Impacts of demography on drinking water supply networks in Gironde (France)

Eddy Renaud, Alain Husson, Patrick Eisenbeis, Bruno de Grissac

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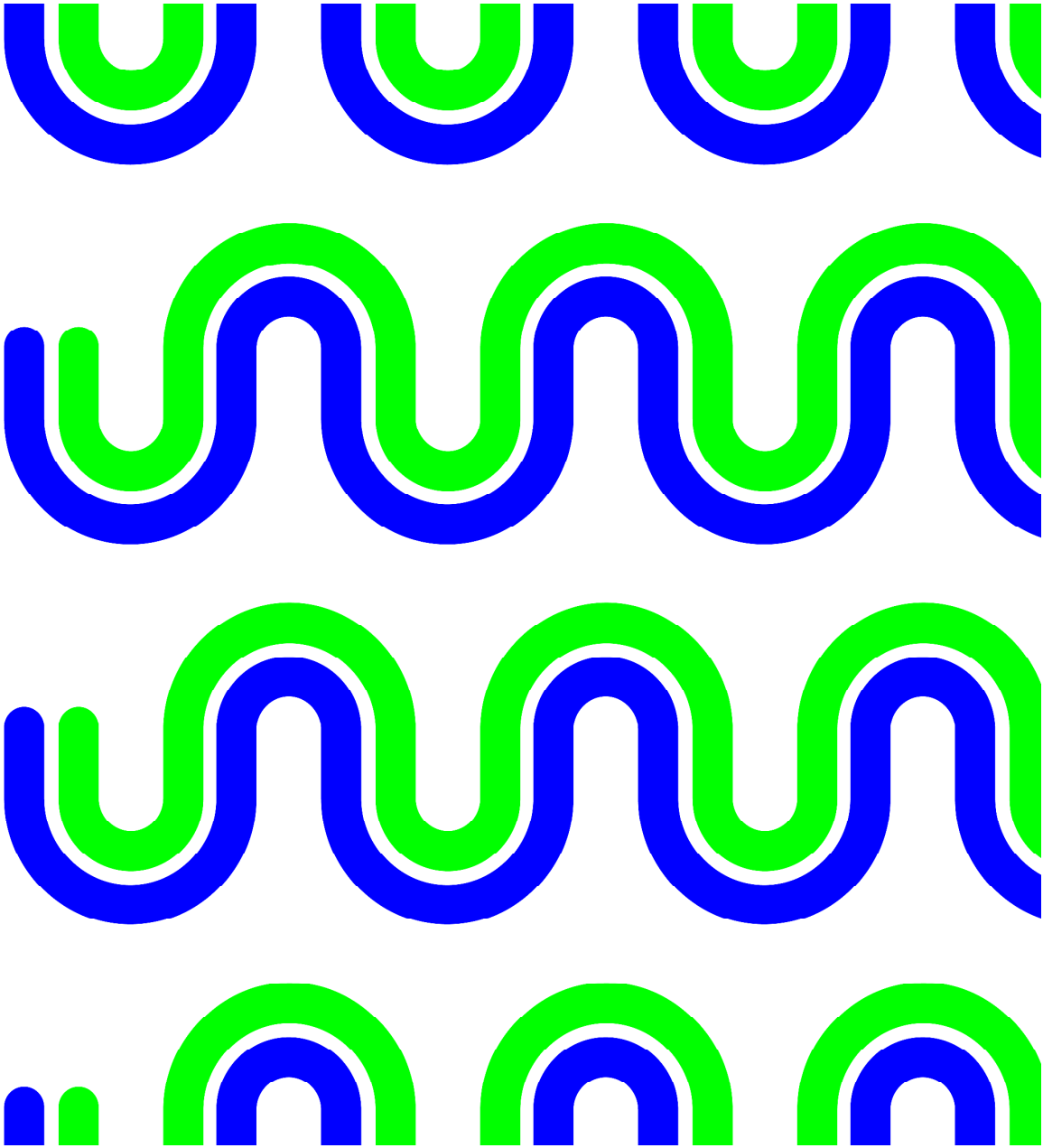

OUTLINE

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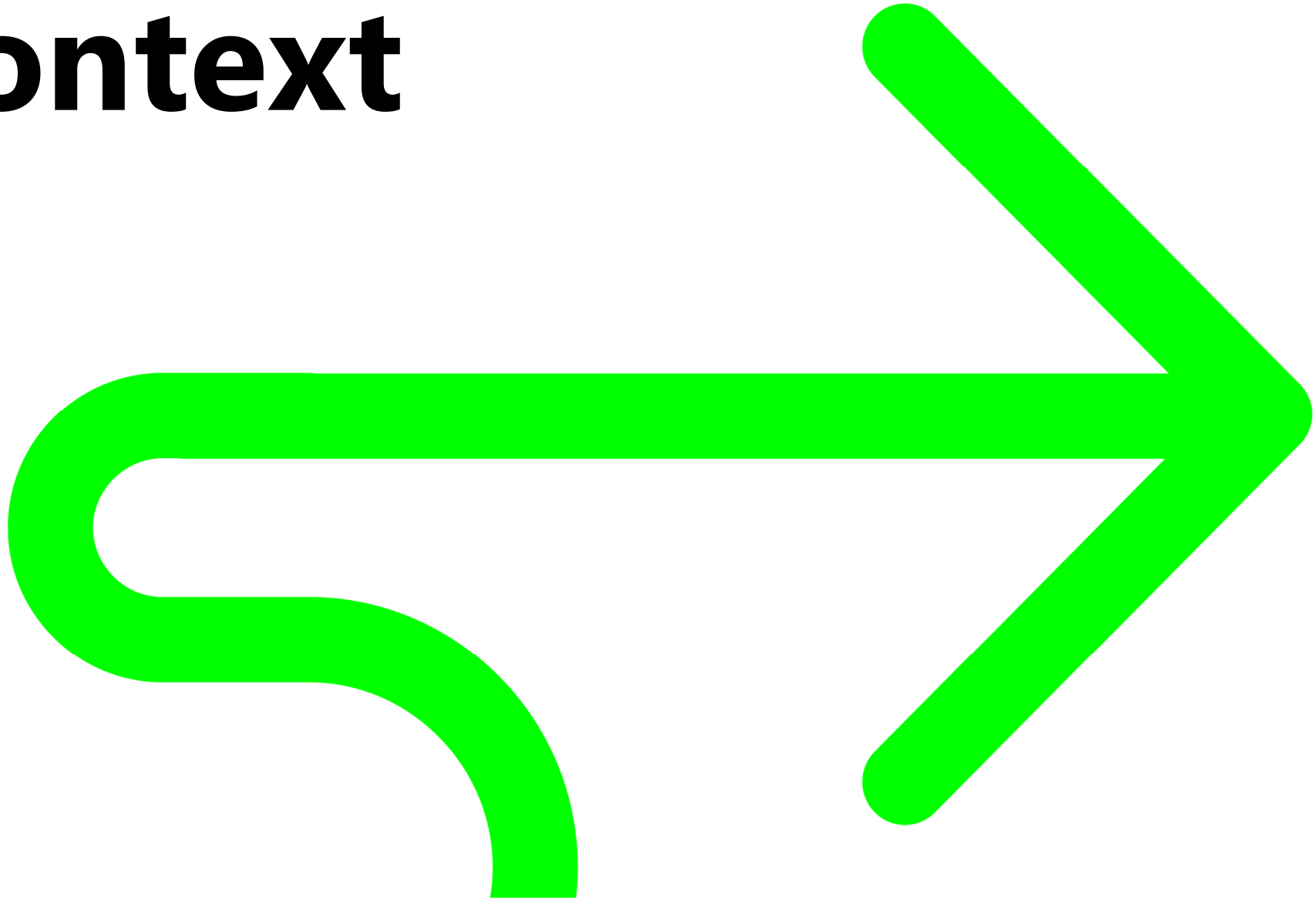
Context



