

WOOL, “RIFIUTOCREATURA” IN EVOLUTION

VALORIZATION AND REGENERATION OF ITALIAN NATIVE WOOL AND POST- CONSUMER WASTE

GIANNI MONTAGNA

Universidade de Lisboa
montagna@fa.ulisboa.pt
Orcid 0000-0002-5843-2047

ELENA PUCCI

Università della Campania Luigi Vanvitelli
elena.pucci@unicampania.it
Orcid 0000-0001-7634-3155

Abstract

This study explores how the transition to sustainable models can restore the value of wool, a traditional material rich in environmental and cultural potential, through innovative strategies of recovery and renewal of production processes. Greasy wool, often considered an unnecessary and costly by-product, is valued when integrated into a sustainable supply chain, stimulating local economic development and creating new opportunities for communities dependent on wool production, particularly those using indigenous sheep breeds. In this context, the concept of “Rifiutocreatura” (WasteCreature) is emerging as a fundamental tool for rethinking textile waste management. No longer a problem to be disposed of, but a potential resource ready to be regenerated in a resilient and conscious production system. This paradigm shift: waste becomes a “creature” waiting for a new life through recycling, eco-design and upcycling processes. The aim of this study is to provide a critical and proactive vision for the valorization of wool, illustrating how the regeneration of this fibre can be a central element in building a sustainable and ethical future textile. This study pretends to concretely demonstrate how such a model can reduce environmental impact but also contribute to a fairer redistribution of resources along the production chain and its territory.

Keywords: *Recycled Wool, Textile Industry, Natural Fibers, Innovative Ecosystems, Material Culture*

SOCIAL AND IDENTITY WOOL

For many millennia, wool has been an indispensable element in human existence, satisfying both material and immaterial essential needs. Among the first textile fibers used by man to protect himself from the elements, it has always represented an essential component in the development and evolution of the human species, contributing to the establishment of collective cultures and identities.

Since the beginning of its use, once shorn, wool was subjected to a consolidation process similar to pre-felting that allowed the sheep's coat to be compacted and used as an object to protect the body, a precursor therefore of what would be, in the future, a fabric and an item of clothing. It goes without saying that this initial process of using

wool, even long before the discovery of spinning, was widespread and guaranteed protection to entire communities in different settlement contexts. Since prehistoric times, allowing entire communities to produce and use protective artefacts, made with the social technologies present in the community, has fostered a common language between the technique and the textile object produced. With the creation of an idea of community and togetherness, we soon began to respond to the social needs of belonging to a cohesive group, sharing a form of integration and belonging where individuals could recognize themselves and give rise to a specific culture, accompanied by a transversal identity, expressed through shared symbols and elements. Wool, a material used mainly to produce clothing

in general, still maintains an inseparable link with the territory where it is born and develops, assuming its characteristics and reflecting them in the properties of the textile fiber produced, both animal and vegetal. The territory as an integral part of the construction of what is produced within it, adapting the characteristics in compliance with its natural, cultural and identity ecosystems, originates its *Genius Loci* spirit, as widely described by the ancient Romans (Lokas et al., 2023). There is no doubt that wool has always been a material with multiple applications and that it has always been an inseparable interface of the relationship between the individual and the social world where he lives and participates (Lipovetsky, 2010). There are many examples of the use of this material which, thanks to its aesthetic and mechanical-elastic characteristics, have allowed the construction of entire communities based on the production of yarns and artefacts created with this raw material, at a national and international level. Some of the best-known communities in Europe are probably found in Great Britain and with greater focus in Scotland, where local wools are abundant and have, for a long time, shaped entire territories and communities. We can include among them Shetland wool which is produced in large quantities on the islands of the same name, or Harris Tweed fabrics which are produced on the island of Lewis and Harris and which, even today, are approved as “genuine” only if all the stages of fabric production are carried out within the same island (Wilson et al., 2021). Even in Italy, as in other countries, there are specific cases of communities developed around a wool reality with a cultural and strongly territorial imprint. There are wool production districts in the Italian national territory, which with more or less territorial coverage, and specific characteristics dictated by the product or material give a high technological and productive response. Some of the most important in the wool sector is undoubtedly the Biella district, for very fine wools (Rosso, 2021) and Prato district, born from the need to regenerate the wool present on the national territory and, today the forefather of carded wool materials (Bellini & Leonardi, 2020). The Italian north-west, rich in processing wool textile and manufacturing high quality industry, is still a textile district where traditionally resided internationally known industries of the weight of Lanerossi and Marzotto.

