

NATIONAL AGROLOGISTICS PROGRAM

5

PRELIMINARY
TERRITORIAL ANALYSIS



MÉXICO

GOBIERNO DE LA REPÚBLICA

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SECRETARÍA DE AGRICULTURA,
GANADERÍA, DESARROLLO RURAL,
PESCA Y ALIMENTACIÓN

NATIONAL AGROLOGISTICS PROGRAM

REPORT 5
PRELIMINARY
TERRITORIAL ANALYSIS

National Agrologistics Program

Report 5

Preliminary Territorial Analysis

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Federal District, Estado de México, Hidalgo, Morelos, Puebla, Tlaxcala

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INTRODUCTION

Towards a Methodology for Geographic and Territorial Analysis of Agri-food Chains

The aim of this work is to evaluate geographic information tools (GIS) for territorial analysis and planning of investments in agrologistics assets. Agrologistics assets are understood to mean collection centers, agroparks, distribution centers, multimodal nodes and export points. All these assets contribute to maintaining closed cold chain for perishable products management. The planning of these assets is to a large extent determined by geographic criteria, which allow validation of both public and private investment as well as site selection and type of facilities to be developed.

These geographic criteria include connectivity with transport Infrastructure and other assets of the agri-food chain, proximity to points of origin, exchange or destination, such as productive areas, and demand centers including cities, ports and customs. The next step consists of superimposing several layers of GIS information, so that reading the geographical distribution of multiple variables can reach an even more meaningful analysis.

GIS Methodology

The work carried out to generate and complement vector information, analyzes relevant data to evaluate the agri-food industry in Mexico. In addition, to facilitate the evaluation of new assets this analysis may be useful to define the agrologistics needs for all the chains, as well as to generate public policies that provide solutions to agri-food problems and thus increase the competitiveness of the sector. The Production of the graphic annex for the National Agrologistics Program in Mexico has been carried out using the Geographic Information System (GIS) ARCGIS 10.0 program, which is a tool that allows the collecting, organizing, managing, analyzing, sharing and distributing of geographic information. The layers of information with which the maps have been developed are in a shape format, which is a vector type storage format that implicitly stores the geographic information (coordinates online, points or polygons), associated to tabular attributes (database). Each shape file consists of a minimum of three required files:

SHP. This is the file that stores the geometric entities of the objects.

QPJ. This is the file that stores the index of the geometric entities.

DBF. This is the database, in Dbase format, where the information of the attributes of each geometric element is stored.

Production of the maps has been carried out in 4 stages:

- 1 Collecting the Information
- 2 Creating Shape file Layers
- 3 Superimposition of layers in shape format
- 4 Formatting the Maps

1 Collecting the Information

In this stage the information provided by the main national institutions responsible for handling geographic data, such as the National Statistics and Geography Institute (INEGI); the Ministry for Communications and Transportation (SCT); and the Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA) was collected. In addition, several other documents have been consulted, among which the National System of Logistics Platforms, developed by the Inter-American Development Bank (BID), together with SAGARPA and the Ministry of Economy (SE). Furthermore, new vector information based on the investigation carried out to perform the National Agrologistics Program has been generated.

2 Creating Shape file Layers

La The collected information devoid of geographic data, such as Population and Housing Censuses and the information regarding Production in tons of agricultural products, has been analyzed in an Excel database, which was subsequently linked to a geo-referenced vector data file. Thus, a Shape file was created that contains the generated database.

3 Superimposition of layers in shape format

The produced Shape files that contain the information collected in the database have been imported by ARCGIS in order to create the maps. The different superimpositions of the layers generated each of the created maps. Since each of the layers is an independent entity, different combinations in different maps can be created according to user needs.

4 Formatting the Maps

Finally the maps were formatted with a graphic language by means of line styles, combination of different colors and textures, in such a way that the resulting product clearly and understandably explains the information represented. For a better understanding of the territory the country was divided into five so called Mesoregions, which its territorial division responds to the association of territories with similar characteristics or potential to generate synergies in different sectors that allow promotion of their economic inclination. This approach allows for maps to be produced and analyzed both on a national level as well as on a Mesoregional level. The five Mesoregions that have been defined are:

Center Mesoregion: Federal District, Estado de México, Hidalgo, Morelos, Puebla, Tlaxcala

Northwest Mesoregion: Baja California, Baja California Sur, Sonora, Sinaloa

West Mesoregion: Aguascalientes, Colima, Guanajuato, Jalisco, Michoacán, Nayarit, Querétaro, San Luis Potosí, Zacatecas

Northeast Mesoregion: Chihuahua, Coahuila of Zaragoza, Durango, Nuevo León, Tamaulipas

South-Southeast Mesoregion: Campeche, Chiapas, Guerrero, Oaxaca, Quintana Roo, Tabasco, Veracruz, Yucatán

Type of Mapped Information

Se The information related with four main items that meet the objectives of the National Agrologistics Program was mapped:

1. Demand: Information referring to the location of the main population centers, which require agri-food products for their subsistence, as well as to food demand nodes and customs post (ports and airports) of the country that mark export demands.

2. Link: Information referring to existing connections between Production areas and demanding areas that include mainly roads and railways, and that also mark the cold storage chain.

3. Production: Information referring to the localization of main national, municipal and state federal institutions of producers of 7 product categories: vegetables, fruits, dairy products, grains, meat, fish and the processing industry.

