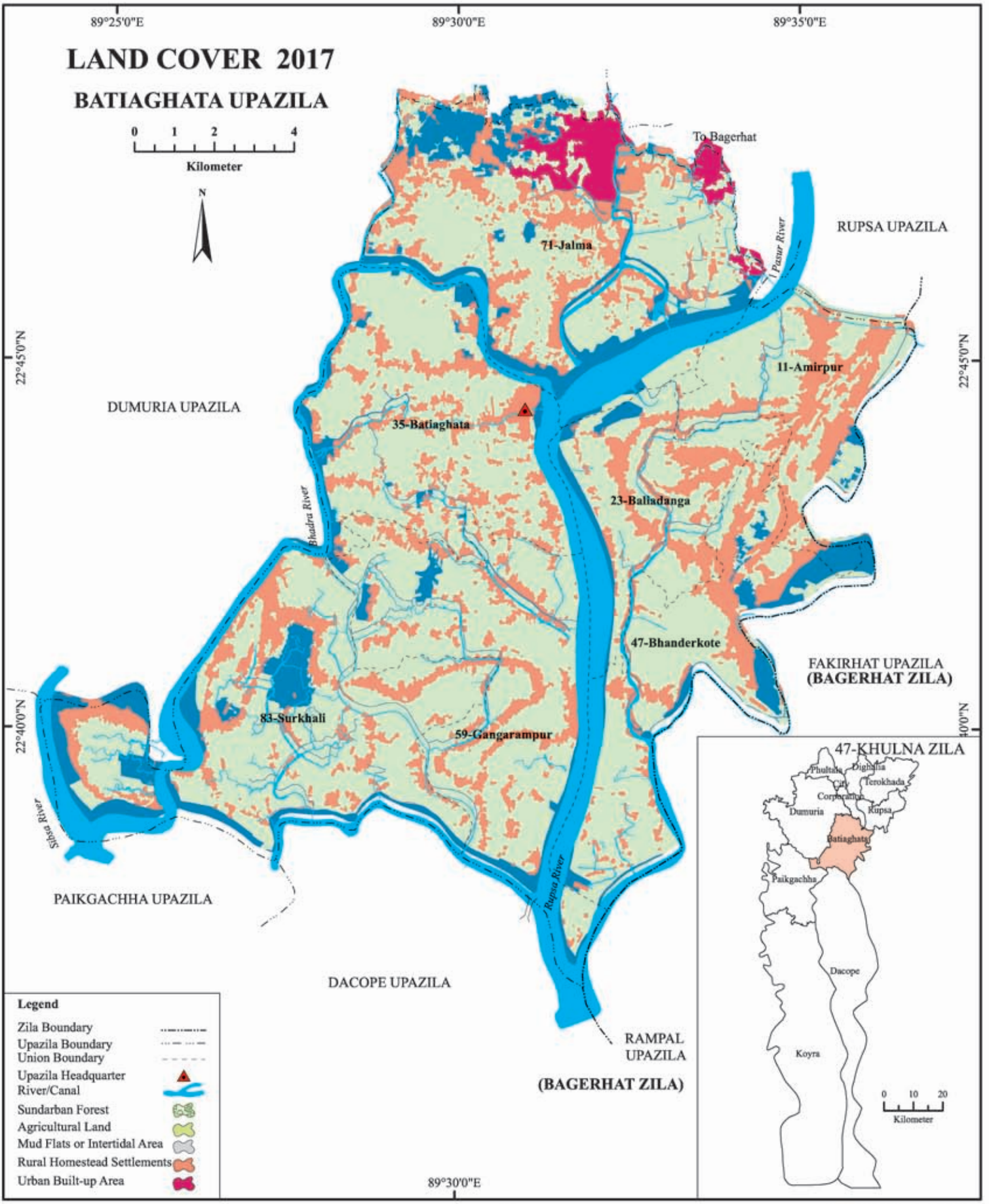

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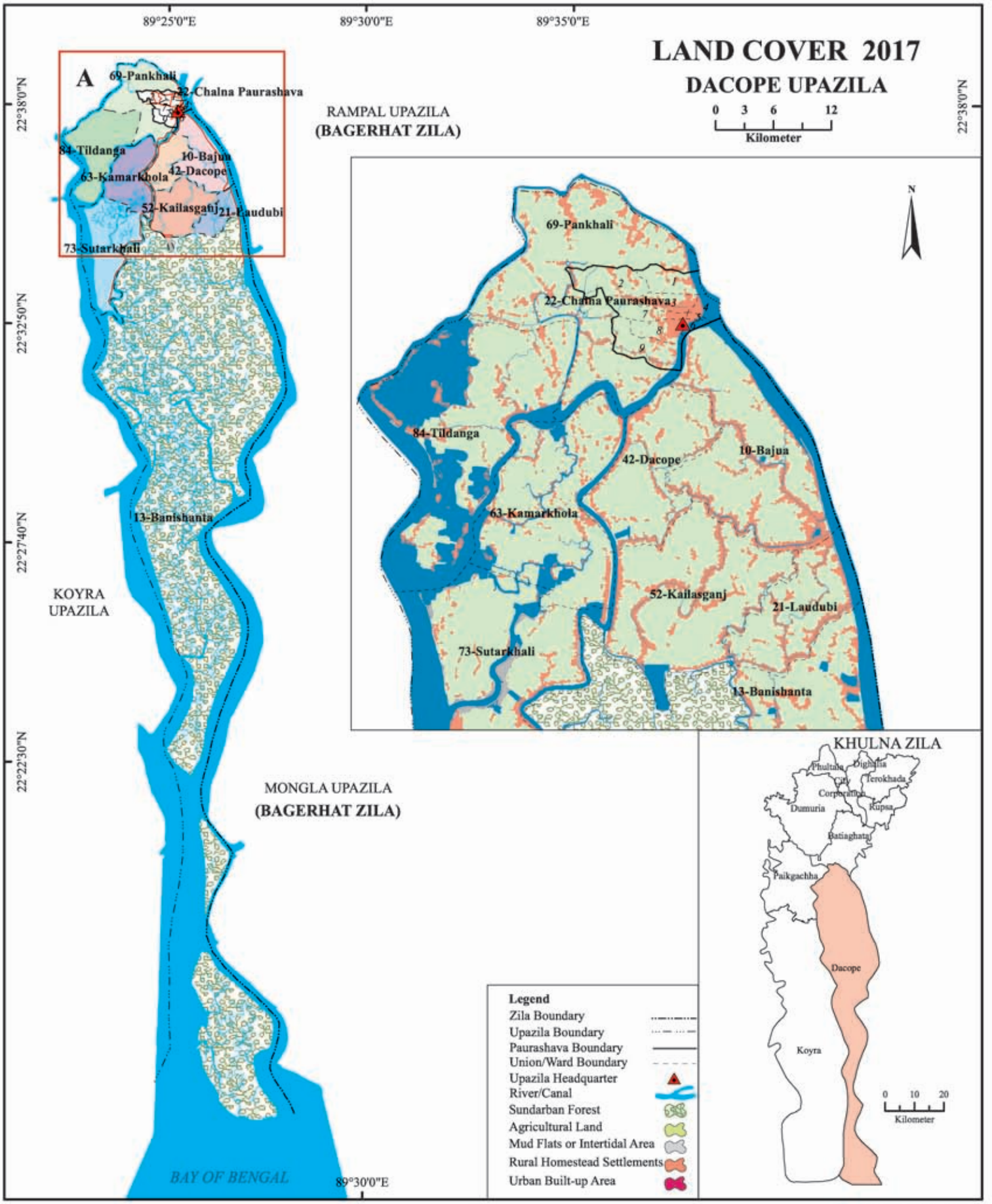

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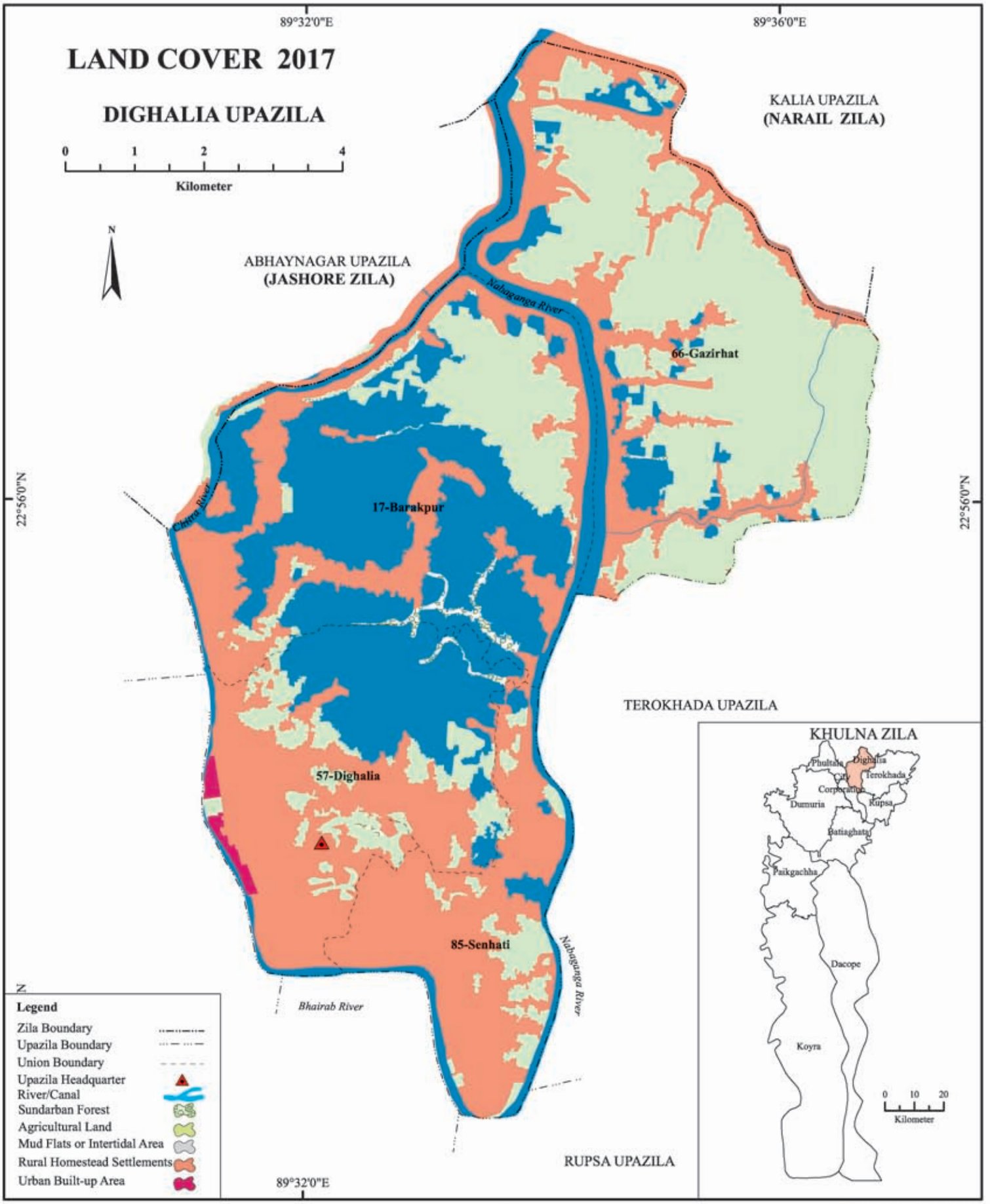

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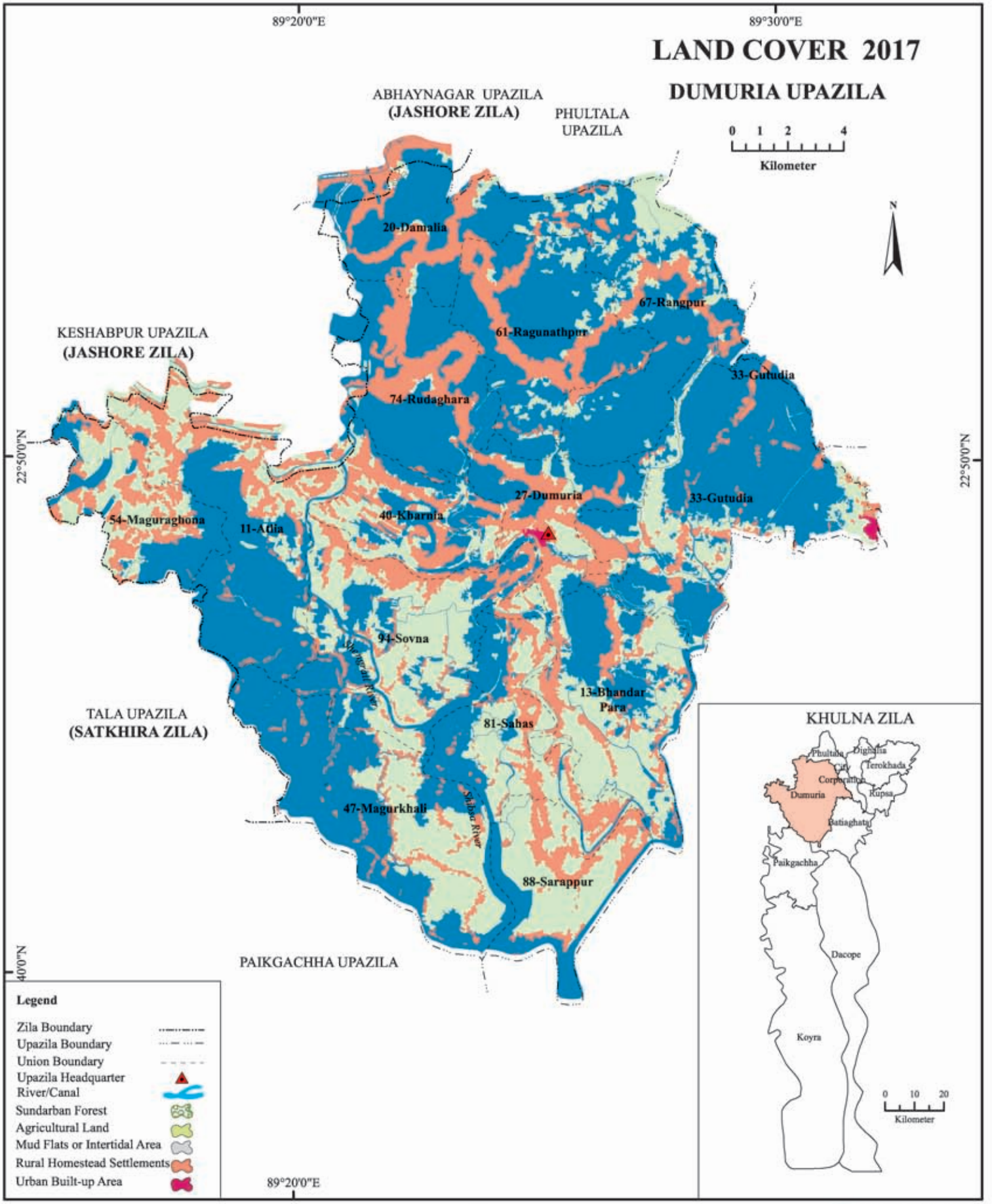

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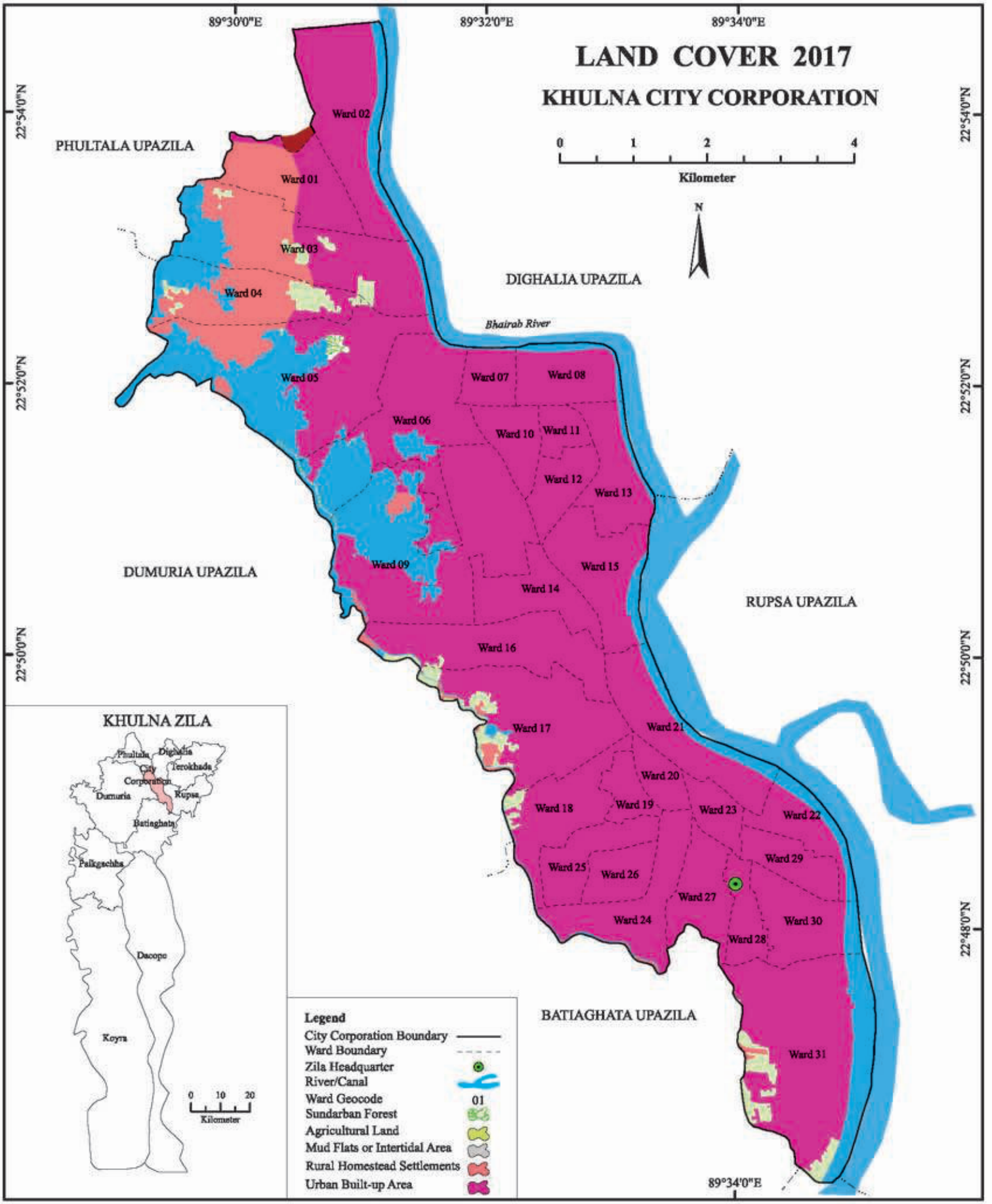

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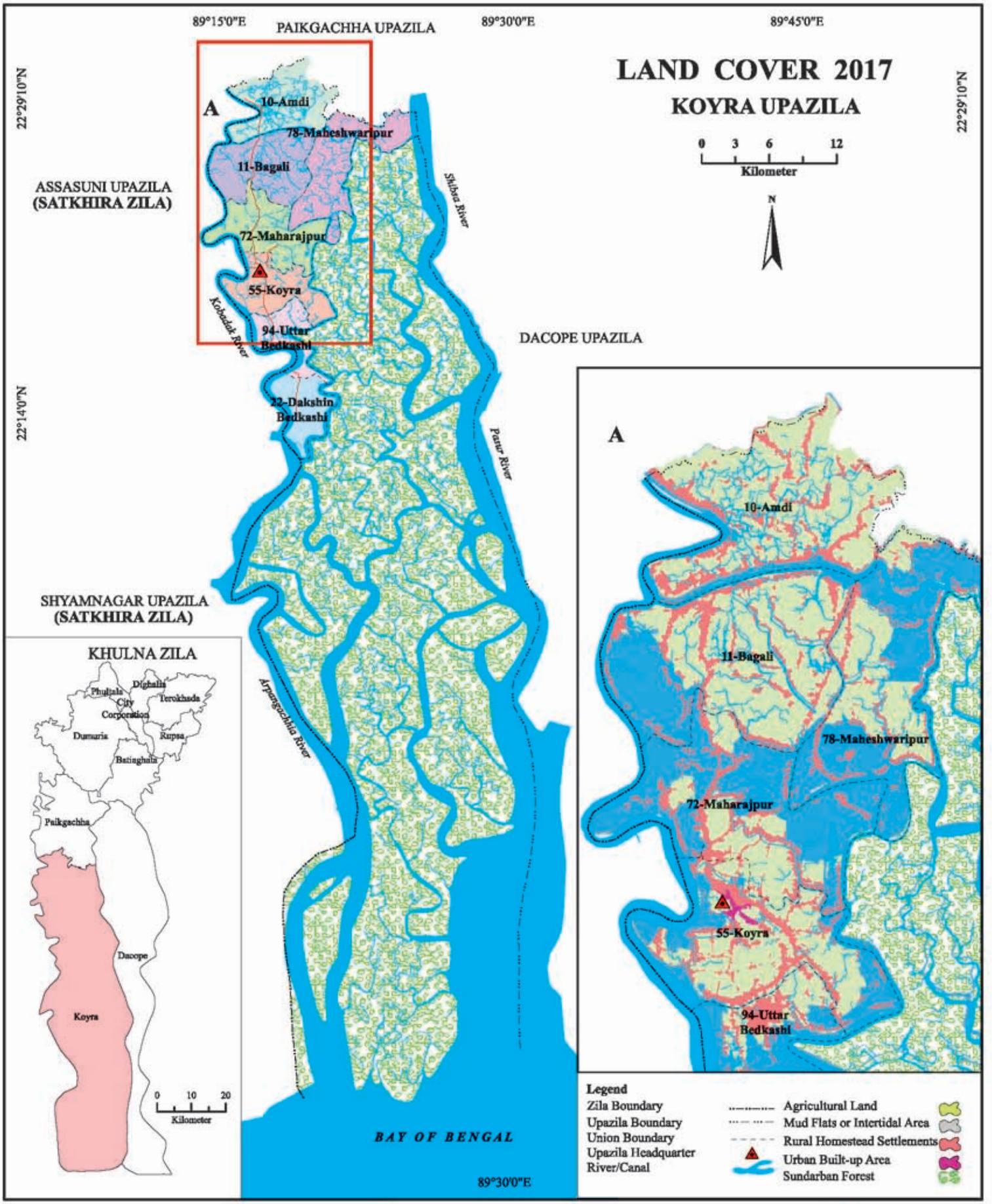

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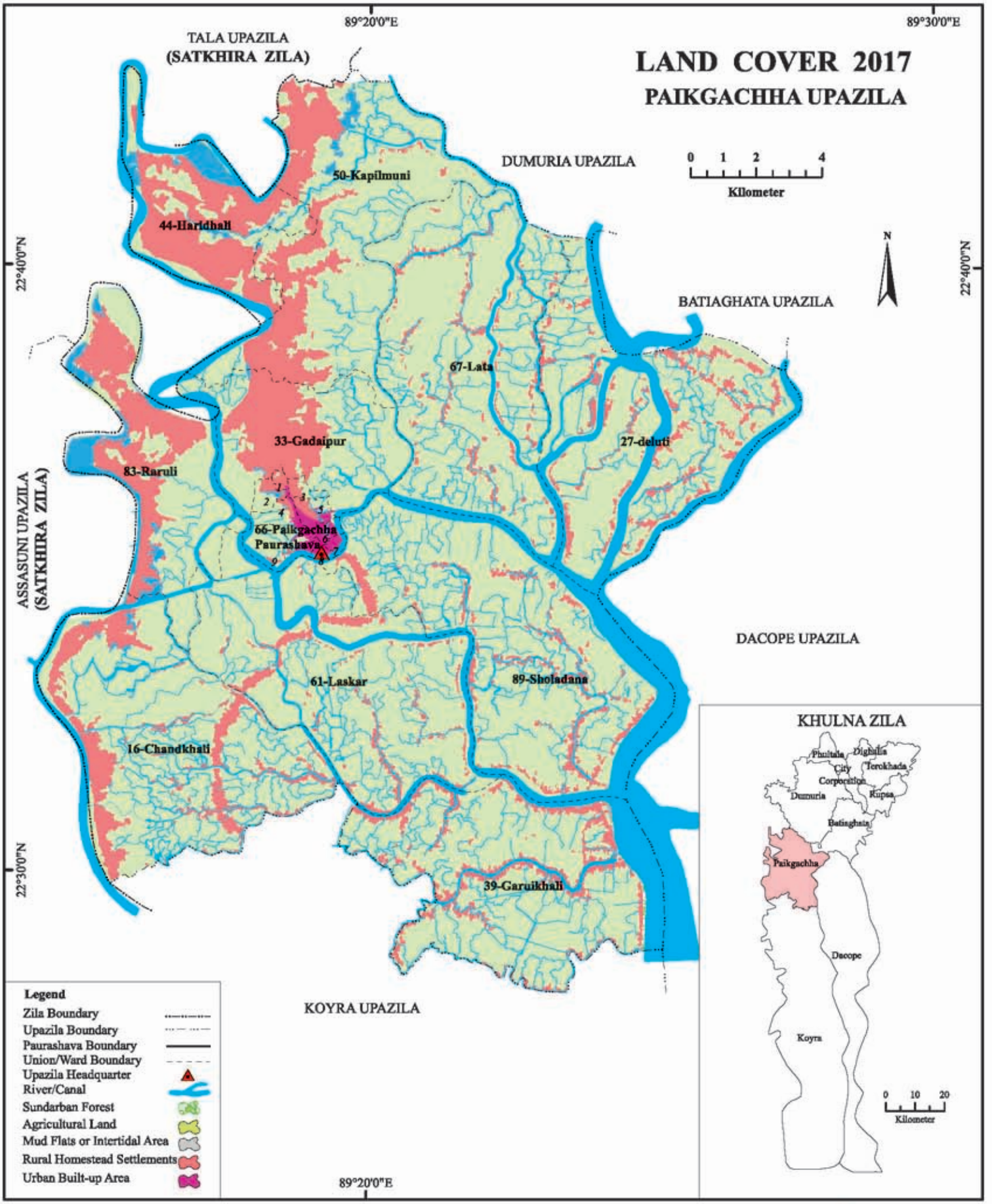

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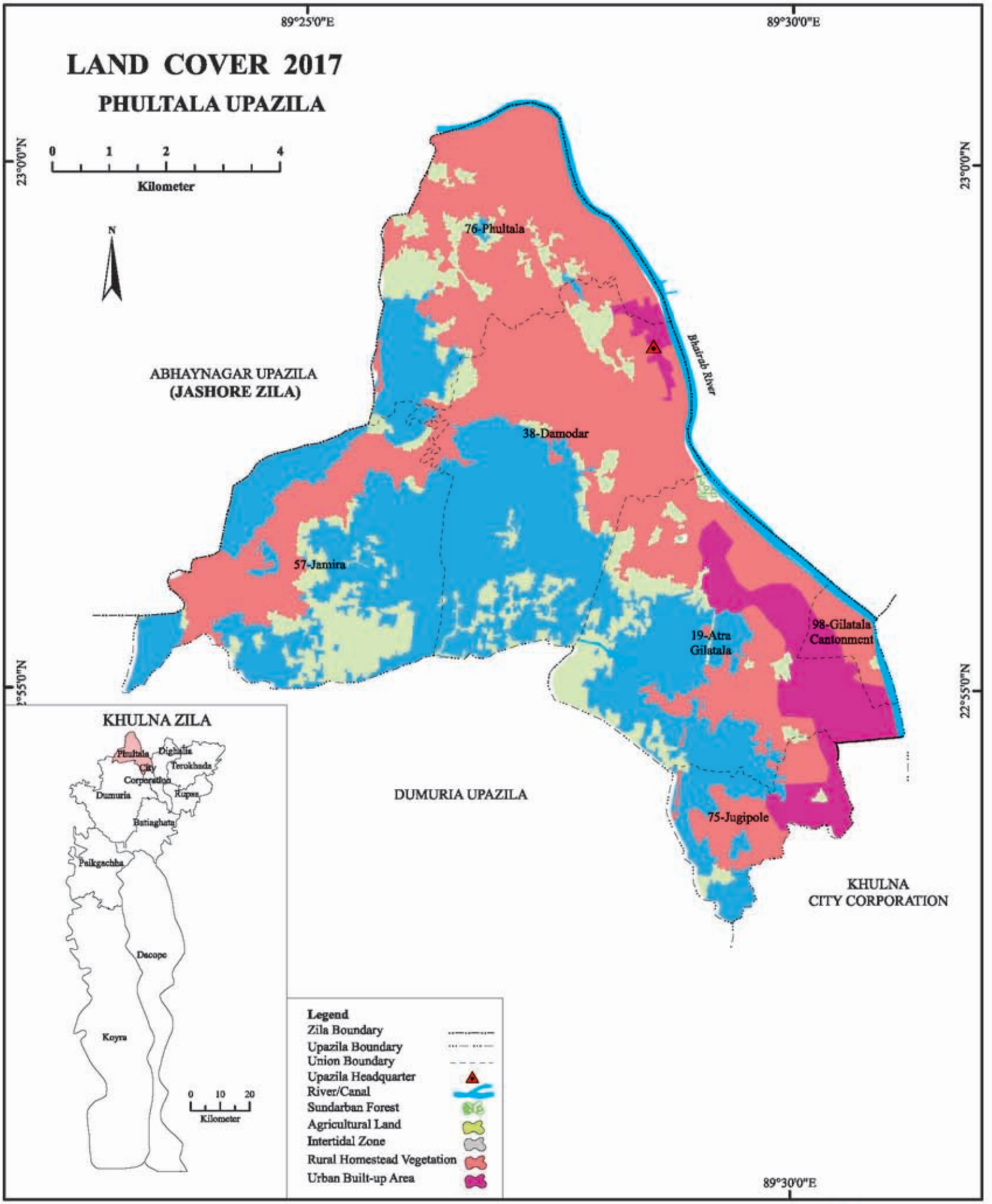

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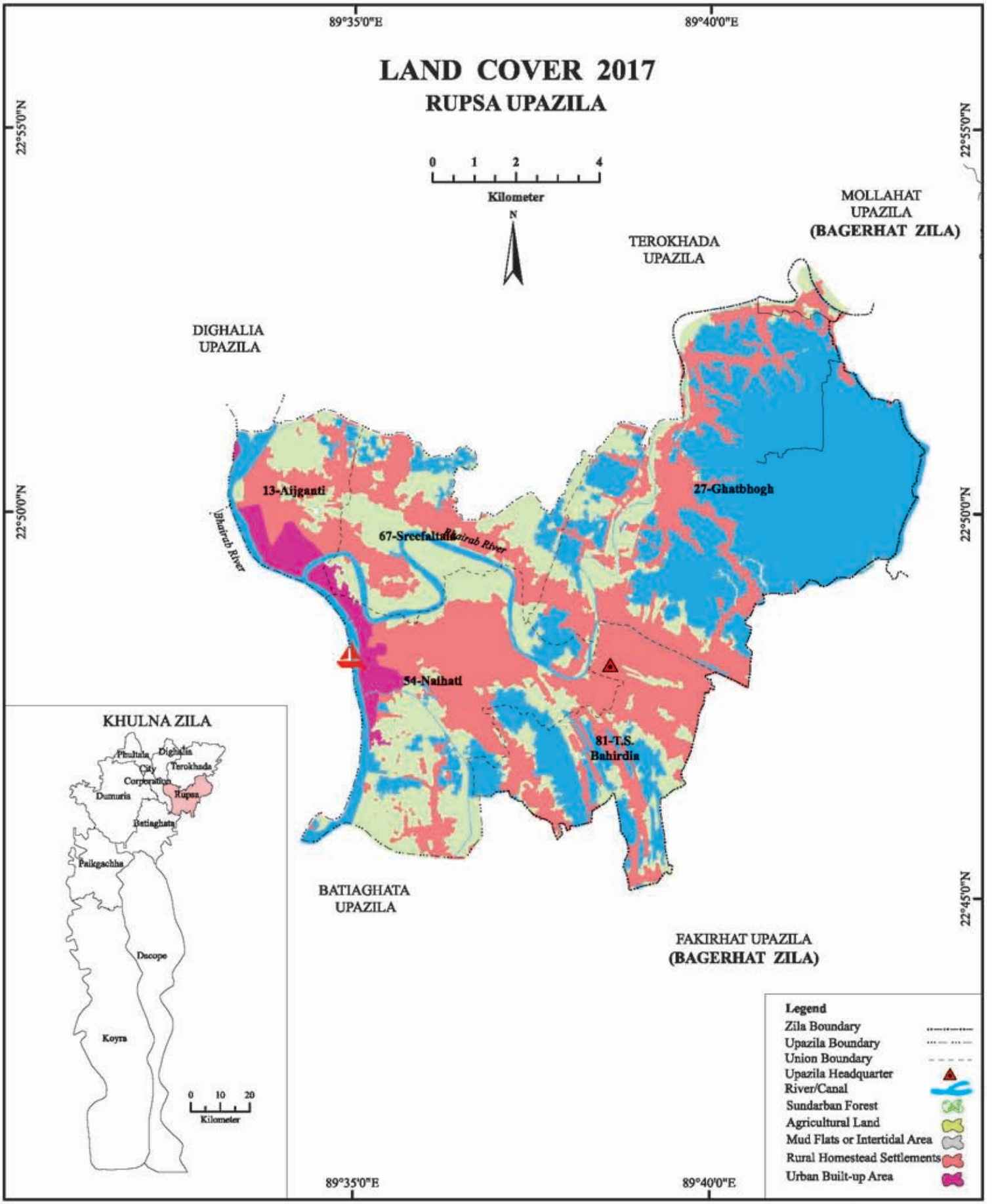

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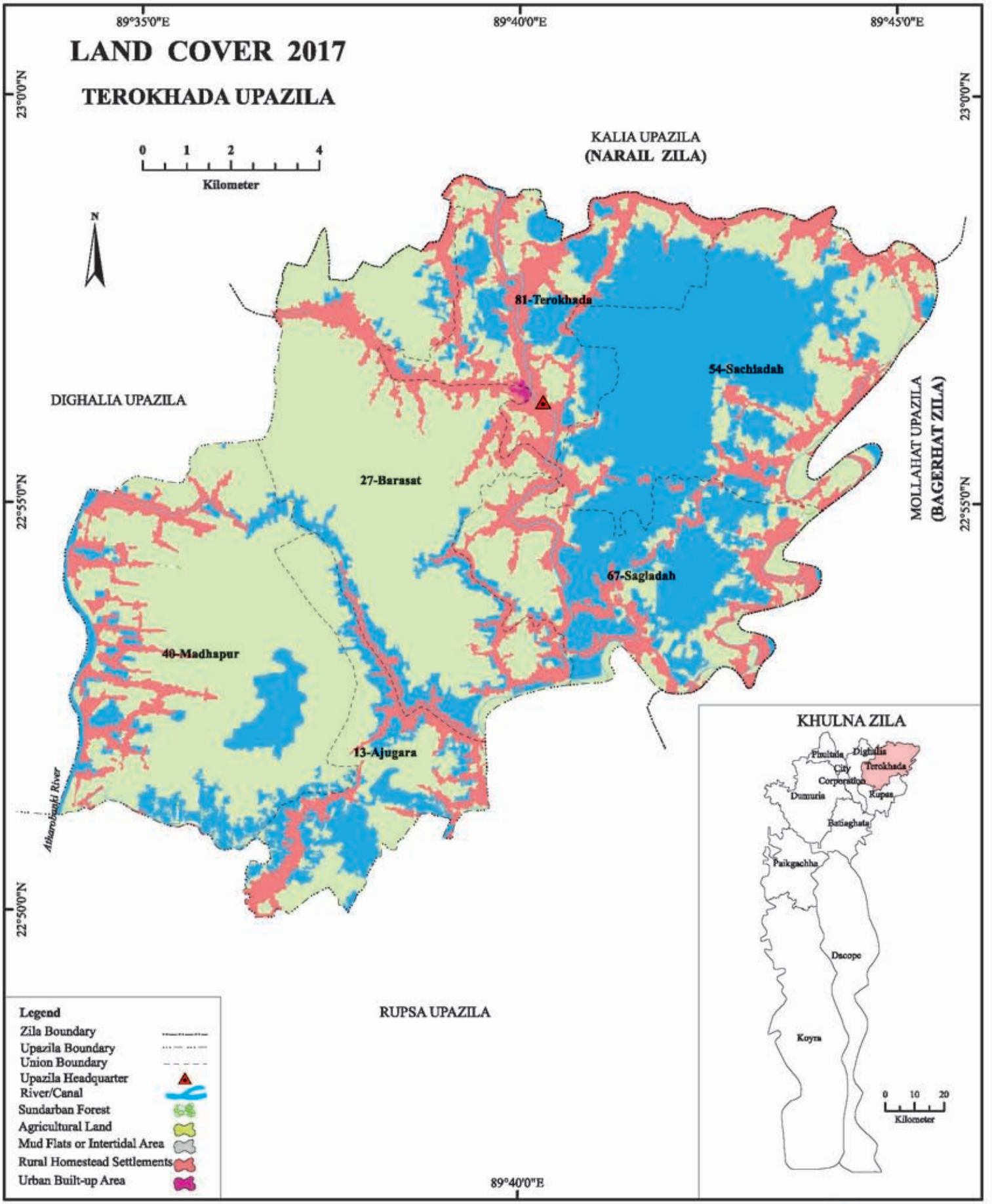

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3.6 Education

The literacy rate of population 7-year age and above is shown in table 3.5. It is noticed that the literacy rate for both sex, male and female in the district, urban and rural areas have been increasing since 1991. The increasing rates show that there are 2.33, 1.06 and 4.02 percent in the district, 5.43, 4.49 and 6.66 percent in urban and 6.57, 4.32 and 9.16 percent increase in rural area for both sex, male and female respectively during the decade 2001-2011.

Table 3.5: Literacy rate of Population 7-Year age and Above by Sex and Residence, 1991-2011 (In percentage)

Years	Zila			Urban			Rural		
	Both Sex	Male	Female	Both Sex	Male	Female	Both Sex	Male	Female
2011	60.14	64.32	55.85	71.79	74.95	68.36	54.16	58.65	49.67
2001	57.81	63.26	51.83	66.36	70.46	61.70	47.59	54.33	40.51
1991	43.90	52.20	34.60	53.00	59.20	45.00	34.50	43.90	24.60

Source: Zila Report, Population and Housing Census 2011, BBS.

Table 3.6: Distribution of various Educational Establishments in Khulna district.

Types of Institutes	Batiaghata	Dacope	Dighalia	Dumuria	Khulna City Corp.	Koyra	Paikgachha	Phultala	Rupsa	Terokhada	Total
Government Primary School	67	56	39	110	77	54	74	39	46	63	**625**
Registered Primary School	48	57	12	96	30	72	90	11	19	45	**480**
Non-govt. Primary School	0	0	2	46	23	6	2	0	3	1	**83**
Kindergarten School	2	4	17	22	66	2	16	12	31	2	**174**
NGO School	18	5	11	57	53	36	4	5	19	19	**227**
Government Secondary School	0	1	1	1	3	0	2	1	0	0	**9**
Non-government Secondary School	26	41	17	54	83	37	56	13	19	15	**361**
School & College	1	1	0	2	7	2	0	4	1	0	**18**

Types of Institutes	Batiaghata	Dacope	Dighalia	Dumuria	Khulna City Corp.	Koyra	Paikgachha	Phultala	Rupsa	Terokhada	Total
Government College	0	1	0	0	7	0	0	0	0	0	**8**
Non-government College	7	5	3	10	12	3	8	4	6	4	**62**
Madrasah	6	5	1	26	17	27	21	6	9	6	**124**
Kawmi Madrasah	5	0	0	5	20	5	13	0	5	21	**74**
Ebtedayee Madrasah	13	3	2	7	19	4	24	9	3	2	**86**
Technical and Vocational Institution	2	1	2	2	8	0	3	0	3	3	**24**

Source: District Statistics, 2011, BBS.

3.7 Health facilities

The mass population mainly depends on government health complex and all type of health facilities are concentrated in Khulna City Corporation. There are few union health & family welfare centres and private clinics. The table 3.7 shows the health facilities in the district.

Table 3.7: Number of health facilities in Khulna district.

Institute Types	Batiaghata	Dacope	Dighalia	Dumuria	Khulna City Corp.	Koyra	Paikgachha	Phultala	Rupsa	Terokhada	Total
Government Health Complex	31	50	31	31	865	50	60	50	31	31	**1230**
Private hospital/clinic	1	1	3	6	73	4	6	3	1	3	**101**
Diagnostic centre	1	1	1	1	40	3	11	1	4	0	**63**
Missionary hospital	0	0	0	0	1	0	0	0	0	0	**1**
Union health centre	7	8	3	13	133	4	10	3	4	6	**191**

Source: Directorate General of Health Sevices, Mohakhali, Dhaka, 2020

3.8 Transport

Palanquin, horse carriage, bullock cart, buffalo cart and country boat were the traditional transports once found in the rural area of Khulna district. These means of transport are either extinct or nearly extinct except country boat. Now-a-days, all the upazilas are connected to the district headquarters by paved roads. Bus, minibus and three wheelers ply over the district.

Table 3.8: Distribution of road types (km) of different Upazilas and City Corporation of Khulna District.

Upazila/ City Corporation	Metalled road	Semi metalled road	Unmetalled (kacha) road	Total	Total Railway	Water way in monsoon (River + Canal)	Water way round the Year (River + Canal)
Batiaghata	79	135	343.4	558	0	16	19
Dacope	29	385	1355	1769	0	303	5
Dighalia	112	72	111	295	0	77	8
Dumuria	129	207	731	1068	0	50	0
Khulna City Corporation	158	67	18	243	19	10	10
Koyra	46	172	394	612	0	92	5
Paikgachha	83	203	419	705	0	16	14
Phultala	47	40	100	187	17	0	6
Rupsa	149	125	446	720	0	65	0
Terokhada	88	66	223	378.95	0	27	15
Total	**920**	**1472**	**4140**	**6535**	**36**	**656**	**82**

Source: District Statistics, 2011, BBS.

3.9 Cyclone Shelters

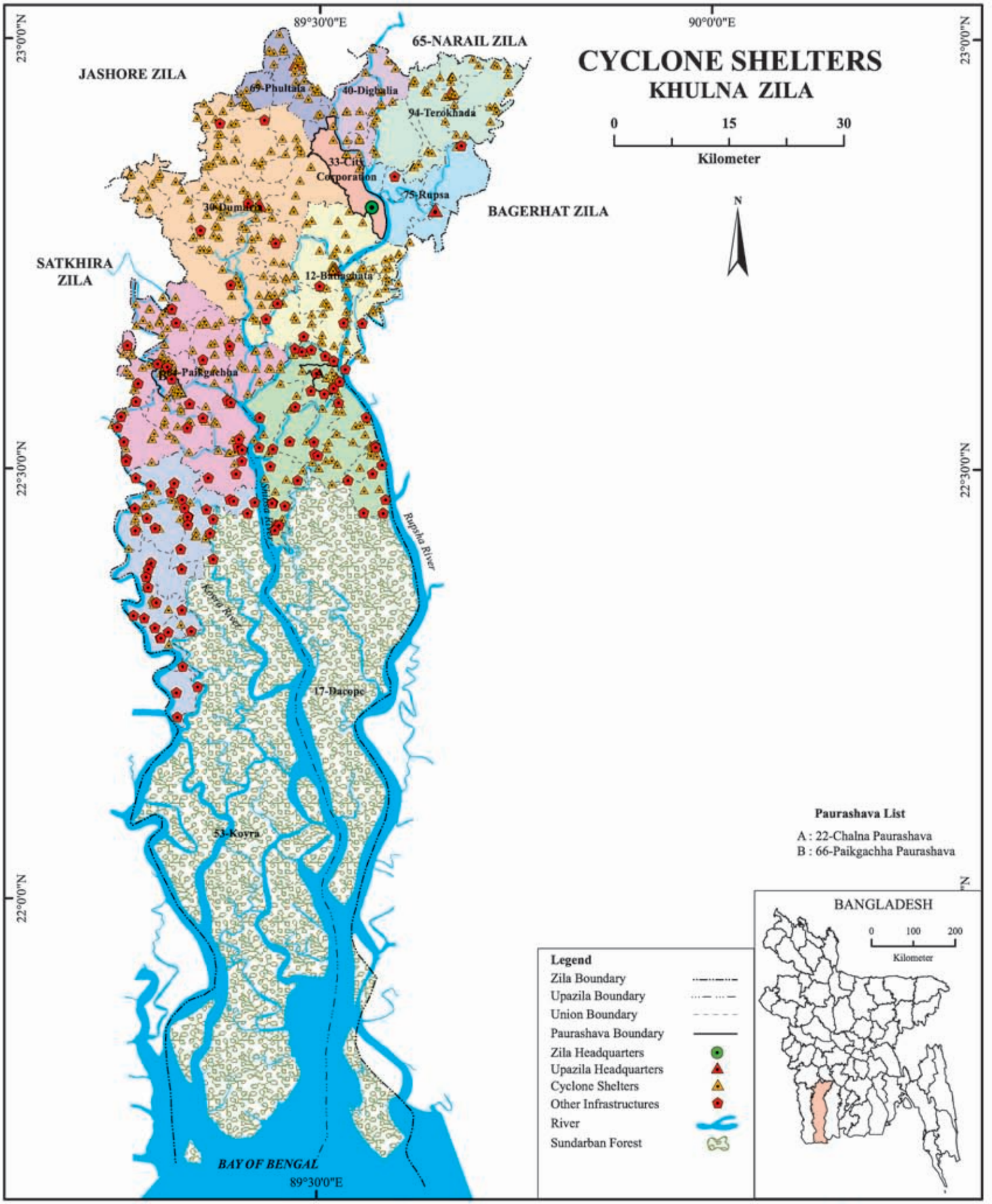
There are only 125 cyclone shelters available constructed by Governmental and where only 116066 number of people can take shelter during the disaster period. On the other hand, there are plenty of Permanent infrastructures which could be used as shelter during any cyclone take place.

Table 3.9: Upazila specific distribution of cyclone shelters and population.