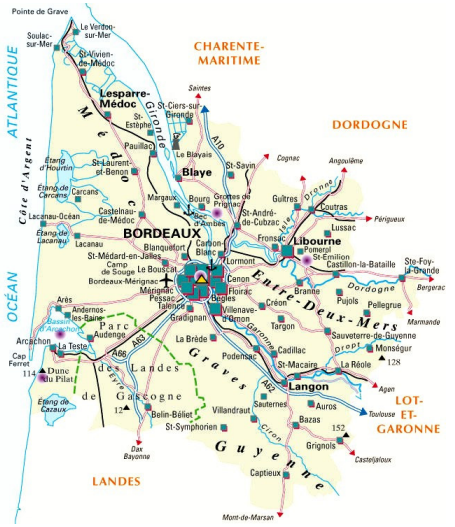
Context

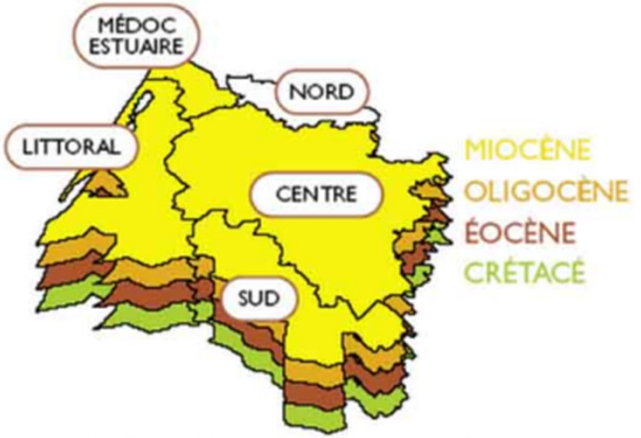
The Gironde county (whose main city is Bordeaux), is mainly supplied with drinking water produced from deep groundwater, some of which are overexploited.

Long-term management of these water resources requires knowing the water needs

- **drinking water consumption of users**
- **needs of the system, most of which consists of water losses from the drinking water supply network (DWSN).**

Thus, estimating the evolution of these water losses requires taking an interest in the evolution of pipes networks, from a qualitative standpoint but also from a quantitative point of view.





Unités de gestion du SAGE

Context

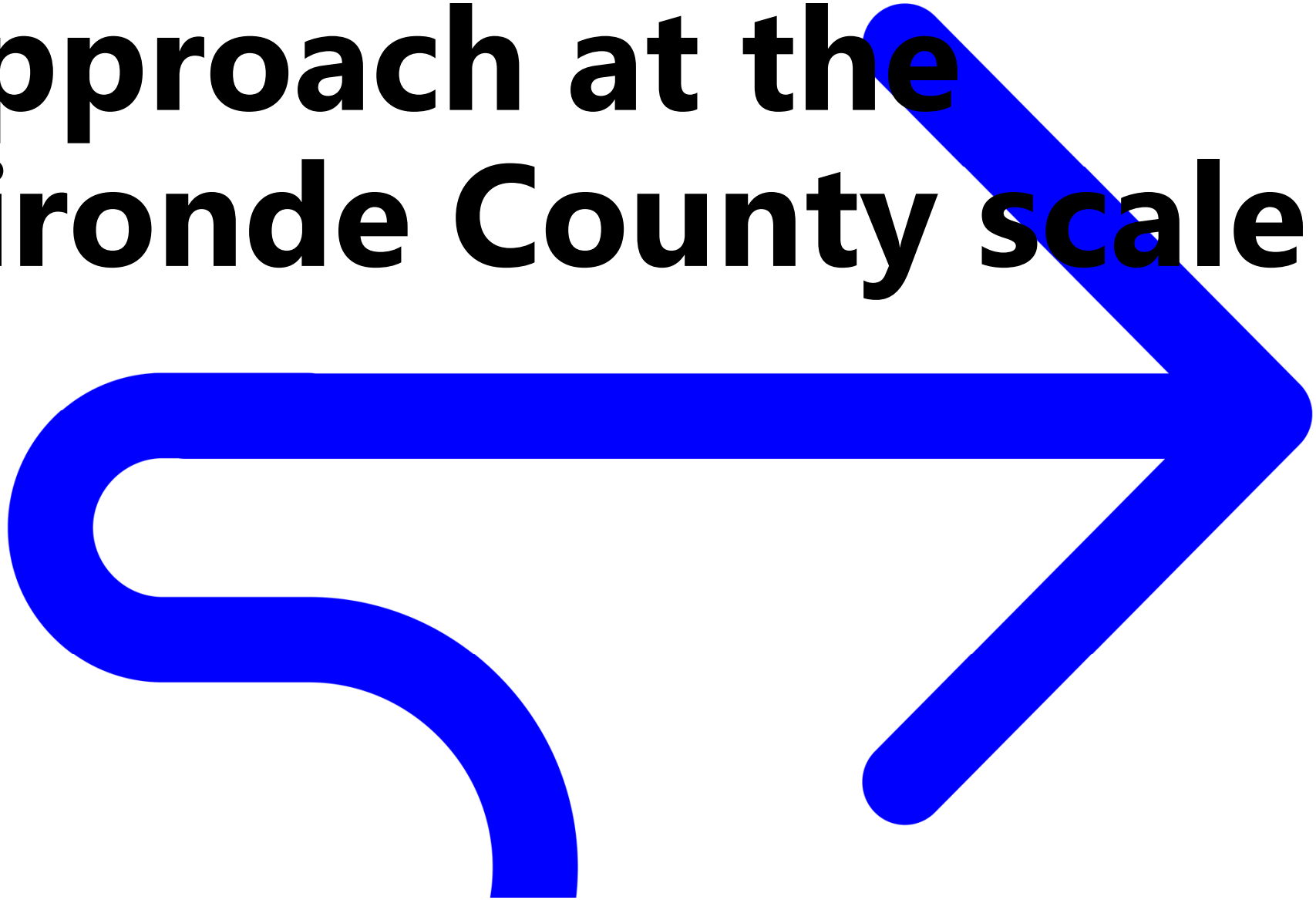
To move forward on this question, the SMEGREG (public watershed establishment in charge of deep aquifers in Gironde, France) and INRAE (French public research institute) are leading a research collaboration to develop a prospective approach of water losses from the DWSNs in Gironde