Based on GIS, each Mesoregion is represented at the municipal Production level. The Production of each municipality is assessed in terms of total volumes and per square kilometer. (See the tables within the maps). The importance of a municipality against another one is valued at the intersection of the parameters. A similar definition, based on the Production of each state, is used to generate the relevant areas in terms of Production at country levels.

4. Agrologistics Infrastructure: Location of the country's agrologistics Infrastructure, that includes distribution centers of agri-food products, Supply Centers, wholesale markets, etc.

The final product created by the addition of the abovementioned information to the two categories of maps consisted of more than 100 images divided in various topics and into the two work scales mentioned above. These images allow for a clear understanding of our own analyzed information and also provide the foundations for further studies regarding agri-food chains in Mexico.

Results

The result of the work on the geographic analysis is understood to be a dynamic tool for sound planning of the network of multimodal nodes, agroparks and related services in the National Agrologistics Program. The location of the strongest Production areas has been studied, the easier routes to transport the products are shown and the location of the most important demanding areas has been identified.

Production and Demand: The first step is to find the relevant information regarding Production volumes and relevant demand figures. Comparing them on a map, located in Mexico's territory, and combining them with the figure of the transport Infrastructure, the spatial order of the agri-food market may be understood. This information is crucial for strategic decision-making and the analysis of optimal localization of new assets.

Agrologistics Corridors: An Agrologistics Corridor may be determined in those places where there is more activity and transport that connects certain agricultural products to areas or points of demand. The corridors are generalizations of existing potentials but they are also ambition lines. Future developments can be managed by recognizing the areas of more activity related to one or a few products, defining and naming them. As a result, the localization of new investments and effectiveness of the allocated public expenditure could be more successful. The network of these corridors together with the Infrastructure of services contained in it provides an agrologistics territorial diagnostic of the country. On this basis, those points and areas with greater potential for new development and Infrastructure and/or services improvement points that affect the value of certain Production areas can positively be localized.

Map of Isochrones: Another crucial tool for decision-makings in the agrologistics planning has to do with response times that are considered relevant for the arrival of agri-food products to the demand centers. For this reason, travel distances are represented based on the mapping of isochrones (concentric polygons drawn on the points that are equidistant in time to a point of origin or destination). Through the analysis of isochrones, we can clearly see the coverage that the agrologistics network has at a country level, as well as the location of “gaps” or opportunity areas, e.g., if a productive area is located at a critical distance from a center of demand or from the cold chain itself.

The criteria used in defining the isochrones are: Google Maps is used to estimate transportation isochrones. 75% of the average speed of a vehicle is estimated to calculate the range of a loaded truck. All highways and roads of the national Infrastructure, including toll roads are used. Isochrones are calculated considering the most important demand centers as the origin point, even if they have a demographic concentration for domestic demand, or ports and customs for export demand. Response times of 2, 4 and 8 hours are shown, that is to say immediate response, a response time of half a day or a response time of an entire day. They are the times that the distribution of cold chain goods needs to reach their markets and logistic distribution centers.

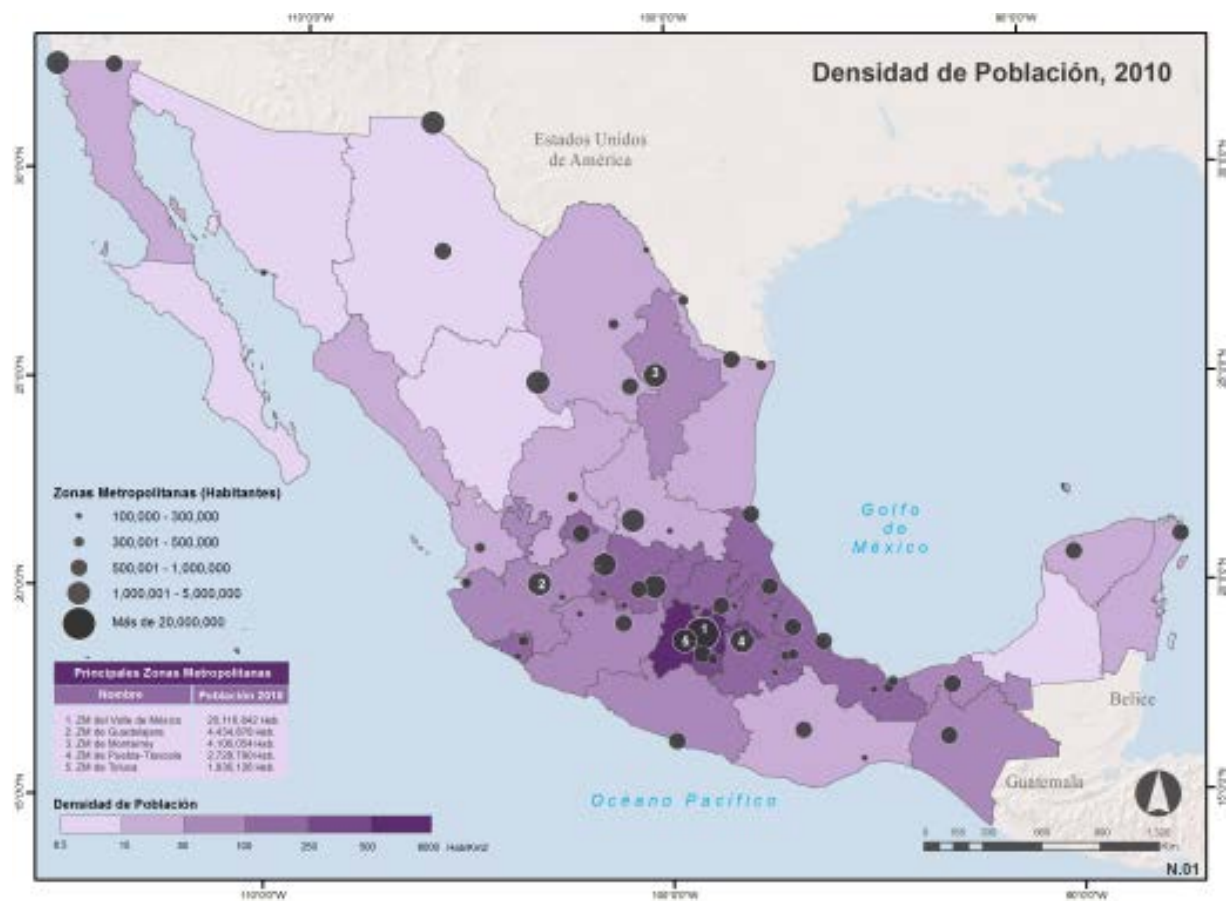
In this phase of the study, a first definition of agrologistics corridors in Mexico has been established. The data generated by the GIS in this study supports their existence in part, but there is conflicting data as well. A deeper study is required for a better substantiation of the definition of the corridors. Likewise, isochrones require greater precision and revision of their parameters to be more influential in this territorial analysis project by means of GIS tools.

Analytical Maps: To conclude this Geographic Analysis, a set of analytical maps has been delivered which allow for a crossing of meaningful data and for a graphical and visual representation of the territorial issue of agrologistics. There are many possible combinations and the tool is easy to handle. This geographical information system can provide the basis for a platform to generate answers to the question ‘Where?’. It is a dynamic database in which more relevant information may be documented and added in order to generate multiple analytical maps.

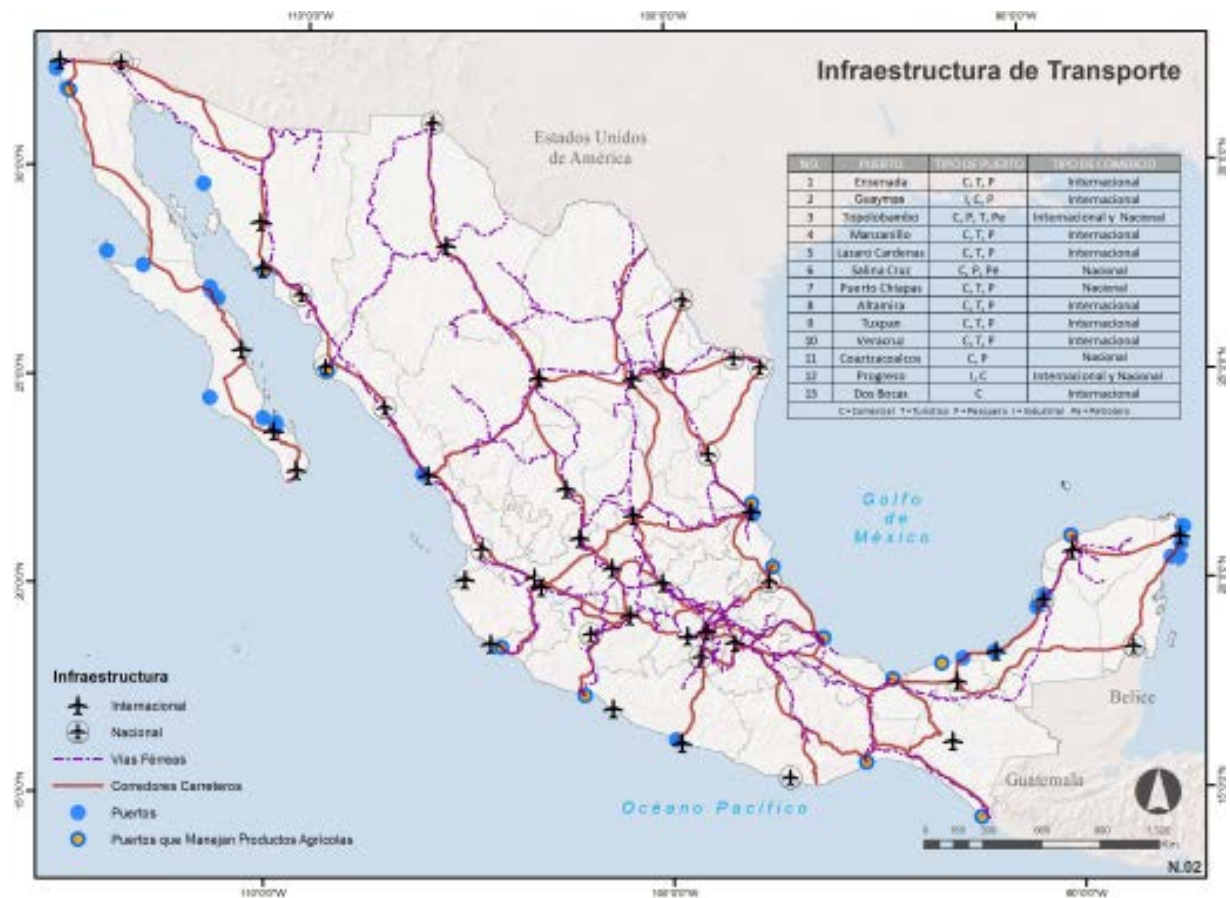
NATIONAL

- N.01 Population Density in 2010
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- N.19 States with Greater Vegetable Production
- N.20 States with Greater Fruit Production
- N.21 States with Greater Dairy Production
- N.22 States with Greater Meat Production and Agrologistics Infrastructure
- N.23 States with Greater Grain Production and Agrologistics Infrastructure
- N.24 States with Greater Processed Food Production and Agrologistics Infrastructure

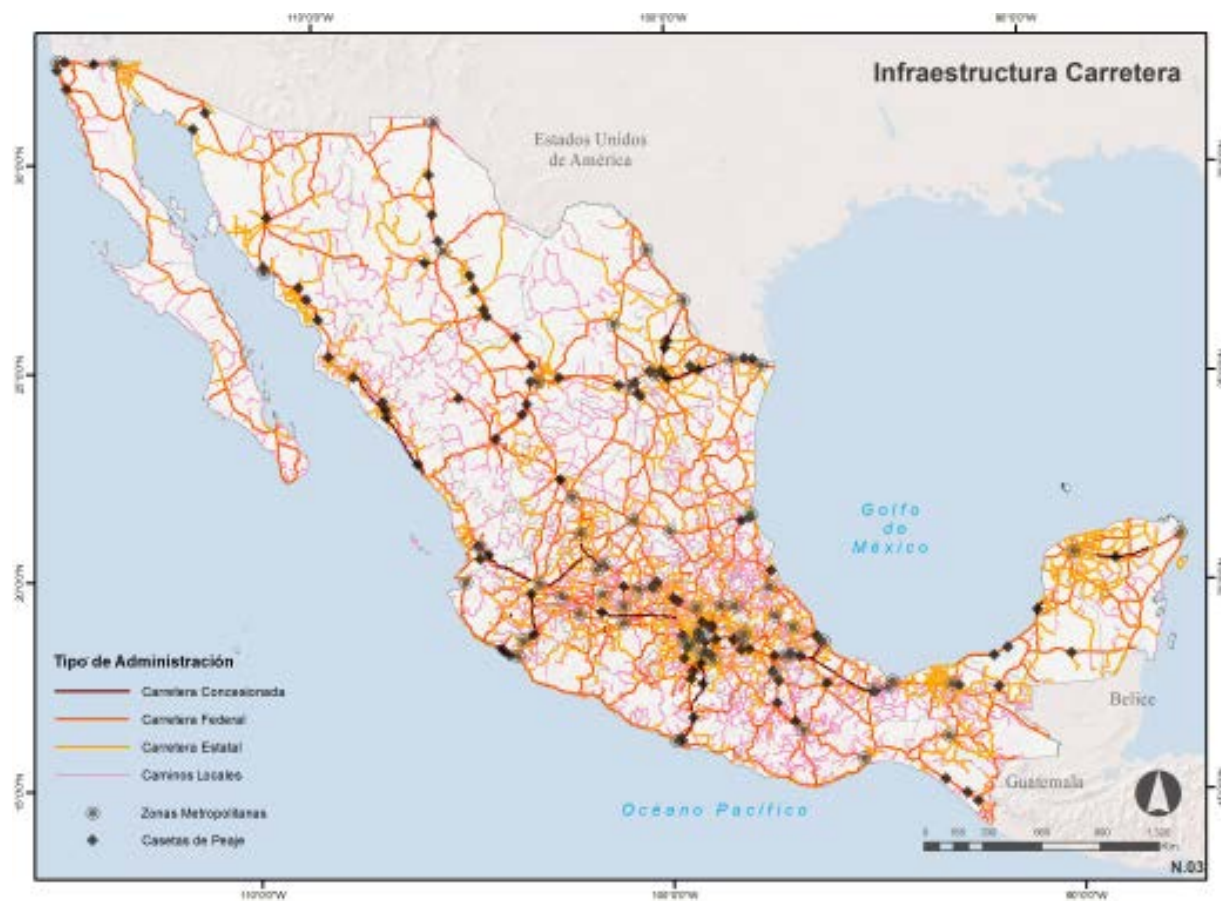
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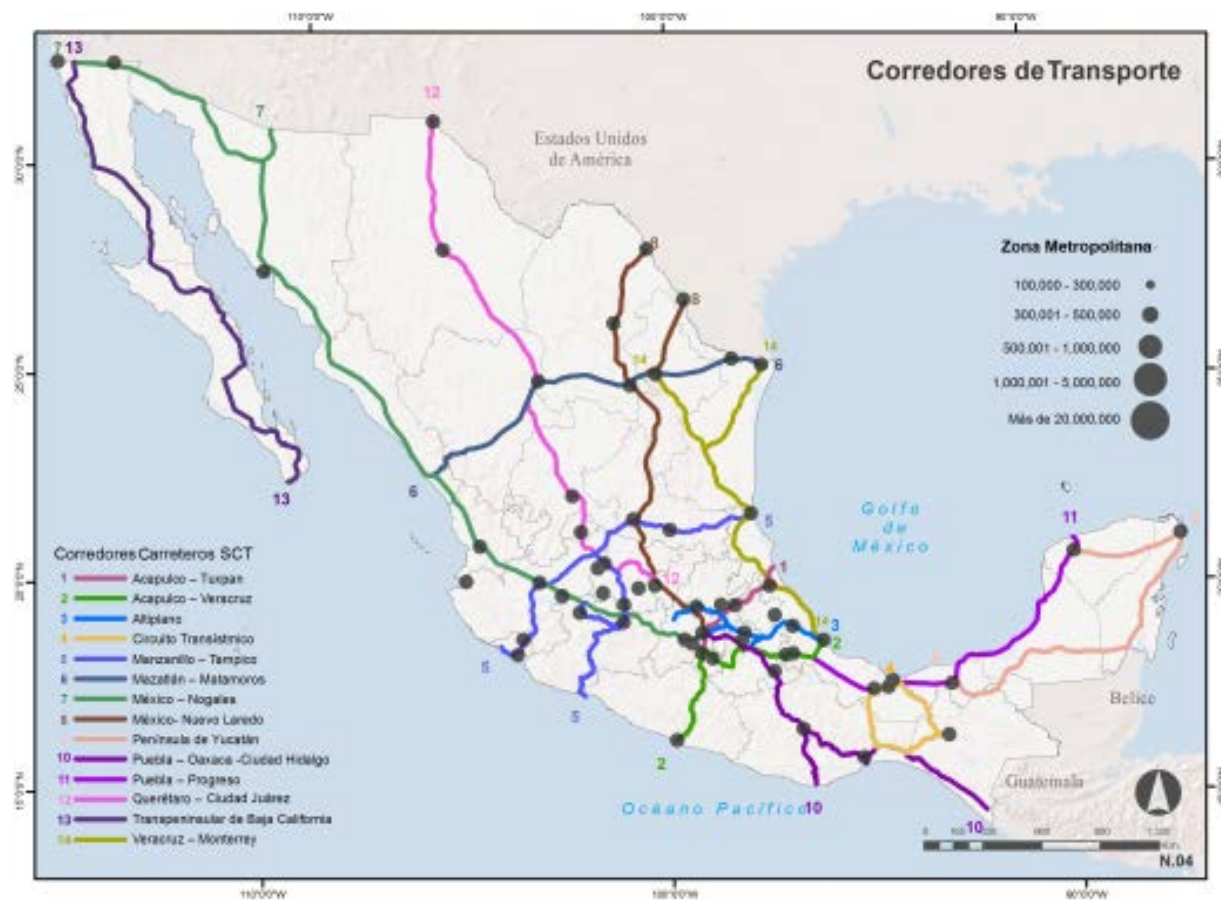
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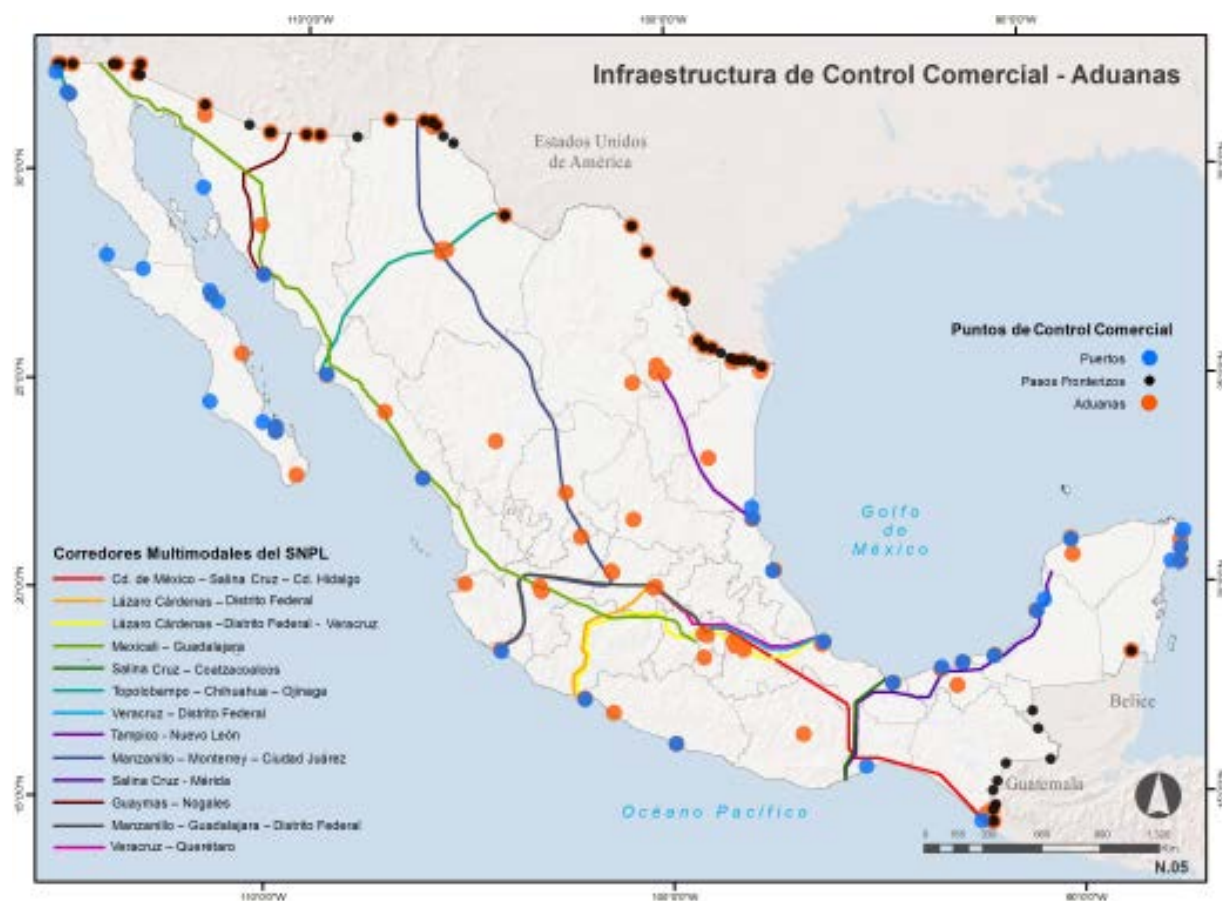
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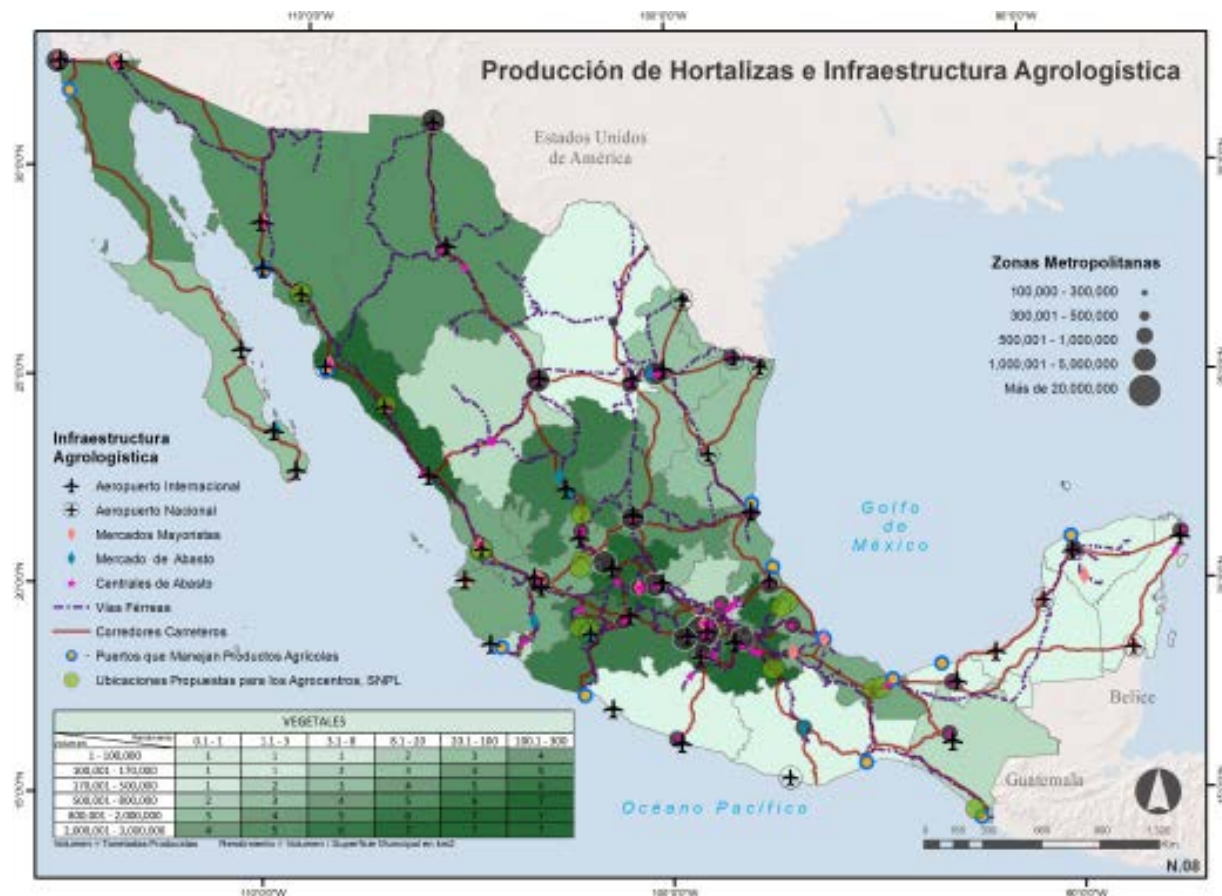
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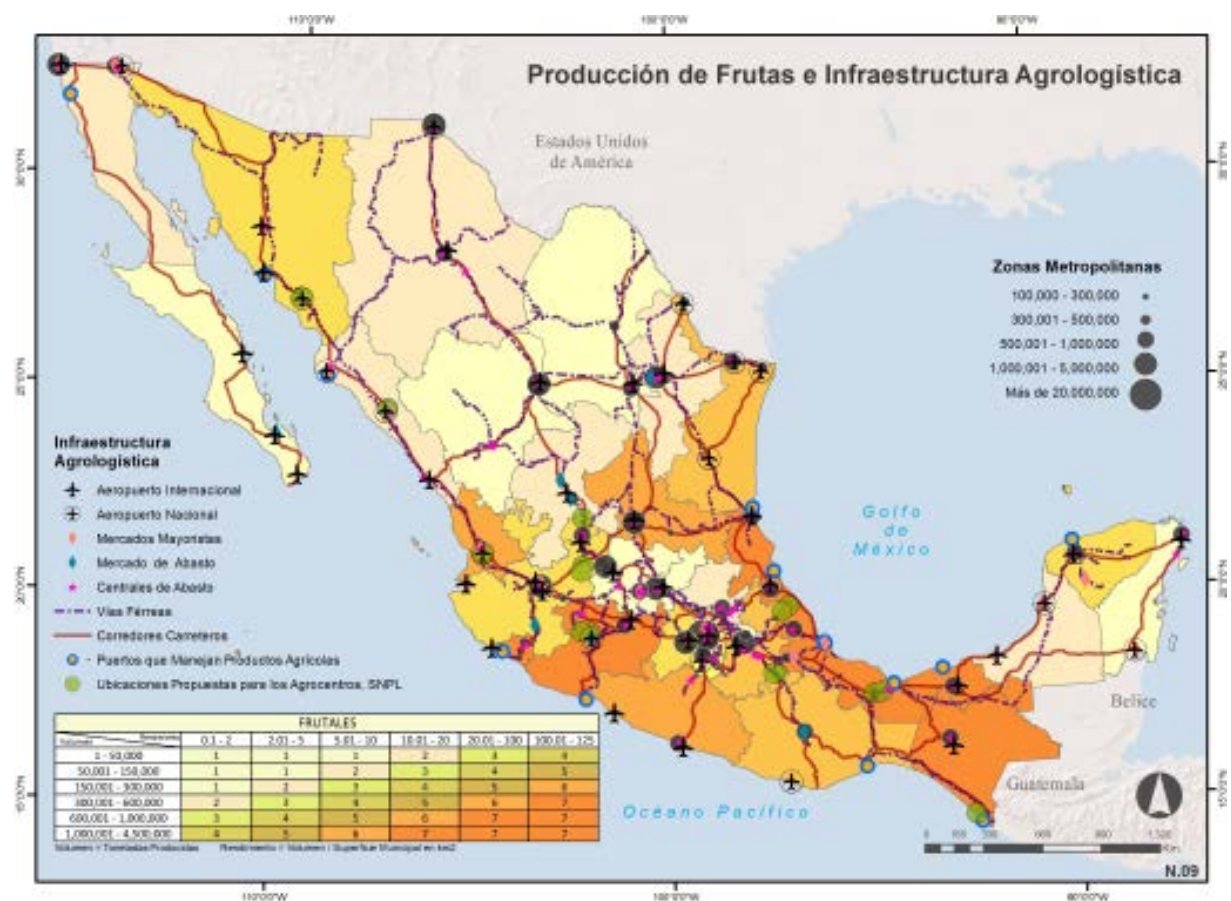
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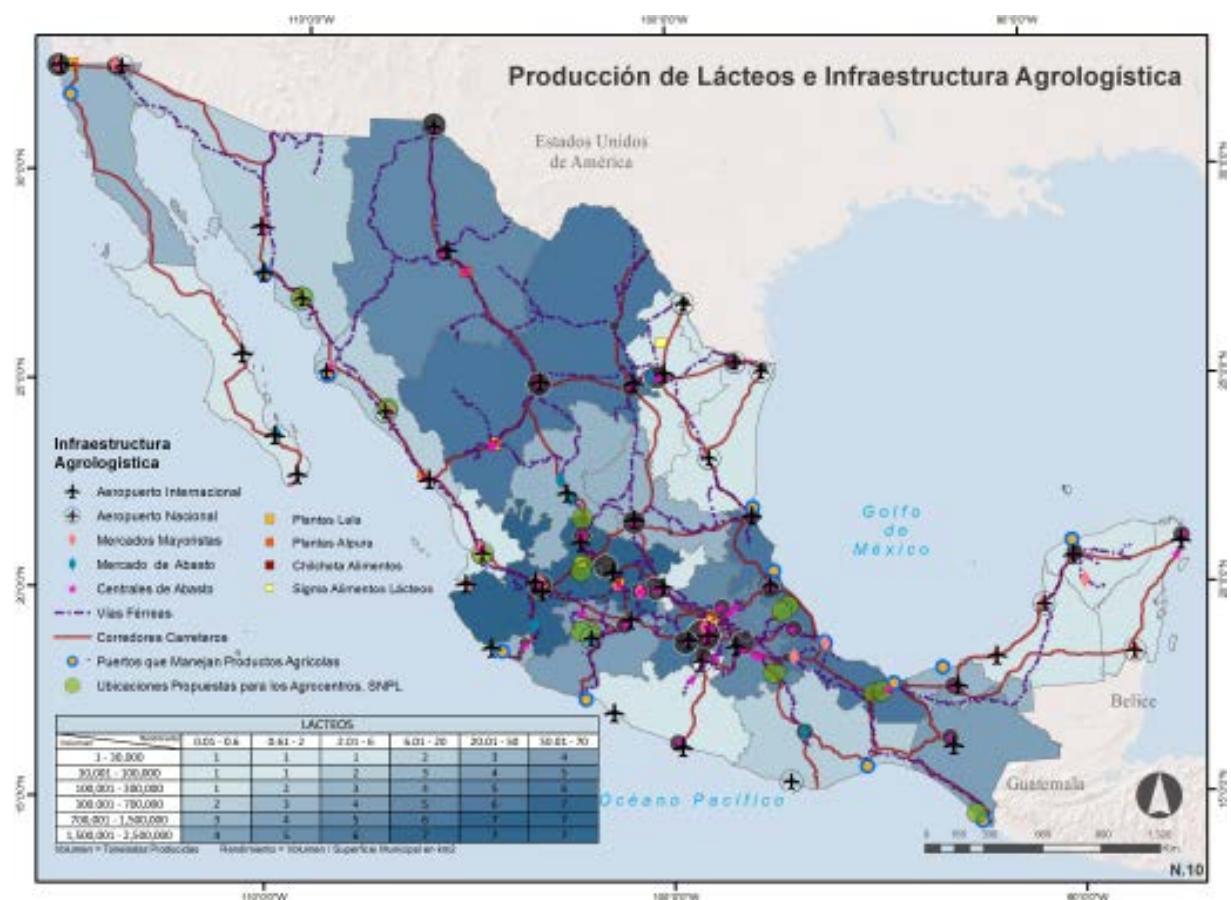
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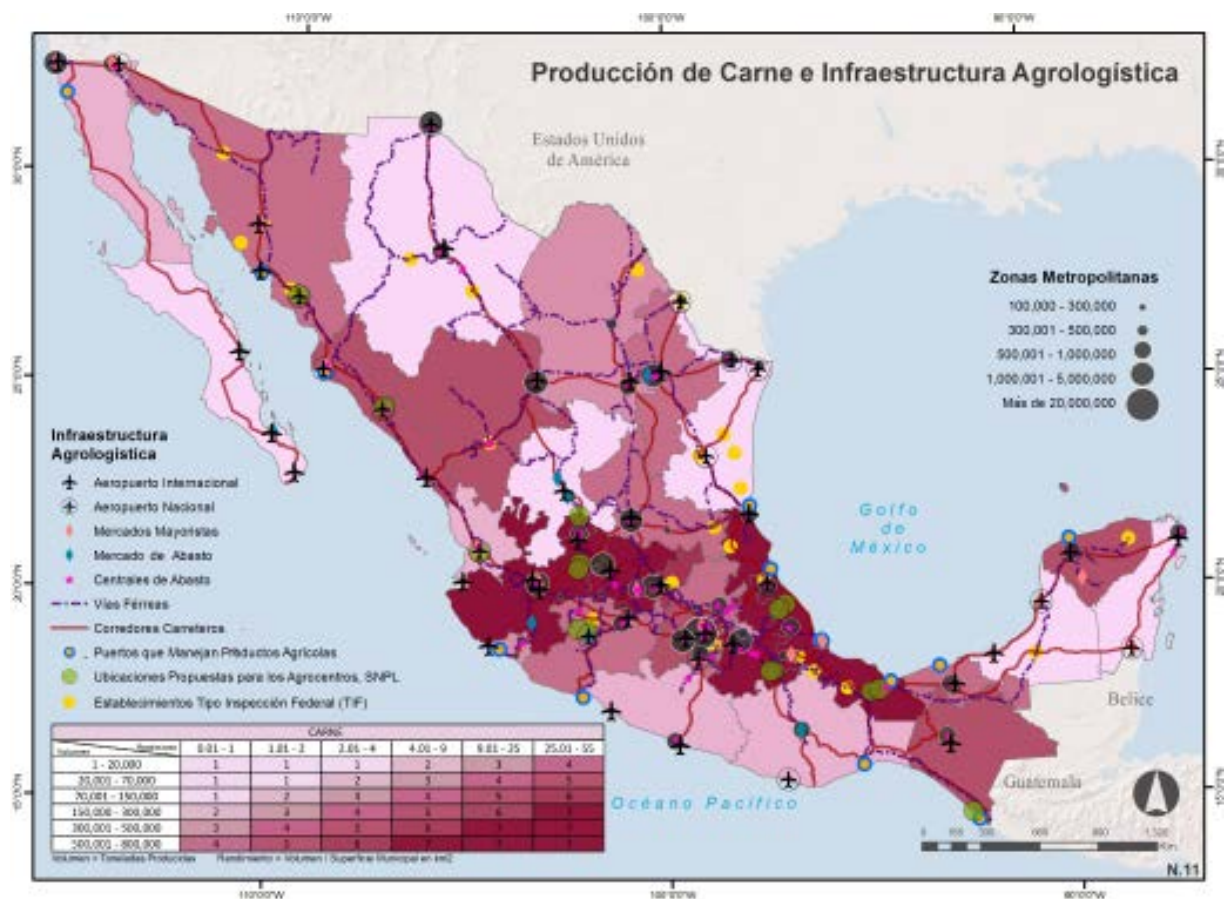
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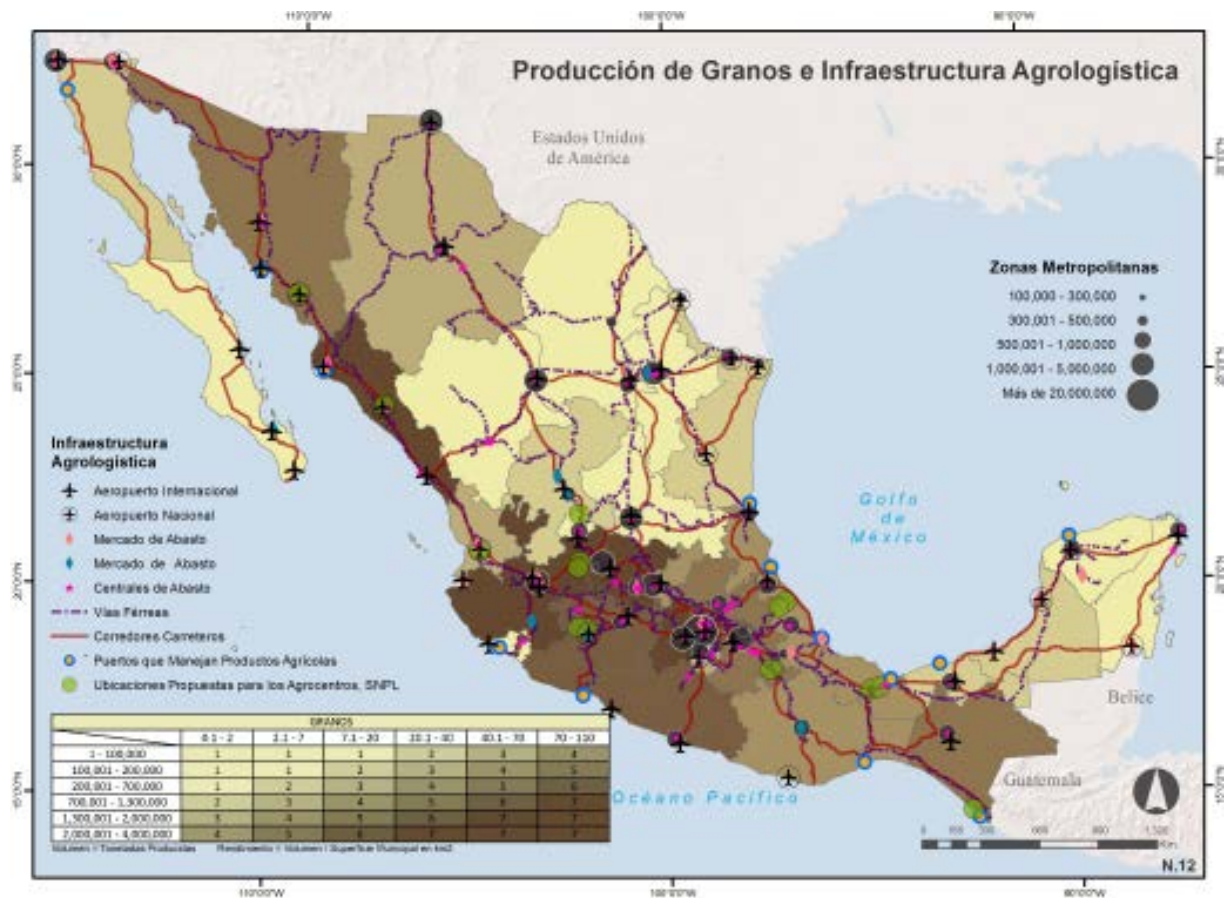
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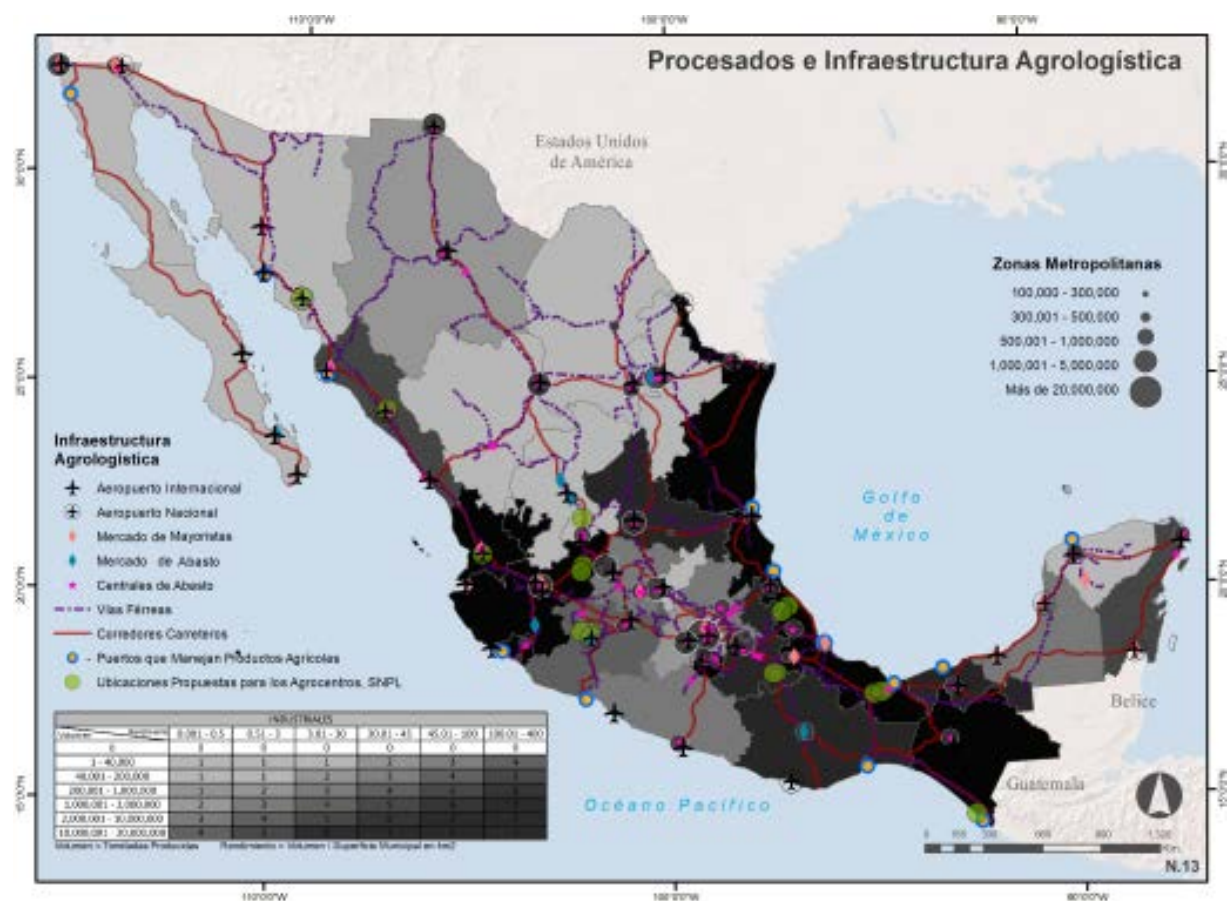
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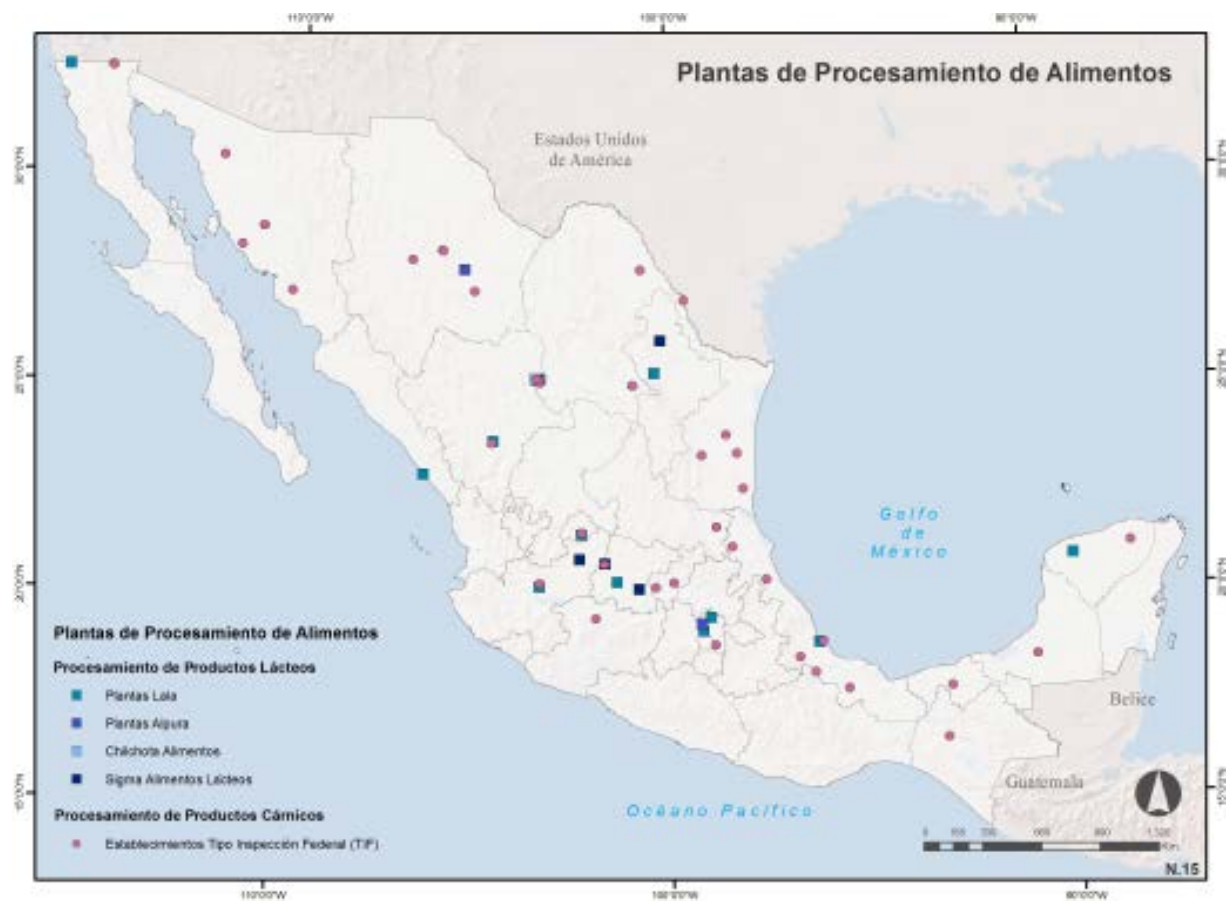
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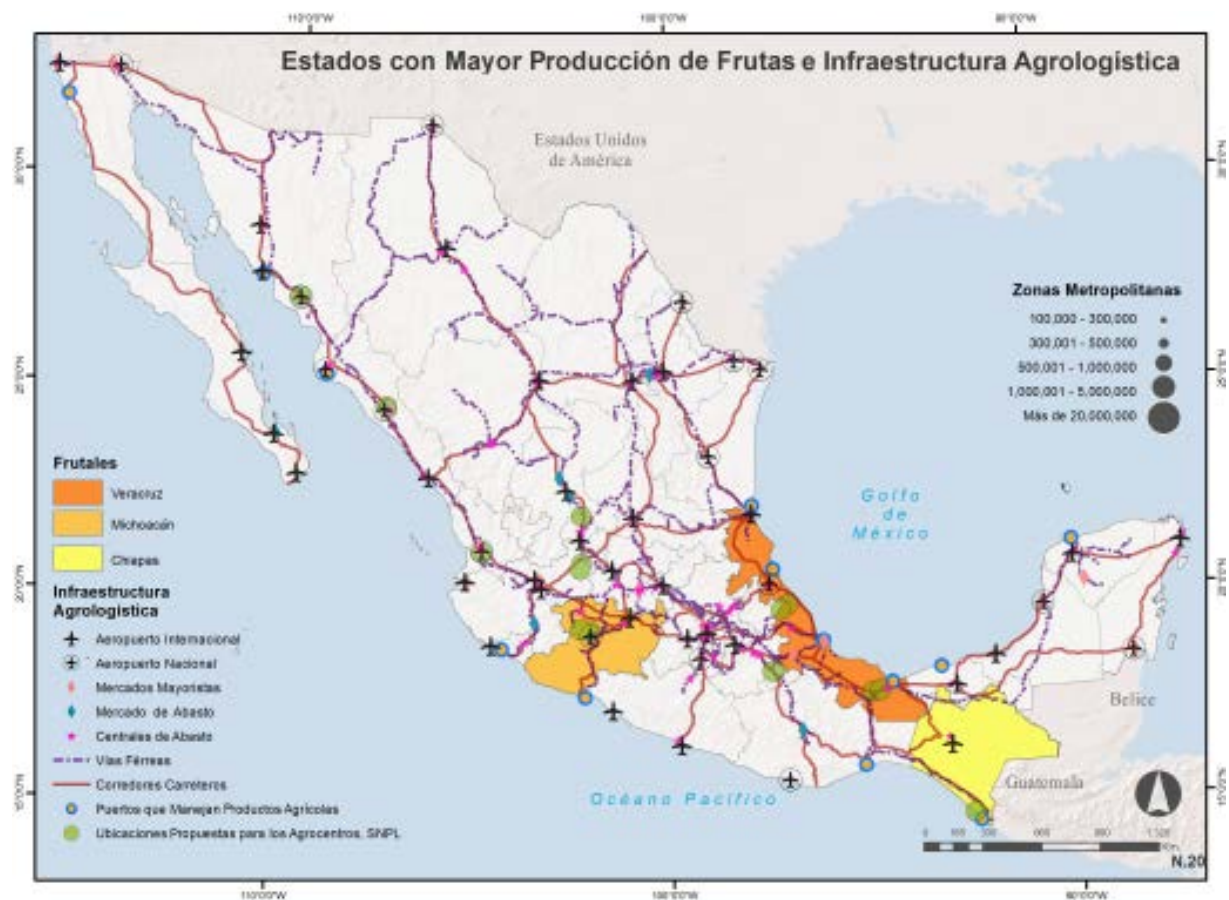
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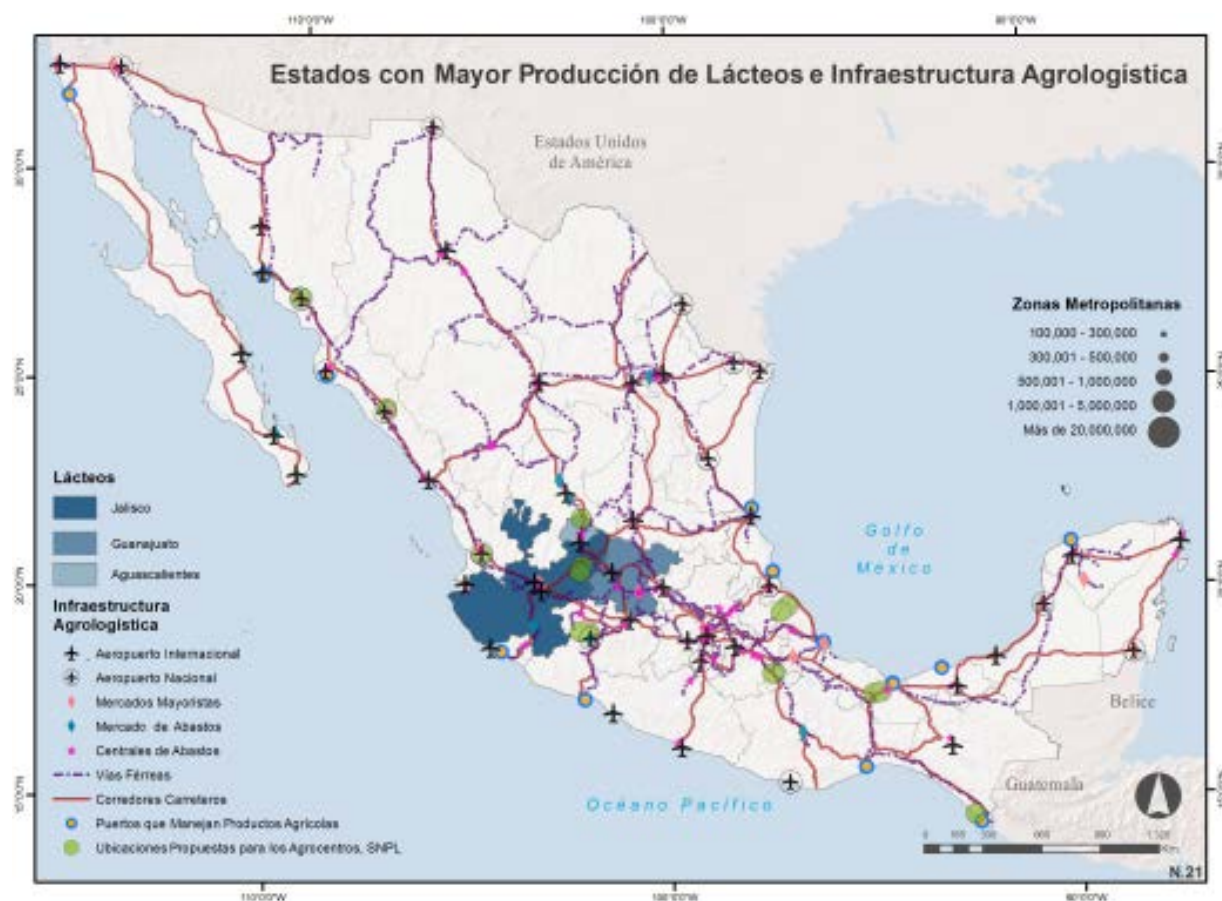
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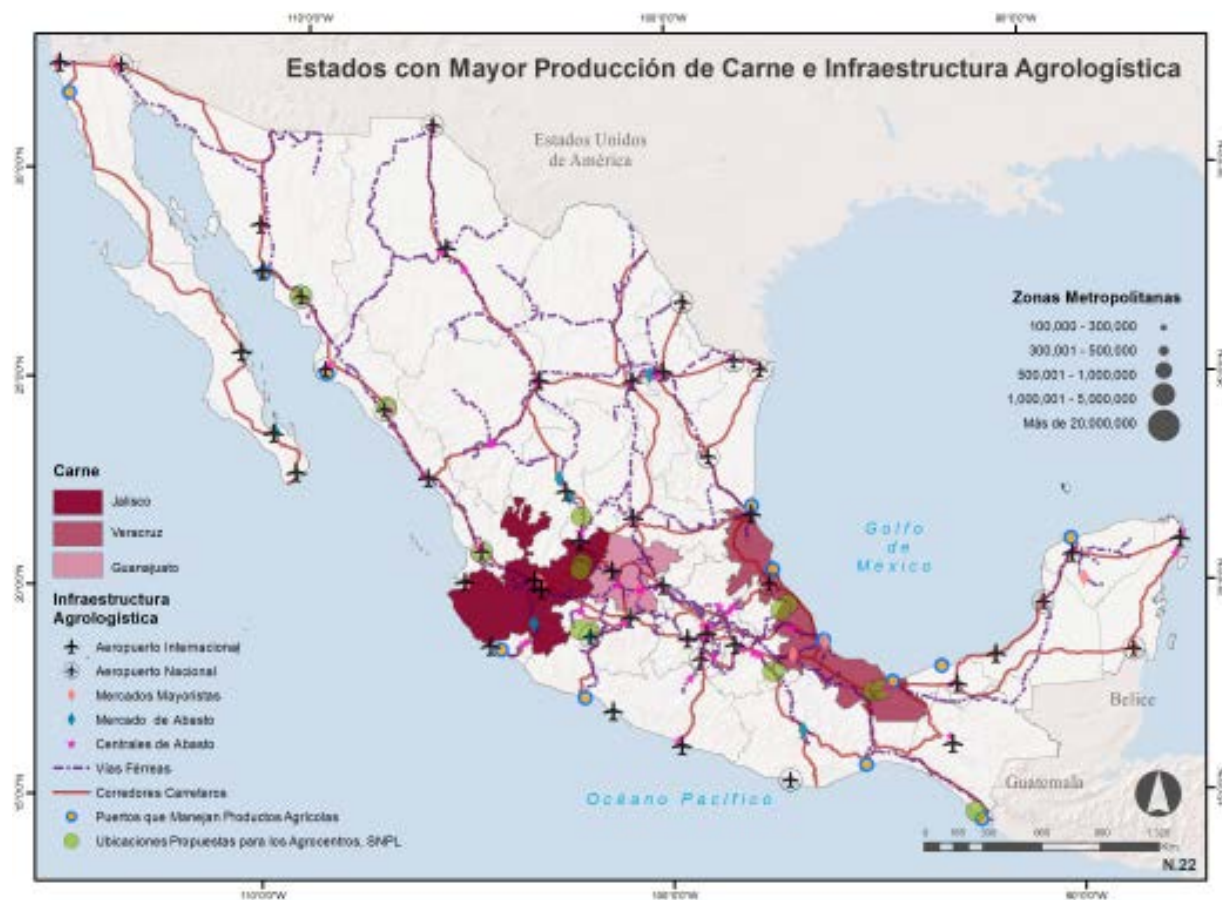
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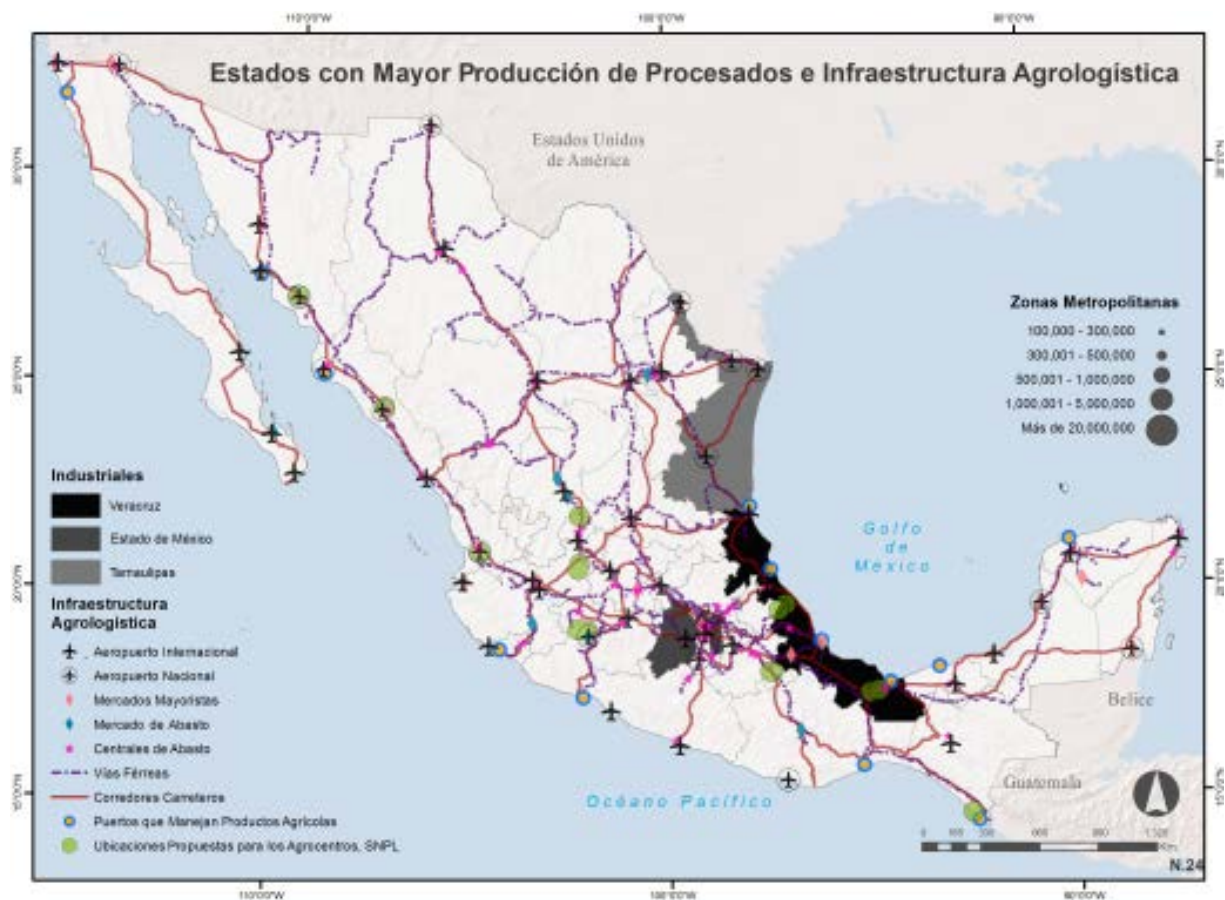
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MESOREGION 1: CENTER