Upazila	Population 2011	Number of Cyclone Shelter	Population Capacity
Batiaghata	171691	5	5325
Dacope	152316	38	34691
Dighalia	115585	0	0
Dumuria	305675	8	6525
Khulna City Corporation	751237	0	0
Koyra	193931	43	41225
Paikgachha	247983	29	26700
Phultala	83881	0	0
Rupsa	179519	2	1600
Terokhada	116709	0	0
Total	**2318527**	**125**	**116066**

Source: Department of Disaster Management and BBS field survey 2020

Cyclone Shelters
Area Map



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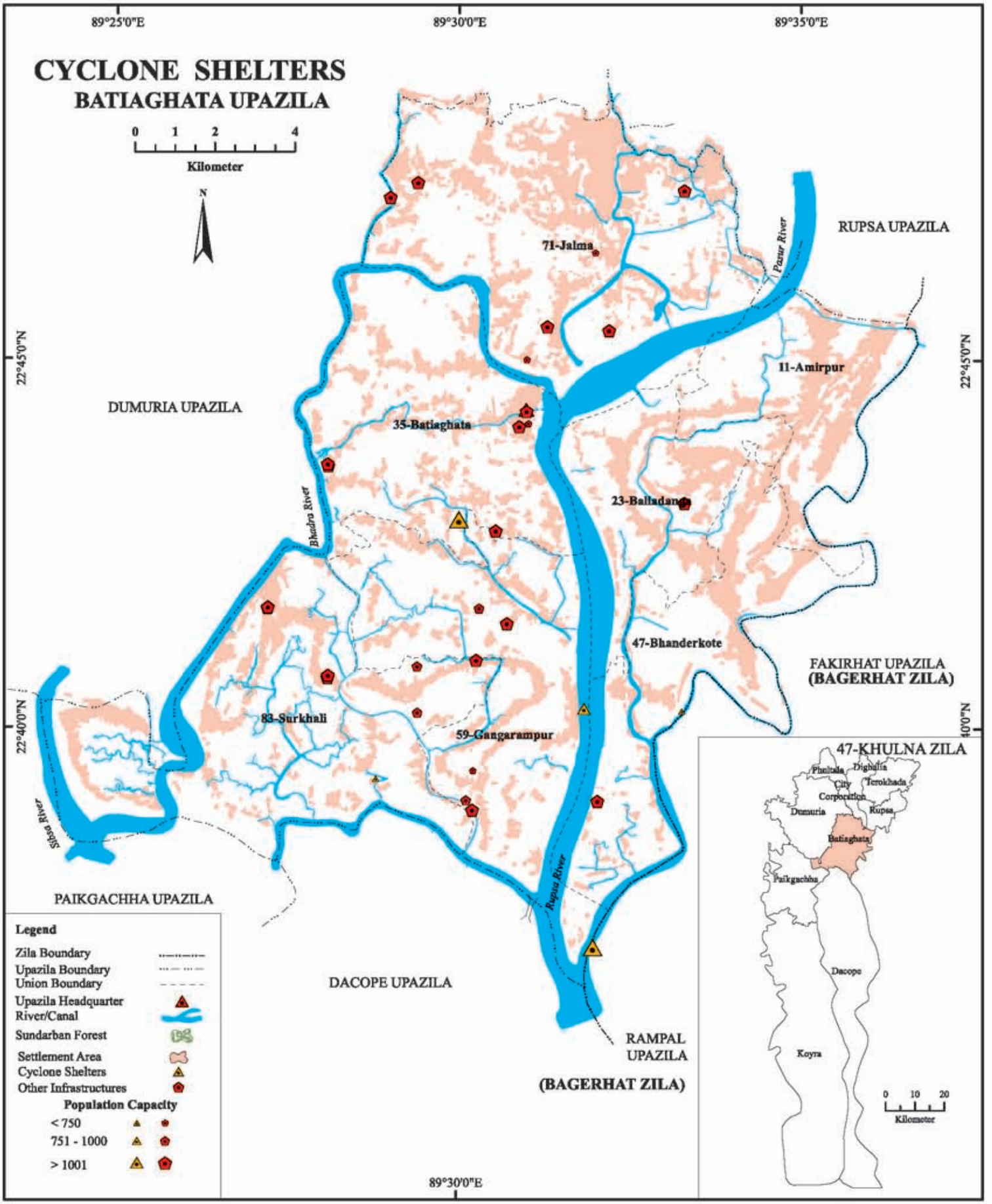

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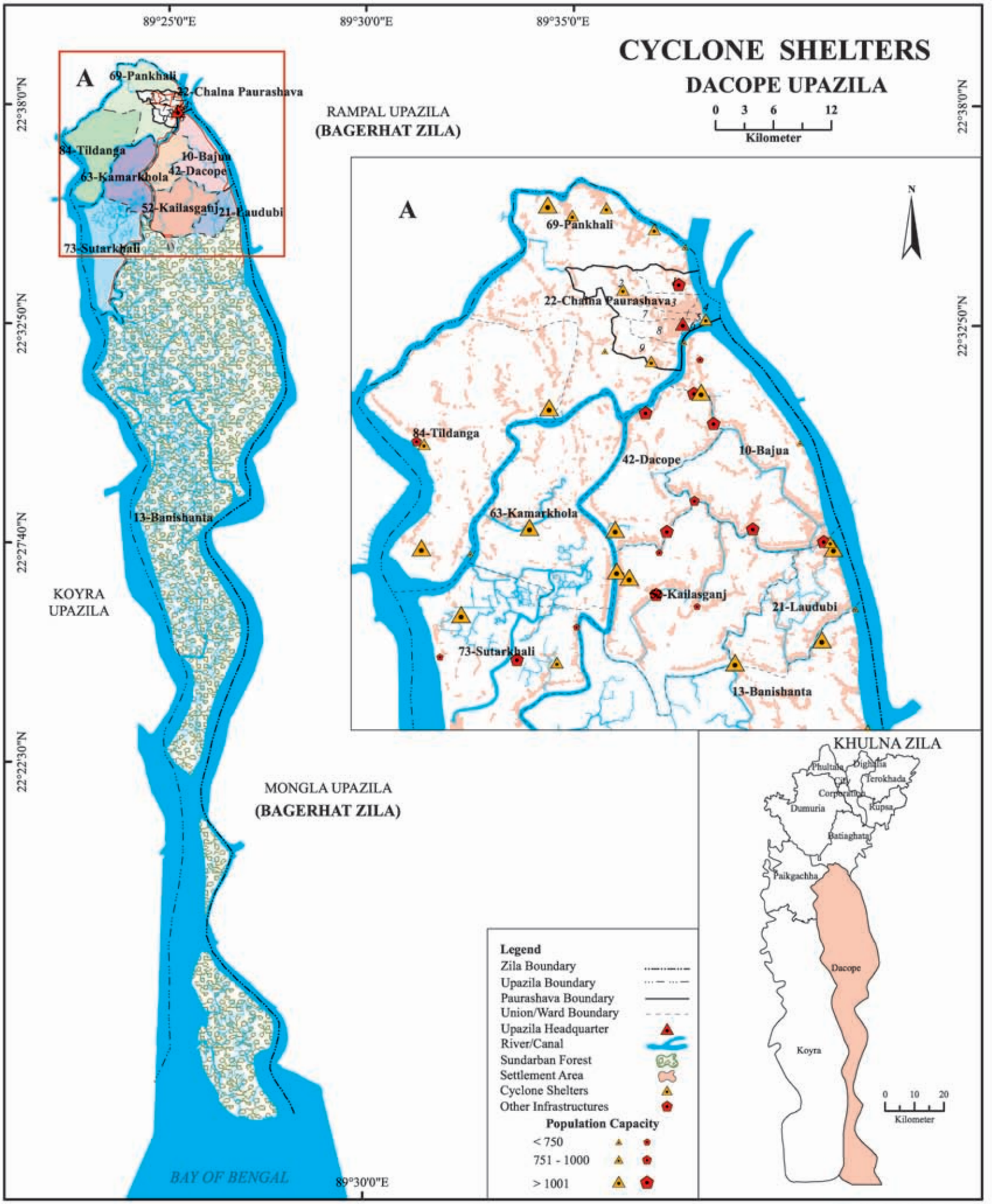

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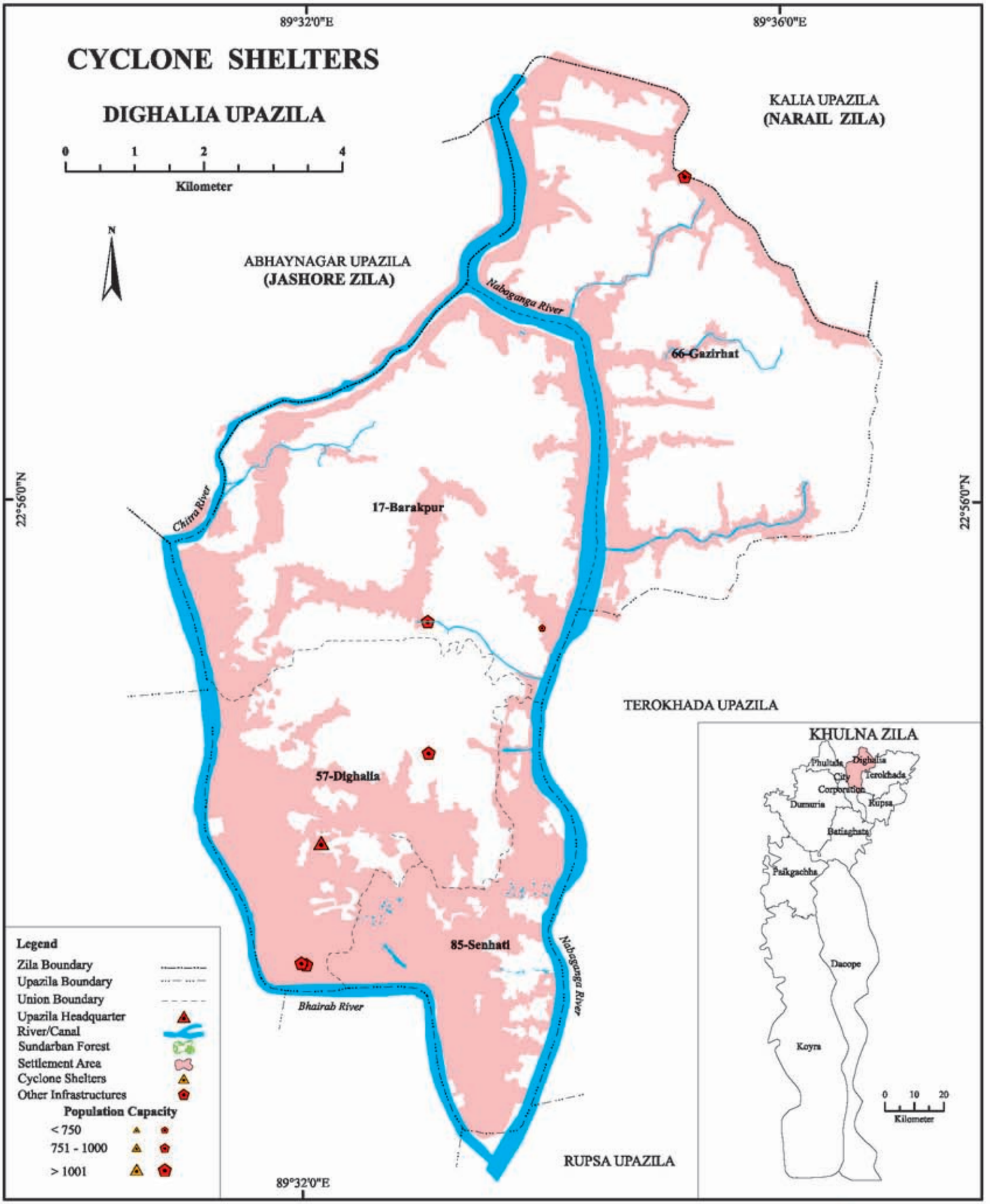

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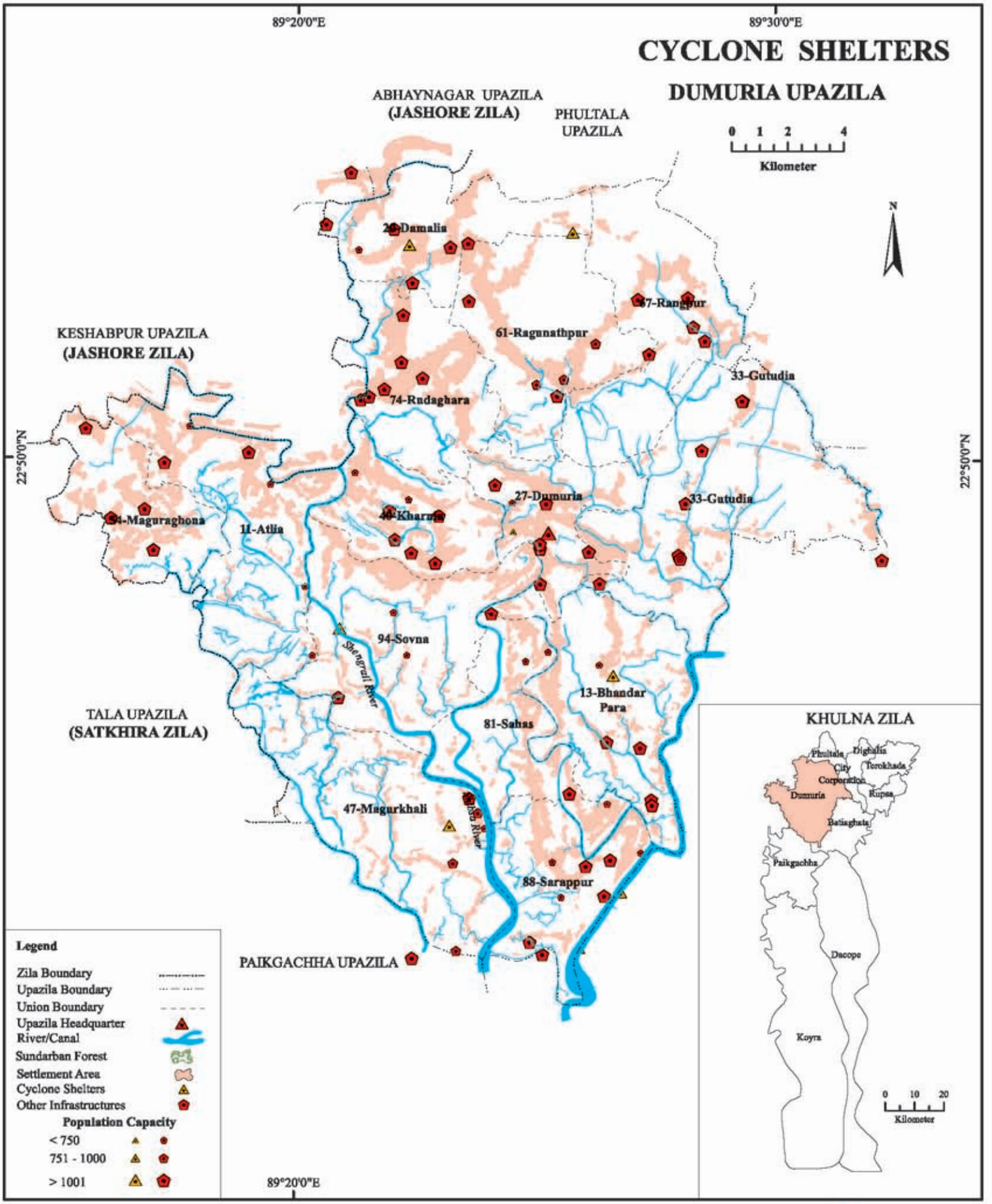

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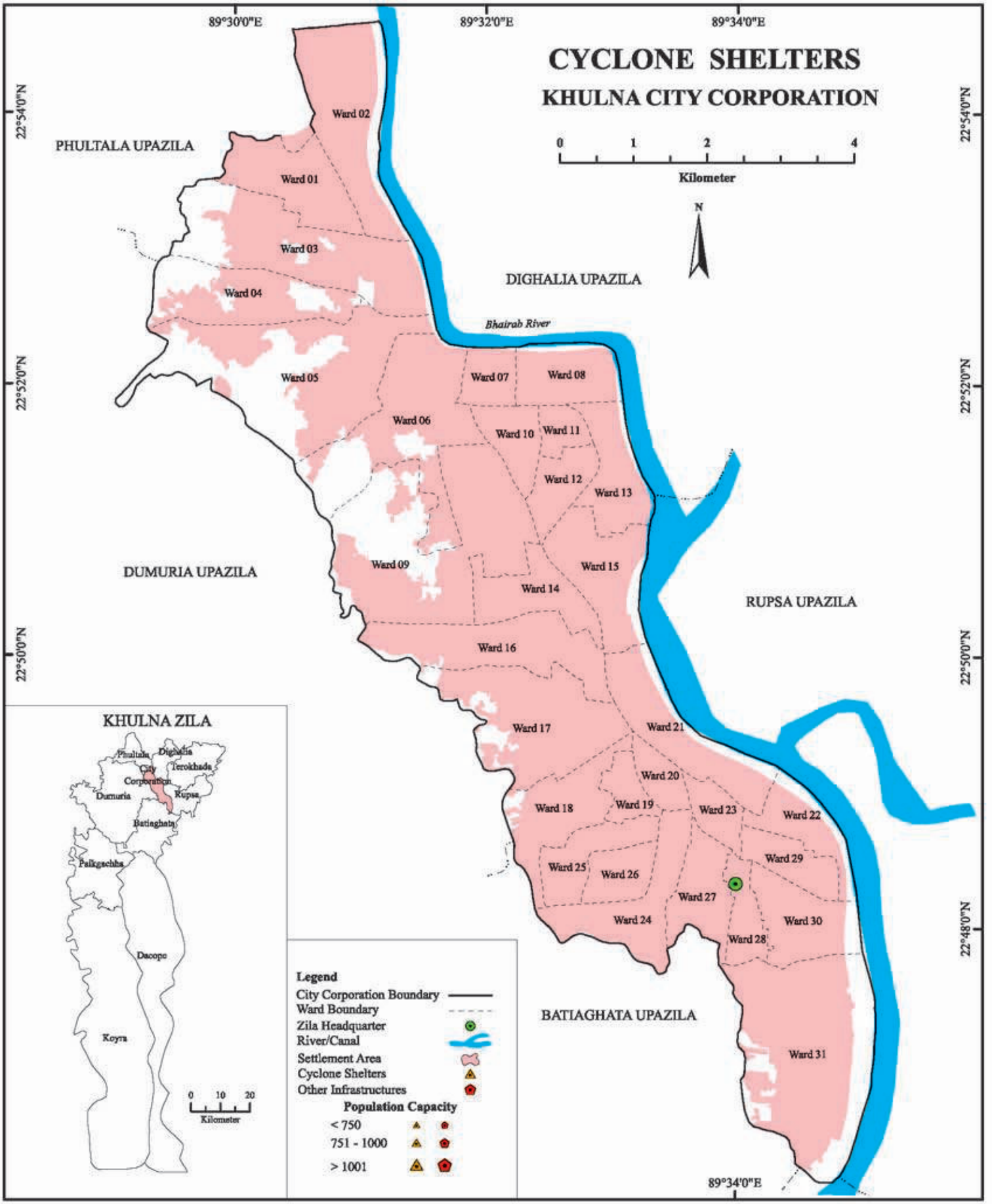

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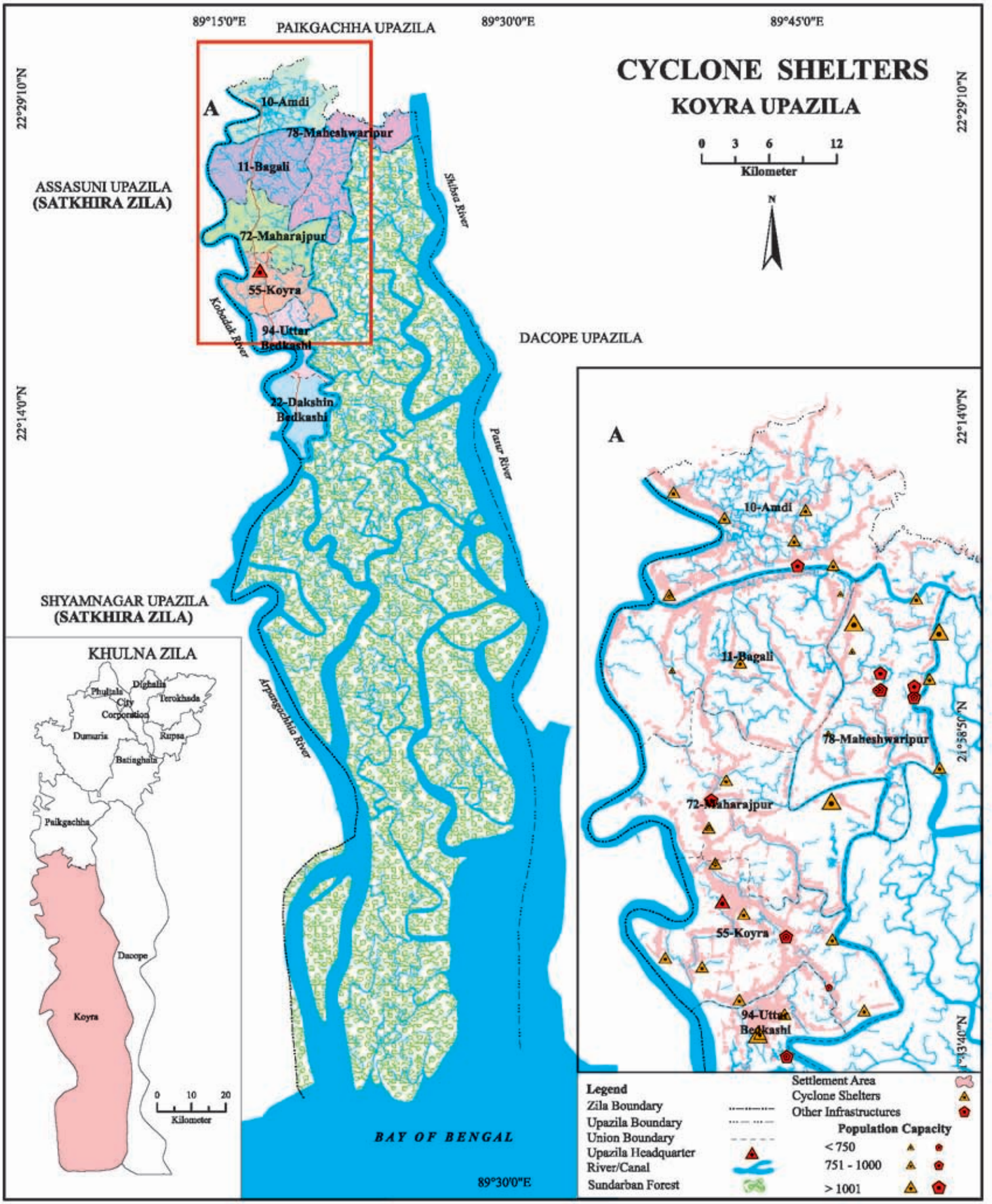

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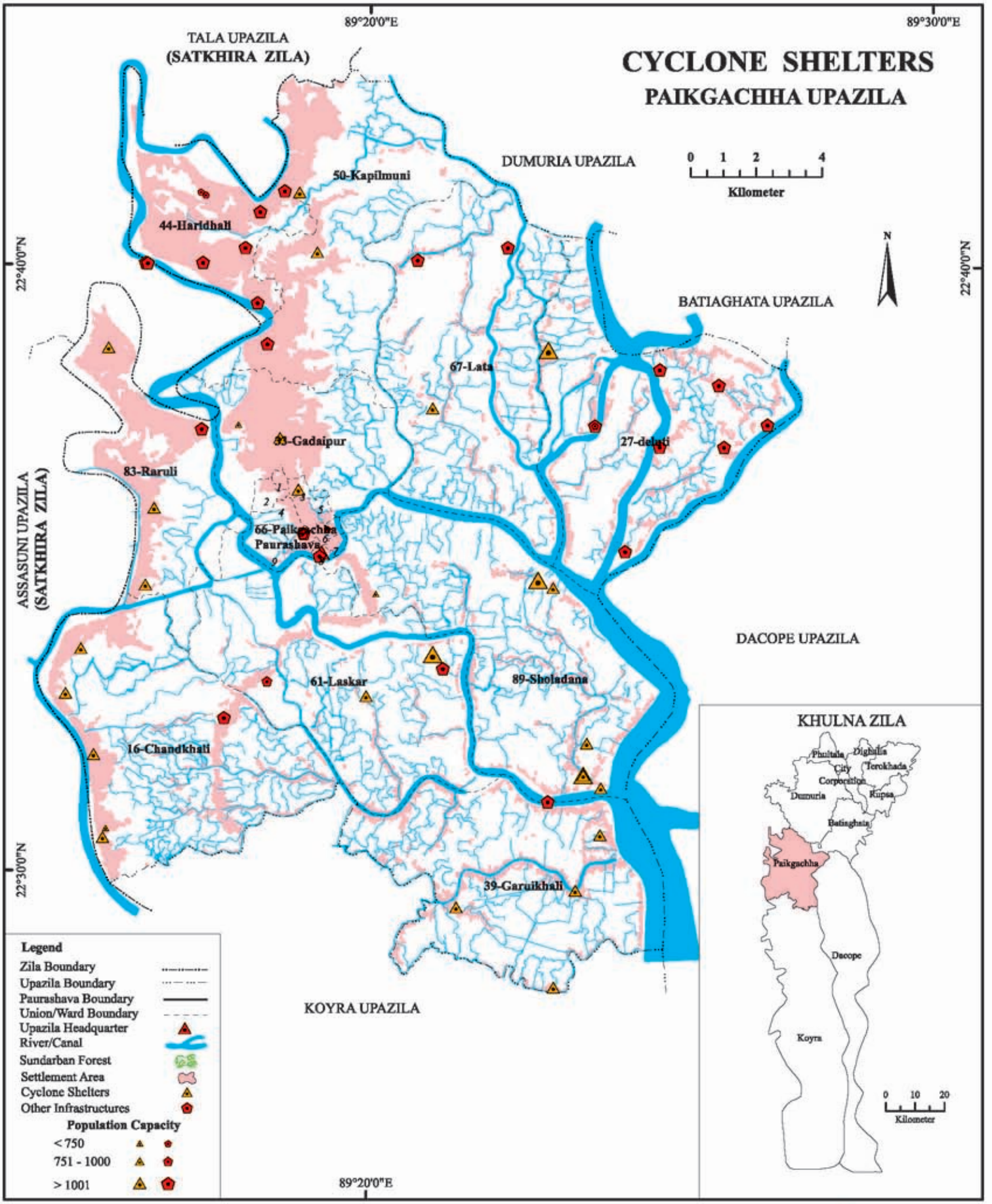

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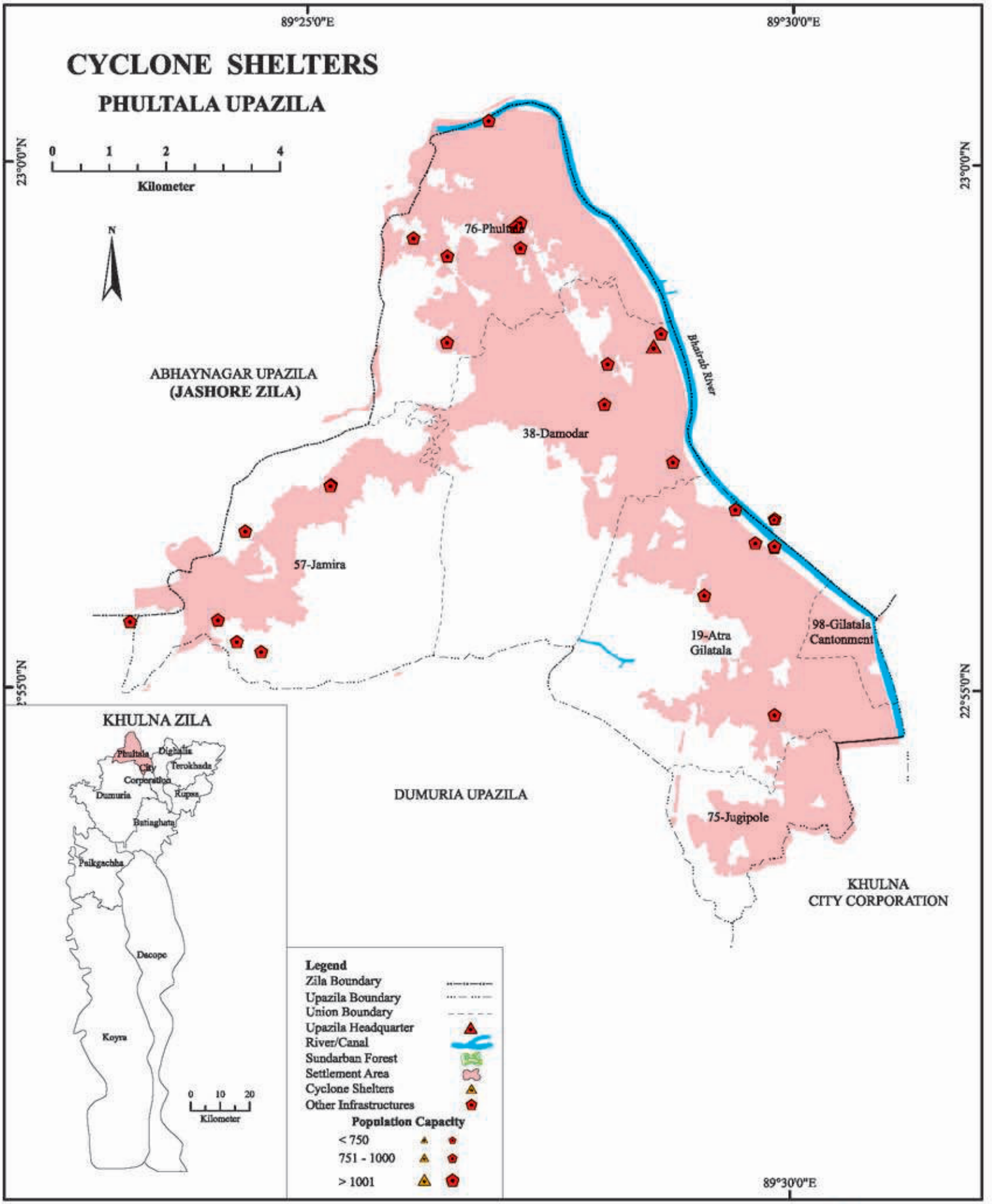

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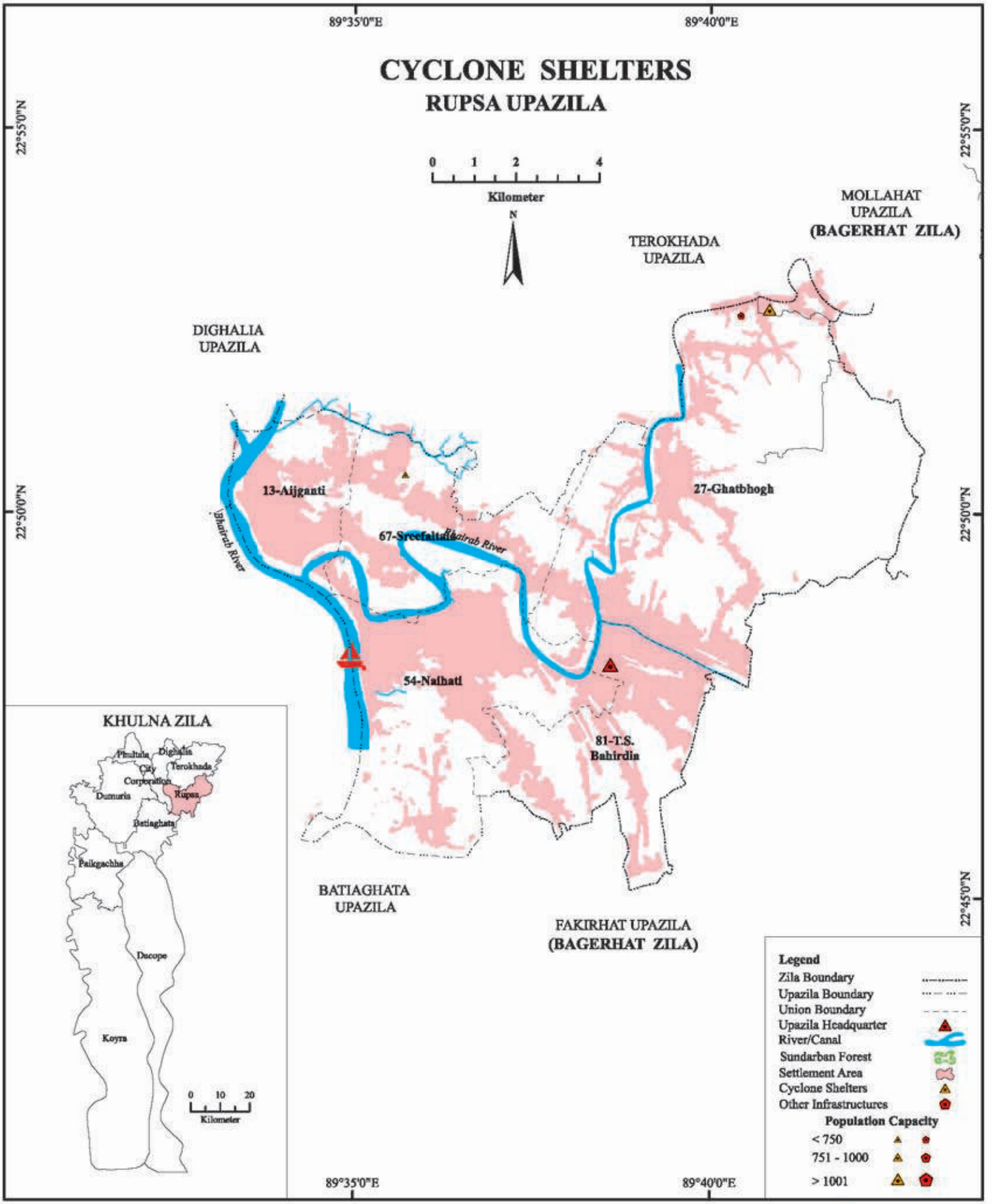

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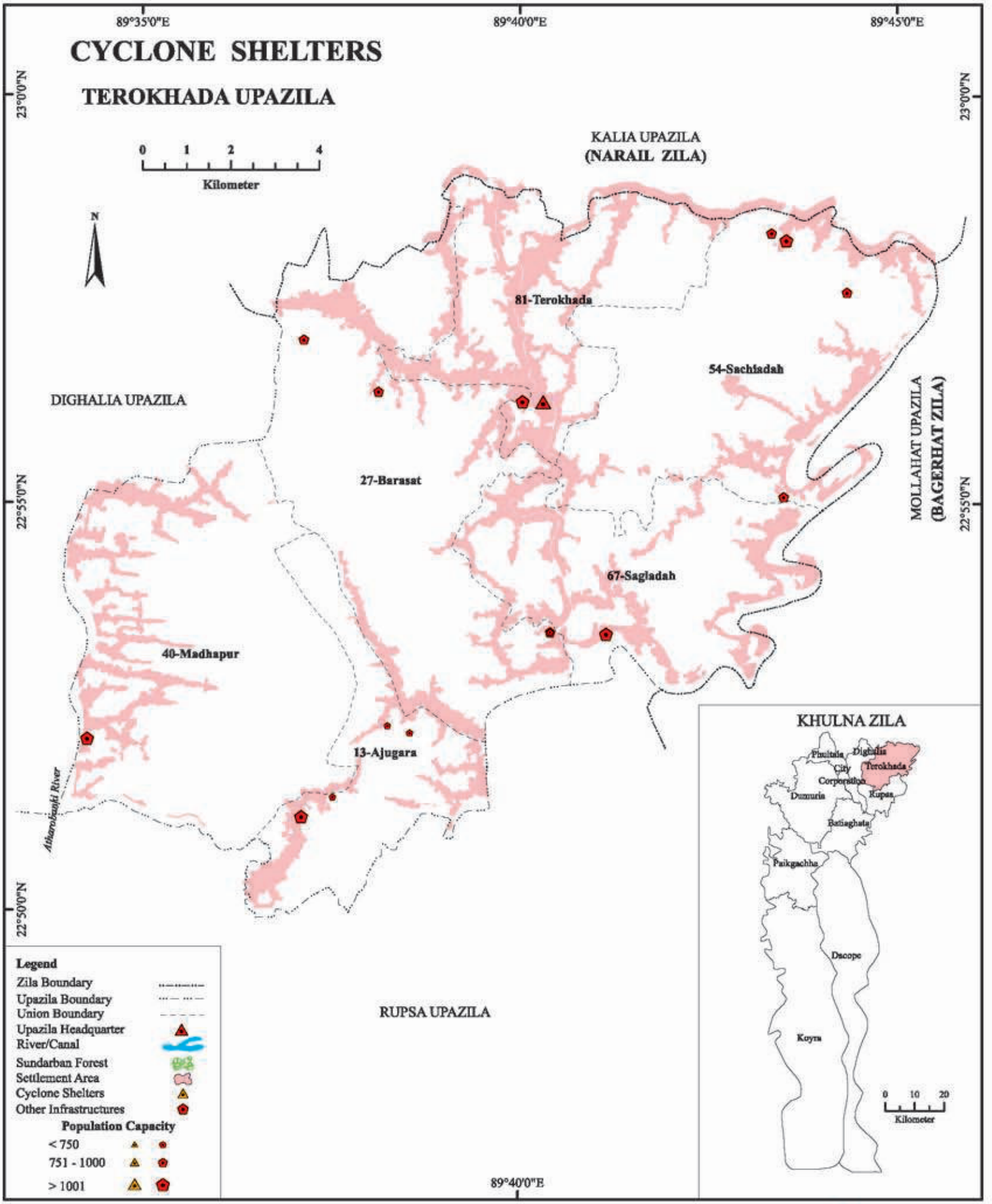

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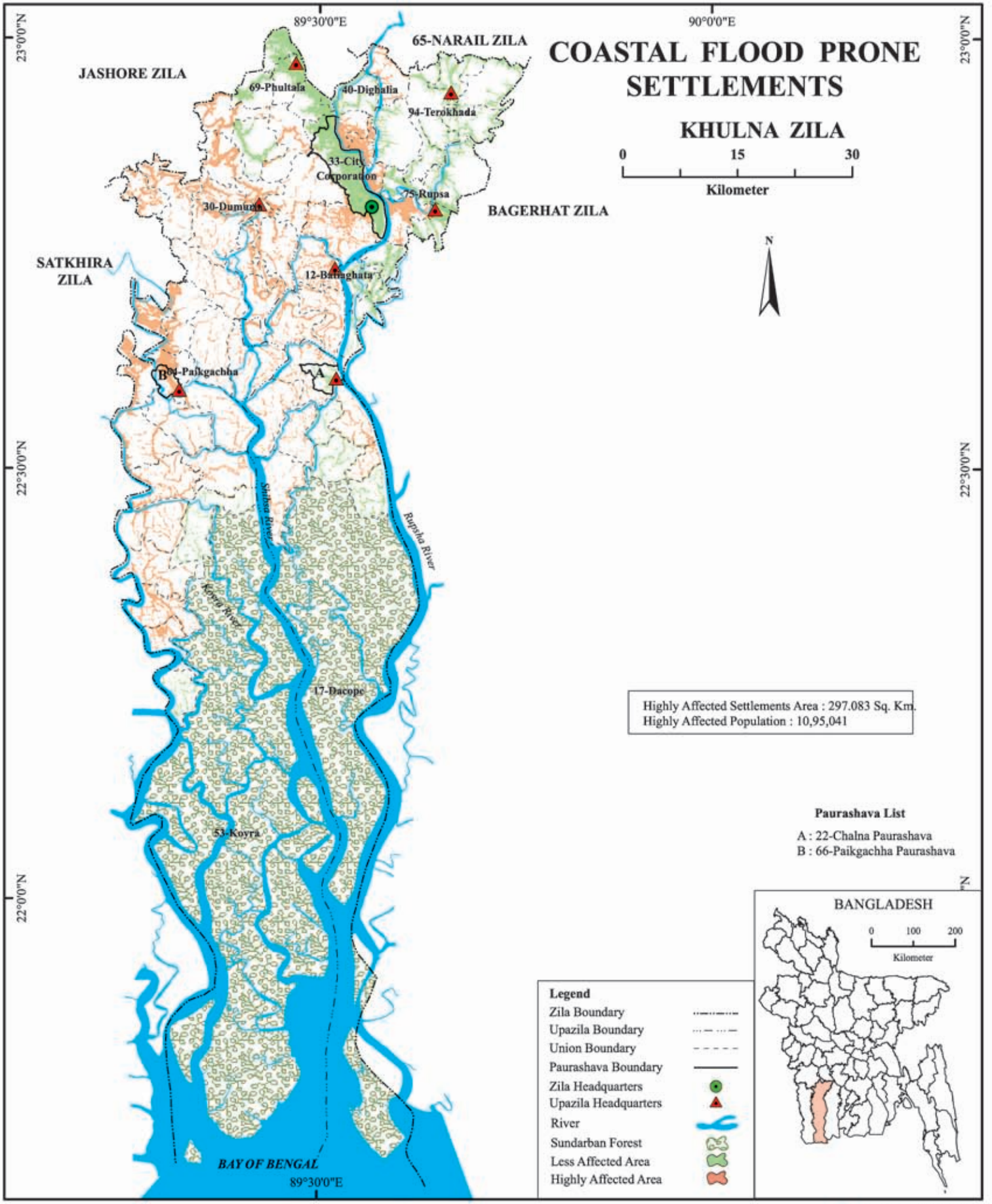
Chapter 4

Hazard Assessment and Mapping

Coastal Flood Prone Area Map



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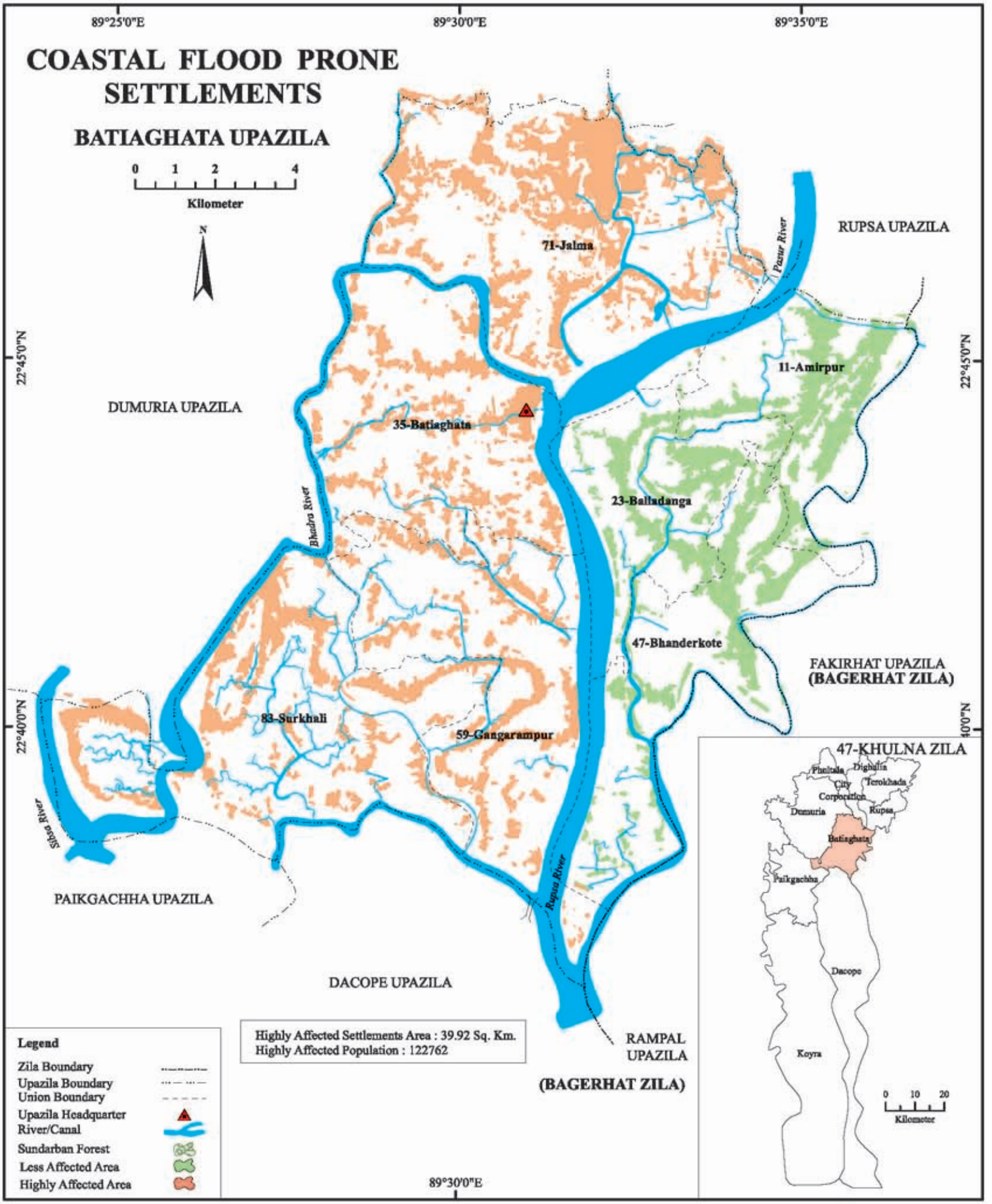

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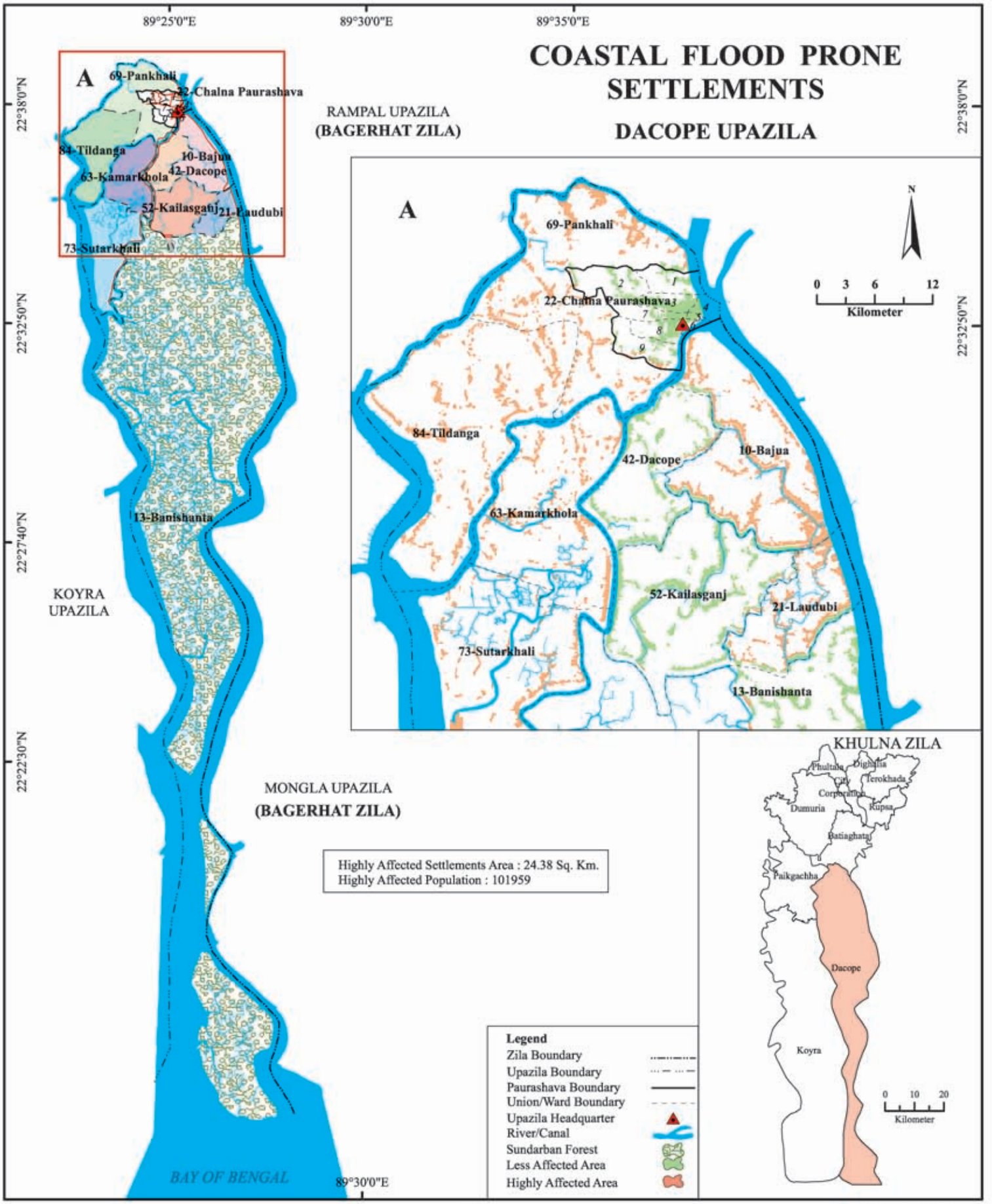

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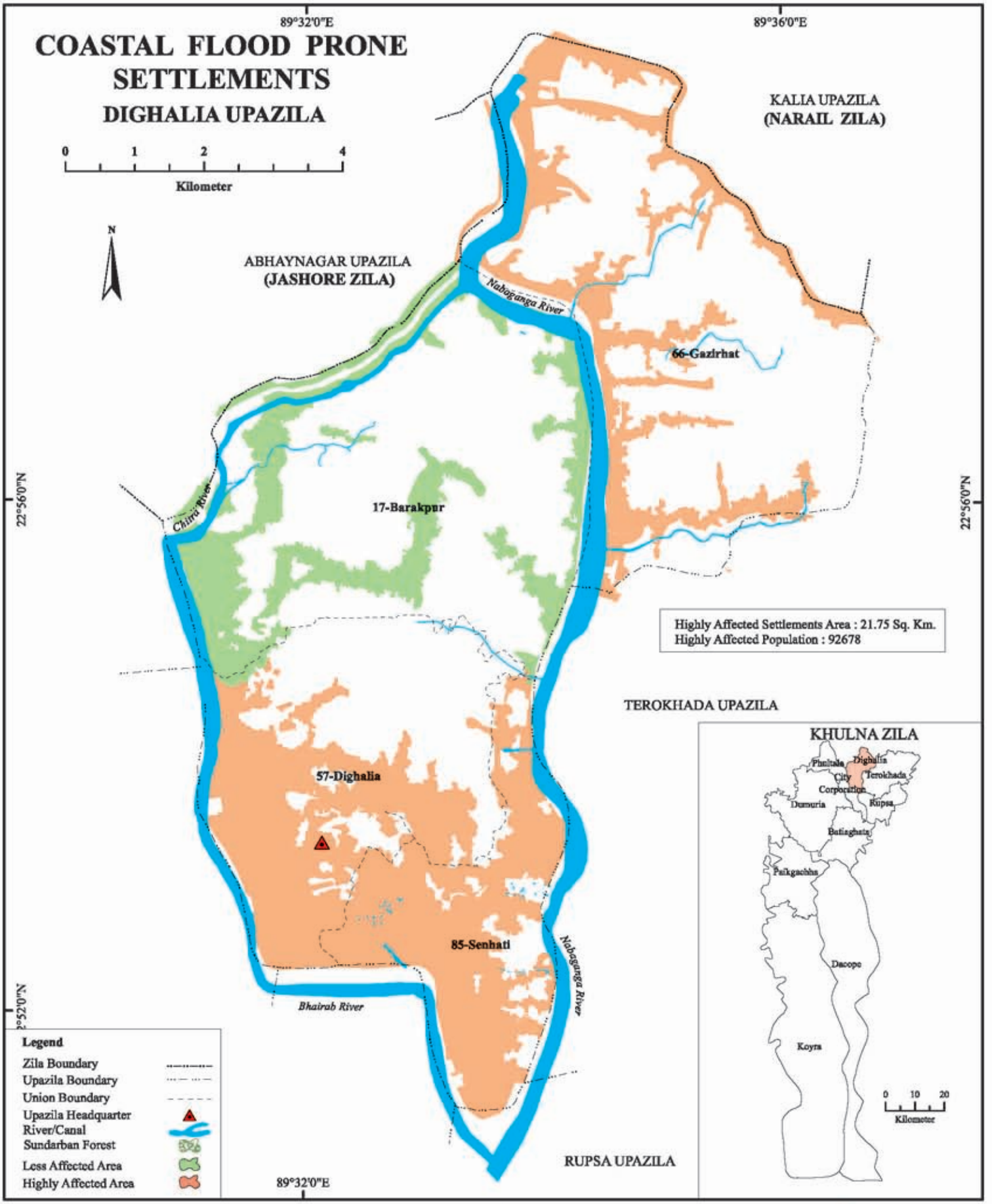

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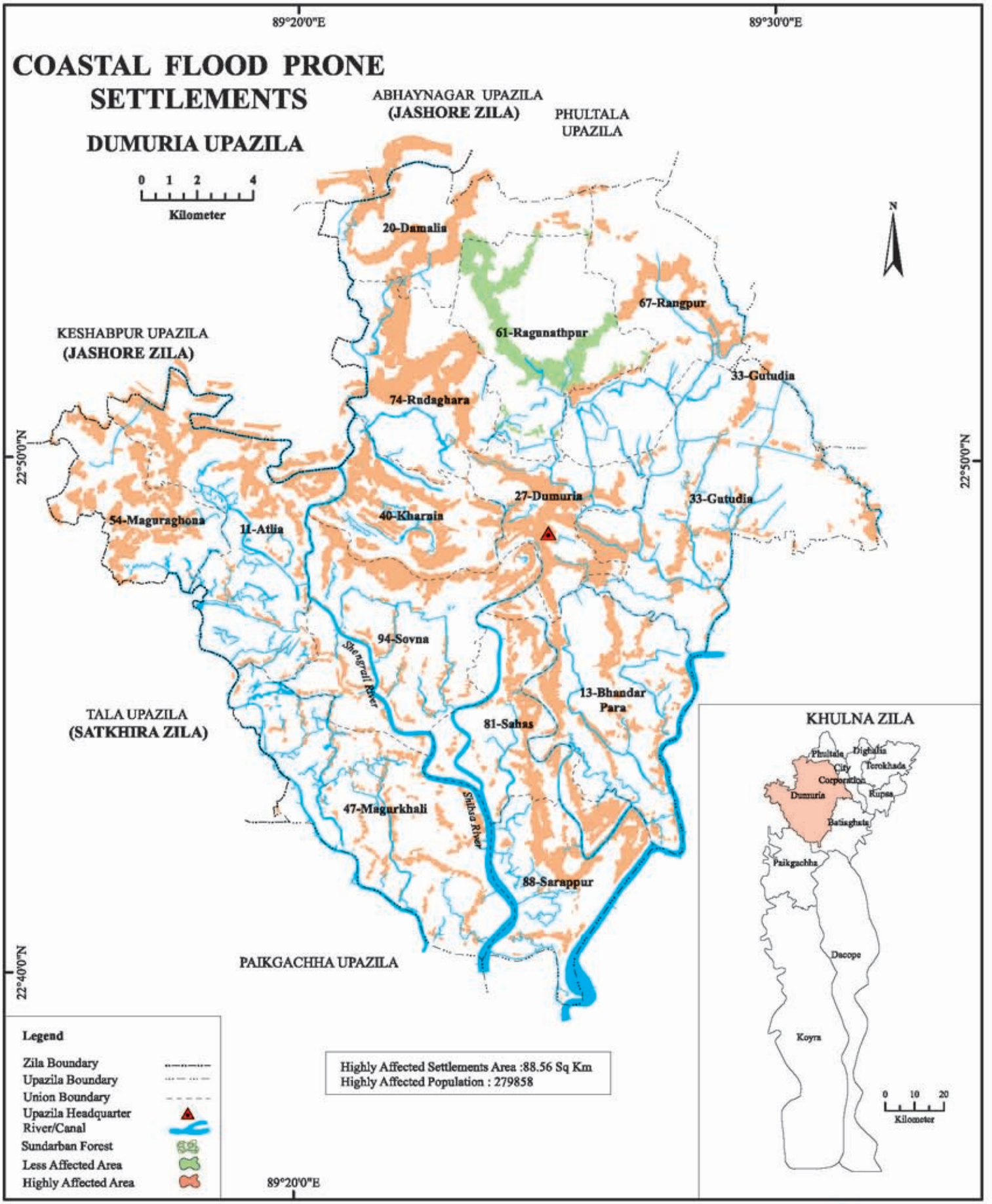

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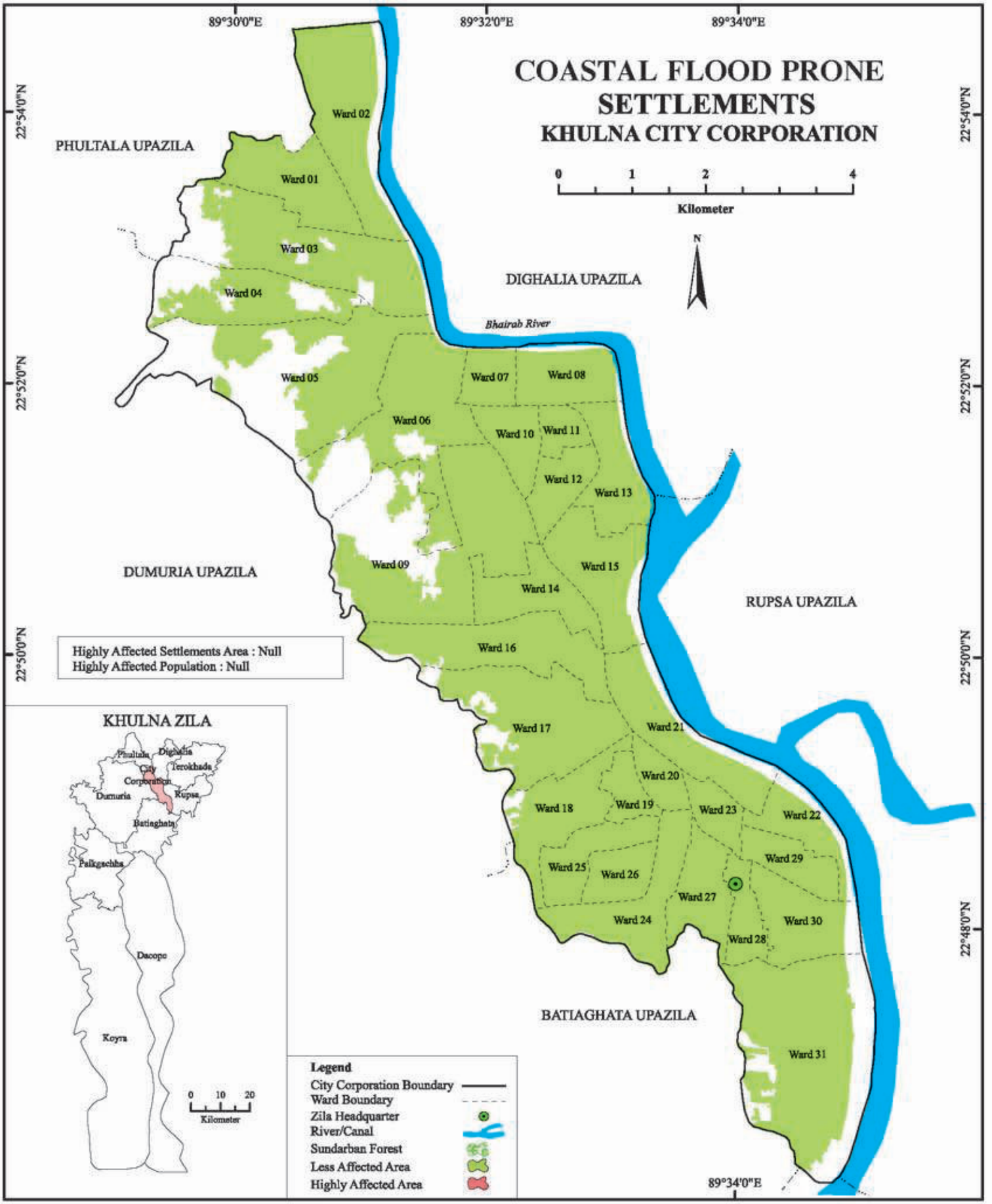

