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Modelling Inter-relationships among water, governance, human development variables in developing countries with Bayesian networks.

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Improving Water and Sanitation Services (WSS), being a complex and interdisciplinary issue, passes through collaboration and coordination of different sectors (environment, health, economic activities, governance, and international cooperation). This inter-dependency has been recognised with the adoption of the "Integrated Water Resources Management" principles that push for the integration of these various dimensions involved in WSS delivery to ensure an efficient and sustainable management. The understanding of these interrelations appears as crucial for decision makers in the water sector in particular in developing countries where WSS still represent an important leverage for livelihood improvement.
In this framework, the Joint Research Centre of the European Commission has developed a coherent database (WatSan4Dev database) containing 29 indicators from environmental, socio-economic, governance and financial aid flows data focusing on developing countries (Celine et al, 2011 under publication).
The aim of this work is to model the WatSan4Dev dataset using probabilistic models to identify the key variables influencing or being influenced by the water supply and sanitation access levels. Bayesian Network Models are suitable to map the conditional dependencies between variables and also allows ordering variables by level of influence on the dependent variable. Separated models have been built for water supply and for sanitation because of different behaviour. The models are validated if complying with statistical criteria but either with scientific knowledge and literature.
A two steps approach has been adopted to build the structure of the model; Bayesian network is first built for each thematic cluster of variables (e.g governance, agricultural pressure, or human development) keeping a detailed level for interpretation later one. A global model is then built based on significant indicators of each cluster being previously modelled. The structure of the relationships between variable are set a priori according to literature and/or experience in the field (expert knowledge). The statistical validation is verified according to error rate of classification, and the significance of the variables. Sensibility analysis has also been performed to characterise the relative influence of every single variable in the model. Once validated, the models allow the estimation of impact of each variable on the behaviour of the water supply or sanitation providing an interesting mean to test scenarios and predict variables behaviours.
The choices made, methods and description of the various models, for each cluster as well as the global model for water supply and sanitation will be presented. Key results and interpretation of the relationships depicted by the models will be detailed during the conference.