Federal District, Estado de México, Hidalgo,
Morelos, Puebla, Tlaxcala

M1.01 Population Density in 2010

M1.02 Transport Infrastructure

M1.03 Road Infrastructure

M1.04 Commercial Control Infrastructure – Customs

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M1.07 Vegetable Production and Agrologistics Infrastructure

M1.08 Meat Production and Agrologistics Infrastructure

M1.09 Grain Production and Agrologistics Infrastructure

M1.10 Food Processing Plants

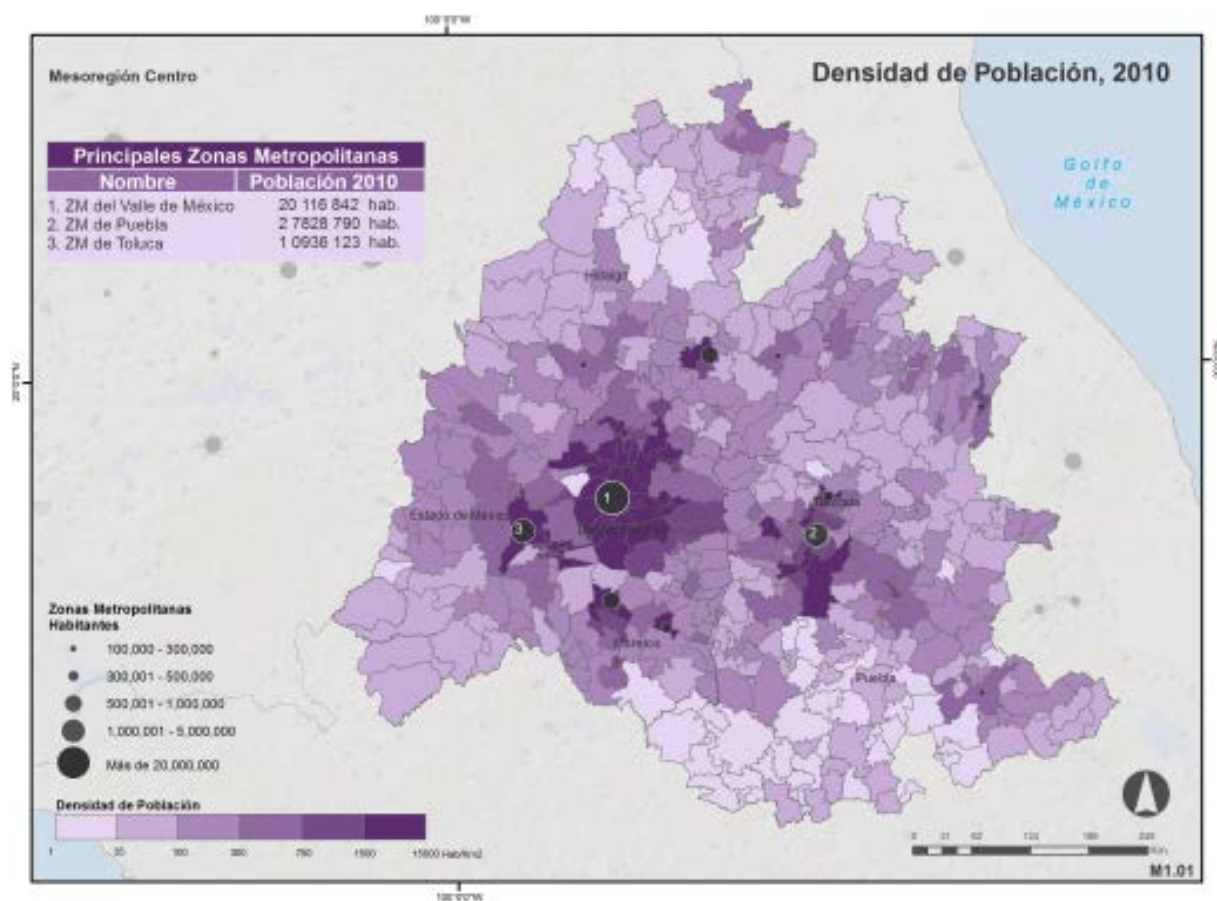
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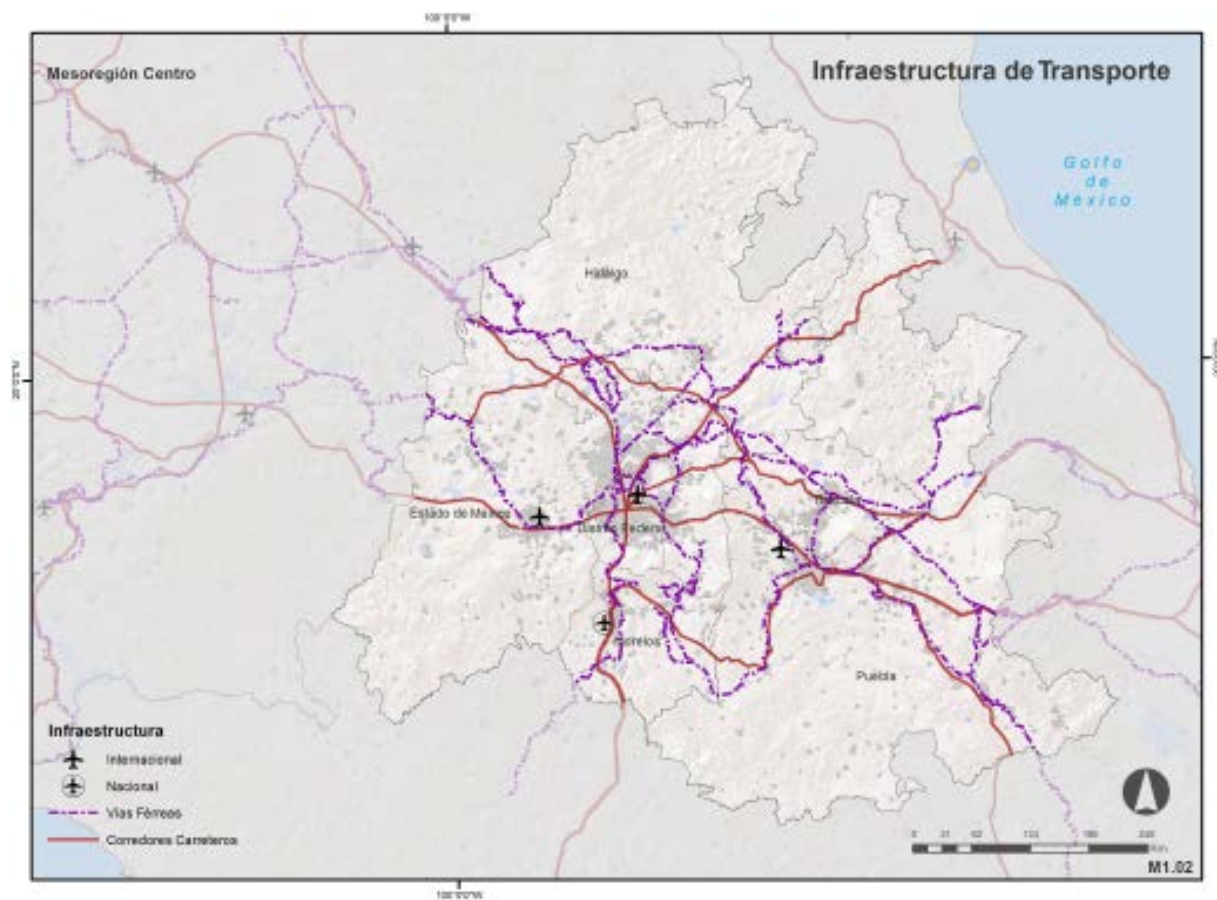
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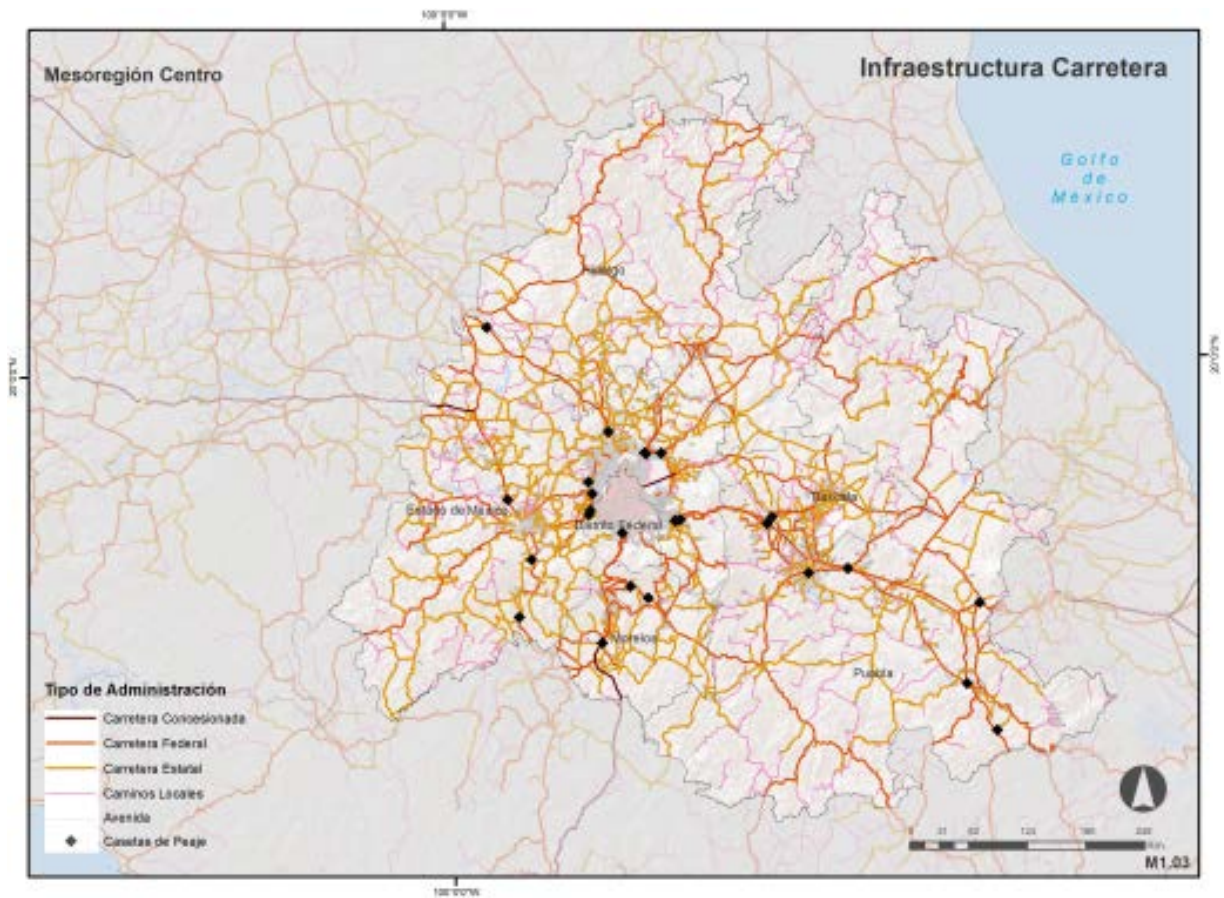
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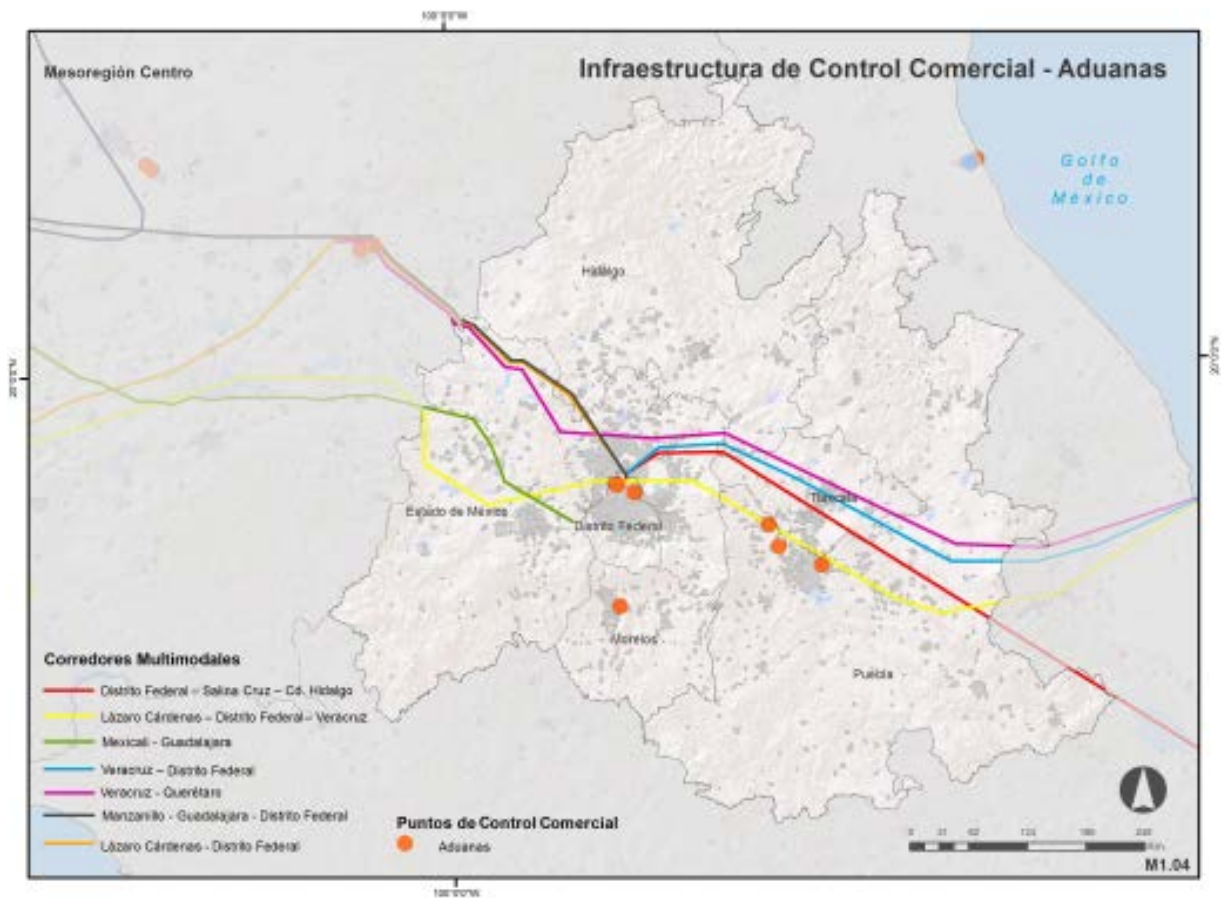
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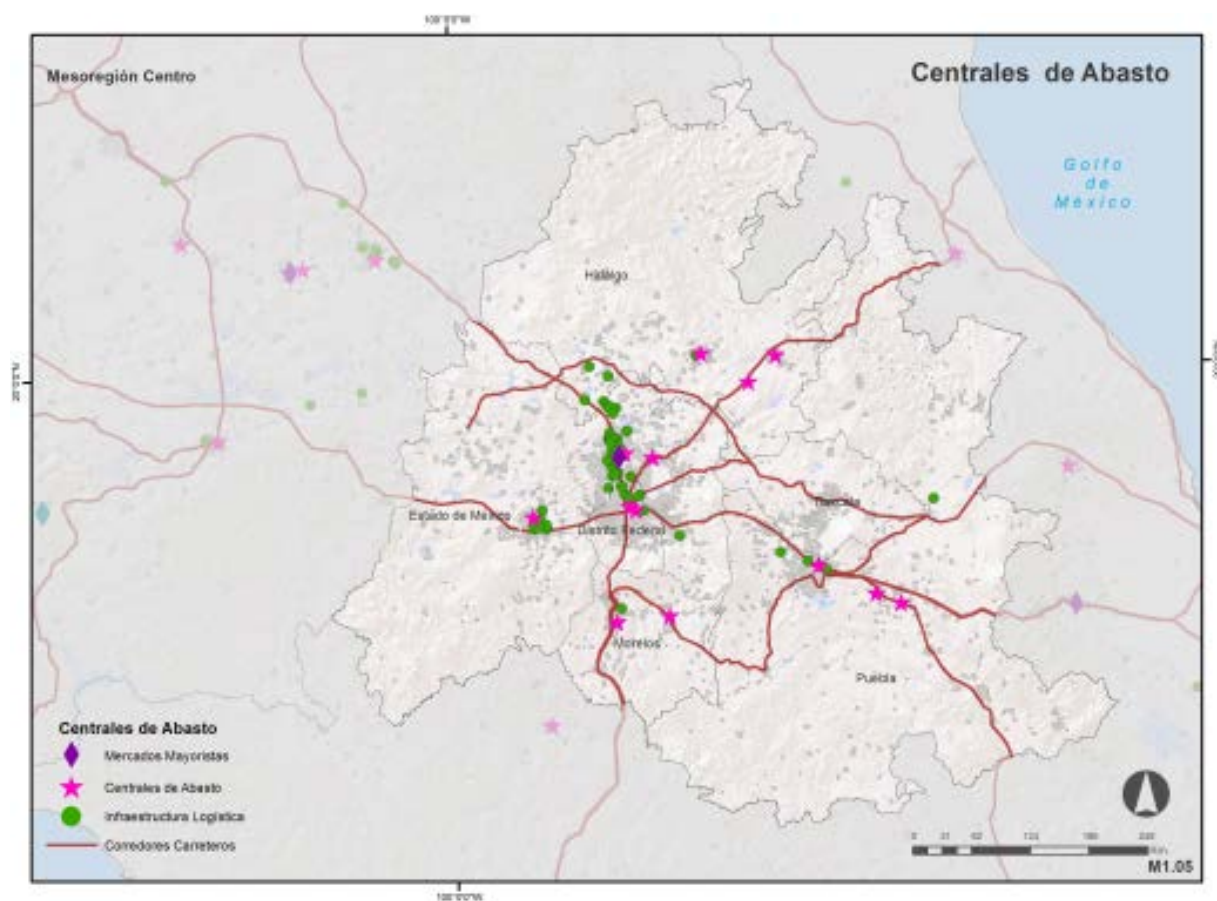
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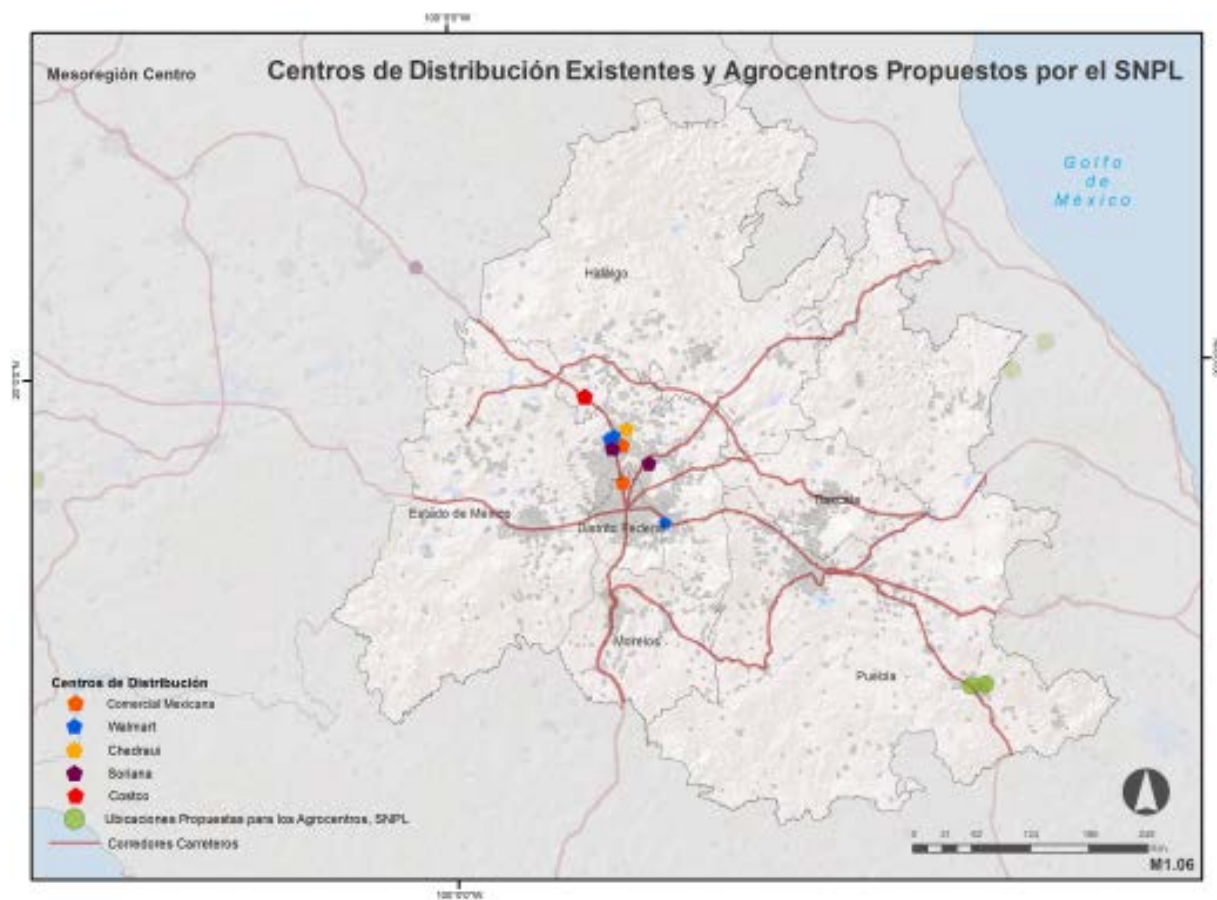
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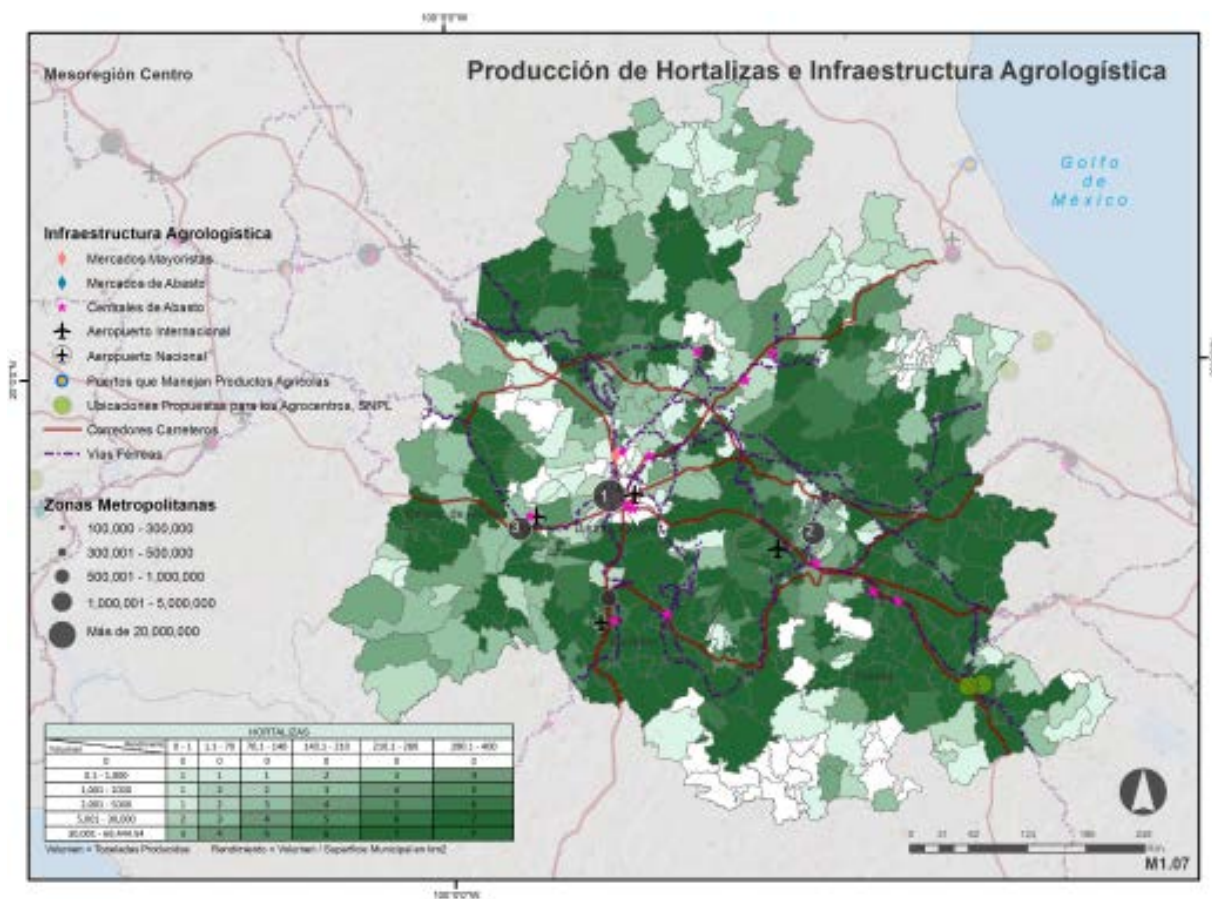
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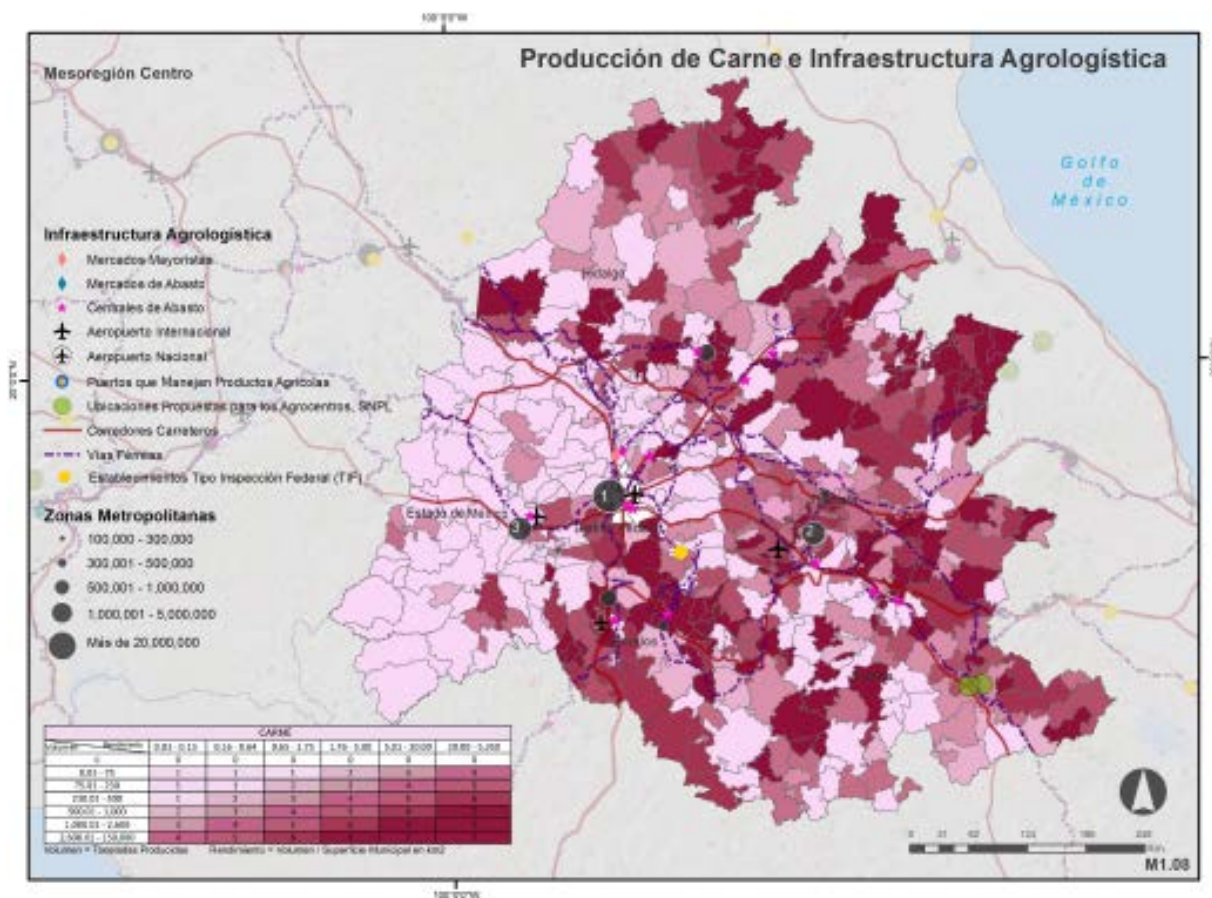
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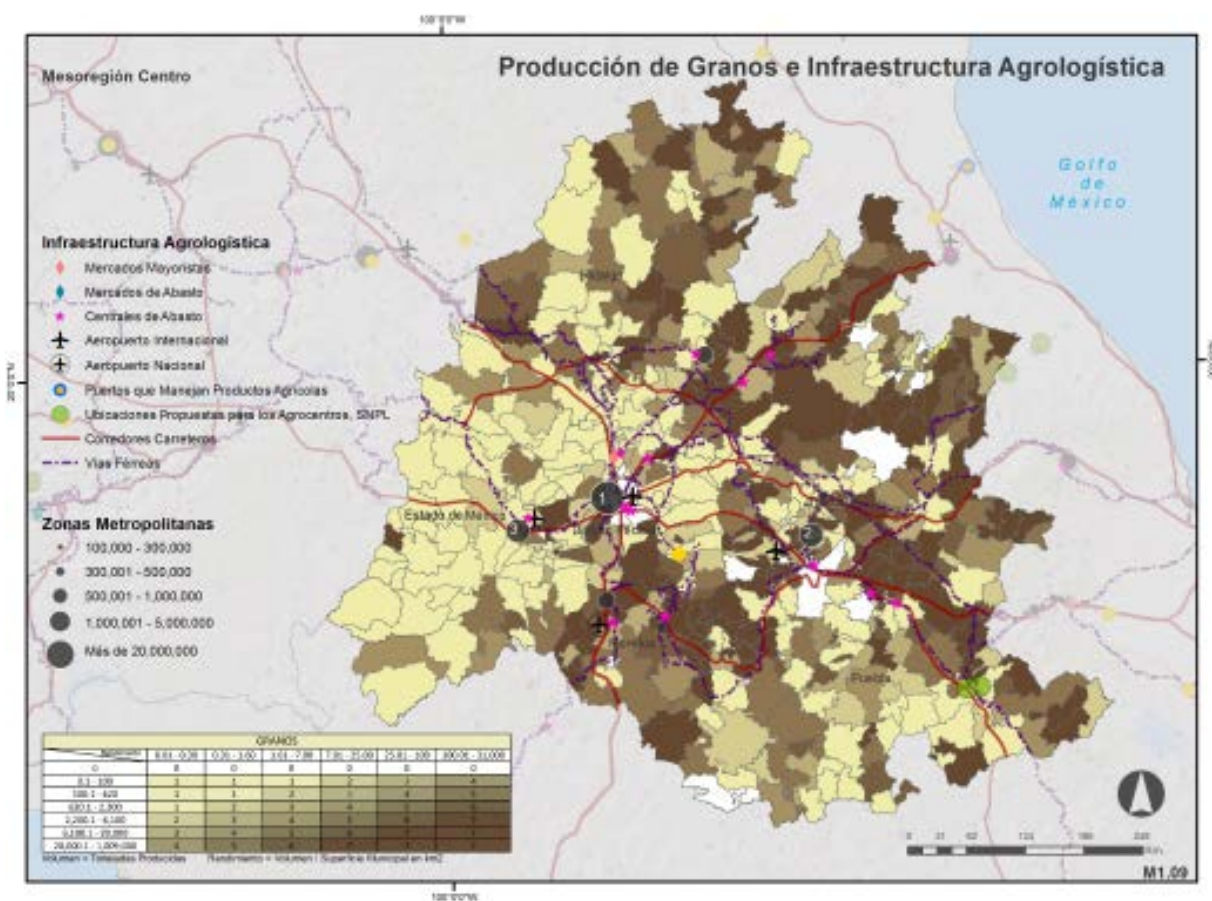
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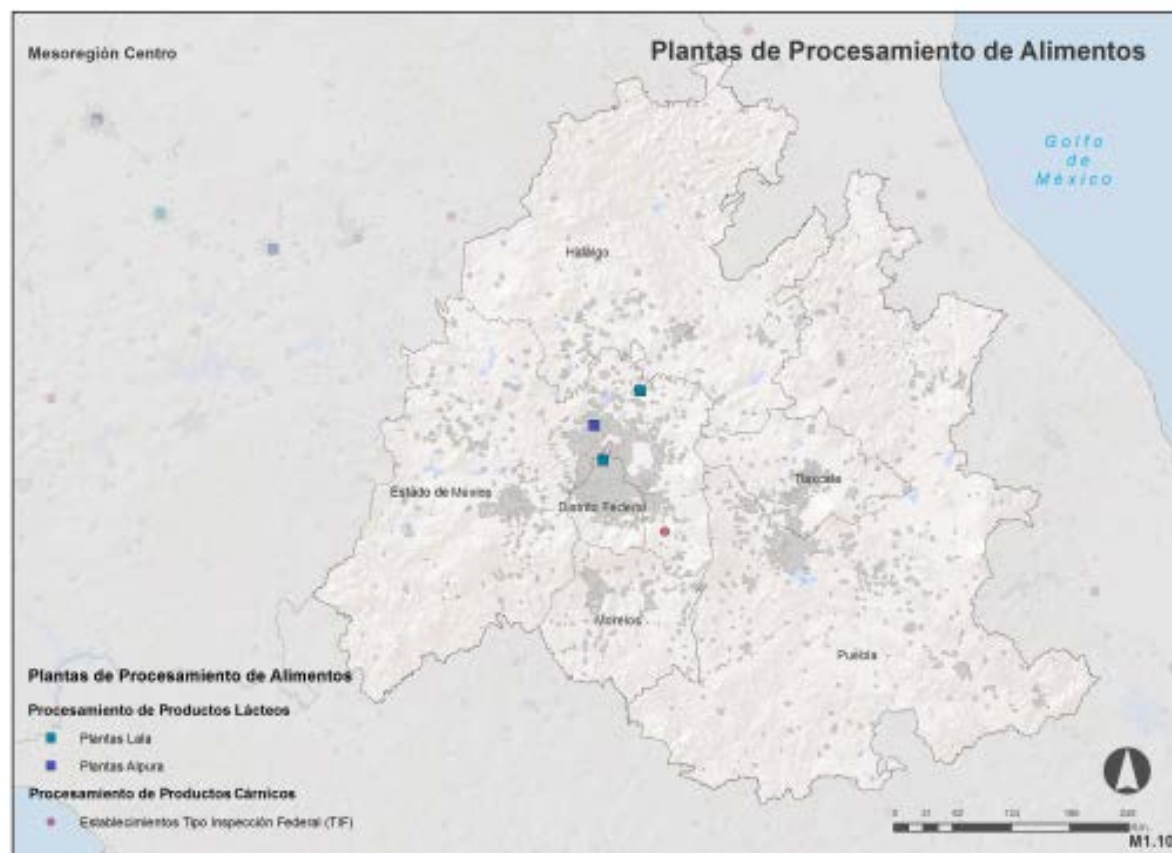
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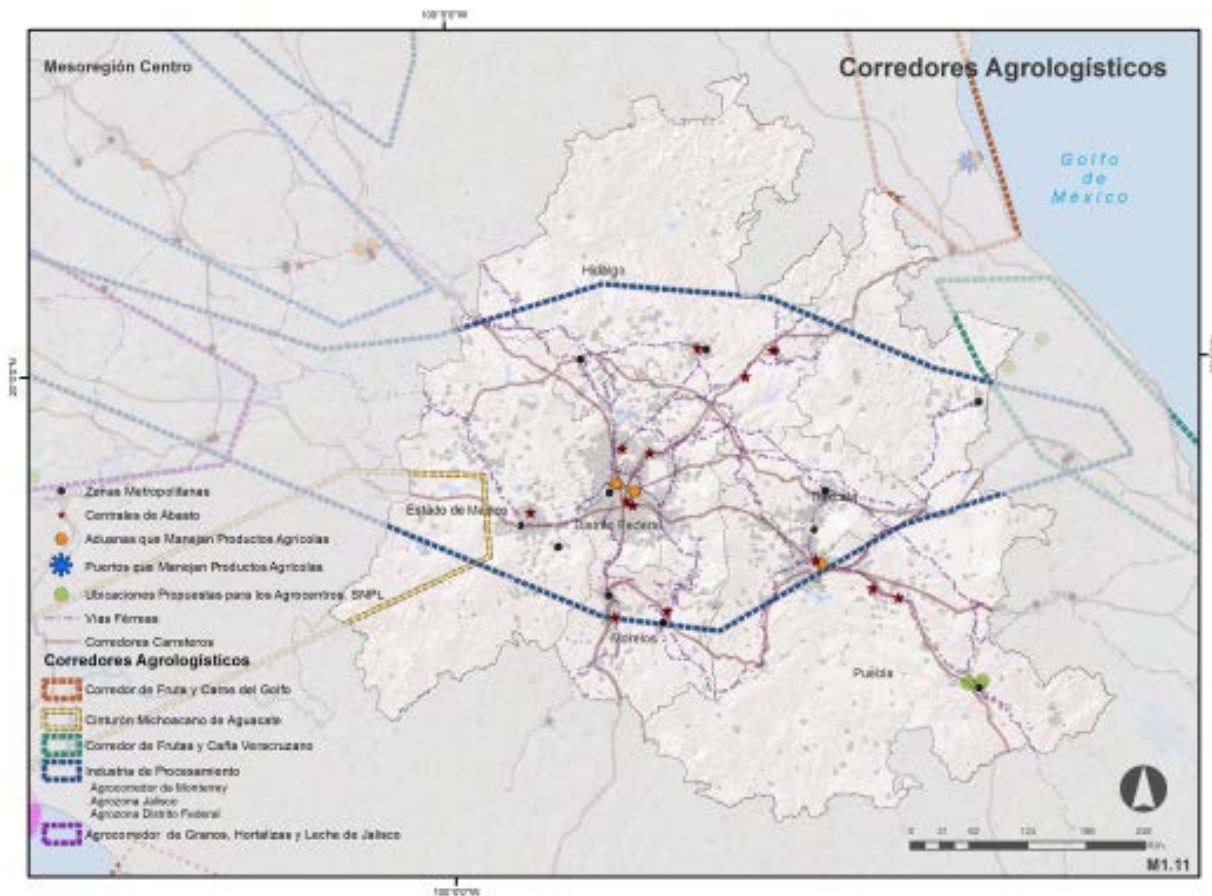
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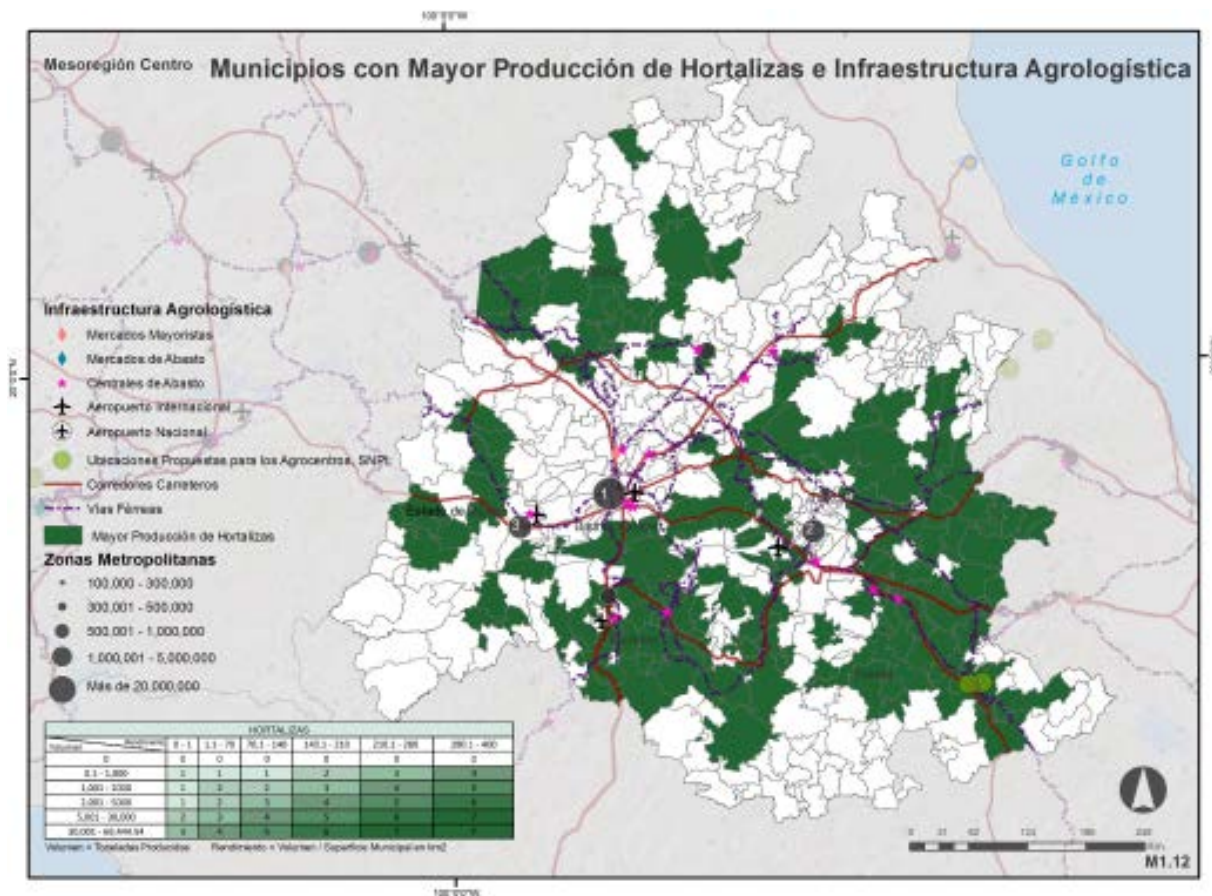
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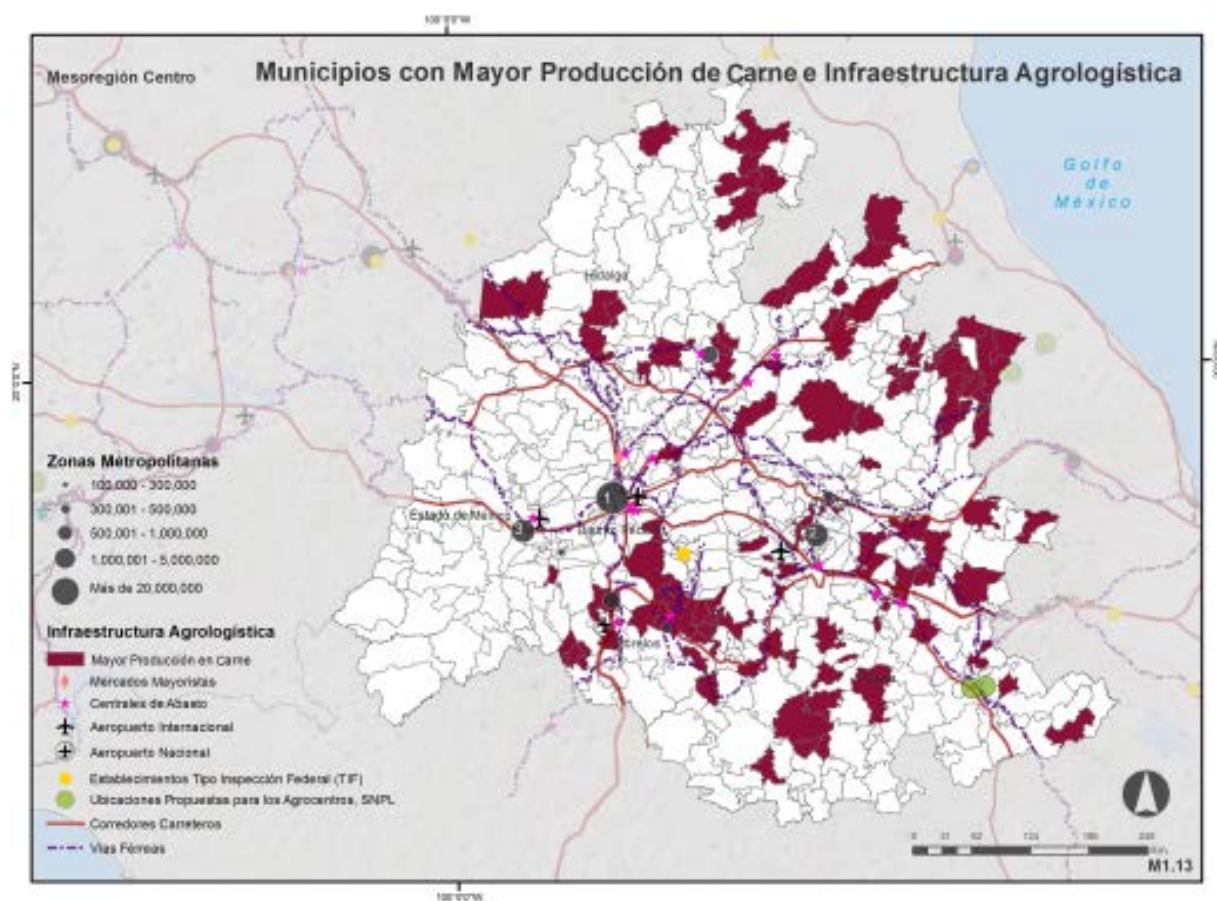
M1.11



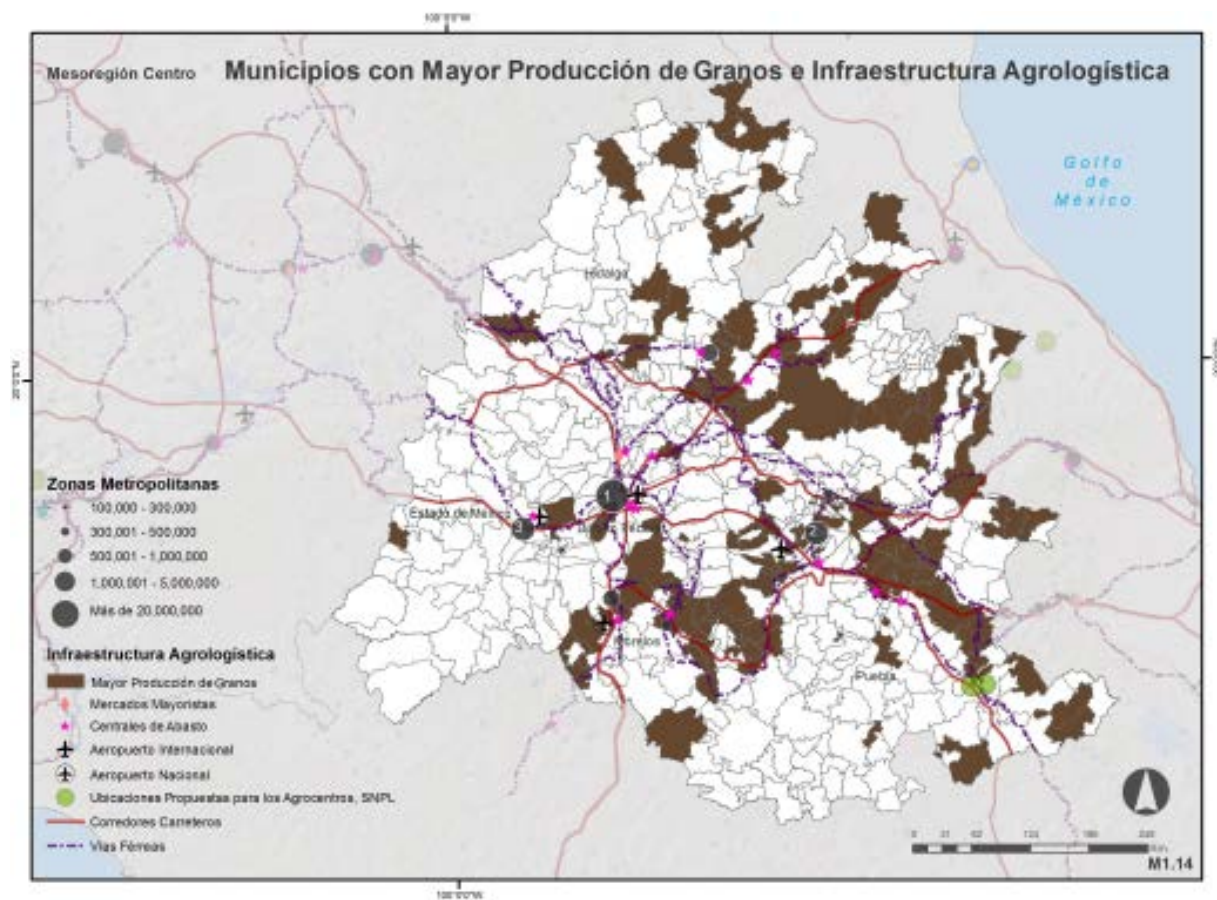
M1.12



M1.13



M1.14



MESOREGION 2: NORTHWEST

Baja California, Baja California Sur, Sonora,
Sinaloa

M2.01 Population Density in 2010

M2.02 Transport Infrastructure

M2.03 Road Infrastructure

M2.04 Commercial Control Infrastructure - Customs

M2.05 Supply Centers

M2.06 Existing Distribution Centers and Agrocenters Proposed by
SNPL

M2.07 Grain Production and Agrologistics Infrastructure

M2.08 Meat Production and Agrologistics Infrastructure

M2.09 Vegetable Production and Agrologistics Infrastructure

M2.10 Food Processing Plants

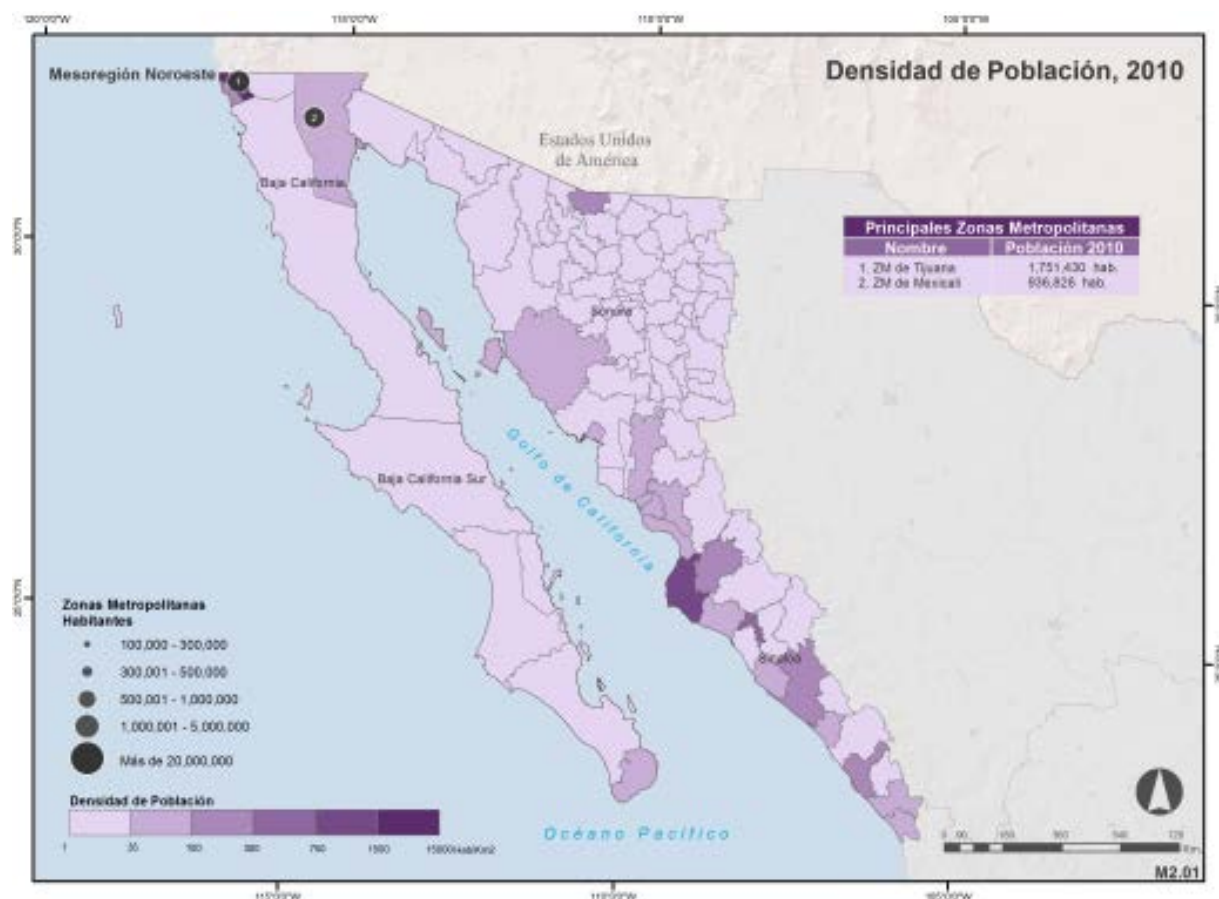
M2.11 Agrologistics Corridors

M2.12 Municipalities with Greater Grain Production and
Agrologistics Infrastructure

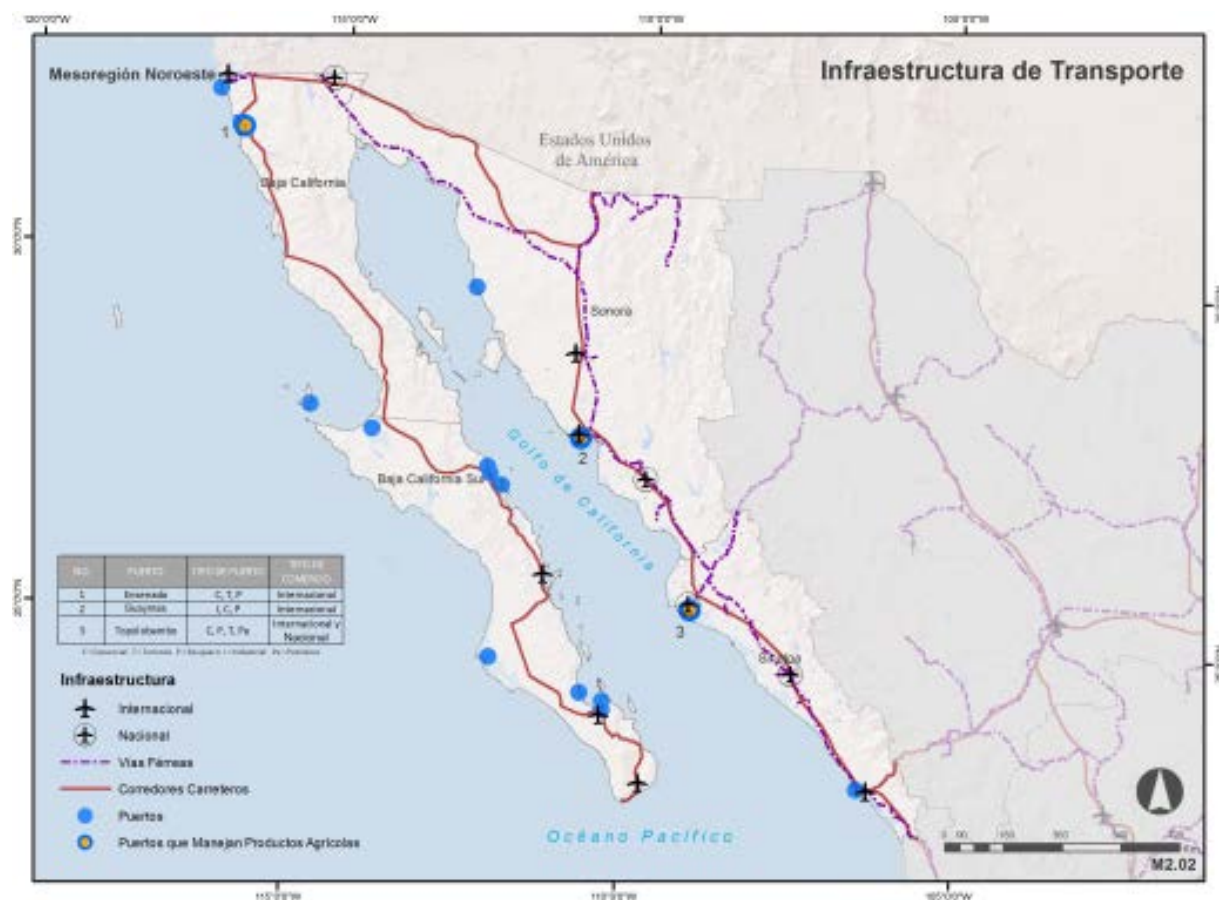
M2.13 Municipalities with Greater Meat Production and
Agrologistics Infrastructure

M2.14 Municipalities with Greater Vegetable Production and
Agrologistics Infrastructure

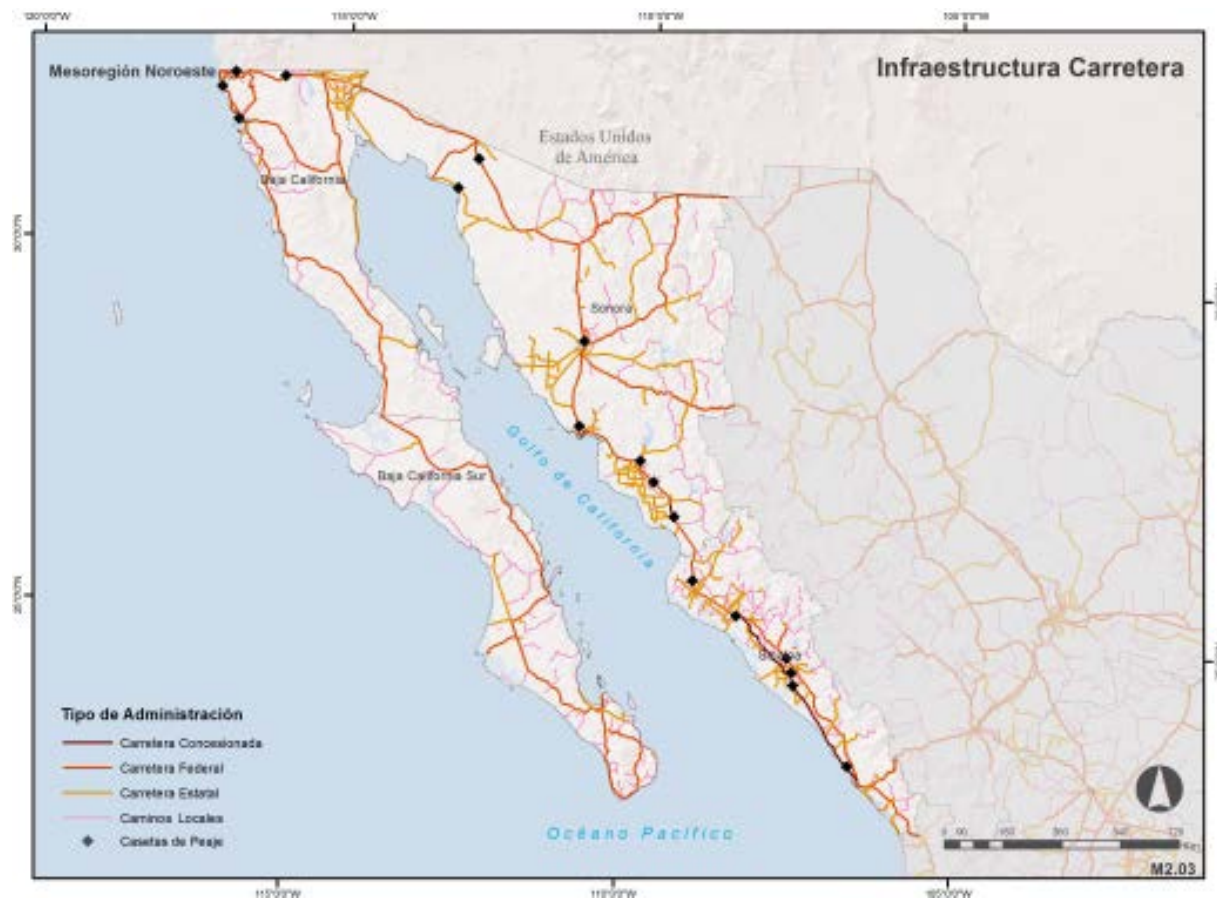
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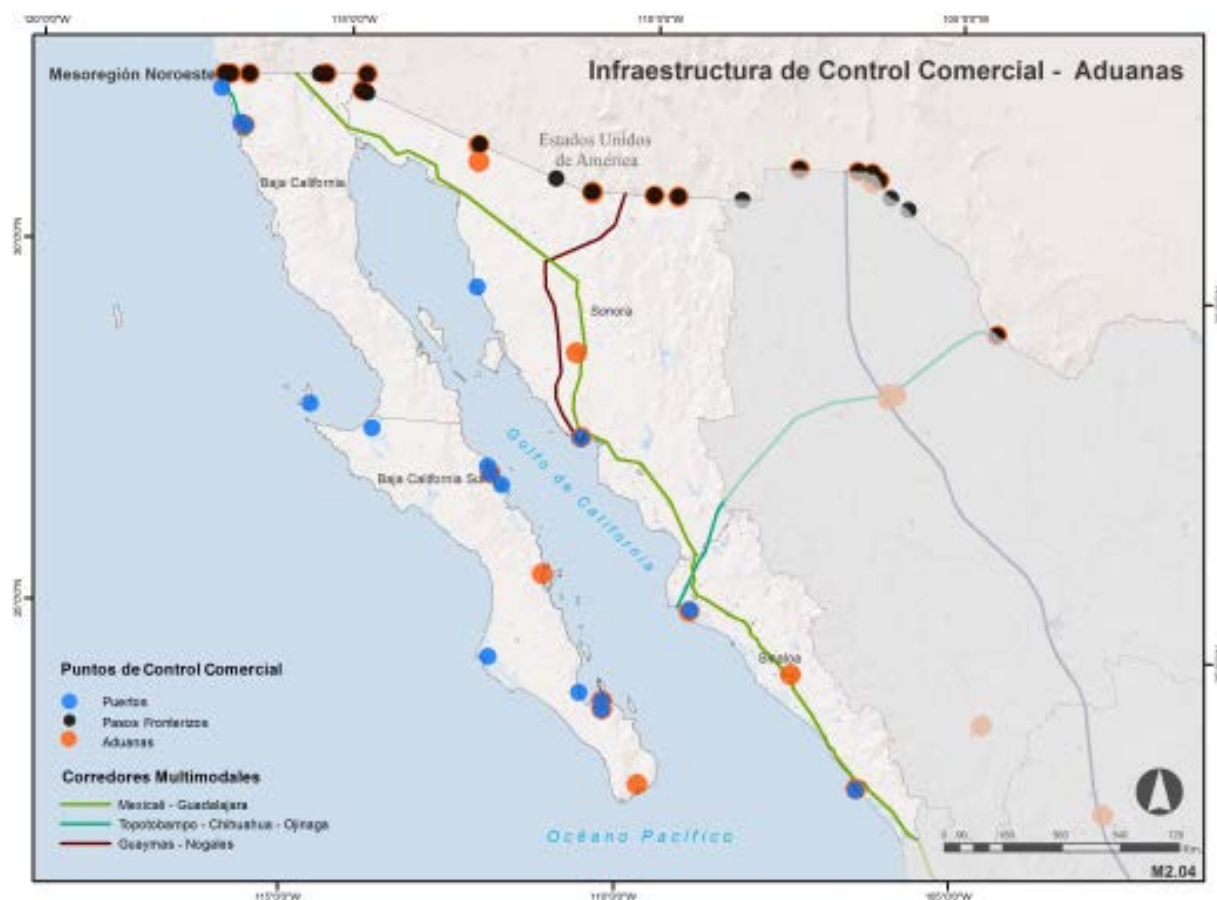
M2.02



