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Enhancing asset knowledge to improve French public policies for sustainable drinking water asset management

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Abstract: With the aim of improving the implementation and evaluation of public policy in France relating to sustainable drinking water asset management (regulation at national level and subsidies at watershed level) the French Ministry of Ecology asked Irstea, a state research body, to create an ongoing system to manage technical and financial knowledge relating to drinking water network assets. In this study we develop a statistical approach to model pipe length by category, based on the geographical characteristics of the territory in which they are installed. Multivariate models including road length have been found to be pertinent. This technical analysis is accompanied by a study of asset values and renewal costs, based on a typology of water suppliers and an examination of economic and financial ratios. A number of disparities between territories are highlighted.

Keywords: sustainable asset management; drinking water networks; technical and financial asset knowledge

Introduction

Asset management policies for drinking water networks are mainly applied at network level. However, the scope of these policies covers a much larger scale, particularly when it comes to water preservation through leak reduction. In France, the two main instruments used by public authorities to encourage water suppliers to apply sustainable asset management are regulation (at national level) and subsidies (at watershed level). At present, knowledge of networks and their financial value at both of these scales is insufficient to allow thorough optimisation of these policies. As in other countries (United States – EPA, 2013), (Denmark – DANVA, 2010) there have been previous studies into asset knowledge at national level in France (Ernst & Young, 2012), (Wittner, 2013), (EauFrance, 2015). However, none of the methods proposed exhibit a sufficiently strong combination of detail, precision, and reproducibility to allow reliable use and regular data updates.

Since 2010, French water suppliers have been legally required to provide detailed descriptions of their networks. Creating these descriptions provides an opportunity to improve network knowledge. At the request of the French Ministry for Ecology and AFB (governmental water agency) Irstea is working on a method to enhance technical and financial asset knowledge at both national and watershed level. This article presents the methods, initial results, and future perspectives of our study, which began in 2016 and is planned for completion in 2018. The first part of our method involves carrying out an inventory of pipes at national level, while the second phase examines economic and financial aspects.

Material and Methods

Technical inventory of drinking water networks

At the present time, it is not possible to access a full and exhaustive inventory of all of France's 13,500 drinking water networks. Only half of these suppliers declare the full

length of their networks in the national database, which itself does not contain any data relating to pipe material, diameter or installation date.

Our method involves searching for links between available information relating to networks and nationwide geographical and demographic data, to create statistical extrapolation models (Figure 1). The first stage in this process is to estimate total network length, mainly by making use of the significant link between pipe length and road length.

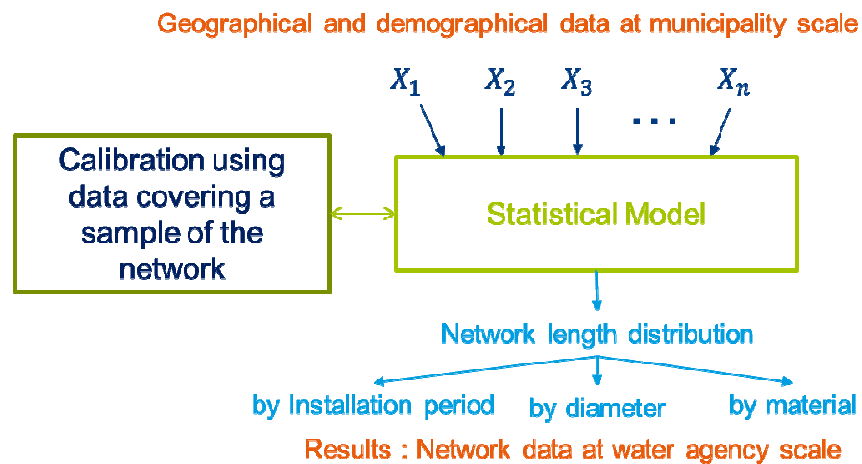


Figure 1 Principle of statistical modelling

Financial and economic evaluation of assets

We estimate the value of French assets by identifying correlations between the unit price of individual assets and various criteria, thus constructing a typology of networks (Figure 2). This allows us to estimate the financial value of those assets, taking into account differences between urban and rural areas, areas with high and low levels of consumption, tourist and non-tourist areas, areas in mainland France and French overseas territories, etc.

We then analyse disparities in the finance capacity of different WSSs by using different ratios, such as the ratio of asset value to annual self-finance capability. This provides a measurement of the time required to finance, from own resources, the capital tied up in assets.

