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## FARM BUILDINGS AS DRIVERS OF THE RURAL ENVIRONMENT: A LITERATURE REVIEW

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**Abstract.** *Farm buildings play a central role for the sustainability of the rural environment. Conceived to host biological production, the farm building constitutes indeed a unique example in the wide epistemological sector of building construction, due to its architectural and technical issues, different from other building sectors. The originality of what happens inside the farm building corresponds to what happens outside. The role that buildings have historically played is strictly connected indeed to the surrounding context, due to the need of the farmer to live in close contact with agricultural land and animal husbandry. In this way, human activities have often strongly influenced the agricultural environment and the visual perception of its landscape. The increasing sensitivity about the concept of sustainable development of the built environment is currently stimulating the valorisation of farm buildings, as well as the assessment of their impact on the rural landscape. In the present article, a general literature review about the role that farm buildings play on the rural environment is presented, with a special focus on the wider opportunities enabled by the implementation of new technologies for the survey, analysis and planning of the interactions among farm buildings, rural environment and landscape.*

**Key words:** *Farm buildings; Rural environment; Cultural landscapes; Built heritage; Geographical Information System; Spatial analysis.*

### 1. INTRODUCTION

Rural heritage is a very important aspect of one Country's identity. Agricultural fields, orchards, natural places are landmarks that connect generations and city dwellers to their origins. Families trace their roots to rural villages, while culinary traditions begin in the countryside. The spirit of a community is a combination of many seemingly unconnected elements: buildings, objects, natural landscapes and traditions. Traditions or

'*intangible heritage*' are often the strongest link between places, people and generations. Preserving a way of life and the identity of a community is more important than preserving only its physical form. Living, vibrant communities give meaning to their surroundings and create a sustainable environment for preserving culture.

Very often this intangible heritage is the most fragile and difficult to sustain. Without it, places lose their meaning, the natural environment is subjected to degradation, and connections within the community and with nearby communities sharing similar traditions are lost. Unfortunately, rural communities everywhere are currently susceptible to long slow declines, if agriculture is no longer economically viable and younger generations move to cities in search of more attractive opportunities. In rural communities this phenomenon has been accelerating in recent decades indeed, as transportation becomes easier and less expensive, urban areas offer better opportunities and globalization reaches every corner.

Most rural areas have unused or abandoned structures that could serve as places to stimulate the education and culture of their communities. The characteristic appearance of natural and cultural landscapes in rural areas is shaped by the traditional building culture of the specific region. However, the traditional building styles are often no longer respected by modern, rapid, featureless construction techniques and materials. Therefore, the characteristic appearance of rural environment and landscape is under serious threat there. The responsible building authorities at local level often lack the capacity and expert knowledge to ensure certain quality standards in planning and construction of new buildings, as well as in the reconstruction or revitalization of existing buildings. New strategies have to be found to raise the awareness of these officials and the local population, to ensure respect for traditional buildings and the landscape, as well as to advise persons requesting a building permit.

The rural built heritage is in a constant state of change. Agricultural fields are abandoned or aggregated, traditions and customs evolve or are forgotten, farm buildings are demolished or adapted to new uses, the whole tangible heritage decay. Decay starts the day after restoration. Most damages are small at first and easy to repair if noticed. However, small damages grow rapidly if no measures are taken. Consequences can be severe, such as the loss of historical value, high costs of restoration and even loss of the building. Yearly visual, non-destructive inspections and immediate repair of small-scale damage have proven to reduce restoration costs and risk of damage caused, for example, by neglect or fire. Half of the activity of the construction industry is spent on repairing and maintaining existing heritage. To successfully carry out preventive maintenance, suitable information and data are needed, while specific analysis targeted to the preservation of the rural built heritage are necessary.

In the present paper, a review on current achievements in the scientific literature about the connections between farm buildings and the rural environment is presented. Special attention has been devoted to define the main components of rural building, *i.e.*: construction materials and techniques; typological characteristics; settlement development. The relevant impact on the surrounding rural environment may be therefore assessed, even with the aim to implement new technological tools able to support policy makers and rural planners in surveying, analyzing and planning the rural landscape in all its components of the total environment.