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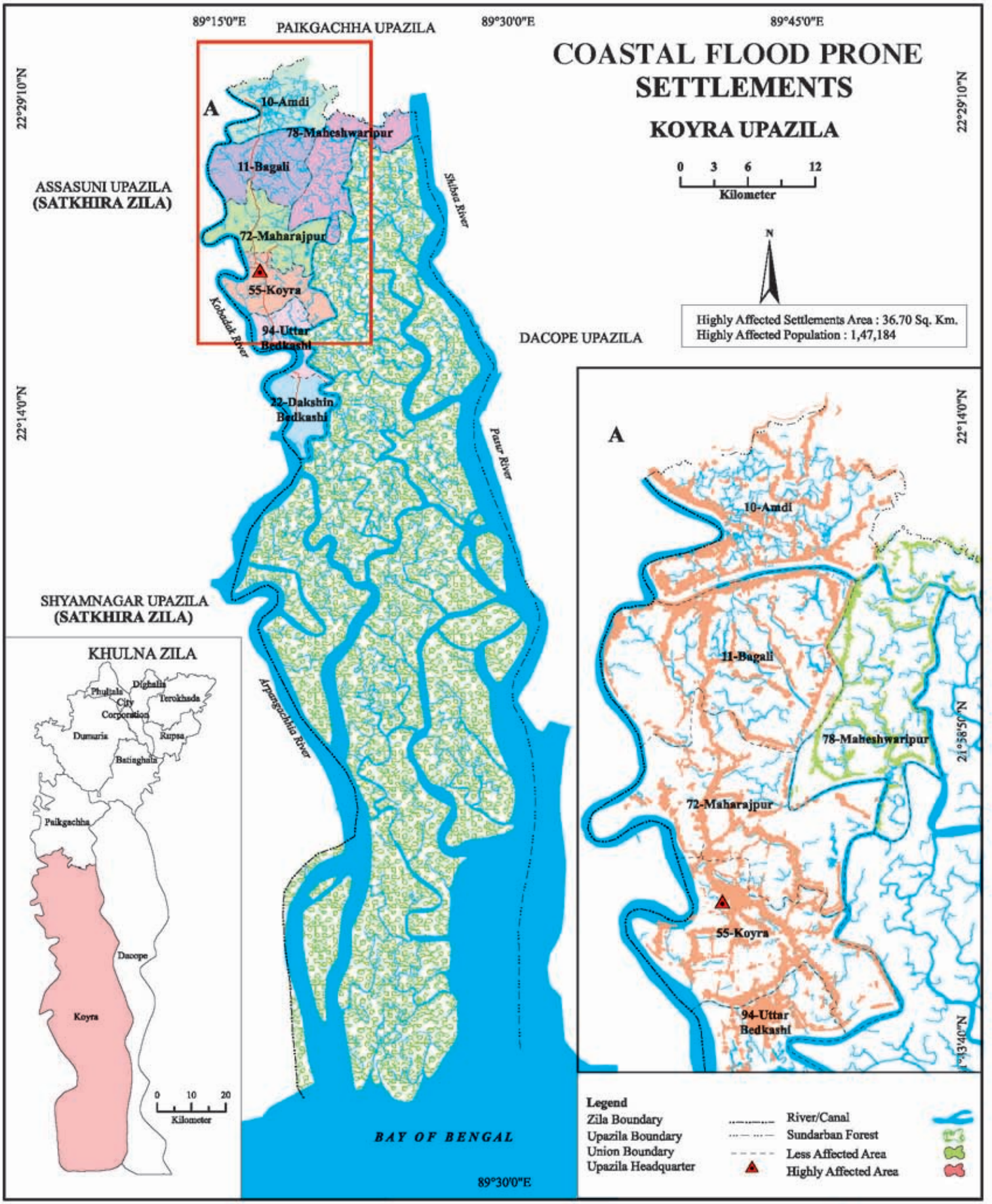

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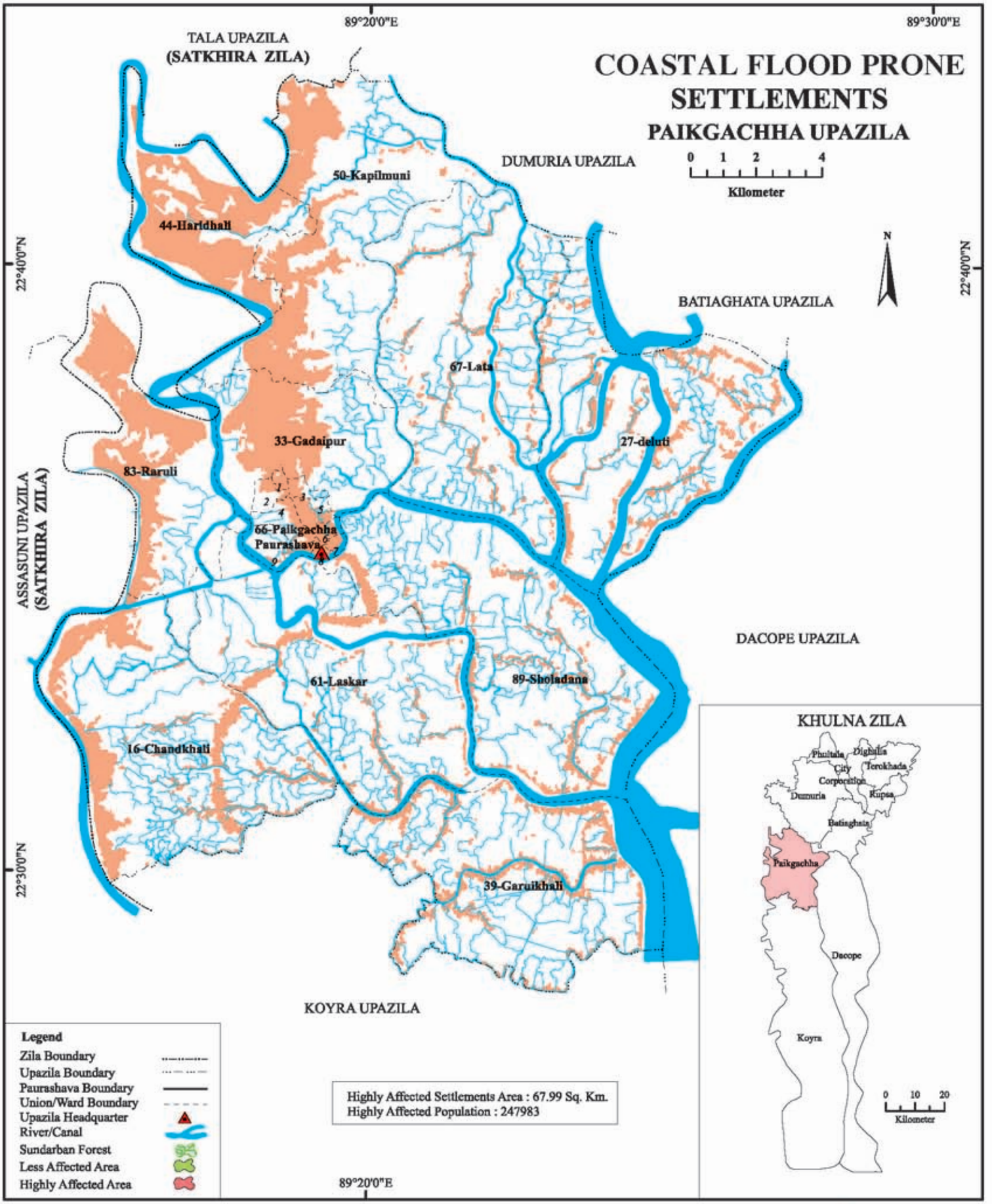
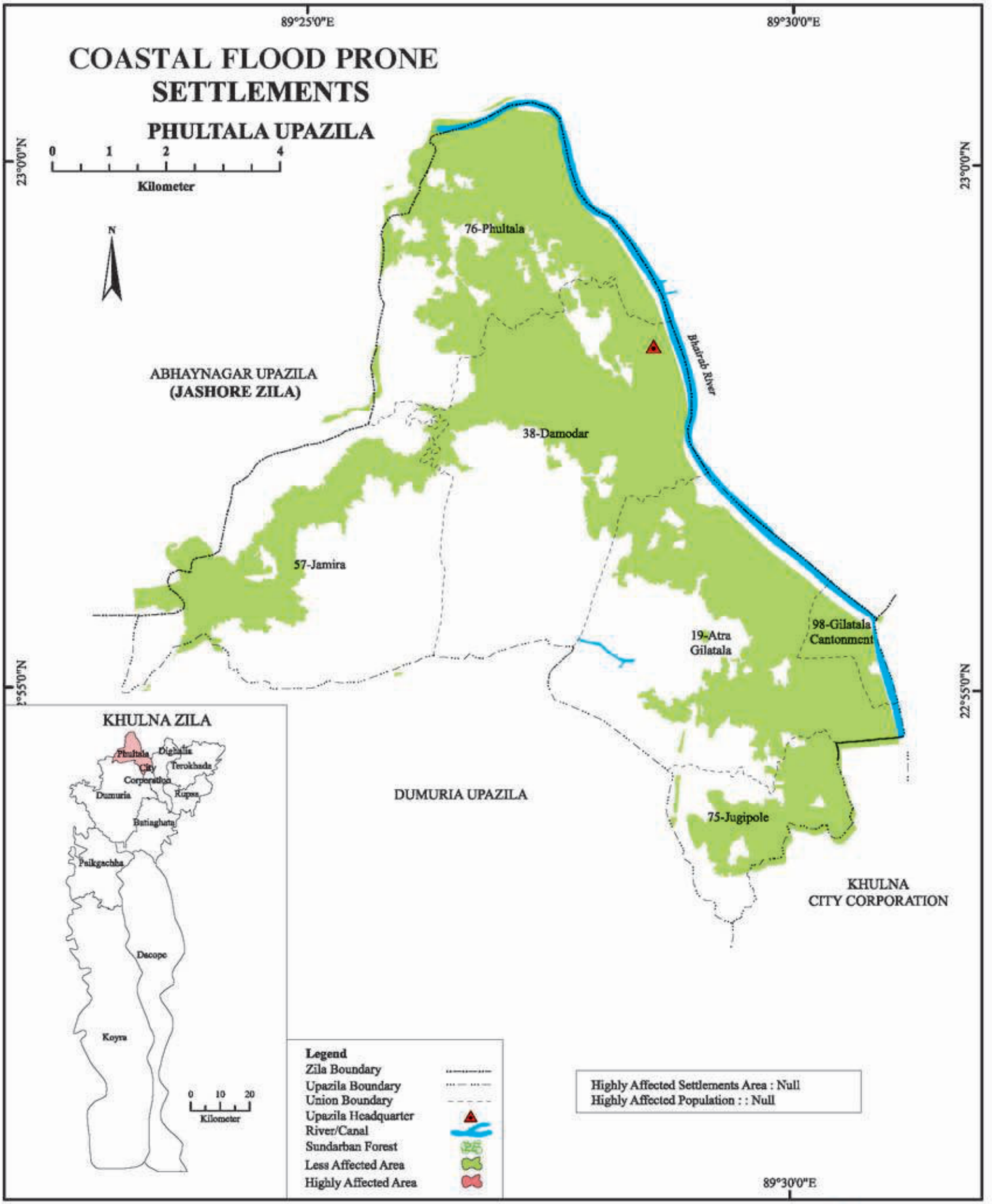

COASTAL FLOOD PRONE SETTLEMENTS
PAIKGACHHA UPAZILA
89°20'0"E
89°30'0"E
22°40'0"N
22°30'0"N
TALA UPAZILA
(SATKHIRA ZILA)
DUMURIA UPAZILA
BATIAGHATA UPAZILA
DACOPE UPAZILA
KOYRA UPAZILA
ASSASUNI UPAZILA
(SATKHIRA ZILA)
0 1 2 4
Kilometer
N
50-Kapilmuni
44-Haridhali
67-Lata
33-Gadaipur
27-deluti
83-Raruli
66-Paikgachha Paurashava
61-Laskar
89-Sholadana
16-Chandkhali
39-Garuikhali
KHULNA ZILA
Phultala
Digholia
City
Terokhada
Corporation
Dumuria
Rupsa
Batiaghata
Paikgachha
Dacope
Koyra
0 10 20
Kilometer
Legend
Zila Boundary
Upazila Boundary
Paurashava Boundary
Union/Ward Boundary
Upazila Headquarter
River/Canal
Sundarban Forest
Less Affected Area
Highly Affected Area
Highly Affected Settlements Area : 67.99 Sq. Km.
Highly Affected Population : 247983



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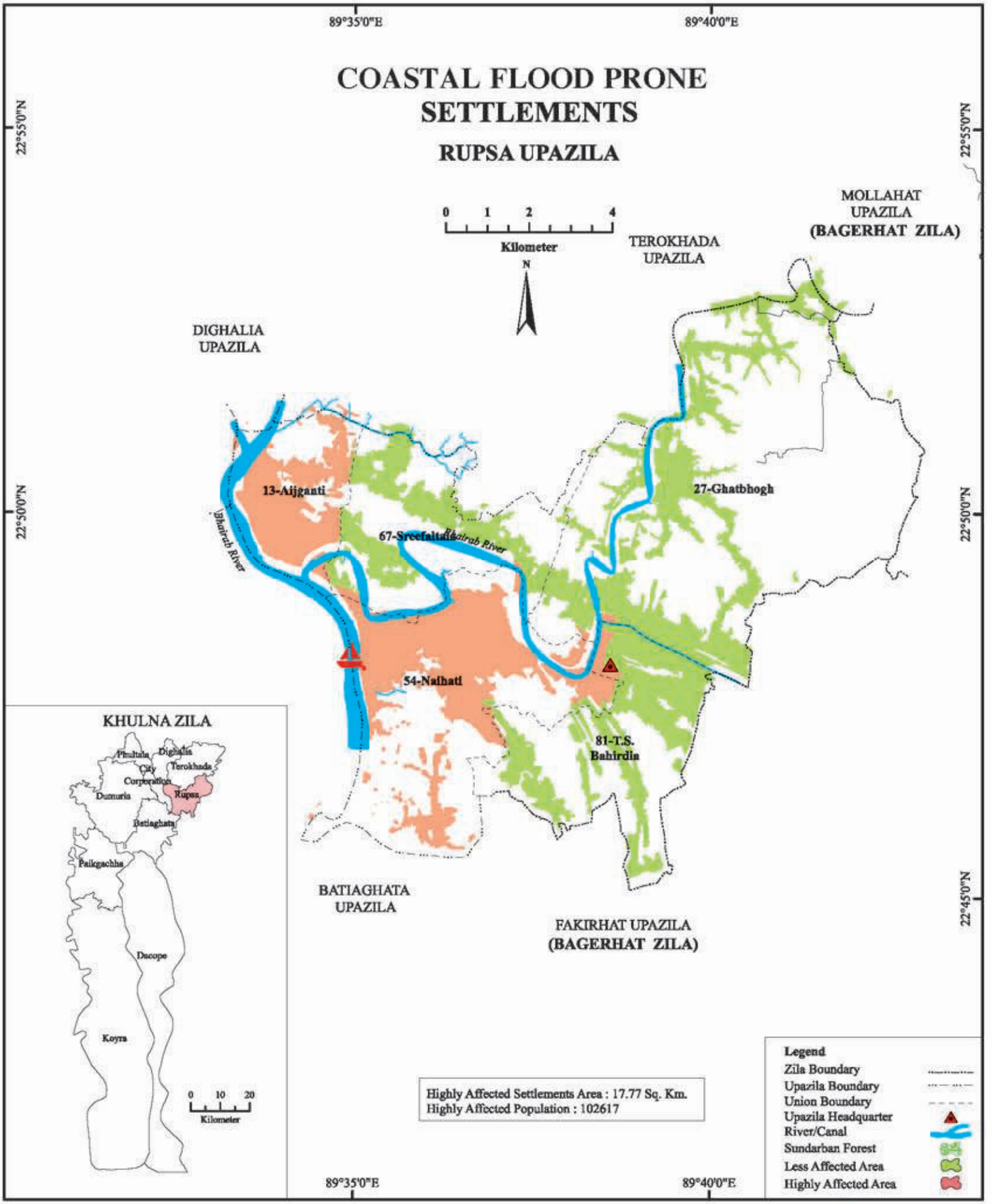

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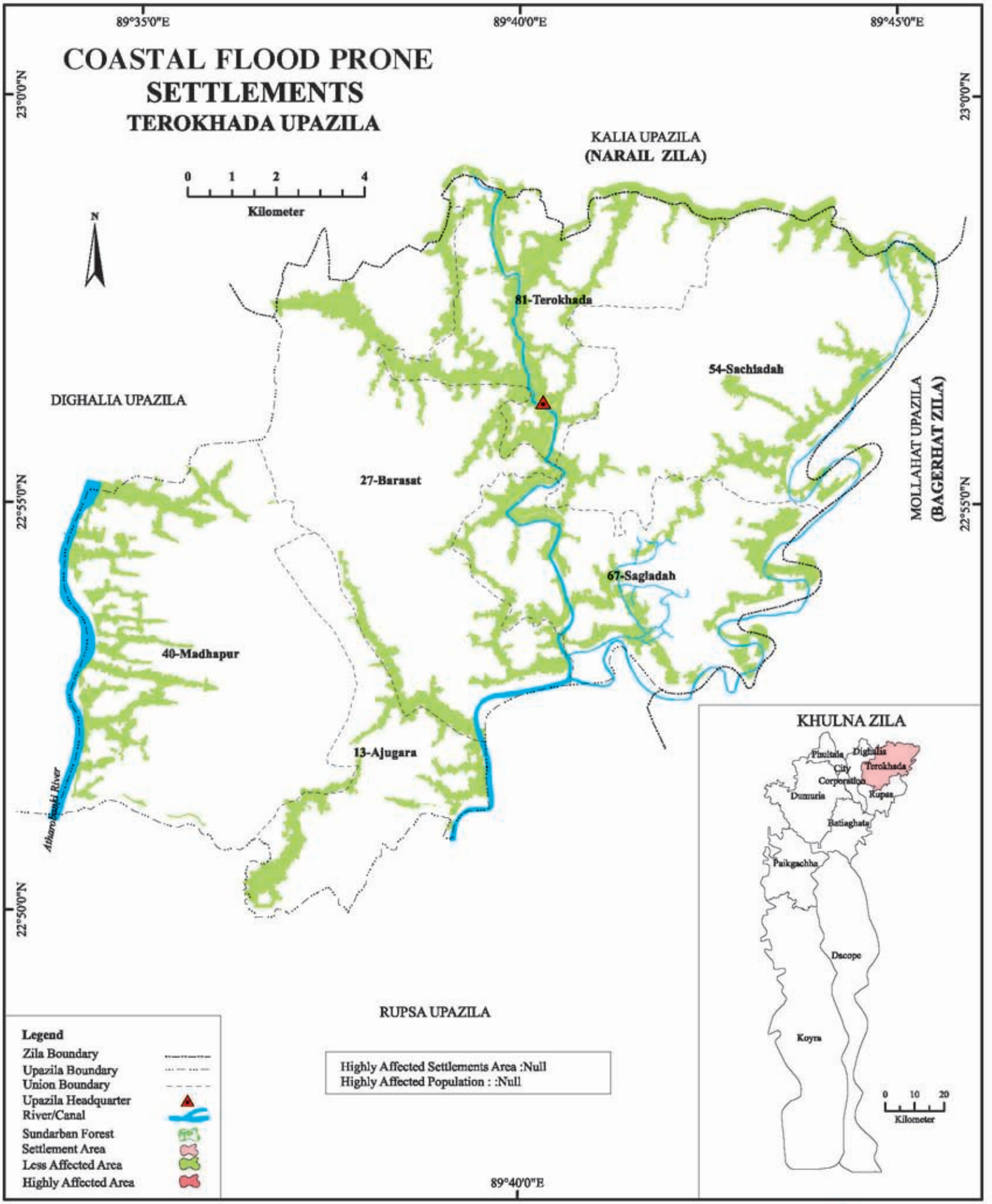

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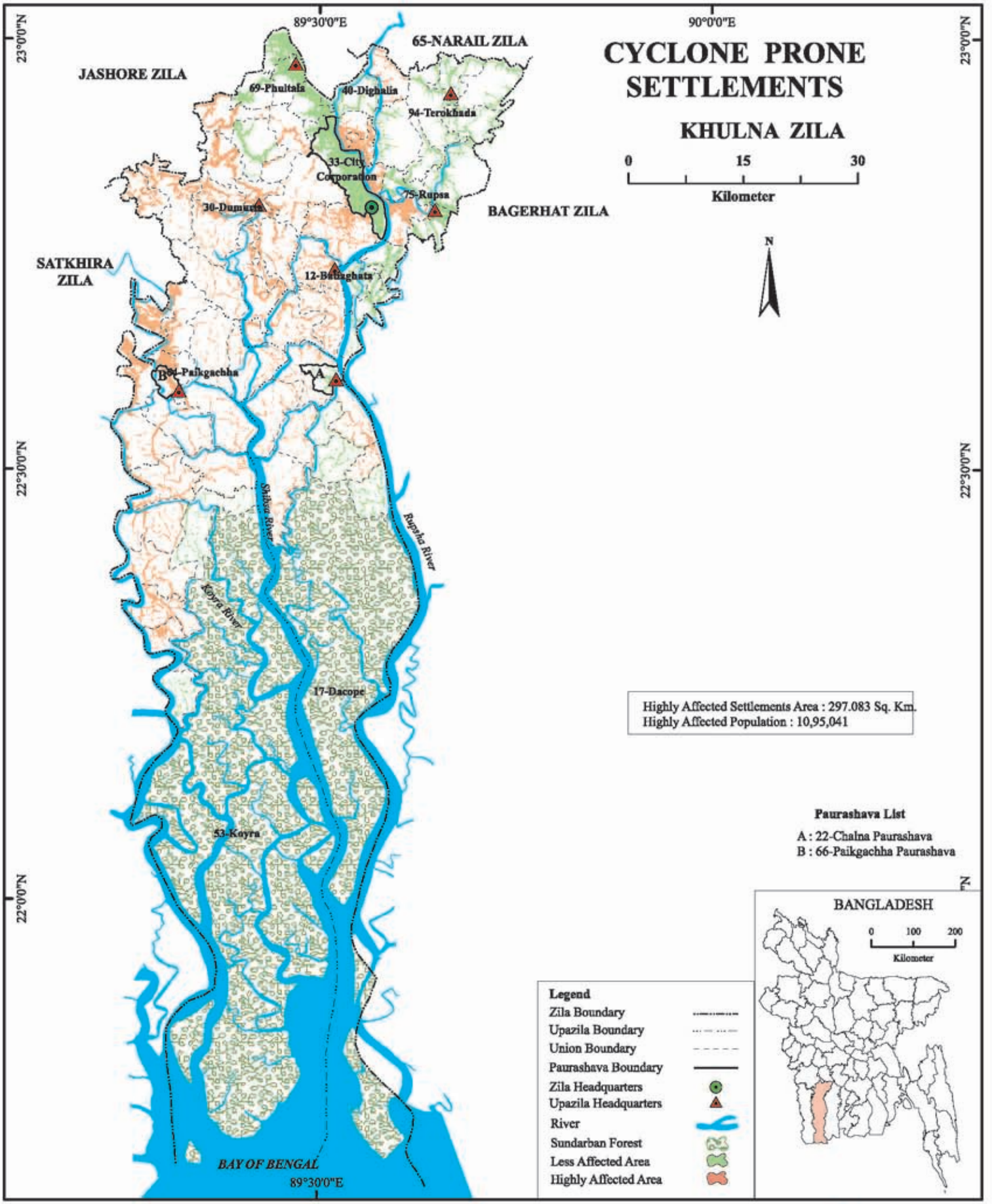
Cyclone Prone Area Map



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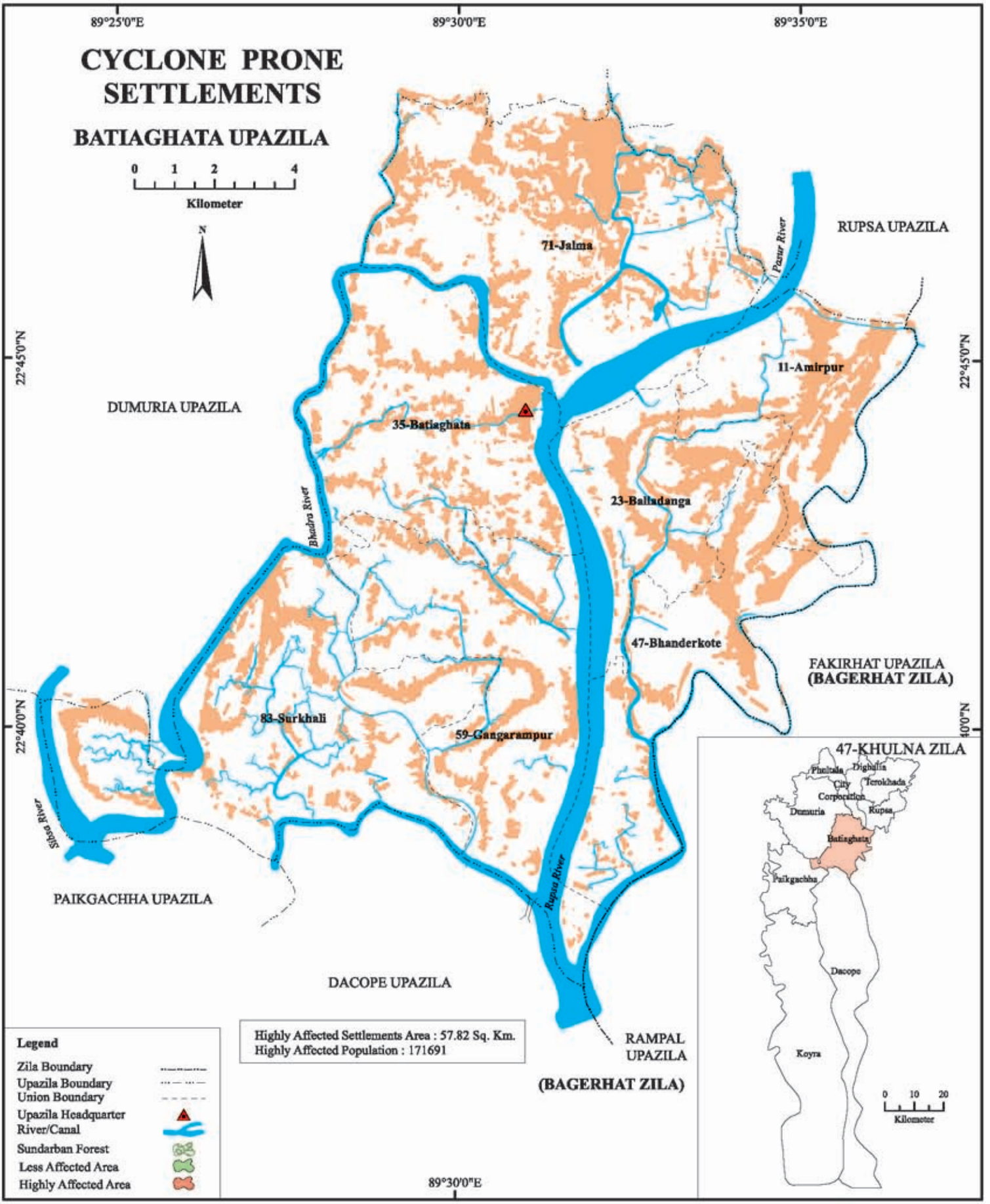

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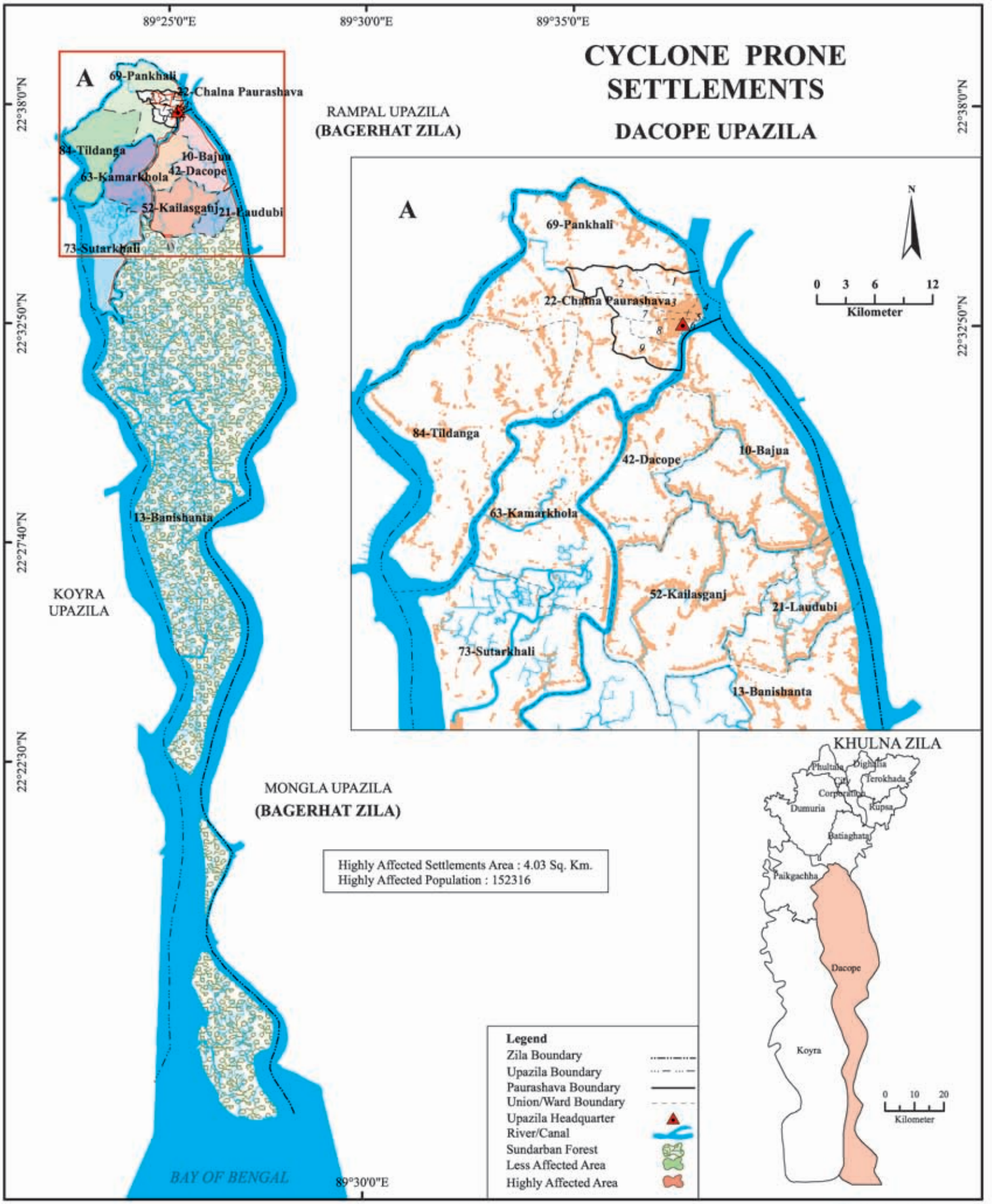

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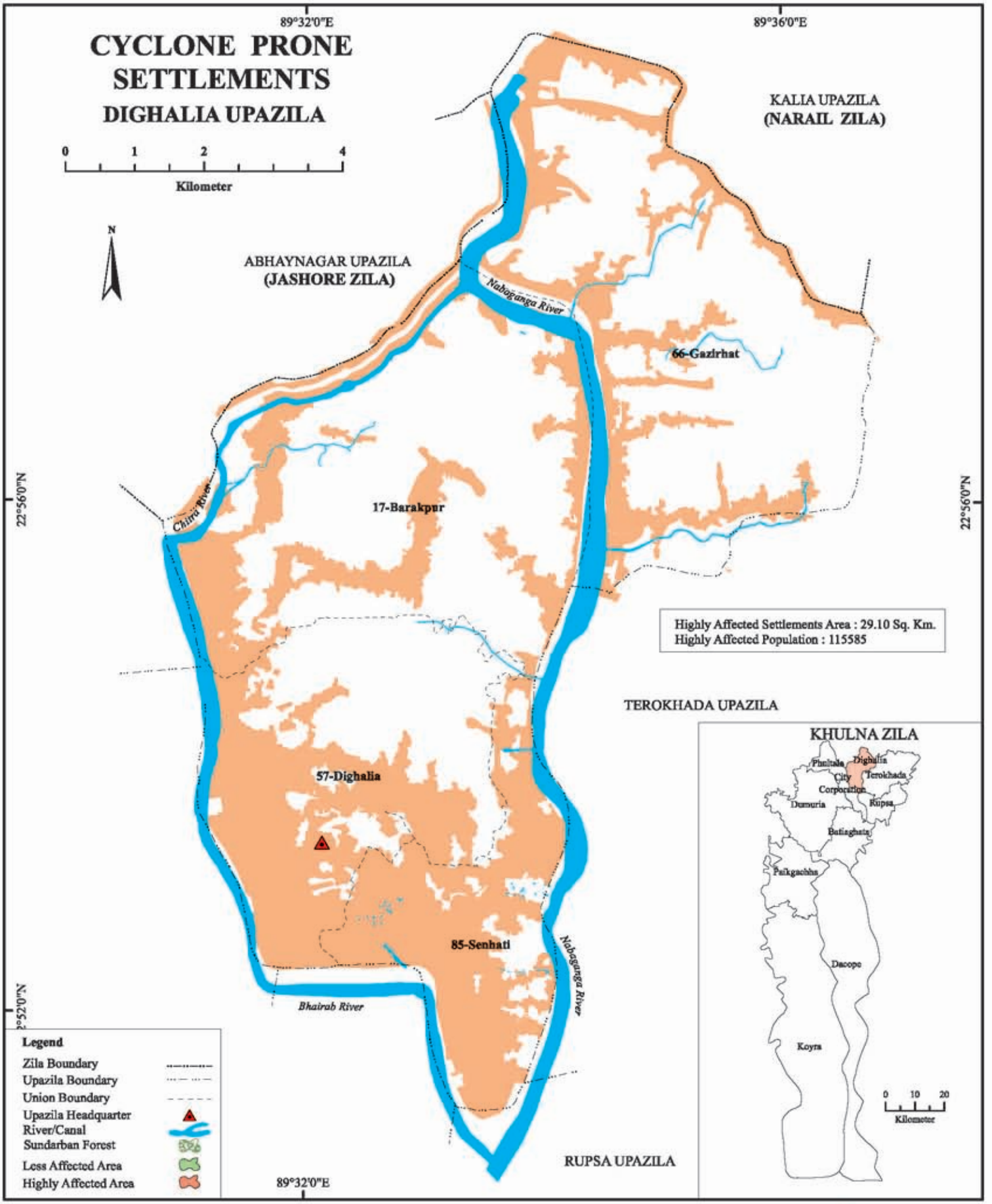

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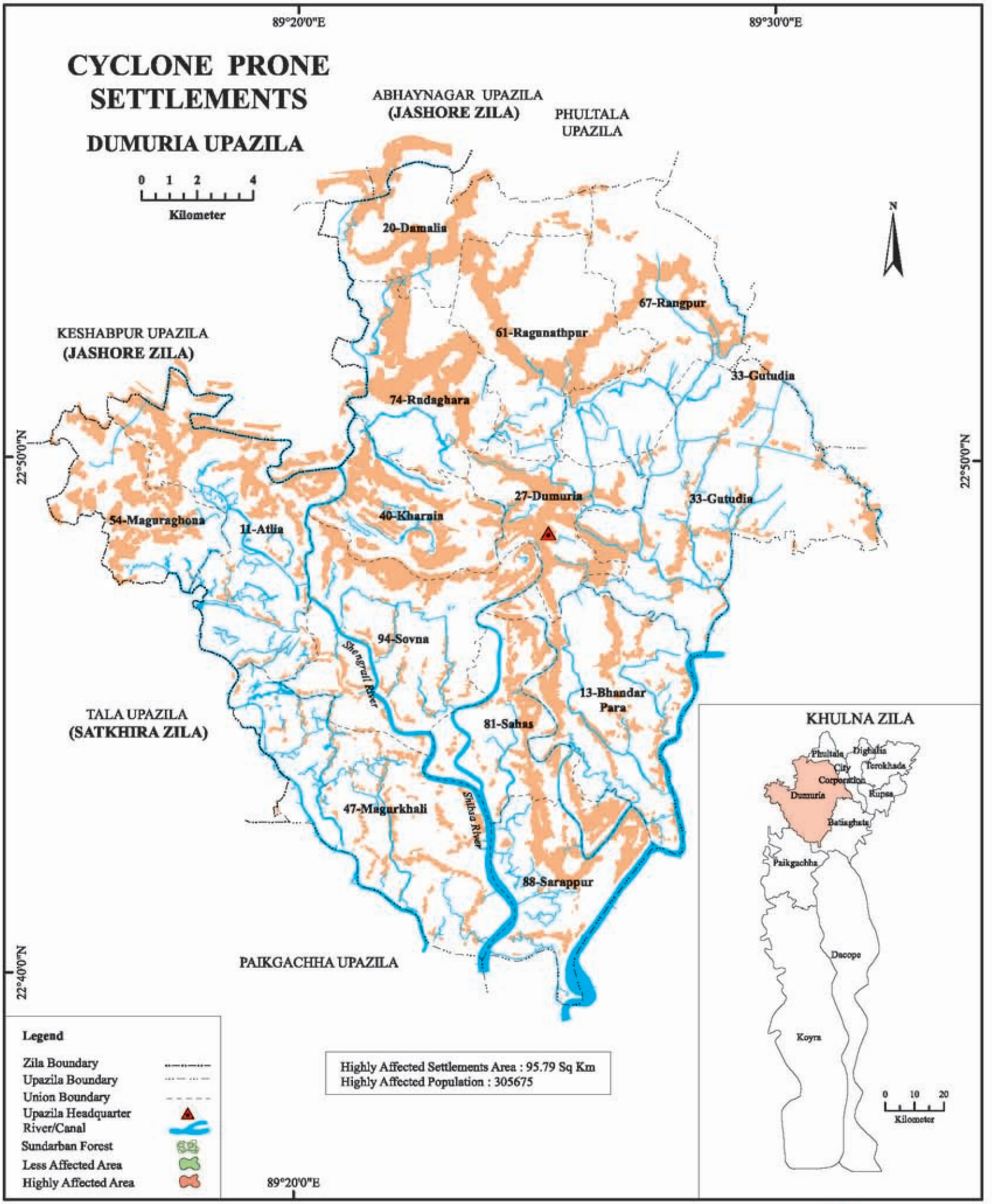

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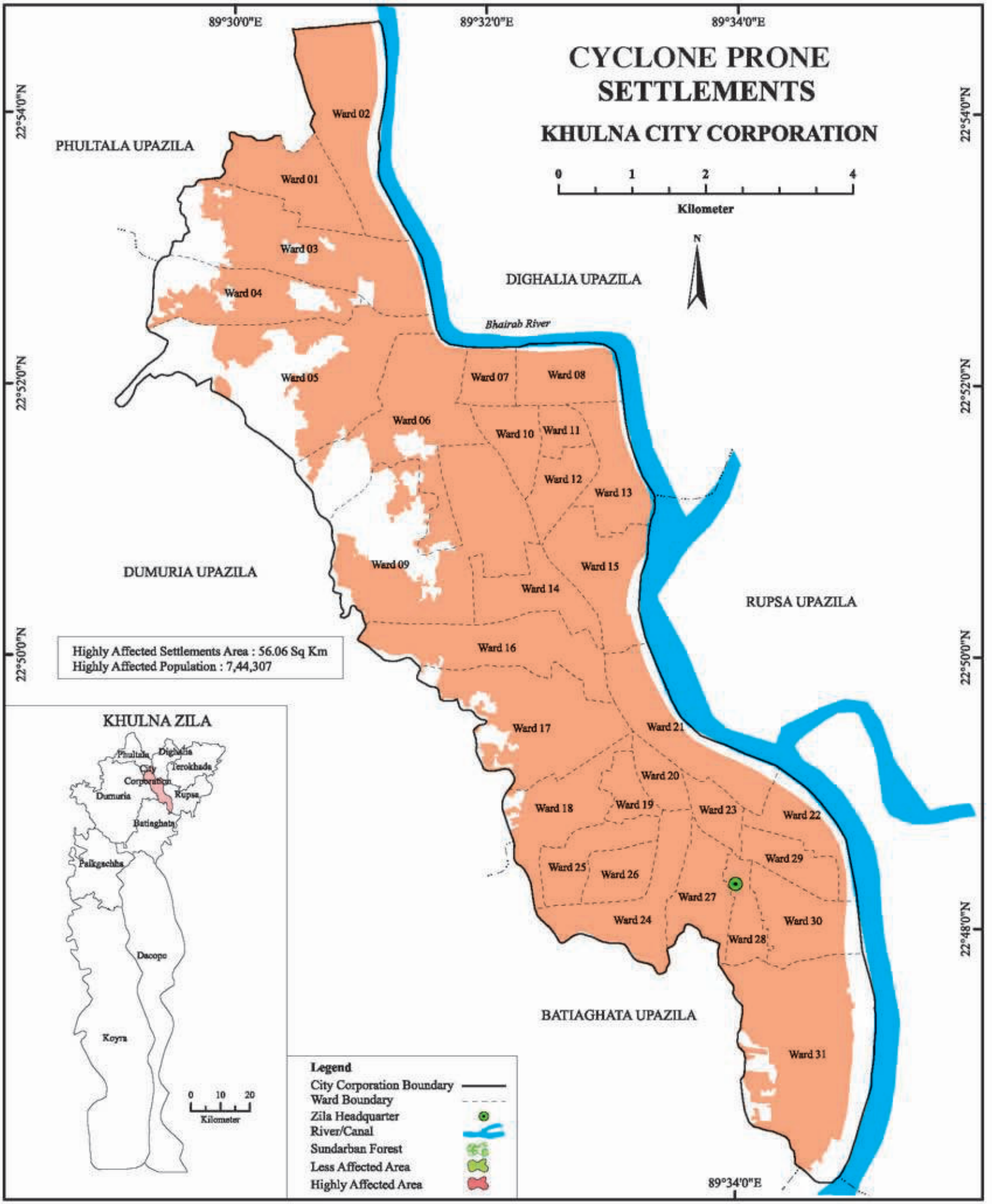

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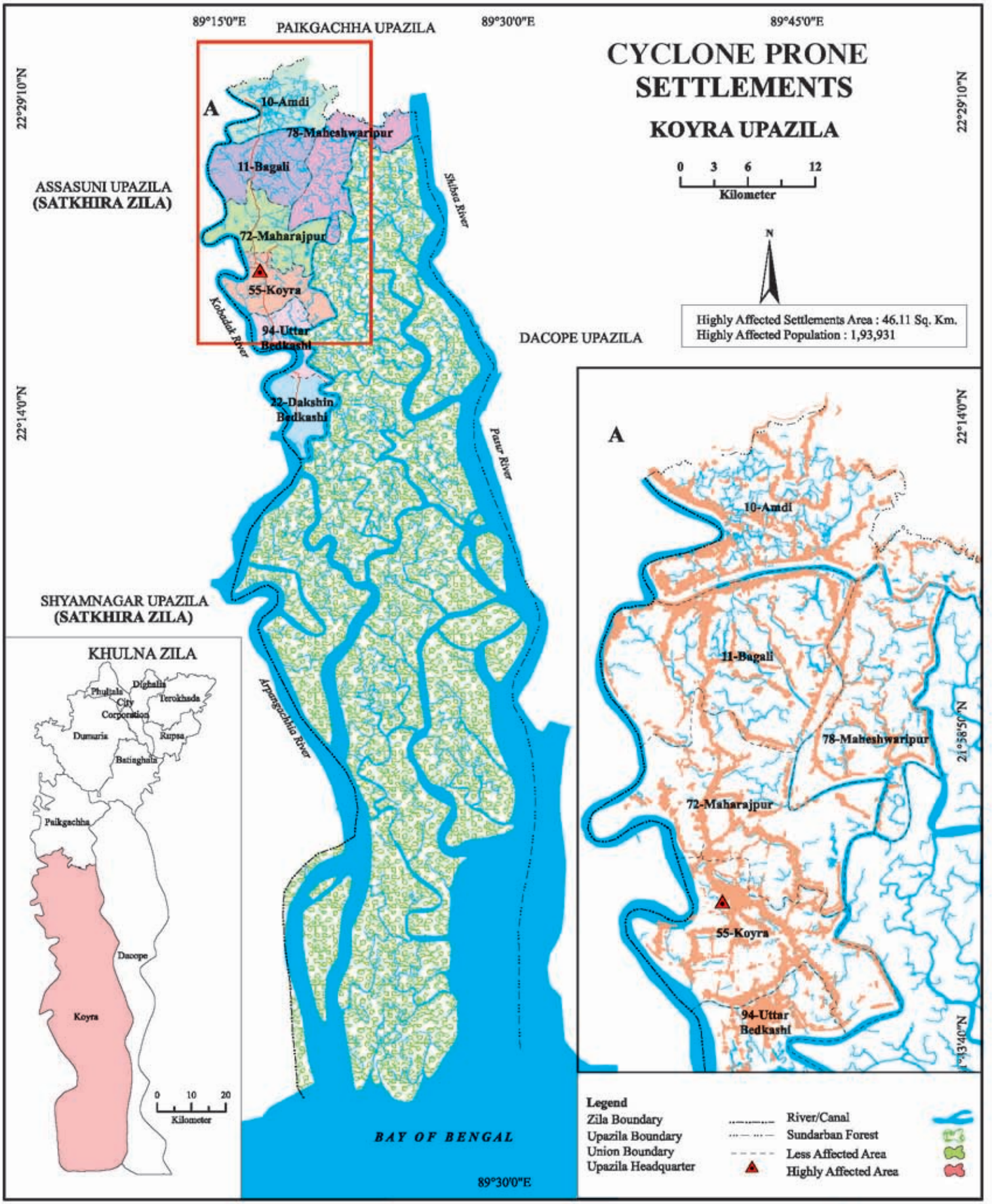

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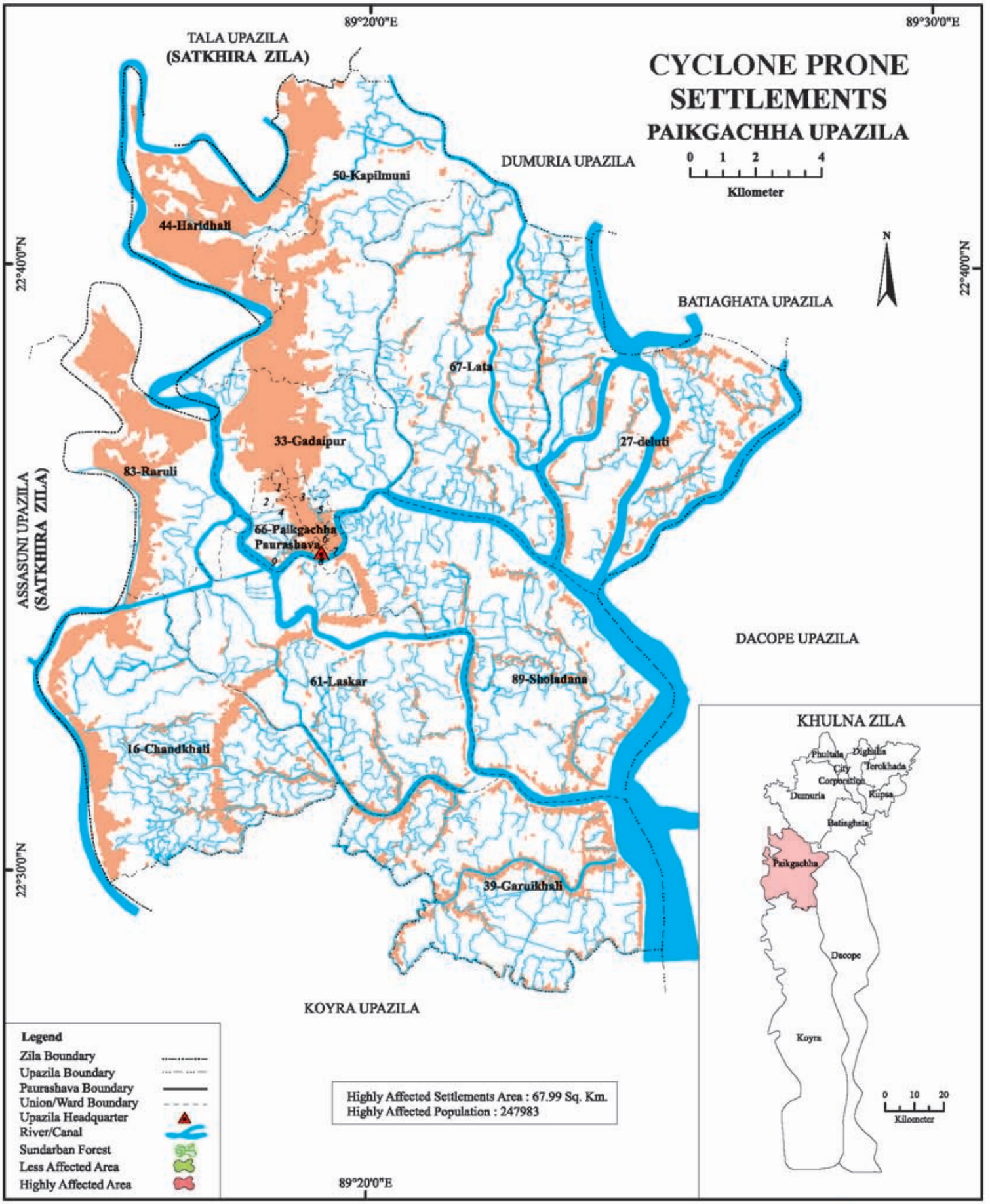
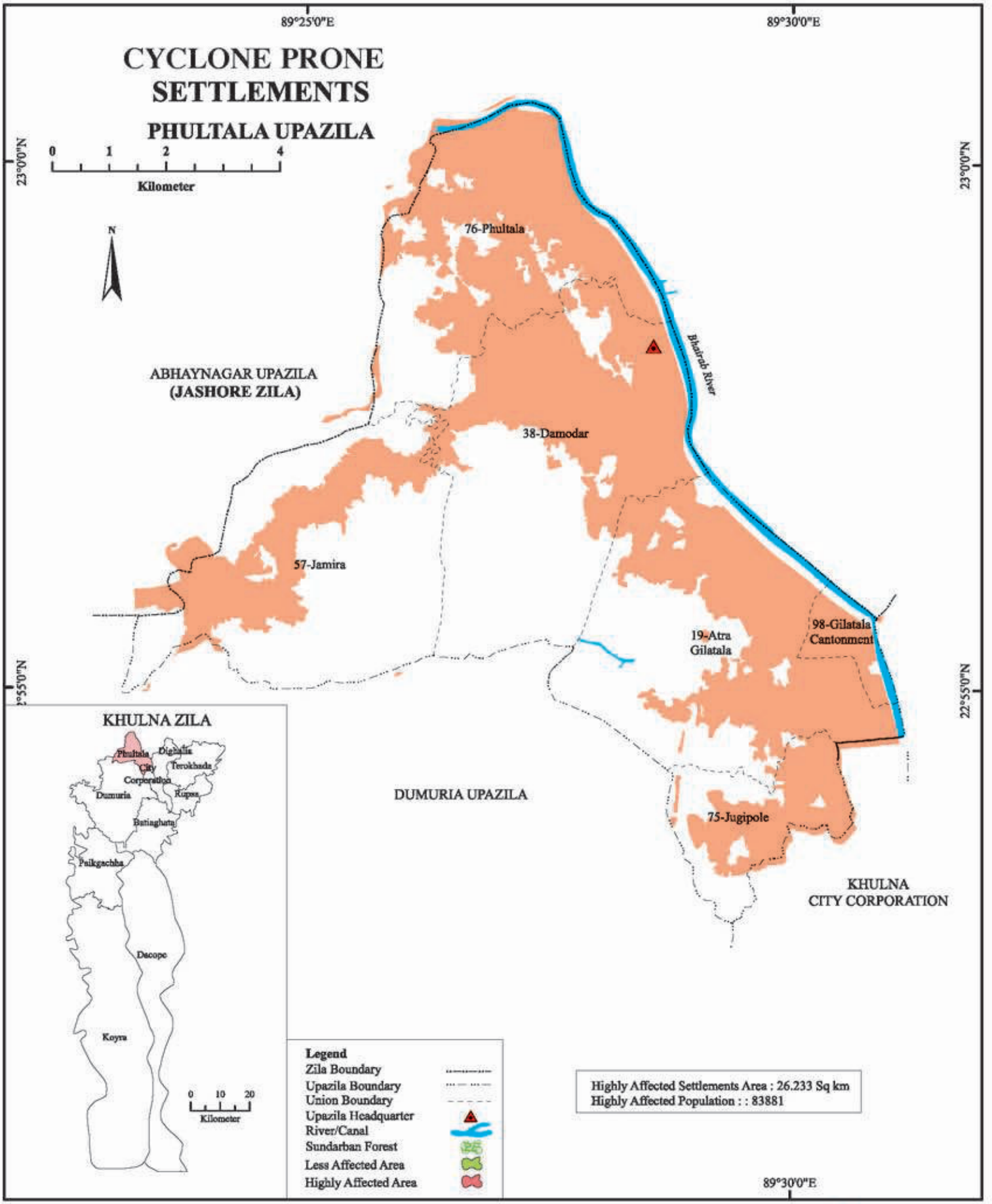