M2.03



M2.04



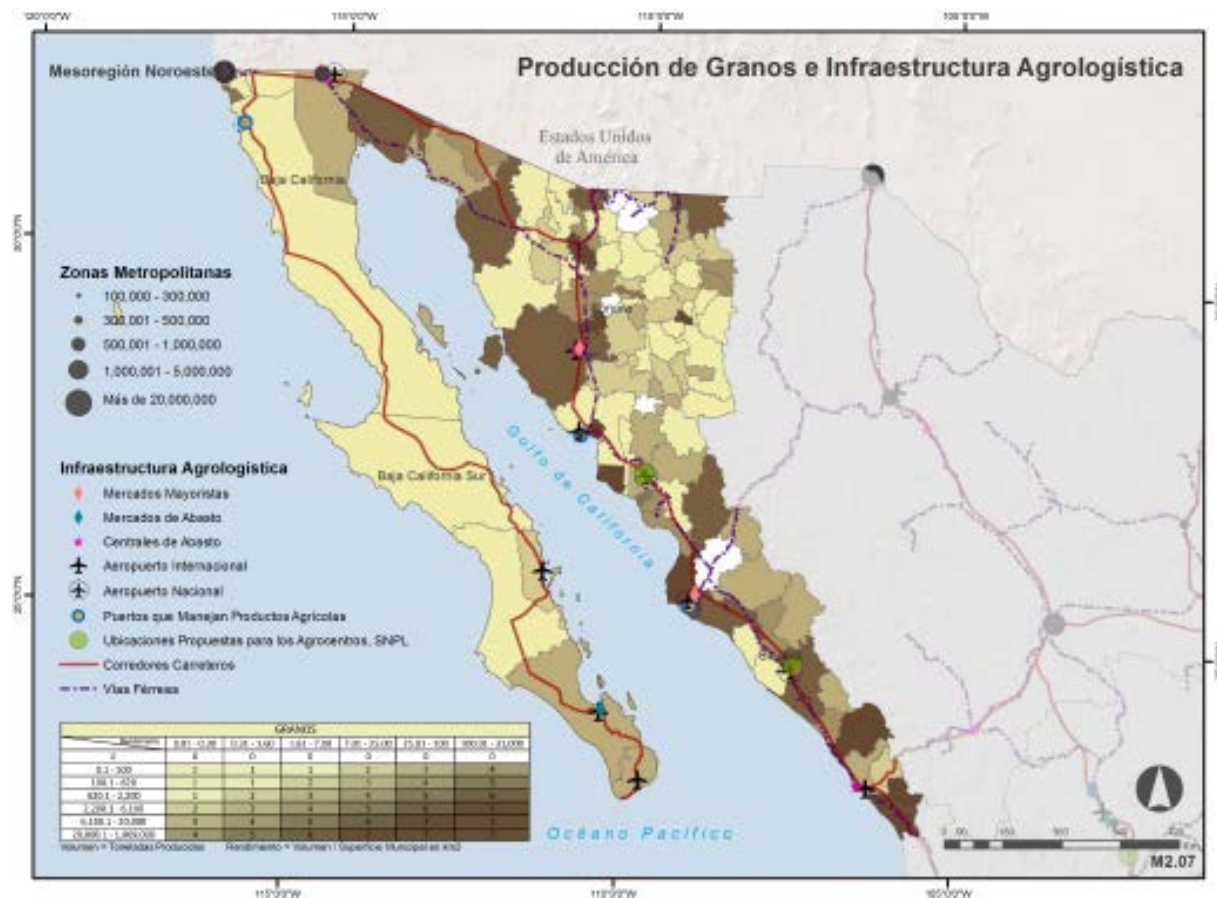
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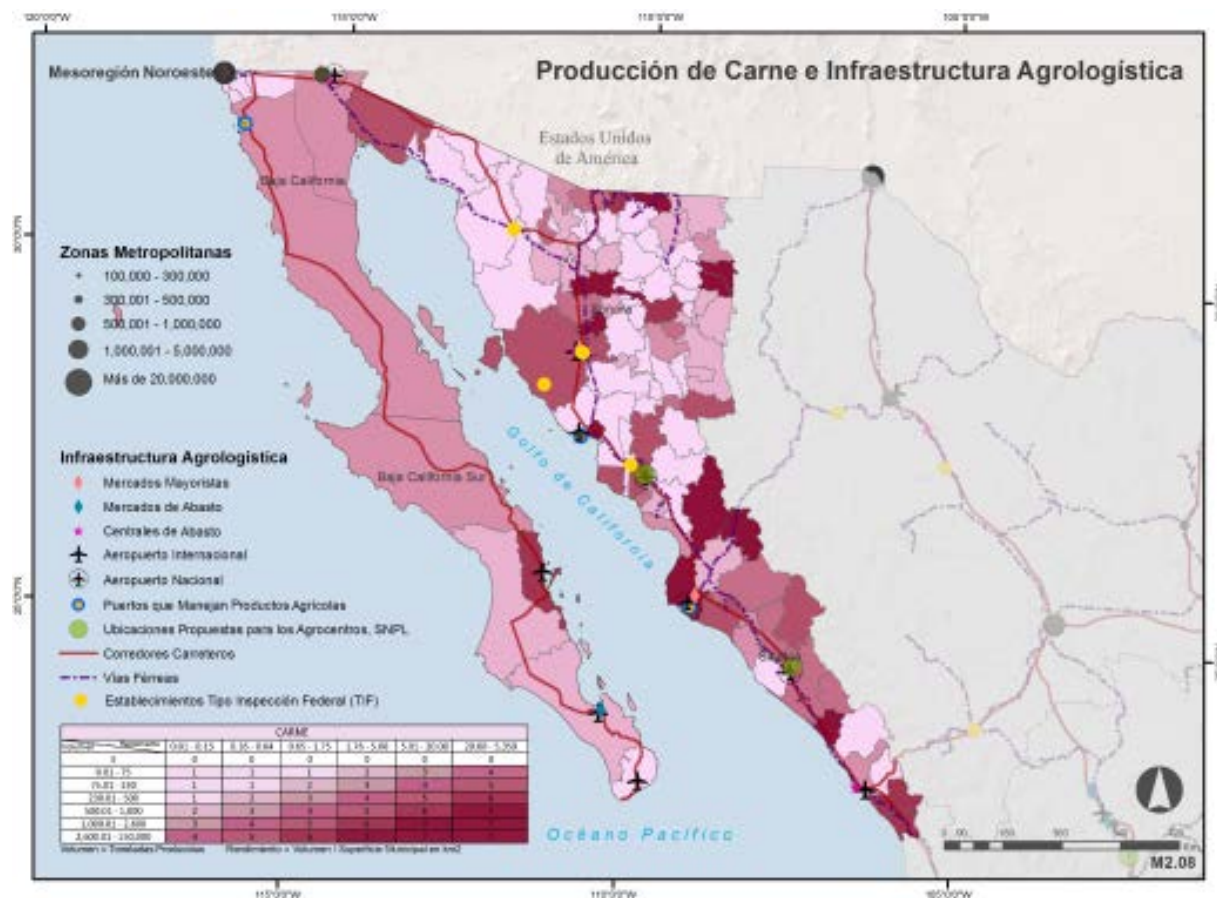
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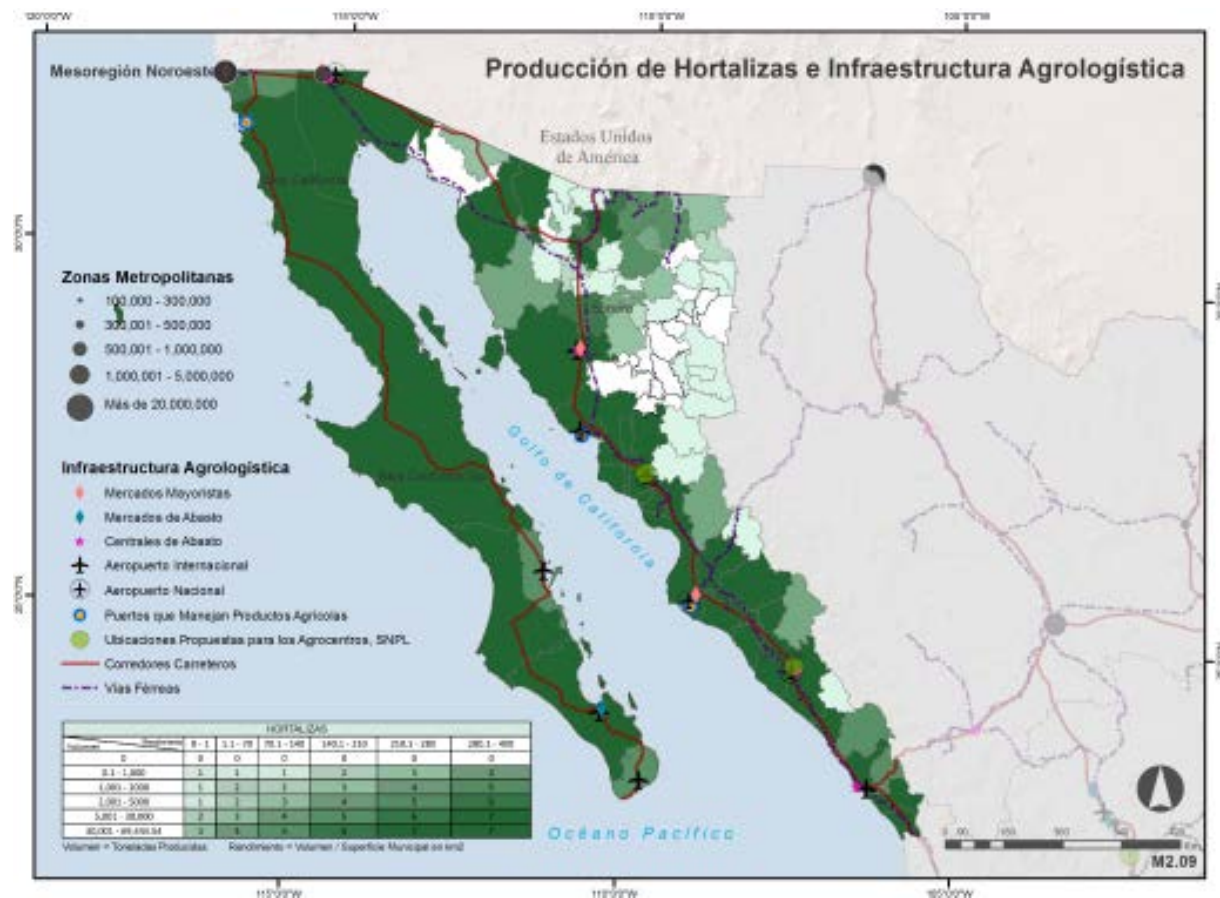
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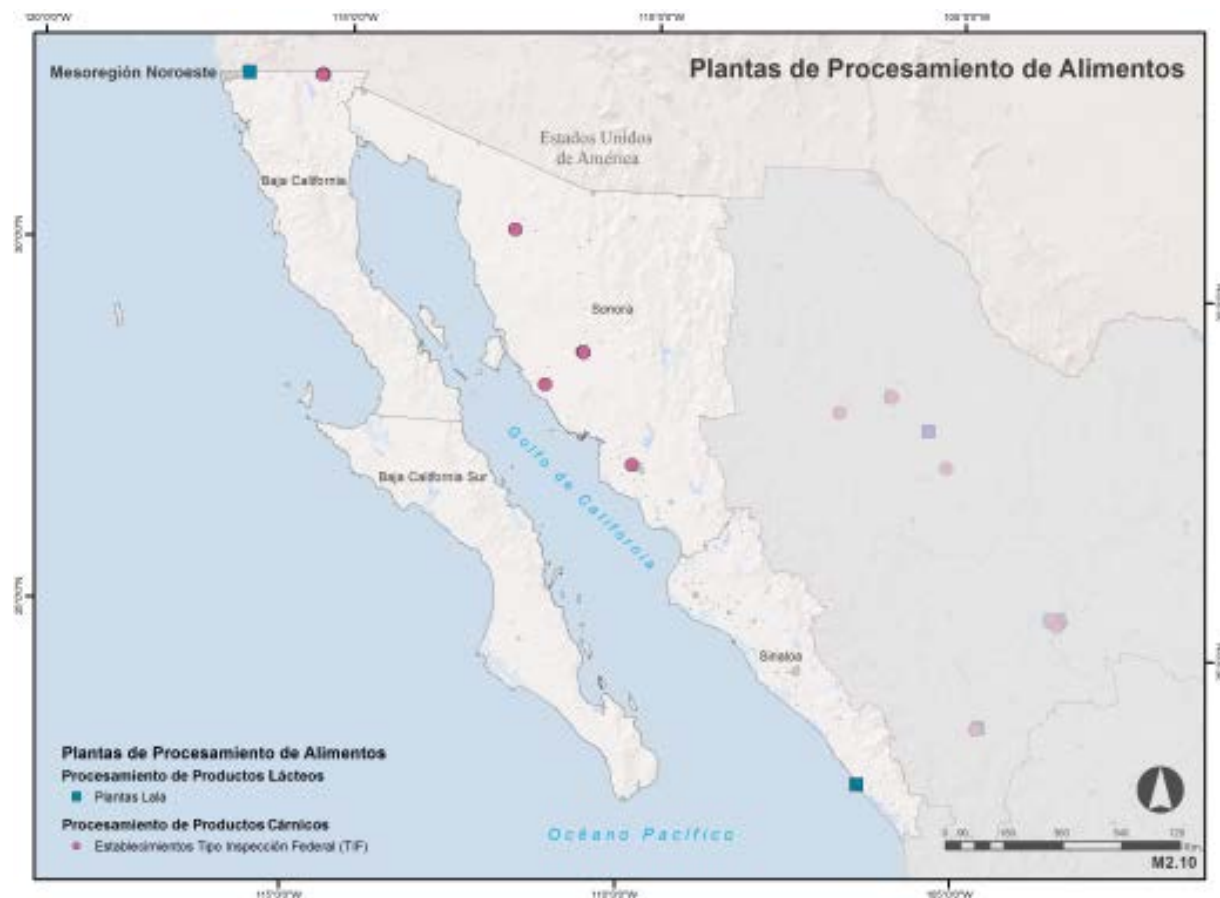
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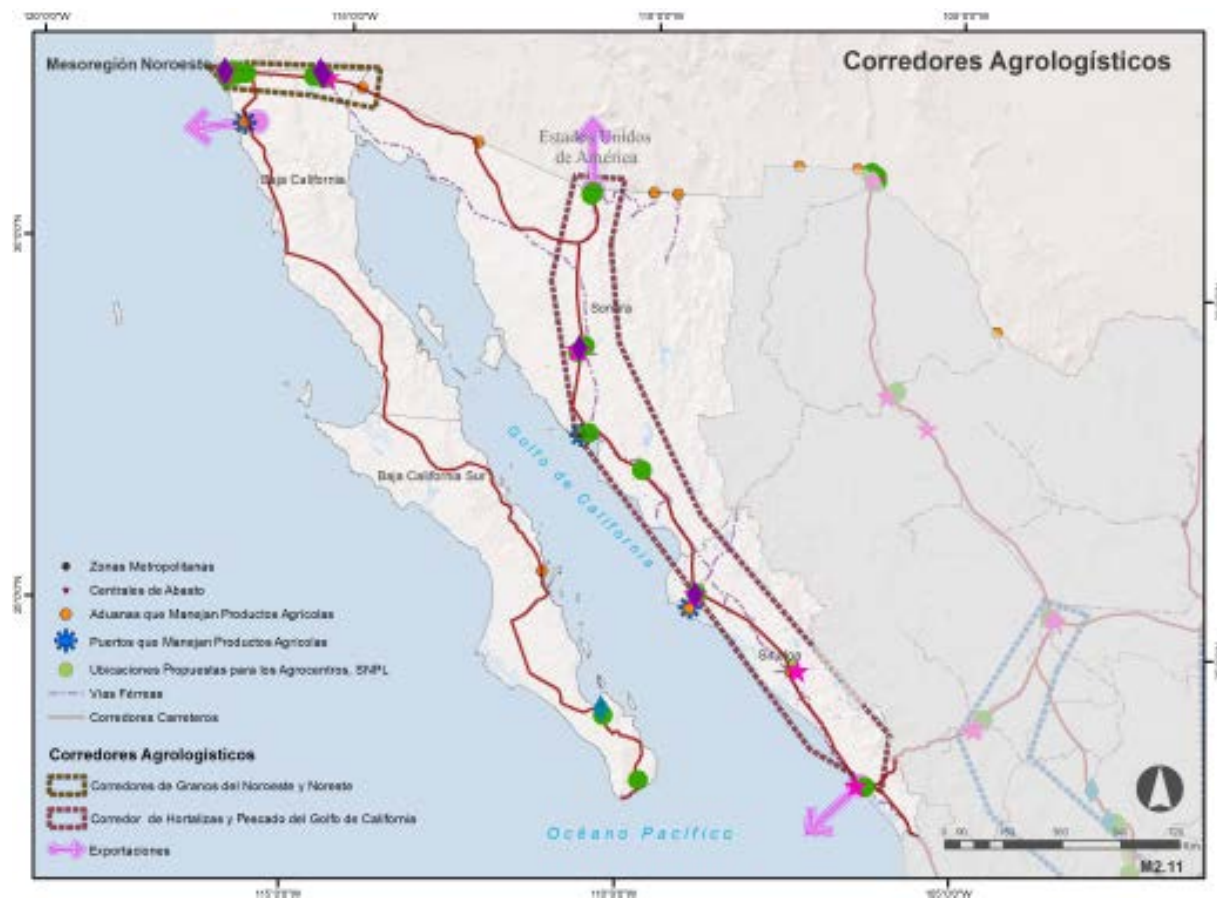
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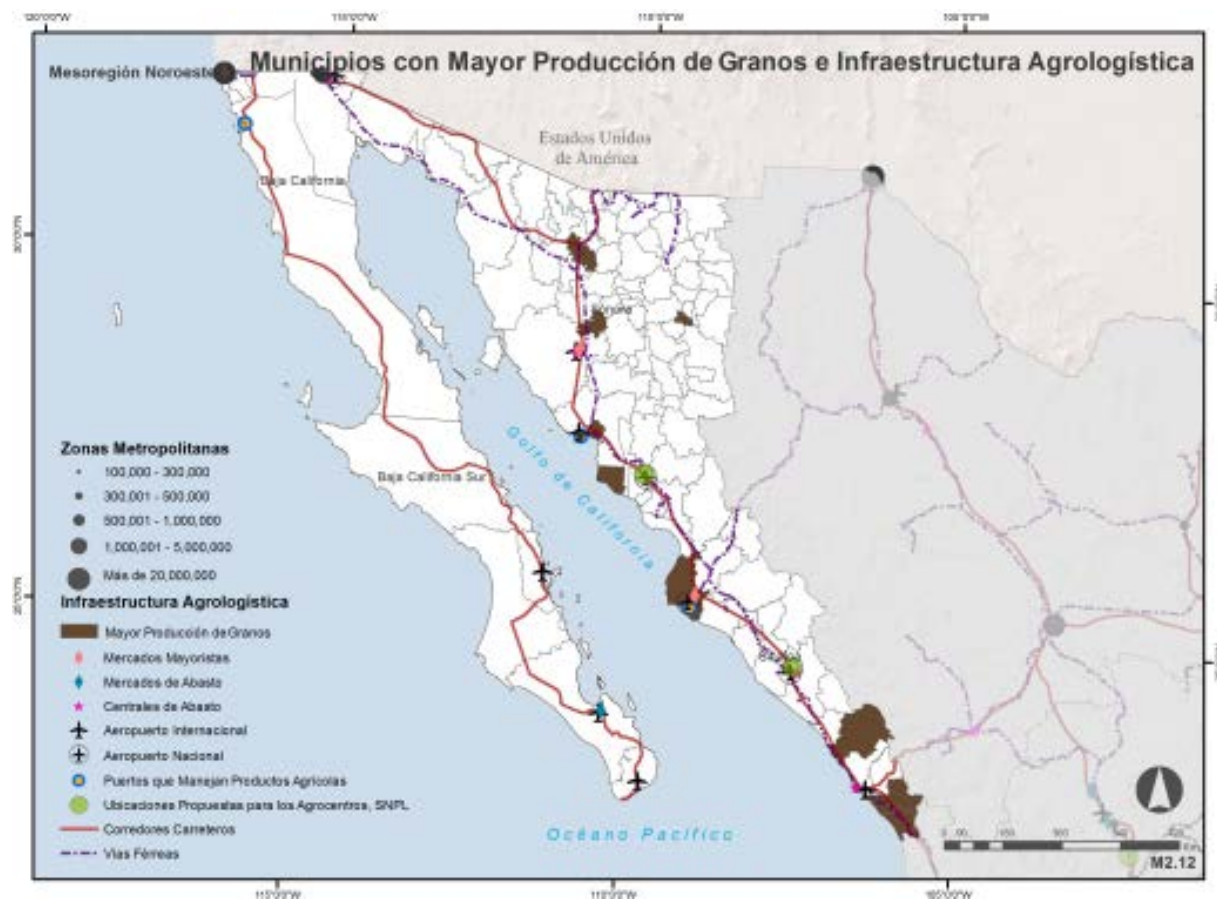
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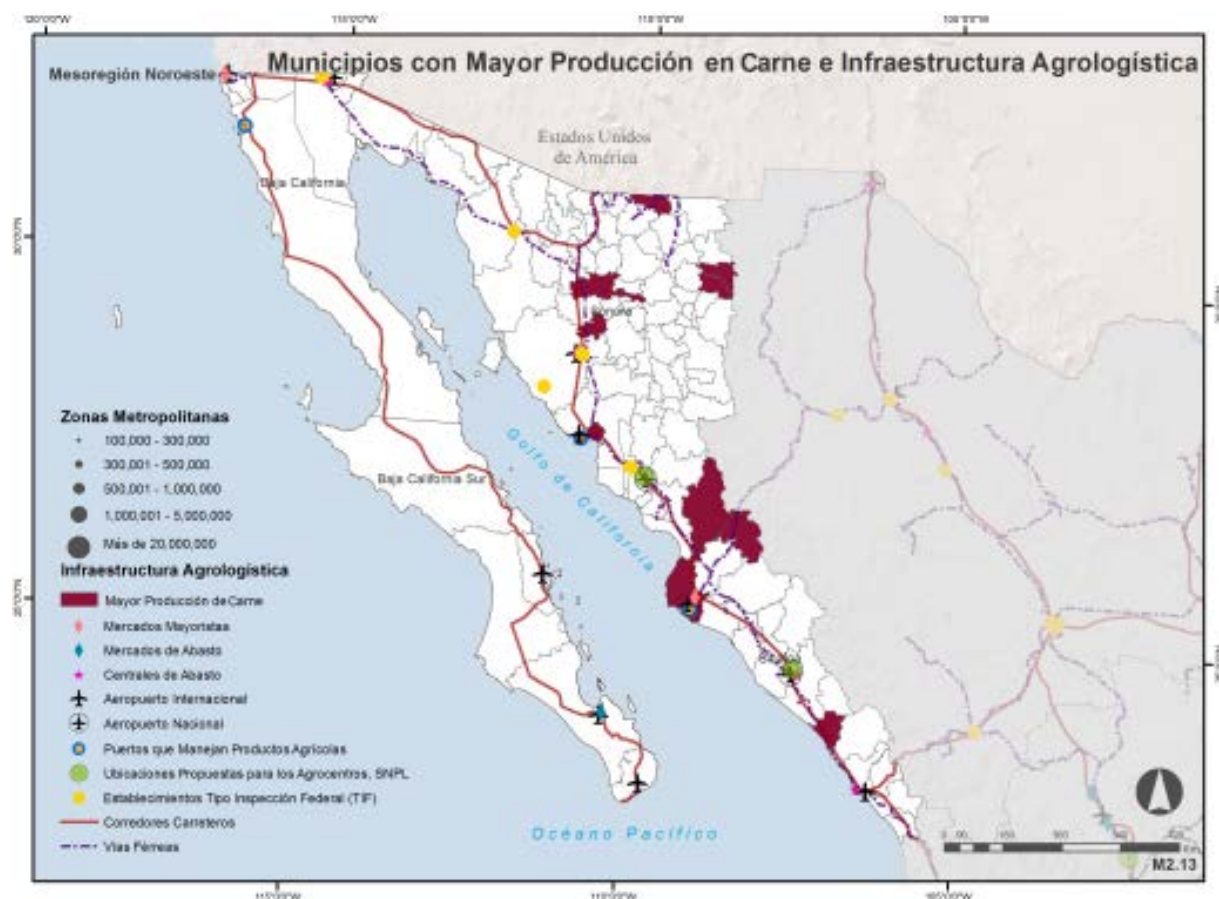
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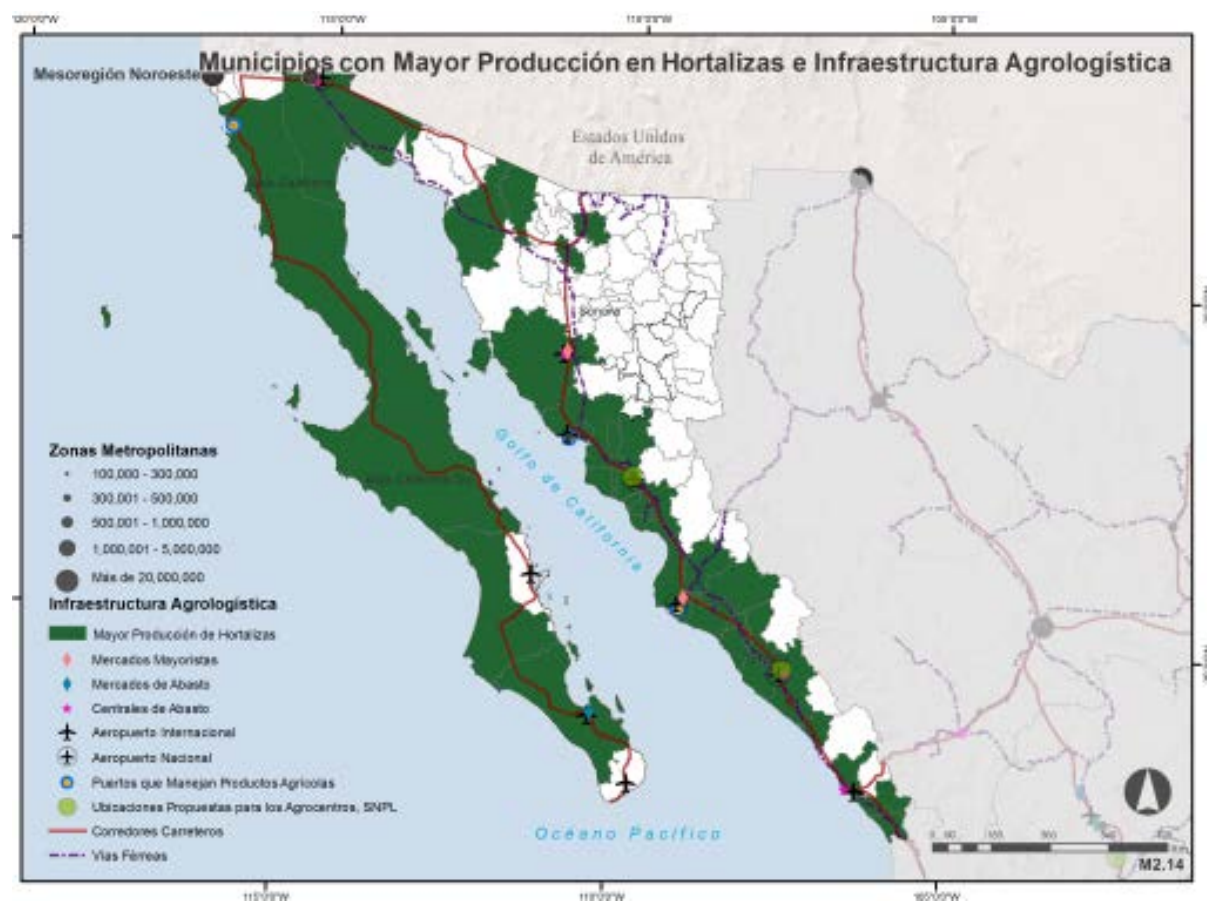
M2.12



M2.13



M2.14



MESOREGION 3: WEST

Aguascalientes, Colima, Guanajuato, Jalisco, Michoacán, Nayarit, Querétaro, San Luis Potosí, Zacatecas.

M3.01 Population Density in 2010

M3.02 Transport Infrastructure

M3.03 Road Infrastructure

M3.04 Commercial Control Infrastructure - Customs

M3.05 Supply Centers

M3.06 Existing Distribution Centers and Agrocenters Proposed by SNPL

M3.07 Grain Production and Agrologistics Infrastructure

M3.08 Meat Production and Agrologistics Infrastructure

M3.09 Processed Food and Agrologistics Infrastructure

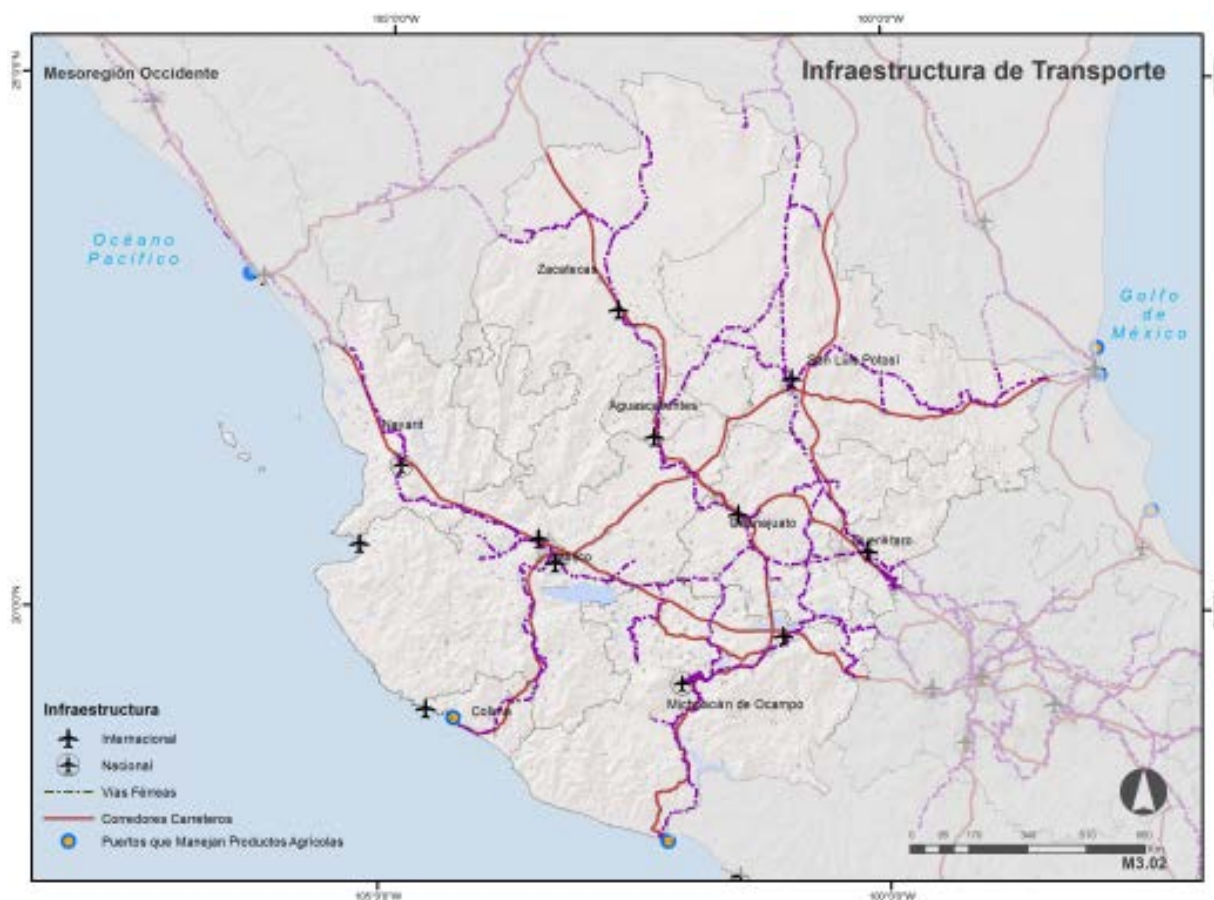
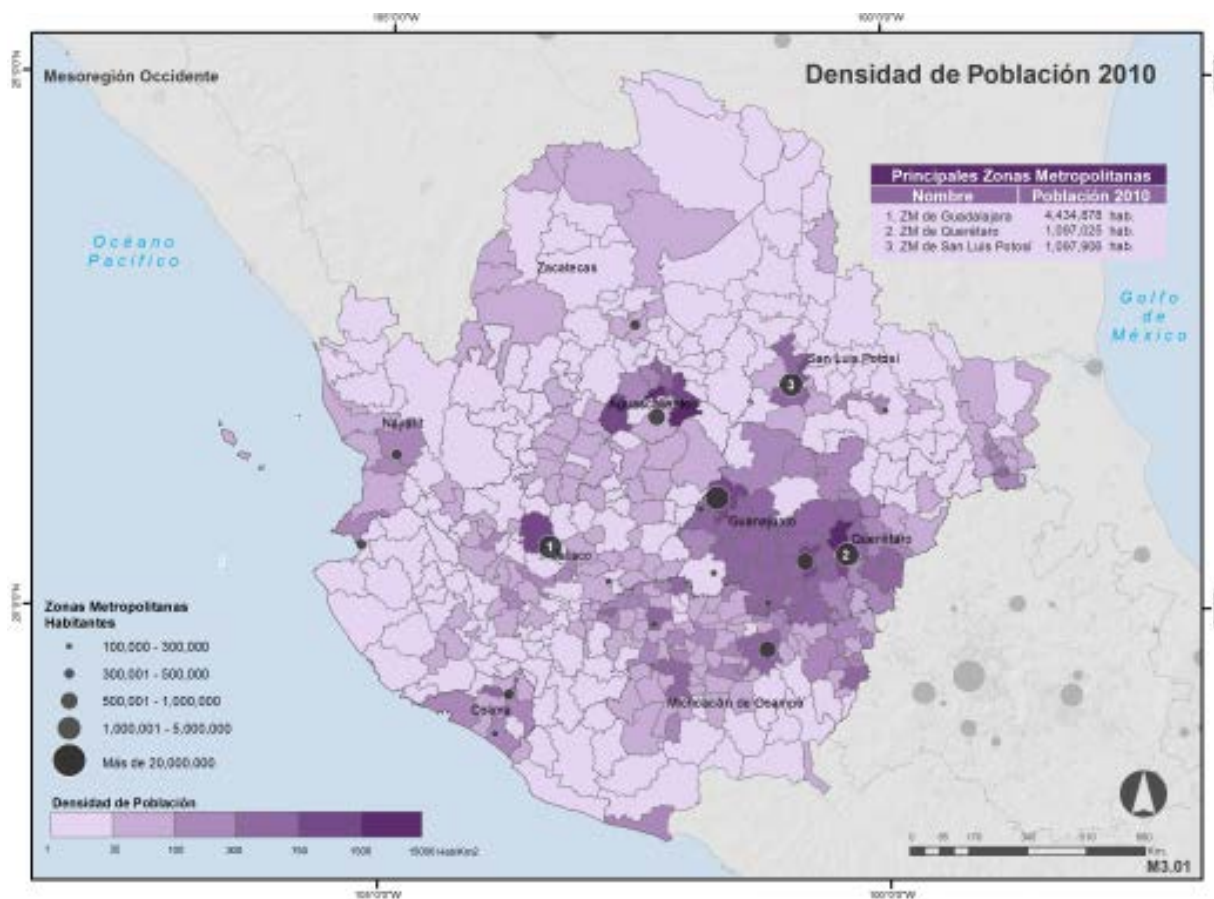
M3.10 Food Processing Plants

M3.11 Agrologistics Corridors

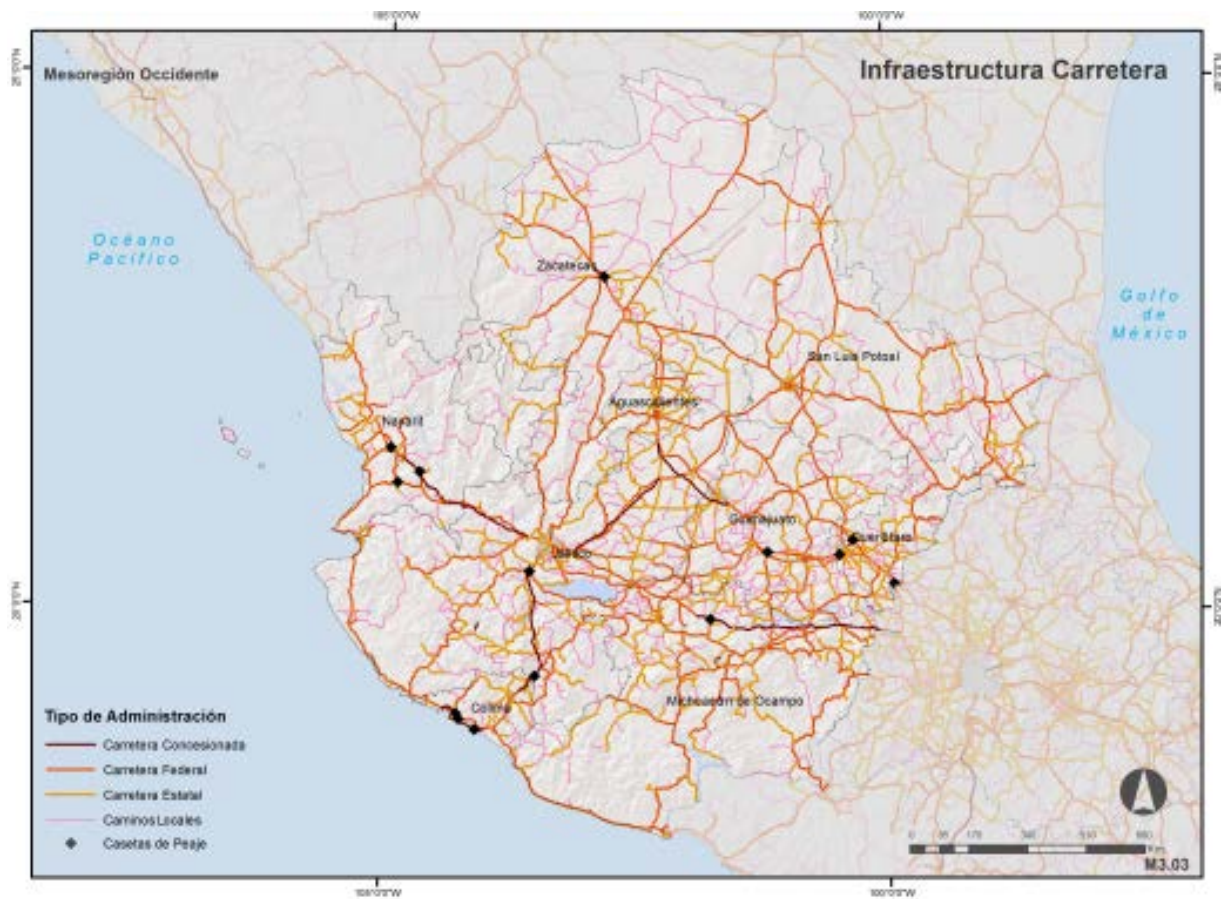
M3.12 Municipalities with Greater Processed Food Production and Agrologistics Infrastructure

