# Prioritization of potential motivations affecting the adoption decision of a sustainable innovation involved in circular economy at the farm level: Catalonia case study.

Agricultural and livestock production has among its environmental challenges the reduction of greenhouse gases (GHG) and nutrient recovery. To achieve this, it must adopt new technologies and innovative solutions at the farm level that allow it to improve efficiency in the use of resources, as well as the recovery of nutrients within its food production systems, allowing it to reach sustainability. The adoption of innovations, in which circular economy actions are implemented such as the transformation of slurry into biofertilizers (**LL20 Low-temperature ammonium-stripping using vacuum–pig** slurry treatment**)**, allows for reducing GHG emissions and recovery of nutrients by improving efficiency in the use of resources and reducing the negative effect on the environment. Identifying the reasons, that drive farmers to decide to adopt a certain technological solution in which the principles of circularity are applied, contributes to the generation of action strategies that favor environmental conservation. That is why this study aims to identify and prioritize the main motivations that affect the adoption of circular agronomy solutions at the farm level by stakeholders of the productive part of the agri-food value chain including farmers, fertilizers' industries, agricultural-associated industries, and institutions involved in regulating the production aspects, using a semi-structured questionnaire in which the method of the AHP hierarchical analysis process is applied to a stakeholders focus groups. Obtained results showed that economic motivations receive the greatest importance for the adoption of innovation (43.2%), followed by environmental (32.4%) and social (24.4%). Being the reduction of costs one of the most important factors in the adoption of innovations (10%). Respect for environmental motivations that that innovation reduces the amount of slurry and manure is the main motivator of adoption (6.57%). The results of preferences on different reasons for adoption can help policymakers design specific measures and tools to help livestock producers address environmental challenges and increase their business opportunities.

**Keywords:** innovation adoption; productors' decision; AHP method; circular economy, farming.

**Introduction.** New technologies and innovative solutions that involve circularity principles have been developed in Agricultural and livestock production to enhance nutrient efficiency and reduce negative effects on the environment. The adoption of these more sustainable innovations is related to the stakeholders´ motivations according to the attitudinal models based on Theory of Reasoned Action and Theory of Planned Behavior. Agricultural and livestock productors decide to adopt an innovation if they rely on their implementation will help them achieve their goals, which may include economic, social, and environmental goals (Greiner et al., 2009). It is necessary that we know the motivations that influence to a greater extent the adoption of more sustainable practices, to help governments in the design of policies, efficient programs, that can affect the adoption of circular economy solutions for environmental conservation.

**Objectives.** The objective of this study is to identify and prioritize the main motivations of the stakeholders from the production side of the agri-food value chain, that are involved in the adoption of the circular agricultural solution at the farm level.

**Methodology.** The analysis of stakeholders' opinions and expectations regarding the adoption of the innovations identified as along the added value chain will be carried out through a qualitative approach by means of Focus groups method (FG). The FG method is defined as "a carefully planned series of discussions design to obtain perceptions on a defined area of interest in a permissive, nonthreatening environment" (Krueger y Casey, 2009). This technique allows to understand the origin and nature of a certain phenomenon, behavior, attitude, or belief. The focus group is characterized by homogeneity with a common interest, but with sufficient variation among participants to allow for contrasting opinions (Landeta et al, 2011). It is a structured variation of a small-group discussion that gathers information where **participants are asked** to **prioritize the ideas or suggestions** of all group members. The prioritization is focused on a set of potential **motivations affecting** the adoption decision of the proposed innovations at farm level. The **prioritization** of the potential motivations of adoption is assessed through the **Analytical Hierarchical Process** (AHP) technique. The AHP is a multi-criteria **decision-supporting method** in discrete environments that aims to decompose a complex decision in a hierarchy into smaller constituent sub-problems (Saaty, 2001). The AHP allows eliciting weights (w) (i.e. priorities) for each motivation of adoption in order to understand individuals' opinions regarding the adoption decision. The priorities (w), also known as relative importance are estimated for the factors' Categories ($C_n$) in the first level of the hierarchy where n is the number of the main categories (identified: Economic motivations, Environmental

motivations and Social motivations' category for adoption). On the lower level of the hierarchy, the relative importance of the factors ($L_{n.p}$) is estimated where p is the number of motivation factors within each category. In order to implement the AHP individuals were asked to make two types of pairwise comparisons: a) a pairwise comparison of the factors within each category; and b) a pairwise comparison of the factors' categories themselves, respondent has to indicate which of the two elements the respondent considers as important to the adoption decision at farm level using a nine-point scale to measure the strength of this importance (Appendix 1). In this context, the factors affecting the adoption decision of sustainable innovations that revalorize the manure and slurry and reduce emissions are presented in the Table 1. which are selected as the main drivers of adopting a sustainable innovation at the farm level.