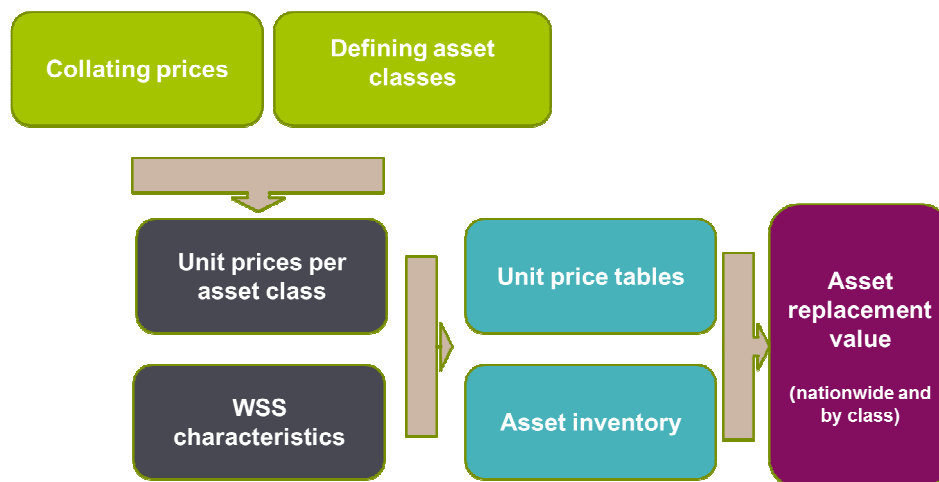


Figure 2 Approach developed to estimate asset replacement value

Results

Models to estimate total length

The main data used to calibrate the model are on one side geographical characteristics and length of 5,043 drinking water networks, and on the other side, geographical information relating to roads, land use type, dwellings, and population information, available in the form of GIS layers for the whole of France. Exploratory studies, carried out on WSSs for which a detailed GIS plan was available, showed a clear link between pipe network layouts and road layouts.

To account for the fact that some rural roads have no nearby pipes, we used a spatial processing method to include only sections of road located close to housing. Large-scale tests showed that the correlation between pipe length and road length is greatest when buffer areas are applied in a radius of 250m around each house (Figure 3).

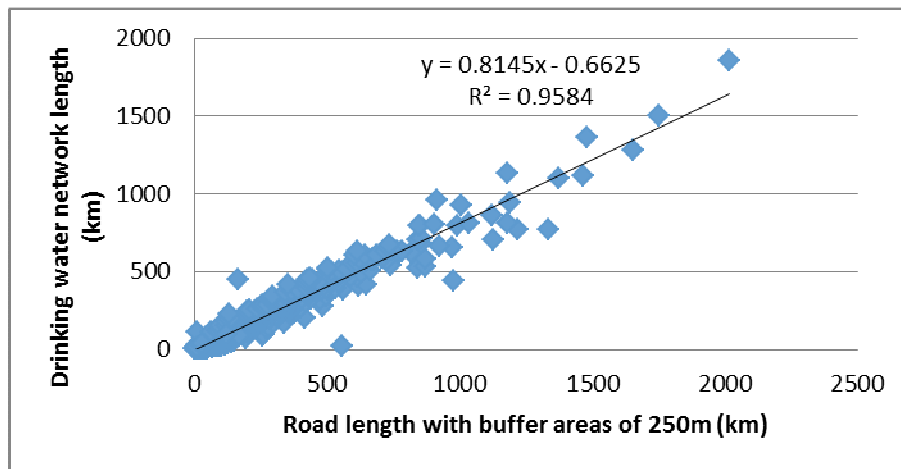


Figure 3 Water network length based on road length after processing (Han-Mui, 2016)

Following this, we created a number of multi-linear models, the accuracy of which was tested with the Monte Carlo method, using some of the available data for calibration and the rest for validation. The final models we selected use road length (corrected as mentioned above) population density, housing density, and inclusion in a particular watershed. Using this method, we estimate the total length of pipes in France to be 896,000 km (accurate to within 3%).

Extrapolation of costs and analysis of disparities between asset values

For the economic and financial part of our analysis, we use cost data (pipes, connections, fittings, ancillary costs such as pre-reception tests and project management, etc.) from the existing literature, as well as using information obtained directly from water suppliers. Based on this, we can create a table of unit prices by material type, diameter, connection density level, geographical area, and type of service. We then use the data in this table to carry out econometric analyses, allowing us to highlight correlations which can be used to create a typology.

The initial results show that our more refined method is an effective way to estimate the financial value of assets. They also highlight disparities between different geographical areas, particularly between urban and rural areas.

By comparing the time required to finance, from own resources, the capital tied up in assets and the price of drinking water, it is possible to examine the relevant scale

and means of financing drinking water asset management policies while ensuring good quality service for users at an acceptable price.

Conclusion and perspectives

Estimation of pipe length based on correlations with corrected road length has provided good results. Models of the same type are currently being developed which will use a sample of networks in different geographical areas to include material type, diameter, and installation period in estimations.

Our economic and financial approach allows us to create a typology of WSSs, as well as highlighting disparities between suppliers in their ability to finance pipe renewal at a price that is acceptable for users. Further work will involve applying the price table to estimations from the technical part of the model, allowing a calculation of network value and the finance required for renewal both at national and local level.

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