CYCLONE PRONE SETTLEMENTS
PAIKGACHHA UPAZILA
0 1 2 4
Kilometer
N
89°20'0"E
89°30'0"E
22°40'0"N
22°30'0"N
TALA UPAZILA
(SATKHIRA ZILA)
DUMURIA UPAZILA
BATIAGHATA UPAZILA
DACOPE UPAZILA
KOYRA UPAZILA
ASSASUNI UPAZILA
(SATKHIRA ZILA)
50-Kapilmuni
44-Haridhali
67-Lata
33-Gadaipur
27-deluti
83-Raruli
66-Paikgachha Paurashava
61-Laskar
89-Sholadana
16-Chandkhali
39-Garuikhali
KHULNA ZILA
Phultala
Digholia
City
Terokhada
Corporation
Dumuria
Rupsa
Batiaghata
Paikgachha
Dacope
Koyra
0 10 20
Kilometer
Legend
Zila Boundary
Upazila Boundary
Paurashava Boundary
Union/Ward Boundary
Upazila Headquarter
River/Canal
Sundarban Forest
Less Affected Area
Highly Affected Area
Highly Affected Settlements Area : 67.99 Sq. Km.
Highly Affected Population : 247983



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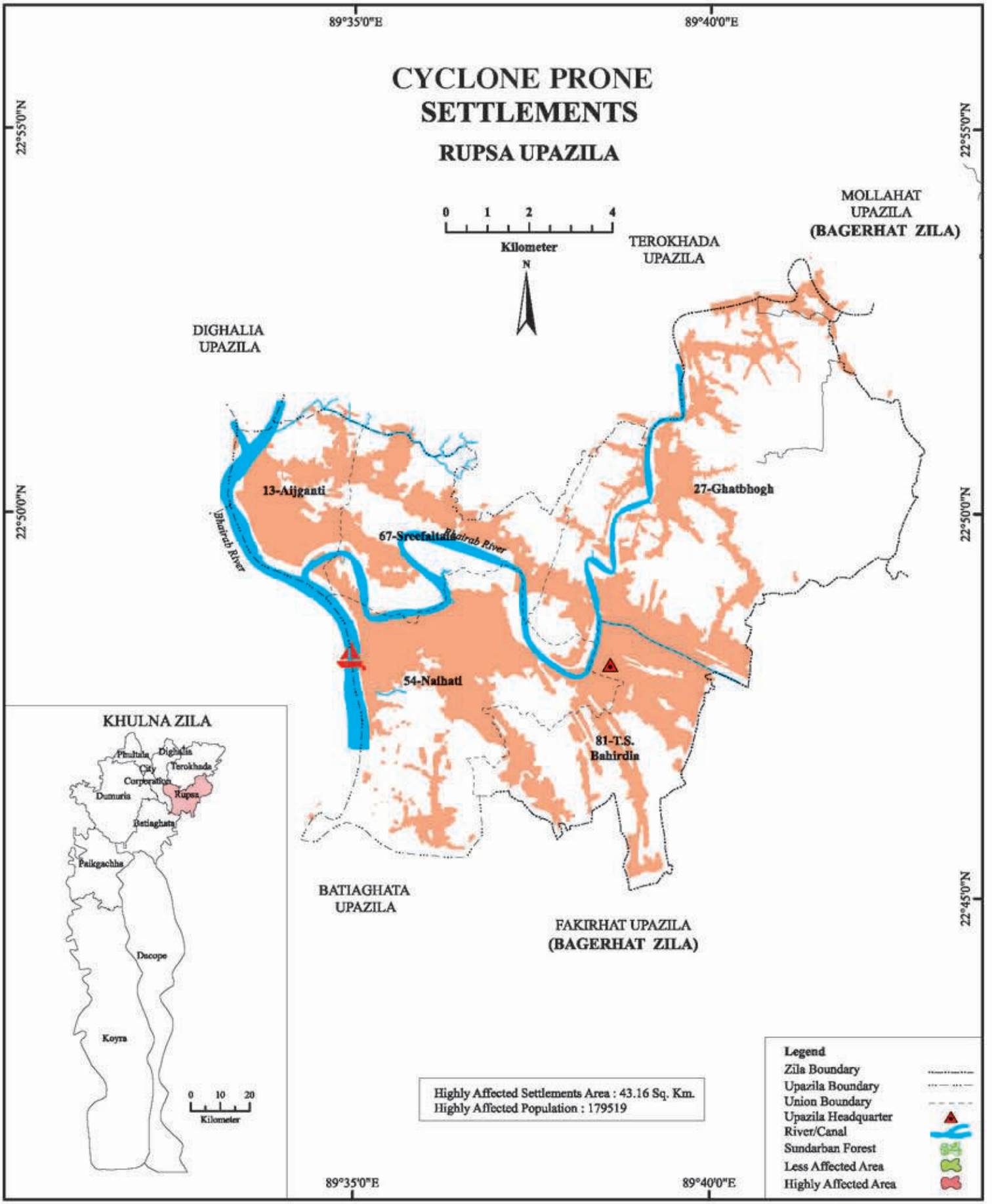

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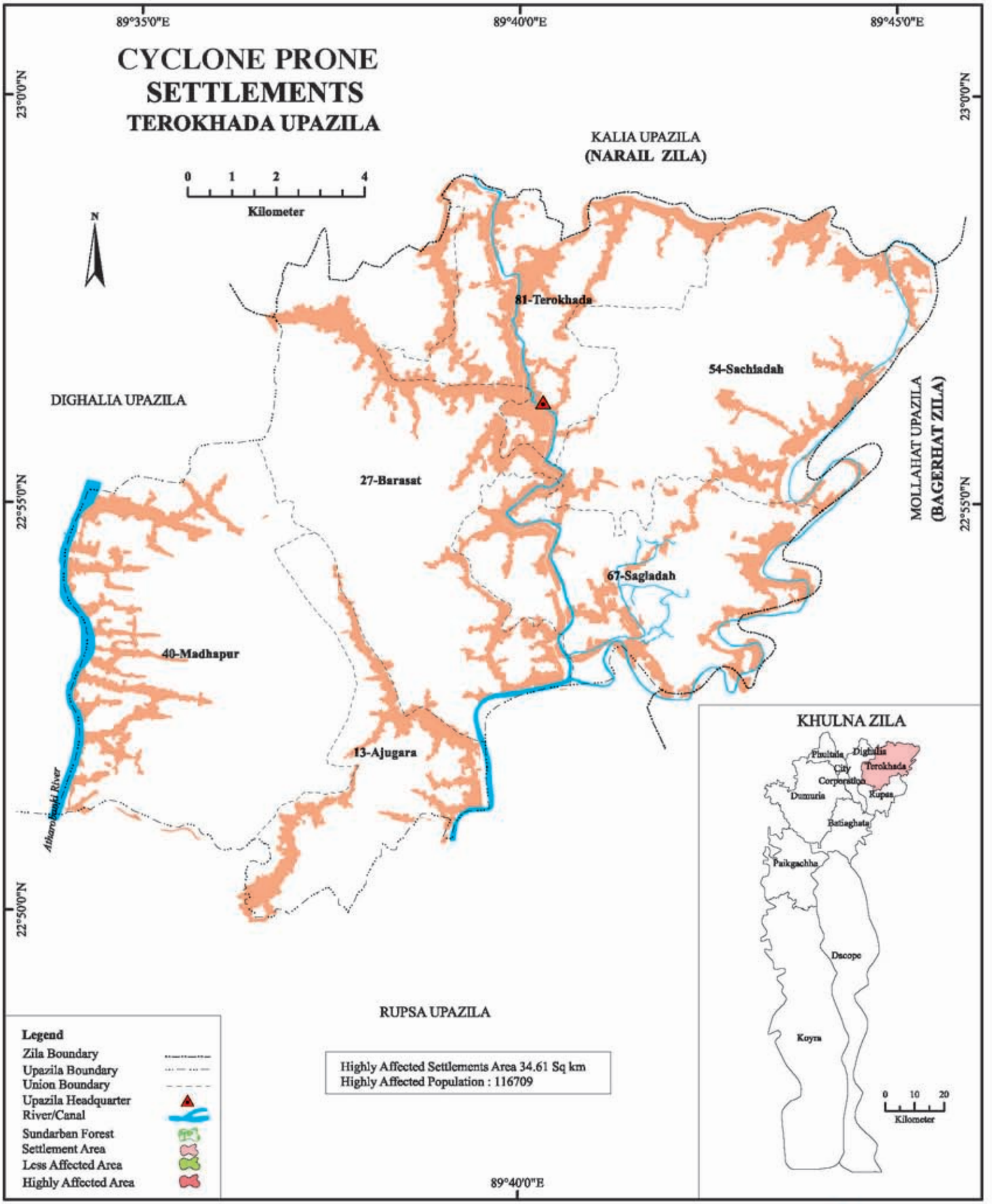
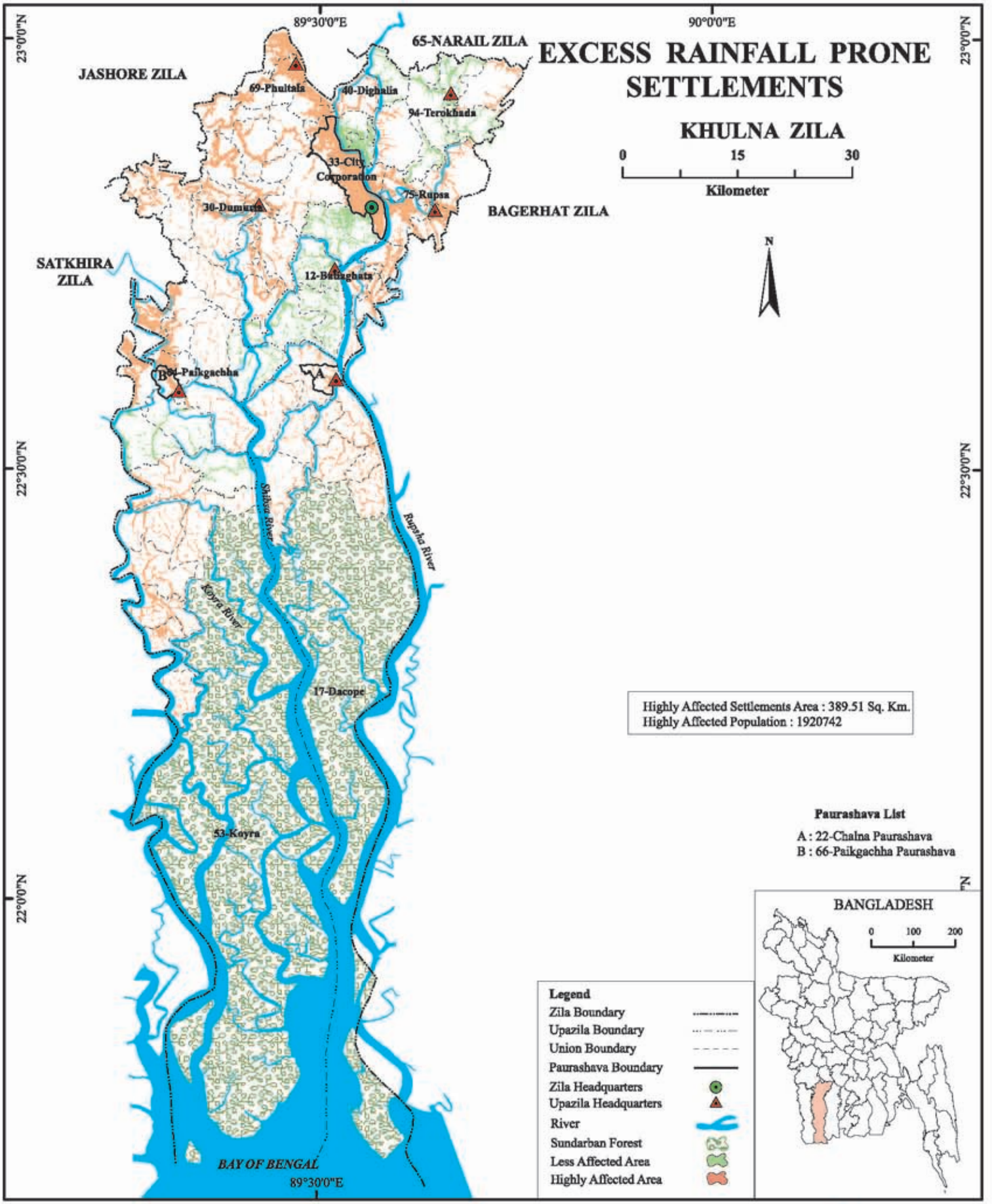


Stat4Dev Project, 2021

Excess Rainfall Prone Area Map



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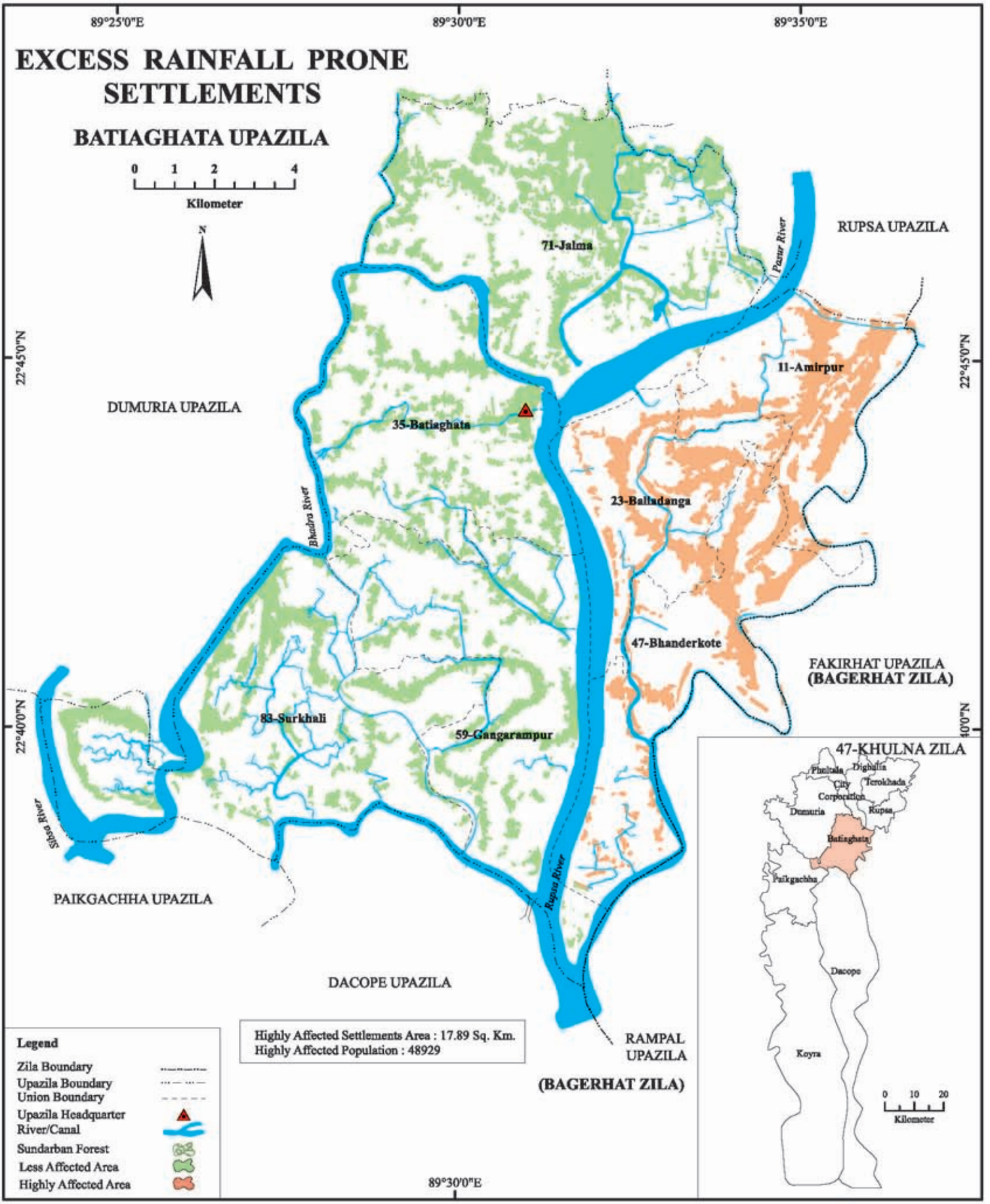

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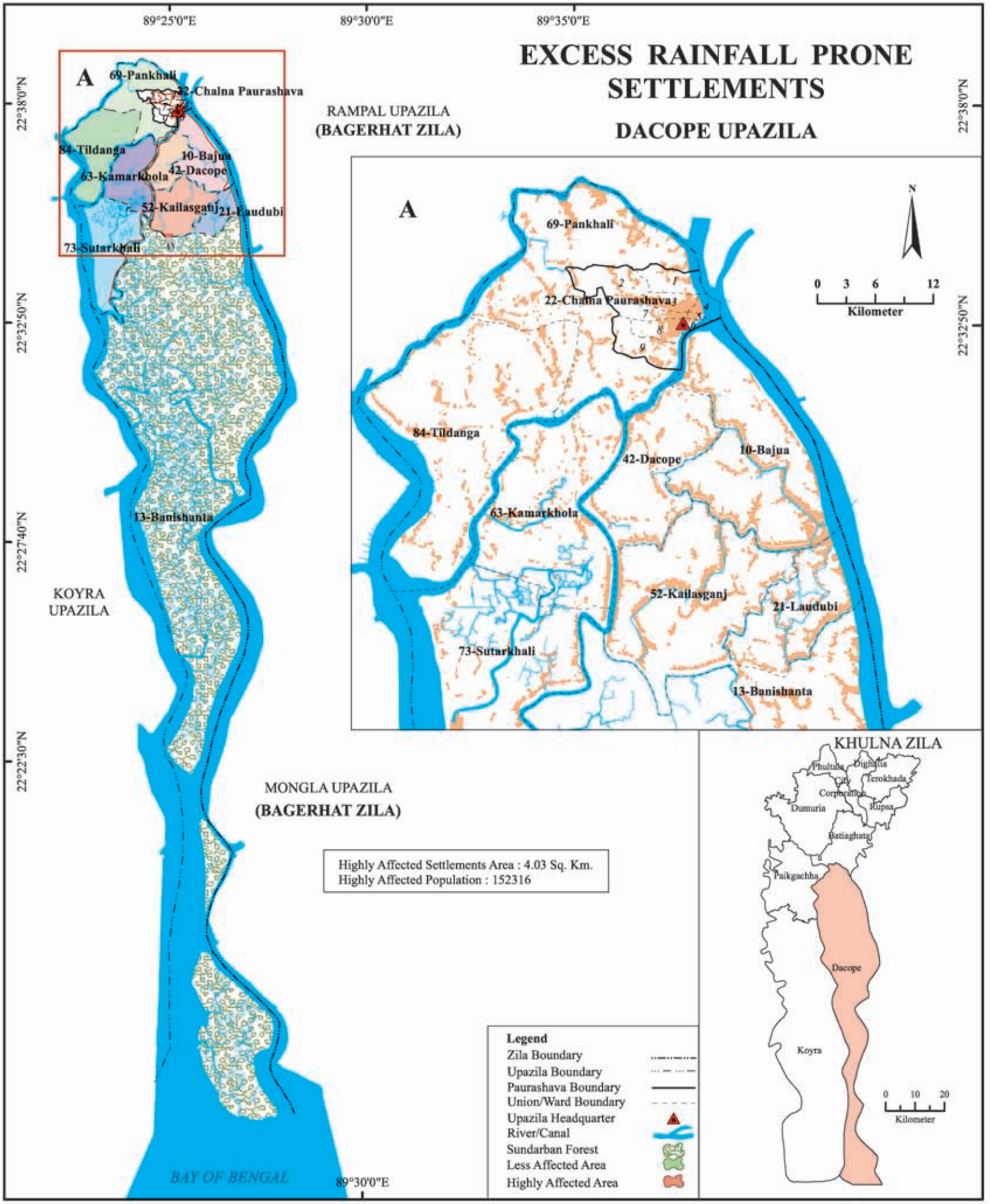

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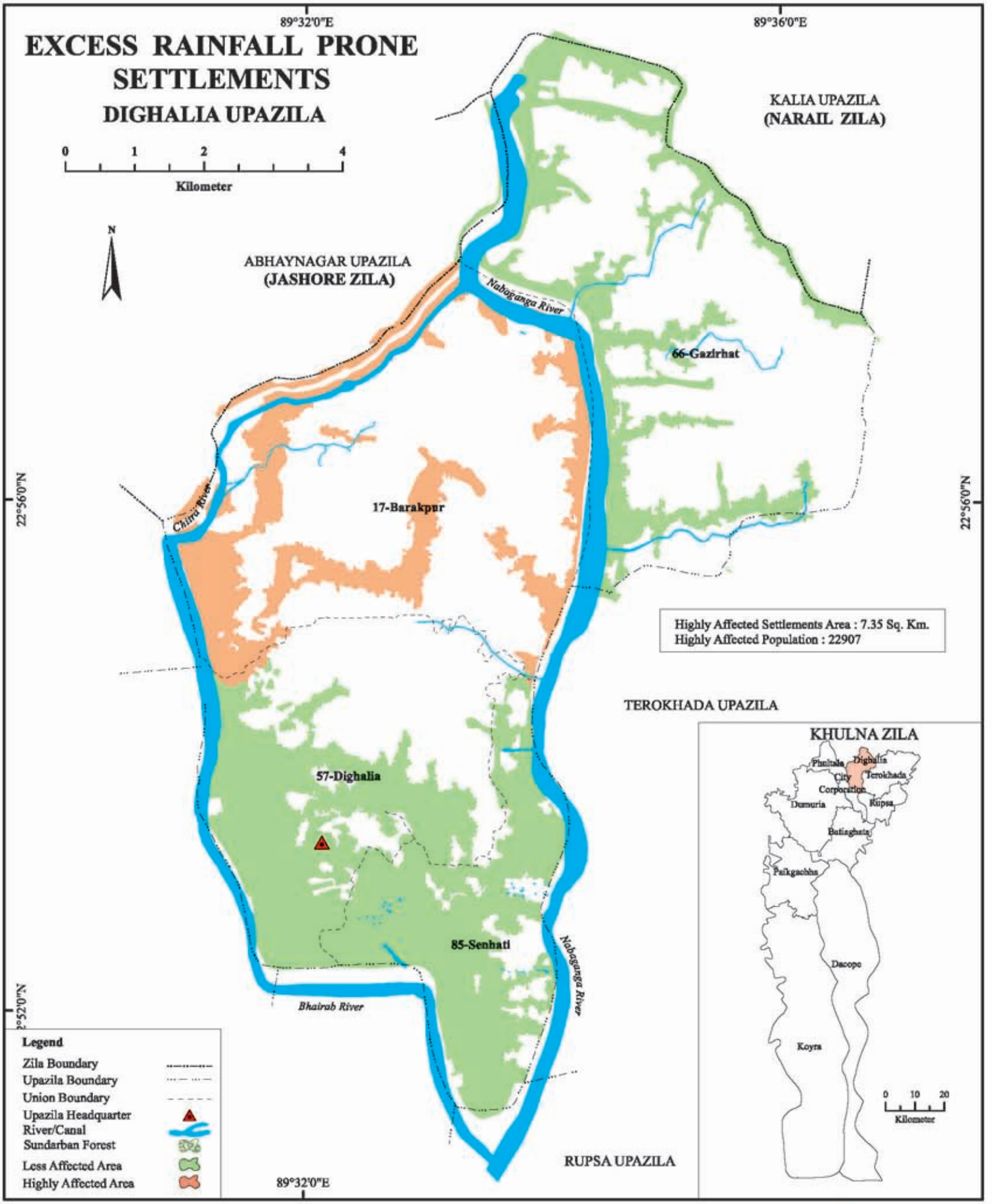

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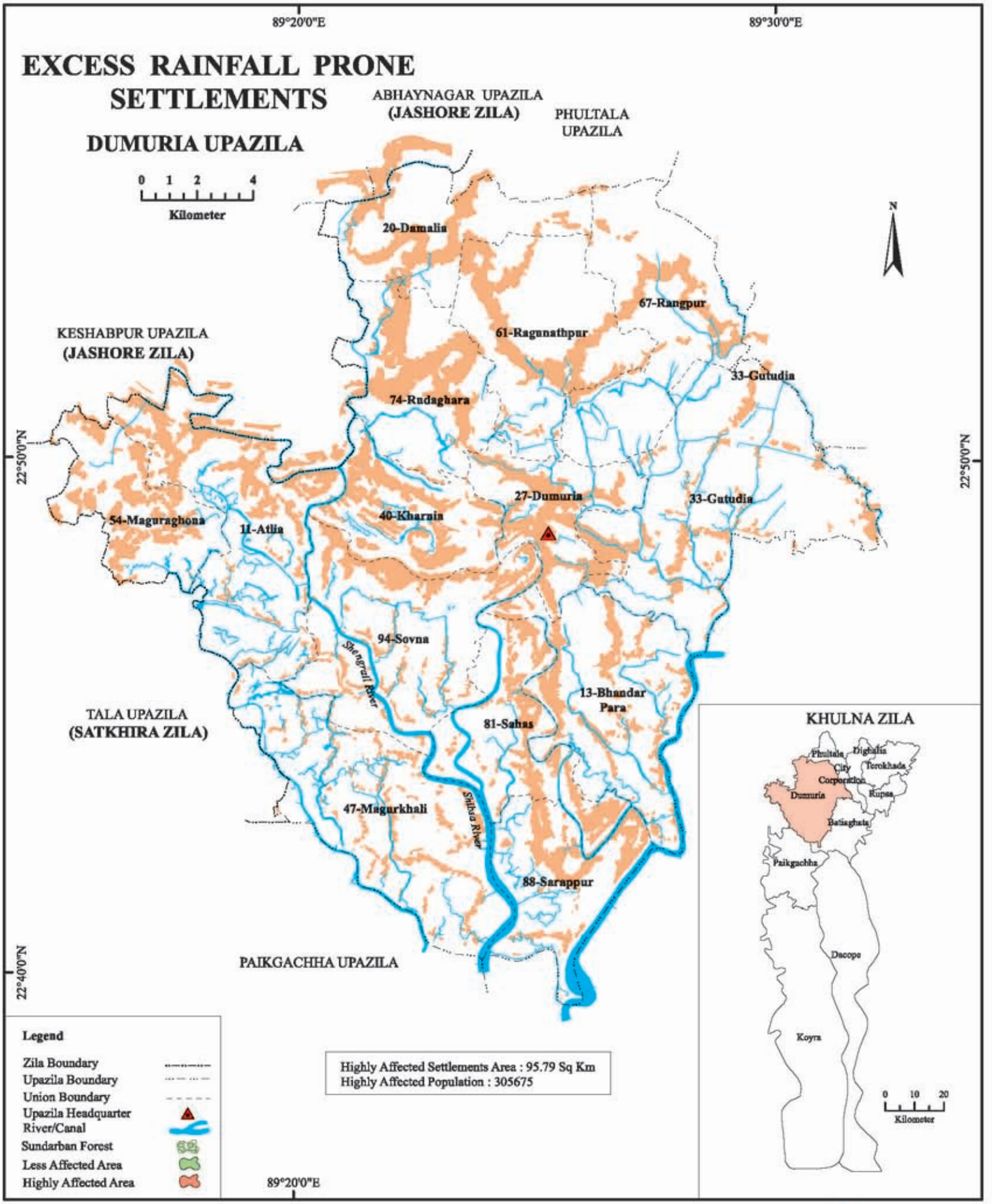

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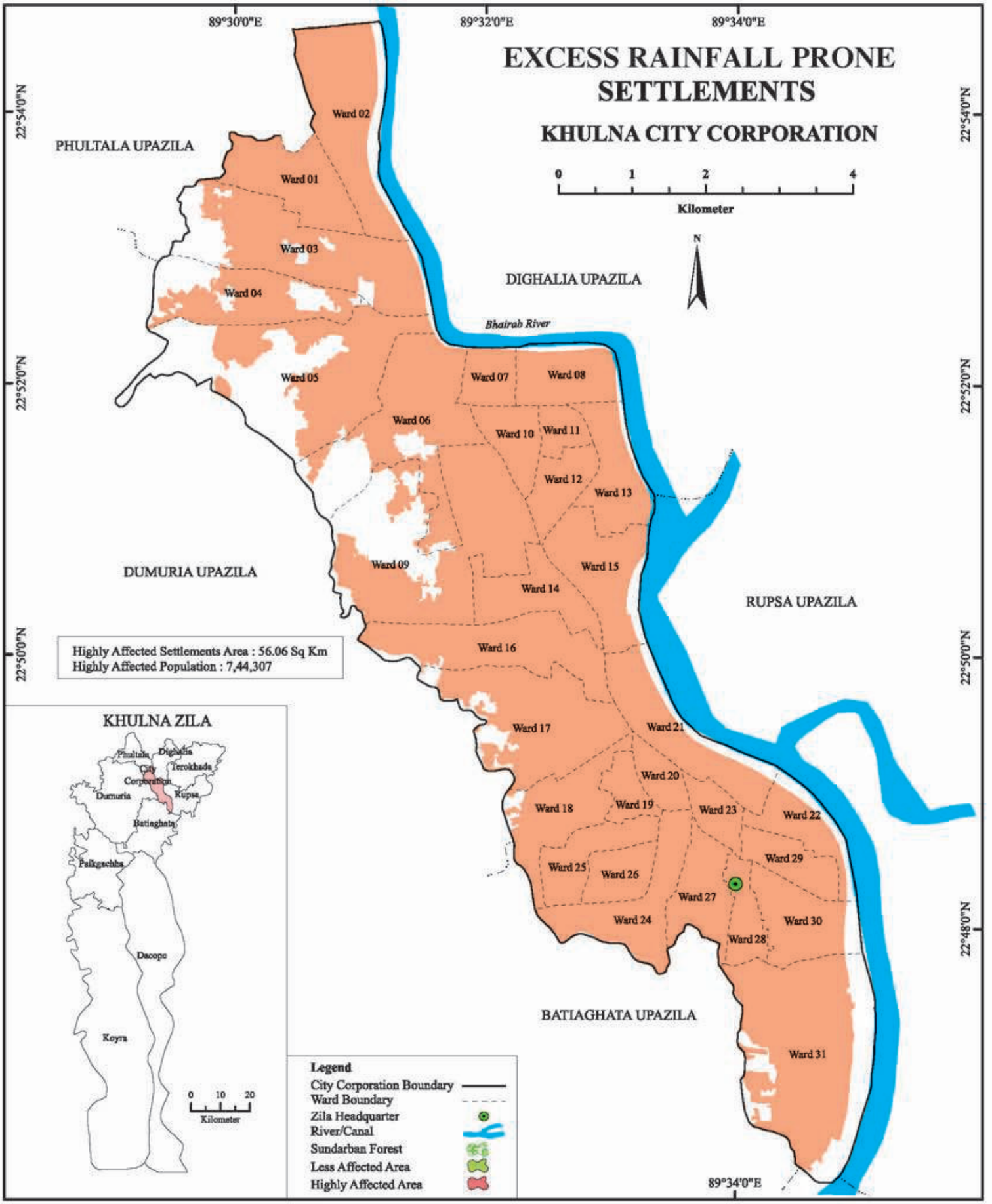

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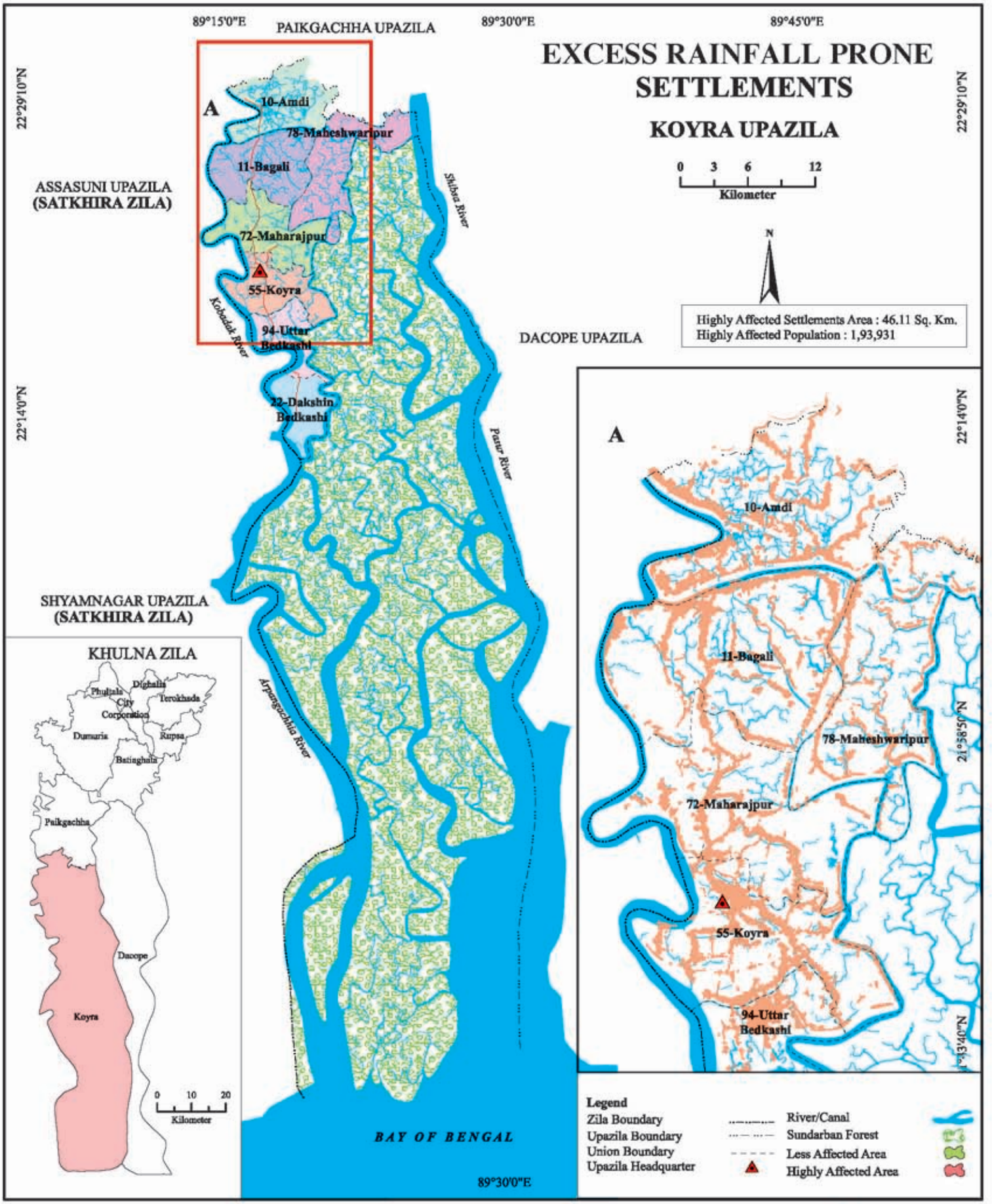

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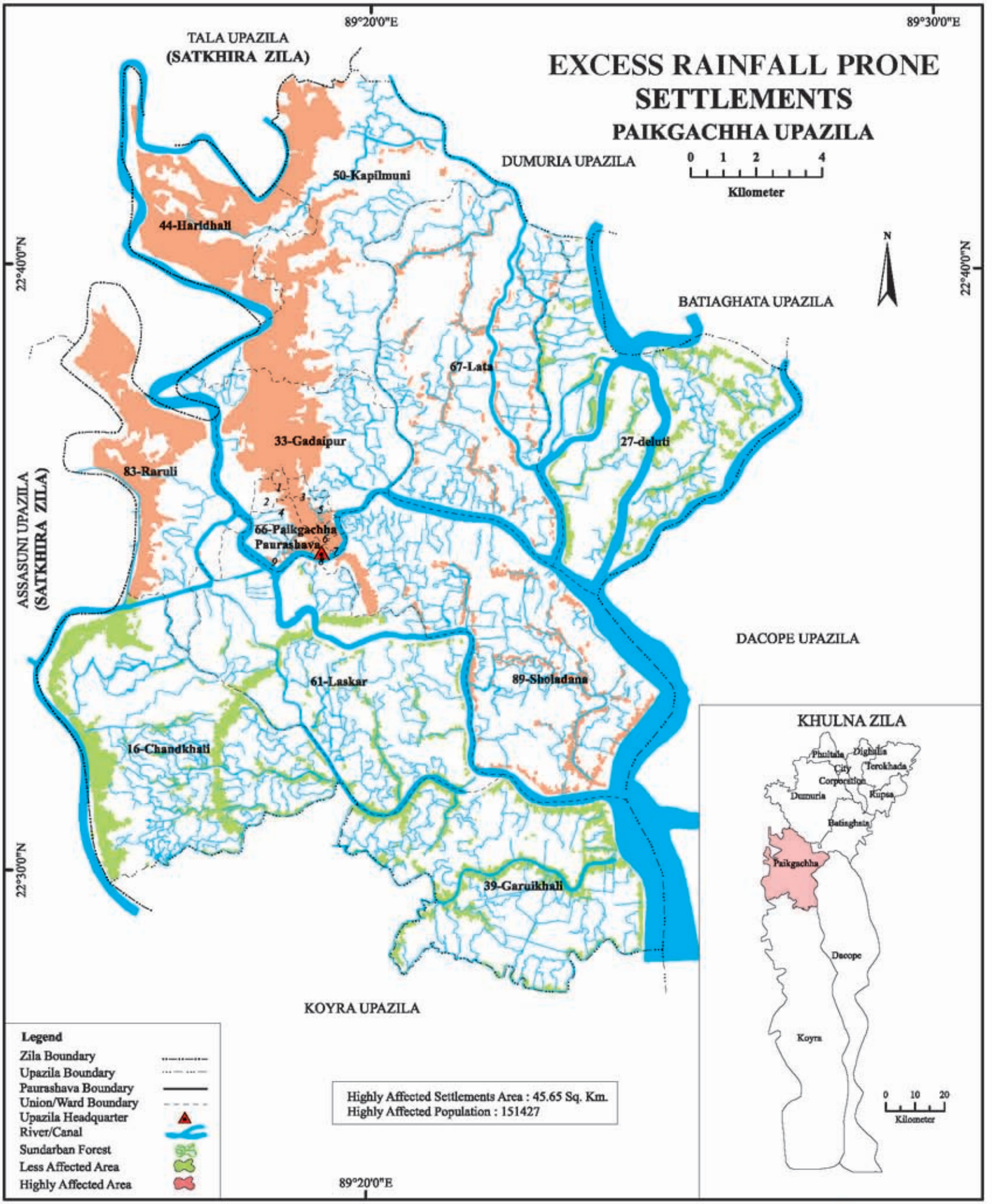
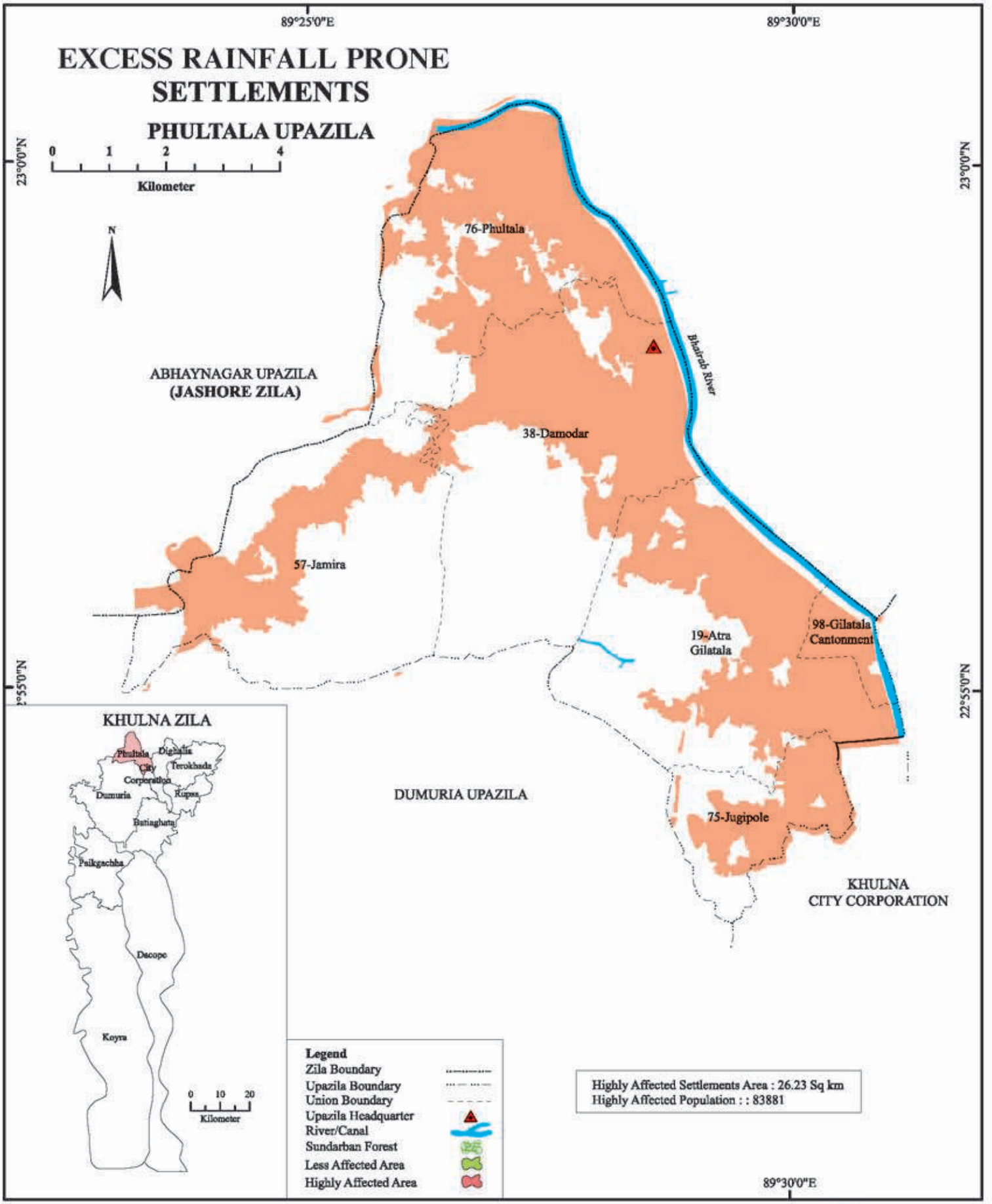

EXCESS RAINFALL PRONE SETTLEMENTS
PAIKGACHHA UPAZILA
89°20'0"E
89°30'0"E
22°40'0"N
22°30'0"N
TALA UPAZILA
(SATKHIRA ZILA)
DUMURIA UPAZILA
BATIAGHATA UPAZILA
ASSASUNI UPAZILA
(SATKHIRA ZILA)
DACOPE UPAZILA
KOYRA UPAZILA
0 1 2 4
Kilometer
N
50-Kapilmuni
44-Haridhali
67-Lata
33-Gadaipur
27-deluti
83-Raruli
66-Paikgachha Paurashava
61-Laskar
89-Sholadana
16-Chandkhali
39-Garuikhali
KHULNA ZILA
Phultala
Digholia
City
Terokhada
Corporation
Dumuria
Rupsa
Batiaghata
Paikgachha
Dacope
Koyra
0 10 20
Kilometer
Legend
Zila Boundary
Upazila Boundary
Paurashava Boundary
Union/Ward Boundary
Upazila Headquarter
River/Canal
Sundarban Forest
Less Affected Area
Highly Affected Area
Highly Affected Settlements Area : 45.65 Sq. Km.
Highly Affected Population : 151427



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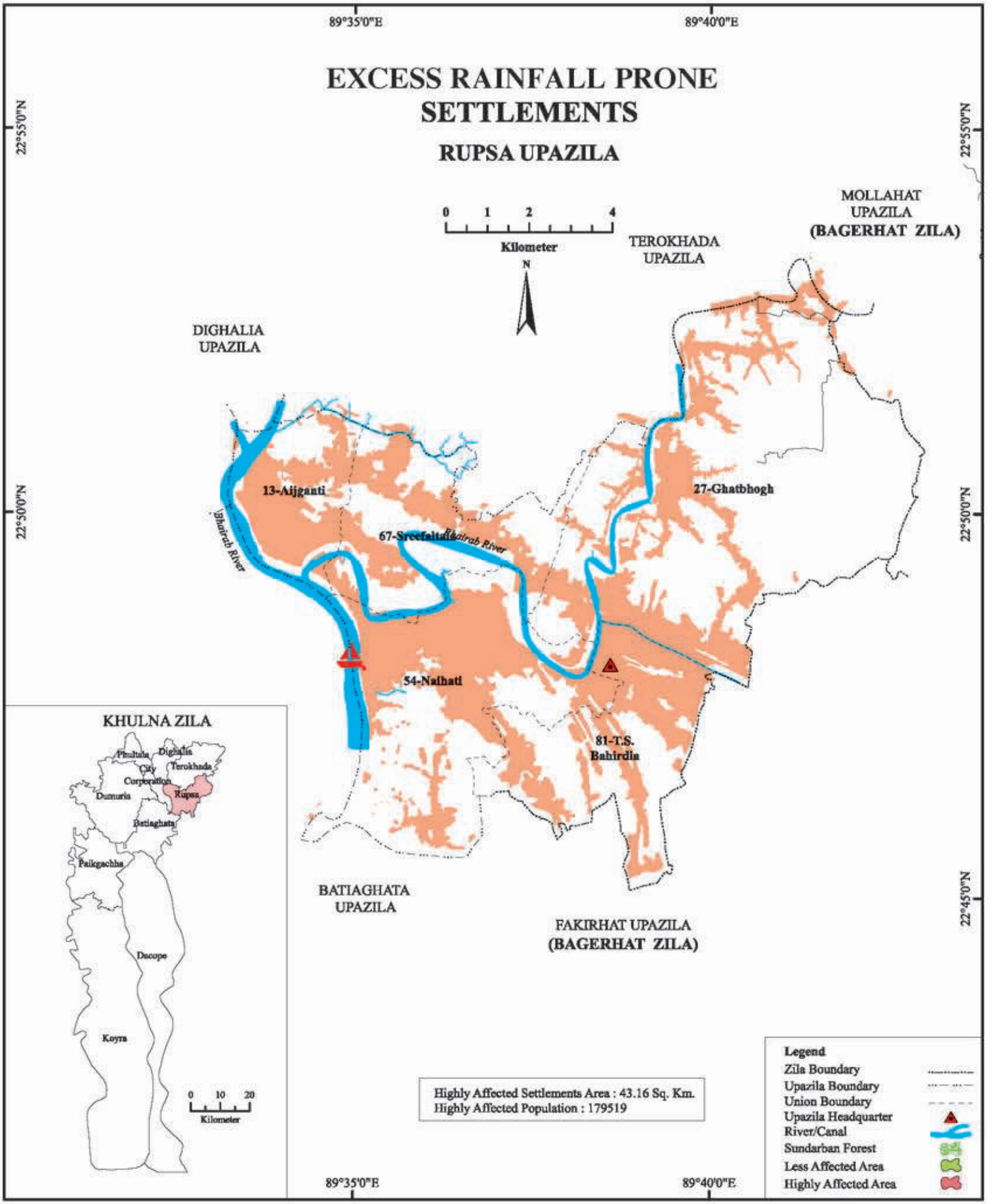

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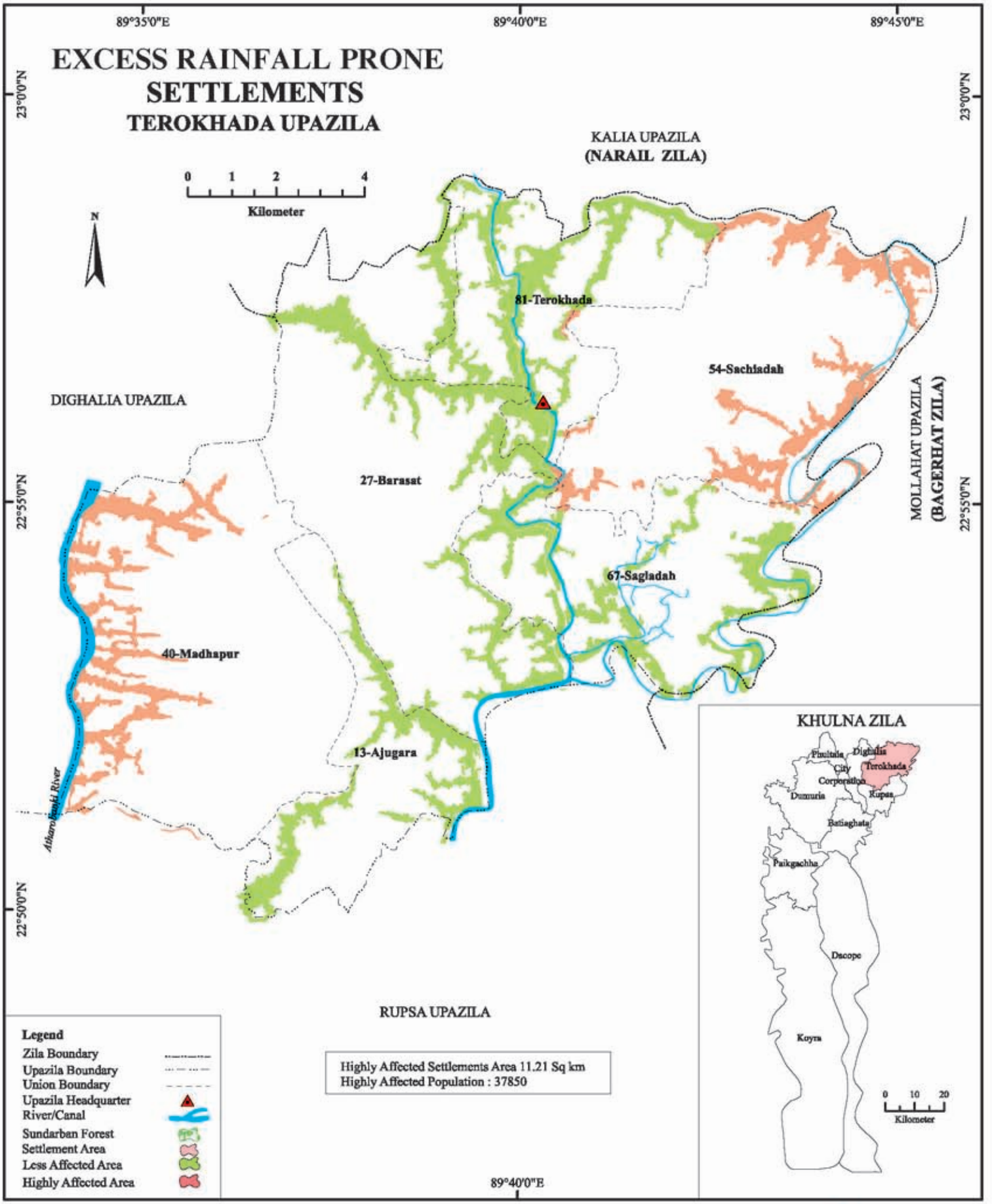
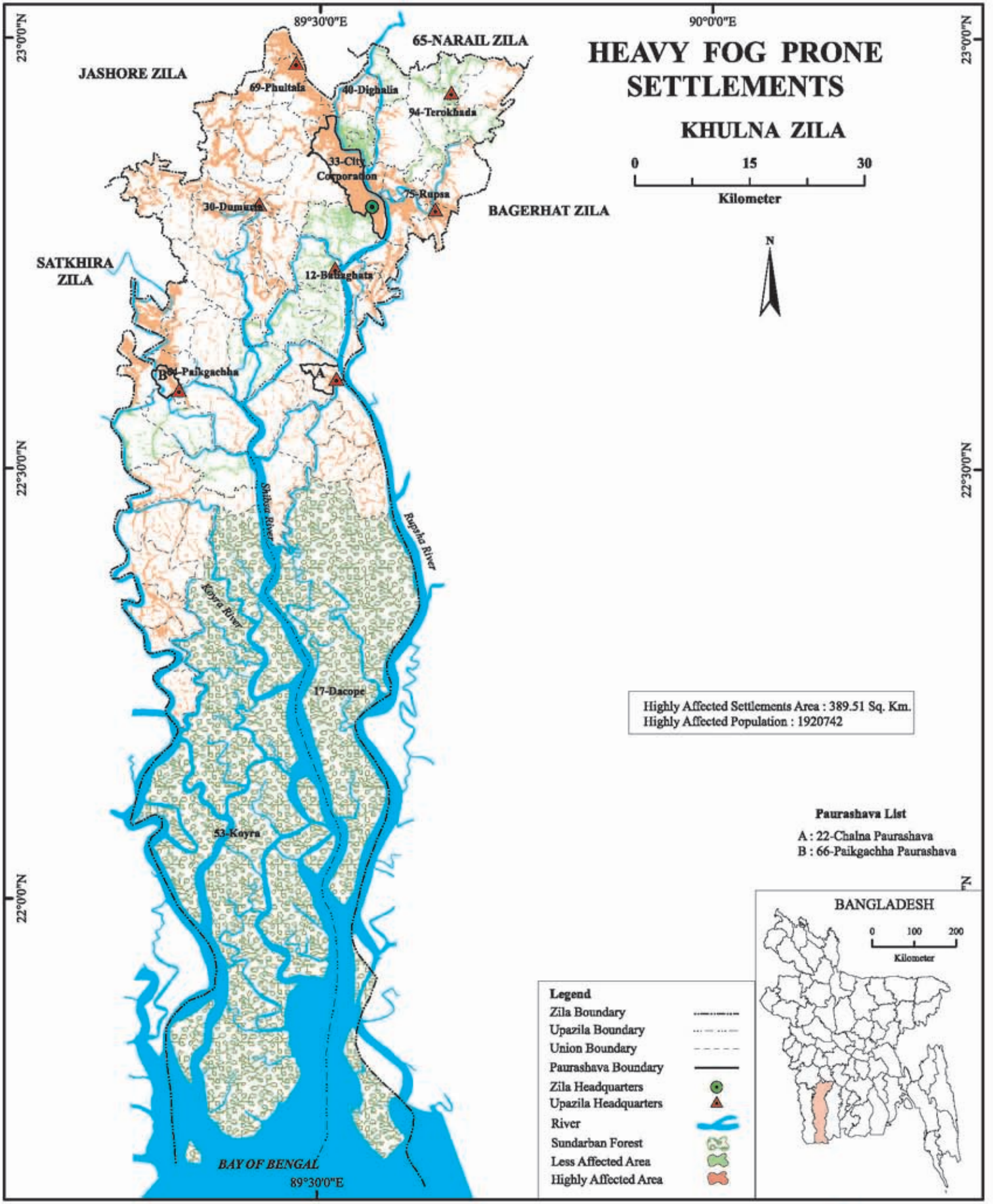