## 2. FARM BUILDING FEATURES

Farm buildings, designed over the centuries to perform their primary agricultural function, have marked the surrounding environment in a distinctive way, playing a central role in the sustainability of the rural environment. Designed to house organic production, the agricultural building is truly a unique example in the vast epistemological sector of construction. The birth, growth and development of living plant and animal organisms contained in these volumes raise indeed architectural and technical problems which are deeply different, when compared to those of other building sectors. Designed to produce optimal environmental conditions for plants and animals, while protecting health and safety of workers involved in daily operations for the care of living organisms at different stages of their development, the rural building is therefore a unique technological model [1].

Furthermore, these buildings express a widespread heritage that in some cases has an irreplaceable architectural value thanks to their past, being in many Countries even more than centenary. Farm buildings are currently registering a renovated interest too, often even pushed by the recent expansion of rural tourism registered in Europe as well as in other Countries in the World [2, 3]. This makes it necessary to monitor farm buildings, both to preserve them as historical and cultural heritage and to re-develop in the perspective of sustainable tourism planning [4, 5].

According to Ruda [6], the rural environment includes three components. They are: the land for agricultural production; the natural surroundings and human settlements; the architectural area. Human, natural and architectural environment co-exist and interact among themselves, so contemporary projects should preserve and reconstruct the essence of tradition. The main characteristics of farm buildings, which make them different from other examples of constructions, have been analysed by several Authors, who have focused their analysis mostly on three main aspects, *i.e.*: building materials and techniques; typological characteristics; settlement formation.

The valorization of locally available building material, used in agriculture for the realization of constructions, both for housing purpose and for the realization of each single element within the farm, is one of the main characteristics which differentiate farm buildings from other construction typologies [1, 7]. This choice, that was at the time one of the pillars at the base of the formation of rural landscape, has its roots in the tradition left by our forefathers, since they had no choice than realize farm buildings and ancillary elements using the local material. Indeed, even if traditionally based mostly on an economic reason, this has very interesting consequences on the current perception of the rural landscape - since the colour of the building is similar to the surroundings [8, 9] - as well on the agricultural environment – this material being able to be incorporated, at the end of its useful life, in the same context.

The typological characteristics of popular architecture, mostly when applied in rural areas, have been historically influenced by the need to design buildings in close relationship to their usefulness as a barrier against the climate. This has been a fundamental parameter, since builders have had few technical resources, and the research of natural solutions has paid an enhanced attention to the interaction of form and energy, leading to a “bioclimatic” approach in vernacular rural building techniques. Bioclimatism

has been therefore one of the most common way for searching solutions able to maximize the exploitation of natural sources of energy – for heating, ventilation, *etc.* – leading to the creation of a well-identified scientific sector, which has recently experienced a renewed attention by several scientists [10, 11]. In some cases [12] bioclimatic architecture was also proposed as a new model for recovery vernacular construction.

Vernacular architecture in rural areas has involved the design of traditional-functional buildings for housing owners and/or their workers [13, 14]. In figure 1 it is reported the façade of two centenary vernacular farm buildings (so-called: "*masserie*"), located in the Basilicata region (southern Italy), having a cultural interest and protected by specific regulations, surveyed through terrestrial photogrammetric techniques [15].



Fig. 1 Façades of *masserie* located in the Basilicata region (southern Italy), surveyed through terrestrial photogrammetric techniques [15].

Other different examples of vernacular farm buildings have been also analyzed with reference to their typological characteristics and architectural solutions, as those for protecting animals in stone-fenced corrals [16] or for agro-industrial production, as flour

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mills [17, 18], wineries [19], *etc.* In figure 2, some centenary flour mills located in the Apulia region (Southern Italy) are showed.