M3.13 Municipalities with Greater Grain Production and Agrologistics Infrastructure

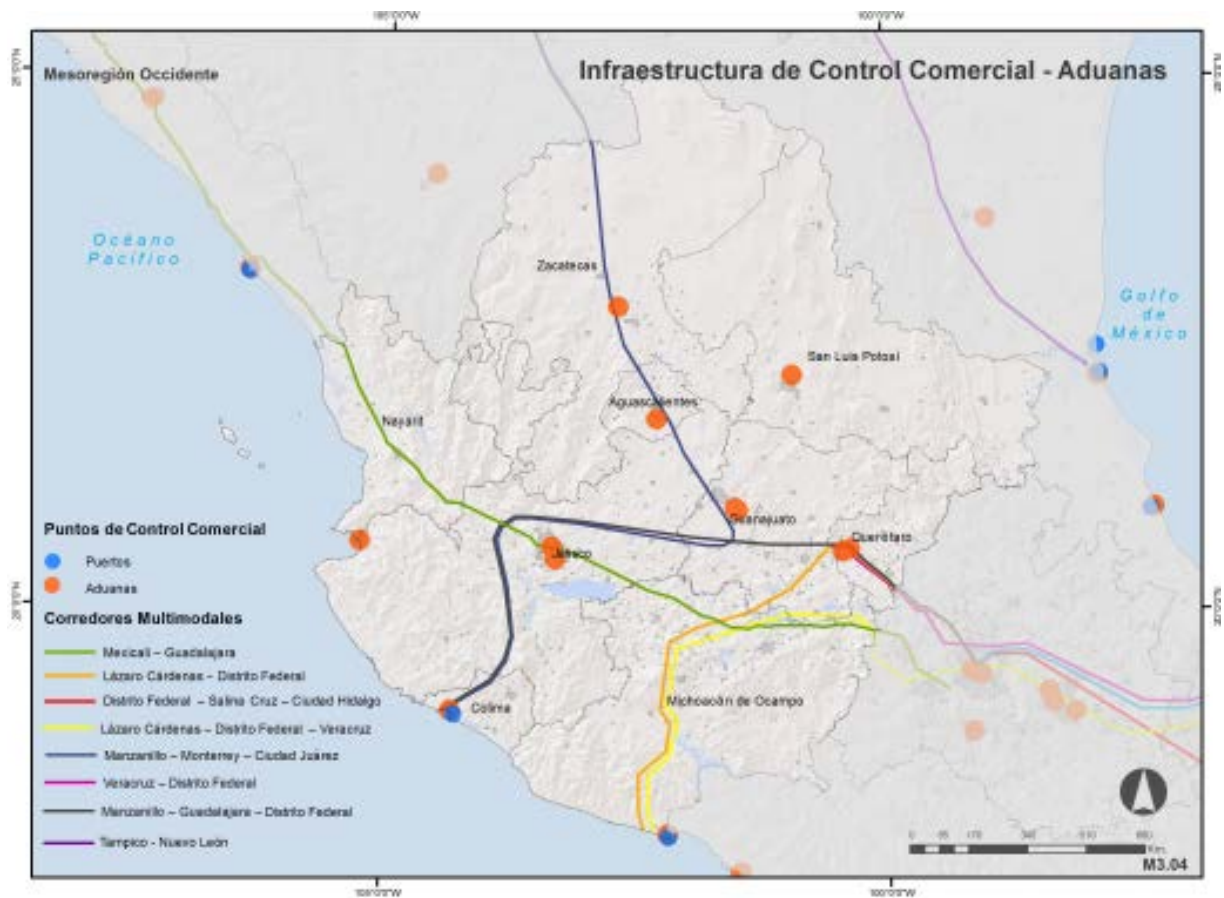
M3.14 Municipalities with Greater Meat Production and Agrologistics Infrastructure



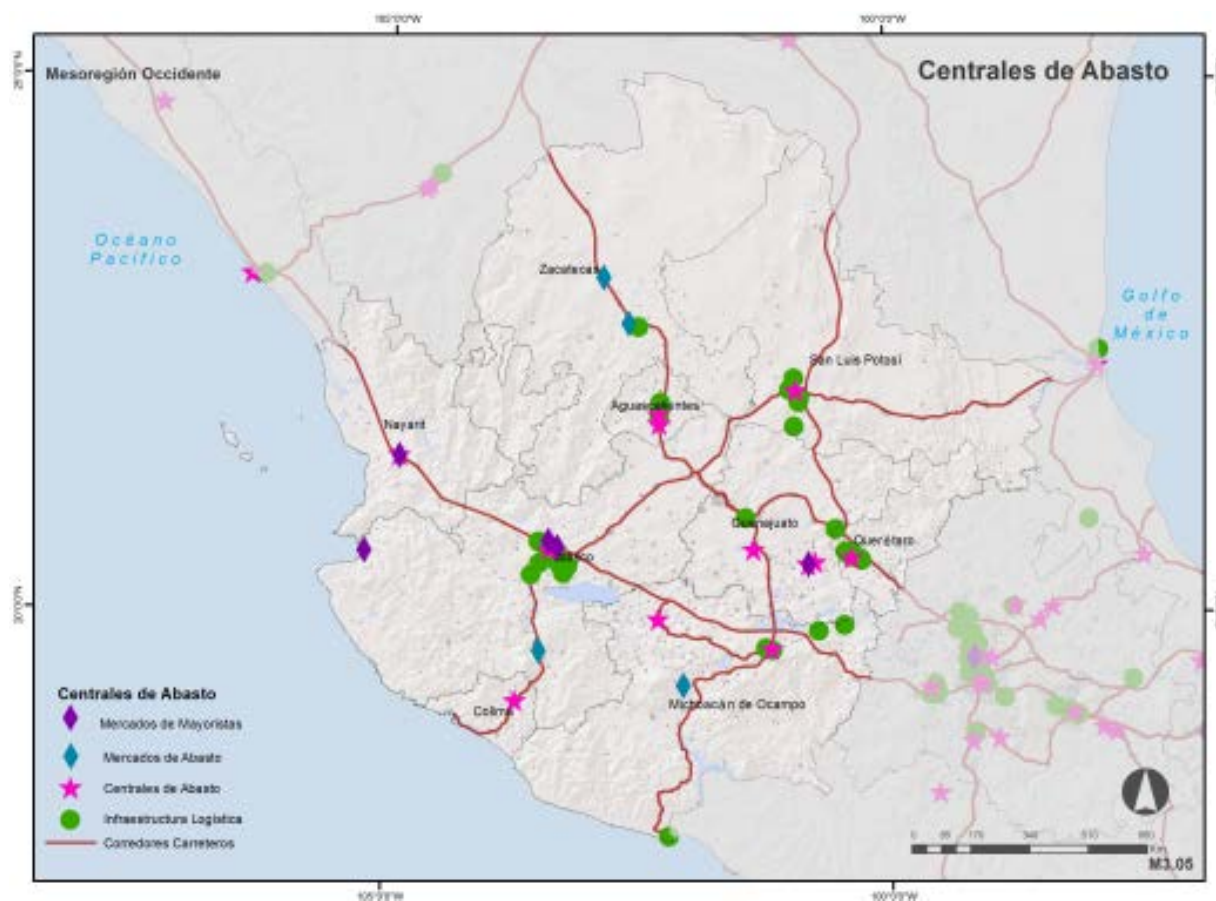
M3.03



M3.04



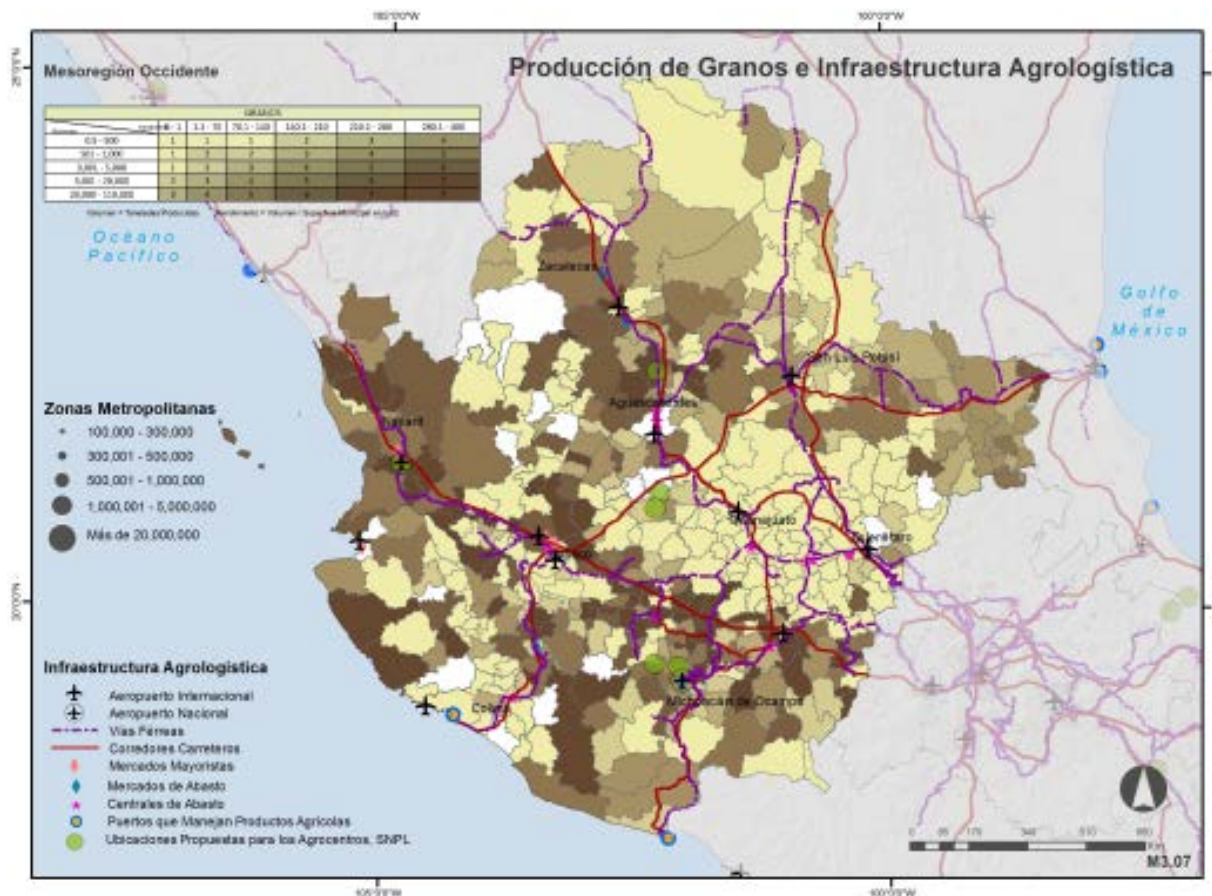
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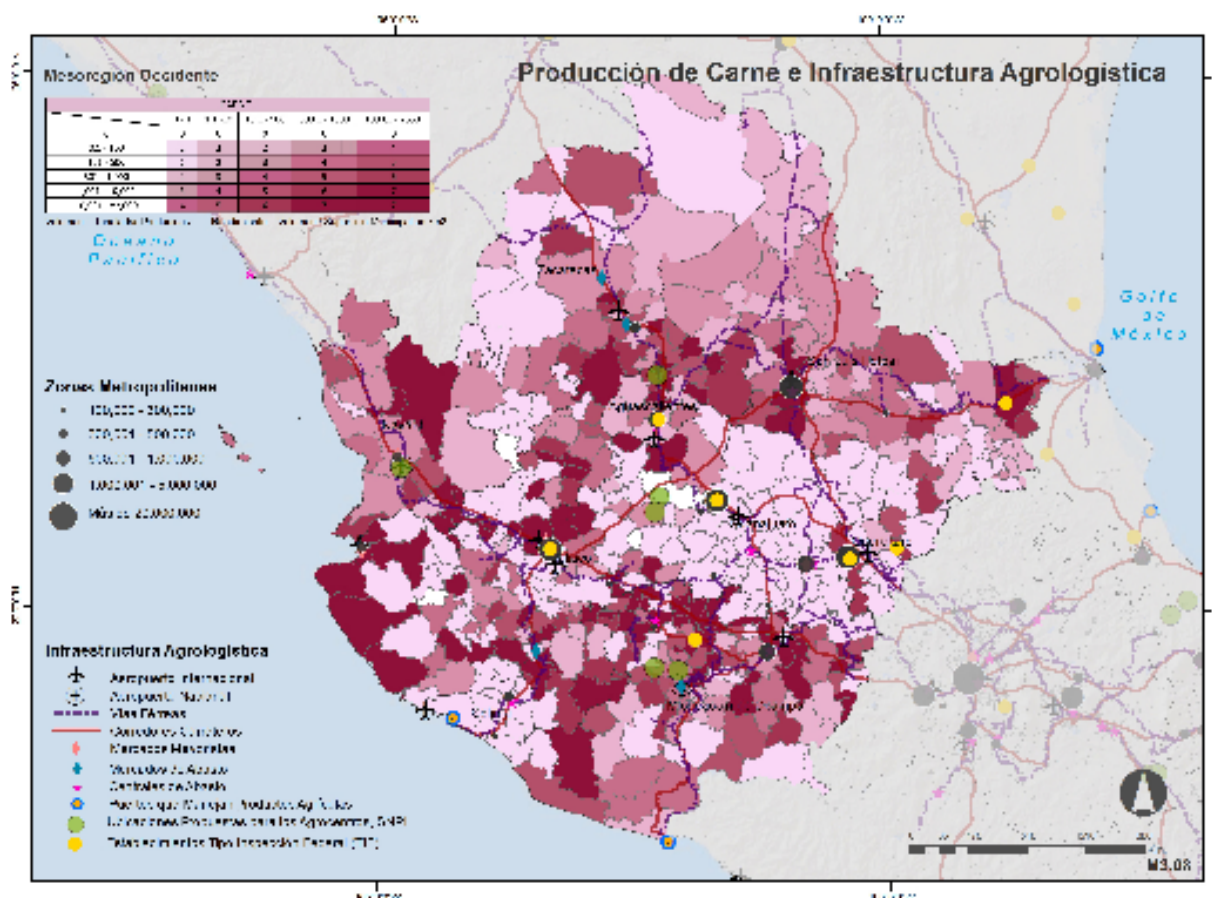
M3.06



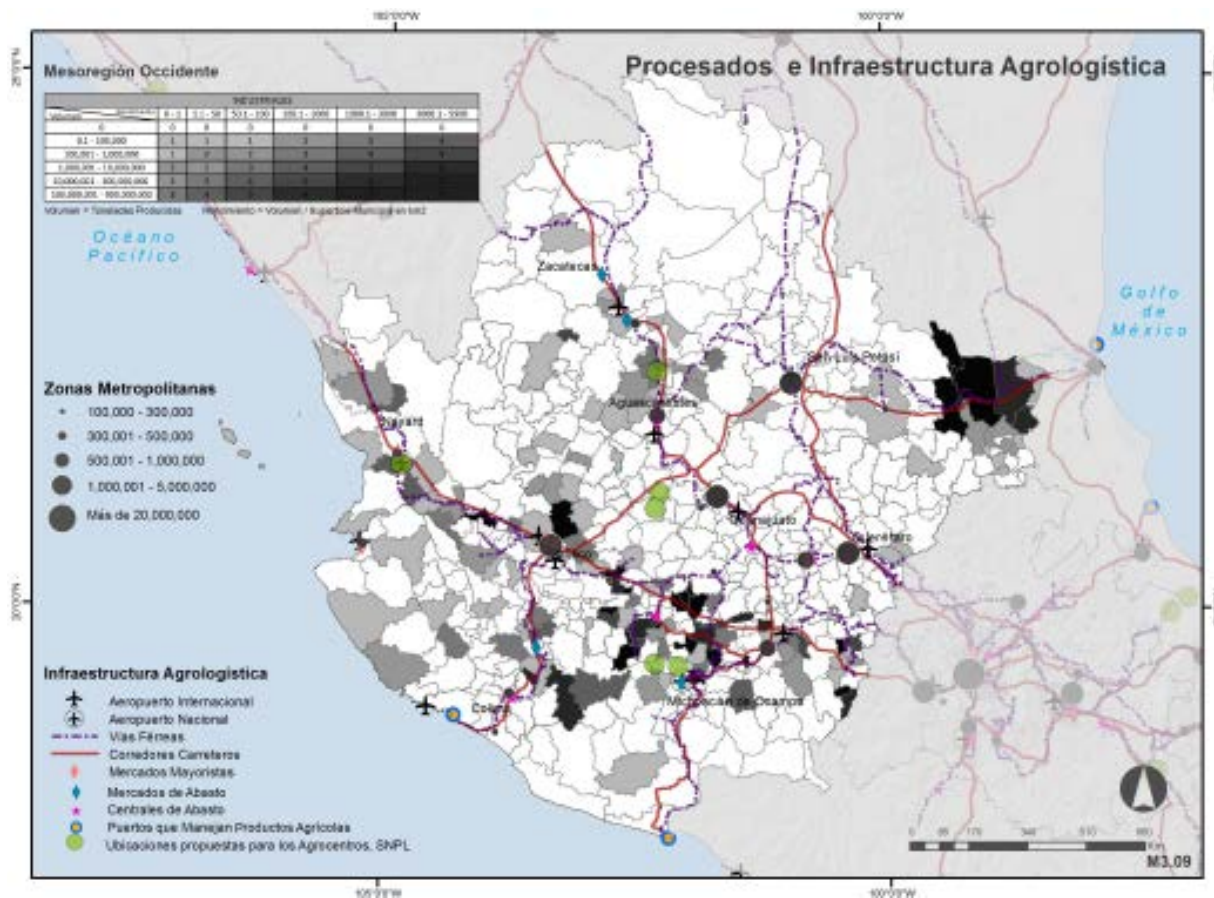
M3.07



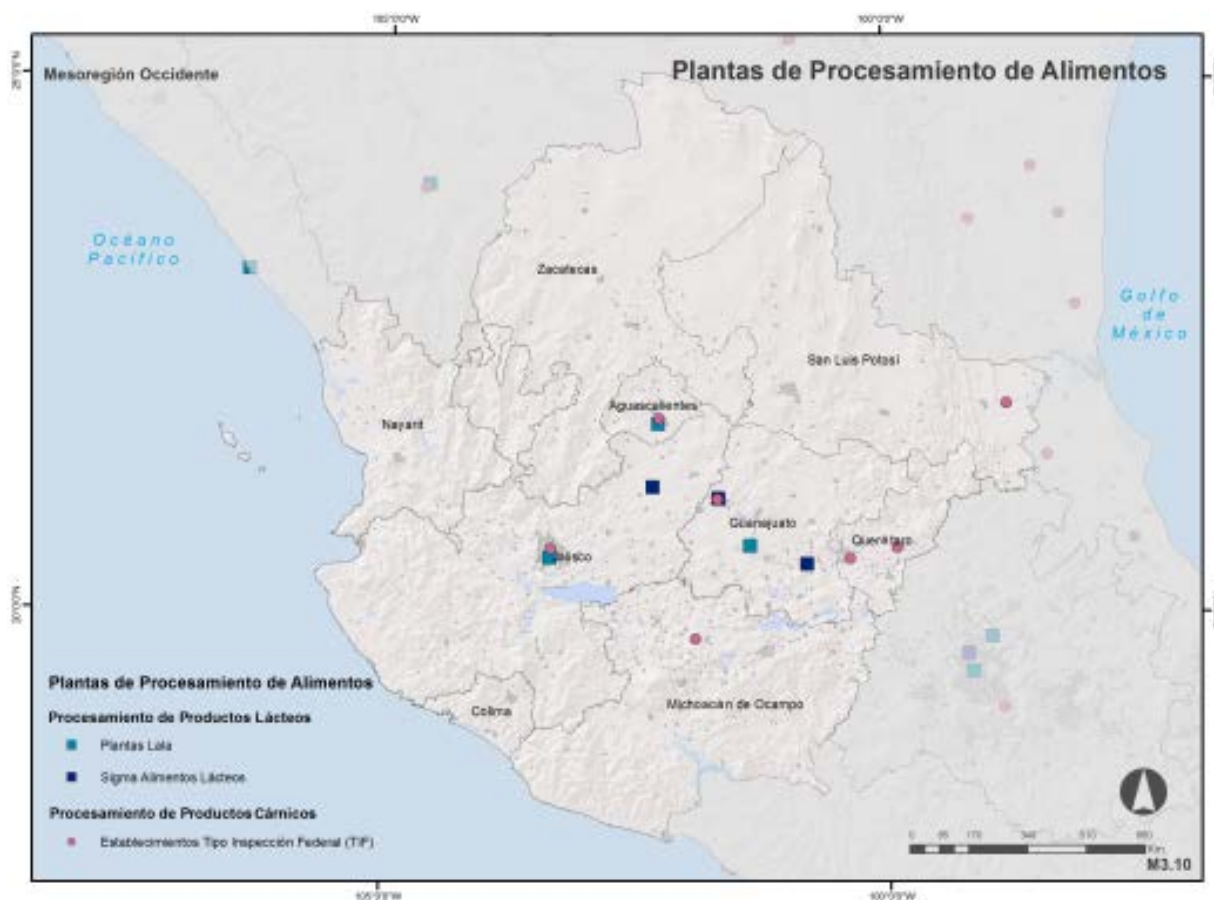
M3.08



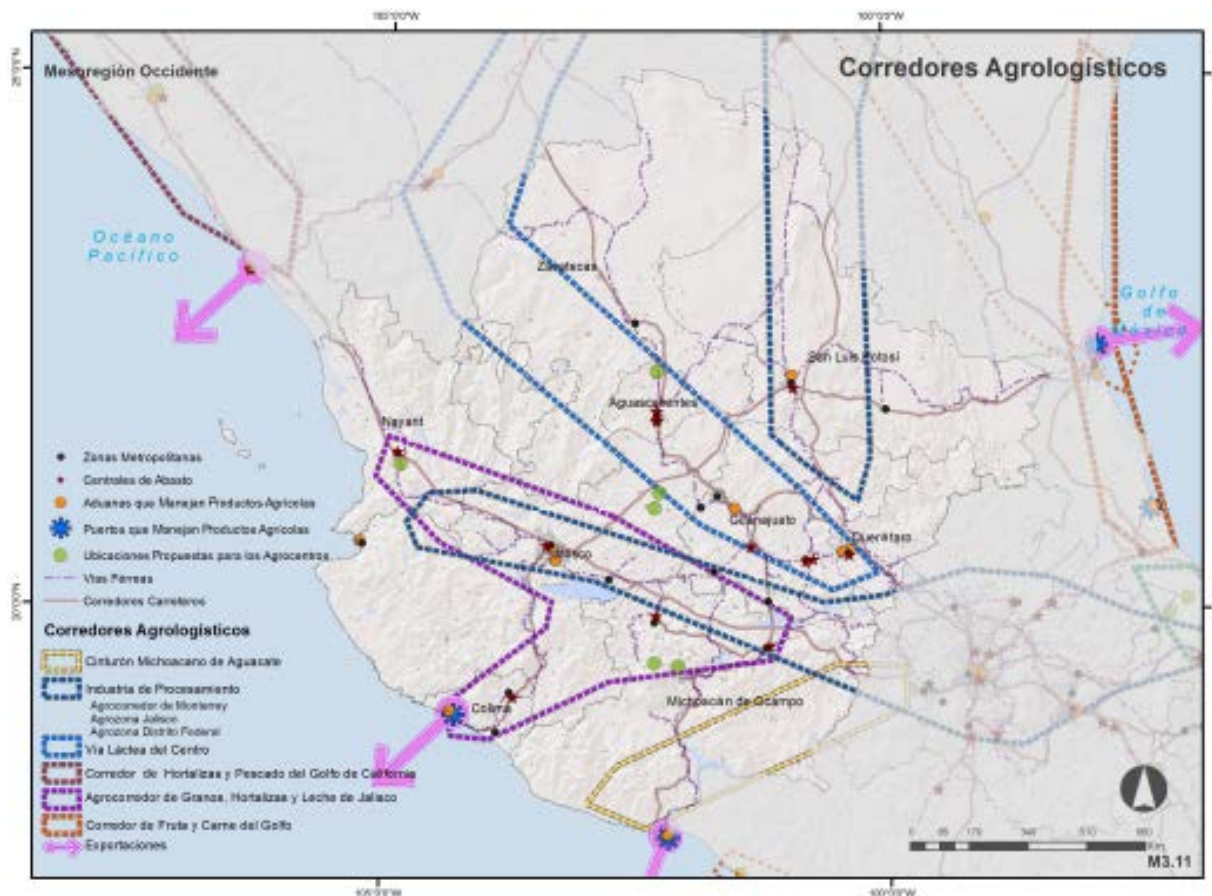
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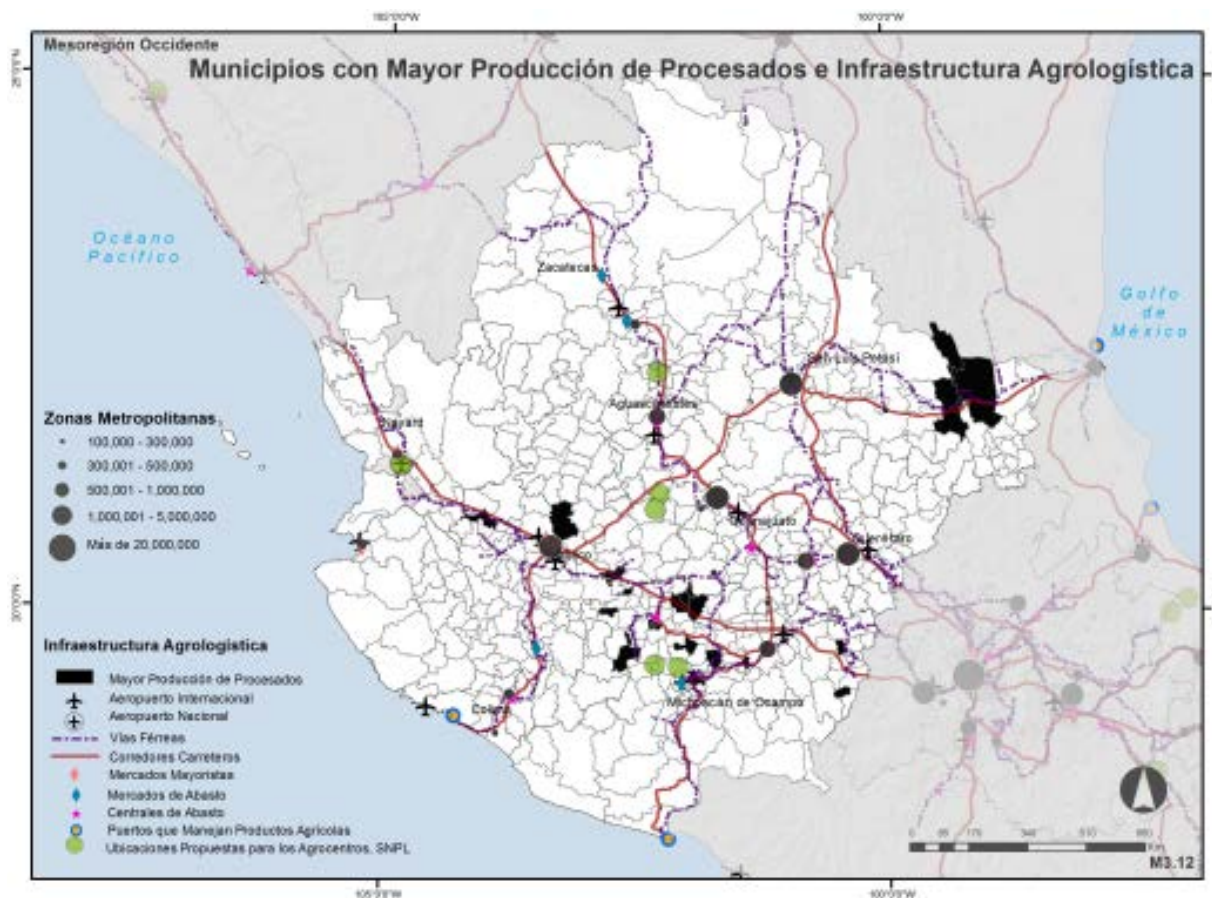
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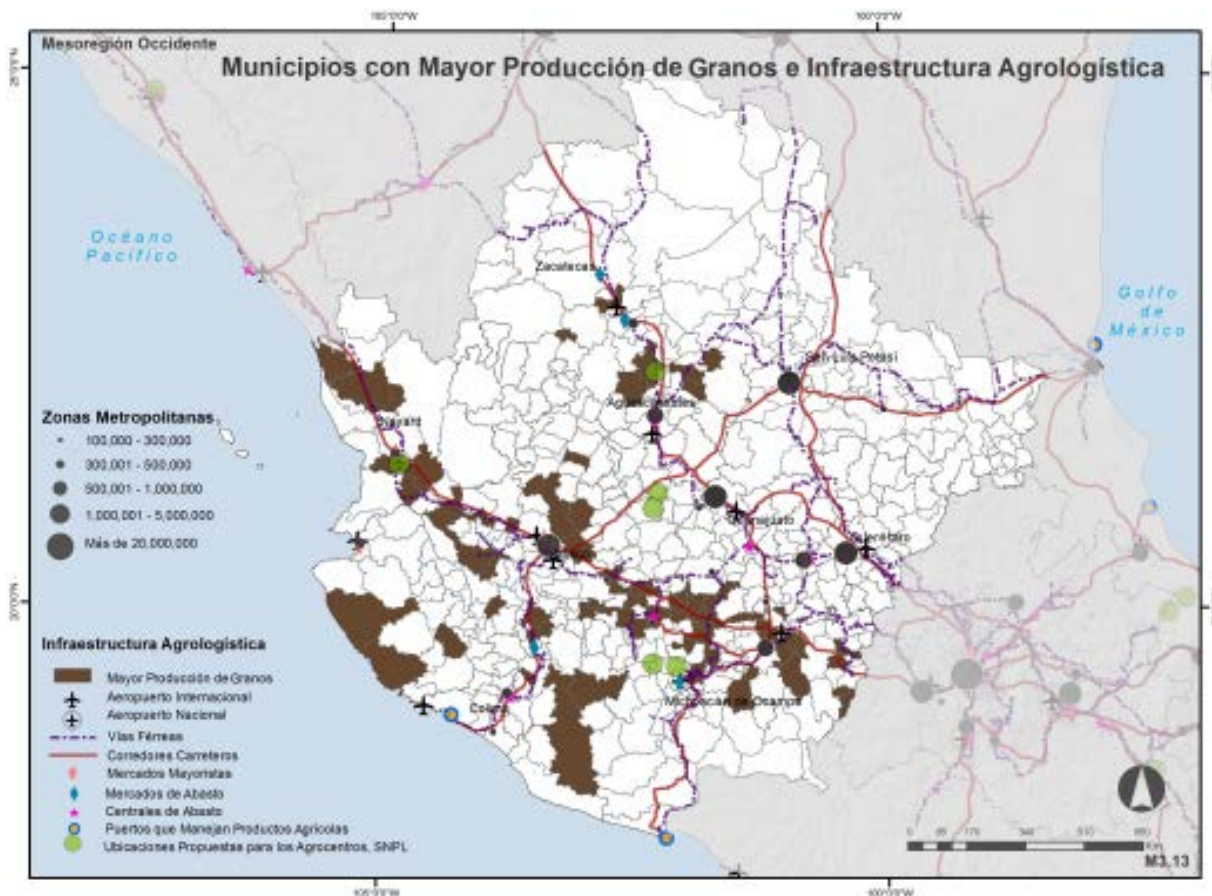
M3.11



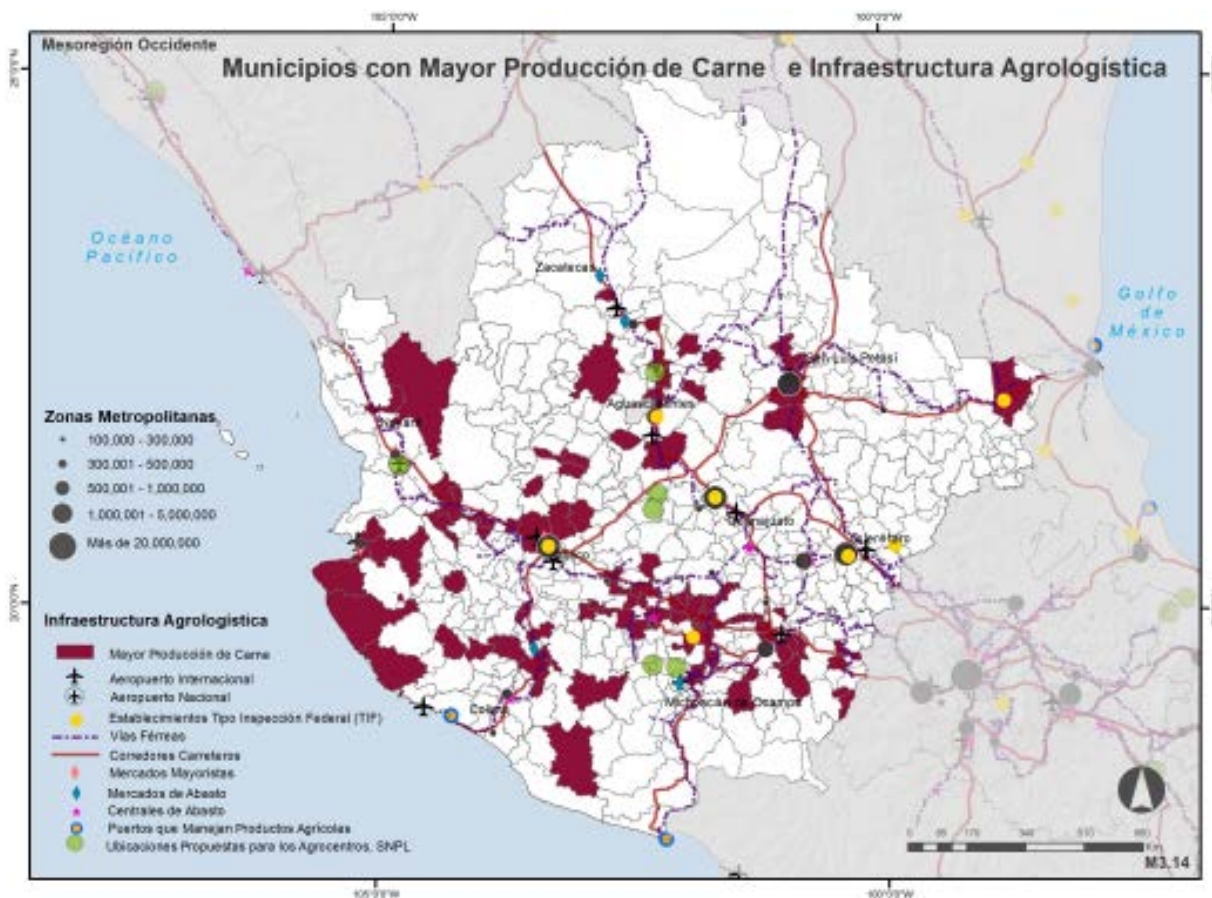
M3.12



M3.13



M3.14



MESOREGION 4: NORTHEAST

Chihuahua, Coahuila of Zaragoza, Durango,
Nuevo León, Tamaulipas.

M4.01 Population Density in 2010

M4.02 Transport Infrastructure

M4.03 Road Infrastructure

M4.04 Commercial Control Infrastructure - Customs

M4.05 Supply Centers

M4.06 Existing Distribution Centers and Agrocenters Proposed by
SNPL

M4.07 Meat Production and Agrologistics Infrastructure

M4.08 Dairy Production and Agrologistics Infrastructure

M4.09 Processed Food and Agrologistics Infrastructure

M4.10 Food Processing Plants

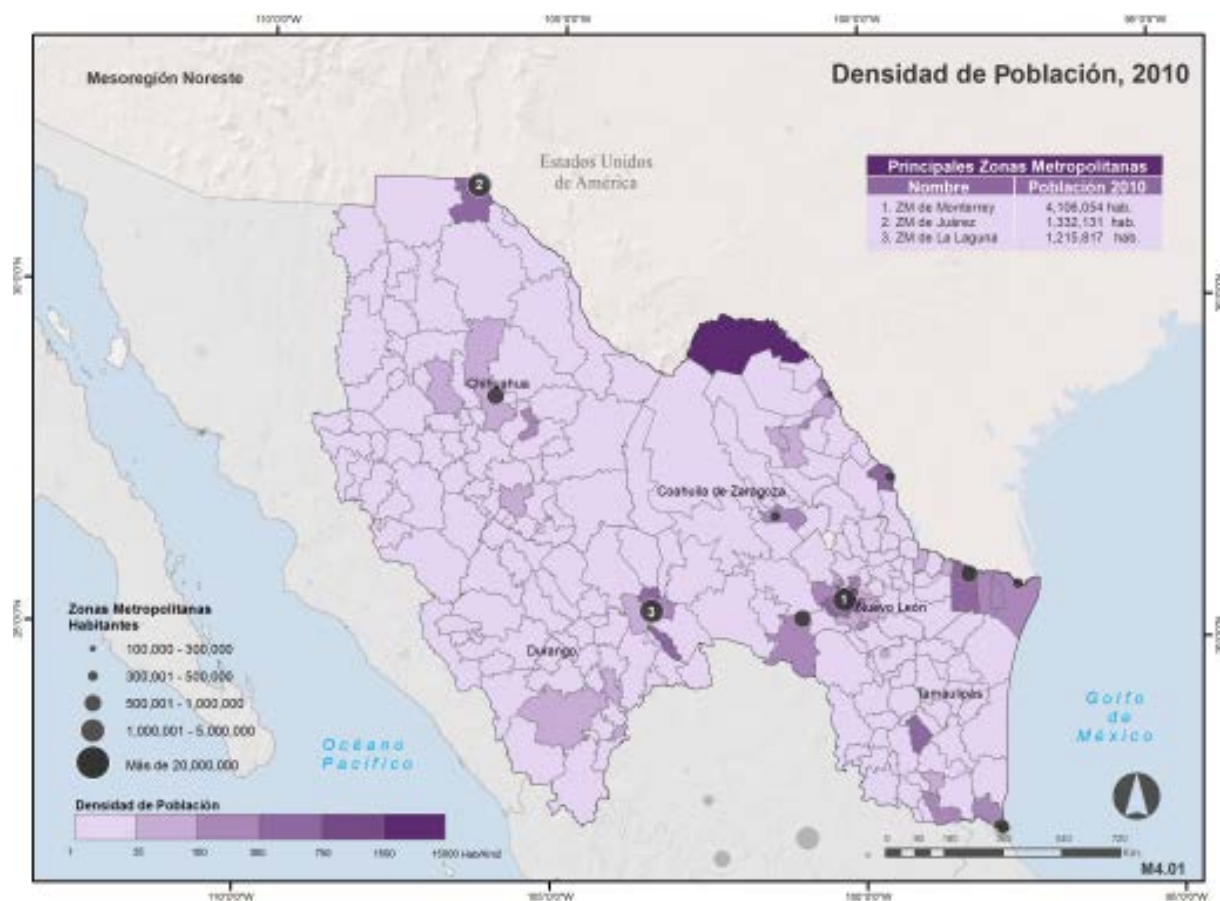
M4.11 Agrologistics Corridors

M4.12 Municipalities with Greater Meat Production and
Agrologistics Infrastructure

M4.13 Municipalities with Greater Processed Food Production and
Agrologistics Infrastructure

M4.14 Municipalities with Greater Dairy Production and
Agrologistics Infrastructure

