

INTRODUCTION

A nitrogen (N) footprint quantifies and connects N losses with consumption patterns. This concept emerged out of the necessity to communicate the importance and the negative effects of N to the general public (N-Print, 2021). Portugal's cultural practices include a serial of habits which are accounted in the N footprint (NF), in particular, food production and consumption and energy costs for housing and transports. Agriculture is the main source of reactive N (Nr) emissions to the global environment – followed by burning of fossil fuels - where beef and dairy products are responsible for 56% of Nr emissions in Europe (nitrogen on the table, Sutton et al). Regardless, although Portugal is a Mediterranean country, the typical Mediterranean diet is not usually followed. In the actual diet, Portuguese daily protein consumption is 120 g/cap (19.2 g N/cap/day). Although the recommended dose for an average sedentary adult is, roughly, 50 g/cap/day (8 g N/cap/day) (IOM, 2005). The main reason for this excess is due to the high animal protein based meals in Portugal.

METHODS

For this study, Leach et al. (2012) approach was used to estimate the NF for Portugal. The total NF takes into consideration the footprints from energy consumption (housing and transport) and food consumption and production. To assess the NF from food consumption it was assumed that all N consumed is excreted and released into the environment as human waste since the average adult does not incorporate N as muscle mass. A weighted average approach was used to assess the N removal from wastewater treatments. For food production NF the concept of Virtual Nitrogen Factor (VNF) was used, where all Nr losses are accounted from the initial nitrogen input as fertilizer. The VNF represent the amount of Nr loss to the environment per N consumption.

