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The role of alfalfa in the transition to organic rice production on farms in Camargue, France

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In *Camargue* (France), the development of organic rice production started in the 1990s. The area of rice under organic farming has increased rapidly, from 11% of rice areas to 25% between the years 2015 and 2020 (Mouret, 2018; Agreste 2020). This increase corresponds to the transition of many farms in *Camargue*, on the order of 90. In the same time, farmers diversified their cropping systems and extended the length of their crop rotations. Some authors reported that the introduction of forage crops, such as alfalfa (*Medicago sativa*) in particular, is a favourable factor for the transition to organic farming. They also focus on the interest of livestock, fed with these forages, to enable the transition (Delmotte et al., 2018). We distinguish two processes in this notion of transition. The first concerns the conversion to organic farming, requiring 3 years for the lands and 6 months for the herds. The second concerns the evolution of cropping systems after the conversion. *Camargue* farmers are actually experimenting with different cropping systems, introducing new crops such as rapeseed, lentils or open-field market gardening (melon, tomato), as well as intercrops for green manuring, which can also be used to feed livestock. The purpose of this communication is to show the roles of forage crops in the transitions. How did the farmers convert their farm to organic farming? What cropping systems did they developed to produce rice in organic farming? What were the interests and constraints of alfalfa in these transition processes?

To study the transitions, we used a case study database comprising 42 farms, 24 of which switched to organic farming. We built this database from a training action with Master 2 level students (Michel et al., 2018) between the years 2010 and 2023. The students questioned the farmers about the history of their farms, since their installations or their arrivals on the farm as crop manager. The work was carried out several times, a few years apart, on the same farm, which made it possible to consolidate and complete the history of the farms, and analyse their evolutions. From the account of the history of his exploitation by a farmer, the students represented the farm trajectory in the form of a succession of stable periods, presenting a coherence of operation, and periods of change (Moulin et al., 2008).

From the 24 individual trajectories with a transition to organic rice production, we identified four types of transition. They differ according to farm type (cultivated area, location, soil types,

degree of original rice specialization, presence or absence of livestock, farm history). They differ according to the degree of conversion to organic farming (on all plots or only part) and the organic cropping systems implemented. All conversion trajectories include alfalfa cultivation. Whether alfalfa is subsequently retained in stabilized organic rotations depends on the situation. Our results show the agronomic benefits of alfalfa for the 3-year conversion period, and then for the construction of organic rotations including rice. But we also show limitations of alfalfa, such as its incompatibility with the lowlands, floodable in winter and prone to salinization. Another constraint is the problem of harvesting and marketing alfalfa for farms without livestock. Growers adopt a variety of strategies, including contractual agreements with livestock farmers who buy alfalfa from them on the hoof and take care of harvesting in the form of grazing and/or mowing, bringing their own equipment. Others are shortening the alfalfa's lifespan (1 to 2 years), and testing alfalfa/cereal combinations to boost gross margin per hectare. Mixed crop-livestock farmers, for their part, use the alfalfa via their animals, and supplement this with forage intercropping, including grazed regrowth after watering, which further diversifies organic rice cropping systems. Some go so far as to use their equipment and know-how to provide alfalfa harvesting services to growers. For these two types of farms, growers and agri-breeders, with large cultivated areas (between 150 and 500 ha), the conversion to organic often concerns only part of their plots, particularly those on the uplands. Some smaller growers (less than 120 ha), located on the uplands, after a full organic conversion, introduce a livestock unit on their farm, valorizing alfalfa and other forage crops, or stop growing them in favor of a diversity of crops including grain legumes. Growing small areas of organic rice, they are improving the value of their produce through on-farm processing and short sales, or through seed production. As for historic cattle farmers, while they were often pioneers in converting to organic farming in their entirety, they are tending to significantly reduce the area under organic rice in favor of developing permanent grassland on lowlands. Some maintain organic rotations alternating rice and temporary meadows (including alfalfa) on the uplands, but may even delegate the cultivation of organic rice to neighboring growers. Converting to organic rice in Camargue has therefore been facilitated by the introduction of alfalfa. Thanks to the creation of exchange contracts between growers and breeders, it benefits a wide range of farms.

Key words: Livestock-crop interactions, cropping systems, farmers' trajectories, socio-economic factors

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