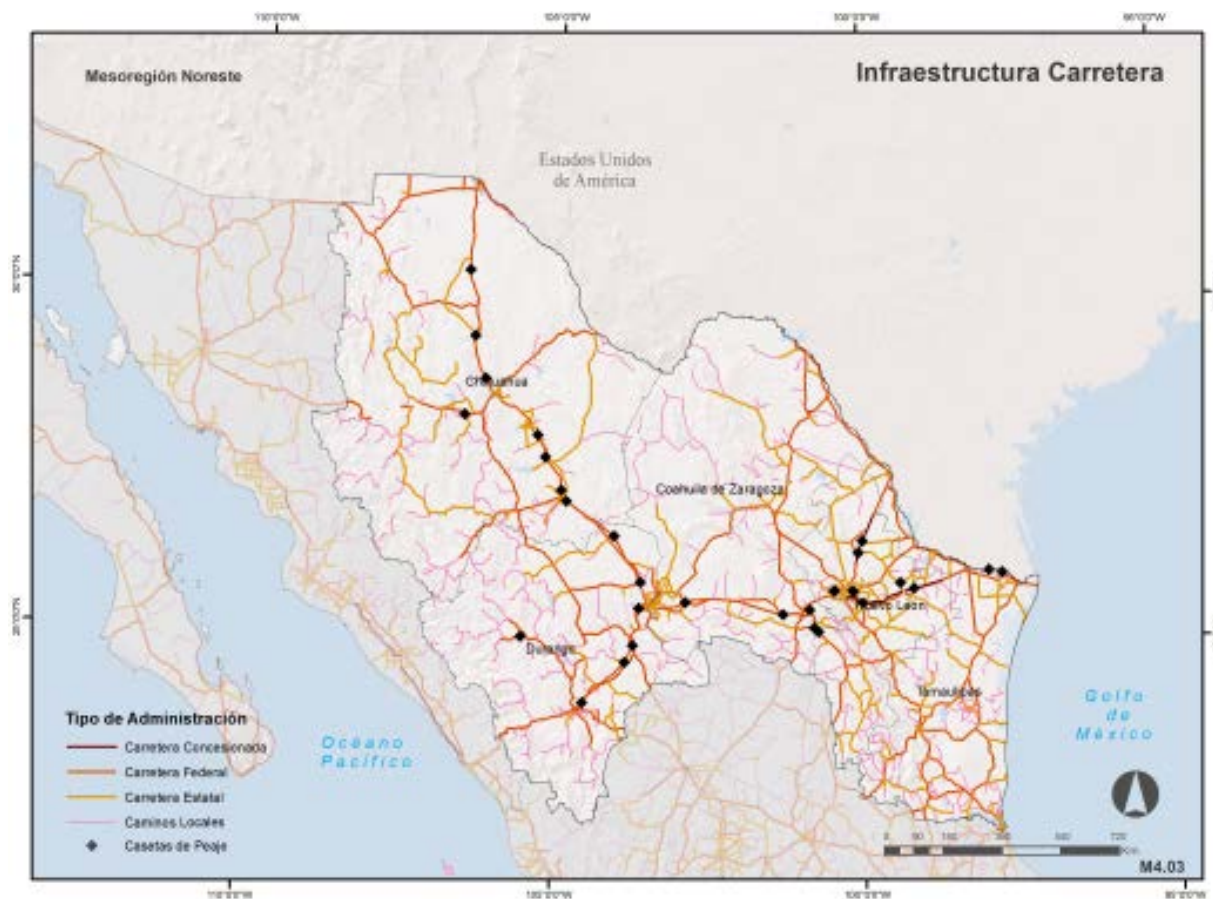
M4.01



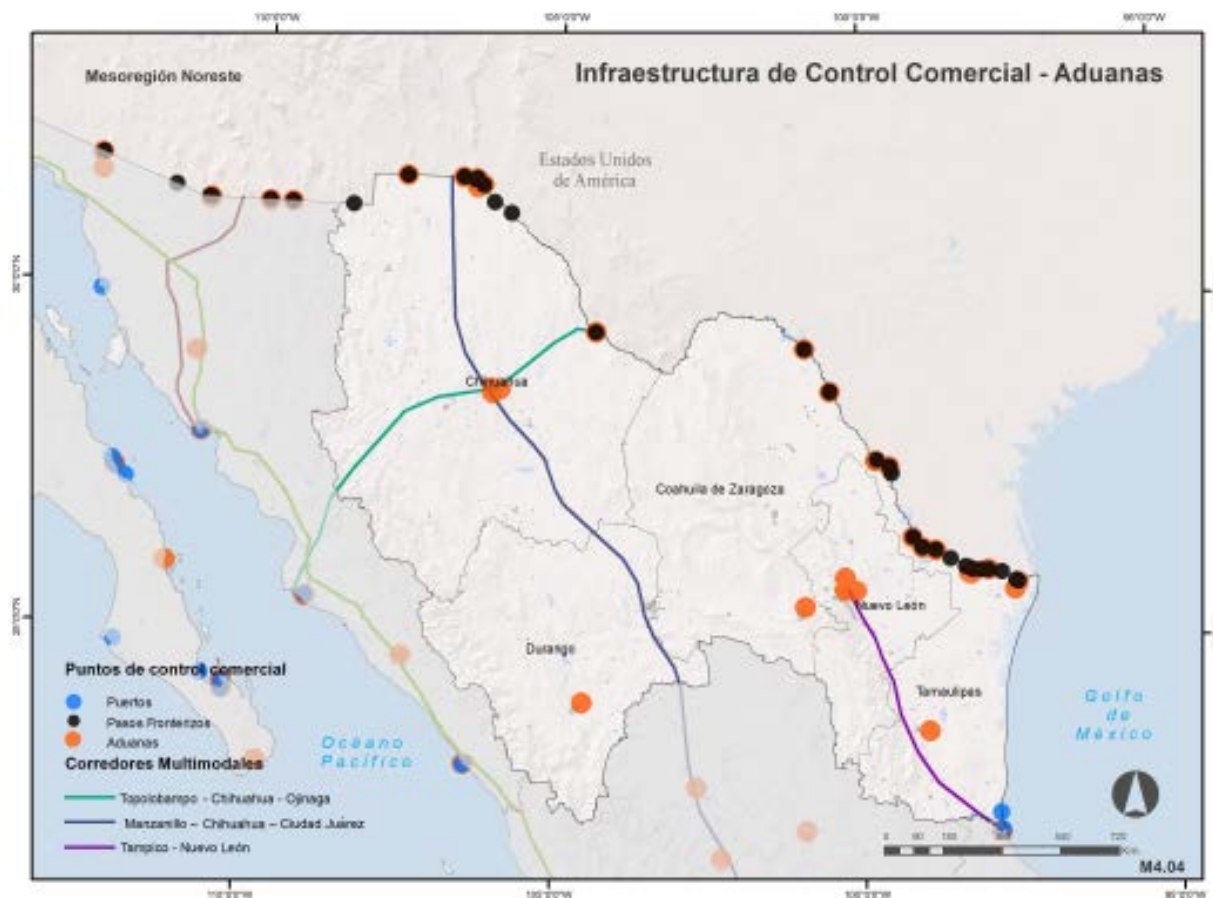
M4.02



M4.03



M4.04



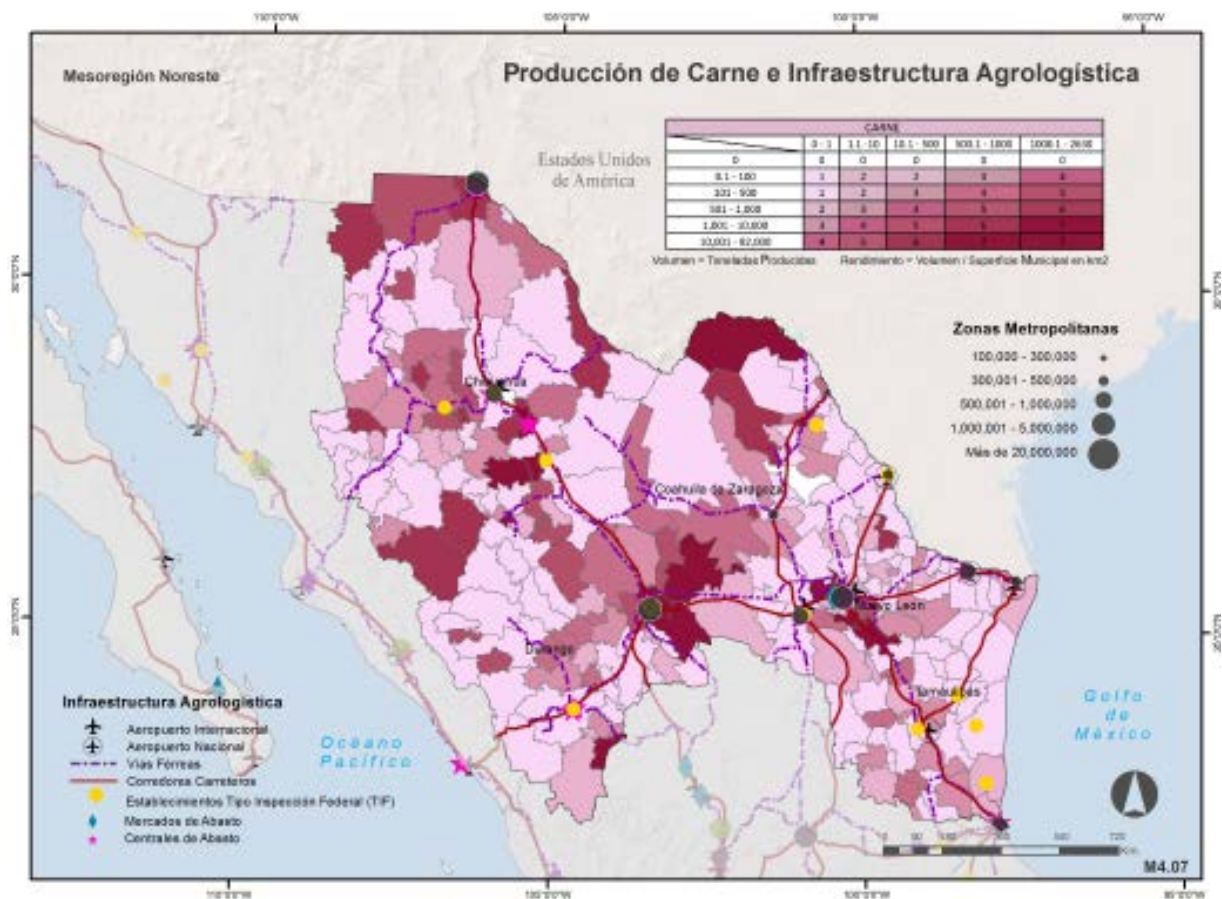
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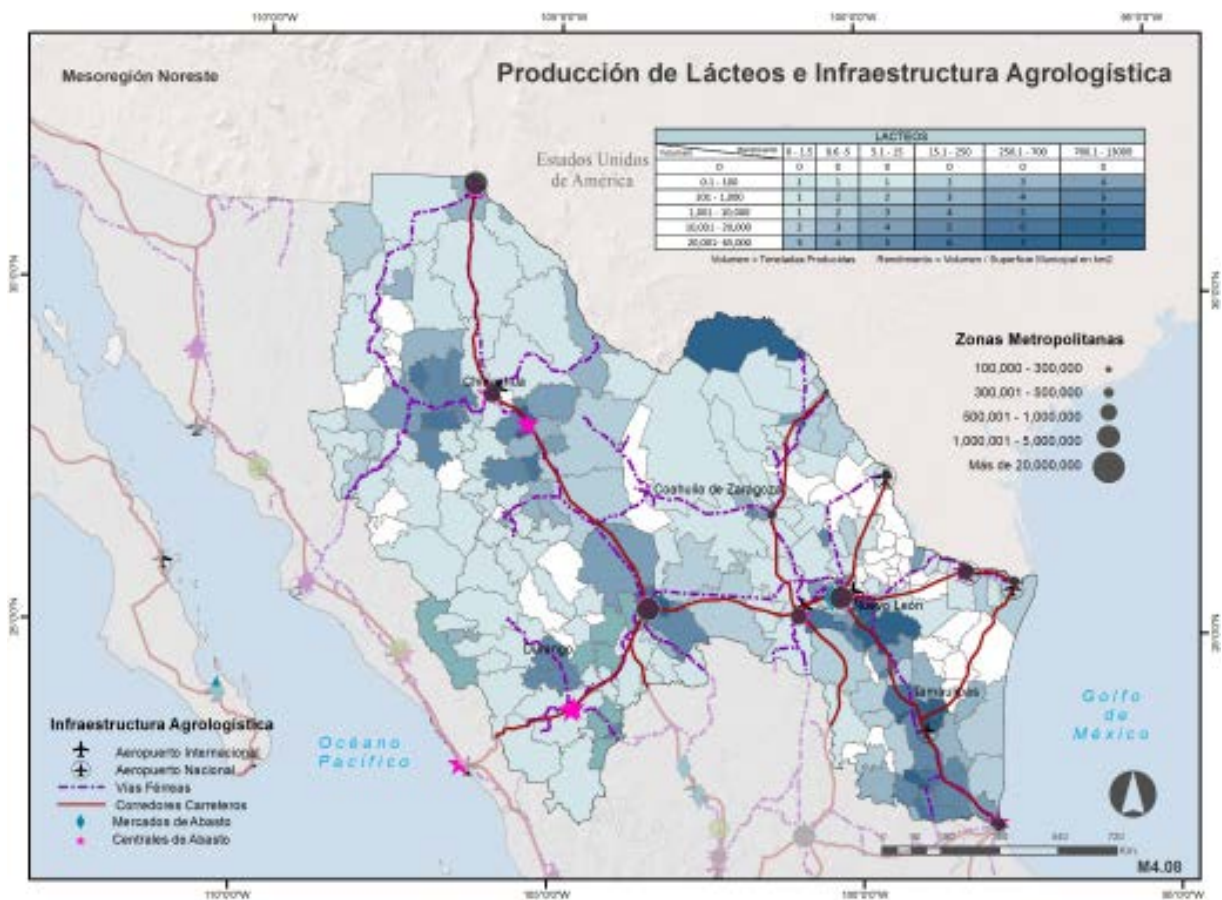
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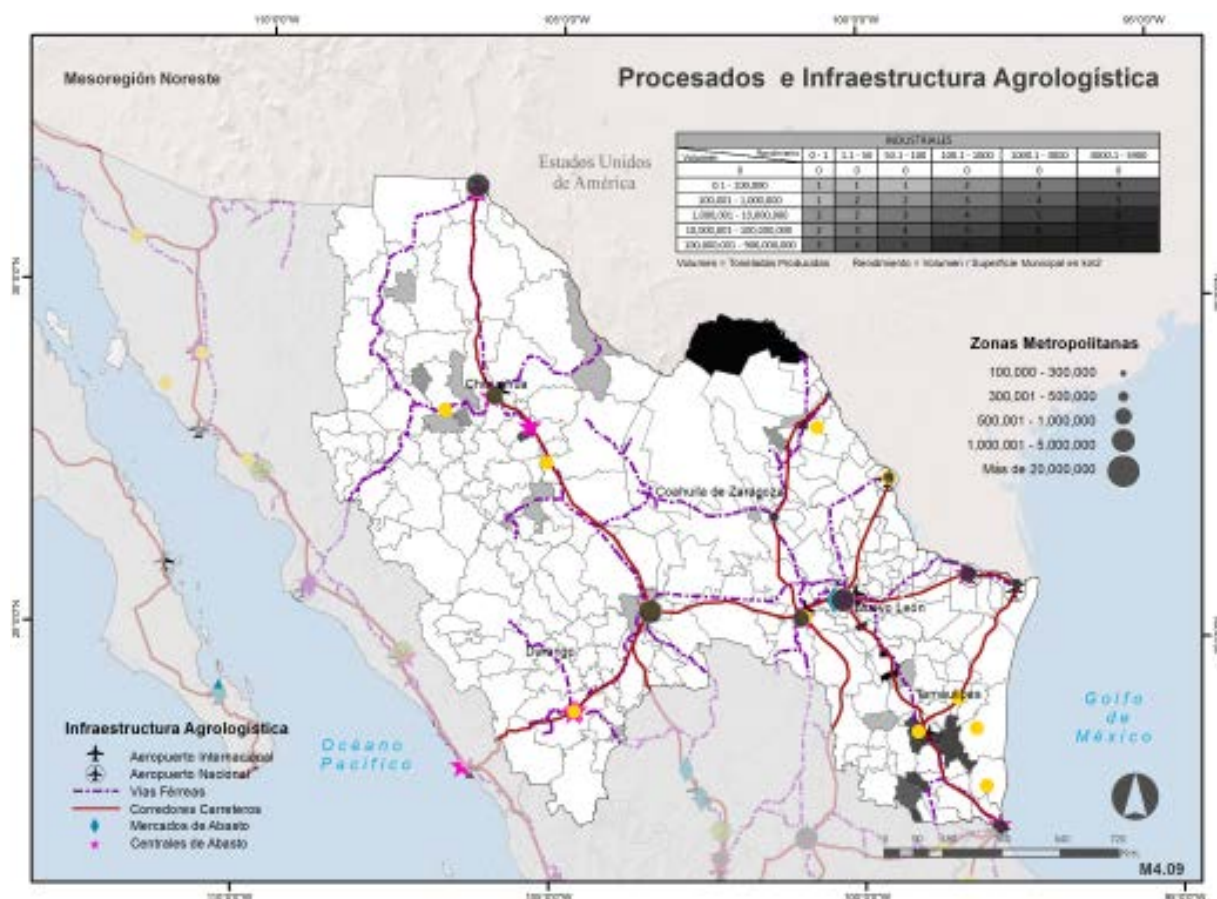
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M4.08



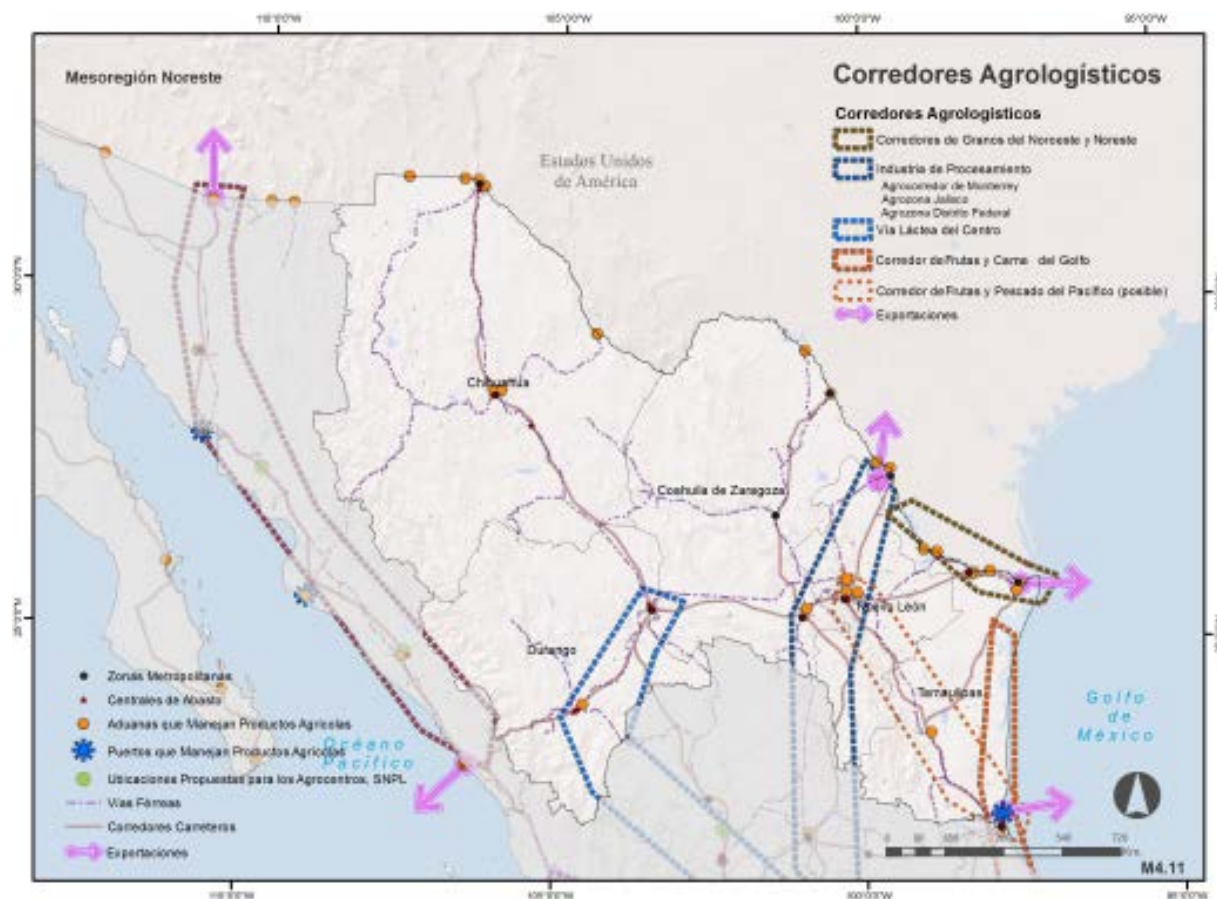
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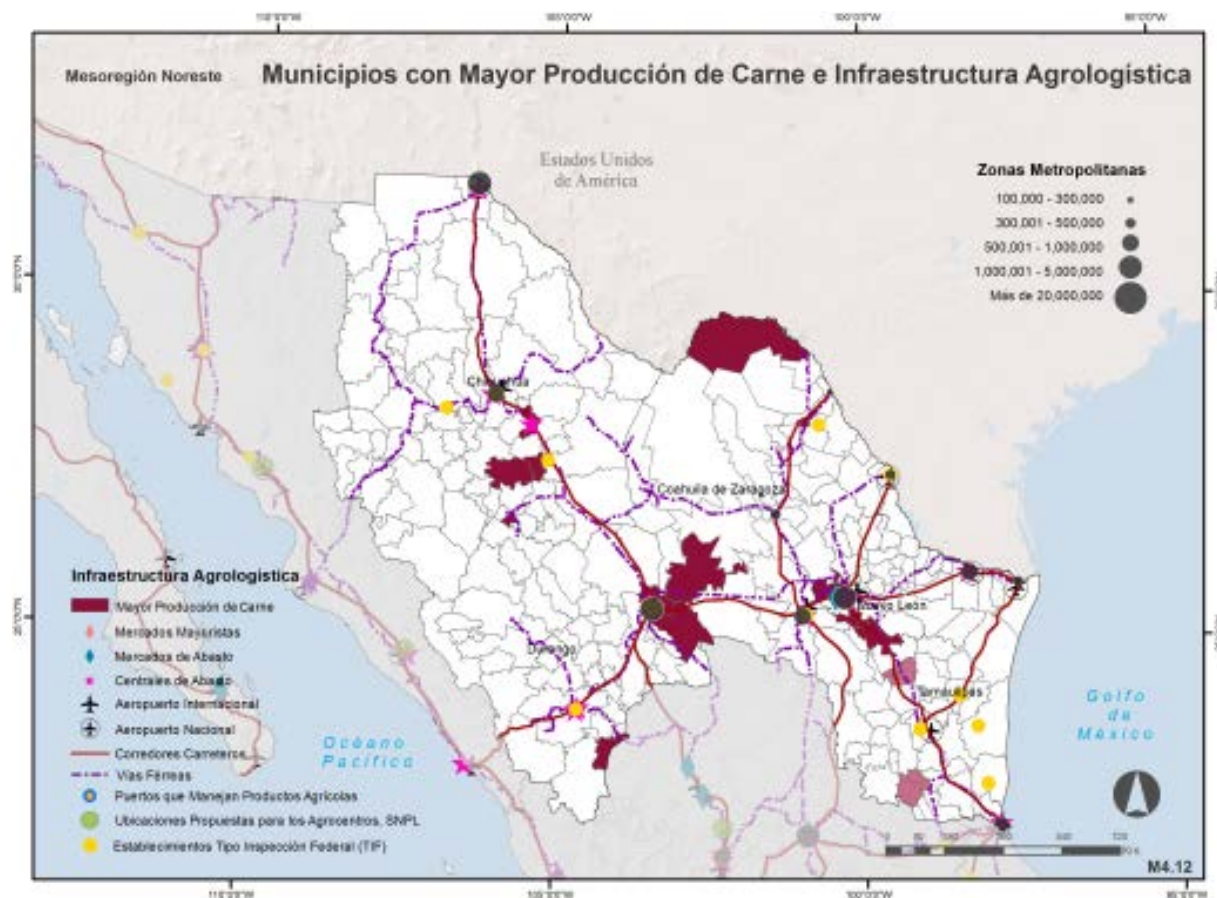
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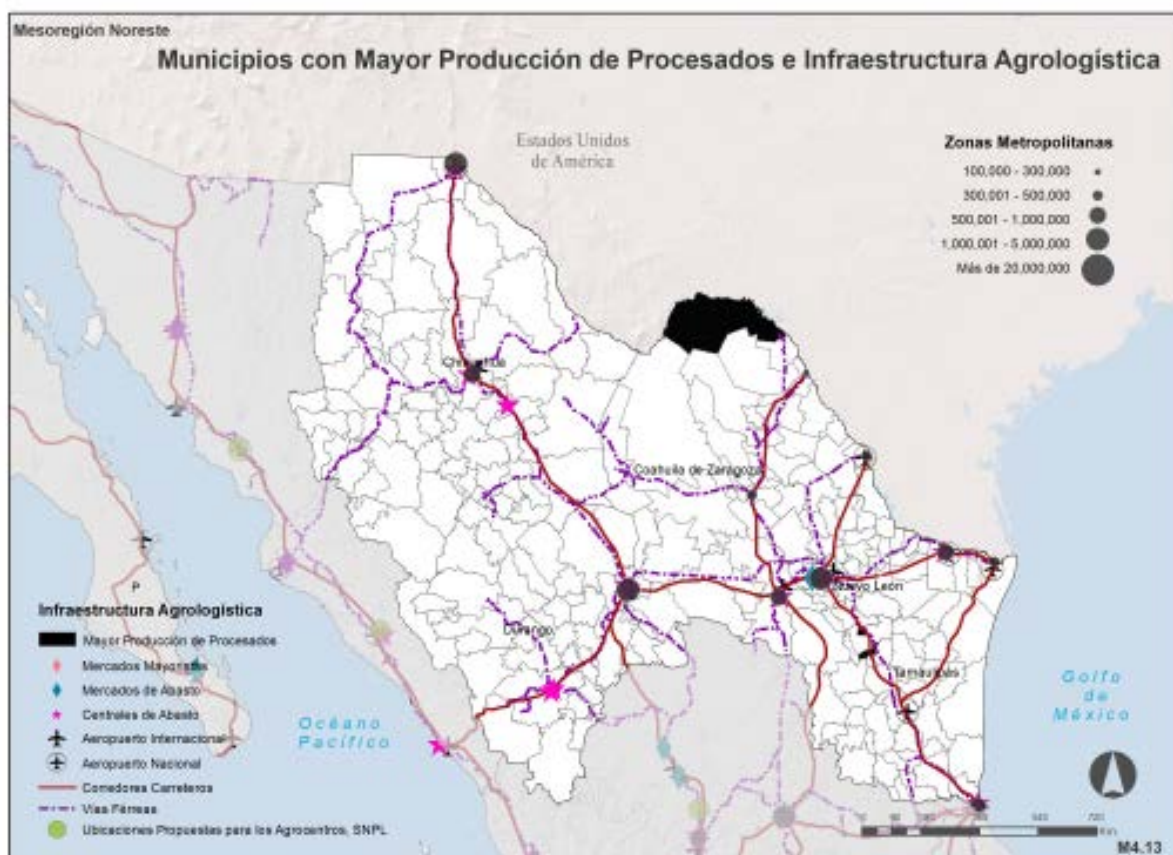
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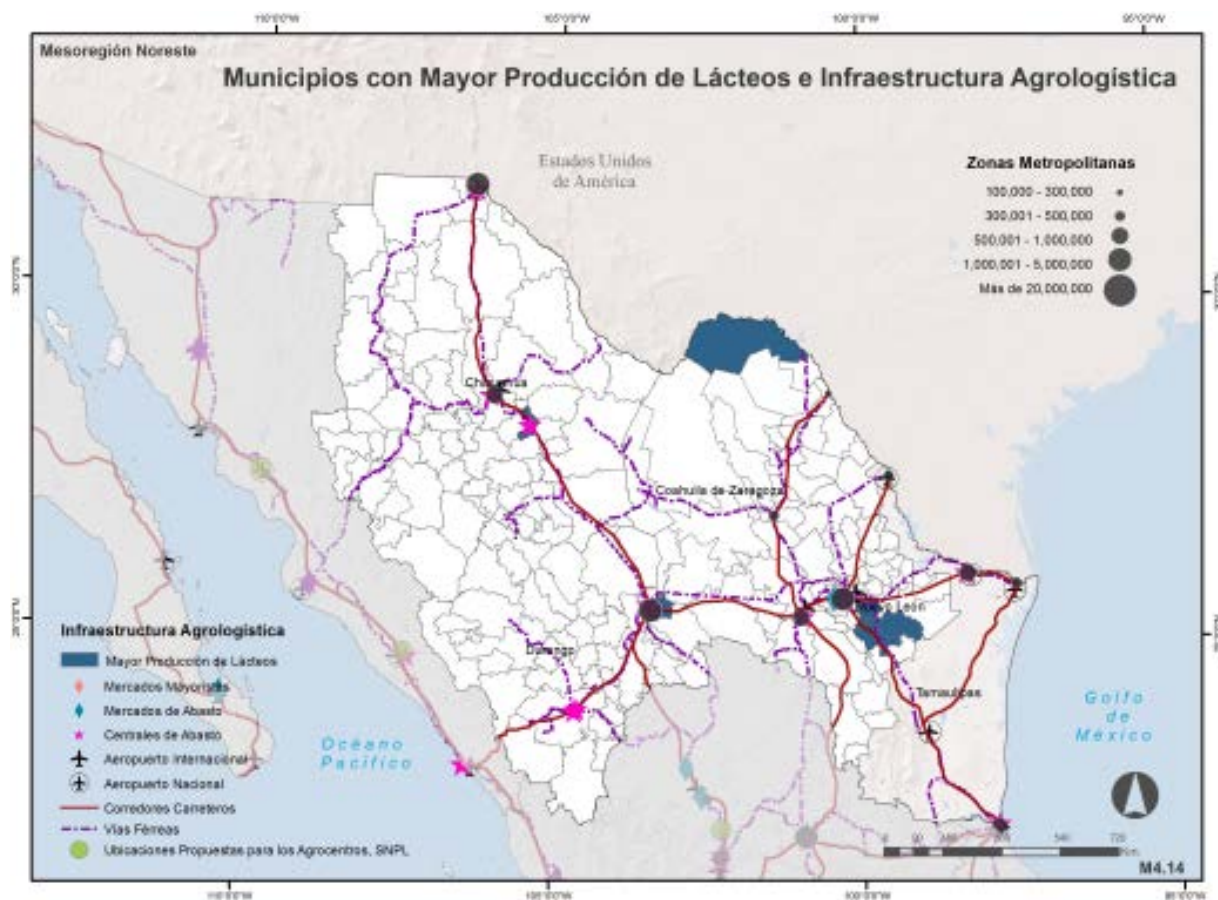
M4.12



M4.13



M4.14



MESOREGION 5: SOUTH-SOUTHEAST

Campeche, Chiapas, Guerrero, Oaxaca, Quintana Roo, Tabasco, Veracruz, Yucatán.

M5.01 Population Density in 2010

M5.02 Transport Infrastructure

M5.03 Road Infrastructure

M5.04 Commercial Control Infrastructure - Customs

M5.05 Supply Centers

M5.06 Existing Distribution Centers and Agrocenters Proposed by SNPL

M5.07 Fruit Production and Agrologistics Infrastructure

M5.08 Meat Production and Agrologistics Infrastructure

M5.09 Processed Food and Agrologistics Infrastructure

M5.10 Food Processing Plants

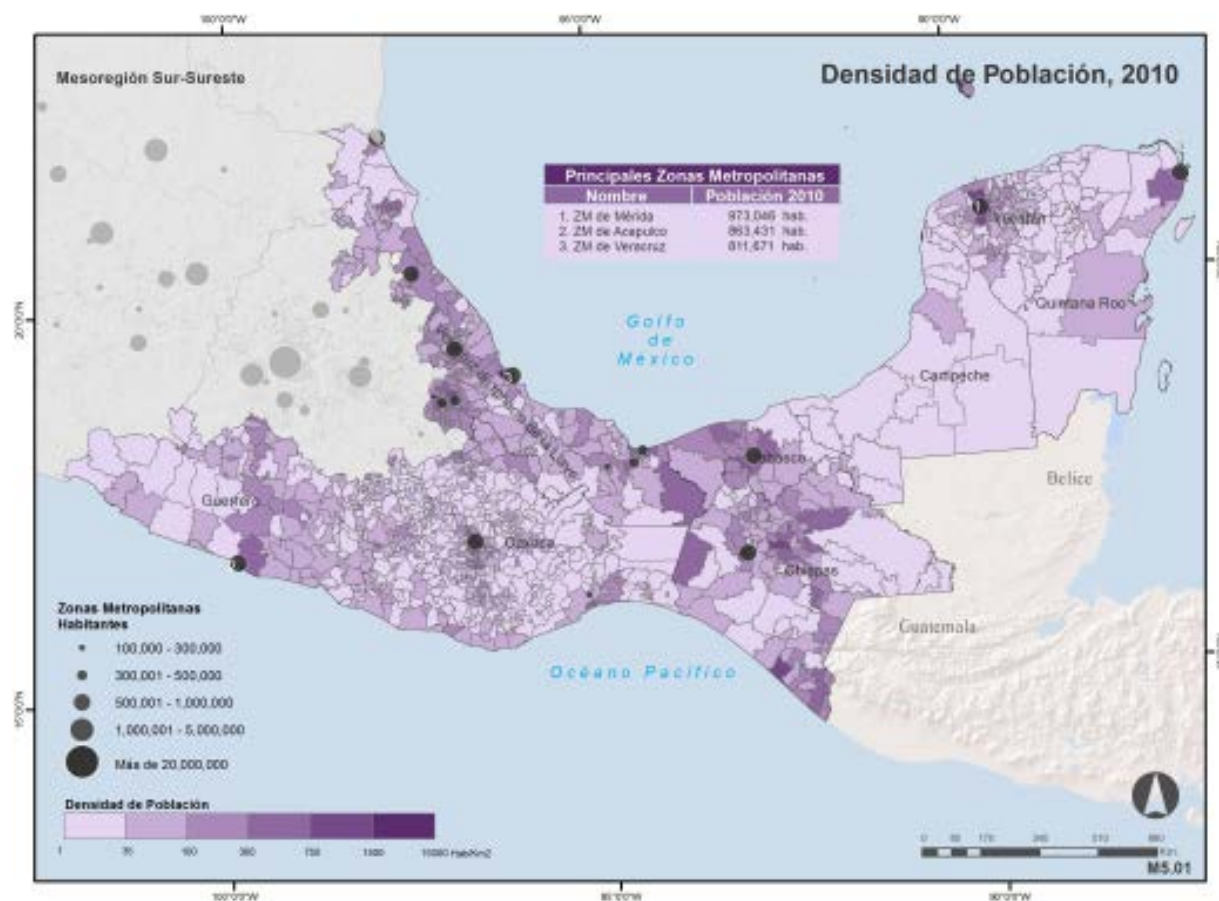
M5.11 Agrologistics Corridors

M5.12 Municipalities with Greater Fruit Production and Agrologistics Infrastructure

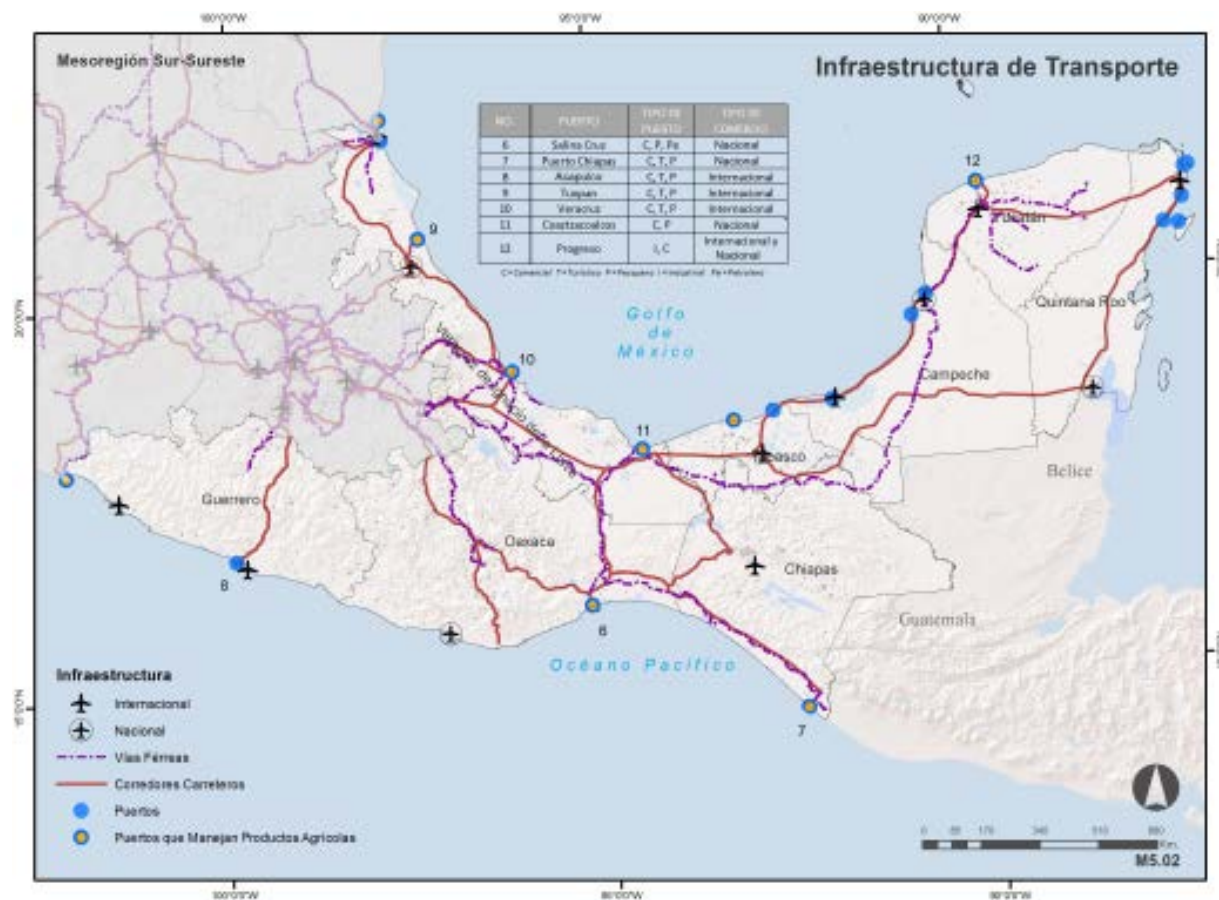
M5.13 Municipalities with Greater Meat Production and Agrologistics Infrastructure

M5.14 Municipalities with Greater Processed Food Production and Agrologistics Infrastructure

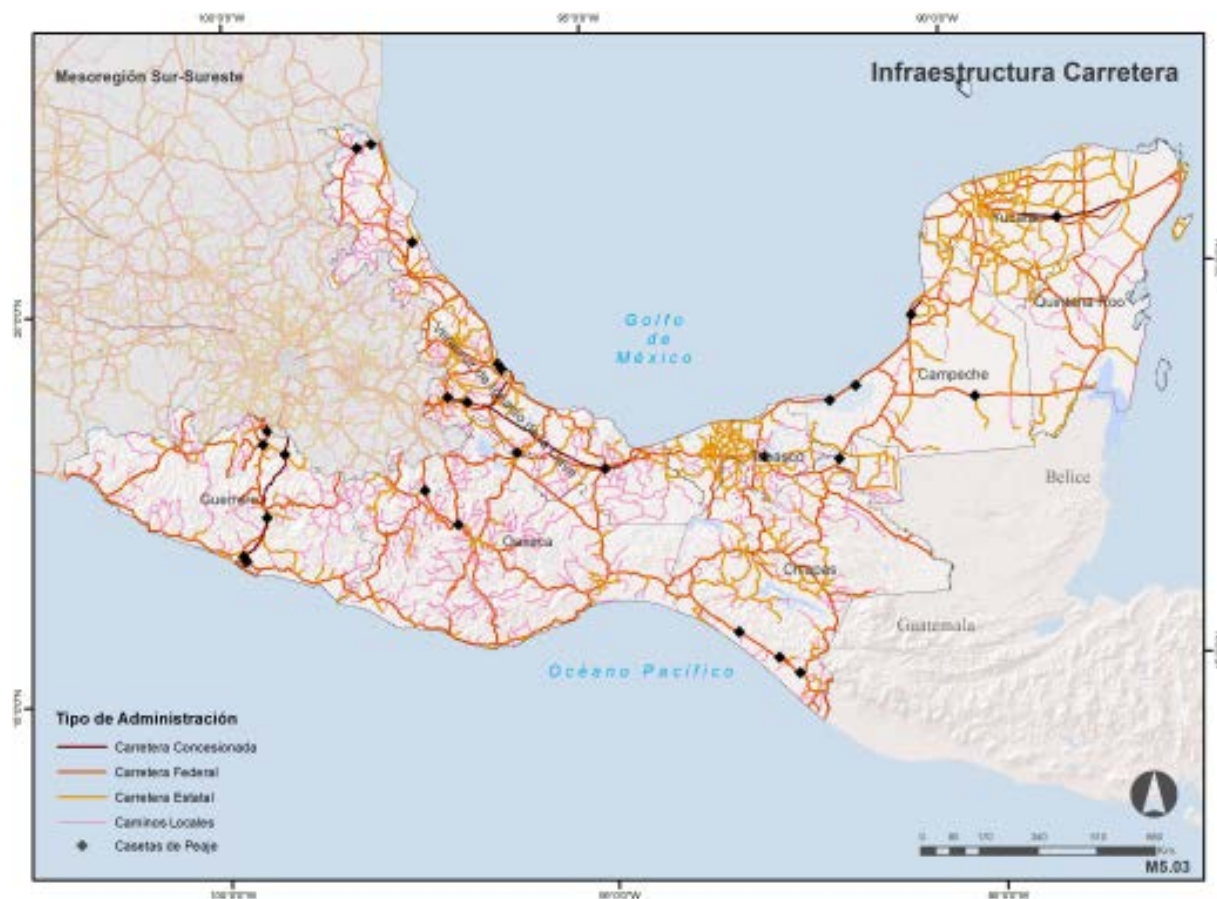
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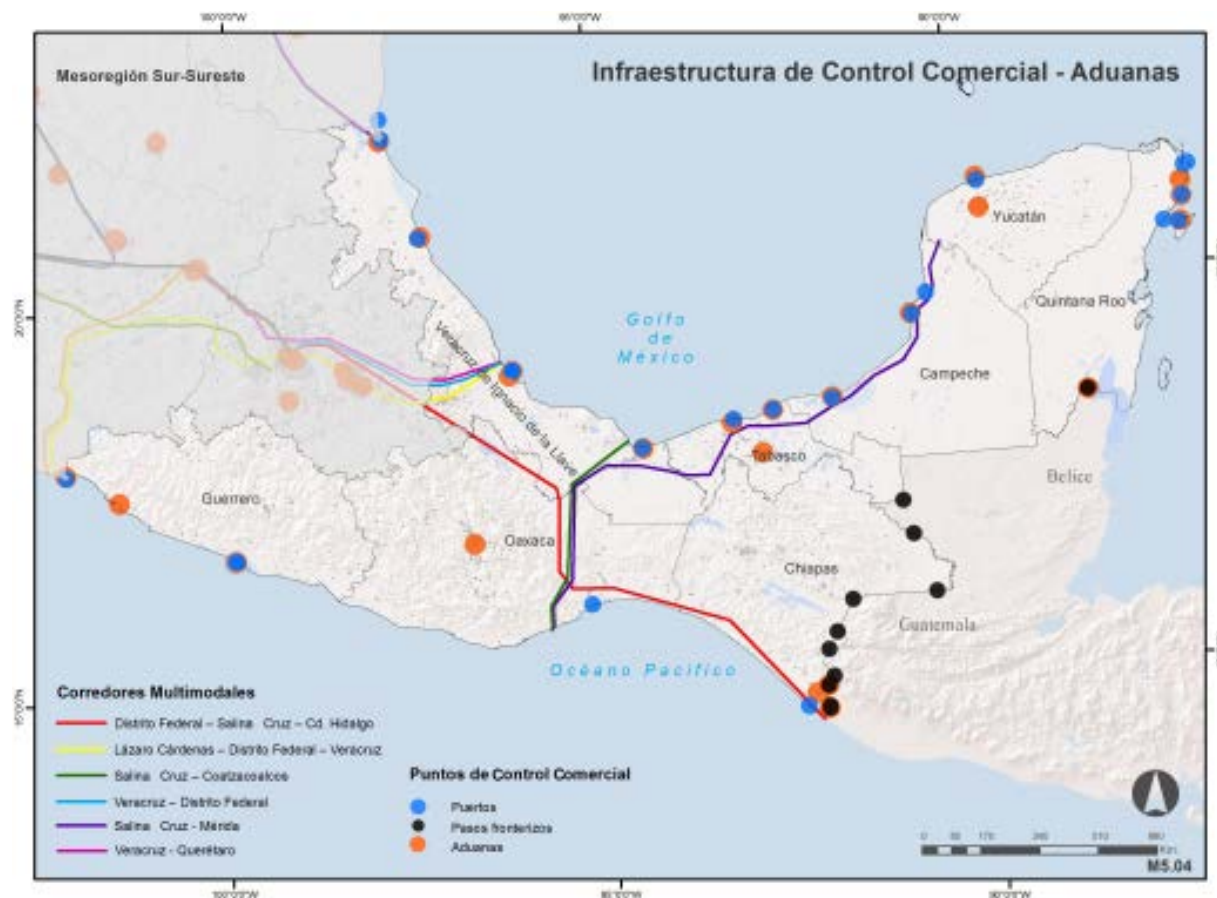
M5.02