Stat4Dev Project, 2021

Heavy Fog Prone Area Map



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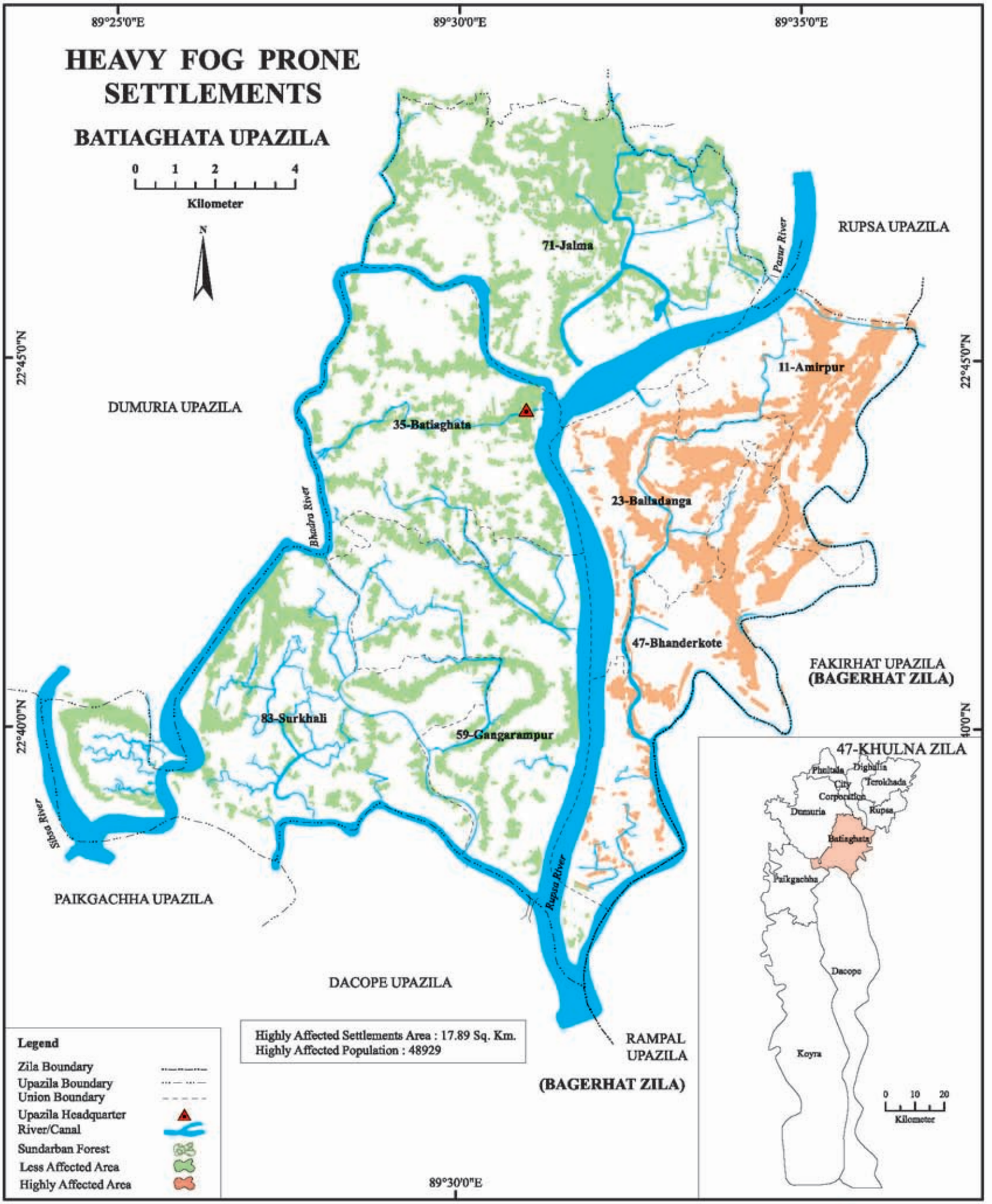

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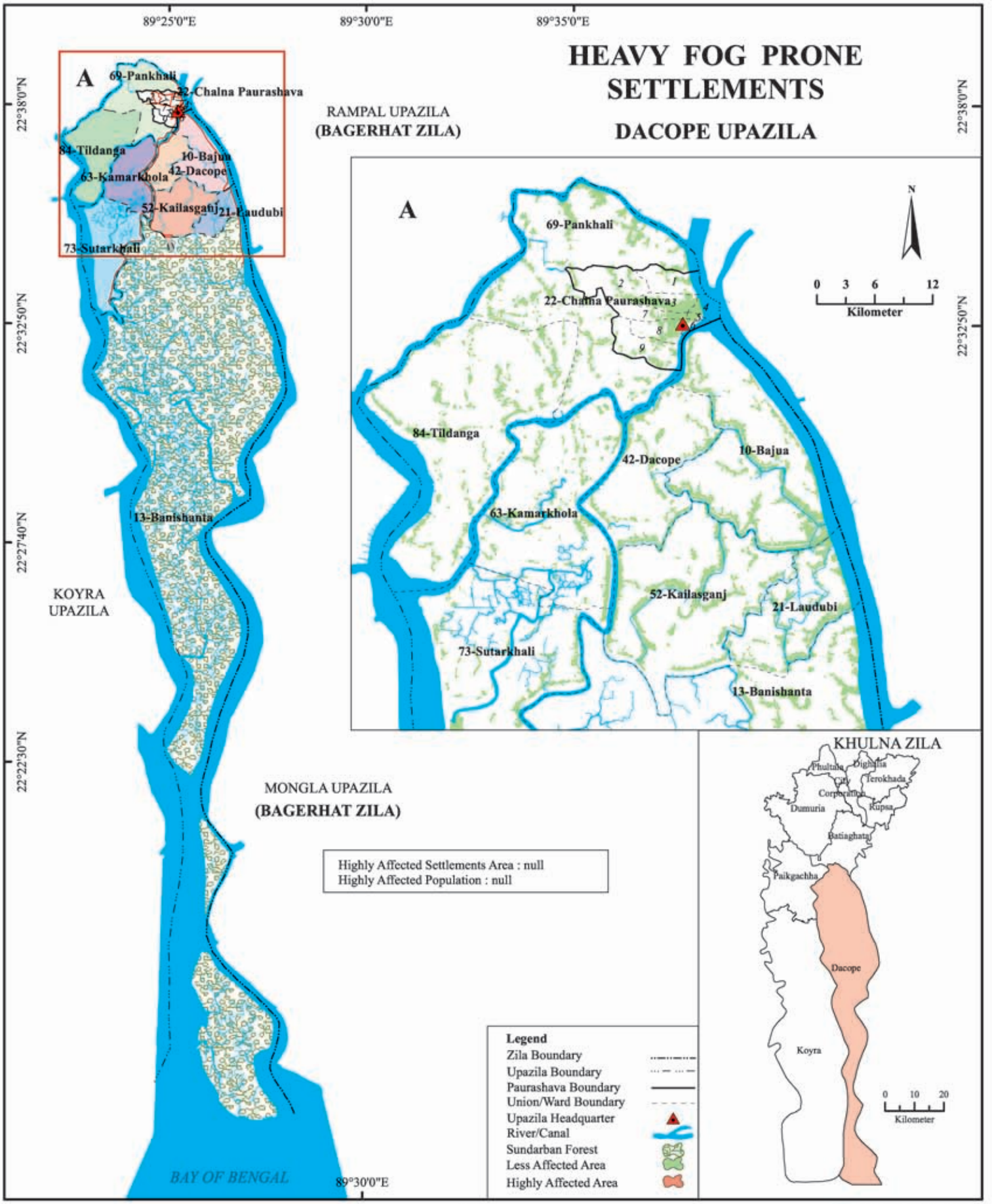

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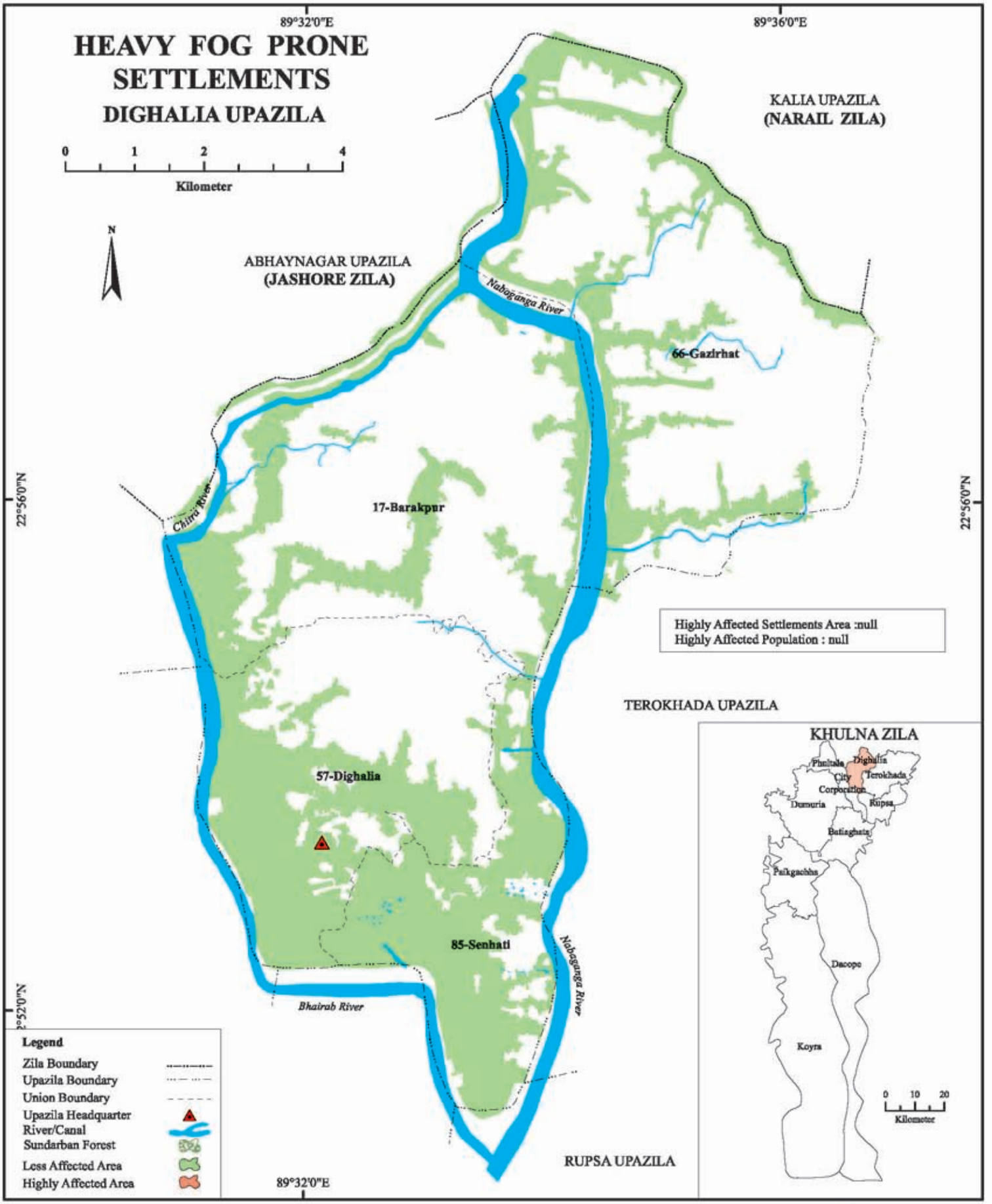

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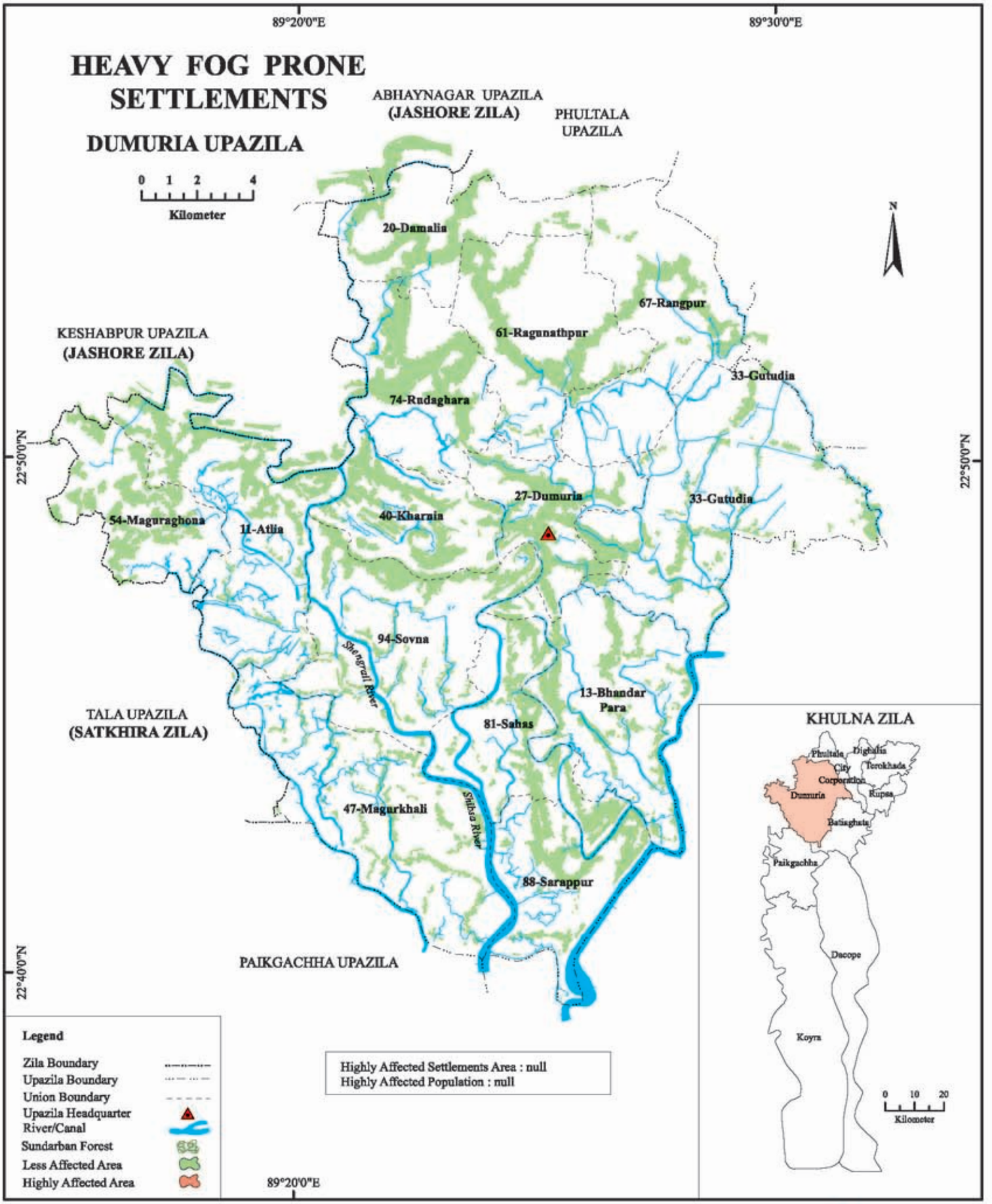

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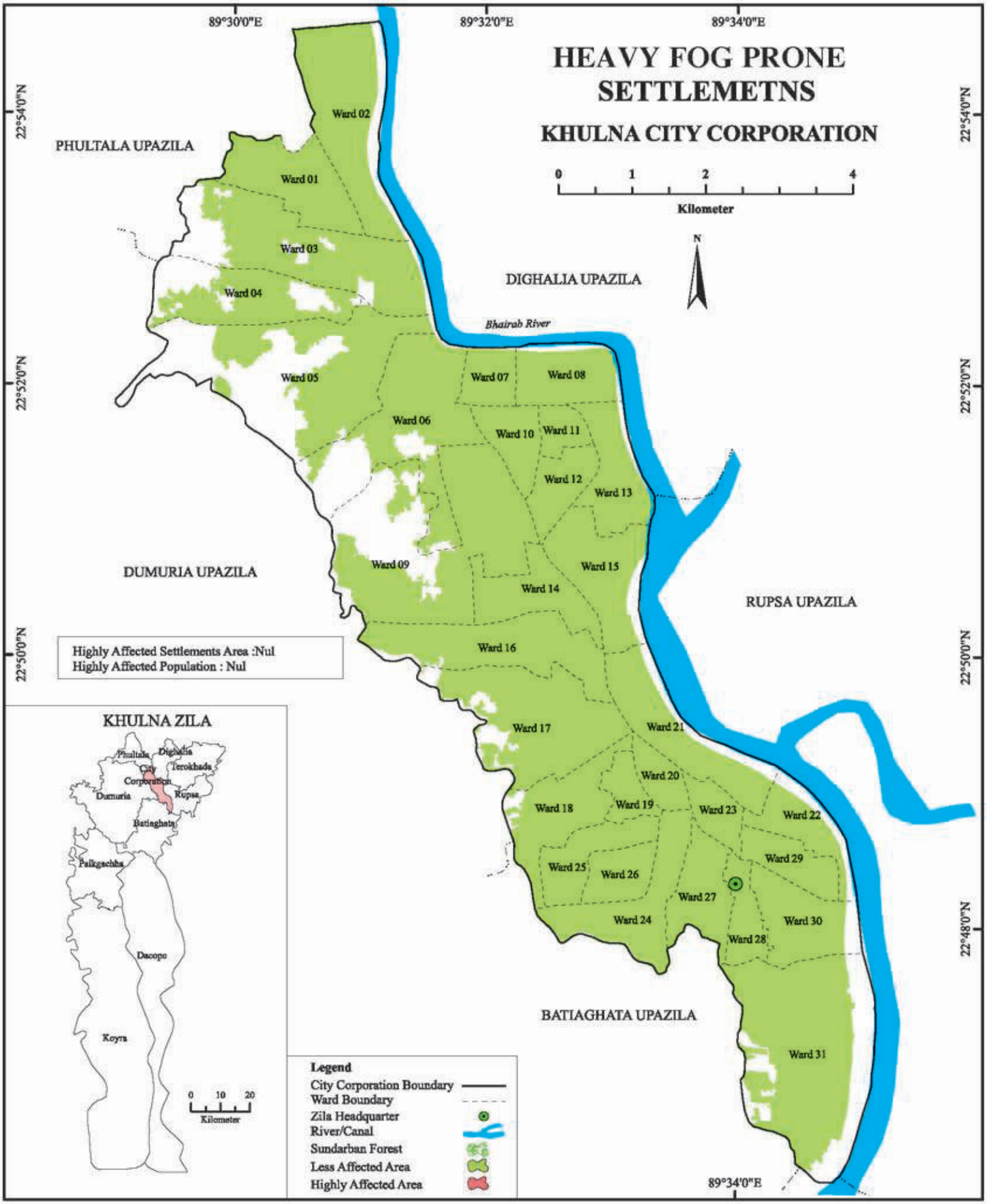

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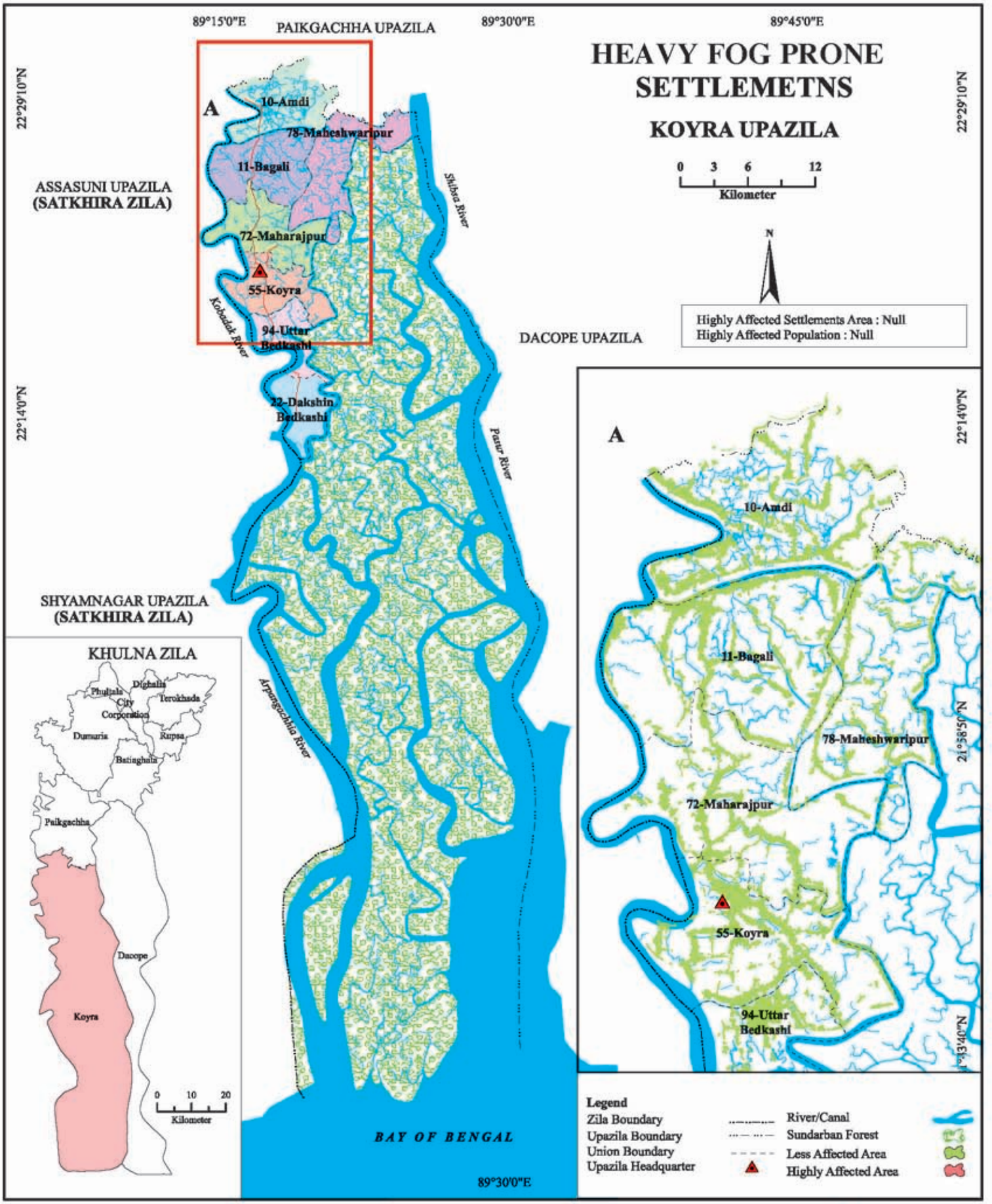

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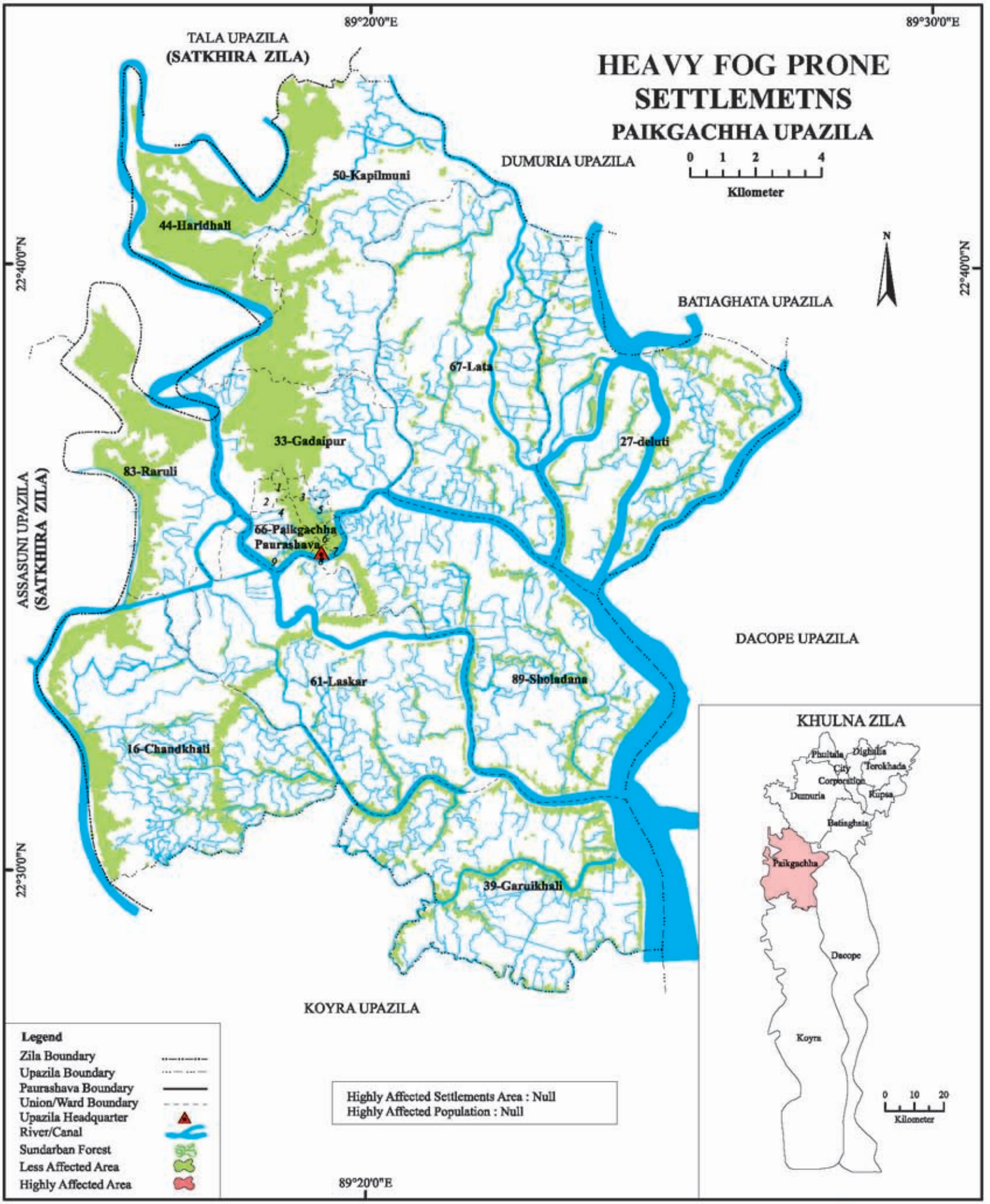

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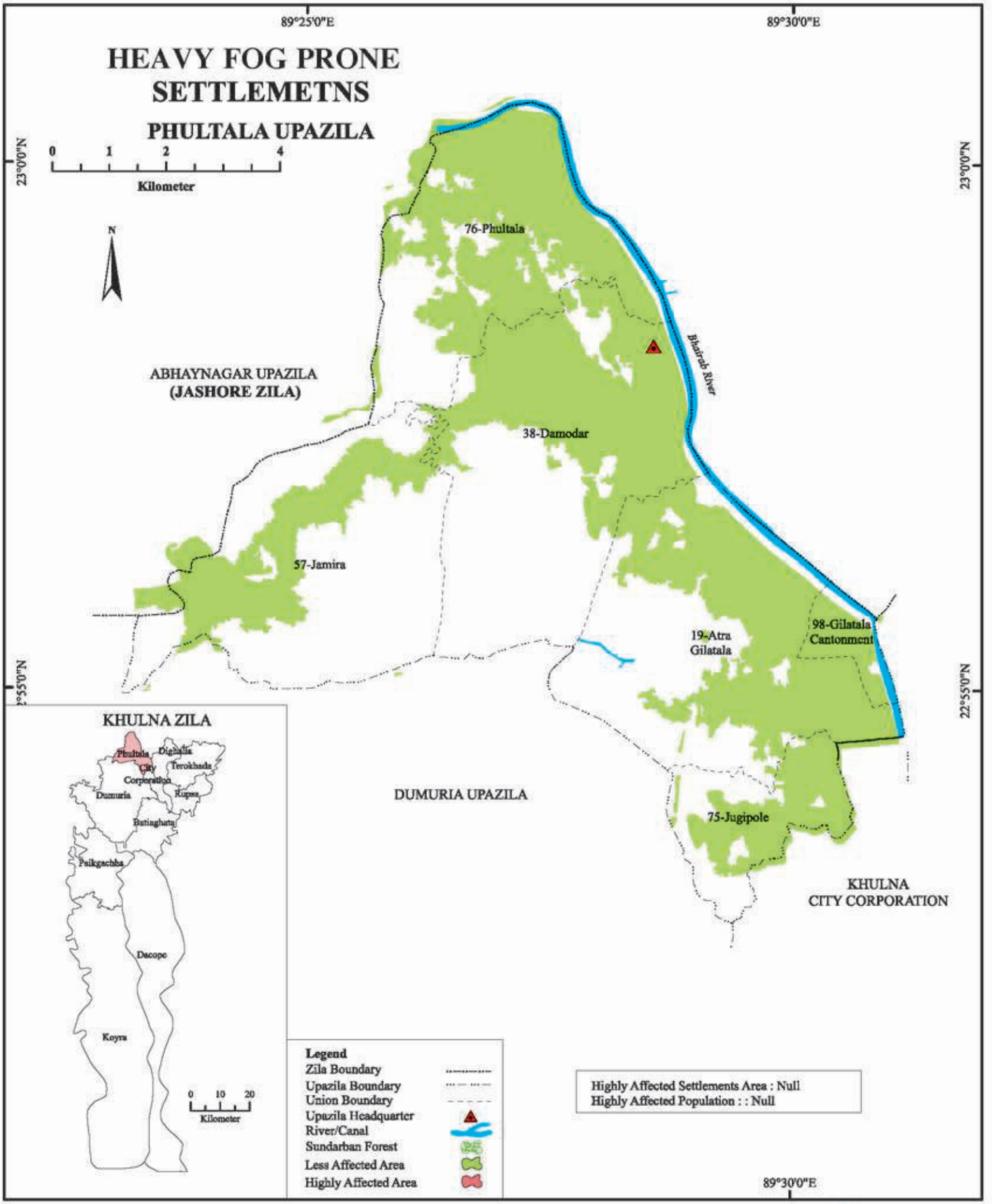

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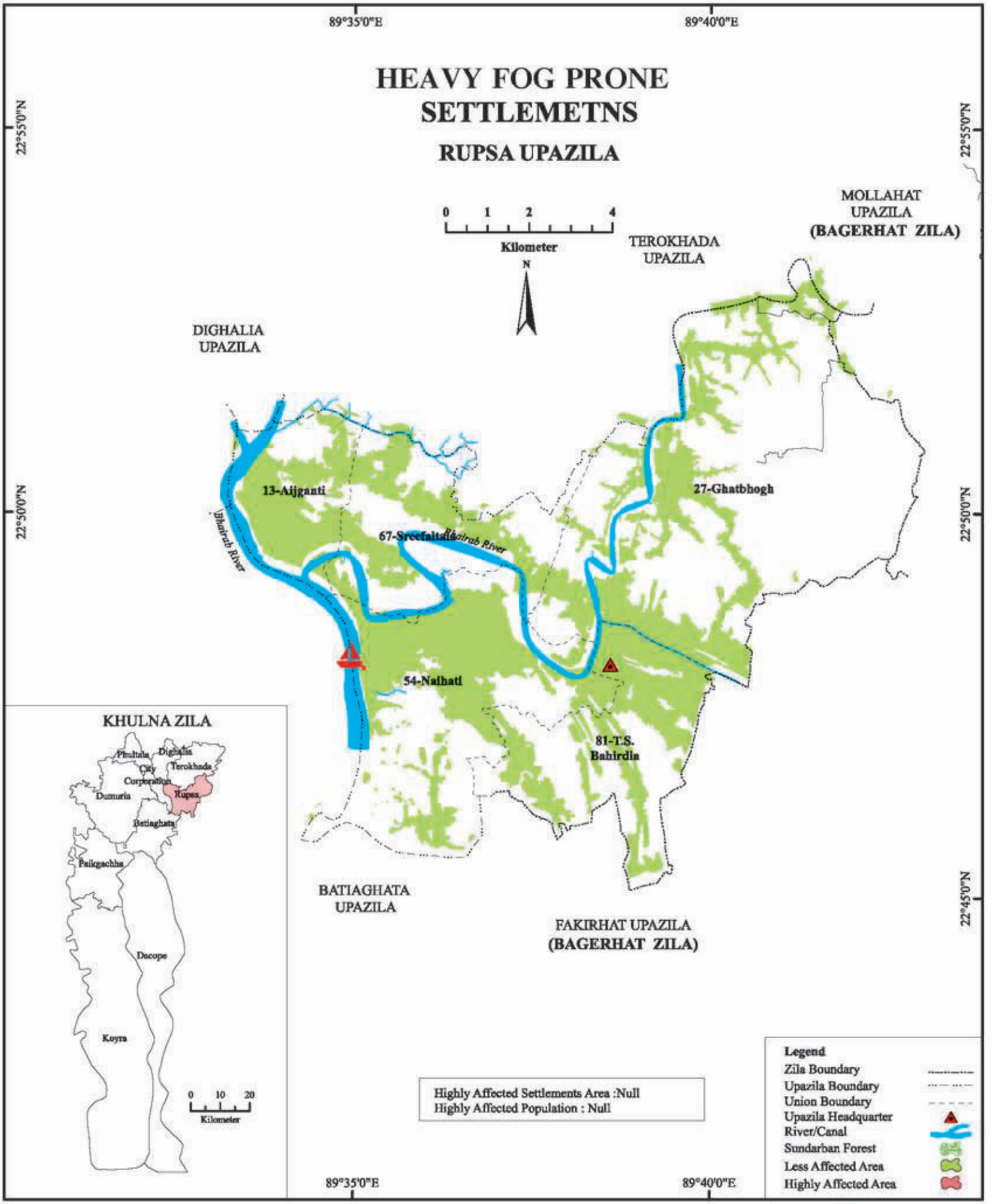

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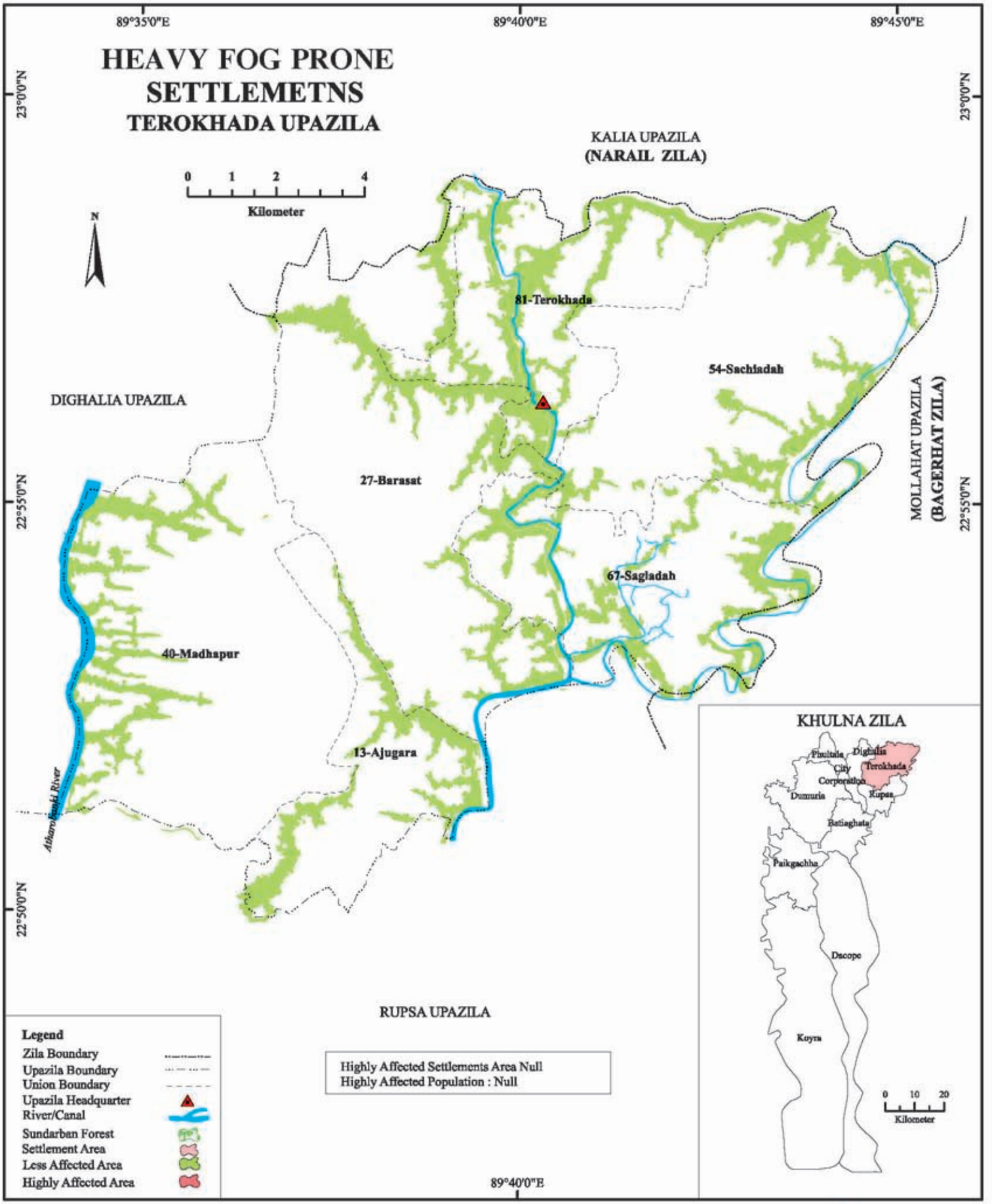
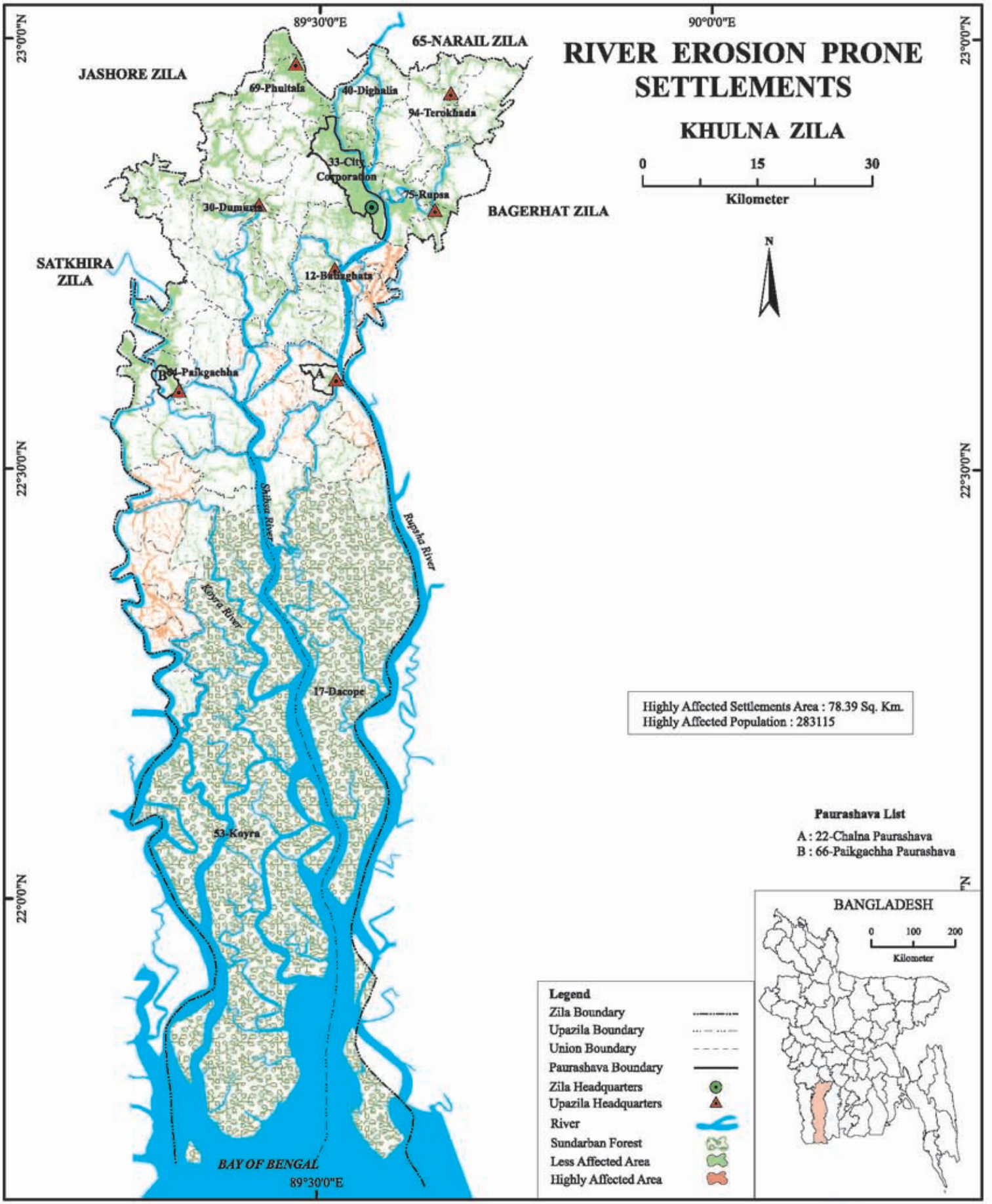


Stat4Dev Project, 2021

River Erosion Prone Area Map



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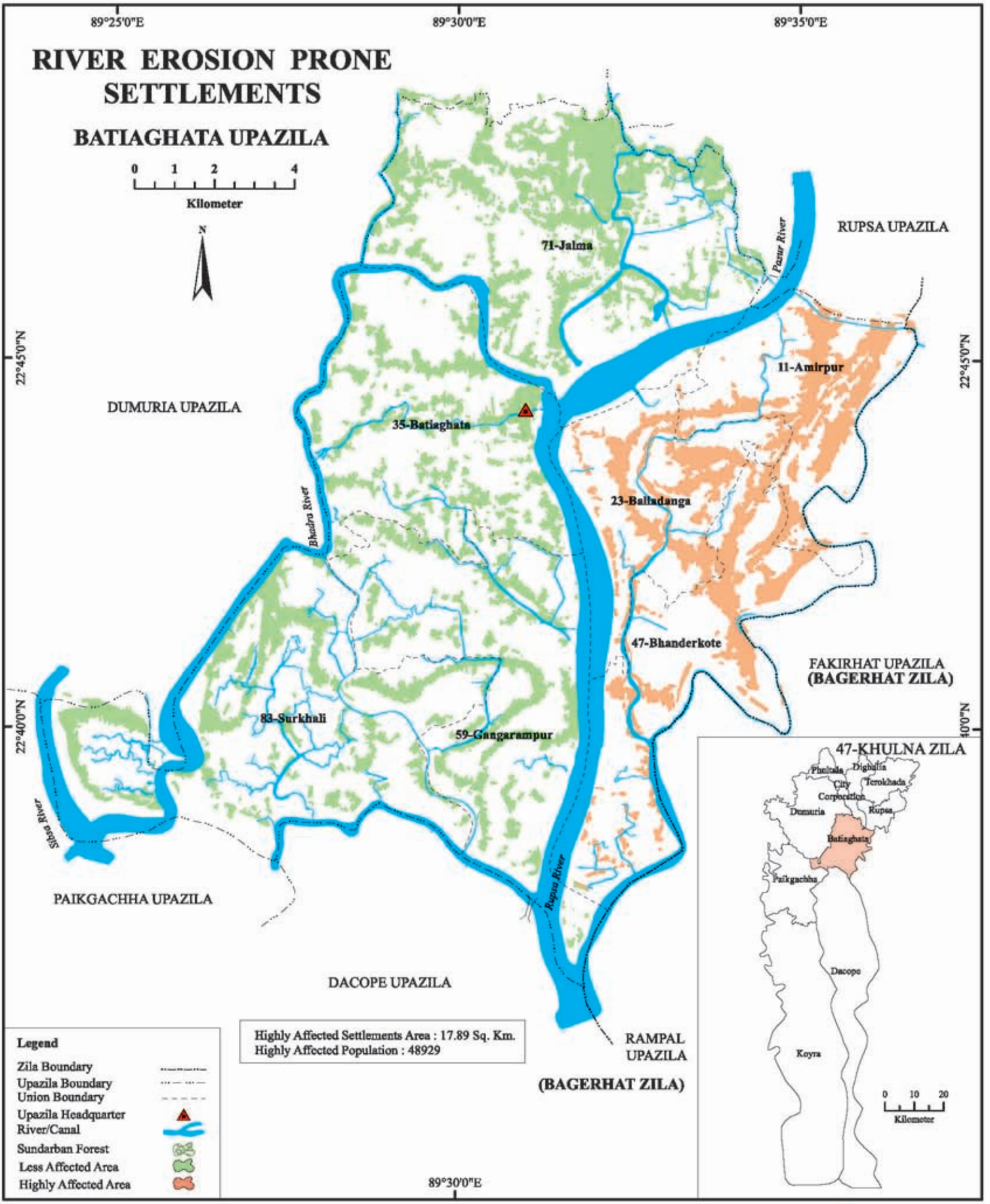

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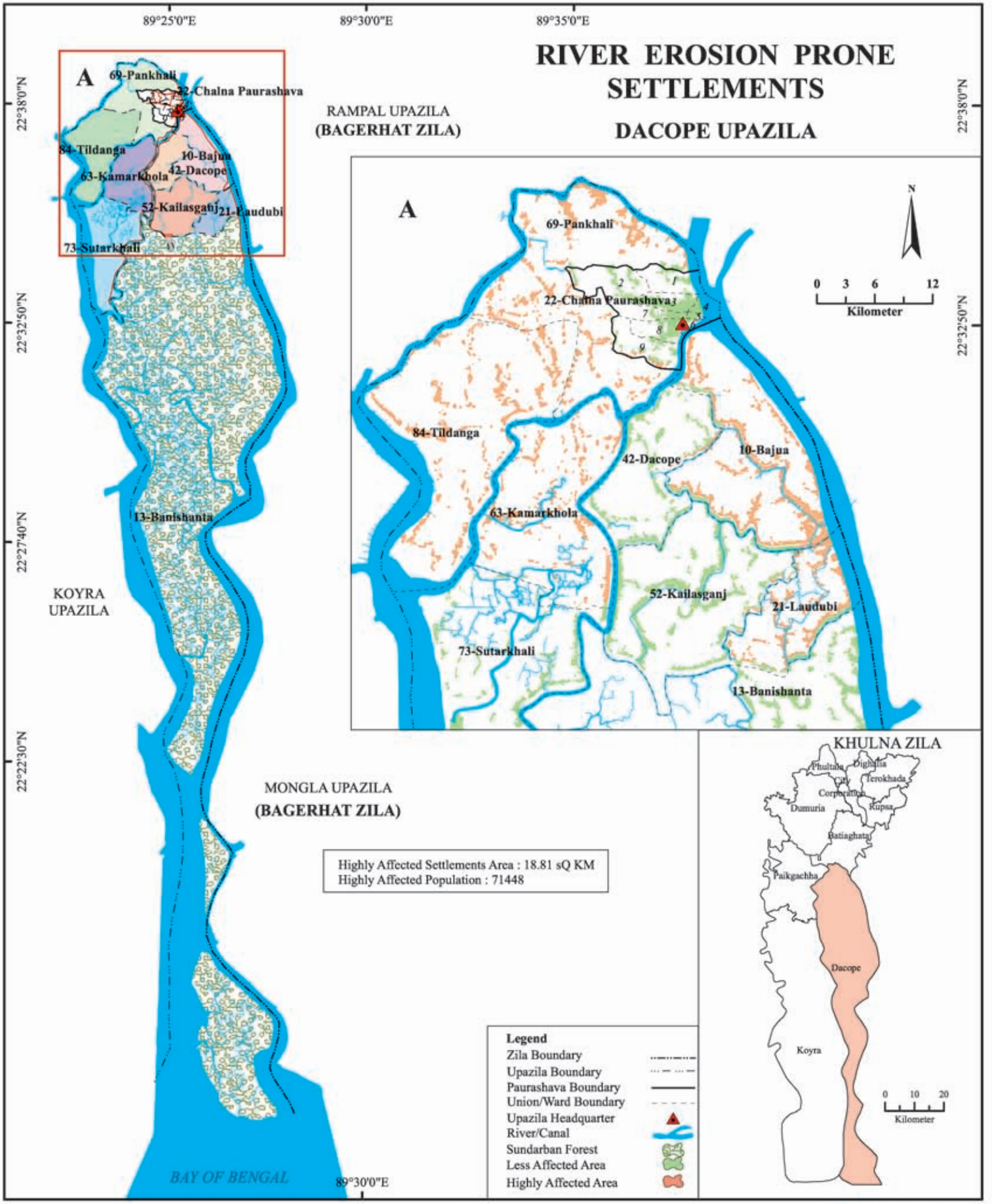

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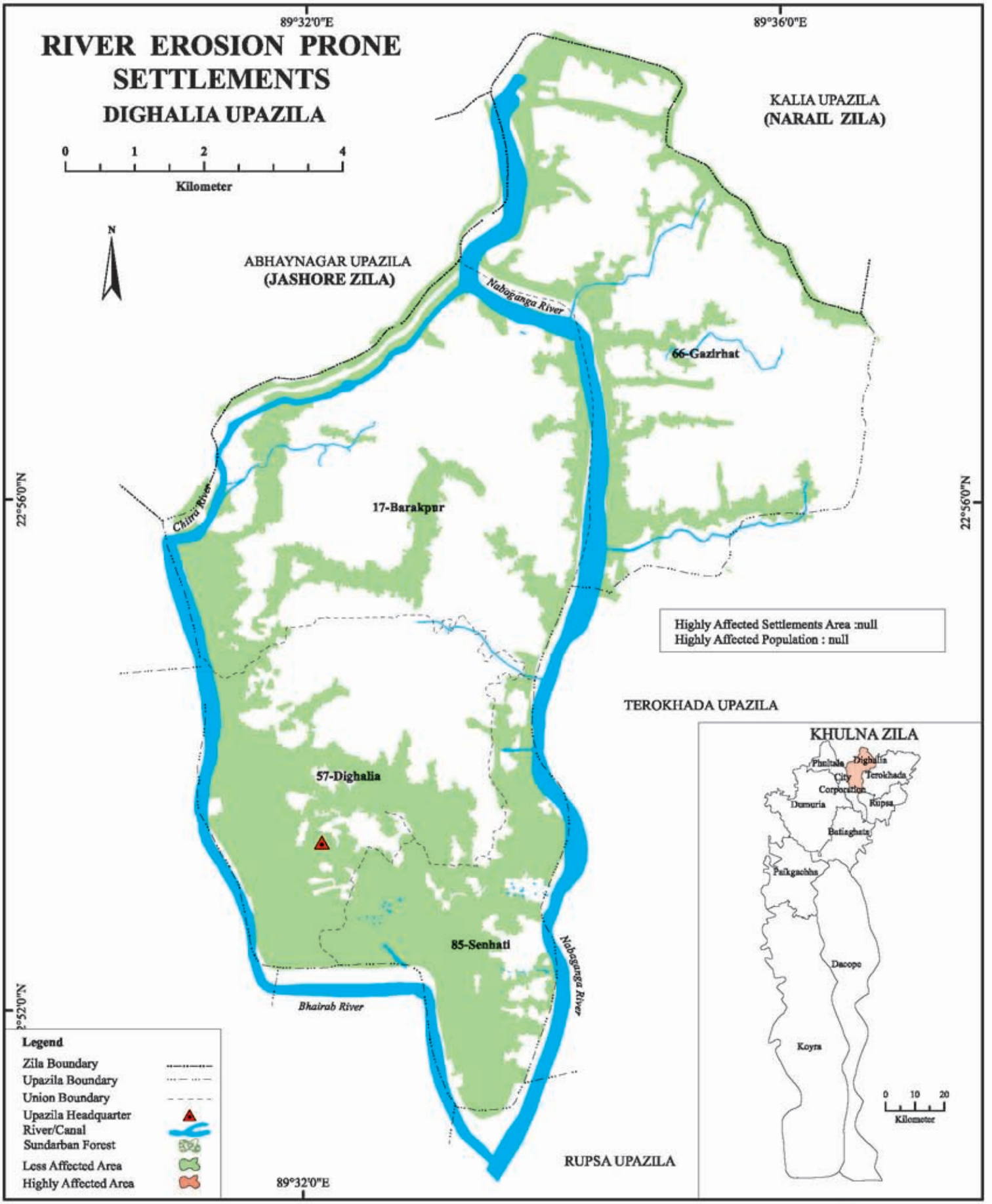