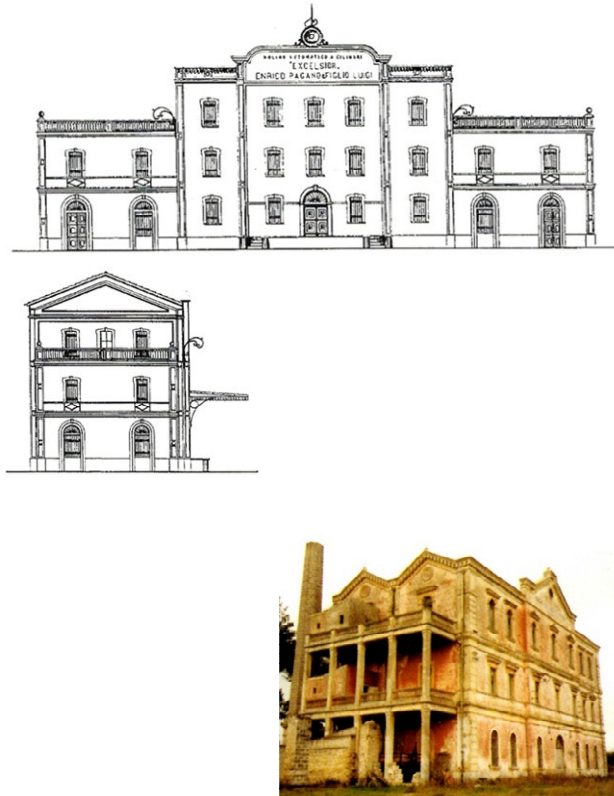


Fig. 2 Centenary flour mills located in Apulia region (Southern Italy).

The formation of human settlement in rural areas has been affected by the particular vocation of rural activities as well, including in a holistic approach the role of the surrounding environment [20, 21, 22]. The settlement dynamics are especially interesting, having played an important role. Several traces of extinct settlements and their access routes are usually still visible in many today's European landscapes. Some specific analyzes have been conducted to assess how the colonization, occurred at large scale during the past centuries, has contributed to shape the image currently perceived from a landscape, evaluating the impact on rural environment of different settlement patterns and relevant accessibility routes [23, 24].

### 3. FARM BUILDINGS AS DRIVERS OF THE RURAL ENVIRONMENT

The originality of what happens inside the farm building corresponds to what happens outside of it. The role that these buildings have historically played is strictly connected indeed with the surrounding context, due to the need of the farmer to live in close contact with agricultural land and animal husbandry [1]. While the organization of human beings involved in the activities of the industrial or tertiary sector allowed aggregation in urban centres, the need to live in constant contact with the agricultural production developed a synergetic function of close proximity to the extra-urban land [25, 26]. This aspect led to the spread in rural areas of many examples of buildings that served for farming, storage and processing of agricultural products, while constituting, at the same time, housing for the farmer and his family. This form of settlement has been - and still is - a unique way by which humans have populated, in harmony with the natural elements, the agricultural territory, joining the primary production needed for human nutrition with the control and care of rural land. So, the activities made by the Man have often strongly influenced the agricultural environment and the visual perception of its landscape [27, 28].

The stratification during time of the interactions among all the components of the total environment - *i.e.*: atmosphere, hydrosphere, biosphere, lithosphere and anthroposphere - is the driver of the formation of the landscape of a given territory [29]. Anthroposphere plays a pivotal role, because it strongly influences - being influenced in turn - the other natural components. The environmental changes occurred during the last decades, mainly caused by human activities and changes in land use, have been dynamic, since they "evolved" considering the needs and the socio-economic conditions, being influenced by the natural forces and continuous interactions with the surrounding context as well. Under this approach, a rural landscape may be defined as the "*System of many concurrent ecosystems, in a mutual correlation with human activities*". It is indeed the holistic result of the evolution of free natural elements and relevant human dynamics of land use, land management practices, agricultural policies and socio-economic modifications imposed by the populations living there.

A growing interest is currently registered towards the ecological effects of the farm buildings on the rural environment, then on the importance of applying a sustainable rural development strategy to improve the protection of habitats and ecosystem services [30, 31, 32]. As reported by Haller & Bender [22], there is a strong link between biodiversity and conservation/restoration of grassland, which necessarily passes through the preservation of the rural built heritage. This is especially true for some Natura2000 priority habitats, such as the semi-natural dry grasslands code 6210 [33, 34]. Monitoring farm buildings and rural environment, considering the multidisciplinary and the spatial component of the information, requires therefore a suitable approach, now possible through the use of new geographic technologies [35, 36, 37].

### 4. ADVANCED ANALYSIS OF FARM BUILDINGS AND RURAL ENVIRONMENT

Several studies have analyzed the potential of advanced tools applied to the analysis of the mutual interactions between farm buildings and the surrounding rural environment. Most of them are based on the implementation of Geographical Information System

(GIS), able to include and link all the information related to the farm buildings. In this way, it has been possible to connect different datasets coming from both field survey (measuring, photographic report, field databases) and spatial analysis work (studies on land use and surrounding landscape, socio-economic analysis, viewshed analysis, index creation) so as to create a single GIS-based model of farm buildings [38, 39, 40]. This database model can be exploited for several purposes, *e.g.*: planning and management; protection and conservation of the built rural heritage; valorisation of the existing farm buildings; strategic decision on the localization of new farm buildings; implementing and monitoring concrete valorisation actions [41, 42].