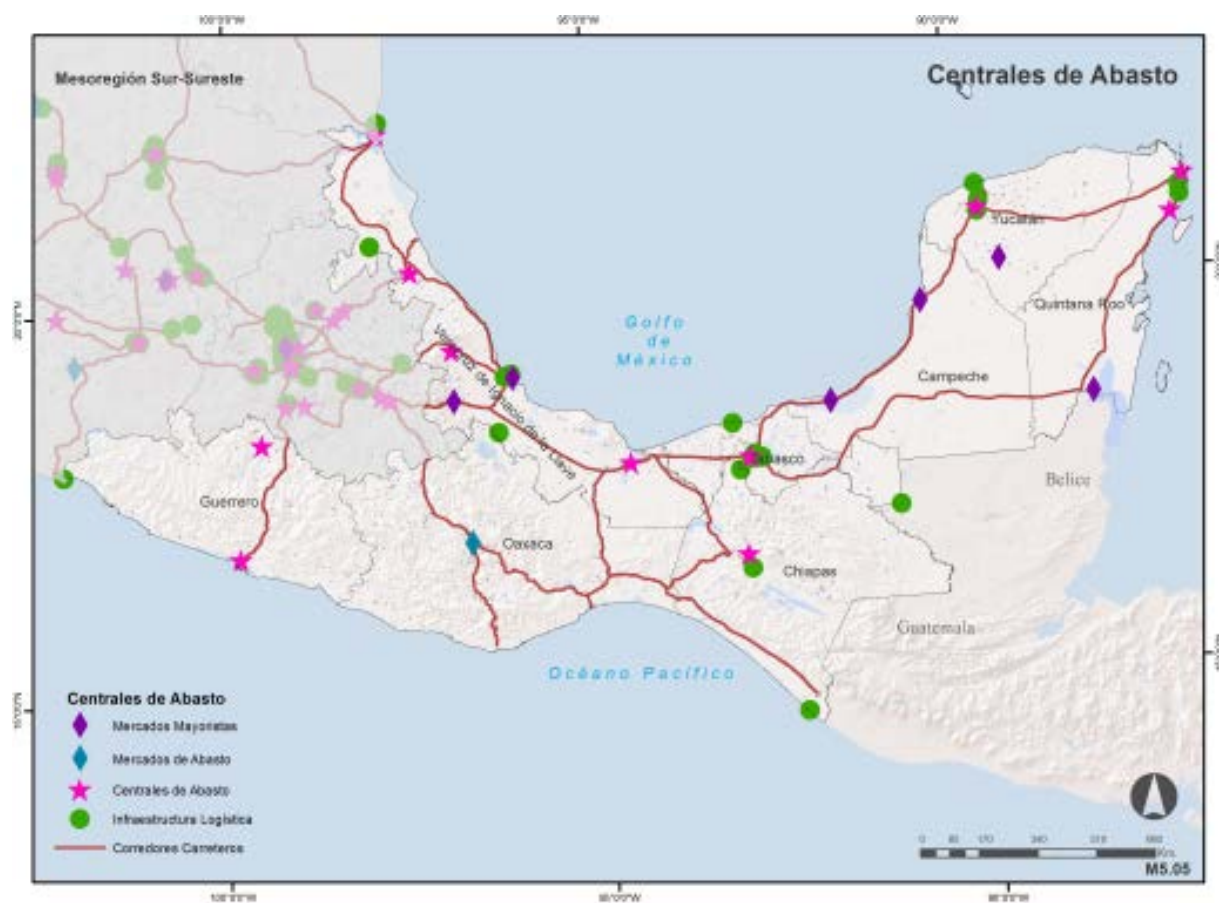
M5.03



M5.04



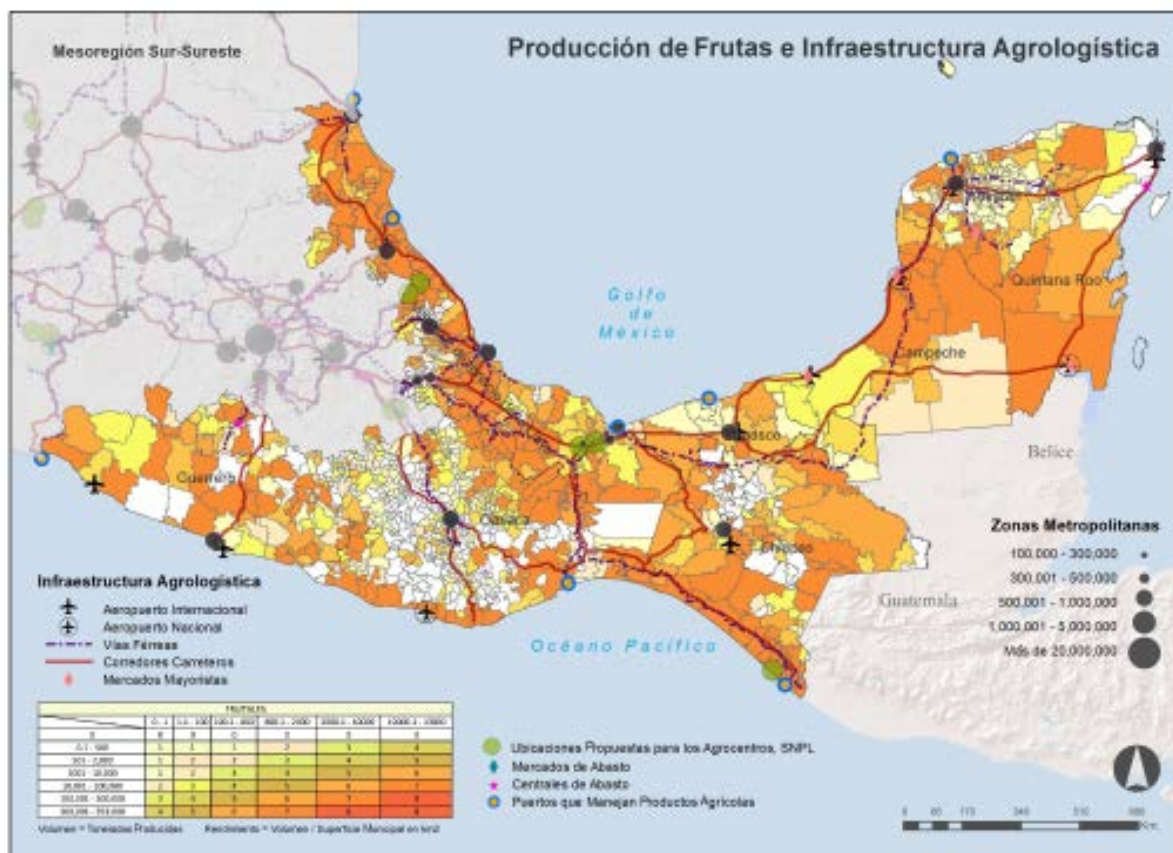
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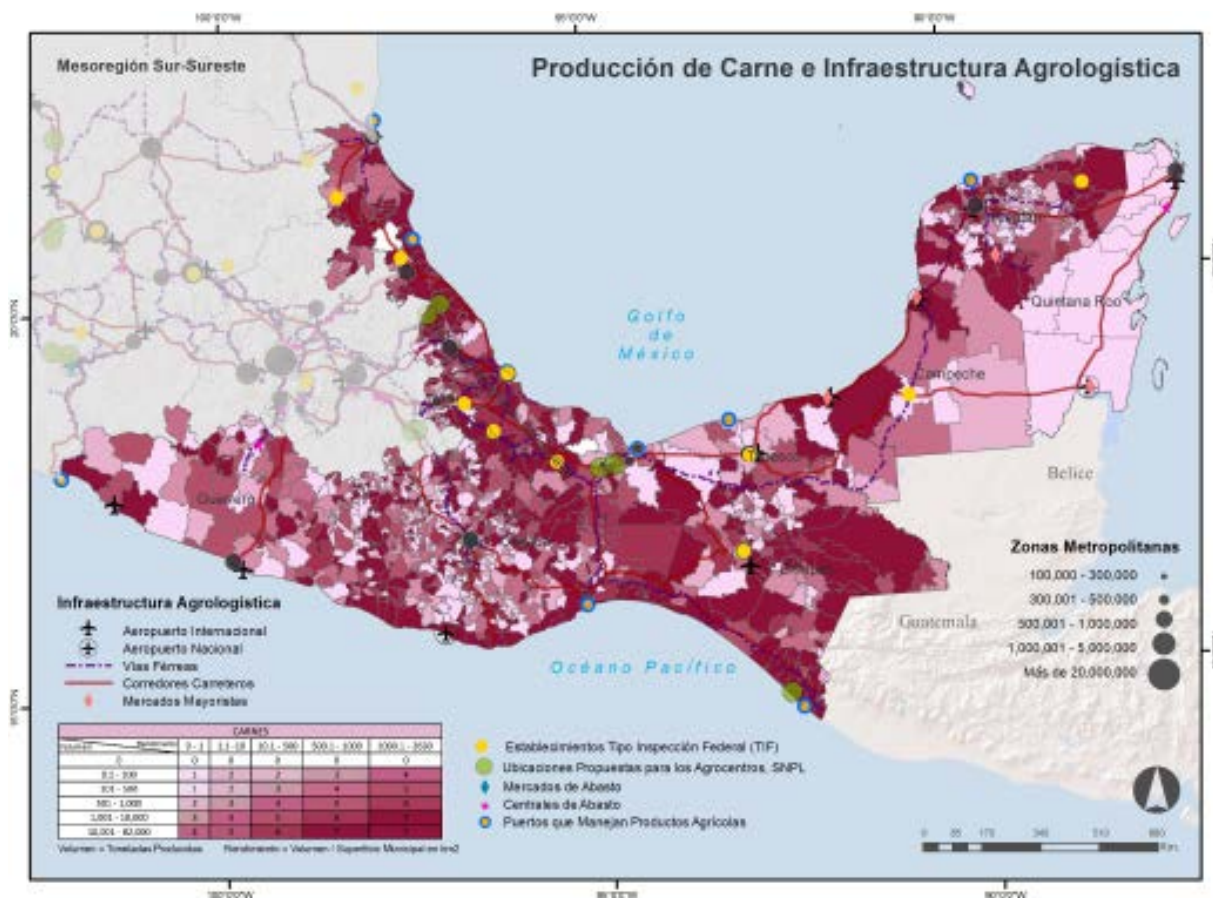
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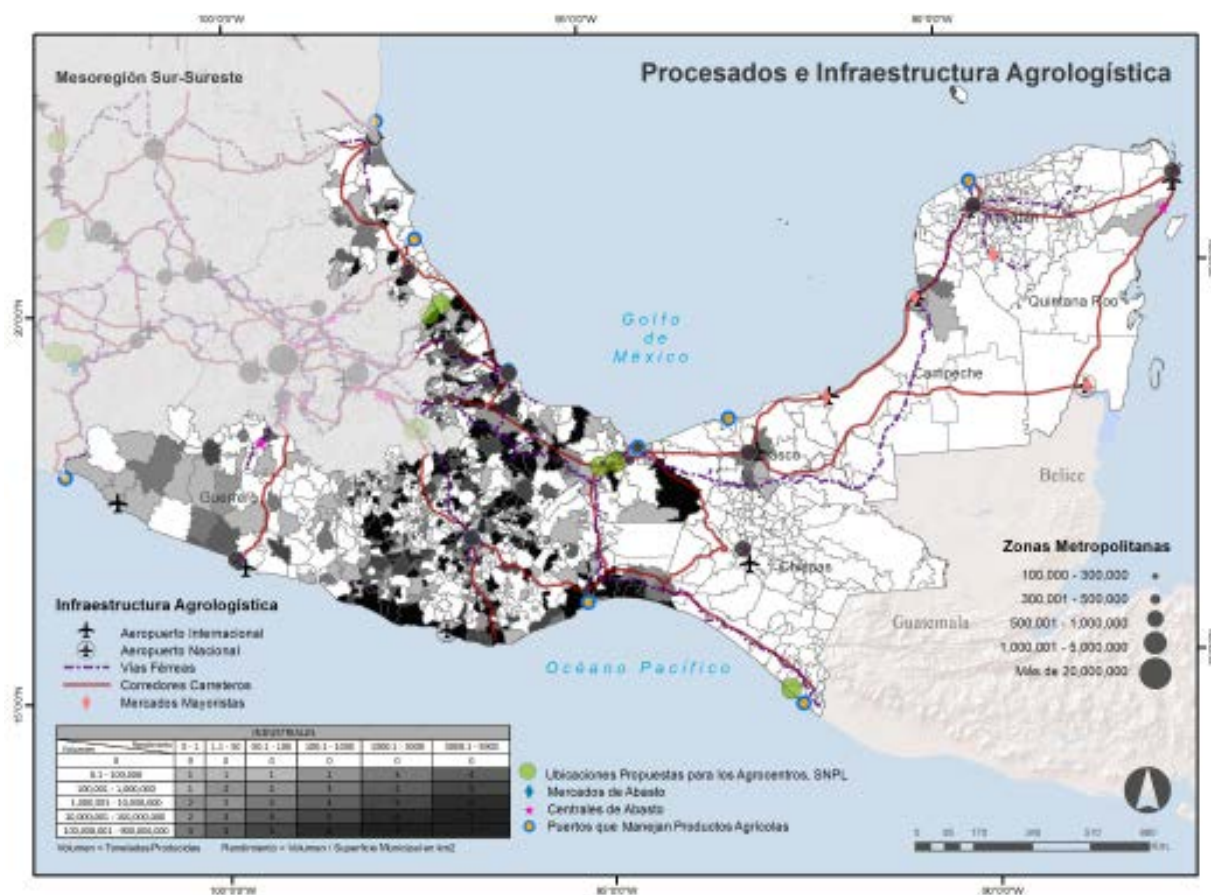
M5.07



M5.08



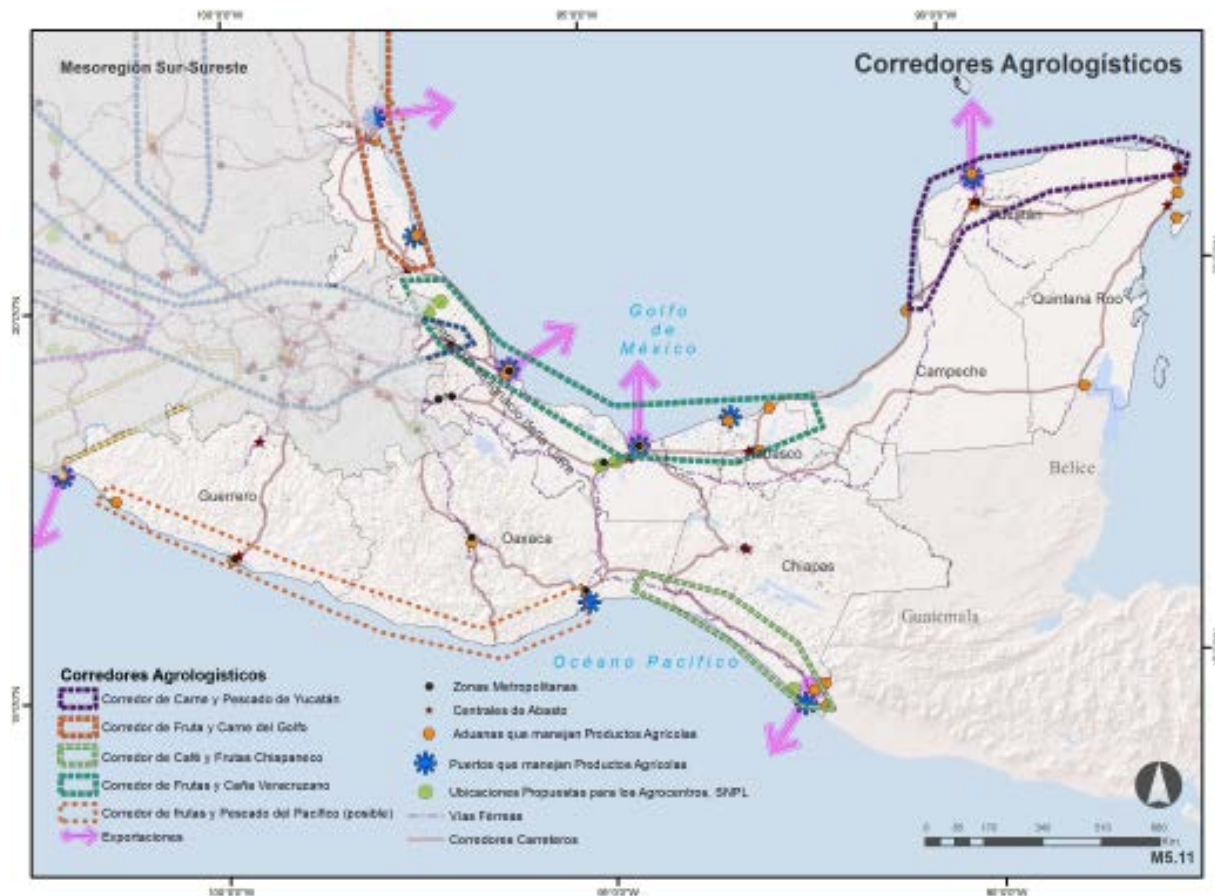
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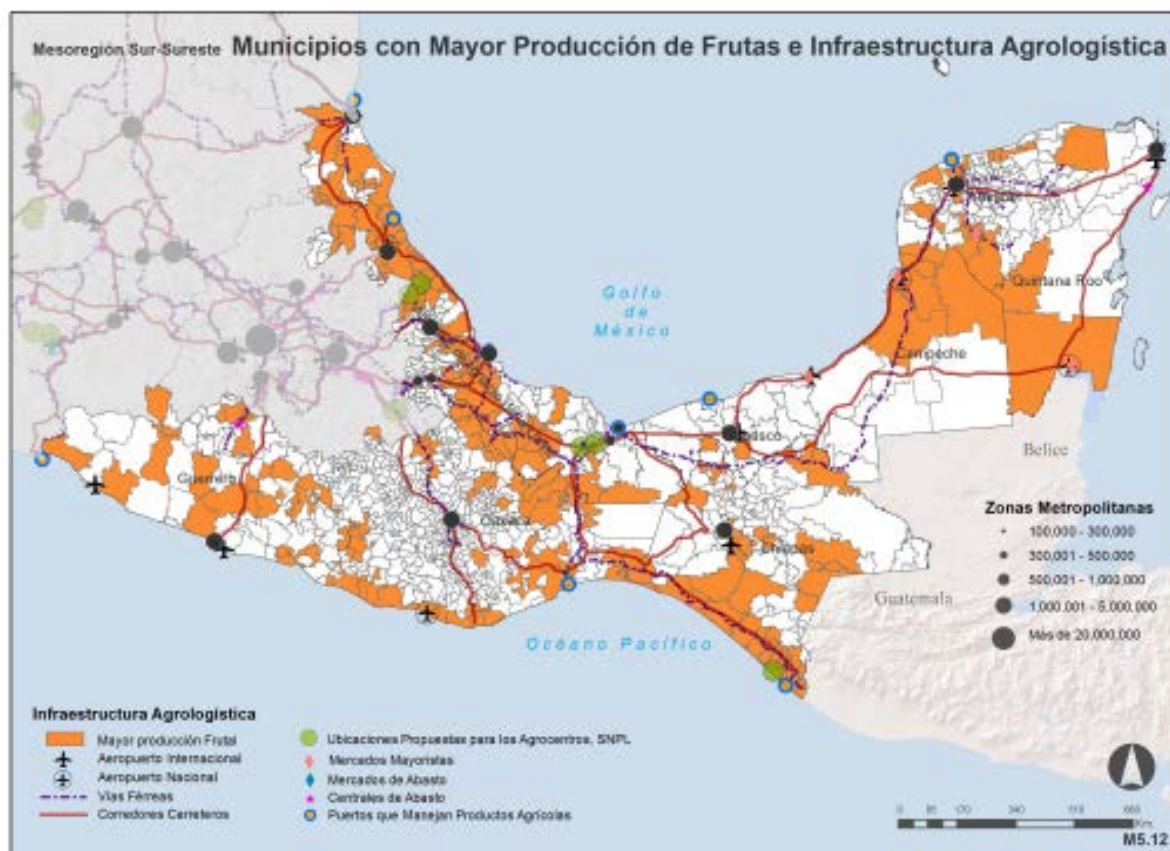
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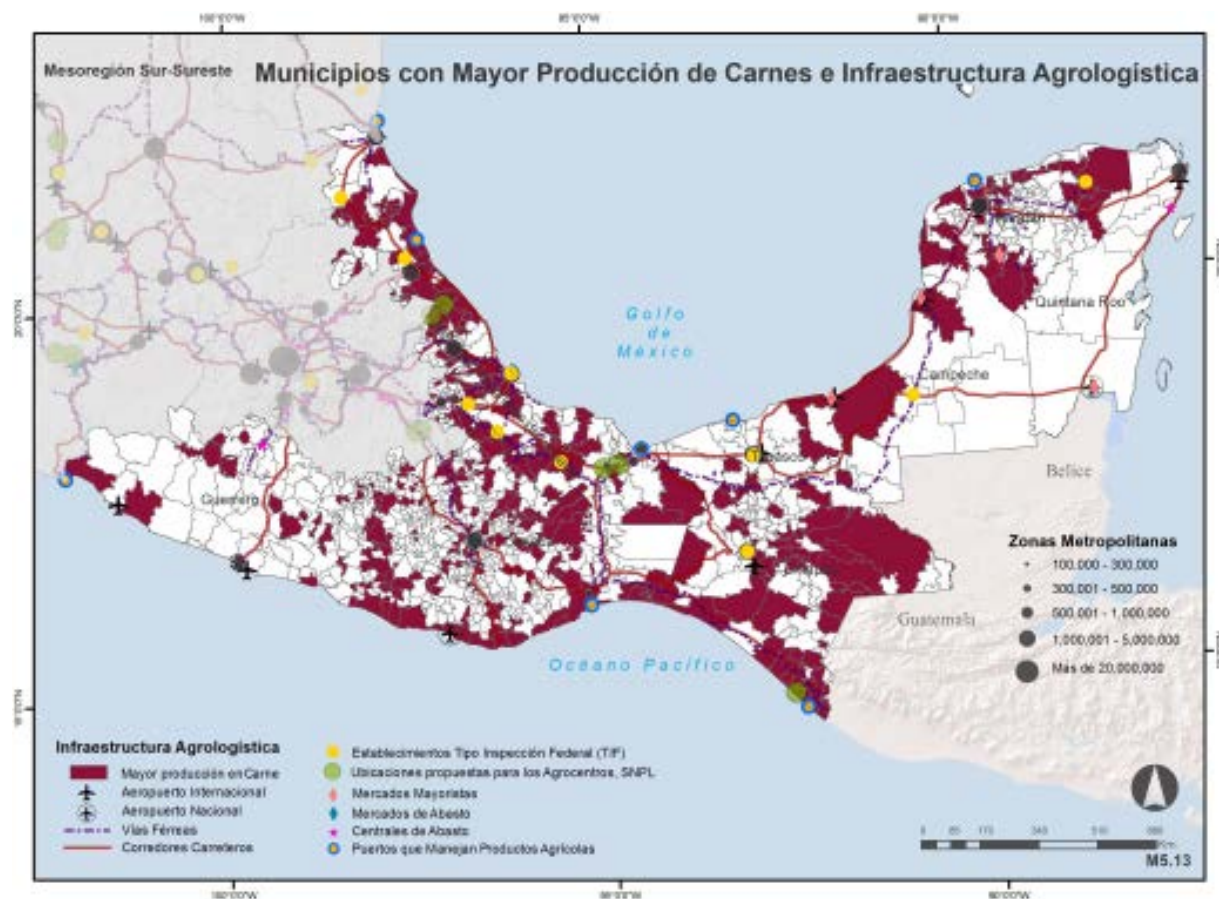
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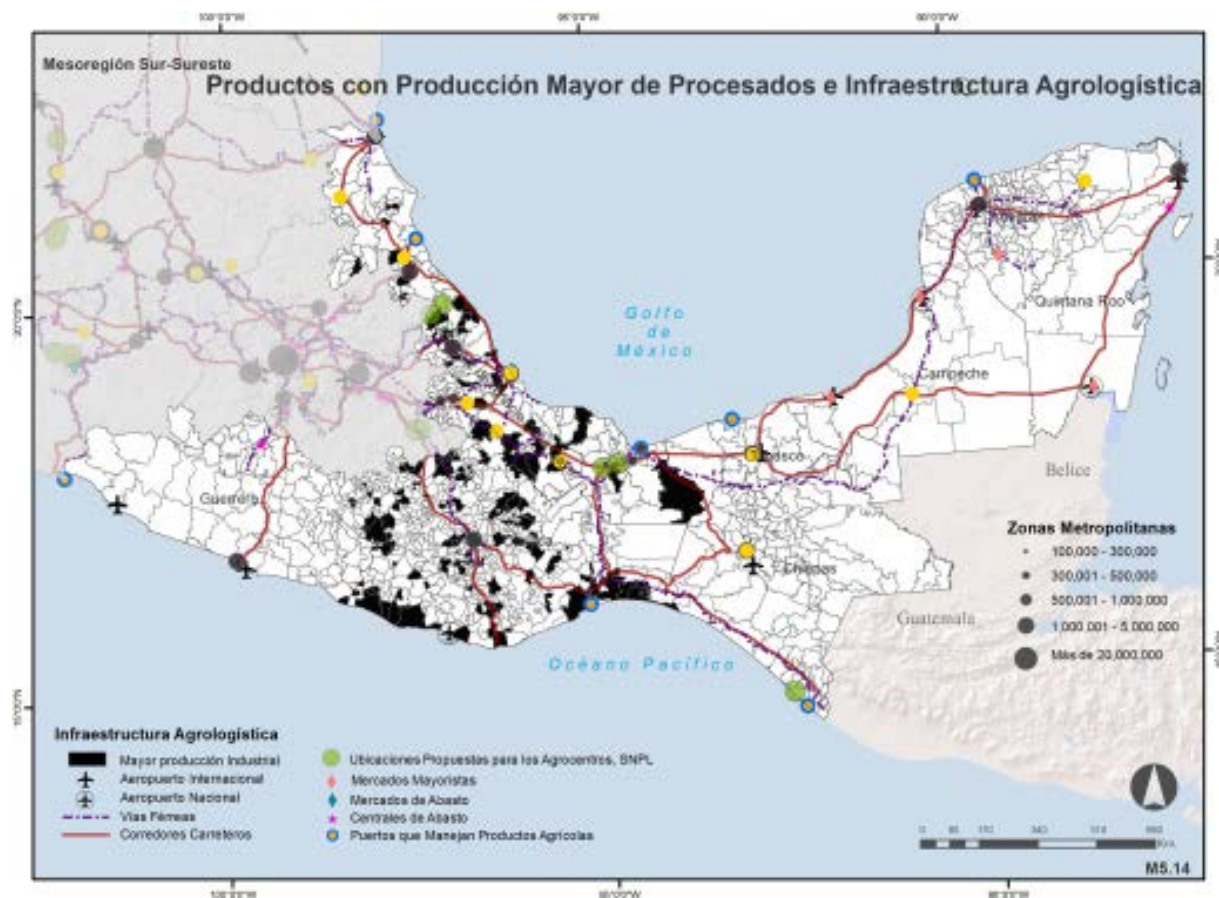
M5.12



M5.13



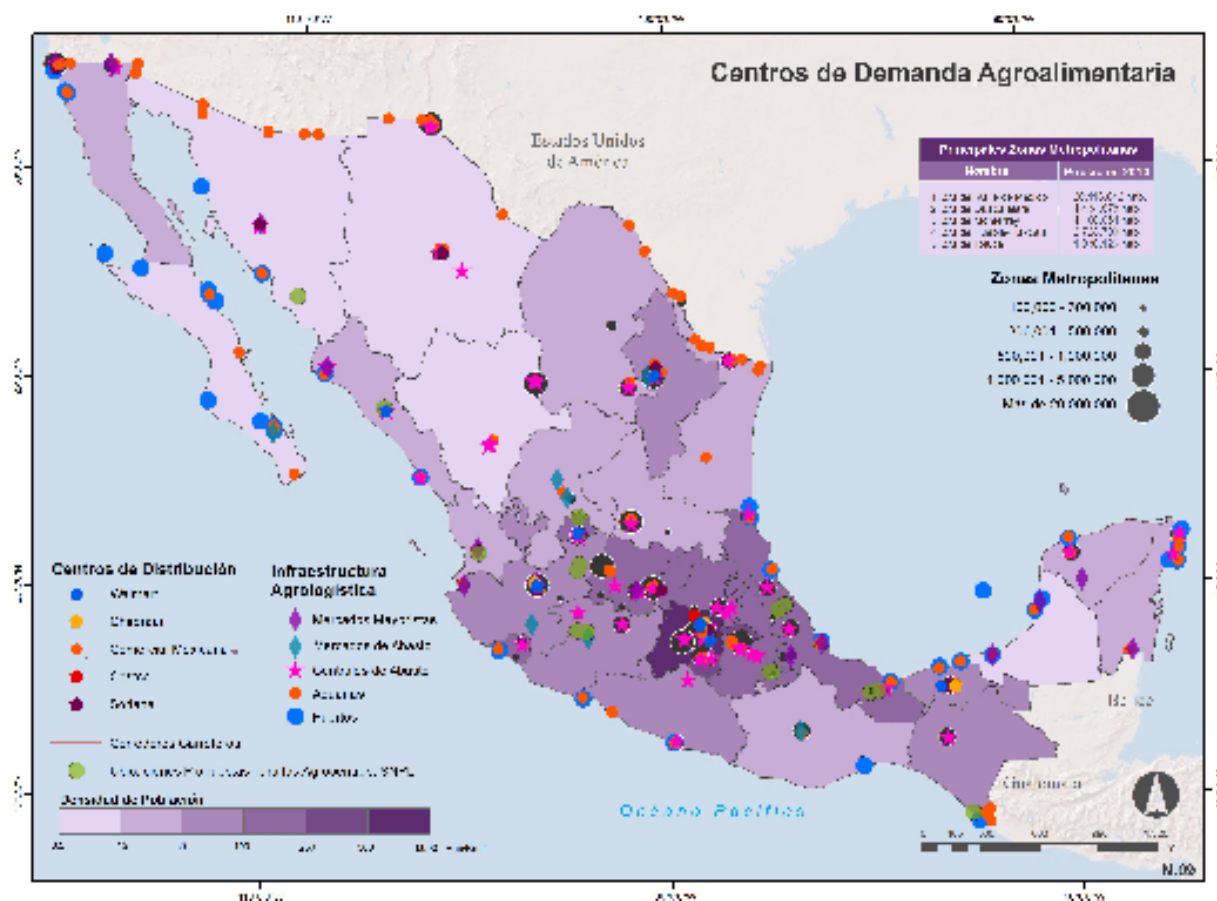
M5.14



ANALYTICAL MAPS

- N.1 Agri-food Demand Centers
- N.2 Infrastructure (Transportation and Cold Chain)
- N.3 Isochrones 4 Hours
- N.4 Isochrones 8 Hours
- N.5 Geographic Distribution of Stratum REU
- N.6 Agrologistics Corridors and Travel Times
- N.7 Fruit Production and Agrologistics Corridors
- N.8 Proposed and Added Network of Agrologistics Potential
- N.9 Potential Agrologistics Network and Agrologistics Infrastructure
- N.10 Geographical Distribution of the REU Stratum and Infrastructure
- N.11 Agrologistics Corridors and Infrastructure
- M5.1 Agri-food Demand Centers
- M5.2 Infrastructure (Transportation and Cold Chain)
- M5.3 Meat Production and Agrologistics Corridors
- M5.4 Fruit Production and Agrologistics Corridors
- M5.5 Processed Food and Agrologistics Corridors