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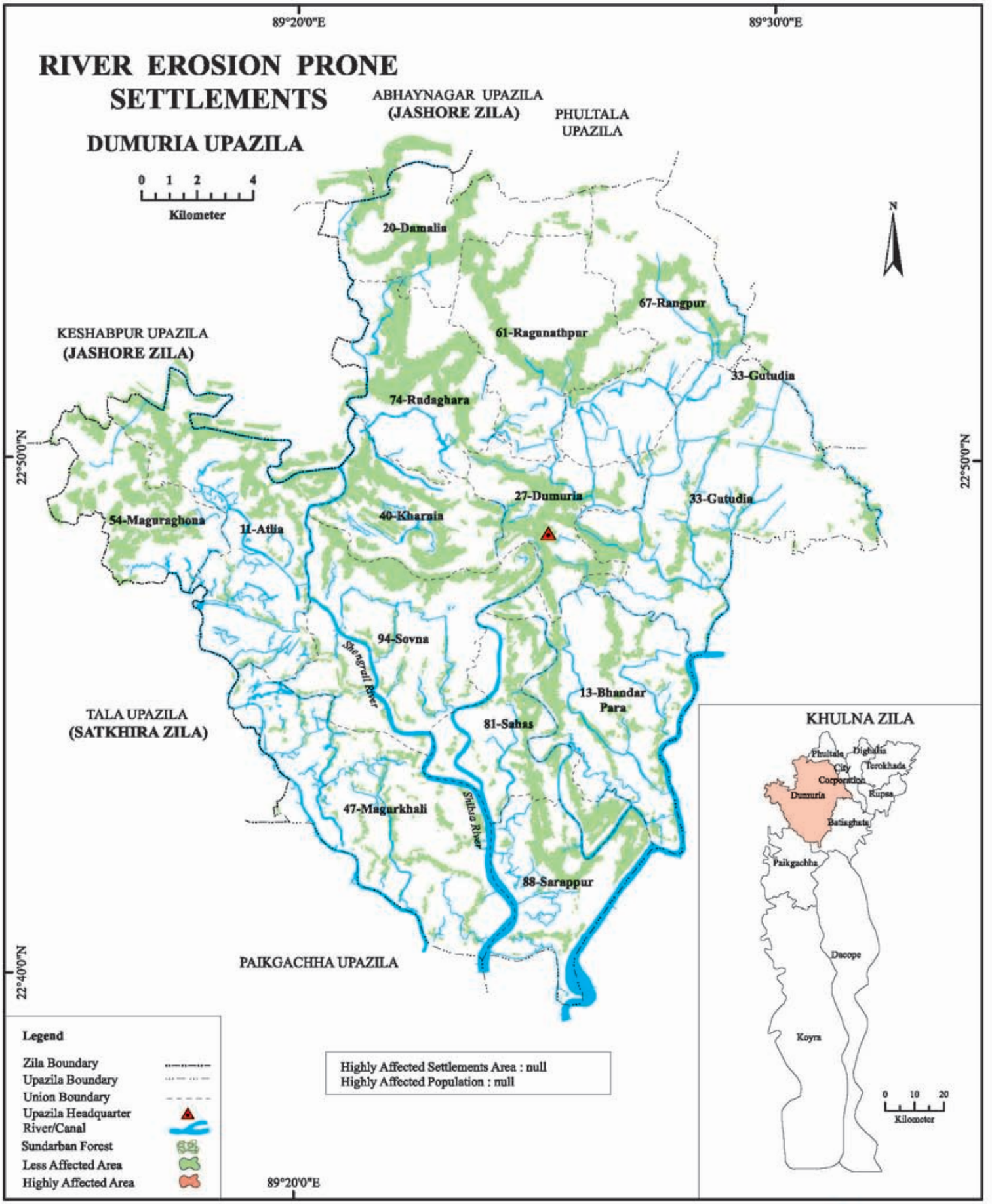

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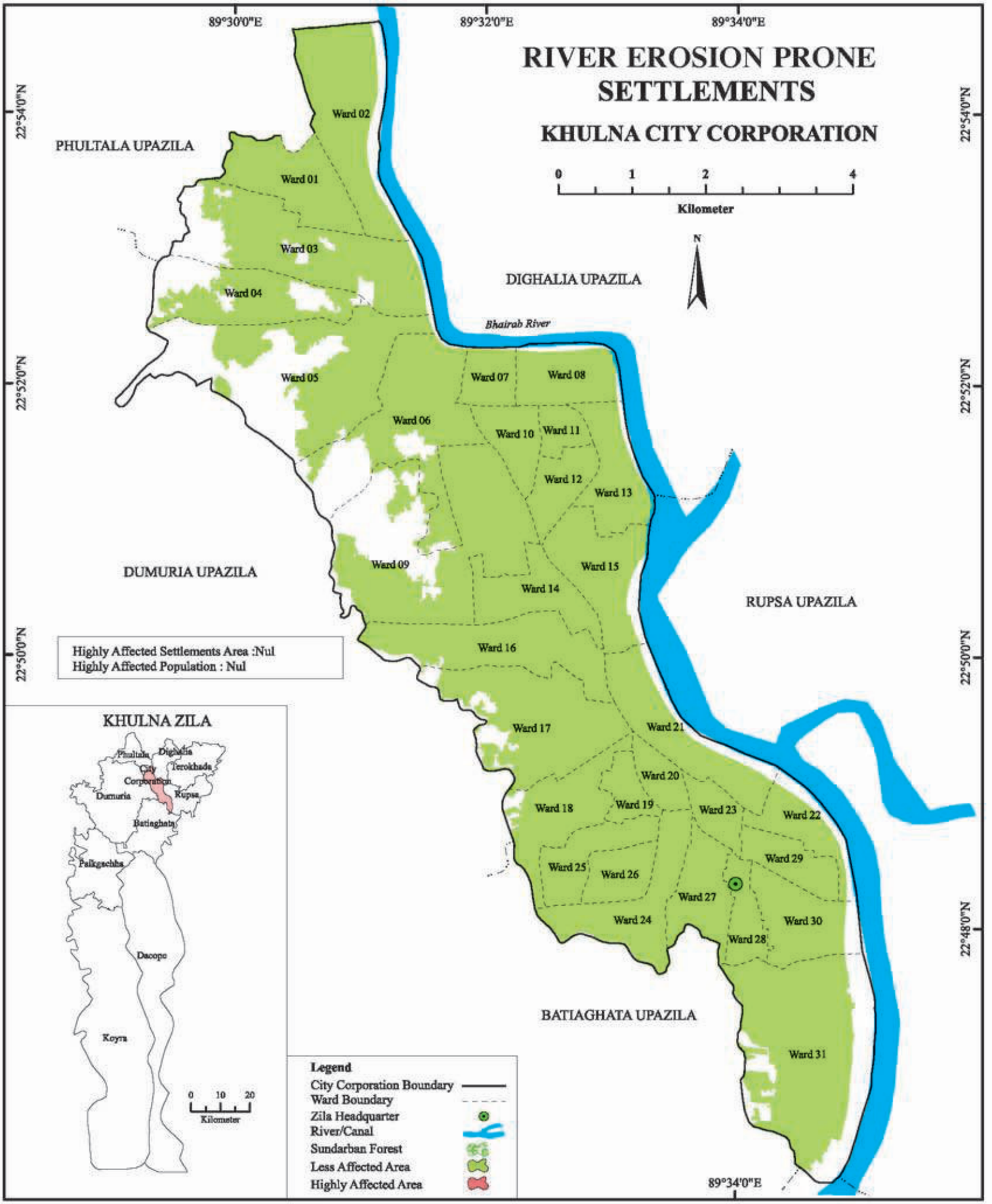

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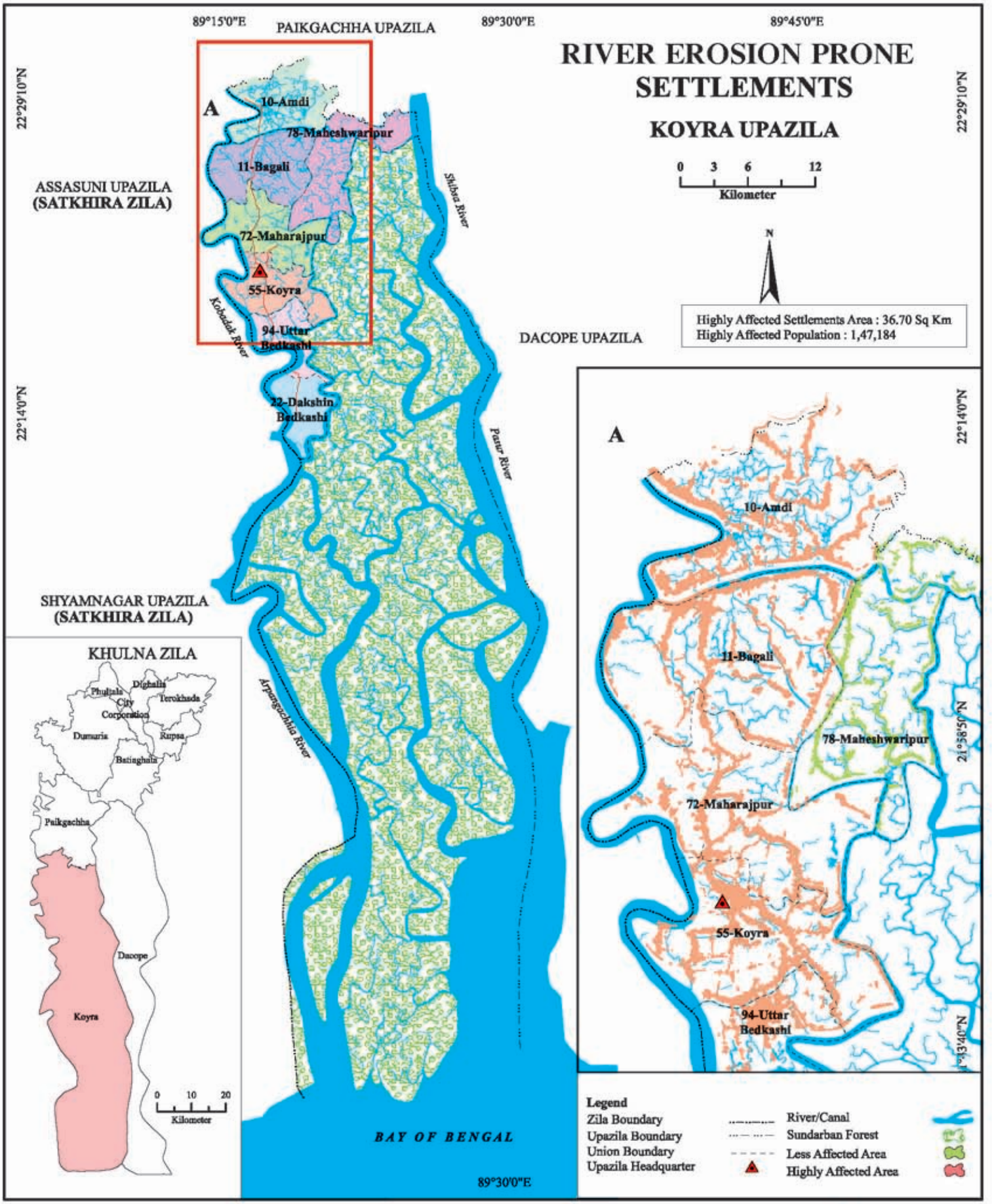

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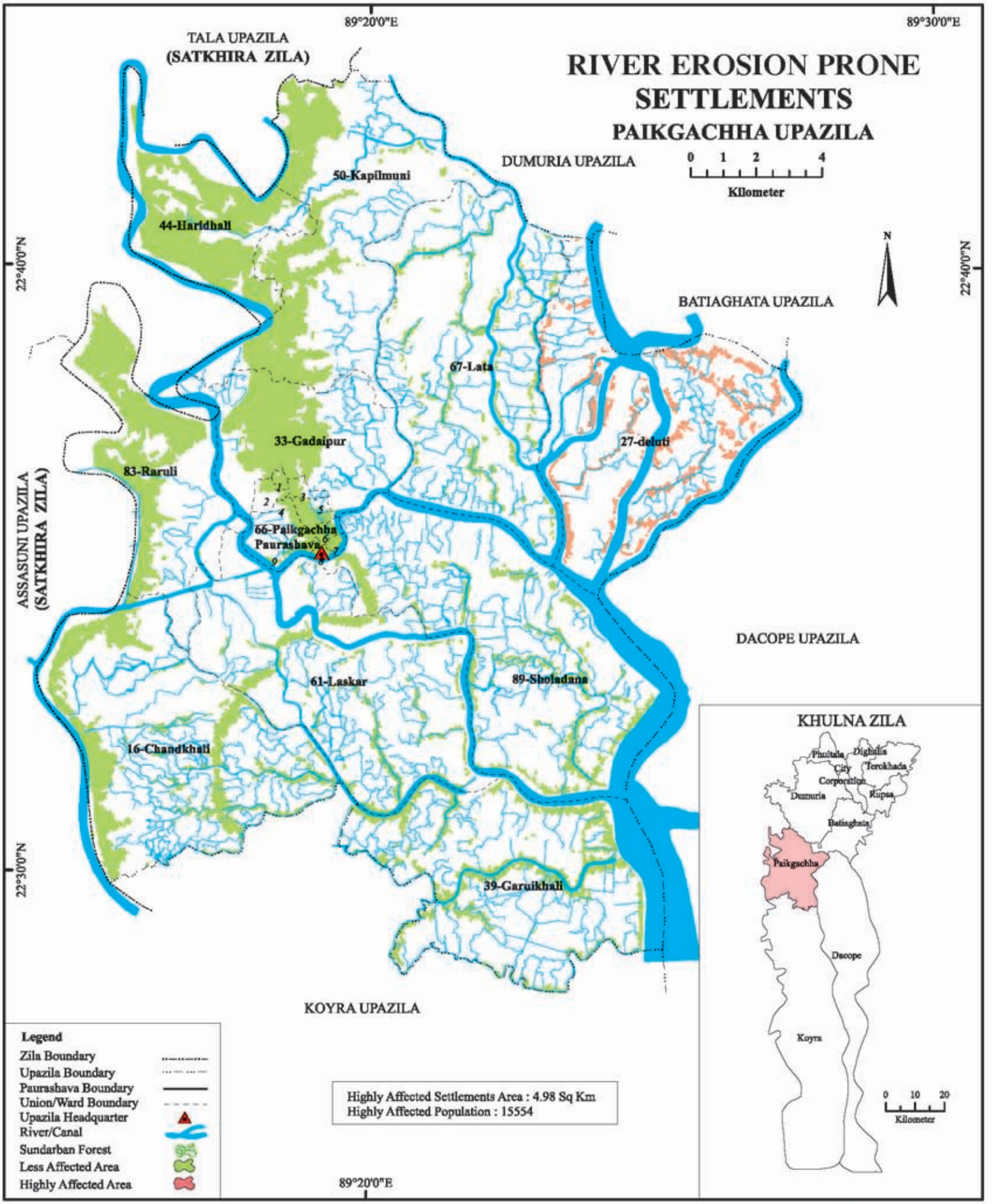

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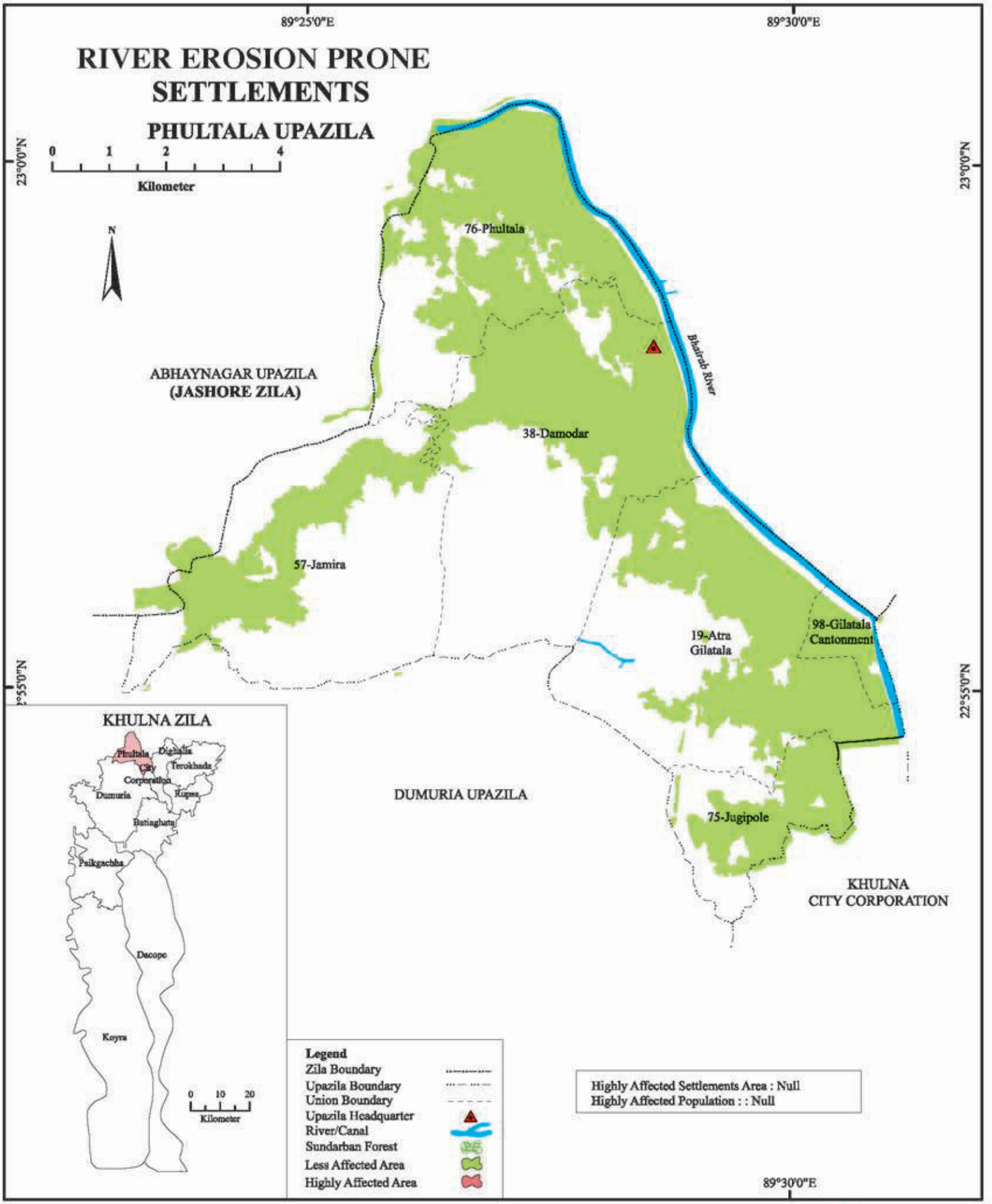

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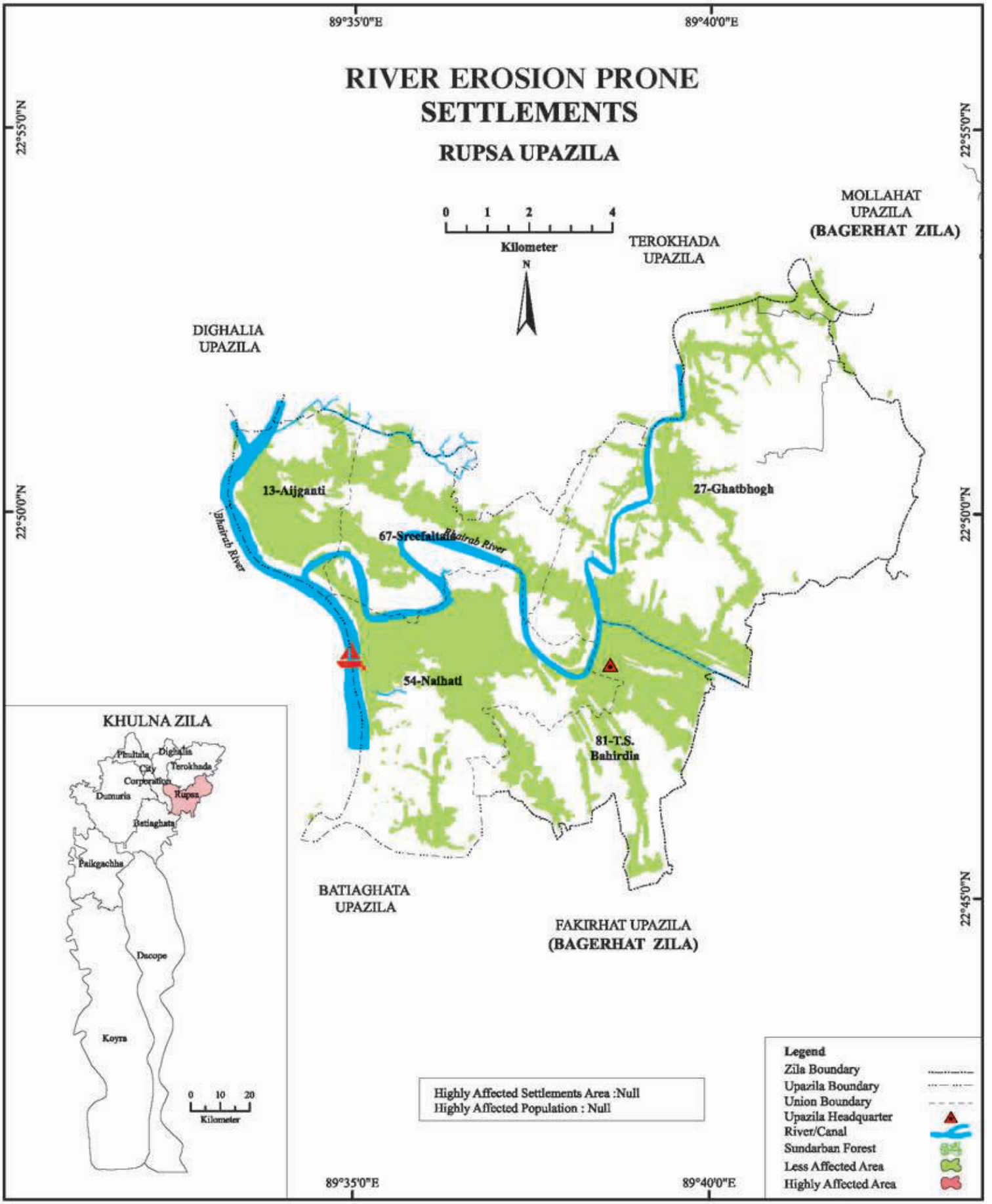

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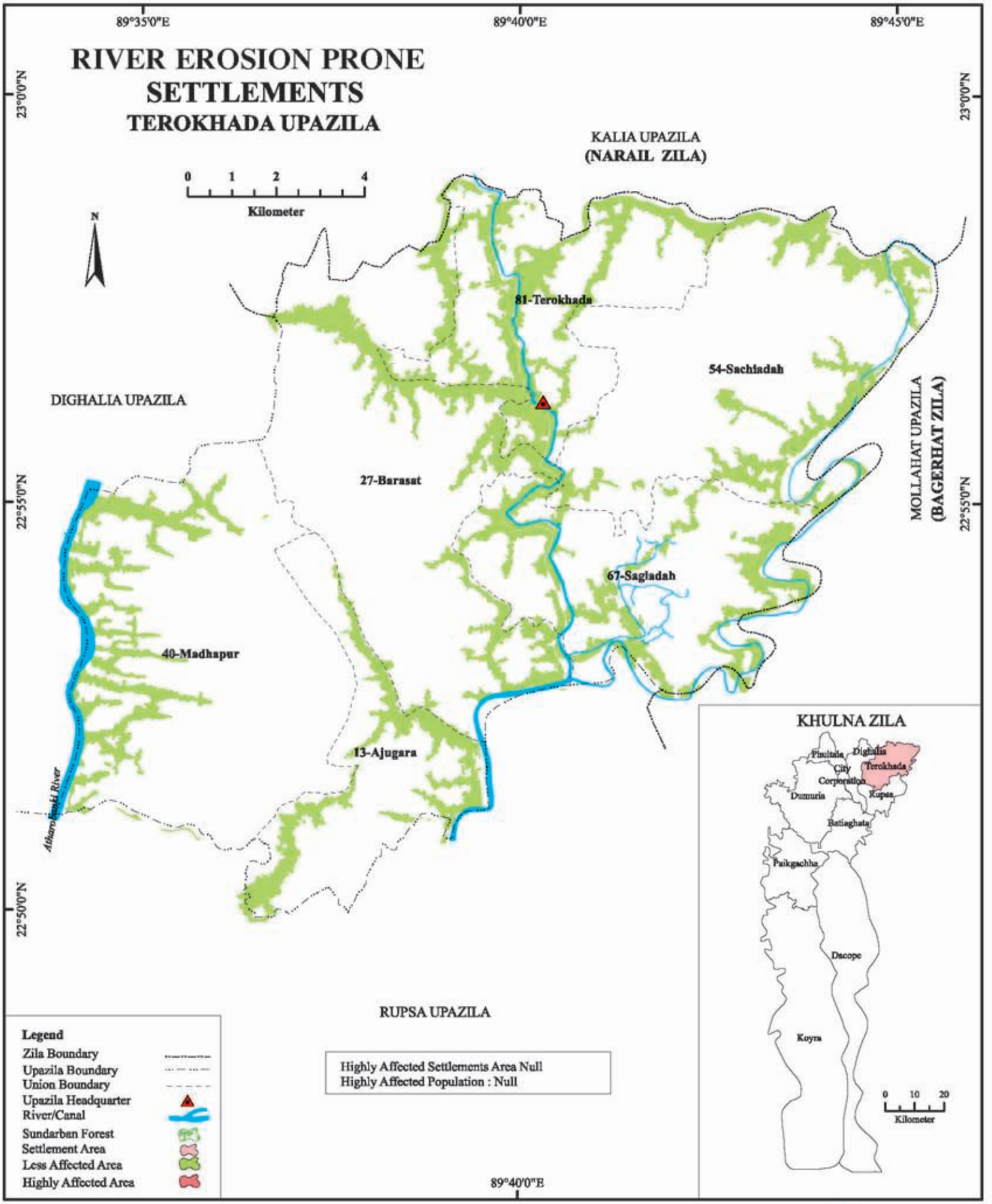
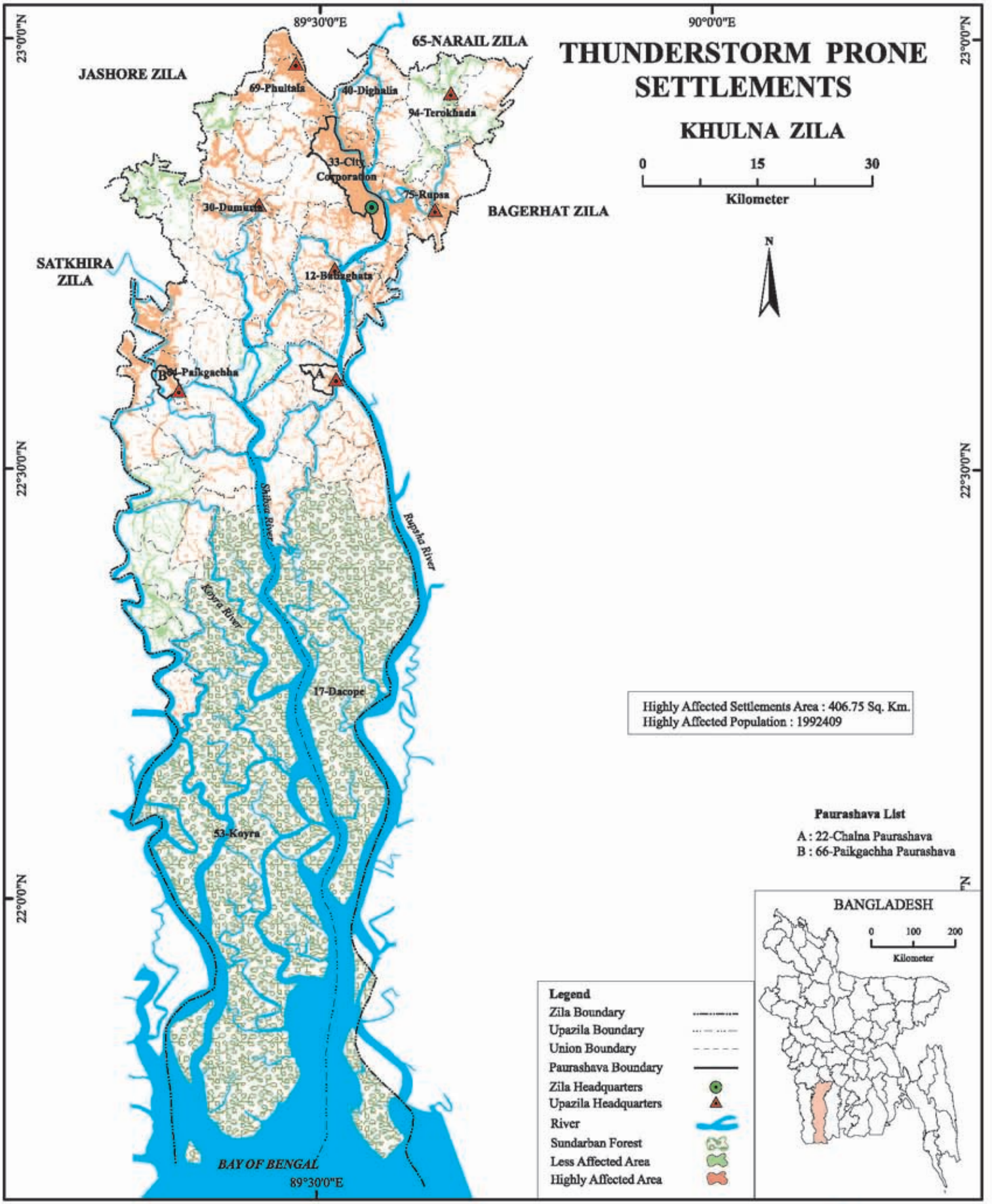


Stat4Dev Project, 2021

Thunderstorm Prone Area Map



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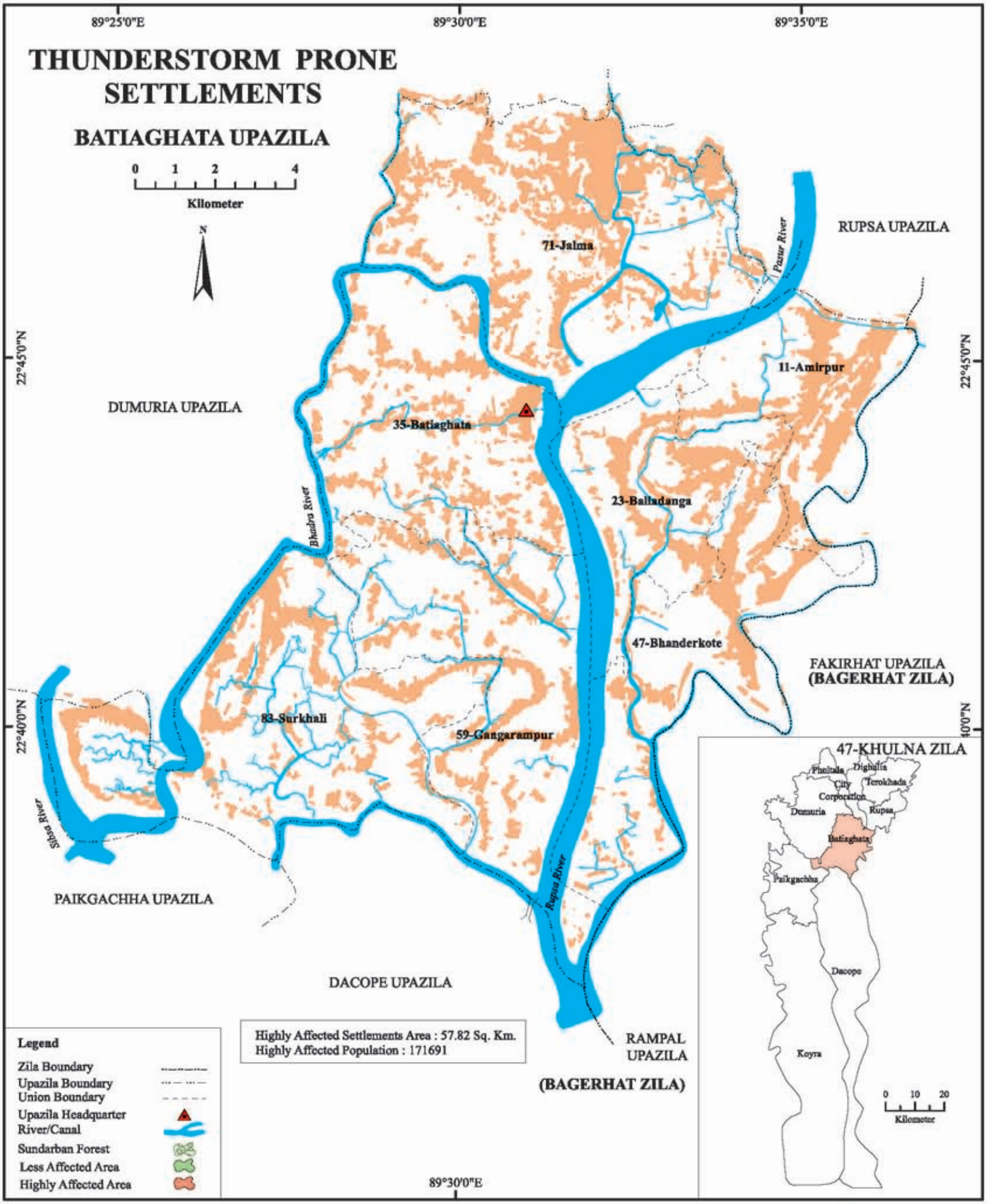

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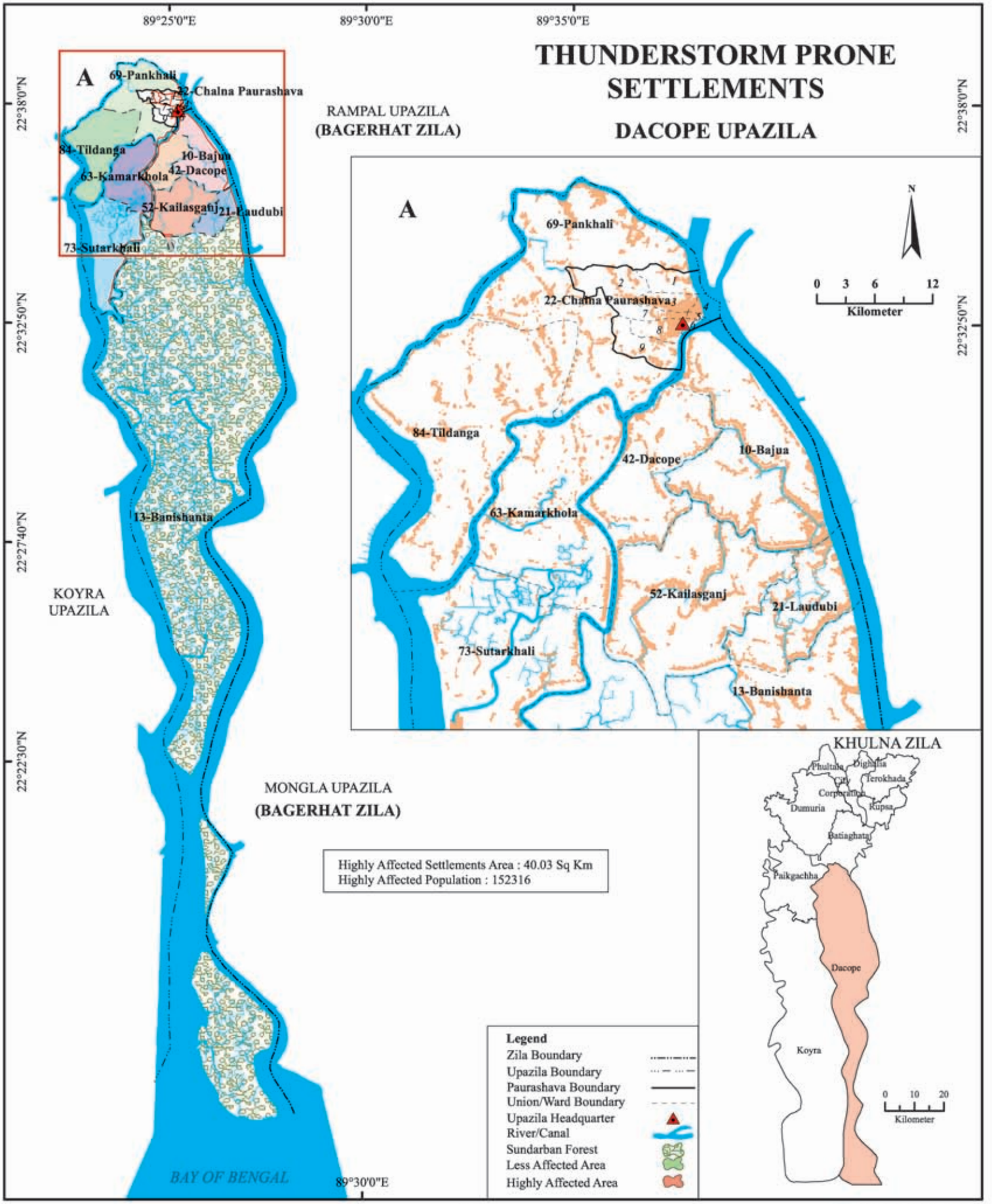

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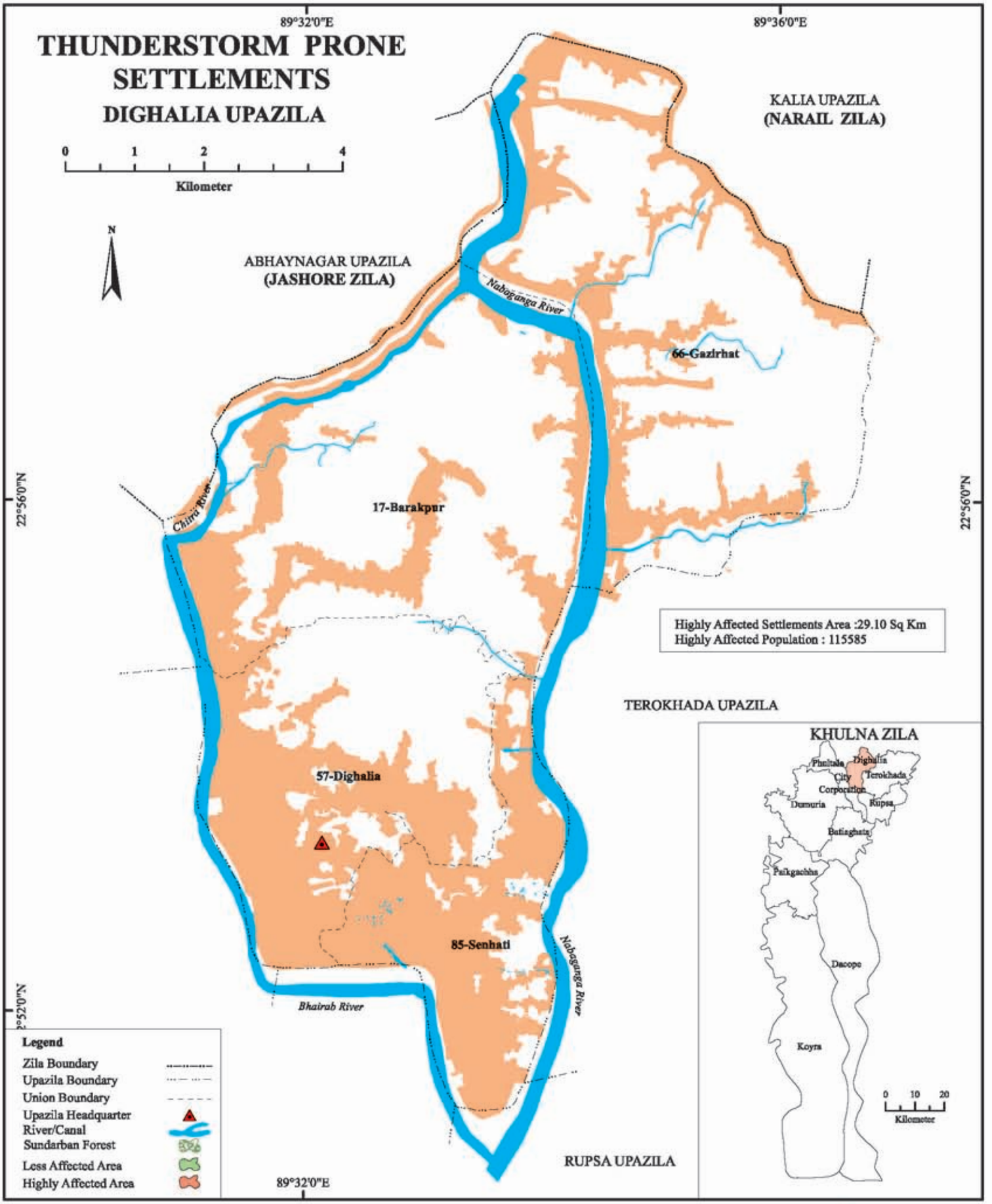

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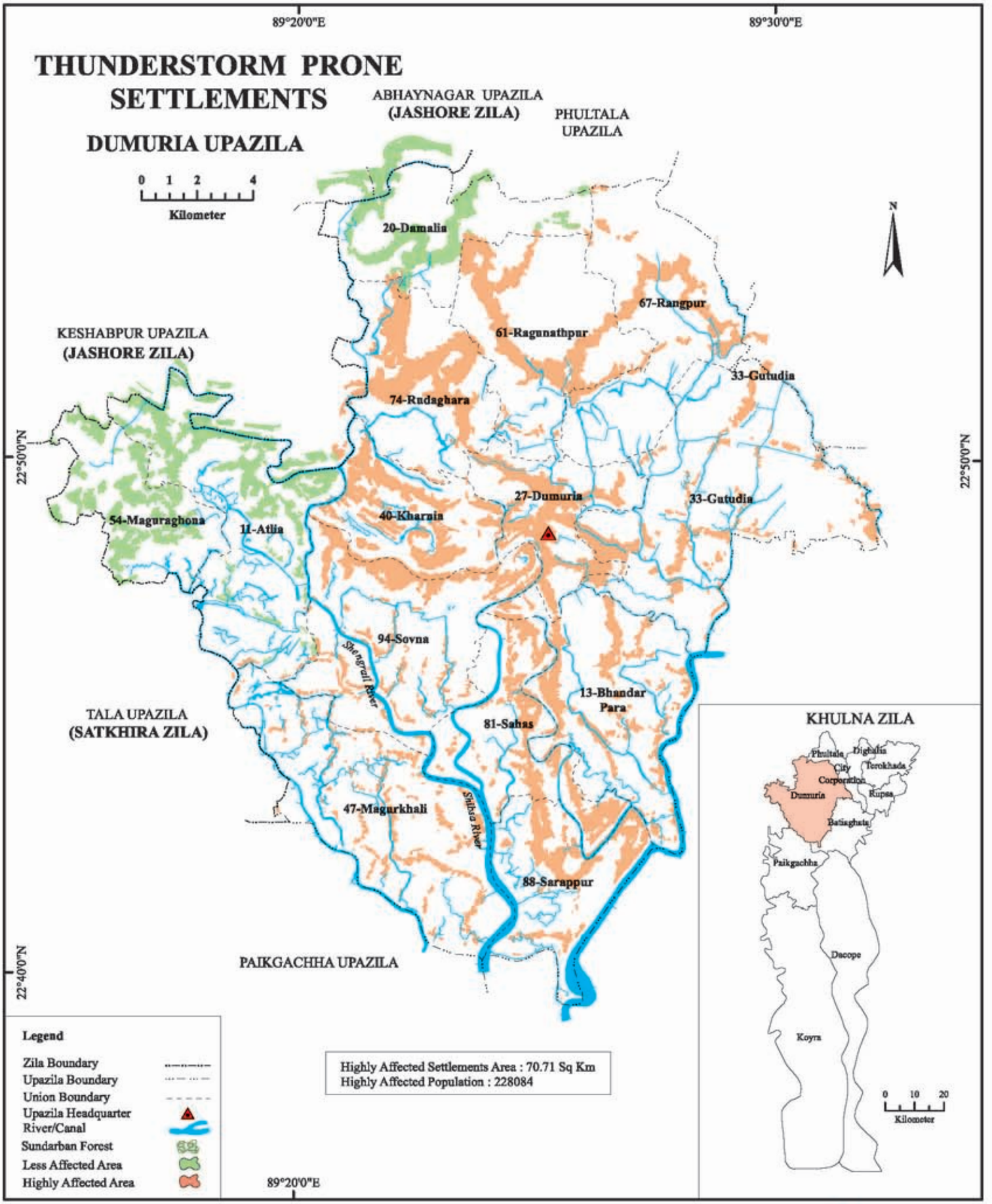

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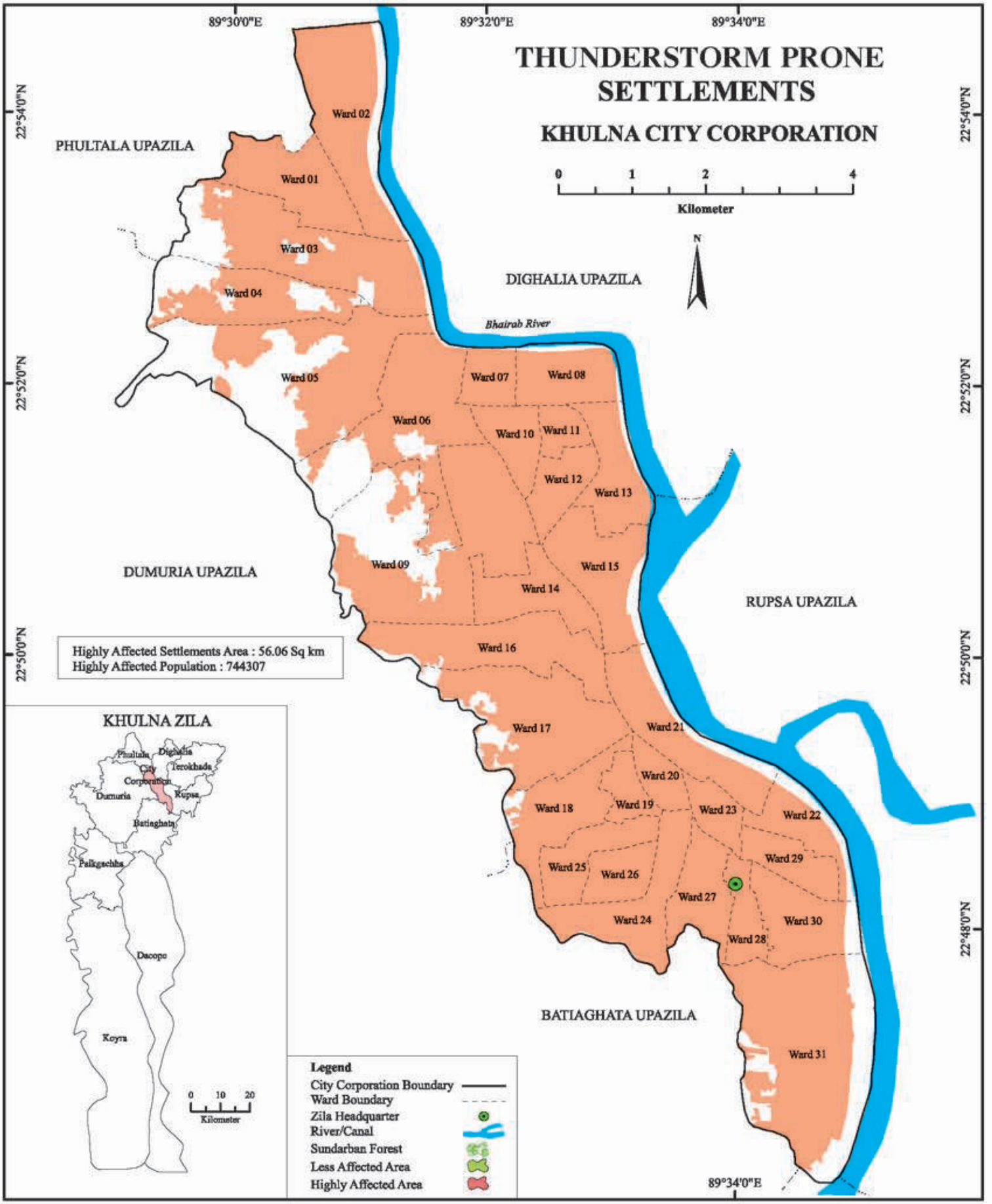

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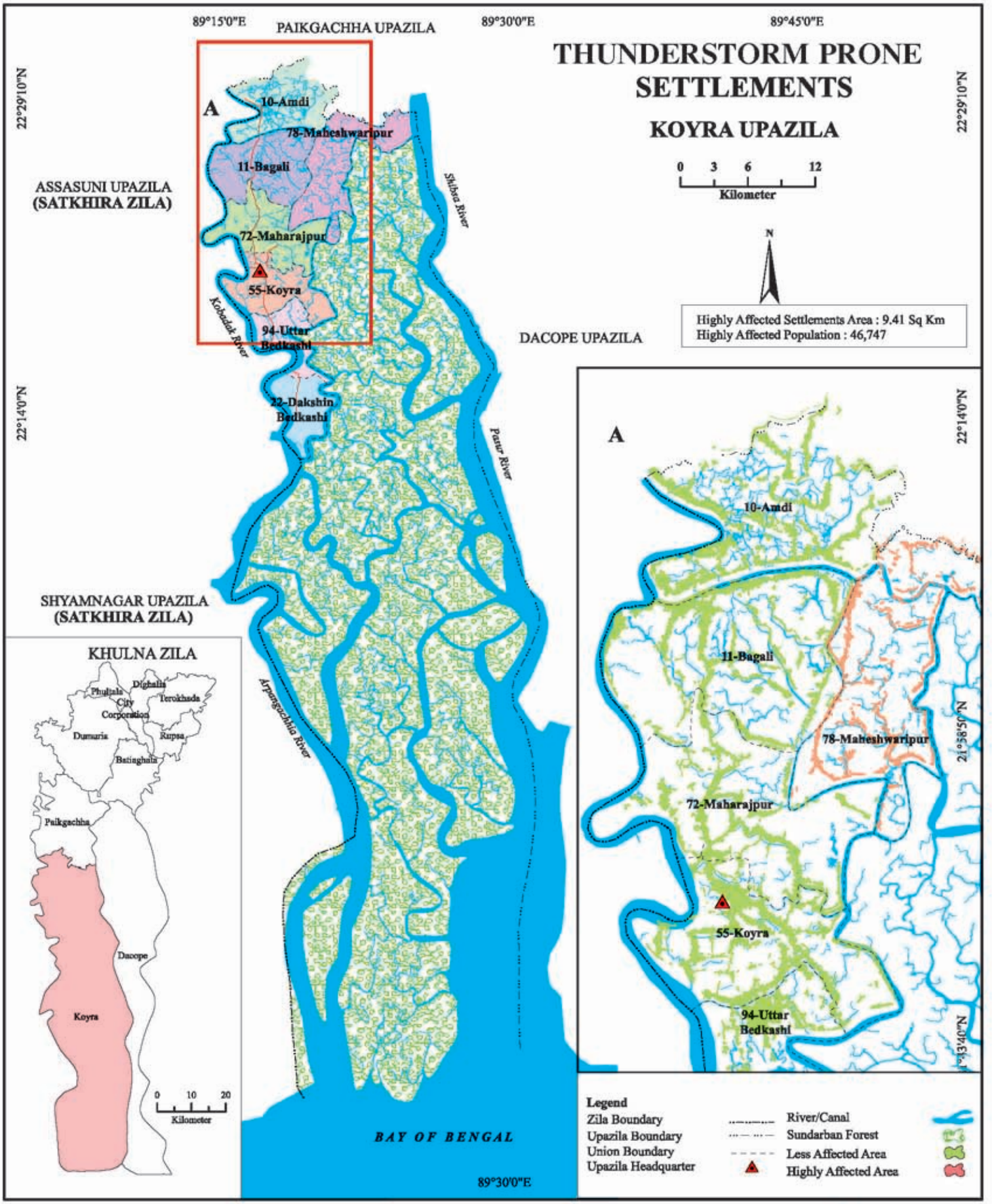

