Weights definition procedure for Sustainability Indicators in the Swine Supply Chain

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Abstract. **S**ustainability in swine supply chains needs to be evaluated by environmental, social and economic indicators. According [1] environmental performance indicators to evaluate soil, water, air, energy and environmental practices; social performance indicators related to human capital and social interaction; and economic performance indicators that address labor remuneration and return on investment. The performance of the swine supply chain companies from the three triple bottom-line (TBL) dimensions is significantly different, and with negative and positive impacts related to specific metrics. The economic dimension commonly presents a better performance than the environmental and social ones, in the most cases [2]. Because swine supply chains generate significant environmental impacts and must be measured and correctly managed, the weights definition (importance levels to the indicators) also represents a relevant task in this measurement [2]. According to the Bellagio Principles [5], economic, social and environmental metrics are fundamental in sustainability assessments [6]. Specific studies about soil analysis, energy production, including greenhouse gases and their waste [7], or the impacts of waste on the environment [4], reveal the need for integrated measures to assess the sustainability of pig production [8], considering environmental, economic, and social variables in order to improve sustainability in supply chains [9], and, particularly, in livestock supply chains [9,10]. Thus, both positive and negative impacts must be measured and analyzed in a multi-criteria analysis and terms of importance levels [8]. Furthermore, there is also a predominance of different levels of importance in the TBL dimensions and theirs respective indicators that should be considered. Particularly, environmental impacts from production and consumption of resources in the swine supply chain are mostly identified and affect households, firms, and society [3]. A summarized structure of the methodology used in this work and based on the dimensions and general indicators adapted from [1] is presented in sequence to demonstrate the relevant criteria (indicators), found in literature for assessment of swine supply chain. **Environmental Indicators** → GROUND: Soil Physical-Chemical Analysis, Soil conservation practices, Land occupation; → WATER: Source used for animal consumption, Facilities distance from the sources, Conscious use of water; → AIR Greenhouse gas emissions, Air quality; → ENERGY: Total energy use, Waste treatment; → ENVIRONMENTAL PRACTICES: Regularization, Animal Welfare. **Social Indicators** → HUMAN CAPITAL: Satisfaction with the countryside, Work System, Personal training and development; → SOCIAL INTERACTION: Quality of life, Social participation, Social programs, Perception of environmental impacts, Providers; **Economic indicators** → LABOR REMUNERATION: Labor remuneration value; → RETURN OF INVESTMENT: Return per housed pig, Net profit, Payback time. These indicators was grouped in this work in pairwise comparisons and analyzed by experts in order to define importance levels for criteria by AHP method application. The AHP method uses the Saaty´s scale [11] in which are attributed values of importance intensity in each criteria comparison (1 to 9). The inverse attributed value for the each comparison is

considered as ($\frac{1}{1}$ to $\frac{1}{9}$). Thus, with the application of this method is possible to recognize the relationships among criteria (indicators), in terms of importance levels, as well as among the global TBL dimensions. As each criteria or each indicator used in the assessment of swine supply chain needs to be evaluated in terms of importance level, based on the each specific application, it is important to construct a procedure to analyze the criteria weights in every case and based on the experts point of view. So, in this work we present a procedure and data comparisons between different cases of swine supply chain, with the analysis and definition of weights, which represents the level of importance of each criterion, using AHP method (Analytic Hierarchy Process) [11]. The AHP multi-criteria method is used in order to determine relationships among criteria and intensity level of importance by a matrix of pairwise comparisons. The applications, comparisons and a sensitivity analysis will be shown in the full paper in more detailed way. Some preliminary results can be highlighted, such as: the recognition of criteria with high relevance in one case and without relevance in another one. The results contribute to the assessment of the impacts of pig production and to the improvement of TBL criteria. Also, new multi-criteria approaches might be started with these presented results, like prioritization of environment, social or economic actions to attend the diversity of scenarios. The methodology, application and results will be presented as full paper in a future version, because it is not possible to submit now, according to the conference rules

Keywords: weights definition, sustainability indicators, triple bottom-line, swine supply chain.

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