The potentiality of a GIS applied to the monitoring, preservation and enhancement of the rural heritage of one southern Italian region, *i.e.*: the Basilicata region, has been recently explored [43]. After the creation of a preliminary geo-database of rural buildings and spatial data related to the rural landscape, two methodologies have been implemented: the first one was aimed to evaluate the role and impact of the rural buildings in the conservation of semi-natural environments of the surrounding context; the second one has been focused on the assessment of the safeguarding of the visual quality of the rural landscape, through an inter-visibility assessment of rural buildings.

Other studies [44] have employed a methodology combined with a *Multi-Criteria Decision Analysis* (MCDA), which borrows GIS capabilities to evaluate the suitability of one region, in order to optimally chose the locations of new agro-tourism building. More recently, a web-based Multi-Criteria Spatial Decision Support System (MC-SDSS) has been developed, validating it to assess the suitability of new rural tourism buildings integration occurred in some Spanish landscapes [45]. Other Authors have used the *Analytic Network Process and Dominance-based Rough Set Approach* for the sustainable requalification of traditional farm buildings in Southern Italy [46].

Finally, the analysis of geographical information derived from historical maps within a GIS has proved to be a very powerful tool for a better-informed decision-making and management of the farm building heritage in the context of the surrounding rural environment [29, 47]. Three-dimensional reconstruction during different time periods (figure 3) obtained through Digital Terrain Models (DTM) have so enabled to highlight the role of farm buildings, as well as to evaluate the land cover changes, demonstrating how these latter have affected the quality of the forest ecosystem in the area. The final results obtained comparing historical documents and current maps, enabled the evaluation of the multi-temporal, morphological and vegetation variations in this rural landscape [48].

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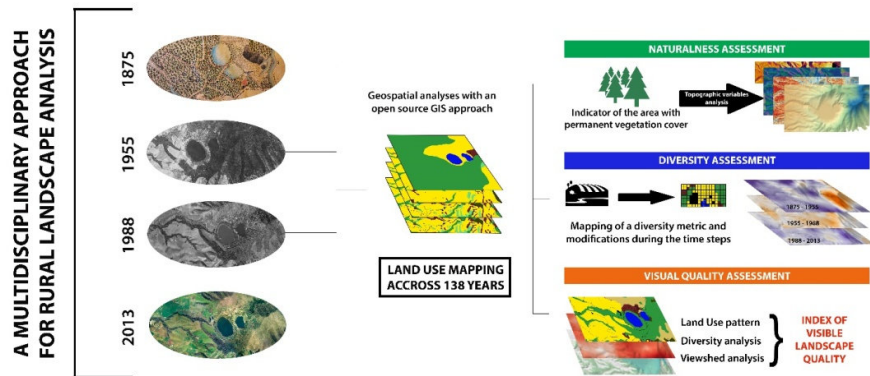


Fig. 3 Implementing historical maps into a GIS for rural landscape analysis [29].

## 5. CONCLUSIONS

The main results coming from the scientific analyzes which have been conducted so far would be the basis for a valorisation of farm buildings in the context of their surrounding rural environment. The relevant competences should be addressed through the development in:

- ) Education: an increase in the level of scientific knowledge, competences and skills for students, expert practitioners and other stakeholders in the management of rural development, in respect of the preservation/valorisation of the rural built heritage;

- ) Research: stimulation actions, aimed to support researchers in completing and deepening their knowledge and scientific activities, based on the use of cutting-edge tools (ICT; IoT; etc.) supporting preservation and valorisation of rural built heritage;

- ) Dissemination & Exploitation: new actions aimed to valorise the results of the activities involving every kind of stakeholder belonging to the *Quadruple Helix*, i.e.: a) Public Institutions (Ministries; Regional/local Authorities; Development Agencies; etc.); b) RTD performers (Universities; Public/private research centers; Technological Parks; etc.); c) Private companies (Industries; SMEs; farmers; relevant associations; etc.); d) Civil society (NGOs; Citizen associations; etc.).

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