A part of this study examines the influence of demography and town planning on the evolution of DWSNs assets.

The study is being carried out at two spatial scales :

1. **the territory of the Gironde county (GC, in grey)**
2. **the territory of the Bordeaux metropolitan area (BM, in red).**

Approach at the Gironde County scale



GC scale

Data and methods

At this scale, the approach is based on :

- **data from SISPEA (French observatory of public drinking water services) with for each DWSN the total length of pipes (*L*) and the number of subscribers (*N*)**
- **demographic data from INSEE (French institute of statistics)**

After concatenation of demographic data at the DWSN level, the usable data cover the period 2010-2017. For each relevant variable *X*, an annual average change ratio *RA-X* is calculated. These ratios are then compared with each other.

In 2017, the GC had :

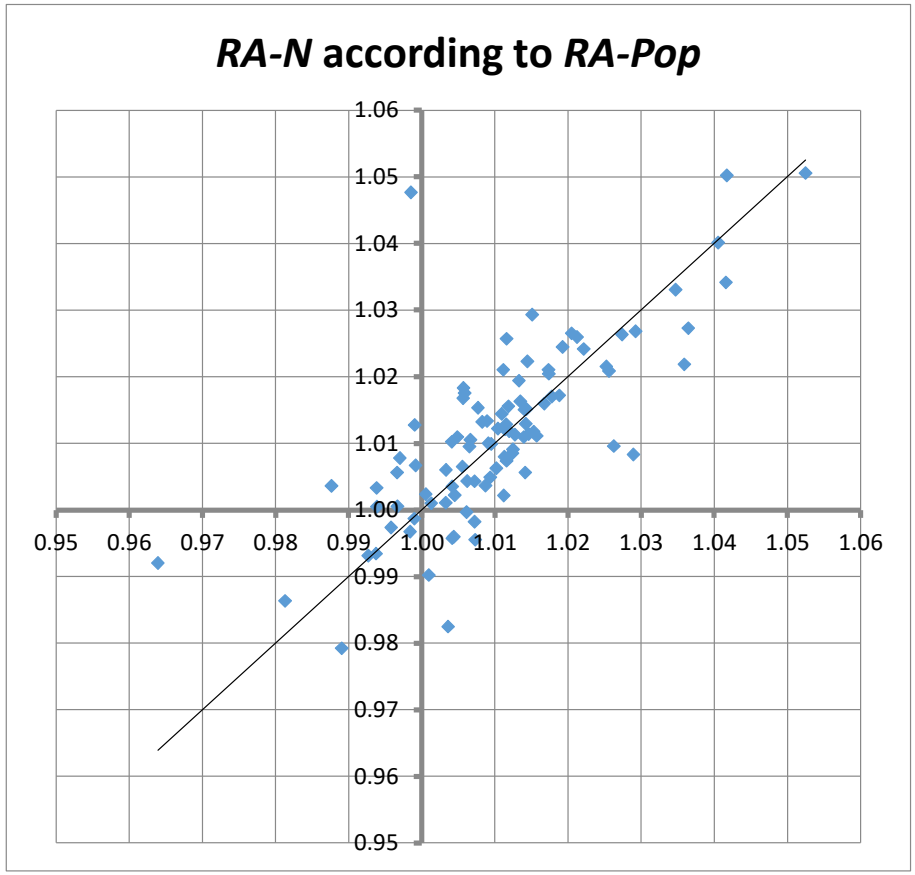
- **1,584,000 inhabitants**
- **703,000 subscribers served with drinking water**
- **9,000 km of main pipes**
- **100 DWSNs.**

GC scale

Number of subscribers / Population

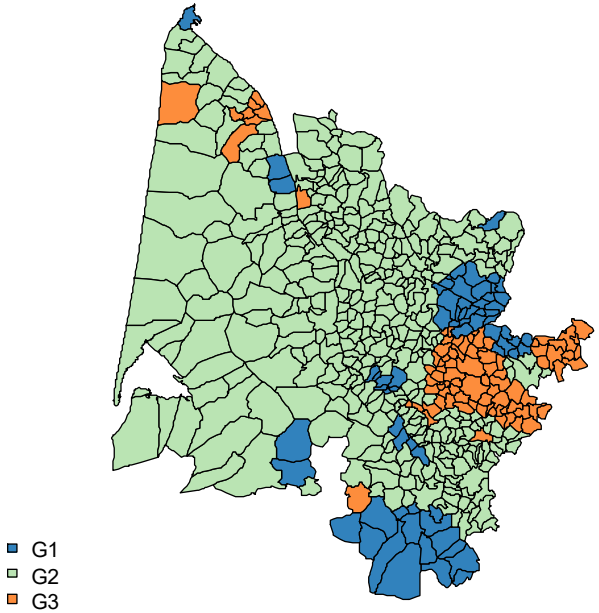
The evolution of the number of subscribers is most often comparable to that of the population