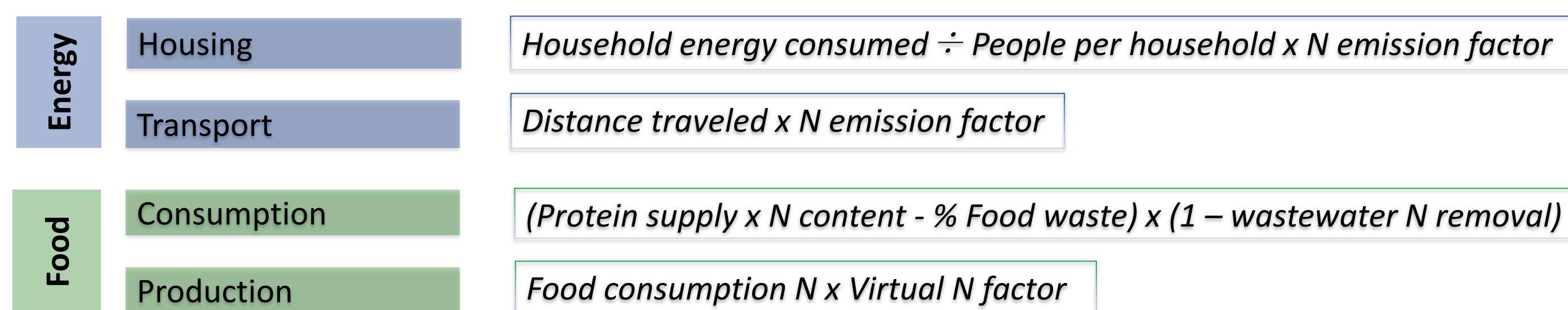


Fig 1. Nitrogen Footprint based model

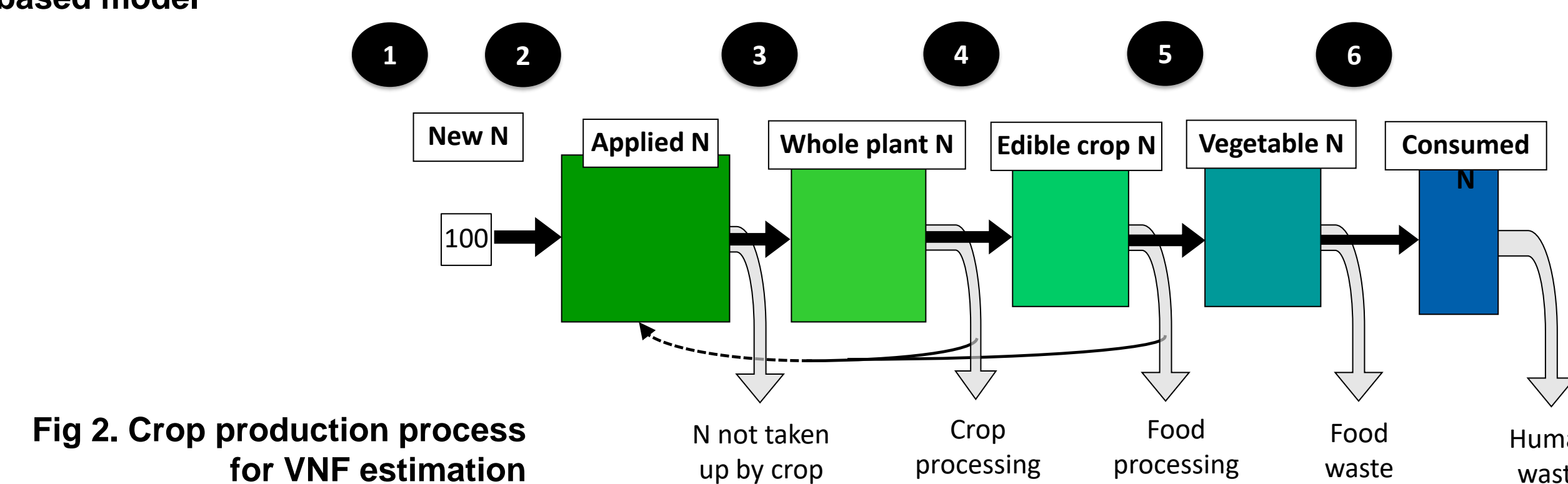


Fig 2. Crop production process for VNF estimation

RESULTS

The N footprint in Portugal is overall 25.1 kg N cap⁻¹ yr⁻¹ for the last year of available data (2018). Around 80% of the total footprint is from food production, followed by food consumption. The products with a higher contribution to these results are beef, pork and vegetables which release into the environment 12.1, 9.9 and 8.8 g of N per g of N consumed, respectively. Preliminary estimations allowed us to highlight that, by following the food wheel for Mediterranean dietary recommendations and decreasing the daily protein intake, food consumption and production NF can obtain a reduction of 44% and 30%, respectively.