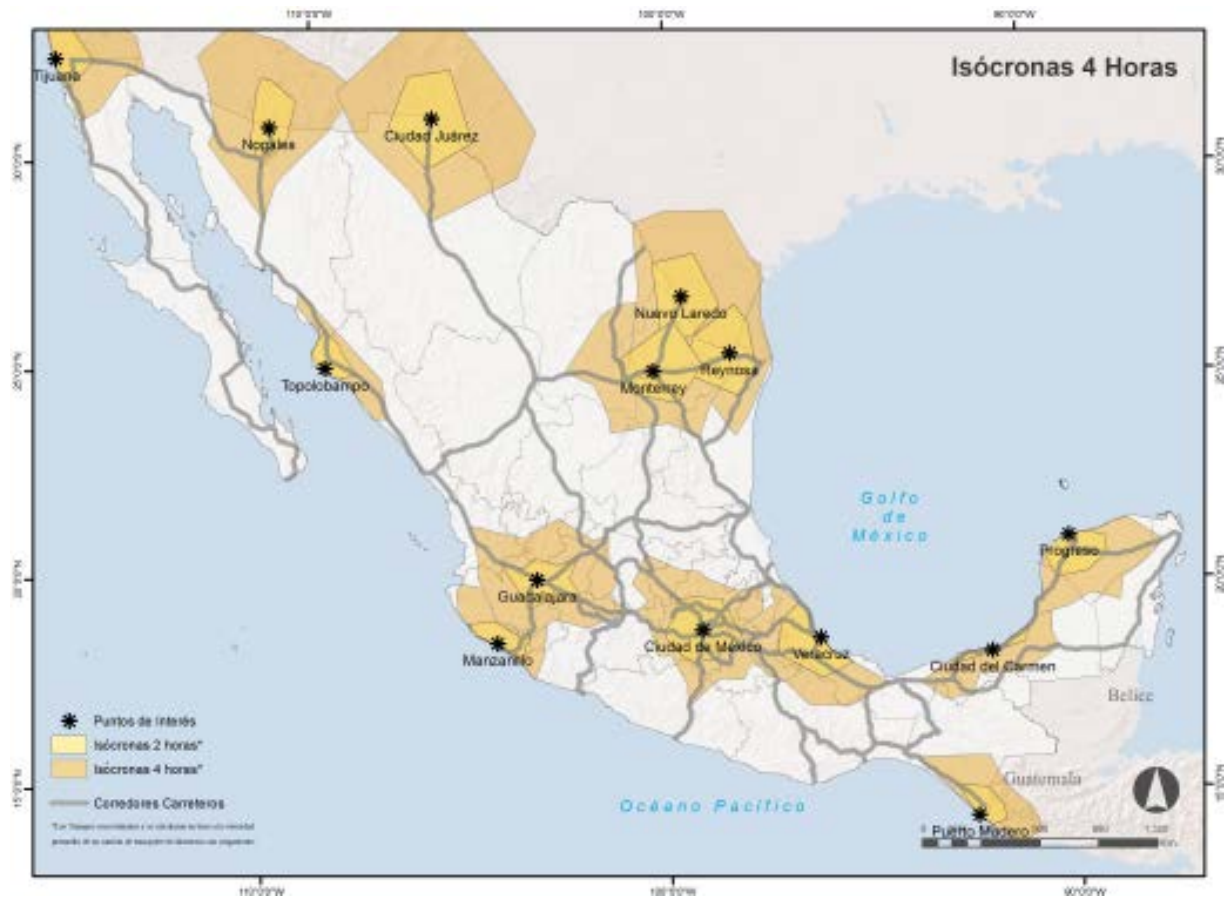
N.01



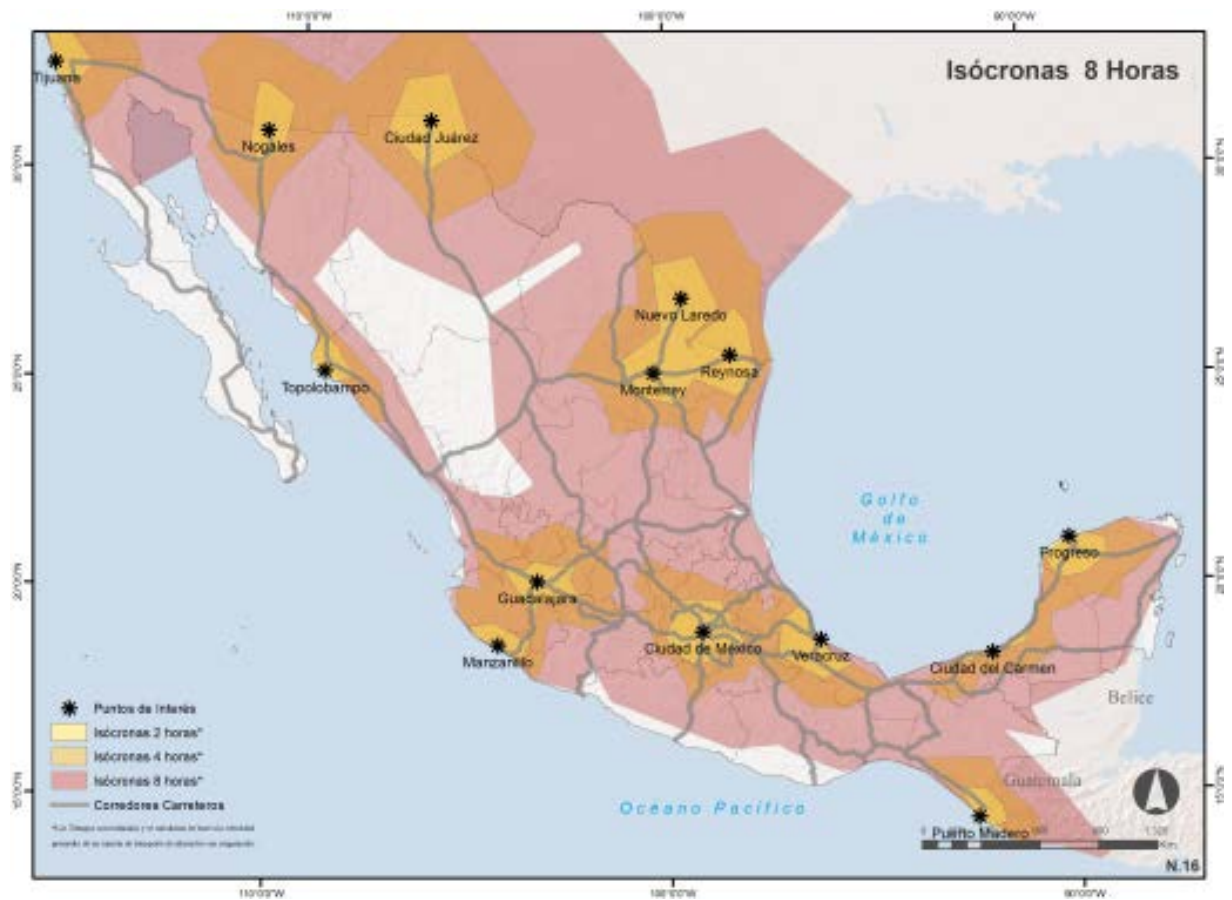
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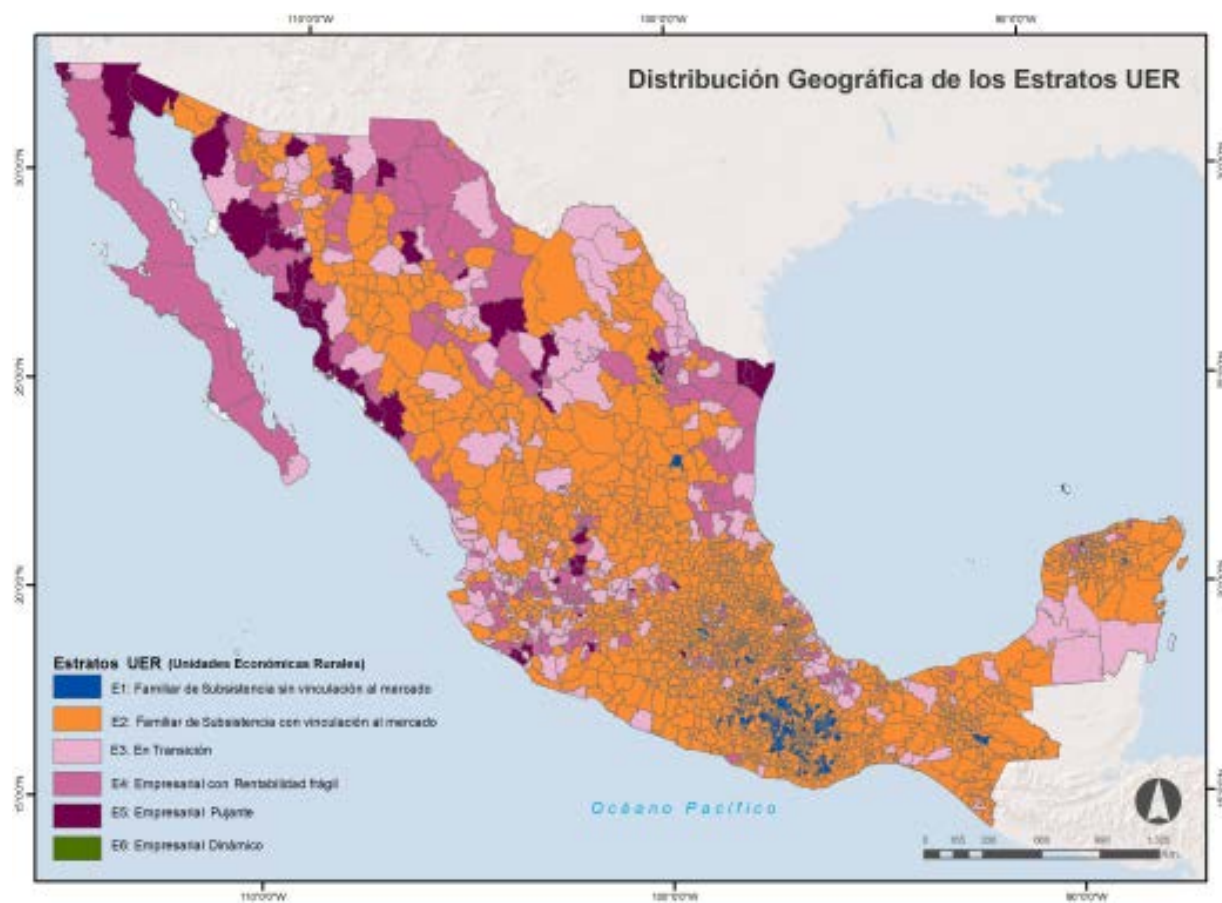
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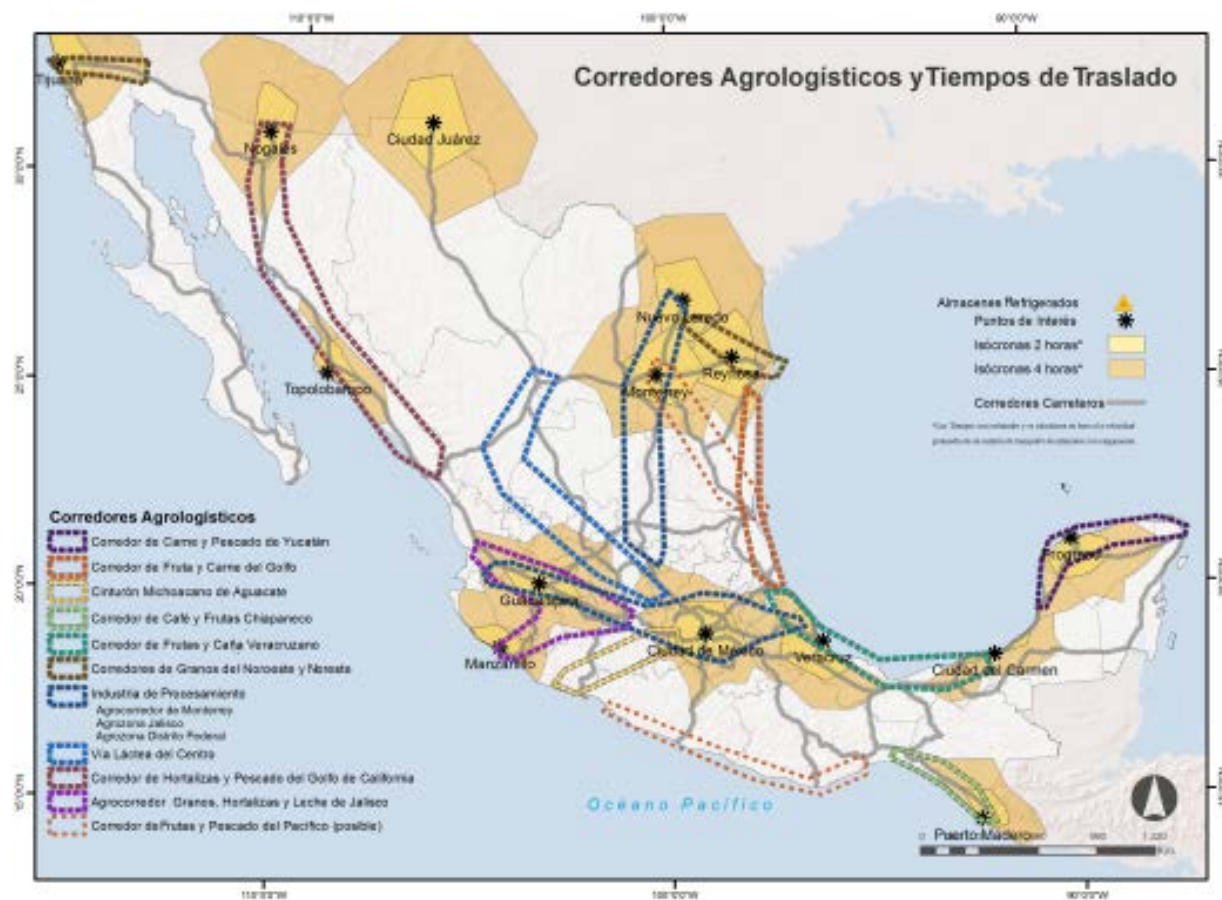
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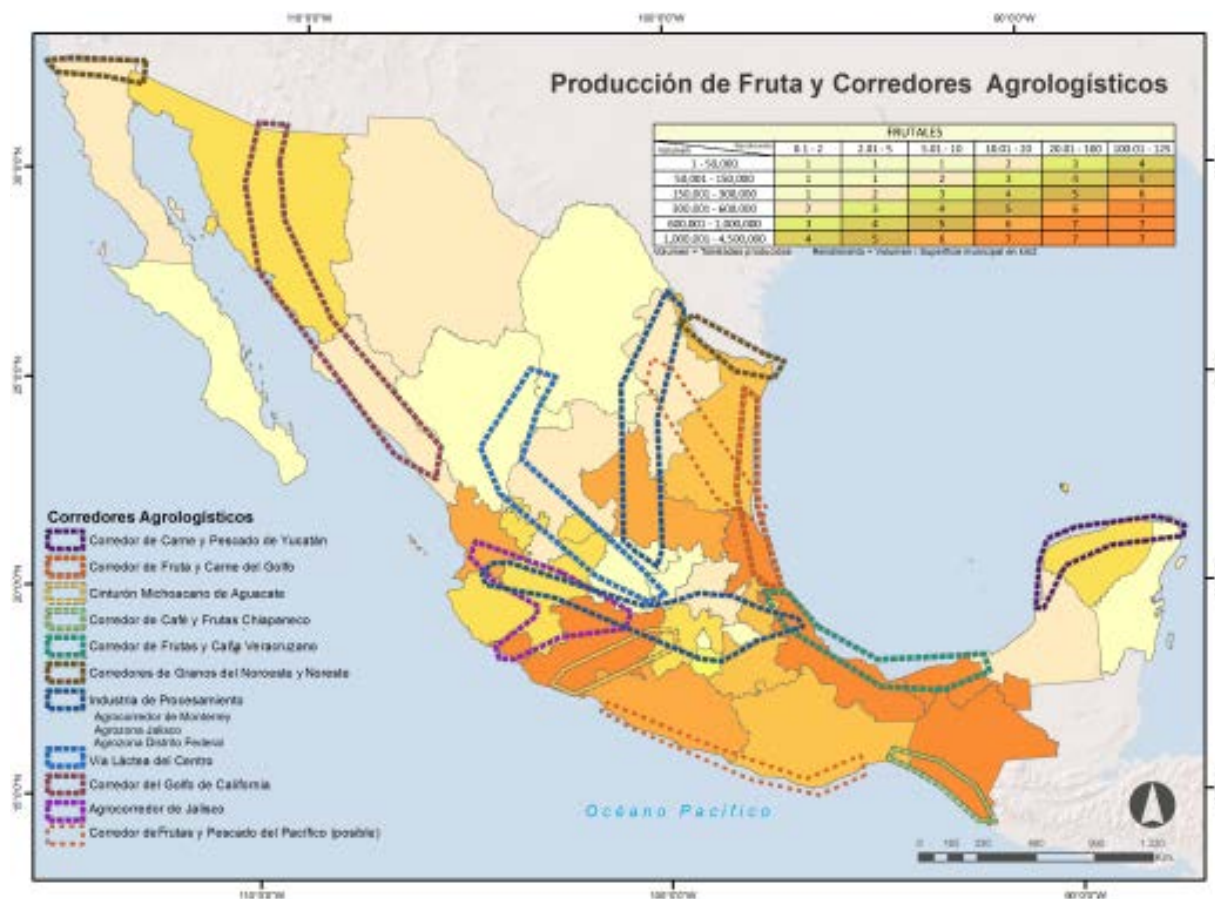
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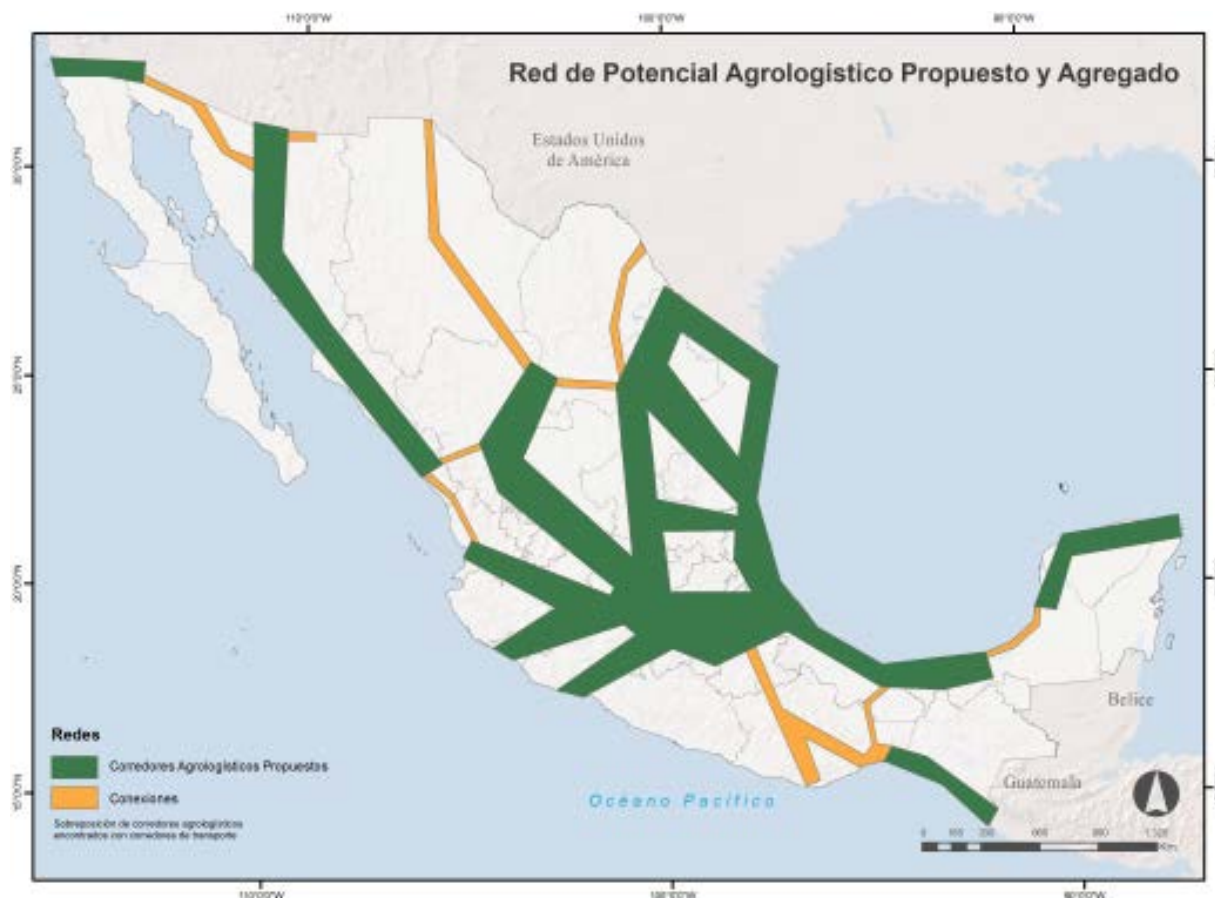
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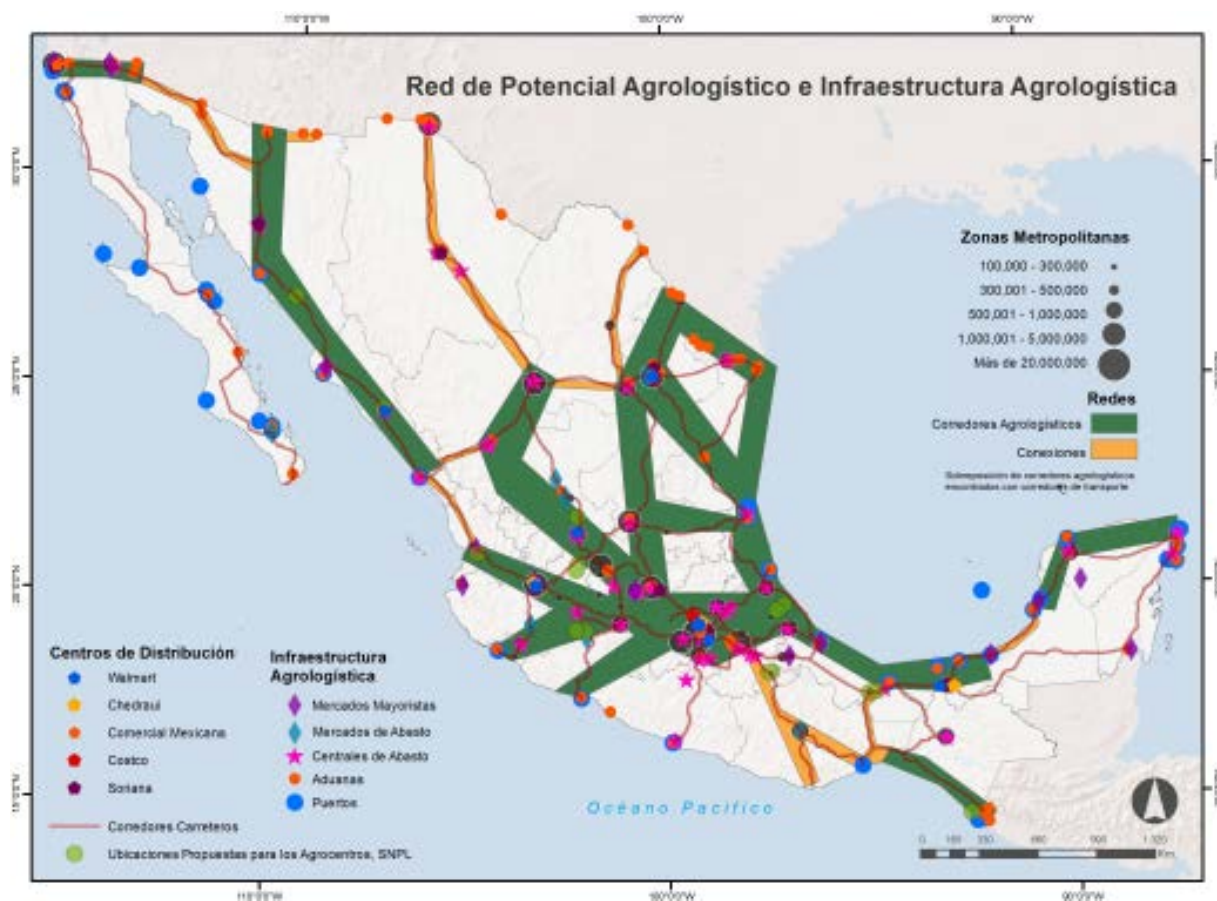
N.07



N.08



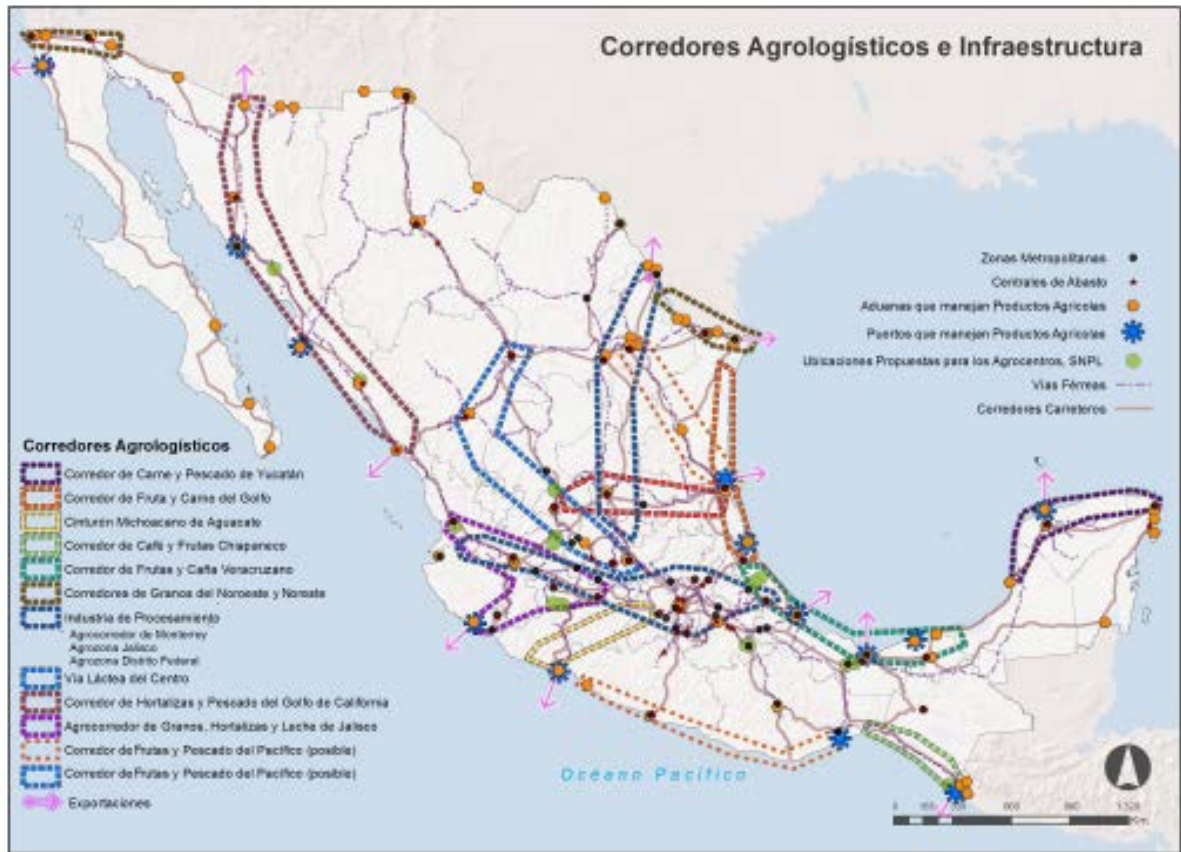
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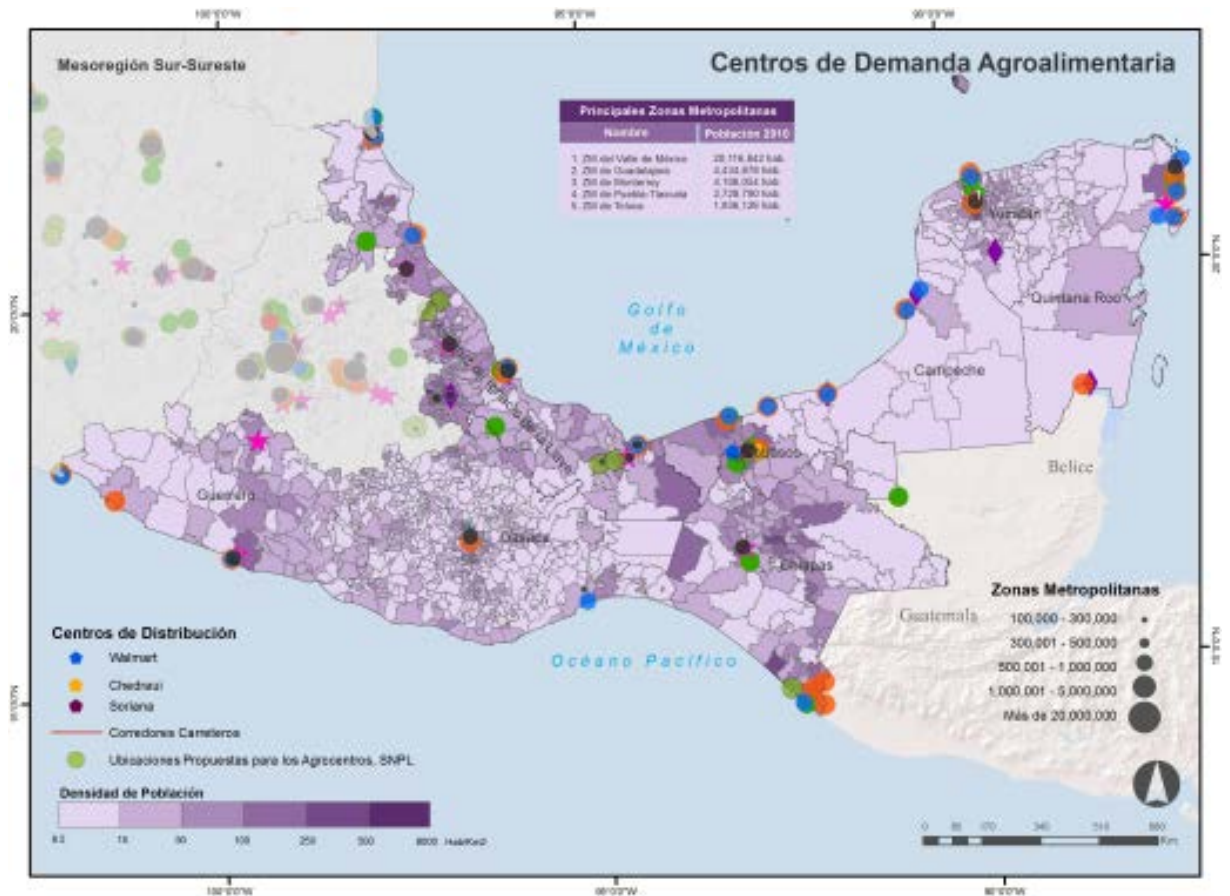
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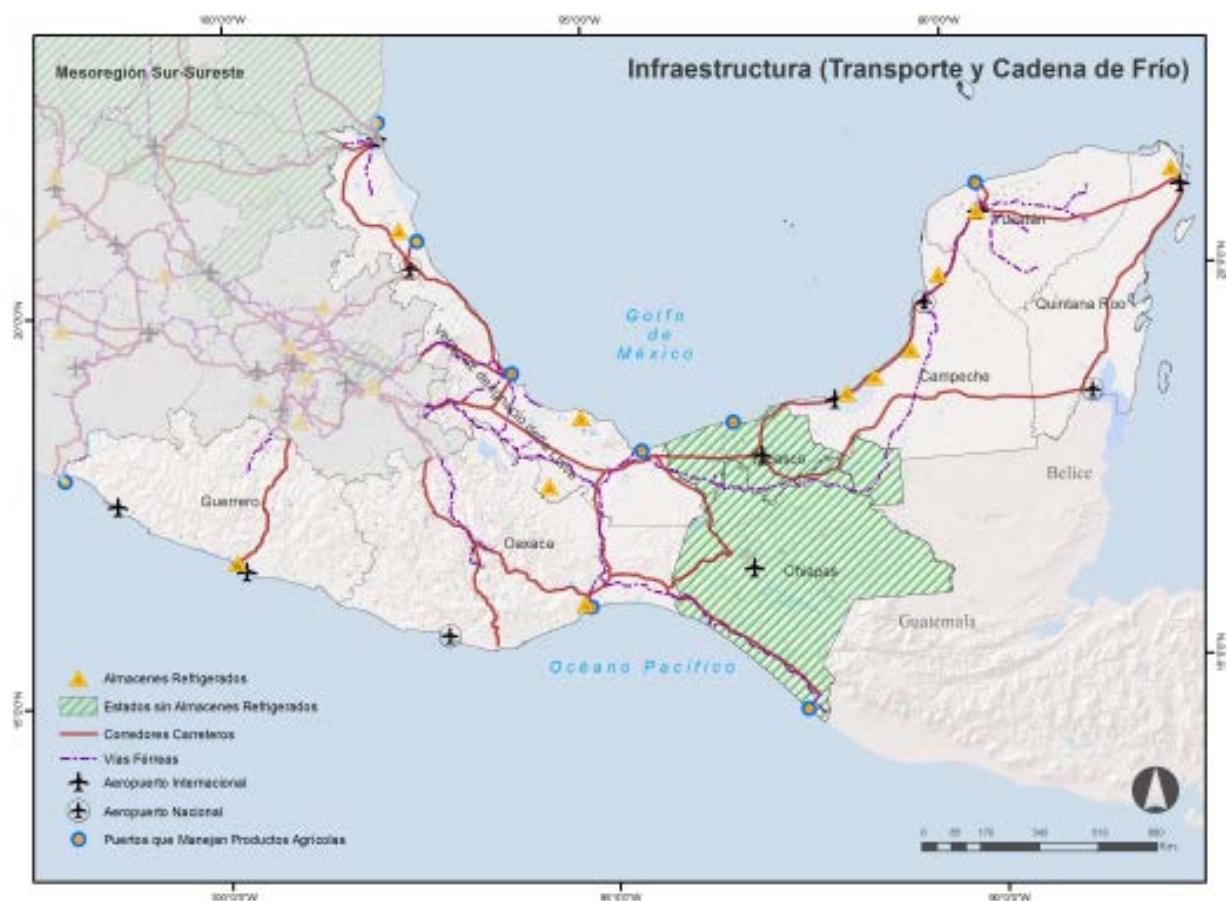
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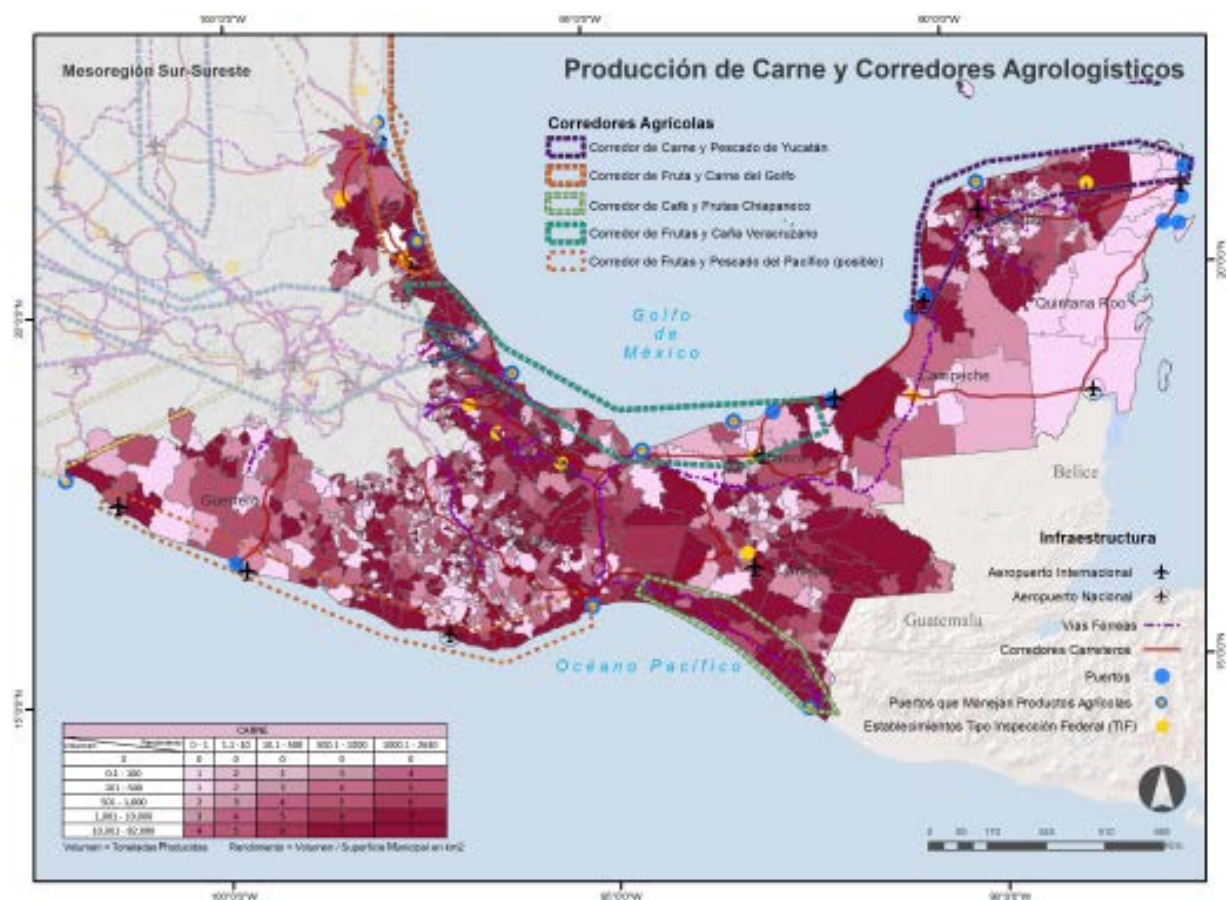
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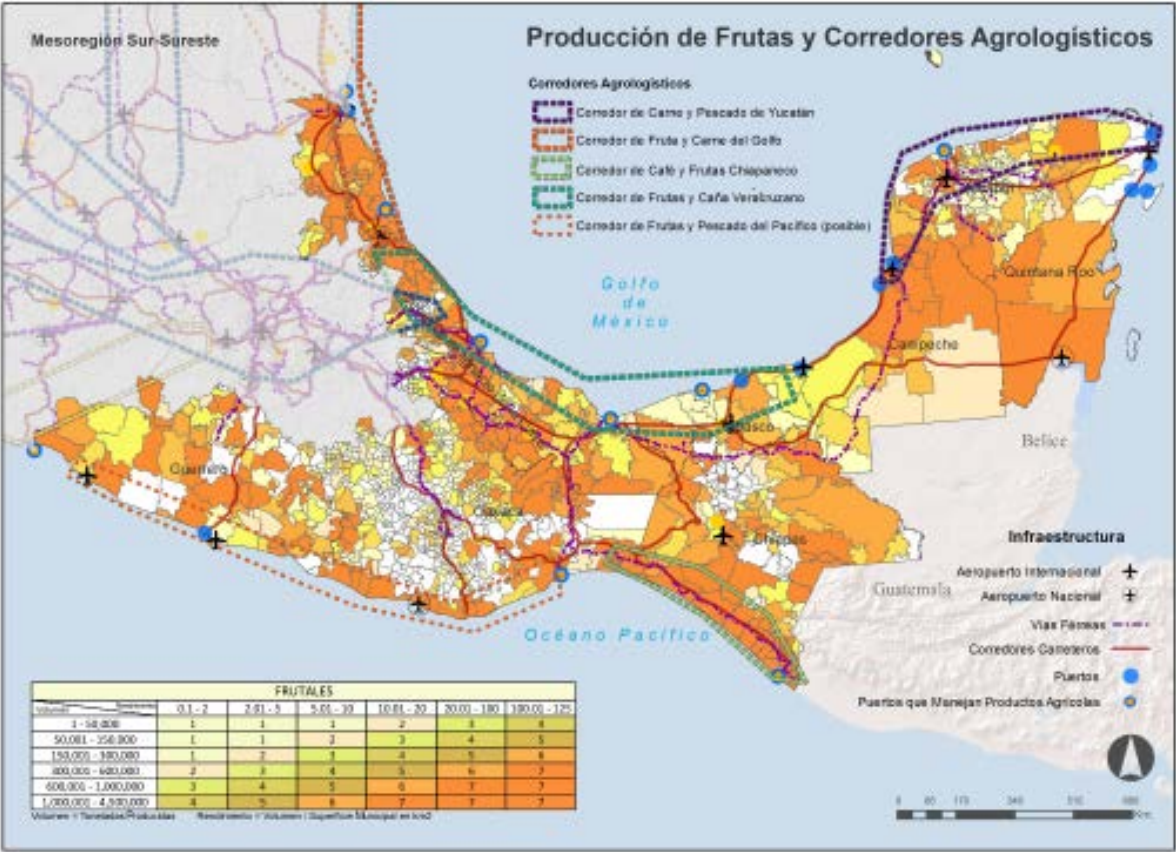
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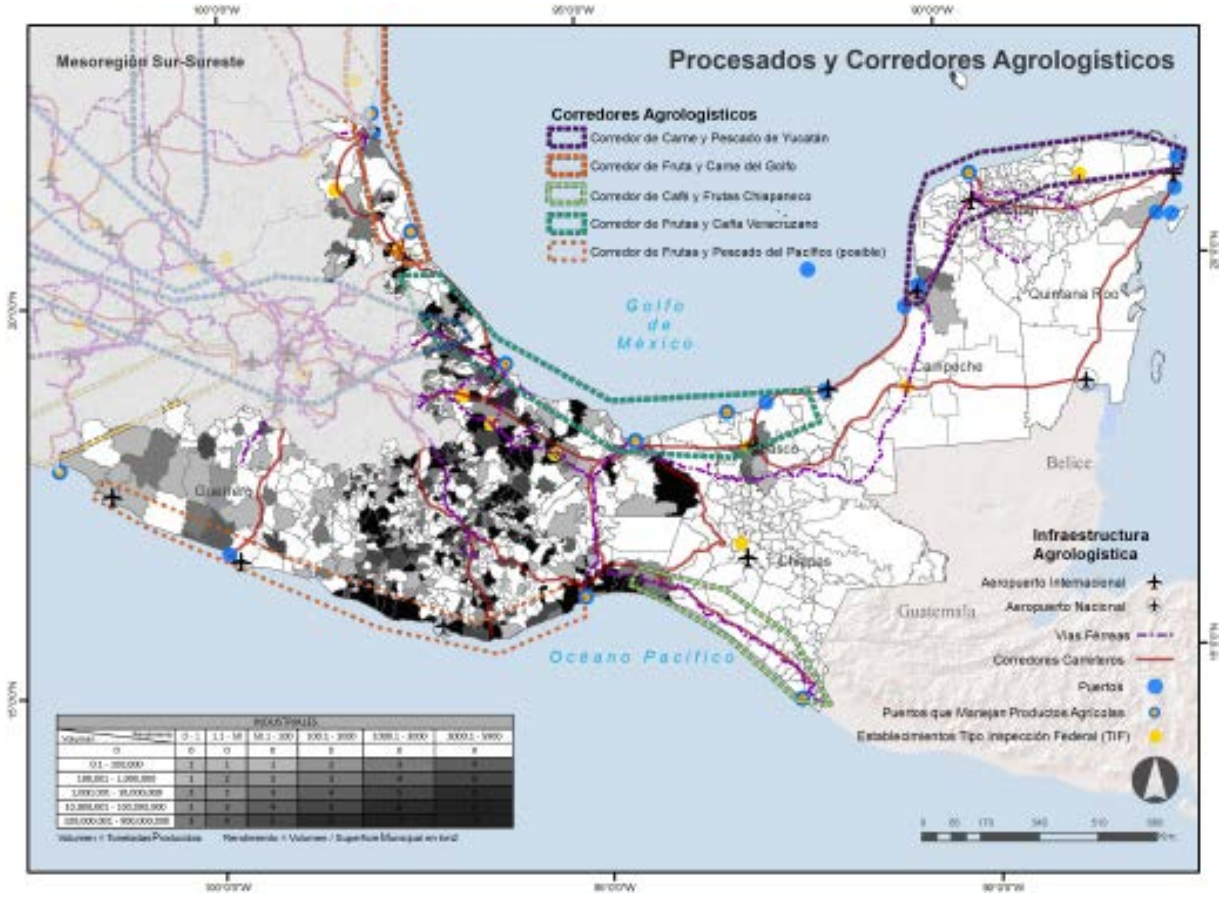
M5.3



M5.4



M5.5



SOURCES

DEMAND CENTERS

Metropolitan Zones

1. Mexico Valley MZ
2. Guadalajara MZ
3. Monterrey MZ
4. Puebla - Tlaxcala MZ
5. Toluca MZ

Source: National Geostatistic Frame, results by locality from the 2010 Population and Housing Census and management programs of conurbations and metropolitan areas

National Population Council (CONAPO), Mexico.

Commercial Control Points

Ports
Border Crossings
Customs

Source: Railway Statistical Yearbook. General Directorate of Rates, Railboard and Multimodal Transport, SCT (1997-2011).

Supply Centers

Wholesaler Markets
Supply Centers (Centrales de Abasto)
Logistic Infrastructure

Source: National Confederation of Supply Center Traders Agrupation, A.C. CEDIS

Distribution Centers

Walmart
Chedraui
Soriana
Comercial Mexicana
Costco
Soriana

Source: Own elaboration based on company data

Food Processing Plants

Planta Lala
Planta Alpura
Chilchota Alimentos
Sigma Alimentos Lácteos
Federal Inspection Type Facilities (TIFS)

Source: Identification of possible "clusters" at the regional level in the bovine production chain from the official websites of each company.

Proposed Locations for the SNLP Agrocenters

Source: Development of the National System of Logistic Platforms and the Implementation Plan.

Cold Storage

Source: IMCO based on INEGI information, 2014.

INFRASTRUCTURE

General

International Airport
Domestic Airport
Railways
Ports
Ports than handle agri-food products

Road Infrastructure

Toll Roads
Federal Roads
State Roads
Local Roads
Tollbooths

SCT Road Corridors

Acapulco – Tuxpan
Acapulco – Veracruz
Altiplano
Transisthmian Road Corridor
Manzanillo – Tampico
Mazatlán – Matamoros
México – Nogales
México – Nuevo Laredo
Península de Yucatán
Puebla – Oaxaca – Ciudad Hidalgo
Puebla – Progreso
Querétaro – Ciudad Juárez
Baja California Trans peninsular
Veracruz – Monterrey

SNLP Multimodal Corridors

Cd. de México – Salina Cruz – Cd. Hidalgo
Lázaro Cárdenas – Cd. de México
Lázaro Cárdenas – Cd. de México – Veracruz
Mexicali – Guadalajara
Salina Cruz – Coatzacoalcos
Topolobampo – Chihuahua – Ojinaga
Veracruz- Cd. de México
Lázaro Cárdenas – Querétaro – San Luis Potosí
Manzanillo – Monterrey – Ciudad Juárez
Salina Cruz – Mérida
Guaymas – Nogales
Manzanillo – Guadalajara – Cd. de México
Veracruz – Querétaro

Source: 2012 Transport Sector of the Ministry of Communications and Transportation (SCT)

Agrologistics Corridors

Yucatán Meat and Fisheries Corridor
Gulf Fruit and Meat Corridor
Michoacan's Avocado Belt
Chiapas Coffee and Fruit Corridor
Veracruz Fruit and Sugarcane Corridor
Northwest and Northeast Grain Corridors
Center Milky Way
Gulf of California Vegetables and Fisheries Corridor
Jalisco Grain, Vegetable and Milk Agrocorridor
Pacific Fruit and Fisheries Corridors

Source: Own elaboration based on SAGARPA information

PRODUCTS

Vegetables

Vegetables, dry pulses, root vegetables

Fruits

Fruits

Dairy (livestock)

Milk: bovine, goats

Meat (livestock)

Carcasses: poultry, bovine, caprine, turkeys, ovine, pork

Grains (without cane)

Cereals

Processed Food

Processing industry (industrial)

Fishing Areas

- Z1: Anchovies, sardines, abalone, tuna, lobster, bonito, mackerel, mullet, chamaron, shark, grouper, turtle, red snapper, snapper, sierra, croaker, flounder, dogfish, clams, oysters
- Z2: Turtle, shrimp, oysters, shark, sea bass, sea bass, smooth, sierra, snapper, snapper, bream, shrimp, kingcroaker, bonefish
- Z3: shrimp, red snapper, sea bass, dogfish, bream, mullet, crab, shrimp, pompano, croaker, oyster, saw, clam, poto, mackerel
- Z4: oysters, sea bass, shrimp, tilapia, shark, turtle, shrimp, octopus, sea bass, sierra, snapper, grouper, pompano, crab, lobster

Source: Agricultural and Fisheries Information Service (SIAP) of the Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA).

OTHERS

Population Density

Inhab/Km²

Source: Own elaboration based on the Gesostatistical Frame and INEGI's 2010 Population and Housing Census.

Formula used:

$$\text{Population density} = \frac{\text{Number of Inhabitants 2010}}{\text{Municipality or State Surface in km}^2}$$

Topography and Main Elevations

Pico de Orizaba
Volcán Popocatepetl
Volcán Iztaccíhuatl
Pico Teyotl
Nevado de Toluca
Volcán Malintzin
Sierra Negra
Nevado de Colima
Cofre de Perote
Cerro Chichimeco

Source: Mountains Digital Encyclopedia.

<http://www.montipedia.com/montanas-altas/mexico/>

Isochrones

Isochrones 2 hours

Isochrones 4 hours

Isochrones 8 hours

Source: Own elaboration based on information provided by Google Maps

REU Strata (Rural Economic Units)

E1: Family of subsistence, without linkage to the market

E2: Family subsistence with linkage to the market

E3: In transition

E4: Entrepreneurial with weak profitability

E5: Booming entrepreneurial

E6: Dynamic entrepreneur

Source: FAO, Mexico rural and fisheries sector diagnosis 2012



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