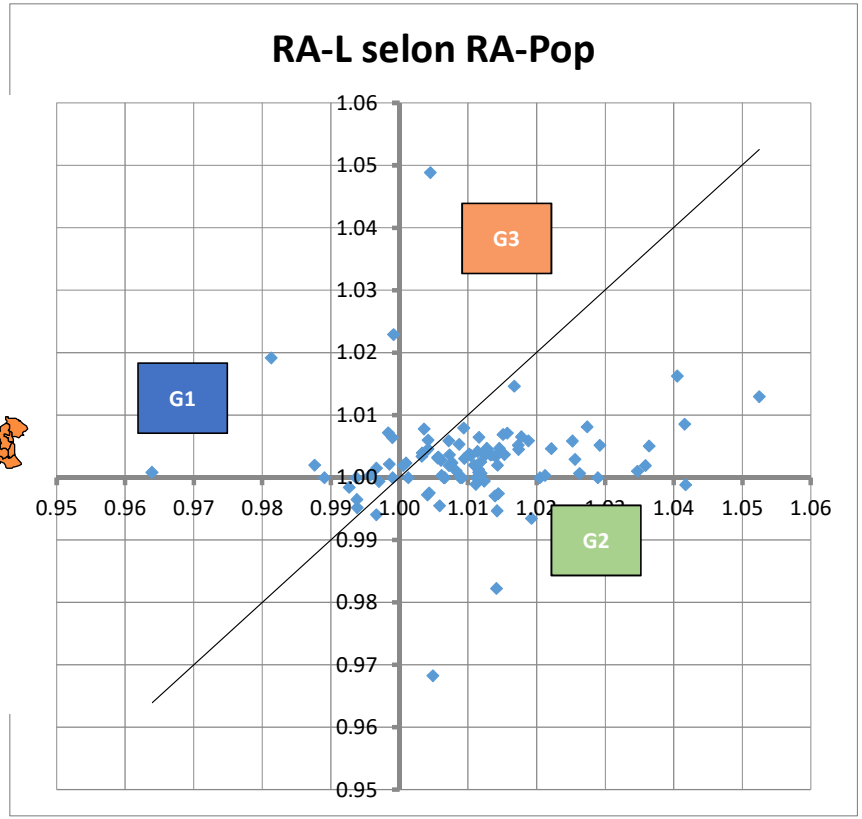
It can either be higher or lower



GC scale

Network length / Population





1. **A minority of DWSN are experiencing a decline in the permanent population (G1)**

2. **For the majority of DWSN (G2) the average annual change in network length is lower than that of the population**

3. **In some very rare cases (G3) the length of the network increases faster than the population**

Approach at the Bordeaux metropolitan area scale

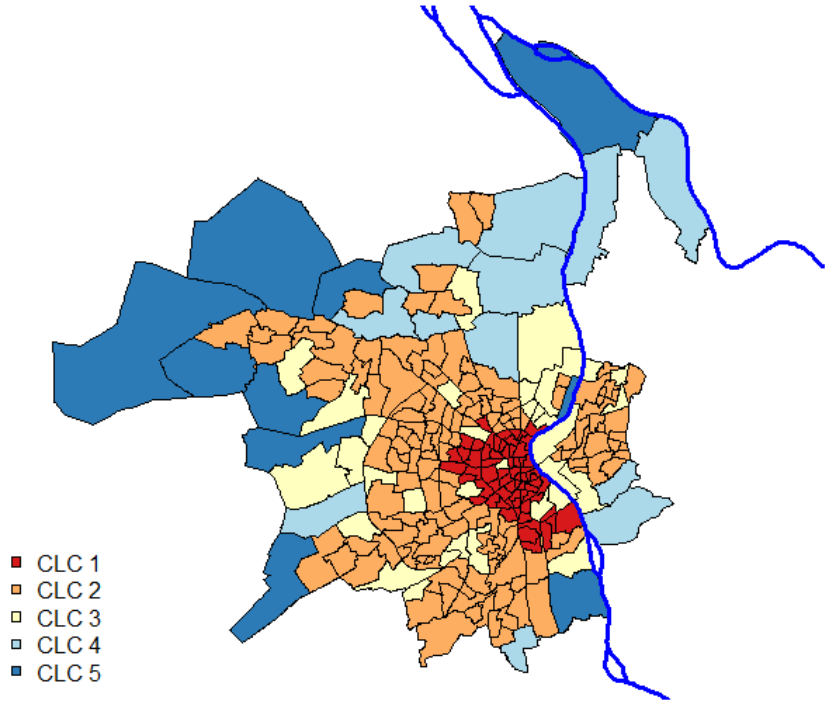
BM Scale

This second approach mobilizes:

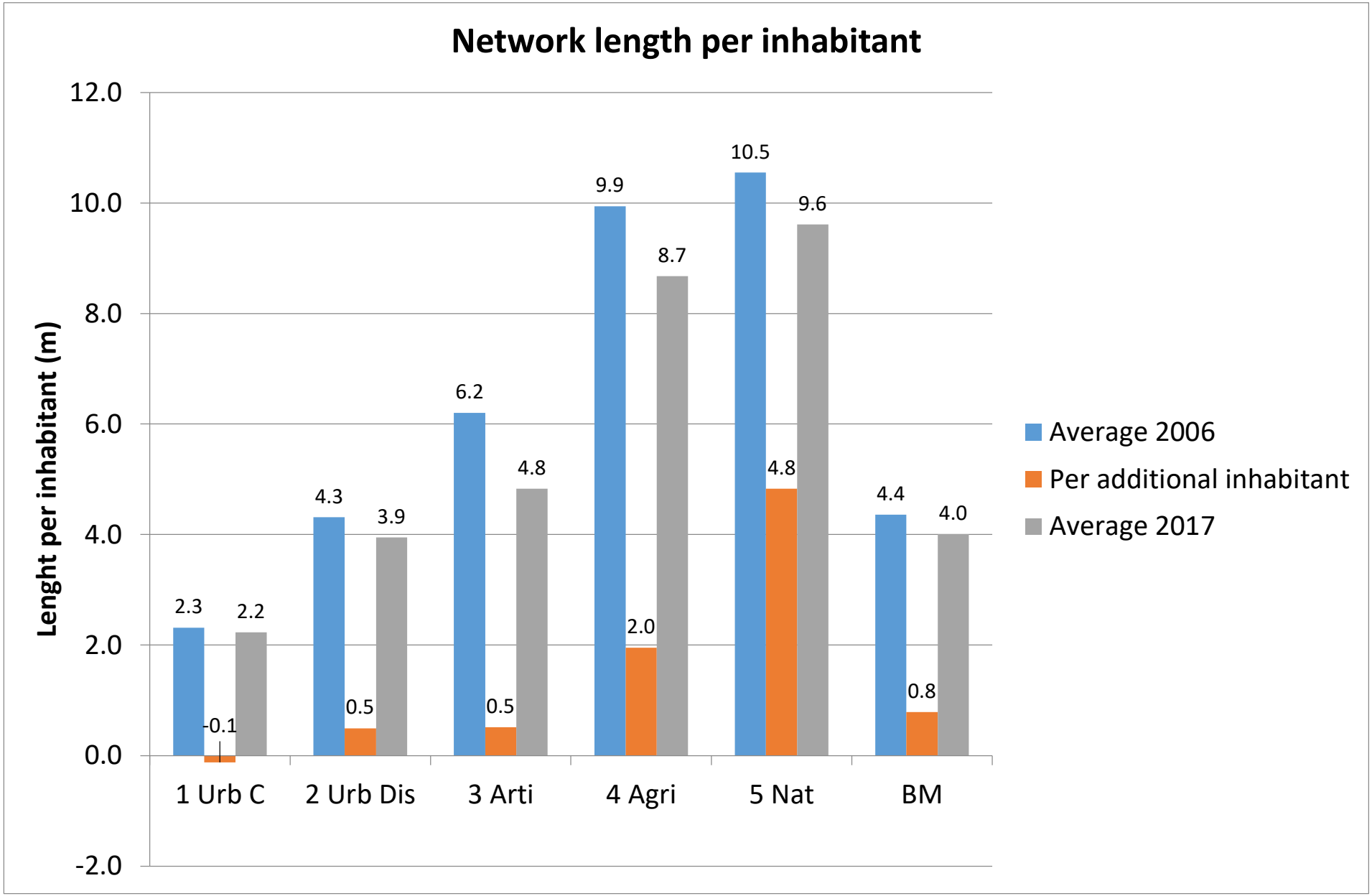
- **the GIS of BM's DWSN**
- **the demographic data of the INSEE at the level of the IRIS which is an infra-municipal statistical subdivision (INSEE, 2021)**
- **European land use mapping (Corine Land Cover, 2018) - Types of land use have been grouped into five classes**
- **IGN (French geographical institute) building mapping (IGN, 2021)**

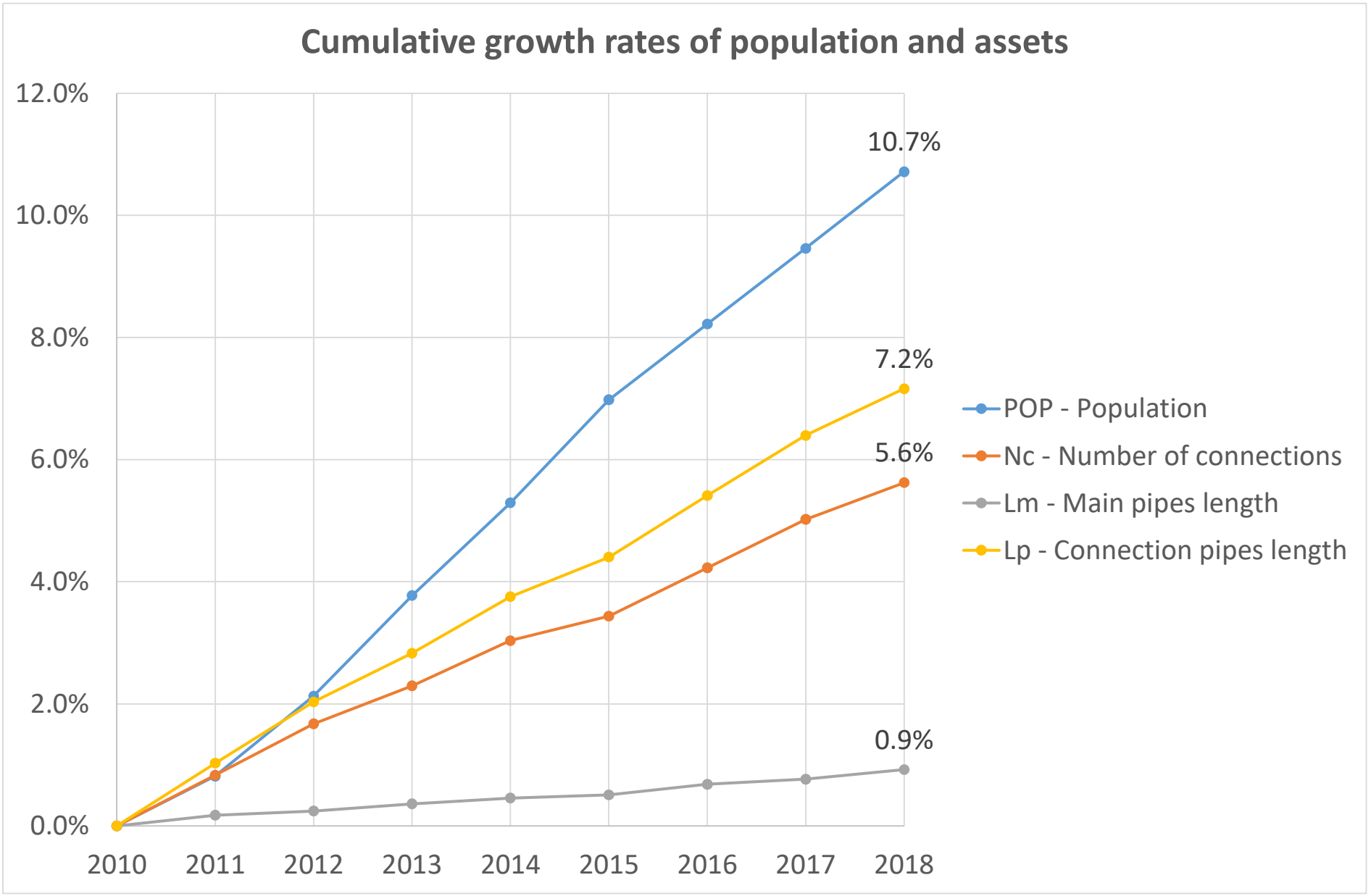
After geoprocessing, the available data make it possible to study, at the IRIS scale and by land cover classes, the changes in the variables from 2006 to 2018.

