

## Introduction

- Nitrates (NO<sub>3</sub><sup>-</sup>) and ammoniacal nitrogen (N) from agriculture are one of the main causes of water pollution in Portugal, by excess nutrients added to the soils, especially through manure applications as fertilizer (APA, 2017).
- Between 2009 and 2016, Baixo Mondego hydrographic region was the only one in Portugal in which the percentage of water bodies with mediocre state increased (20% to 23%; APA, 2017).
- Fertilizer application management is a way of reducing the amount of N applied and its losses, as well as increase the N use efficiency (Nicholson et al., 2013; Mamun et al., 2018).
- MANNER-NPK (MANure Nutrient Evaluation Routine) is a software developed in the UK that helps farmers to do the management of organic fertilizer applications (Nicholson et al., 2013).

## Objectives

The present study aims to assess the application of manure in different cultures in Baixo Mondego region, through the quick estimate of crop available N from organic manure applications, as well as their losses and efficiency. It is also a goal to compare the different crop characteristics and agriculture practices with the results.

## Material and Methods

The study area is Baixo Mondego region (2062 km<sup>2</sup>), which includes the downstream of Mondego catchment and a small part of the downstream of Vouga catchment (Figure 1). The agricultural land occupies about 30% of the total area, while urban and forest lands occupies 10% and 60%, respectively. There were analyzed 11 farms: 5 in a nitrate vulnerable zone (NVZ) and 6 upstream of the water extraction.

