Research Summary Sheet

Deliverable n°: 3.1 (T1.3)

"Computational Social Choice software programming and data analysis"

Context and Challenges

The **NoAW** project's goal is driven by a "near zero-waste" society requirement and focuses in the development of innovative efficient approaches that allow the conversion of growing agricultural waste issues into eco-efficient bio-based products. These approaches aim for direct benefits for the environment, the economy and the EU consumer. Nonetheless, one major challenge is the selection of these new waste valorization routes when the preferences of the stakeholders are taken into account. In order to achieve that, we refer to Computational Social Choice techniques and methods.

Results and Applications

Nowadays, there is an increasing demand for collective decision-making and aggregation of preferences by the members of our societies. In all cases, the individual agents, i.e., the involved stakeholders express their preferences, and the objective is to fairly aggregate them into a collective preference and thus obtain a decision which satisfies the group as a whole. This setting can directly apply also in the decision-making for agricultural problems, e.g., selecting new valorization routes for agro-waste management. The problem we are considering refers to decision-aiding in relation to valorization options for agricultural materials using Computational Social Choice and argumentation framework. We believe that by combining these two fields we can propose fair social decisions by taking into account the agents' preferences and the reasoning behind these preferences. Note that there has been significant research towards decision-making on both of these fields independently but not combined. Social choice theory has been integrated in the analysis of some popular aggregation methods in multi-criteria decision aiding, i.e., the ordinal methods are based on the Condorcet method, e.g., (Roy 1991), and the cardinal ones are based on the Borda method, e.g., (Von Winterfeldt & Edwards 1986). On the other hand, a seminal work towards the usage of AF in decision-making is the one by (Amgoud & Prade 2009) which proposes an abstract argumentation-based framework with a 2-step procedure where at first the arguments for beliefs and options, and the conflicts (inconsistencies) between them, are built and at the second step we have pairwise comparisons of the options using decision principles. The problem we are focusing on in this deliverable is the classical collective decision-making problem, where we have a set of alternative options A, and a set of agents N. Usually the set of agents corresponds to the set of the various stakeholders that are involved in the decision problem. Each agent expresses his/her preference over the alternative options by producing a linear order on them. We expand this classical collective decision-making problem by asking the agents to consider the reasoning behind the linear ordering of the alternatives. It is the reasoning behind the agents' preferences that is crucial to our analysis since we intend to present a decision-making procedure that takes into

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account both argumentation analysis and social choice. The deliverable describes in detail the design and implementation of a decision-making software tool which is being developed for the needs of the NoAW project. The goal of this software is to provide social choice functionalities and methods for the involved agents, in order to support the collective decision-making by taking into account their viewpoints and their justified preferences. Our objective is to provide a generic software for the reasoning and aggregation of the preferences that will be directly applied to the specific use-cases used in the NoAW project. Currently, our team (INRA), in collaboration with IFV and University of Montpellier, is designing a survey regarding possible valorization routes for viniculture and viticulture. In this survey, the involved stakeholders, e.g. winegrowers and technical centers, are called to express their preferences on different questions regarding current and future valorization routes/products used in viniculture and viticulture. The survey's input will be a really beneficial use-case for the application of our tool and the tool's computed collective preferences will hopefully help the decision-makers regarding new possible valorization routes. In order to demonstrate the functionality of our tool, we have applied the software procedure on an existing use-case which is extracted from a survey that was conducted for the needs of the FP7 Ecobiocap (ECOefficient BIOdegradable Composite Advanced Packaging) project. The use-case objective is to evaluate the interest of consumers in new-generation packaging made of agro-waste materials and hence, the decision problem includes aspects related to the agro-waste valorization questions but is not limited to them. However, note that this use-case is not restrictive on the applicative usage of the software as we are considering a more general framework for the abovementioned or other future possible applications that will appear inside the NoAW project.

Breakthroughs, benefits and added value

It is common that in most of these collective decision-making problems the preference aggregation is done using simple aggregation methods, such as the plurality voting rule, using tools that are not even intended to serve this purpose. For example, doodle is one of such unsuitable tool that is used for preference aggregation, while its original functionality was for scheduling joint activities. Therefore, we designed and implemented a procedure for supporting more complex collective decision-making problems, which can be directly applied to agricultural problems. The goal of this deliverable is to build a software tool for decision-making that takes into account theoretical insights from social choice in order to propose fair social decisions that take into account the preferences of the agents.

Further information on NoAW project: *http://noaw2020.eu*

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