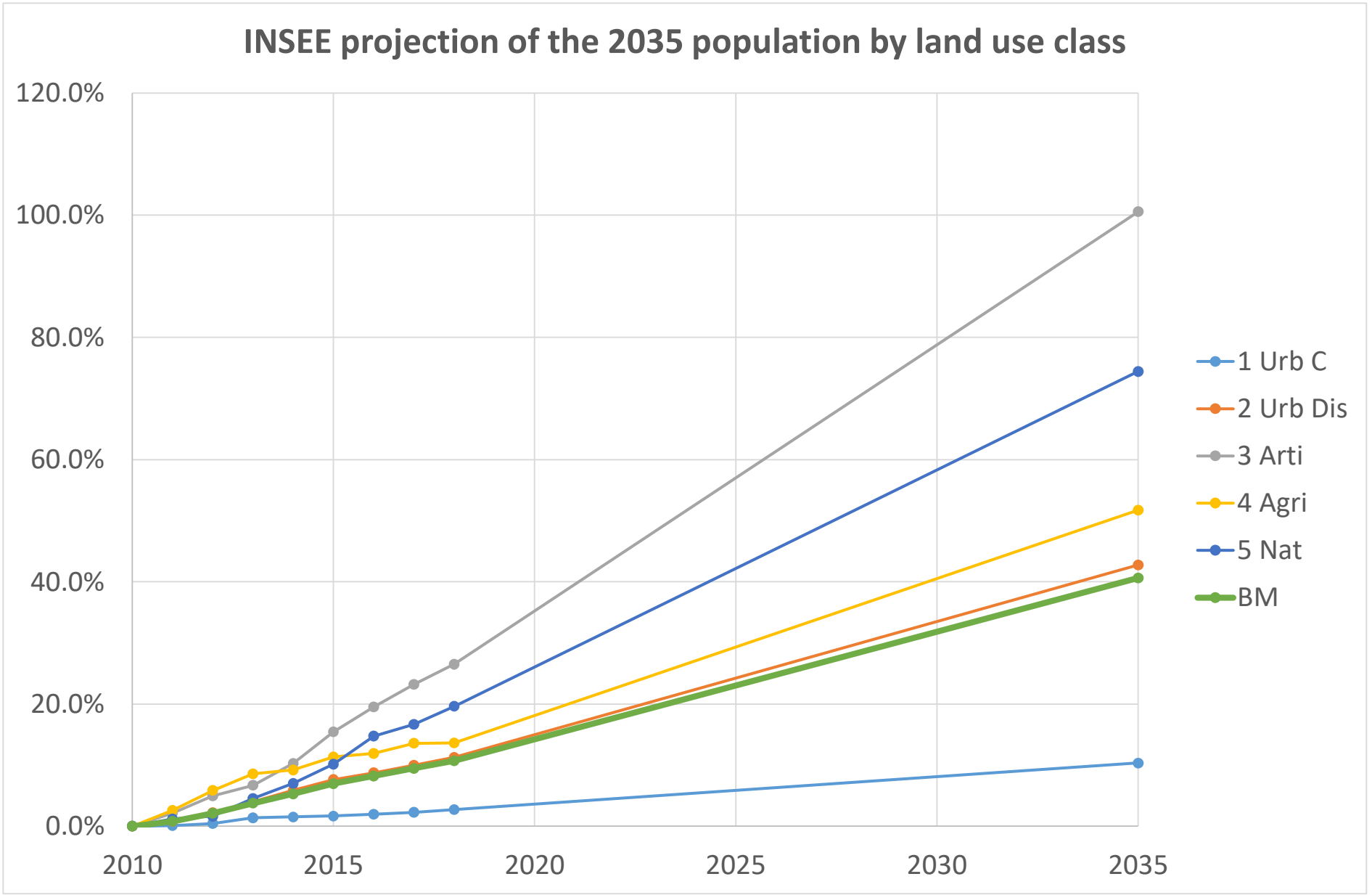
BM Scale

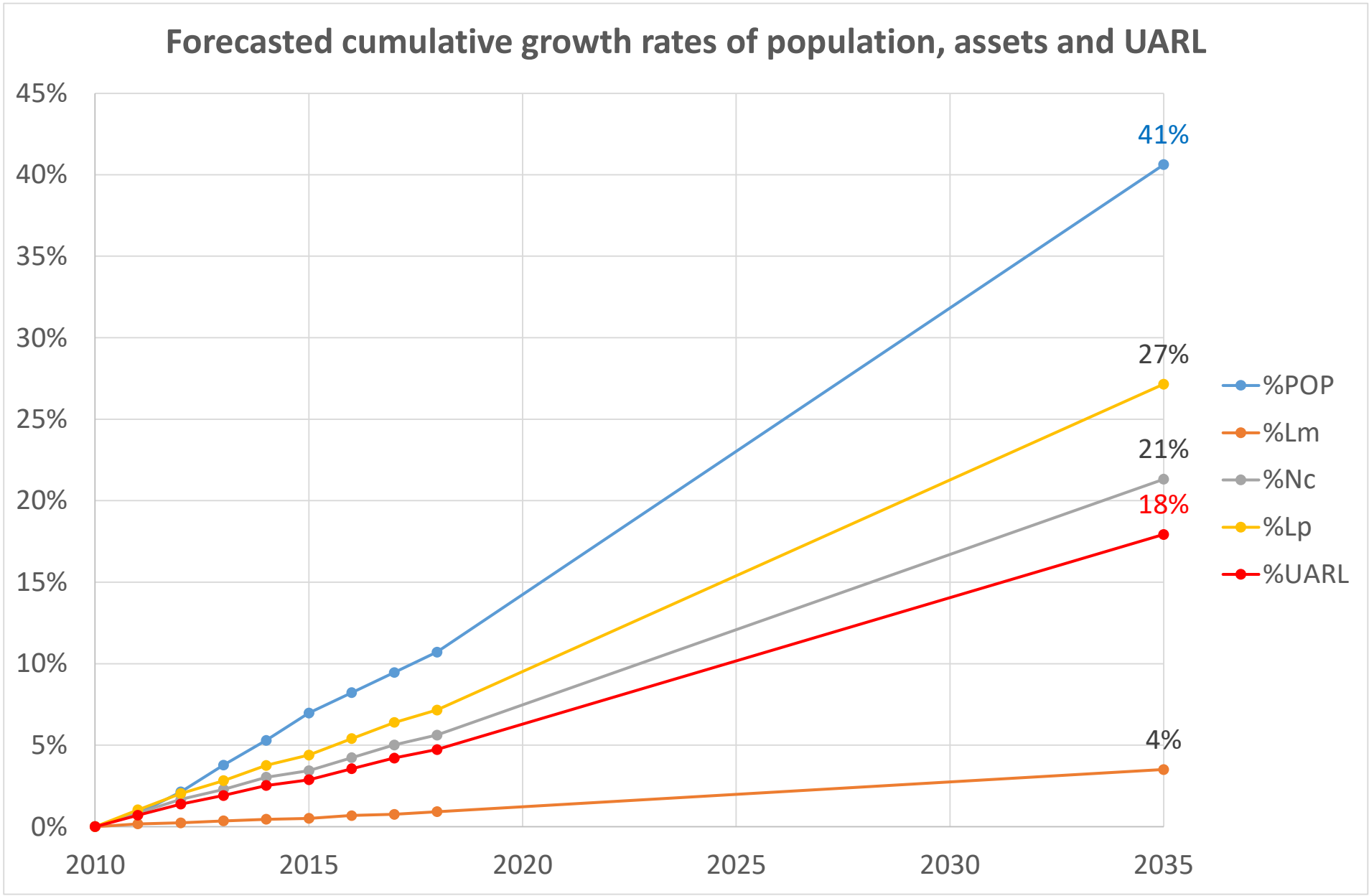


	IRIS	Surface area		2006 population		Density
	u	km²	%	u	%	u/km2
CLC 1 - Continuous urban	65	21.7	4%	179 870	27%	8 304
CLC 2 – Discontinuous urban	143	156.3	31%	384 688	57%	2 461
CLC 3 - Artificial	32	70.0	14%	56 866	8%	812
CLC 4 - Agricultural	12	100.5	20%	27 456	4%	273