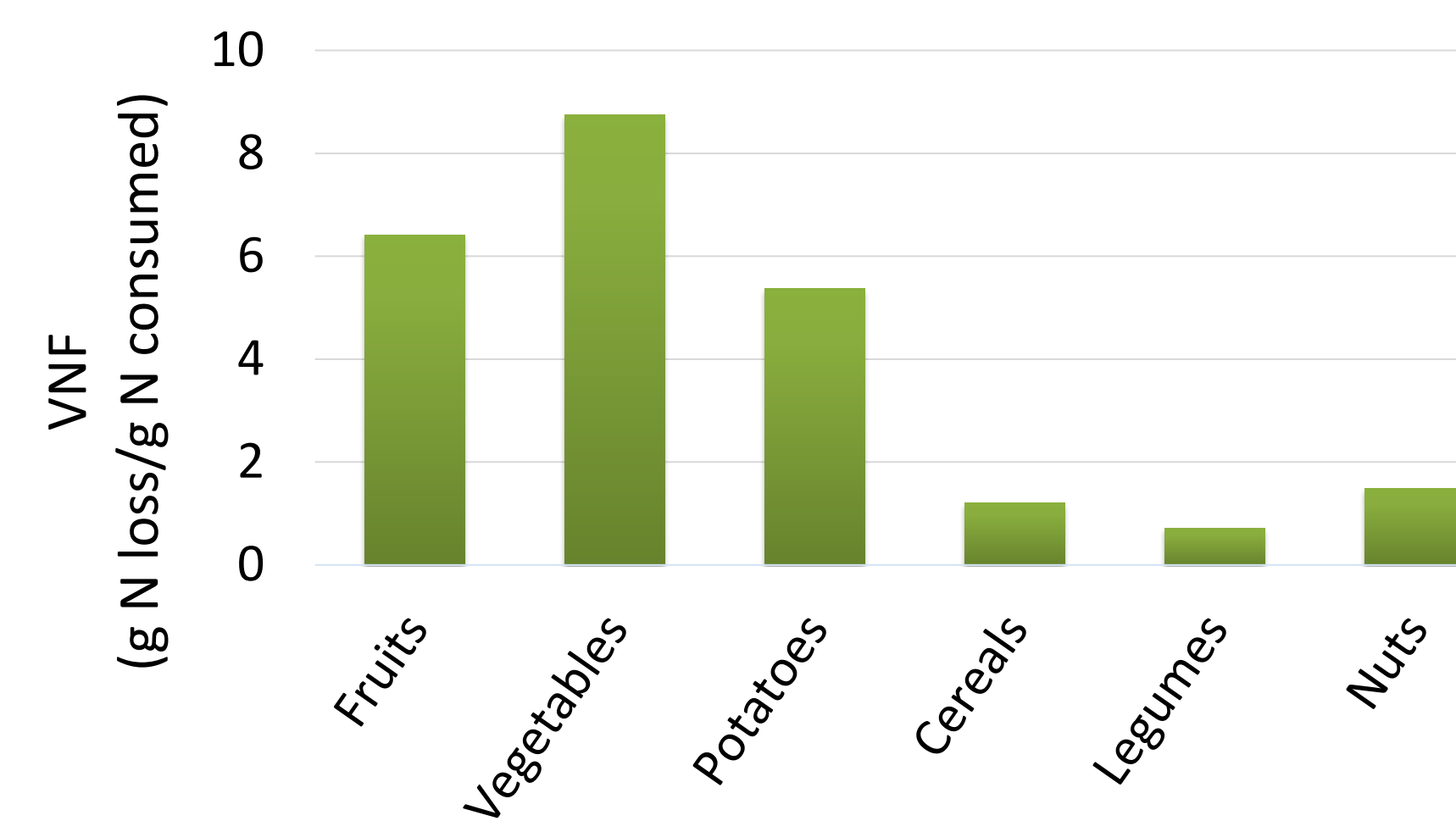


Figure 3. VNF for plant based products

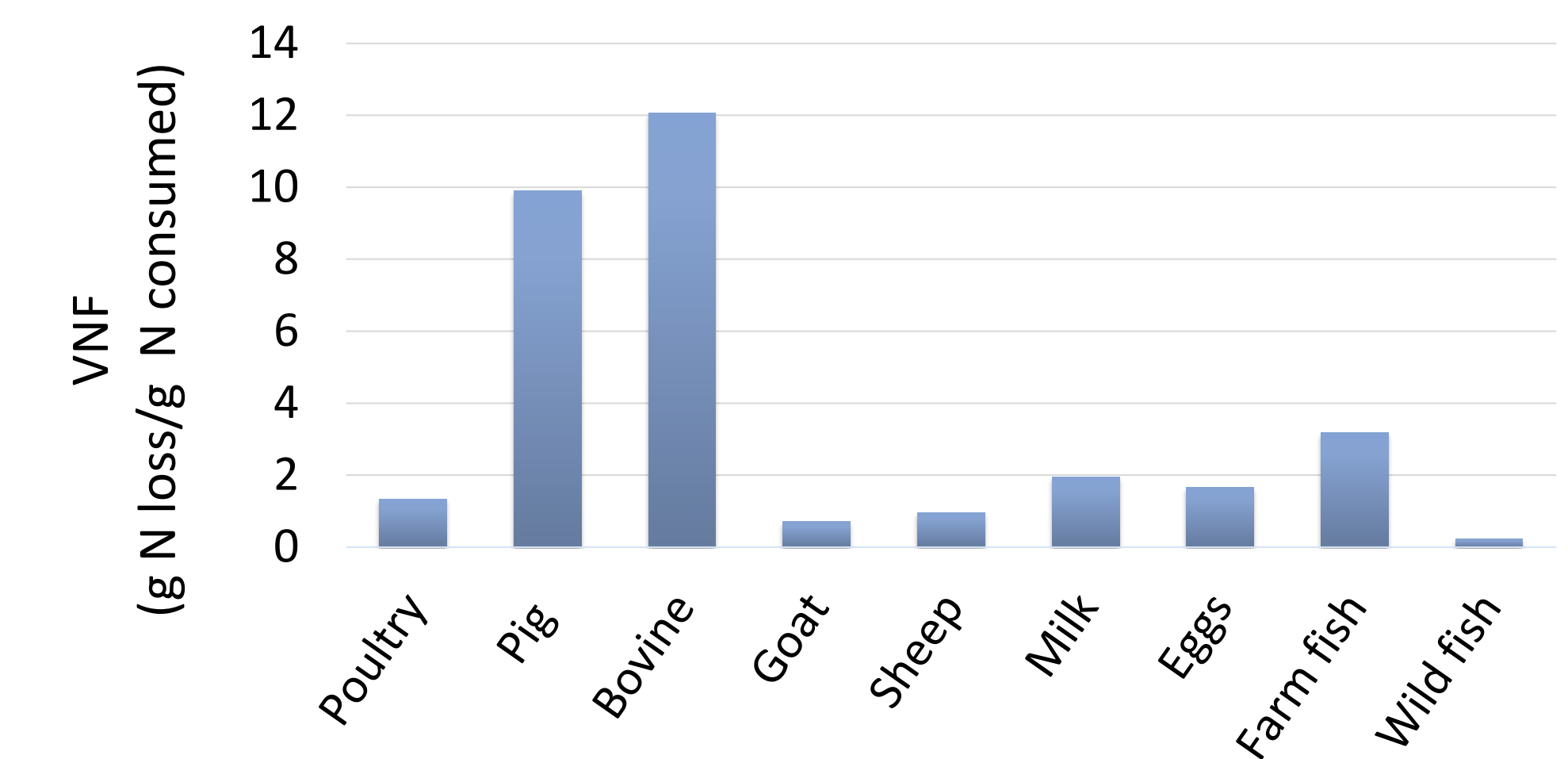


Fig 4. VNF for animal based products

CONCLUSIONS

- Food production is the main contributor sector for the total N-Footprint in Portugal, in particular for animal based products, followed by food consumption.
- Mediterranean diet has the potential to help mitigate N losses into the environment.