Table 1: Motivations affecting the adoption of the sustainable innovation at farm level

| a) Economic motivations | b) Social motivations | c) Environmental motivations |
|---|---|---|
| 1. The adoption of the innovation is accompanied by **subsidies** | 1.The innovation will **create jobs** in the territory | 1.The innovation will improve the **compliance** with environmental **regulations** |
| 2.The innovation will **reduce** the **farm cost** | 2.The innovation will improve **working conditions** | 2.The innovation will **reduce** the farm's **water** use |
| 3.The **cost of the innovation** (Low initial investment) | 3.Improve my **market image** in society | 3.The innovation will reduce the farm's **energy consumption** |
| 4.The innovation will **increase** the farm's **productivity** | 4.Satisfy consumers' demand for more sustainable farming products | 4.The innovation will **reduce** the **amount** of slurry and manure |
| 5.Transmit the cost of the innovation to the sale price by **market labelling** | 5.The innovation will improve **work-life balance** | 5.The innovation will **reduce** farm's unpleasant **odours** |
| 6.The innovation is **not a financial risk** | 6.Feel accompanied (the innovation is **adopted** by **other** farmers) | 6.Replace **synthetic** fertilizers by **organic** one |

**Limitations.** The inclusion of a long list of factors (motivations) makes the list of pair comparations too extensive, making it more difficult to maintain the participant's attention and the consistency of their answers.

**Conclusions.** The choice priorities (w), known as the relative importance estimated for each motivational factor showed through the results, that the economic motivations received the highest importance related to the adoption of the proposed innovation, with a value of (43.22%) (on a scale up to 100%), followed by the environmental motivations with (32.39%) of the preference, positioning the social motivations at the end with (24.39%). Globally, the adoption decision at the farm level is mainly derived from economic motivations, being the farm cost reduction the major motivational factor that promotes the adoption of the proposed innovation, followed by a reduced cost of innovation implementation "low initial investment" and the third motivation that was more preferred correspond to the increase of farm's productivity whit a rate of preference of (10.06%, 9.1% and 7.9%) respectively. From environmental motivations the reduction of slurry and manure is the main motivator for the adoption of innovation with a global rate of (6.57%). And, although social motivations were the less important for the stakeholders from the production side, motivation identified as Feel accompanied "the innovation has been adopted by other farmers" obtaining (6.08%) of the global rate. This result highlights the importance of having a demonstration site of the innovation at the farm level where potential adopters can visit, ask and inform about results, advantages, and difficulties in the real context of adoption.

**Key References**


Greiner, R., Patterson, L., & Miller, O. (2009). Motivations, risk perceptions and adoption of conservation practices by farmers. *Agricultural systems*, *99*(2-3), 86-104.

Krueger, R.A. y Casey, M.A. (2009). Focups groups: A practical guide for applied research (4th edition). Thousand oaks, CA: Sage Publications.

Landeta J., Barrutia J. y Lertxundi A. (2011). Hybrid Delphi: A methodology to facilitate contribution from experts in professional contexts. Technological Forecasting and Social Change, Volume 78 (9). Pages. 1629-1641.

Bourlakis, Michael A., and Paul WH Weightman, eds. Food supply chain management. John Wiley & Sons, 2008

Saaty, T.L. (2001). Fundamentals of the analytic hierarchy process. In the Analytic Hierarchy Process in Natural Resource and Environmental Decision Making; Springer: Dordrecht, The Netherlands.

# Appendix

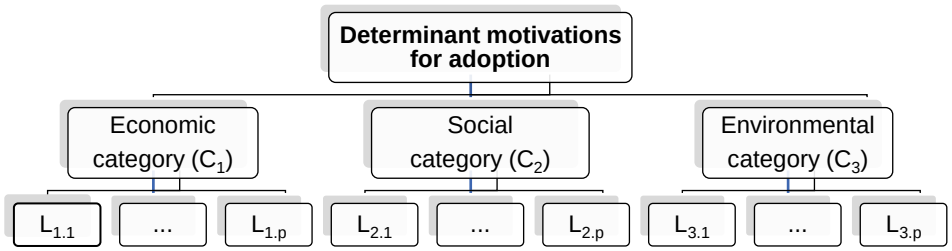


Figure 1: Hierarchical structure to prioritize the motivations of adoption

| Category / Factor | | | | | | | | | | | Category / Factor | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | |
| **More important** | | | | | | | | **Equal importance** | | | | | | | | | **More important** | |

Table 1: The pairwise comparison structure

Table 1: The AHP comparison scale

| Degree of importance rating | Definition of the scale |
|---|---|
| **1** | The two elements have **the same importance** |
| **2** | The first element has an importance between 1 and 3 against the compared element |
| **3** | The preferred element is **slightly** more important |
| **4** | The first element has an importance between 3 and 5 against the compared element |
| **5** | The preferred element is **moderately** more important |
| **6** | The first element has an importance between 5 and 7 against the compared element |
| **7** | The preferred element is **strongly** more important |
| **8** | The first element has an importance between 7 and 9 against compared element |
| **9** | The preferred element is **absolutely** more important |

Saaty Matrix structure for cluster 1 (economic category)

| | | **A1** | **A2** | **A3** | **A4** | **A5** | **A6** |
|---|---|---|---|---|---|---|---|
| 1. The adoption of the innovation is accompanied by **subsidies** | **A1** | **1** | A12 | A13 | A14 | A15 | A16 |
| 2.The innovation will **reduce** the **farm cost** | **A2** | | **1** | A23 | A24 | A25 | A26 |
| 3.The **cost of the innovation** (Low initial investment) | **A3** | | | **1** | A34 | A35 | A36 |
| 4.The innovation will **increase** the farm's **productivity** | **A4** | | | | **1** | A45 | A46 |
| 5.Transmit the cost of the innovation to the sale price by **market labelling** | **A5** | | | | | **1** | A56 |
| 6.The innovation is **not a financial risk** | **A6** | | | | | | **1** |

*Local (WL) and global weight (WG) relative importance of sustainable objectives*