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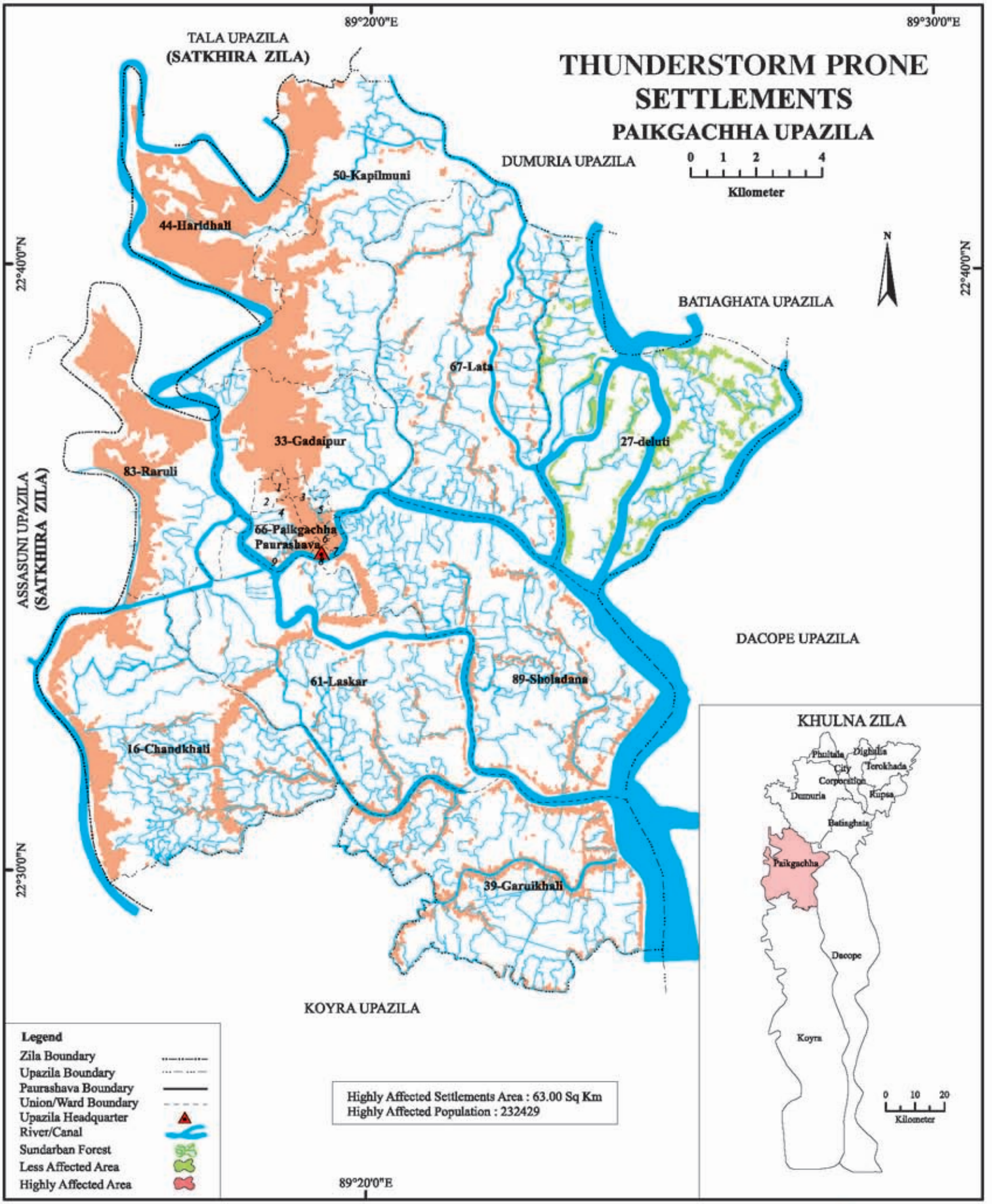
THUNDERSTORM PRONE SETTLEMENTS
PAIKGACHHA UPAZILA
89°20'0"E
89°30'0"E
22°40'0"N
22°30'0"N
TALA UPAZILA
(SATKHIRA ZILA)
DUMURIA UPAZILA
BATIAGHATA UPAZILA
ASSASUNI UPAZILA
(SATKHIRA ZILA)
DACOPE UPAZILA
KOYRA UPAZILA
0 1 2 4
Kilometer
N
50-Kapilmuni
44-Haridhali
67-Lata
33-Gadaipur
27-deluti
83-Raruli
66-Paikgachha Paurashava
61-Laskar
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KHULNA ZILA
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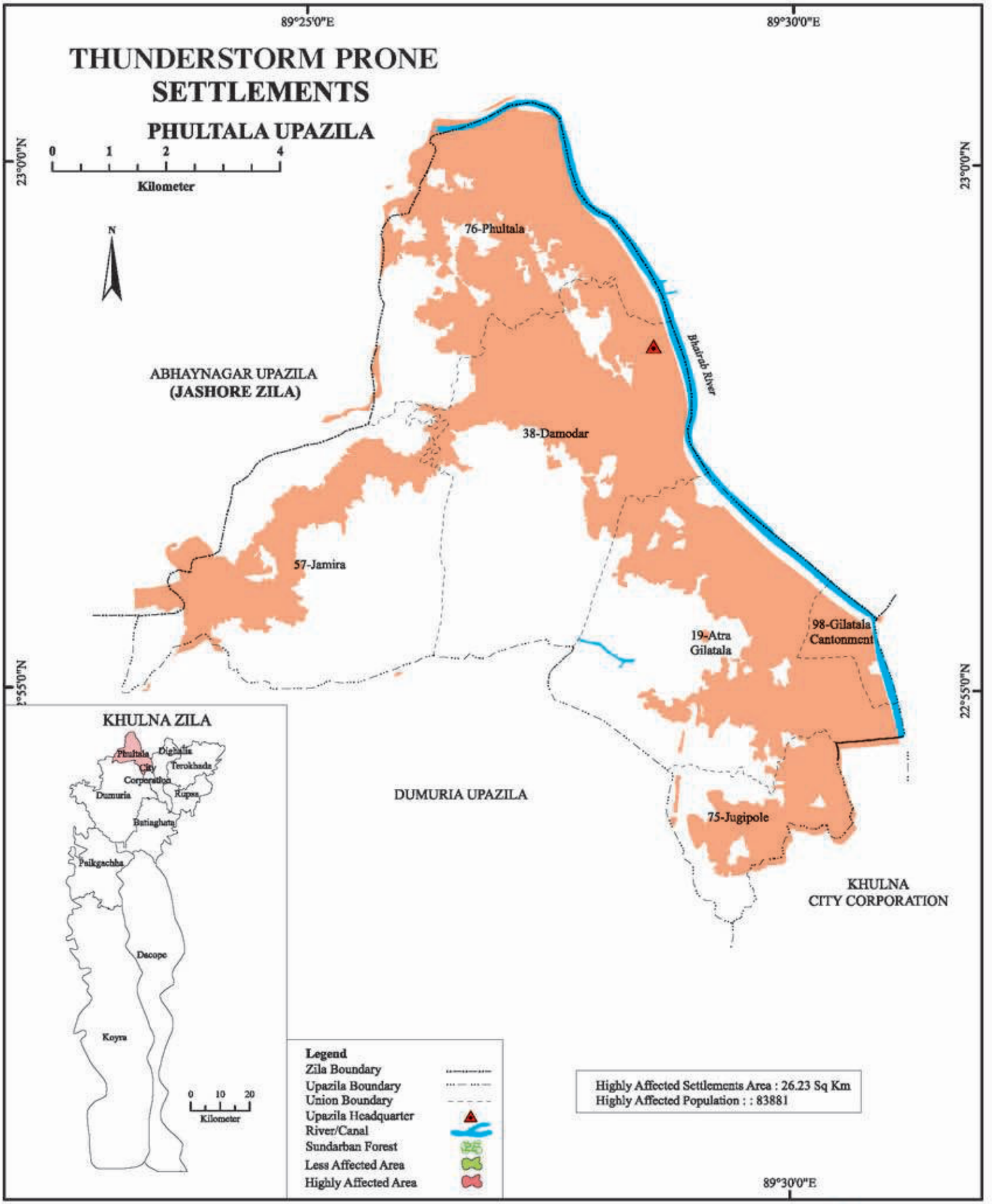
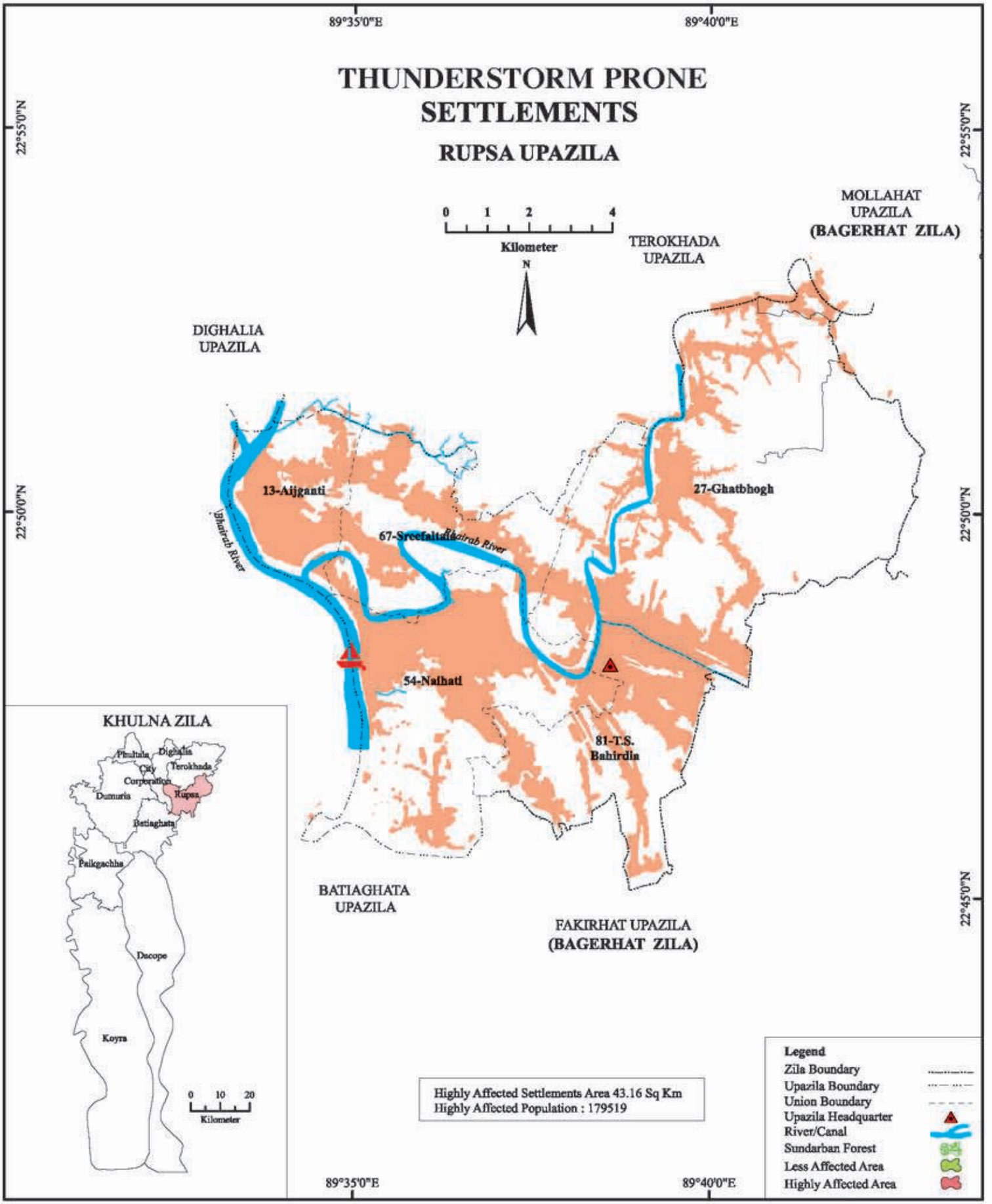
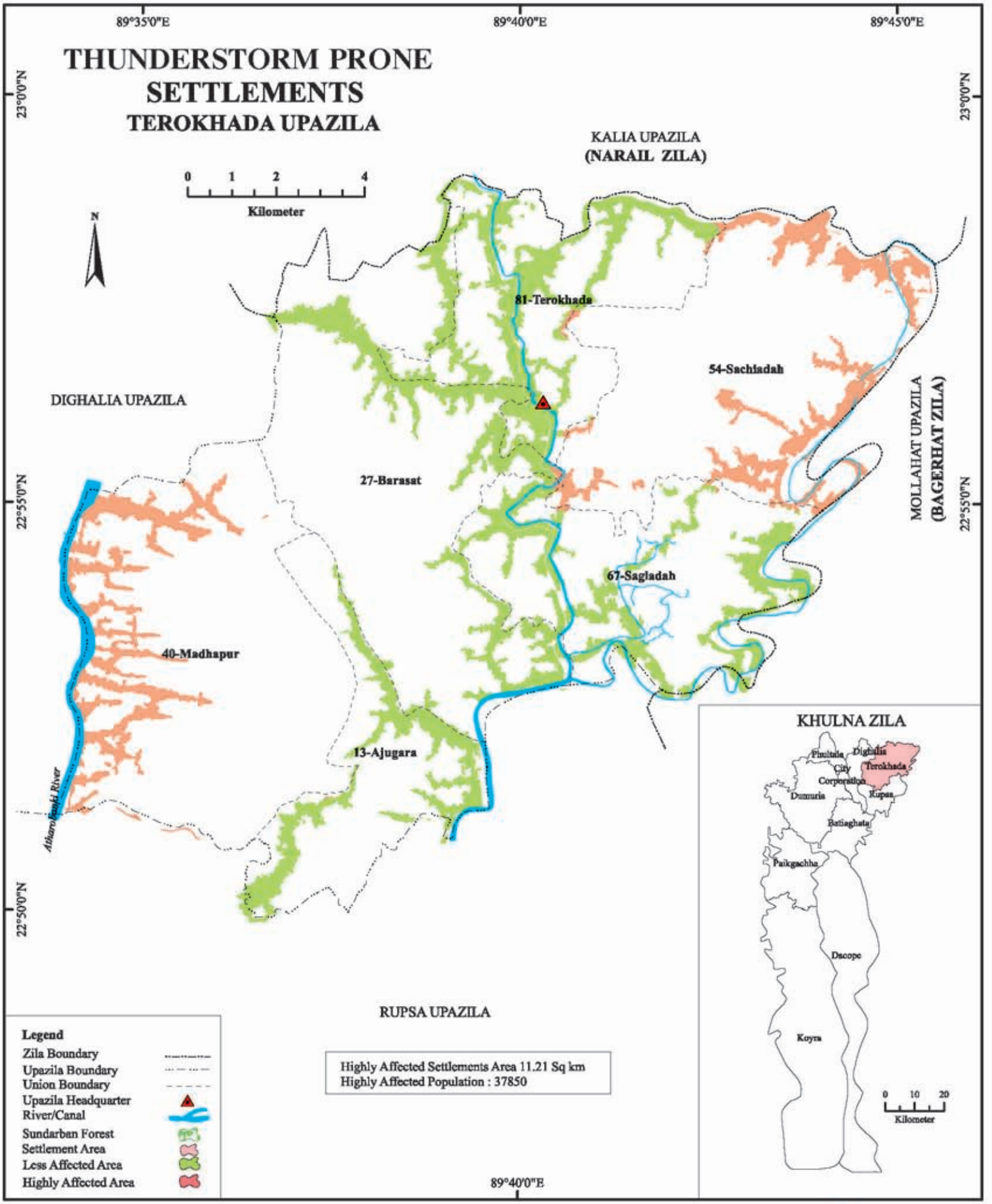
City
Terokhada
Corporation
Dumuria
Rupsa
Batiaghata
Paikgachha
Dacope
Koyra
0 10 20
Kilometer
Legend
Zila Boundary
Upazila Boundary
Paurashava Boundary
Union/Ward Boundary
Upazila Headquarter
River/Canal
Sundarban Forest
Less Affected Area
Highly Affected Area
Highly Affected Settlements Area : 63.00 Sq Km
Highly Affected Population : 232429



Stat4Dev Project, 2021

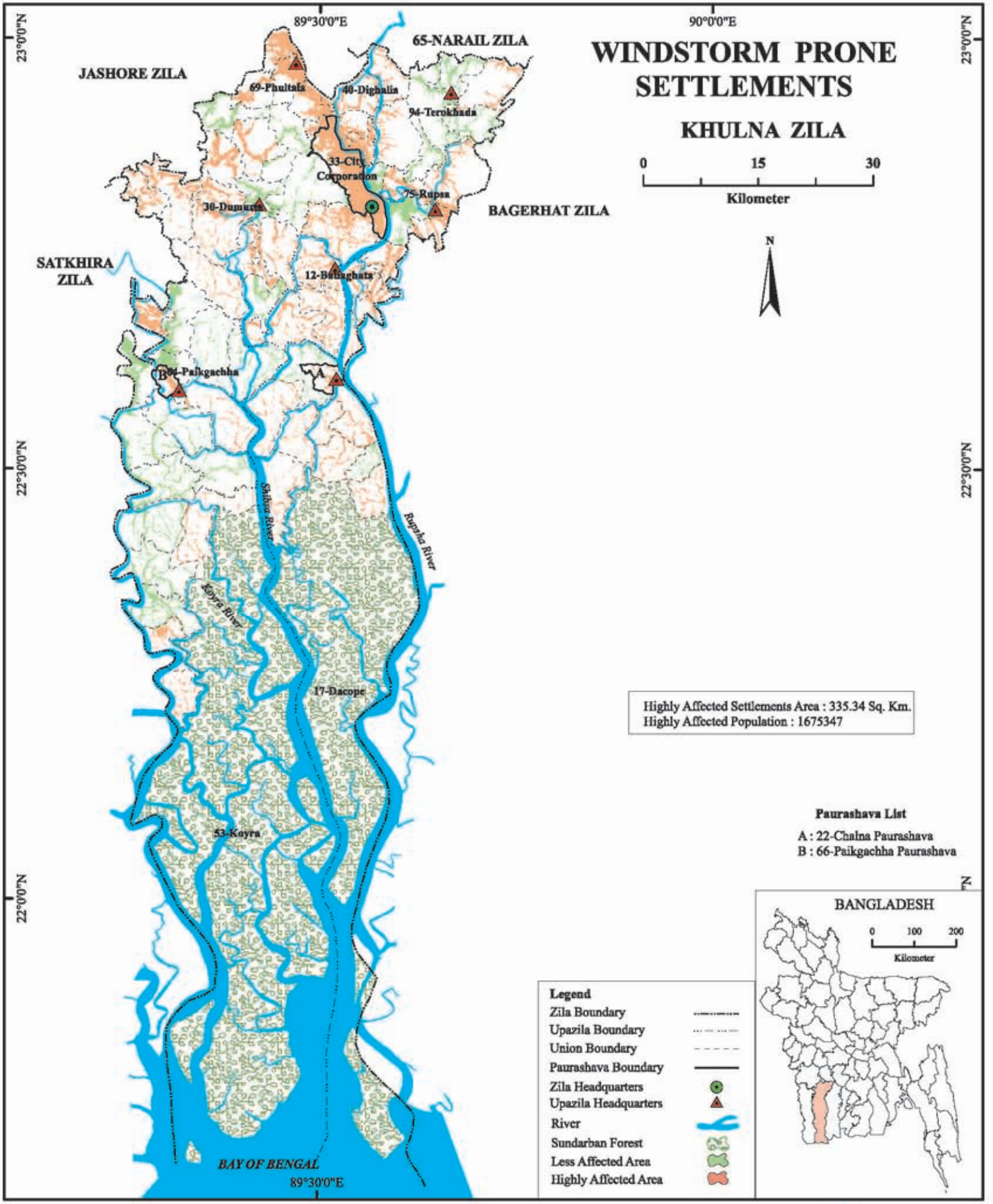


Stat4Dev Project, 2021

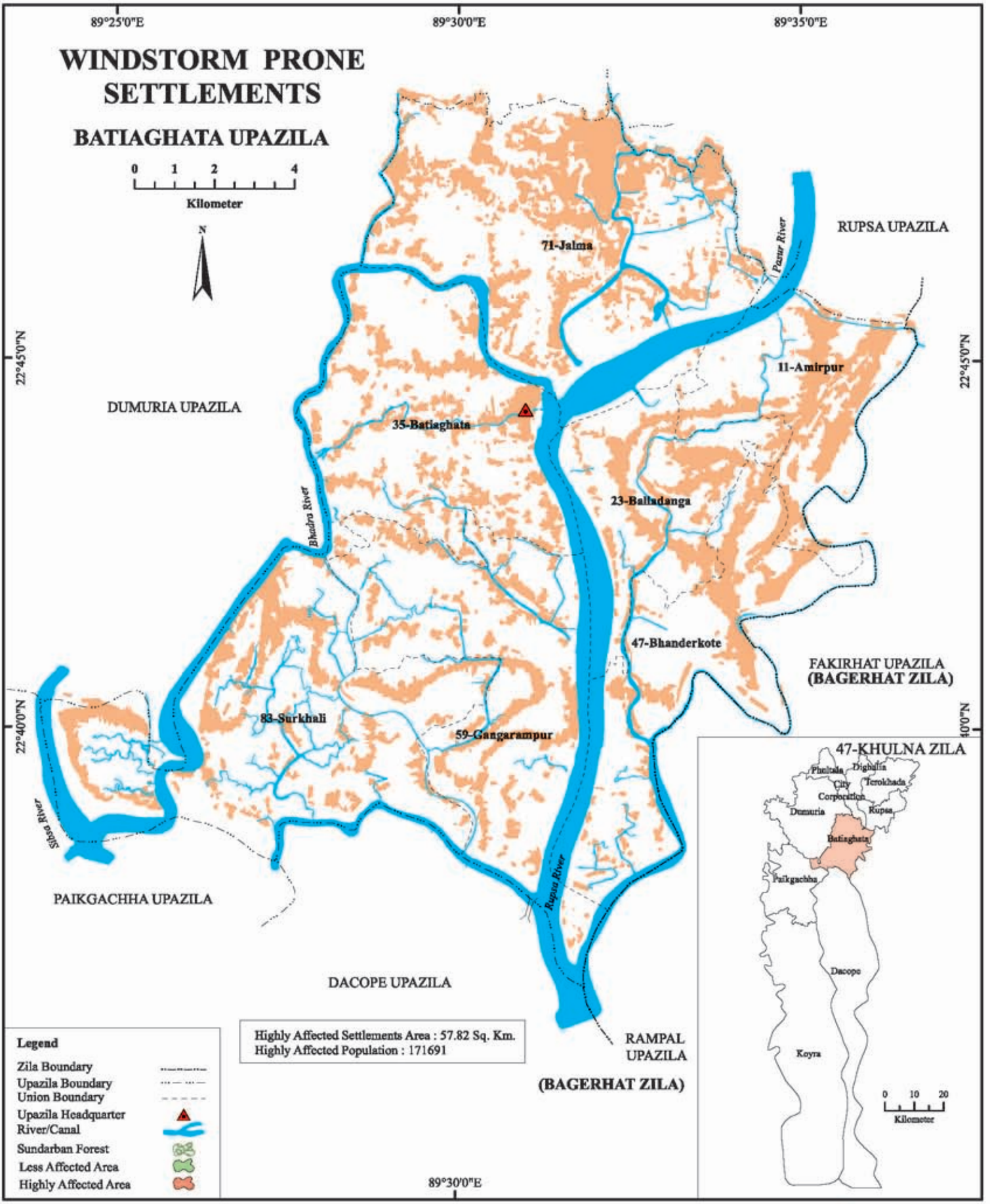


Stat4Dev Project, 2021

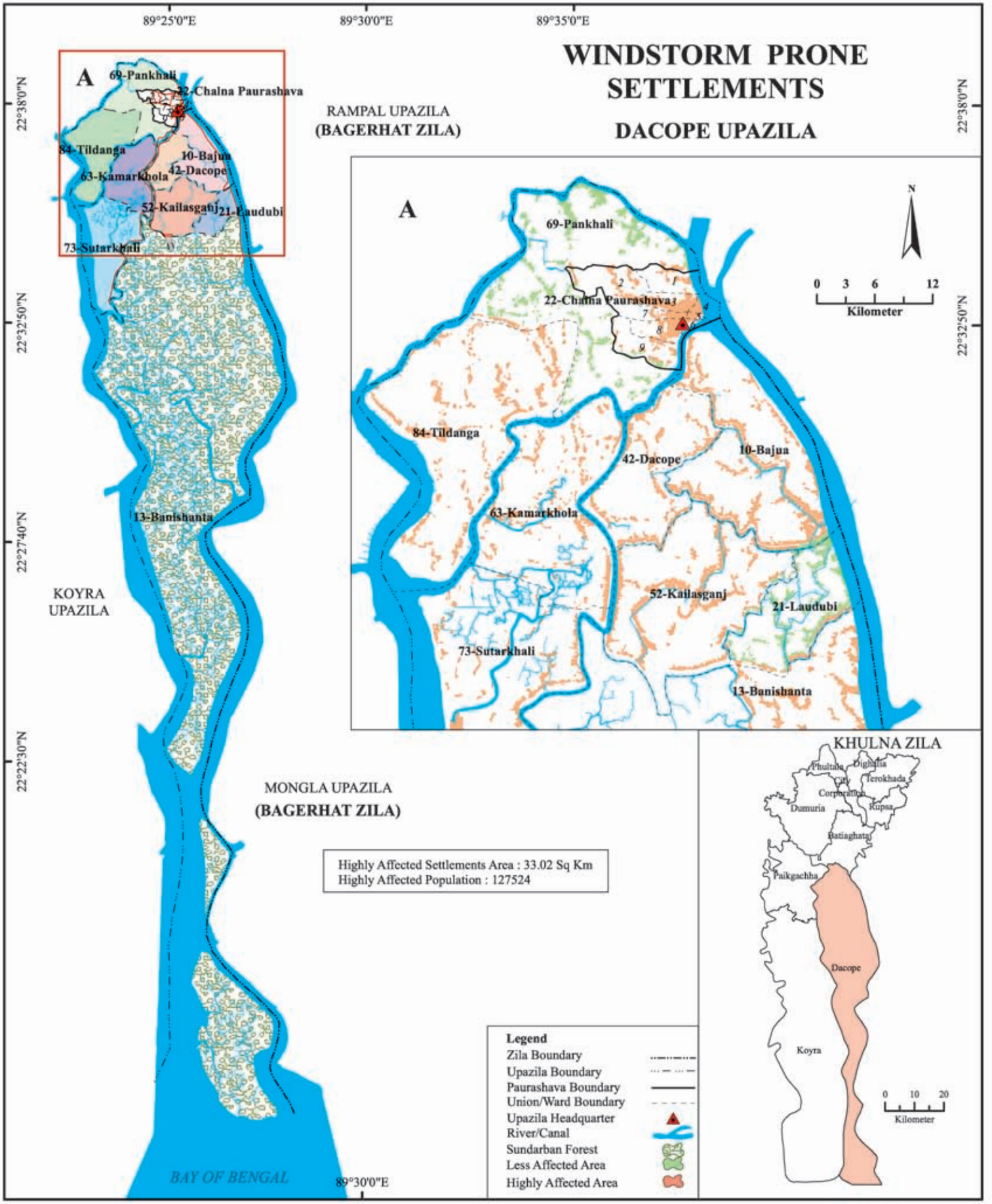
Windstorm Prone
Area Map



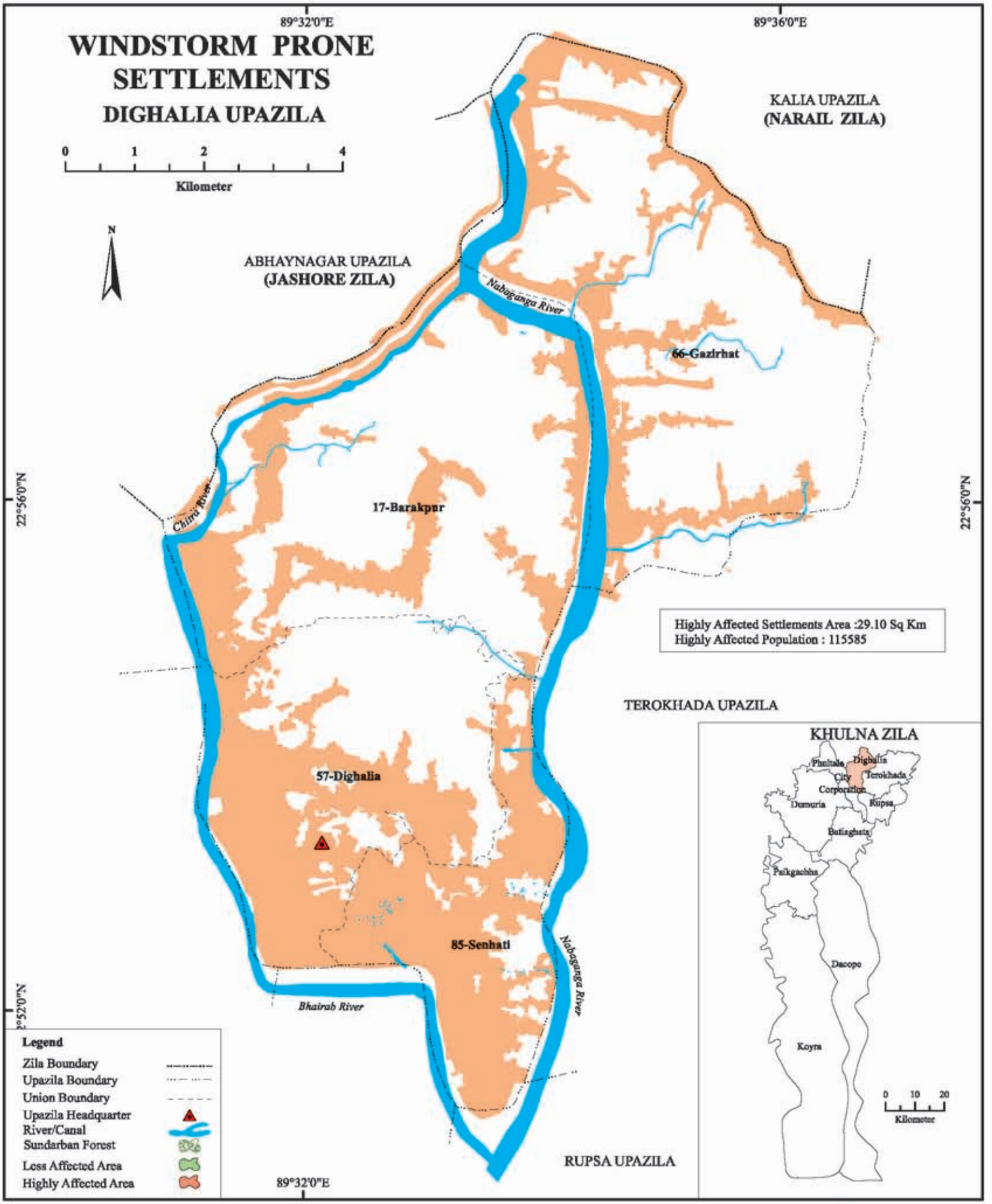
Stat4Dev Project, 2021



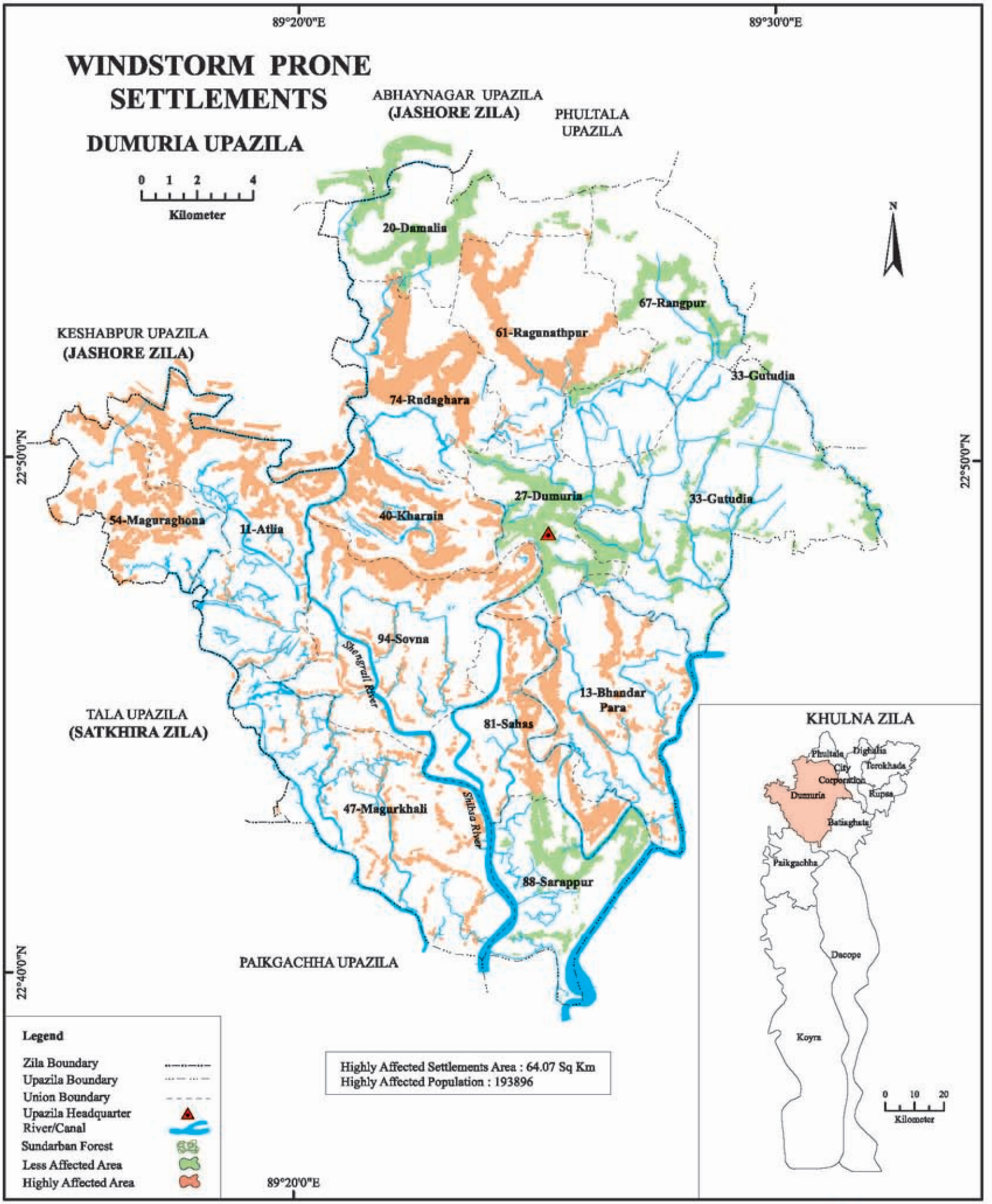
Stat4Dev Project, 2021



Stat4Dev Project, 2021



Stat4Dev Project, 2021



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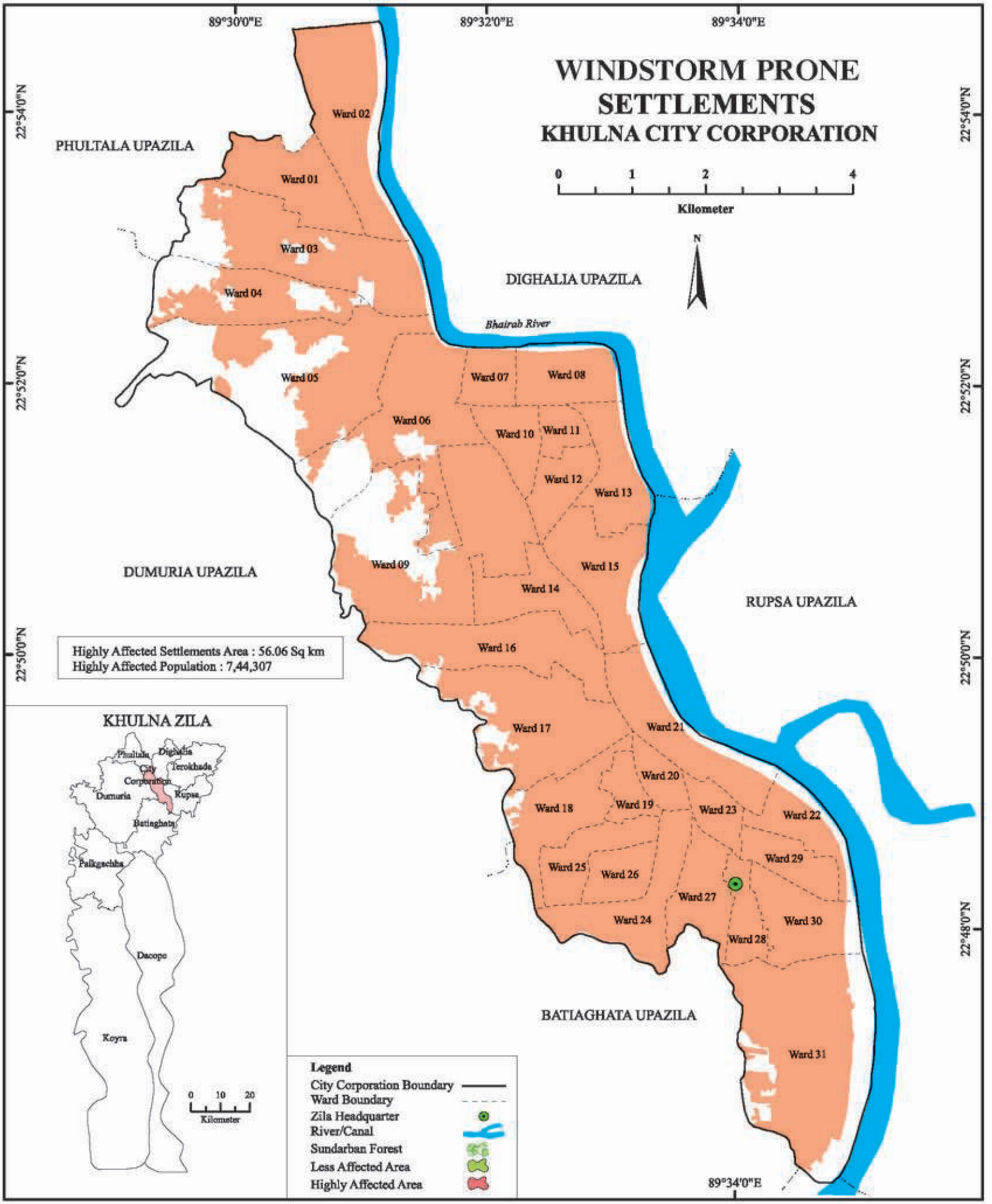

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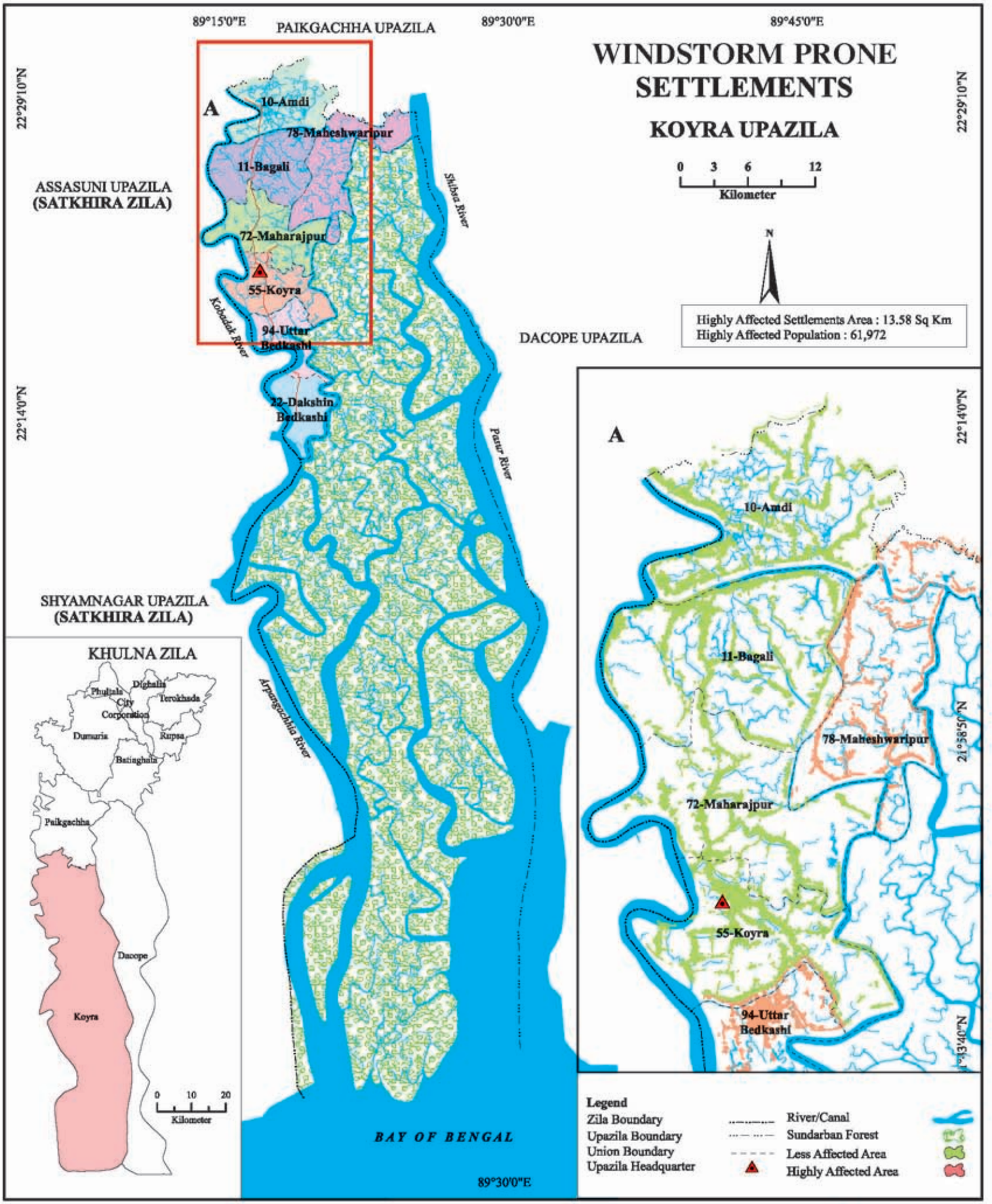

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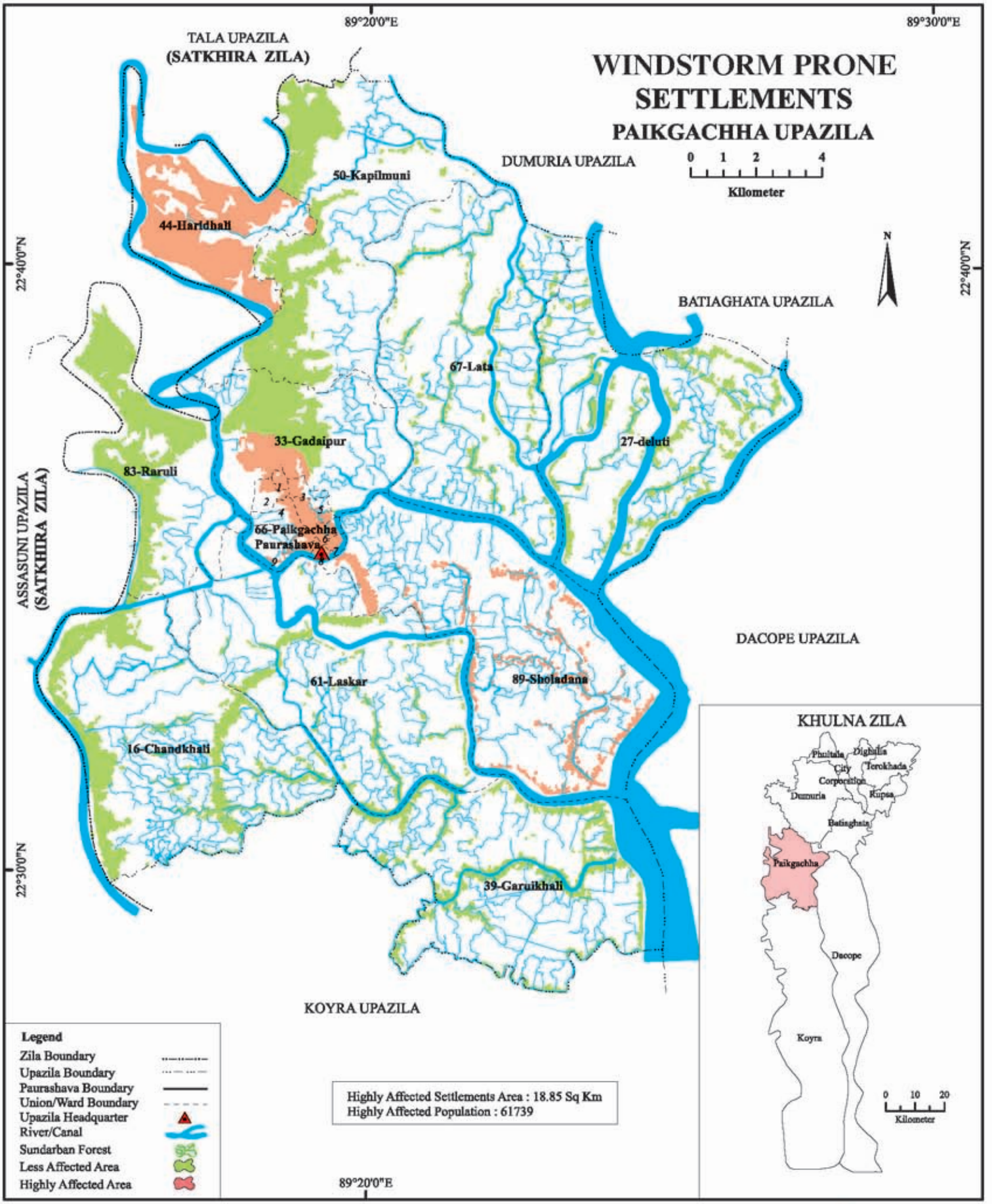
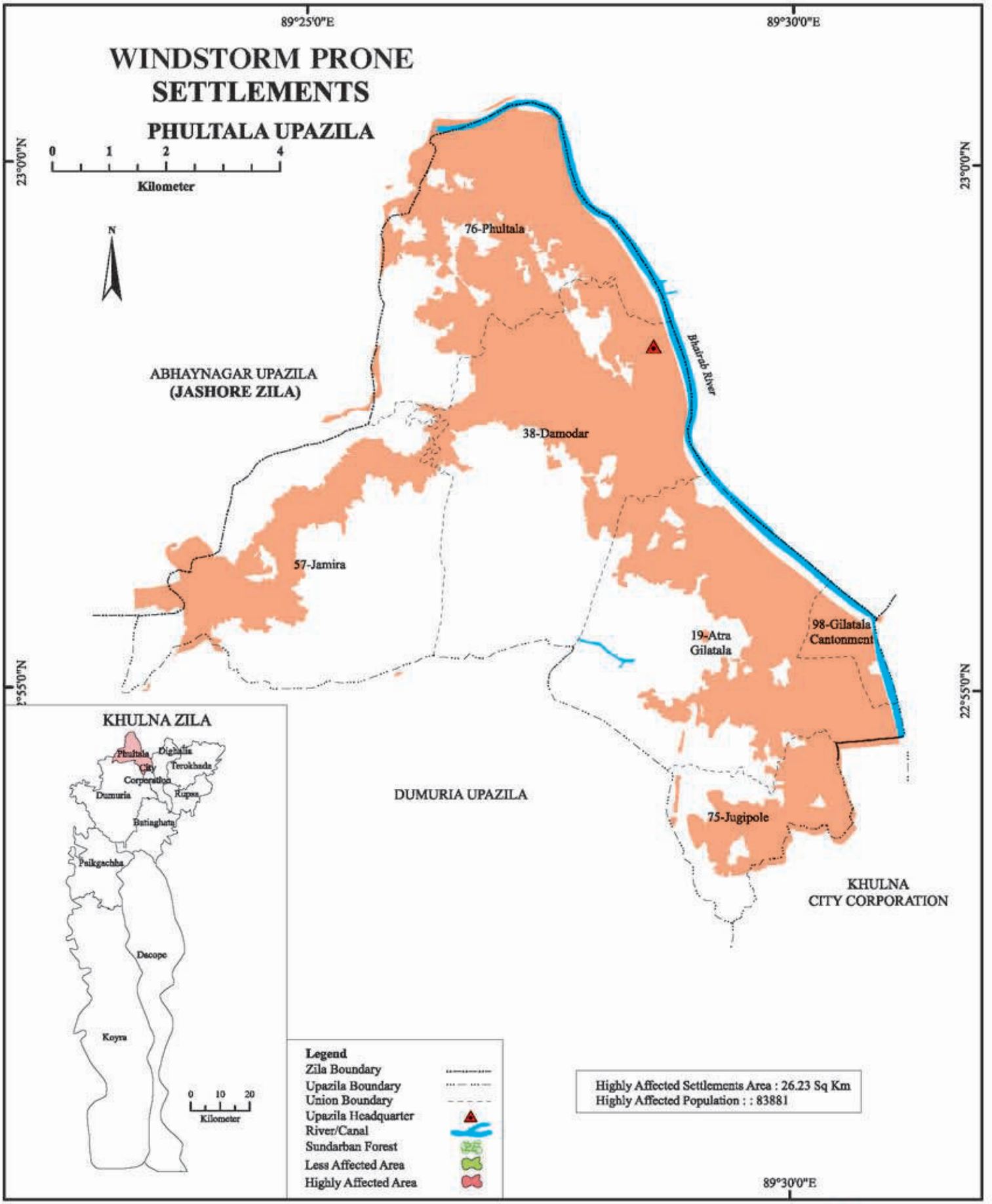
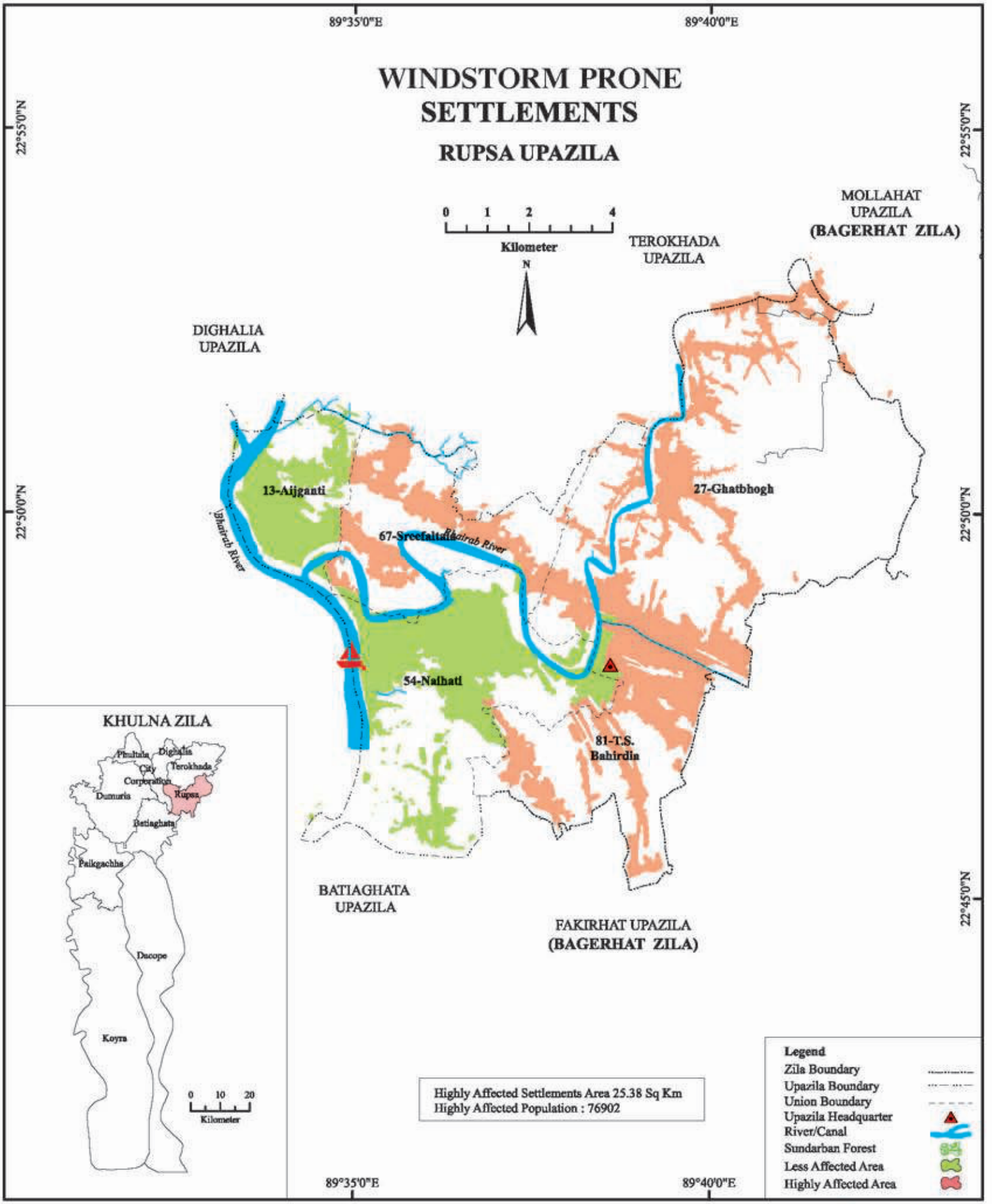
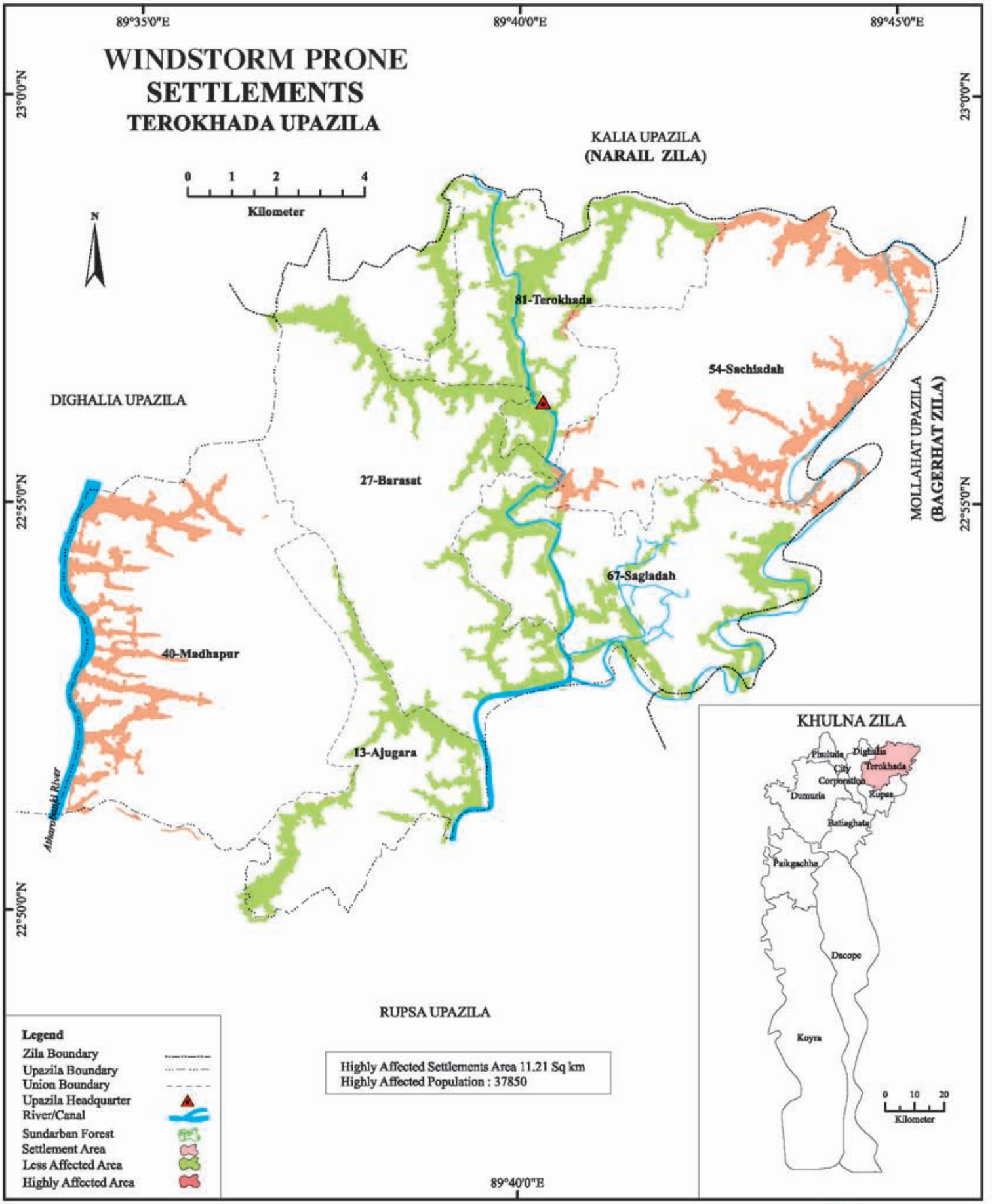