CLC 5 - Natural	10	155.1	31%	20 911	3%	135
BM	262	503.6	100%	669 791	100%	1 330

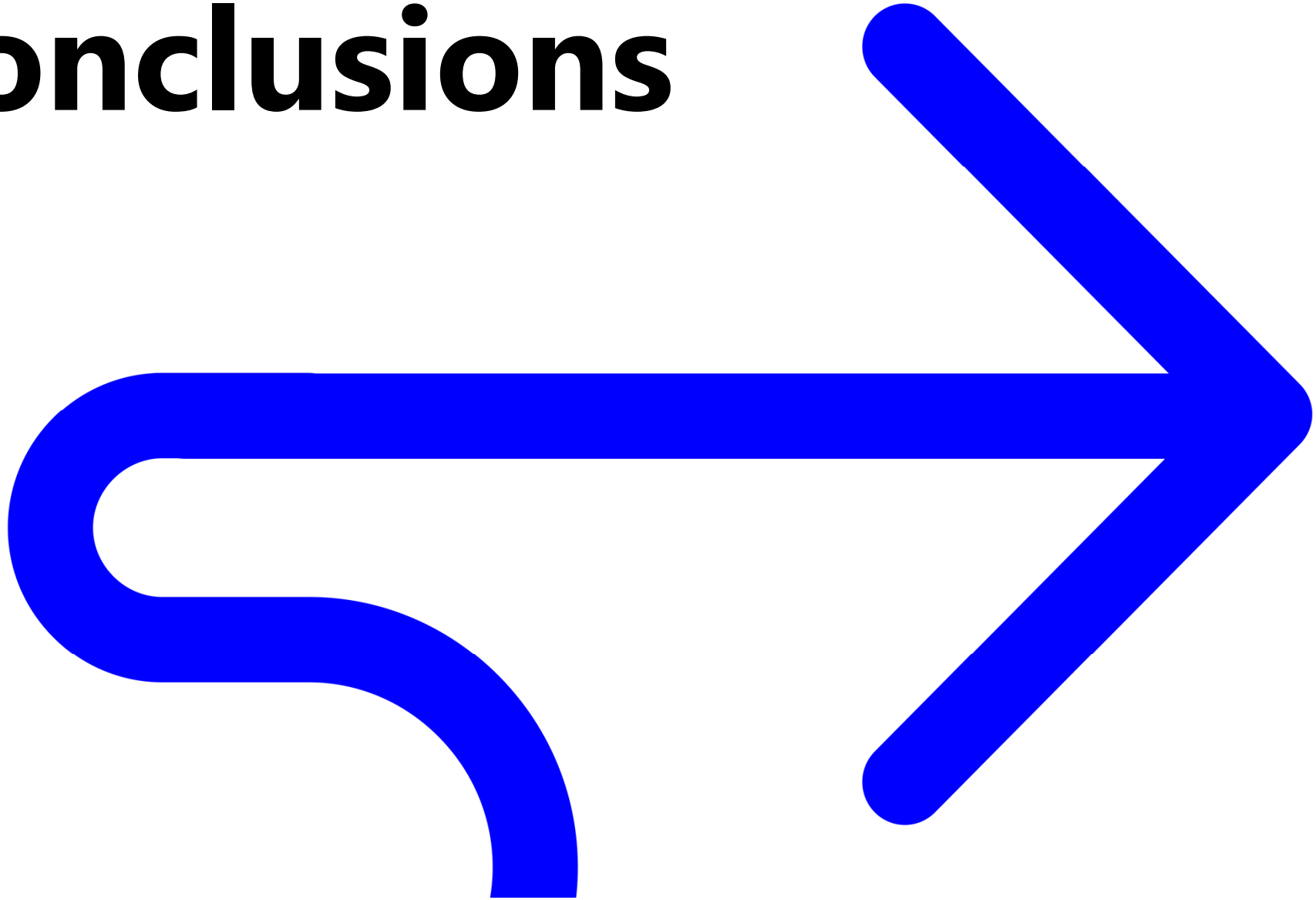

Network length per inhabitant
Lenght per inhabitant (m)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
2.3
-0.1
2.2
4.3
0.5
3.9
6.2
0.5
4.8
9.9
2.0
8.7
10.5
4.8
9.6
4.4
0.8
4.0
1 Urb C
2 Urb Dis
3 Arti
4 Agri
5 Nat
BM
Average 2006
Per additional inhabitant
Average 2017