- Mediterranean diet can reduce the impact on the final N footprint, especially by favouring the consumption of fish over meat and increasing the consumption of plant based proteins.

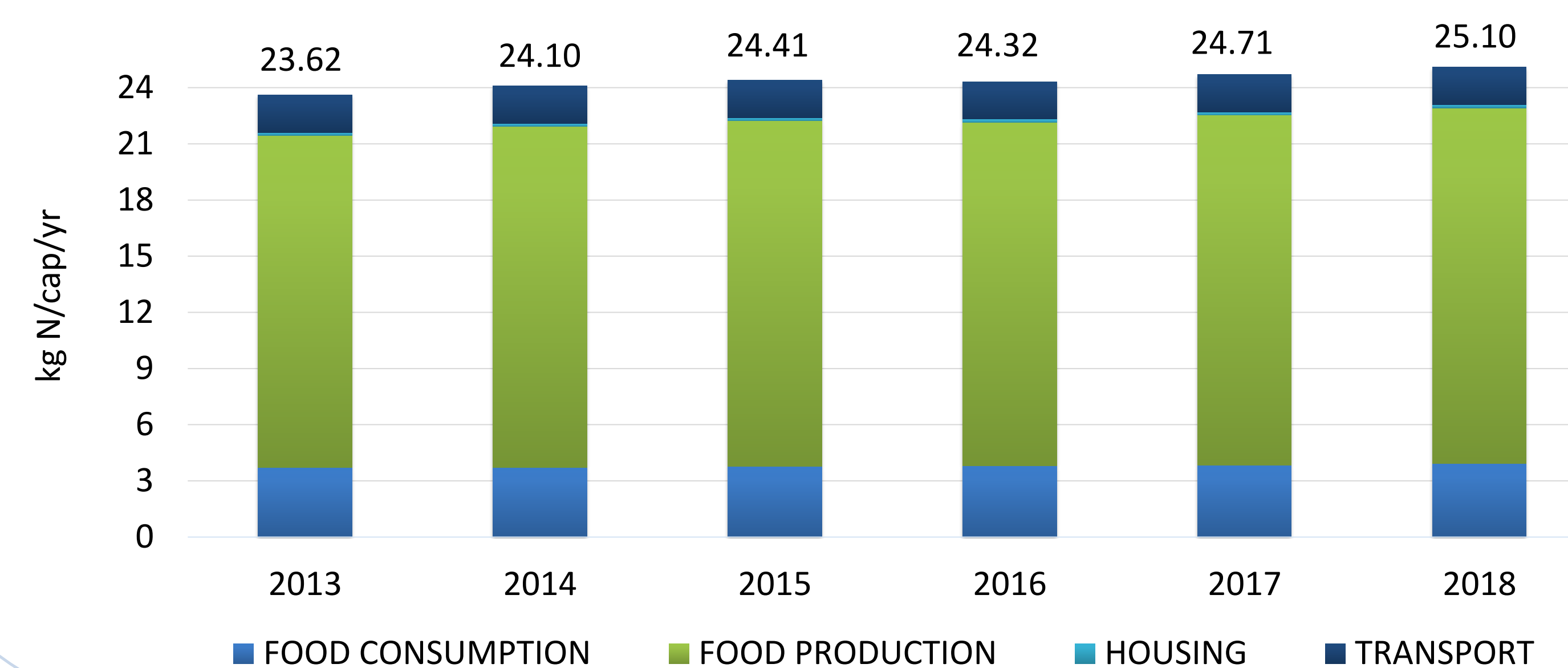


Fig 5. Total Nitrogen footprint of Portugal per sector (2013-2018)

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