WINDSTORM PRONE SETTLEMENTS
PAIKGACHHA UPAZILA
89°20'0"E
89°30'0"E
22°40'0"N
22°30'0"N
TALA UPAZILA (SATKHIRA ZILA)
DUMURIA UPAZILA
BATIAGHATA UPAZILA
ASSASUNI UPAZILA (SATKHIRA ZILA)
DACOPE UPAZILA
KOYRA UPAZILA
0 1 2 4
Kilometer
N
50-Kapilmuni
44-Haridhali
67-Lata
33-Gadaipur
27-deluti
83-Raruli
66-Paikgachha Paurashava
61-Laskar
89-Sholadana
16-Chandkhali
39-Garuikhali
KHULNA ZILA
Phultala
Dighalia
City
Terokhada
Corporation
Dumuria
Rupsa
Batiaghata
Paikgachha
Dacope
Koyra
0 10 20
Kilometer
Legend
Zila Boundary
Upazila Boundary
Paurashava Boundary
Union/Ward Boundary
Upazila Headquarter
River/Canal
Sundarban Forest
Less Affected Area
Highly Affected Area
Highly Affected Settlements Area : 18.85 Sq Km
Highly Affected Population : 61739



Stat4Dev Project, 2021

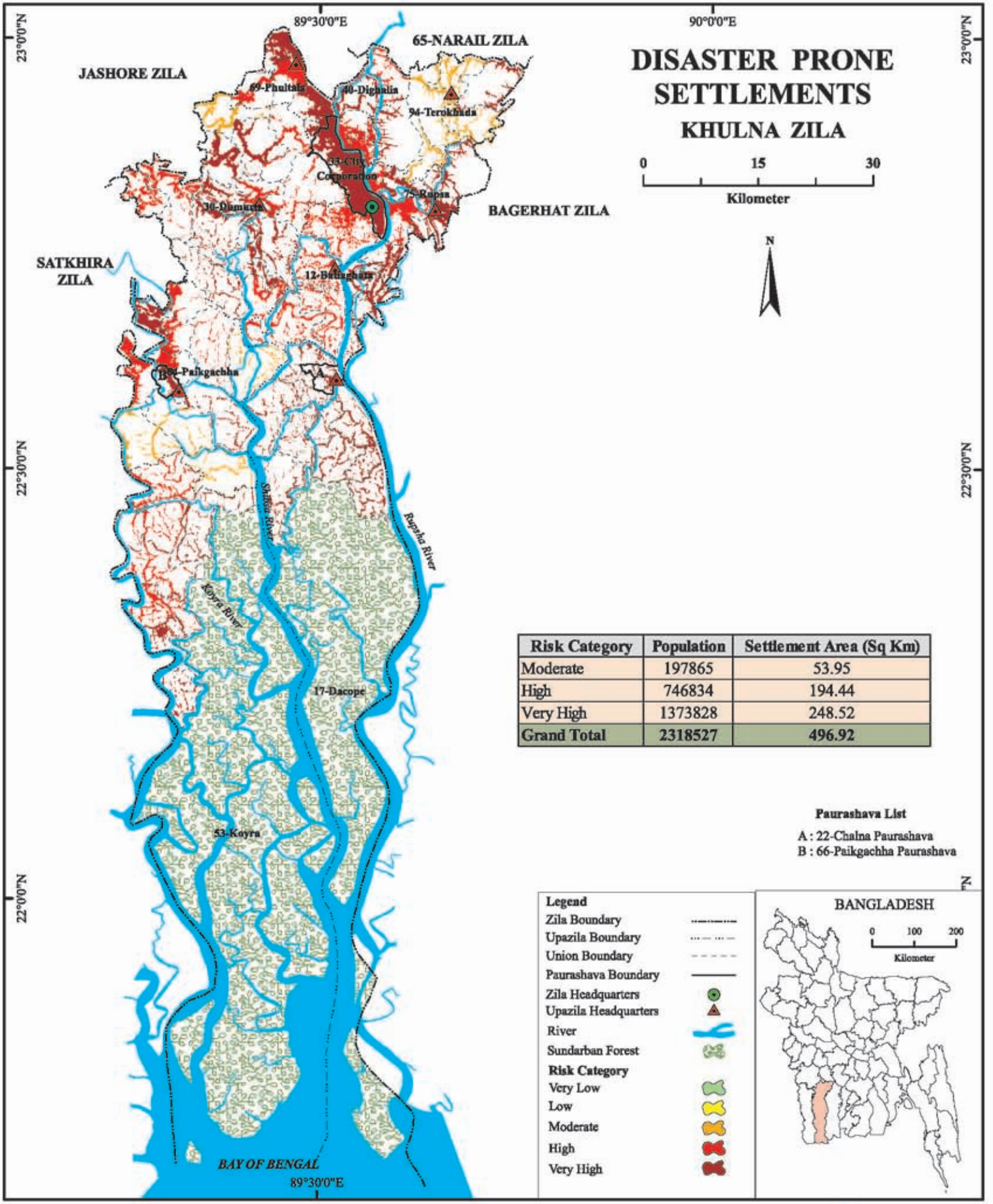


Stat4Dev Project, 2021



Stat4Dev Project, 2021

Disaster Prone Area Map



Risk Category	Population	Settlement Area (Sq Km)
Moderate	197865	53.95
High	746834	194.44
Very High	1373828	248.52
Grand Total	**2318527**	**496.92**

Paurashava List

A : 22-Chalna Paurashava
B : 66-Paikgachha Paurashava

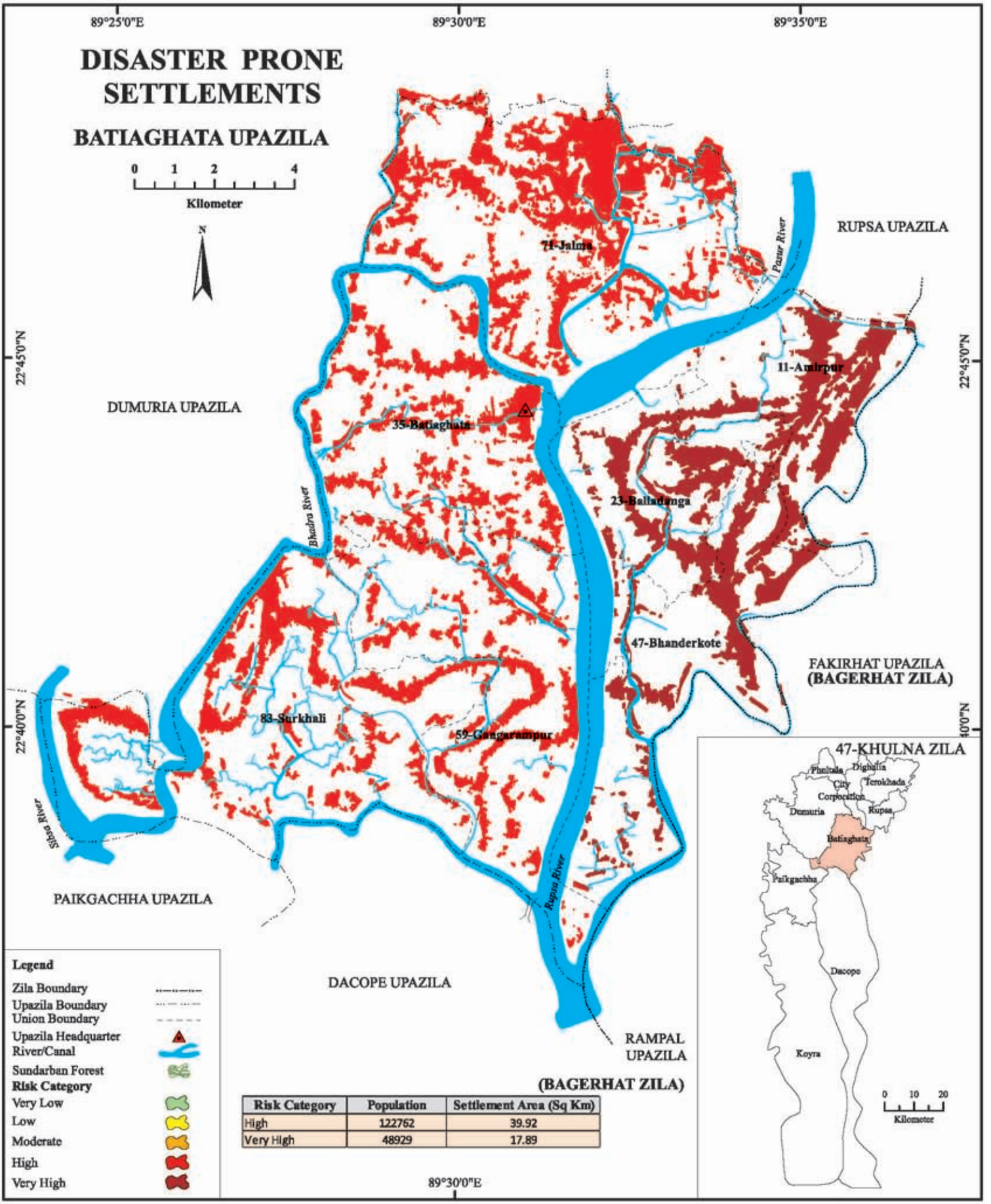
Legend

- Zila Boundary
- Upazila Boundary
- Union Boundary
- Paurashava Boundary
- Zila Headquarters
- Upazila Headquarters
- River
- Sundarban Forest

Risk Category

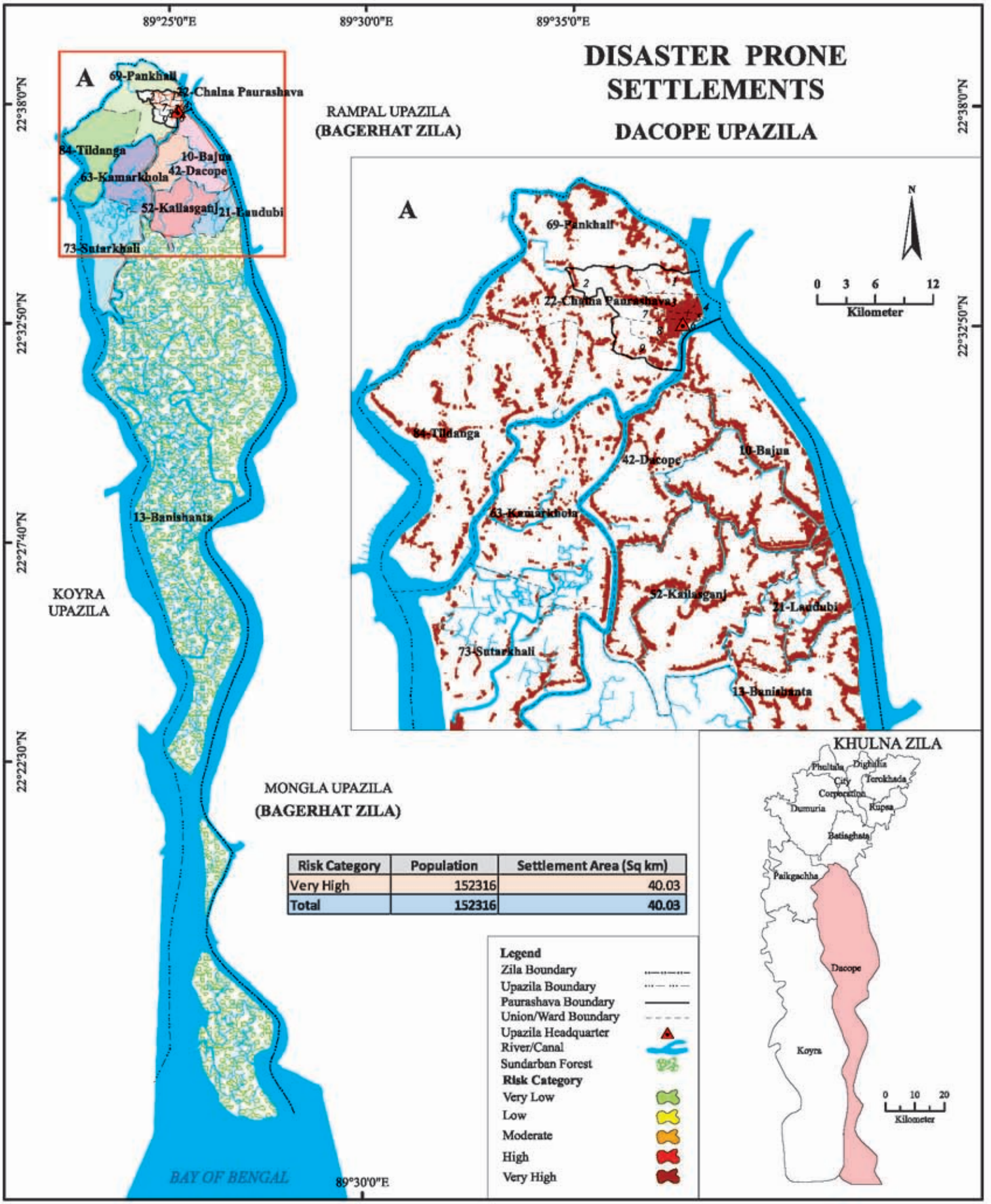
- Very Low
- Low
- Moderate
- High
- Very High

Stat4Dev Project, 2021



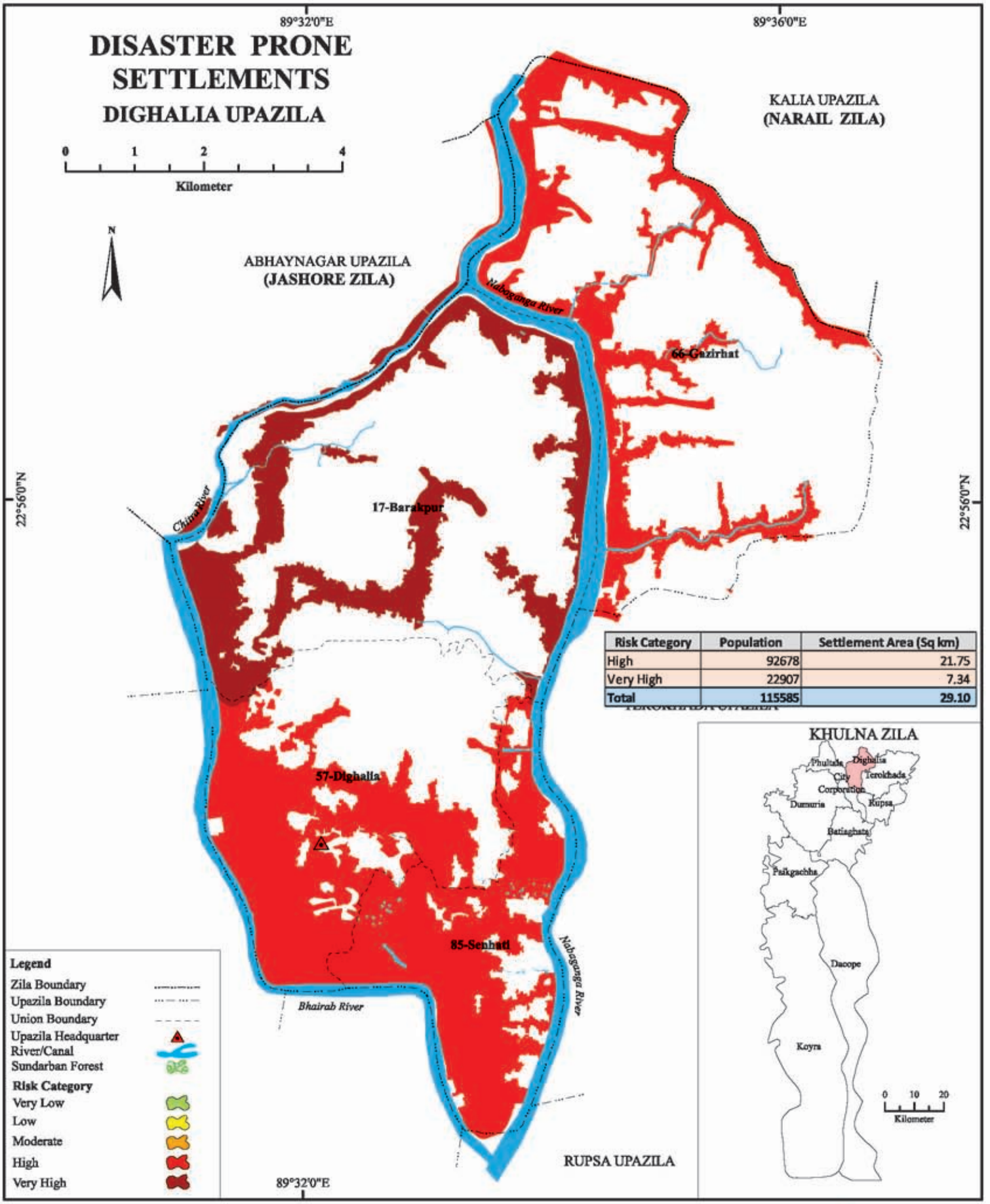
Risk Category	Population	Settlement Area (Sq Km)
High	122762	39.92
Very High	48929	17.89

Stat4Dev Project, 2021



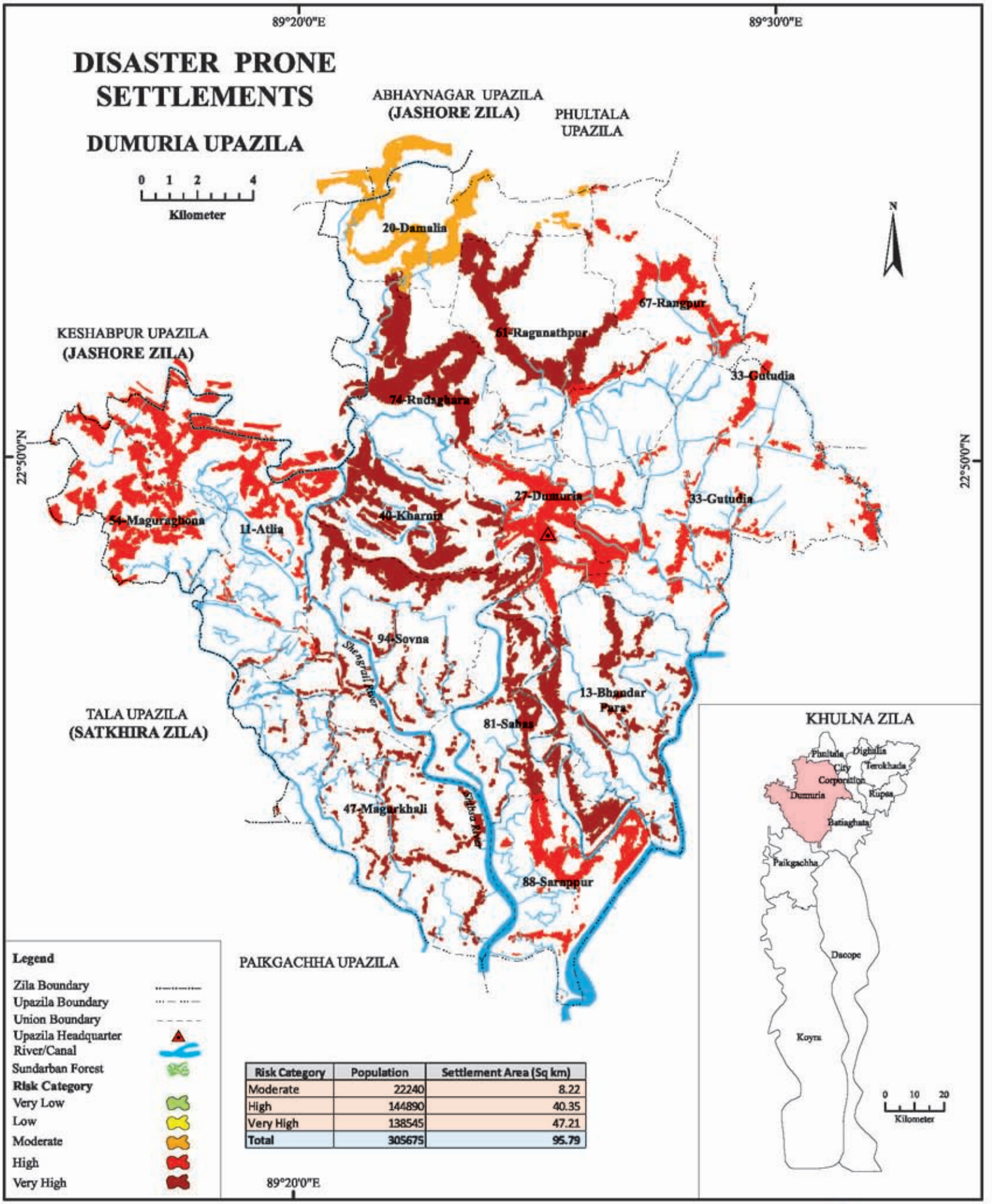
Risk Category	Population	Settlement Area (Sq km)
Very High	152316	40.03
Total	152316	40.03

Stat4Dev Project, 2021



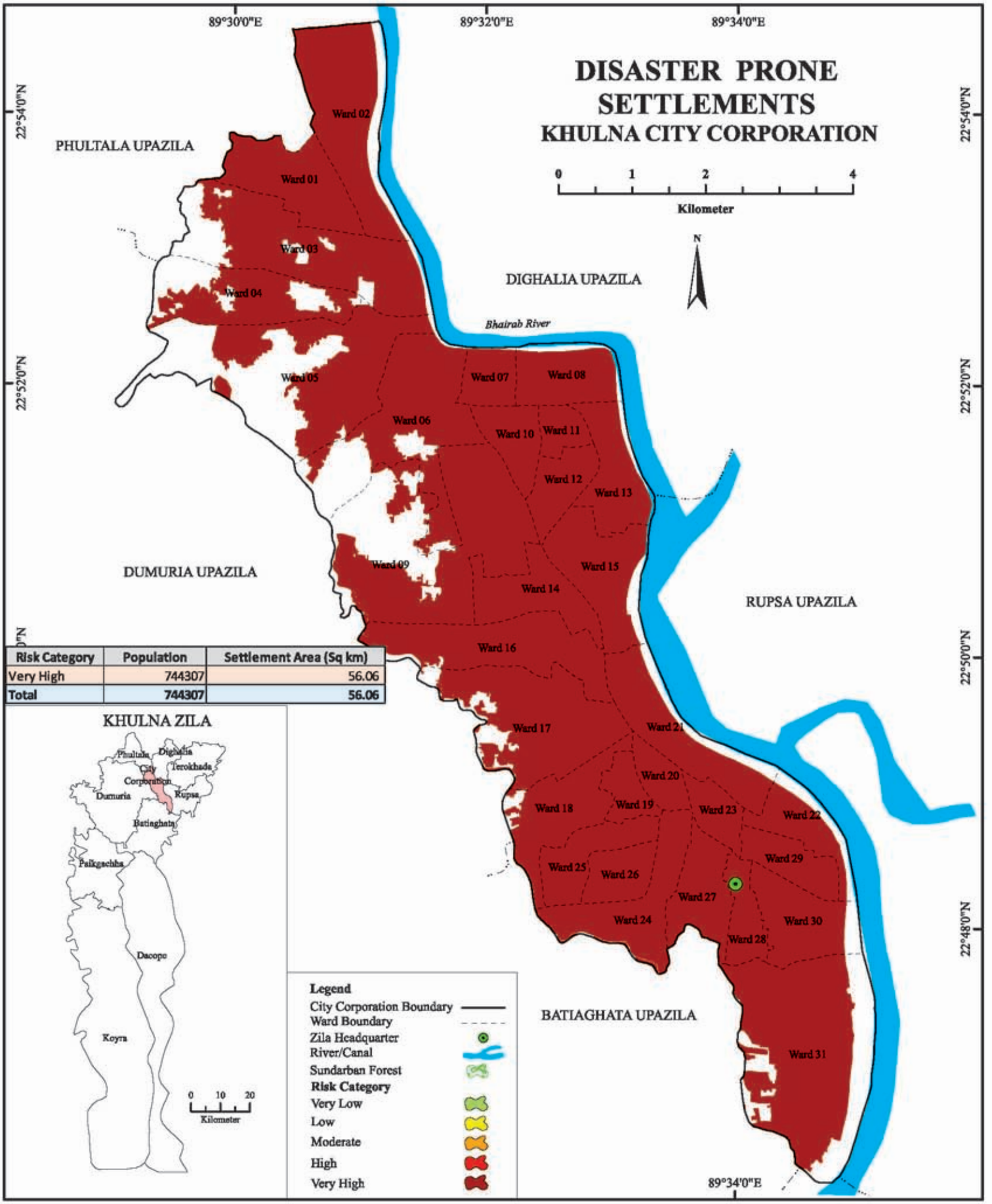
Risk Category	Population	Settlement Area (Sq km)
High	92678	21.75
Very High	22907	7.34
Total	**115585**	**29.10**

Stat4Dev Project, 2021



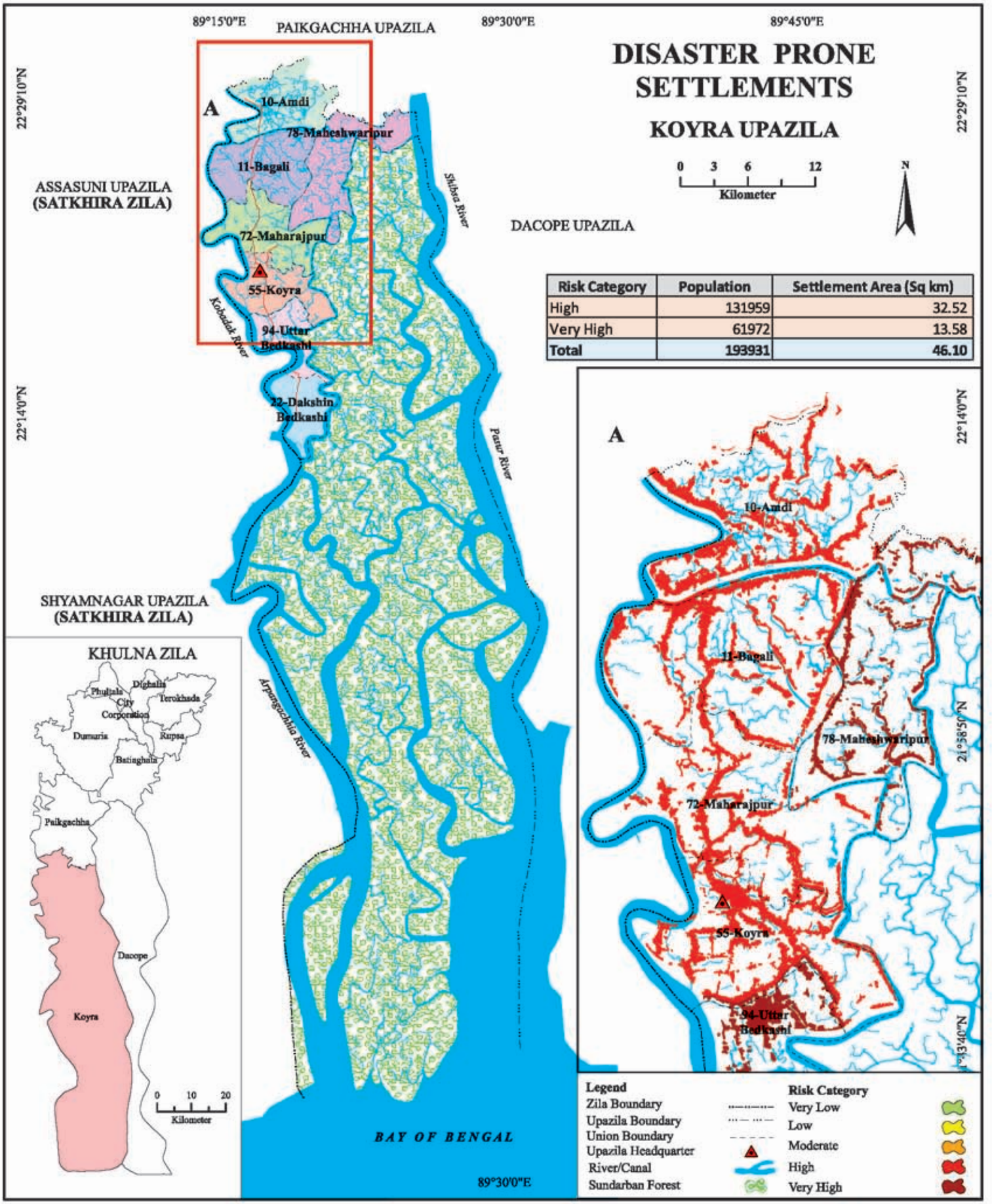
Risk Category	Population	Settlement Area (Sq km)
Moderate	22240	8.22
High	144890	40.35
Very High	138545	47.21
Total	305675	95.79

Stat4Dev Project, 2021



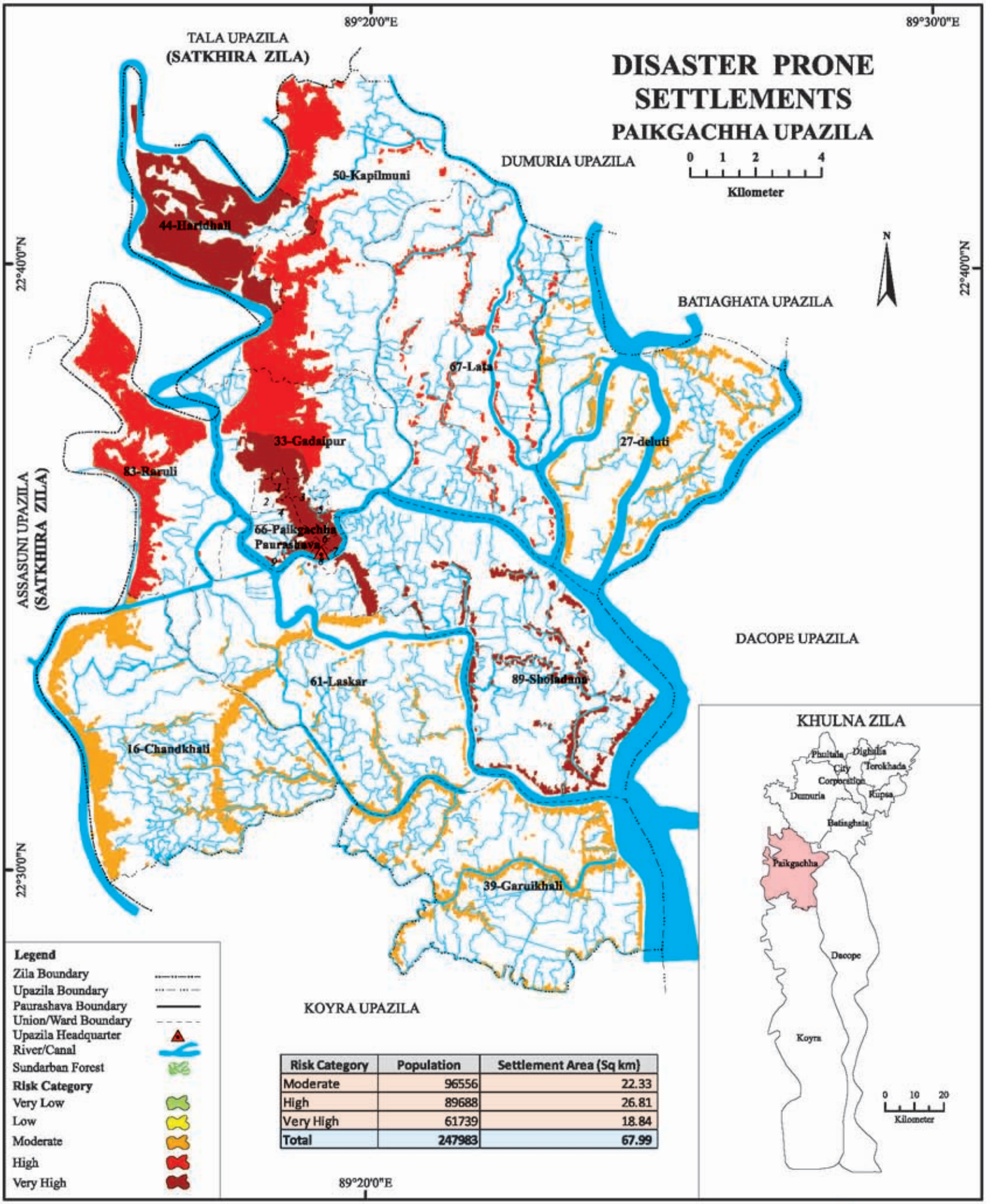
Risk Category	Population	Settlement Area (Sq km)
Very High	744307	56.06
Total	**744307**	**56.06**

Stat4Dev Project, 2021



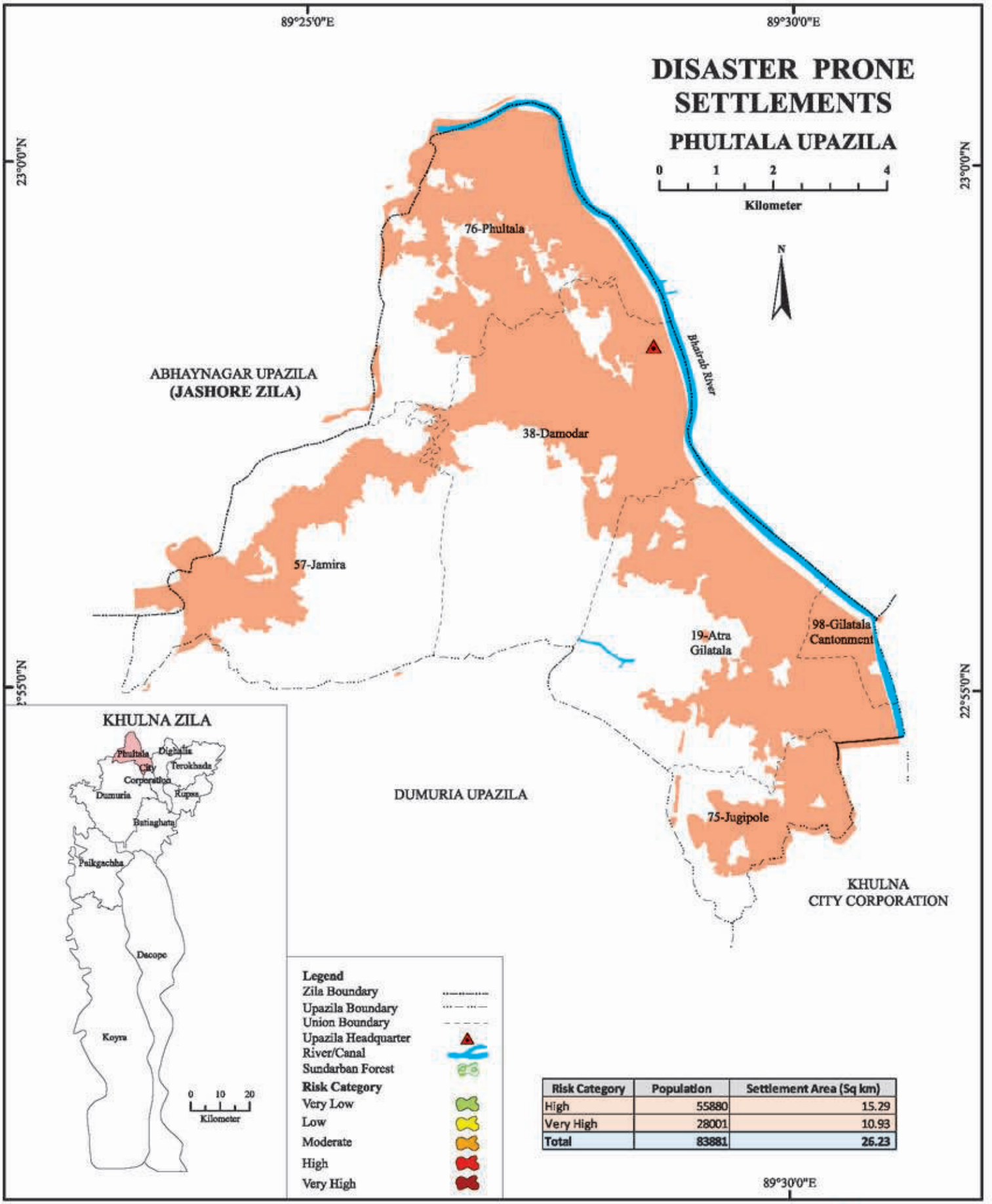
Risk Category	Population	Settlement Area (Sq km)
High	131959	32.52
Very High	61972	13.58
Total	**193931**	**46.10**

Stat4Dev Project, 2021



Risk Category	Population	Settlement Area (Sq km)
Moderate	96556	22.33
High	89688	26.81
Very High	61739	18.84
Total	247983	67.99

Stat4Dev Project, 2021

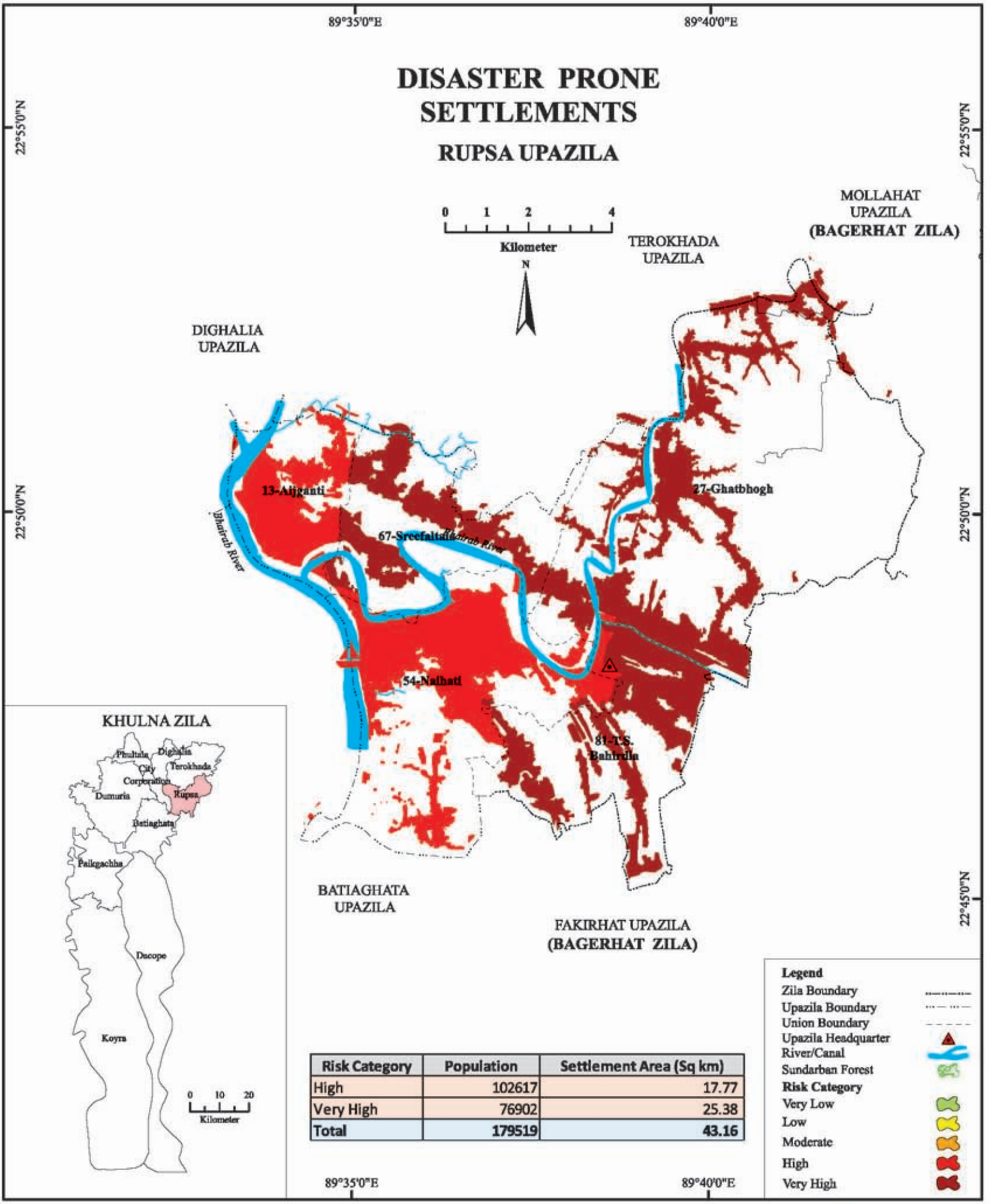


Risk Category	Population	Settlement Area (Sq km)
High	55880	15.29
Very High	28001	10.93
Total	**83881**	**26.23**

Stat4Dev Project, 2021

DISASTER PRONE SETTLEMENTS

RUPSA UPAZILA



Risk Category	Population	Settlement Area (Sq km)
High	102617	17.77
Very High	76902	25.38
Total	179519	43.16

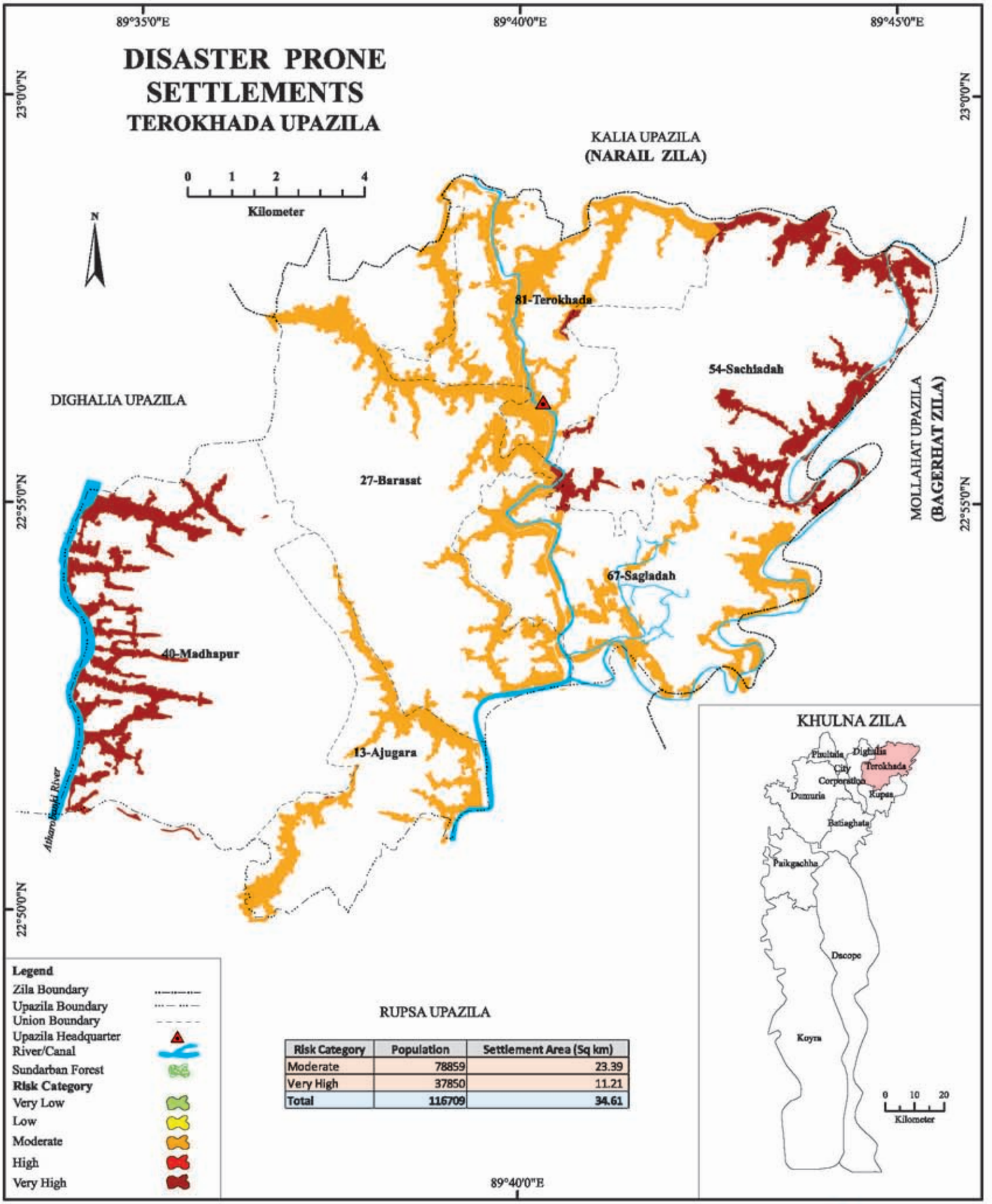
Legend

- Zila Boundary
- Upazila Boundary
- Union Boundary
- Upazila Headquarter
- River/Canal
- Sundarban Forest

Risk Category

- Very Low
- Low
- Moderate
- High
- Very High

Stat4Dev Project, 2021



Risk Category	Population	Settlement Area (Sq km)
Moderate	78859	23.39
Very High	37850	11.21
Total	**116709**	**34.61**

Stat4Dev Project, 2021

Appendix A

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
বাংলাদেশ পরিসংখ্যান ব্যুরো
Stat4Dev প্রকল্প
পরিসংখ্যান ভবন
ই-২৭/এ, আগারগাঁ, ঢাকা১২০৭

দুর্যোগ প্রবণ এলাকা অ্যাটলাস (Disaster Prone Area Atlas) তৈরির জন্য তথ্য সংগ্রহ ফরম

জেলার নাম: কোড:	সিটি কর্পোরেশনের নাম: কোড:	উপজেলার নাম: কোড:	পৌরসভার নাম: কোড:
ইউনিয়নের নাম: কোড:	ওয়ার্ডের নাম: কোড:	গ্রামের নাম: কোড:	মহল্লার নাম: কোড:

১. অবকাঠামো / স্থাপনার নাম:			
২. অবকাঠামো / স্থাপনার অবস্থান:	অক্ষাংশ **(Y):**	দ্রাঘিমাংশ **(X):**	
৩. স্থাপনার প্রতিষ্ঠাকাল:		৪.স্থাপনাটি কত তলাবিশিষ্ট:	তলা
৫. স্থাপনার ধরন (অবকাঠামো):	**(নিচের নোট অনুযায়ী লিখুন)	পাকা 1	.আধা পাকা 2
৬. মোট কামরার সংখ্যা:		৭. মোট আয়তন (বর্গফুট):	বর্গফুট
৮. জেলার সঙ্গে যোগাযোগের মাধ্যম: ৯. উপজেলার সঙ্গে যোগাযোগের মাধ্যম:	ক. সড়কপথ: কাঁচা / পাকা ..... কি.মি. ক. সড়কপথ: কাঁচা / পাকা ..... কি.মি.	খ. জলপথ: ..... কি.মি. খ. জলপথ: .....কি.মি.	গ. রেলপথ: ..... কি.মি. গ. রেলপথ: ..... কি.মি.
১০. খোলা মাঠ আছে কি?	হ্যাঁ 1	না 2	হ্যাঁ হলে, আয়তন (বর্গফুট): বর্গফুট
১১.বিদ্যুৎ সুবিধা আছে কি?	হ্যাঁ 1	না 2	১২. টেলিভিশন আছে কি? হ্যাঁ 1 না 2
১৩. সংঘঠিত দুর্যোগের বিবরণ:			

দুর্যোগের ধরন (কোডসহ)	কারণ (কোডসহ)	সময় (কোডসহ) (কোন মাসে)	উৎস (কোডসহ) (প্রাকৃতিক/ মানবসৃষ্ট)	স্থায়িত্ব (দিন/মাস)	ব্যাপ্তি (মৌজা /গ্রামের নাম)	কত দিন পর পর সংঘটিত হয়	গত ৫ বছরে কতবার সংঘটিত হয়েছে

**** যে সমস্ত তথ্য সংগ্রহ করতে হবে:** 1. শিক্ষাপ্রতিষ্ঠান (প্রাথমিক /নিম্নমাধ্যমিক/উচ্চমাধ্যমিক বিদ্যালয়, মাদ্রাসা, কলেজ/বিশ্ববিদ্যালয়) 2. সাইক্লোন সেন্টার 3. হাসপাতাল/ক্লিনিক 4.ব্য ক্তি মালিকানাধীন বহুতল ভবন 5. বাস/রেলস্টেশন 6. হেলিপ্যাড 7. স্টিমার/লঞ্চঘাট 8. বিমানবন্দর

দুর্যোগকালিন সময়ে লোকজনদের আশ্রয়স্থল, অসুস্থ লোকজনদের জরুরি চিকিৎসার জন্য ফিল্ড হাসপাতাল স্থাপনের জায়গা, জরুরি ত্রাণ সহায়তা প্রদান ইত্যাদির জন্য অবকাঠামোর নাম, দুর্যোগকালীন সহায়তা, উদ্ধার ইত্যাদির জন্য যোগাযোগ ব্যবস্থার পূর্ণাঙ্গ বর্ণনা ম্যাপে প্রদর্শন এবং প্রদত্ত ফরমে সঠিক তথ্য সংগ্রহ করা আবশ্যক। জিপিএস রিডিংয়ের জন্য স্থাপনার নিকট গিয়ে রিডিং নিতে হবে।

তথ্য প্রদানকারীর নামঃ পিতার নামঃ মাতার নামঃ বয়সঃ পেশাঃ মোবাইল নম্বরঃ	তথ্য সংগ্রহকারীর স্বাক্ষর: নাম: পদবি: তথ্য সংগ্রহের তারিখ:	তত্ত্বাবধায়ক কর্মকর্তার স্বাক্ষর: কর্মকর্তার নাম: পদবি:

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
বাংলাদেশ পরিসংখ্যান ব্যুরো
Stat4Dev প্রকল্প
পরিসংখ্যান ভবন
ই-২৭/এ, আগারগাঁ, ঢাকা১২০৭

Paurashava/Union Wise Disaster Calendar for Coastal Area of Bangladesh

জেলার নাম: কোড:	সিটি কর্পো: নাম: কোড:	উপজেলার নাম: কোড:	পৌরসভার নাম: কোড:	ইউনিয়নের নাম: কোড:	ওয়ার্ডের নাম: কোড:

DISASTER	Jan পৌষ/মাঘ	Feb মাঘ/ফাল্গুন	Mar ফাল্গুন/চৈত্র	Apr চৈত্র/বৈশাখ	May বৈশাখ/জ্যৈষ্ঠ	Jun জ্যৈষ্ঠ/আষাঢ়	Jul আষাঢ়/শ্রাবণ	Aug শ্রাবণ/ভাদ্র	Sep ভাদ্র/আশ্বিন	Oct আশ্বিন/কার্তিক	Nov কার্তিক/অগ্রহায়ণ	Dec অগ্রহায়ণ/পৌষ	RANK

তথ্য প্রদানকারীর নাম: পিতার নাম: মাতার নাম: বয়স: পেশা: মোবাইল নম্বর:	তথ্য সংগ্রহকারীর স্বাক্ষর: নাম: পদবি: তথ্য সংগ্রহের তারিখ:	তত্ত্বাবধায়ক কর্মকর্তার স্বাক্ষর: কর্মকর্তার নাম: পদবি:

Statistics for DEVELOPMENT

Strengthening Statistical Capacity of BBS for Collecting Data on Population and Development Project

Bangladesh Bureau of Statistics (BBS)
Statistics and Informatics Division (SID)
Ministry of Planning

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