Cumulative growth rates of population and assets
12.0%
10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
2010
2011
2012
2013
2014
2015
2016
2017
2018
10.7%
7.2%
5.6%
0.9%
POP - Population
Nc - Number of connections
Lm - Main pipes length
Lp - Connection pipes length


INSEE projection of the 2035 population by land use class
120.0%
100.0%
80.0%
60.0%
40.0%
20.0%
0.0%
2010
2015
2020
2025
2030
2035
1 Urb C
2 Urb Dis
3 Arti
4 Agri
5 Nat
BM


Forecasted cumulative growth rates of population, assets and UARL
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
2010
2015
2020
2025
2030
2035
41%
27%
21%
18%
4%
%POP
%Lm
%Nc
%Lp
%UARL

Conclusions



Conclusions

The study conducted by SMEGREG and INRAE to assess the influences of demography and urbanization on the evolution of drinking water supply networks leads to the first following results:

- **An increase in population translates into a much smaller increase in assets, especially for main pipes**
- **The level of urbanization of the area concerned (assessed according to land use) has a strong impact on the influence of demography on the evolution of assets → This influence increases when the level of urbanization decreases;**
- **As a result, in the case of Bordeaux Metropolitan area, the UARL should increase half as fast as the population by 2035**

The next step will be to make an estimate of the evolution of real losses to compare it to the evolution of demand.
After that, it will be decided whether or not a more detailed analysis of evolutions of water losses is necessary to improve the long-term management of water resources.

Thank you for attention

INRAE

SMEGREG
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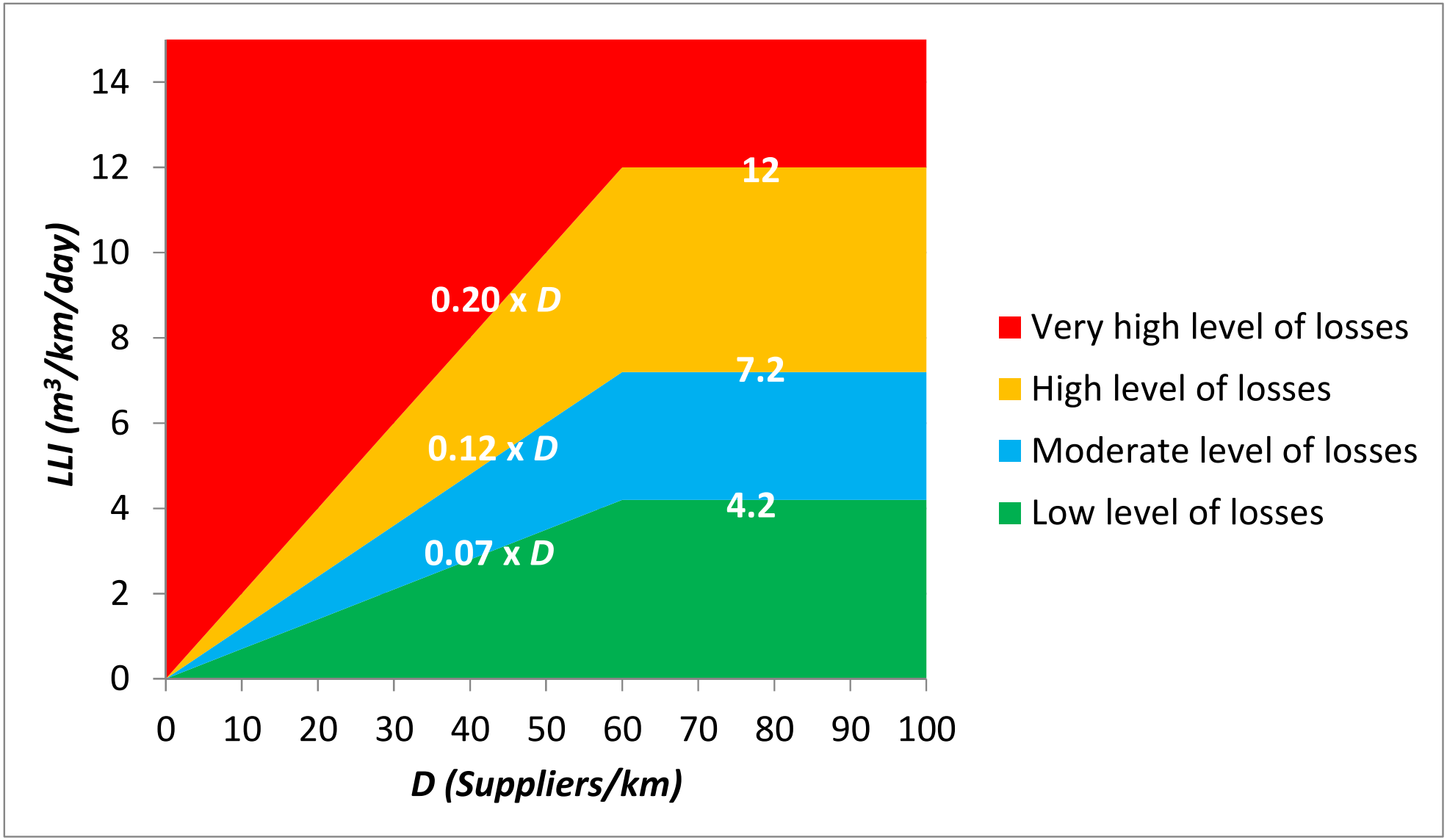
14
12
10
8
6
4
2
0
LLI (m³/km/day)
0.20 x D
12
0.12 x D
7.2
0.07 x D
4.2
0
10
20
30
40
50
60
70
80
90
100
D (Suppliers/km)
Very high level of losses
High level of losses
Moderate level of losses
Low level of losses