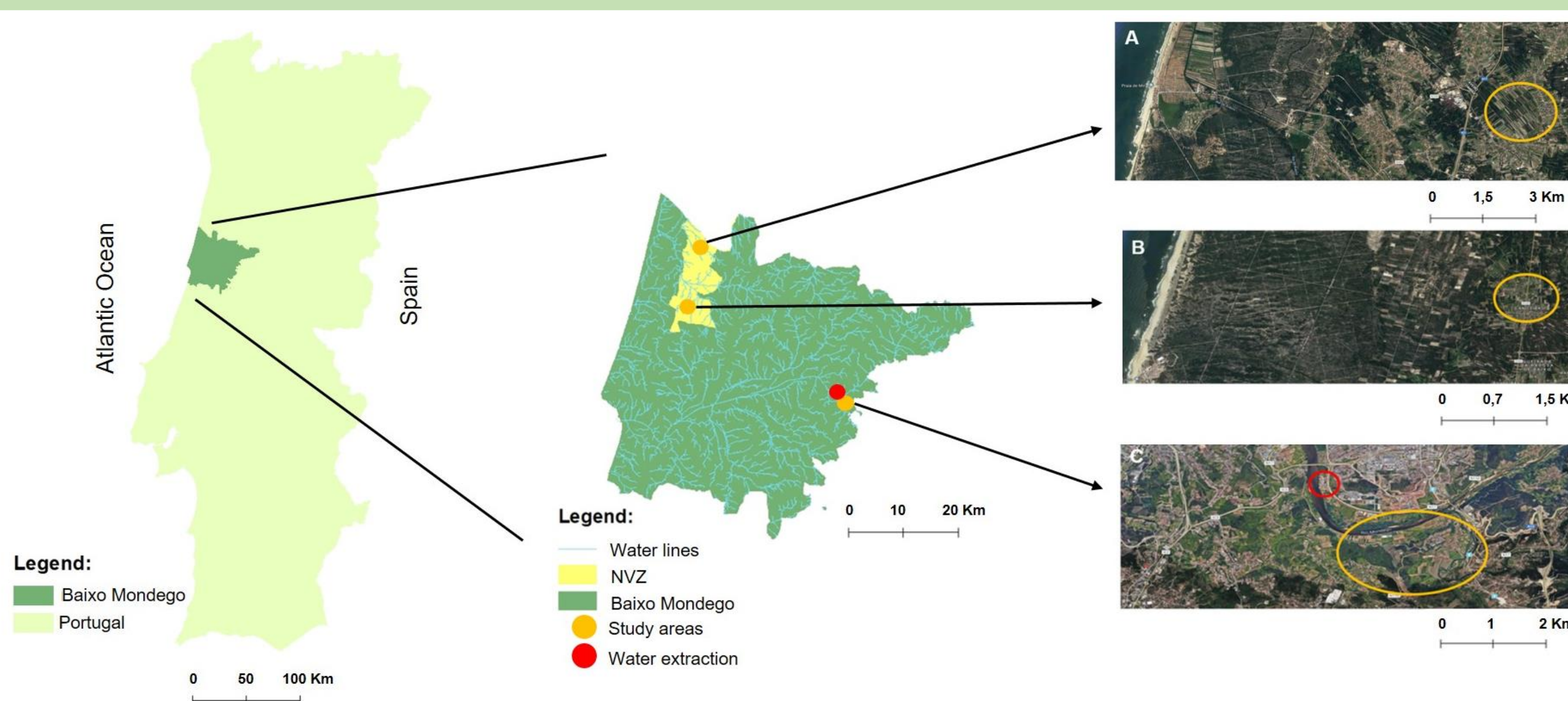


Figure 1 – Farms analyzed in Baixo Mondego region

There were analyzed 20 manure applications. To run the model (MANNER-NPK), it was introduced farm details, field details, manure application details and weather details (Nicholson et al., 2013). This information was obtained through: (1) farmers' questionnaire about their practices and (2) weather station information.

## Results

More than half of the analyzed farms (55%) do not obey the allowable N limit application (170kg / ha / year – DR n.º 201/1998). In case of NVZ, 44% of the analyzed farms do not obey this limit.

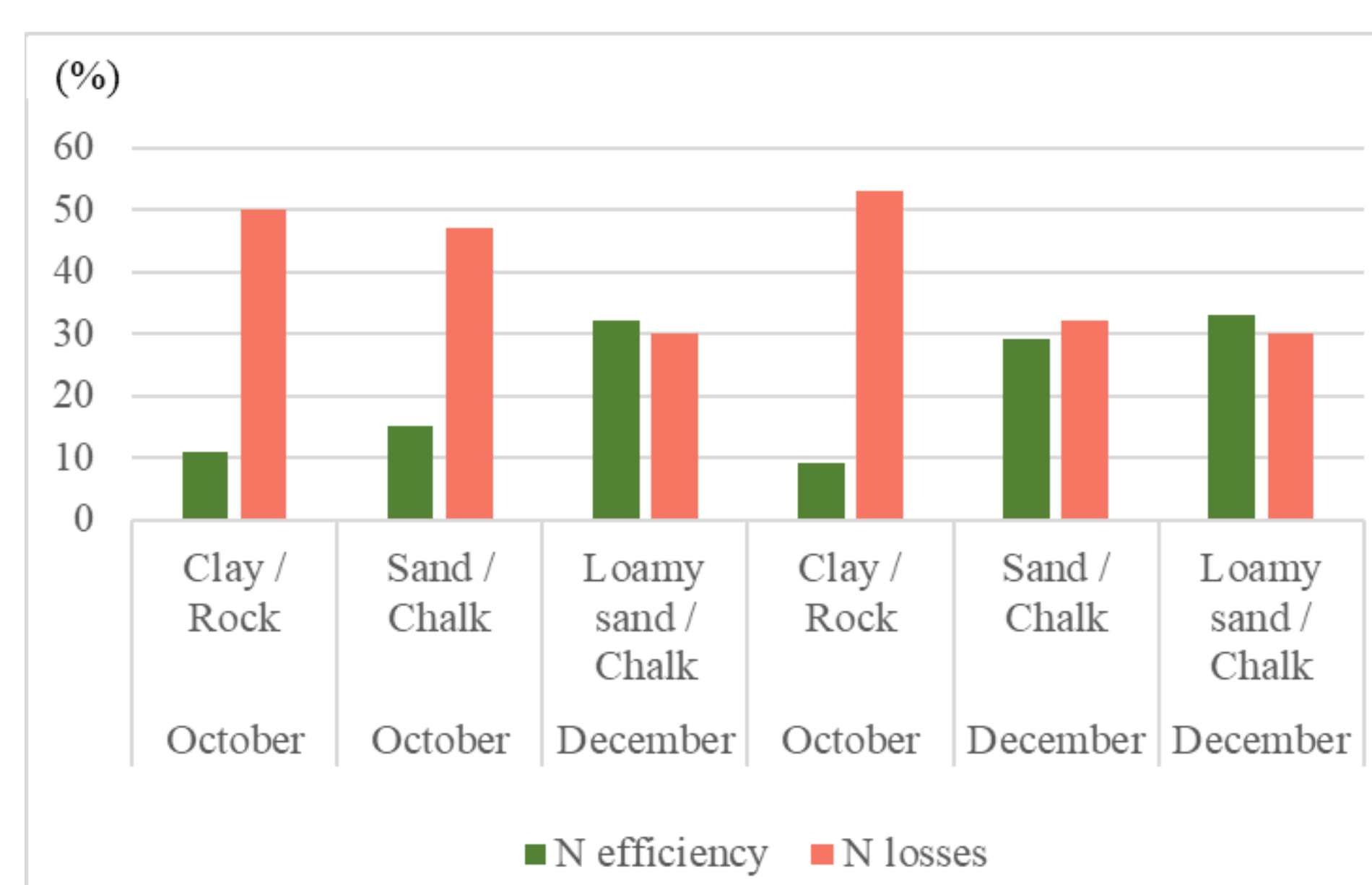
Generally, the N efficiency of the crops is low, varying between 3%-33%. The N losses varies between 0%-53% (Table 1). Layer manure and broiler/turkey litter have the greatest percentage of N efficiency and losses, despite the big differences. Green and food compost have the lowest percentage of these values (Table 1). The crops with the lowest N efficiency (3%) were winter cereals late sown with green compost application, being simultaneously the cases with the lowest N losses (0-3%). Cabbage had the highest N efficiency (33%) with layer manure application.

Cases analyzed	Type of manure	N efficiency	N losses
6	Layer manure	9%-33%	30%-53%
4	Broiler/turkey litter	12%-30%	21%-38%
1	Biosolids composted	14%	3%
2	Cattle FYM – fresh	10%	14%
1	Pig FYM – old	8%	9%
1	Horse FYM	7%	6%
1	Duck FYM (old)	7%	12%
1	Green / food compost	5%	0%-3%
3	Green compost	3%-5%	0%-3%

Table 1 – N efficiency and losses by type of manure

The highest N losses are by ammonia emission (40%-100%), followed by nitrate leaching (15%-60%) and denitrification (0%-10%).

In layer manure applications to cereals, potatoes and cabbage, the variability in N efficiency and losses is associated with different soil textures and application dates (Graphic 1). Sandy soils are associated with higher N efficiency and lower N losses, while the opposite happens with rocky soils. The farmers who applied manure in December had higher N efficiencies and fewer N losses than those who applied it in October.



Graphic 1 – N efficiency and losses by soil texture and manure application date in layer manure application cases

## Conclusions

- Most farmers analyzed in Baixo Mondego do not manage the application of N, which translates into non-compliance with the law (N limit application).
- N efficiency did not increase proportionally to the amount of N applied to the soil through fertilizer. The N efficiency depended on the month of fertilizer application and the soil type.
- Tools like MANNER-NPK are an easy way to help farmers to improve the management of organic fertilizer applications, in order to reduce the amount of nitrogen and nitrate lost to the environment, as well as improve the N efficiency of their farms. The results can be used in crop nutrient management plans.

## References

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## Agradecimentos/Acknowledgments

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