AN EVOLVING PATH

Wool is one of the oldest natural fibers used by humans (Rast-Eicher & Jørgensen, 2013), a material that has gone through centuries of history and innovation and that today faces critical challenges related to its valorization and sustainable management (Barlucchi et al., 2022). On the one hand, native wool, once the cornerstone of the textile economy, is now subject to increasing economic devaluation due to competition from synthetic fibers, but also due to the lack of adequate infrastructure for its recovery (Doyle et al., 2021). On the other hand, post-consumer [but also pre-consumer] textile waste constitutes an environmental emergency and an unexplored opportunity for the circular economy, where waste can be transformed into a resource through regeneration processes (Binotto & Payne, 2017).

The current crisis of native wool and the problem of managing wool textile waste are two sides of the same coin: both reflect a production system that struggles to recognize the value of available resources and to be able to re-integrate them into virtuous cycles of production and consumption (Fletcher & Tham, 2019). The marginalization of greasy wool and the dispersion of textile waste derive from an economic vision that is still too linear, which contrasts with the urgency of more sustainable and circular models (Barlucchi et al., 2022). This research work intends to analyze the wool ecosystem in its double face: as a material heritage to be preserved and as waste to be regenerated, highlighting the opportunities offered by sustainable models that can restore value to a resource that is too often forgotten.

ECOSYSTEM OF A RESOURCE: PROSPERITY AND VALORIZATION

The ideology of a wool ecosystem evokes a concept of interconnection and sustainability, where wool loses its material meaning and connects to an integrated system that embraces nature, production, consumption, recovery and recycling, thus also representing a paradigm of immaterial sustainability, contextualized in current environmental challenges. In recent decades, wool has undergone a progressive economic devaluation due to the competition of synthetic fibers, which have dramatically expanded its market share (International Wool Textile Organisation [IWTO], 2019). If wool was once a pillar of the textile industry, today its production is in a structural crisis, aggravat-

ed by the lack of adequate recovery policies and the growing inattention of the international and national market (Doyle et al., 2021).

According to the Association of Man-Made and Synthetic Fibers, the market share of man-made raw fiber worldwide has increased from 51% to 76% in the last twenty years, to the detriment of cotton, wool and, more generally, other natural fibers (Trivellin, 2022). This has led to a drastic drop in the value of wool, often making it a marginal by-product in the livestock industry. Natural fibers, despite their excellent technical properties, have been progressively replaced by man-made fibers due to technological, economic and cultural factors. Synthetic and artificial fibers, thanks to the possibility of being produced with extremely small diameters, offer greater softness and lightness, improving comfort in contact with the skin and reducing the risk of skin irritation, caused by some natural fibers, such as wool above 28/30 μ m (Naebe et al., 2015).

The decline in the use of wool on a large scale, as reported by (Doyle et al., 2021) has had an even more marked impact on varieties from regional or local sheep breeds. These wools, produced in limited quantities and characterized by a high variability of fibers within each flock, escape the logic of standardized industrial use, due to the high costs of analysis and certification. The progressive devaluation of wool has led to a reduction in its market value, compromising the economic sustainability of local supply chains, often family- or community-run. These production realities, generally small-scale, are frequently integrated into conservation programs of native breeds, with a key role in biodiversity and genetic variability (ERSAF Lombardia, 2023).

In many European regions, there is a high level of disinterest in local wool, and traditional spinning and weaving practices struggle to meet the demands of an increasingly restricted market with high management costs. According to Cariola et al., (2013), in Italy there are approximately 6 million sheep raised for the production of cheese and meat, and it is estimated that the wool from their shearing is around 8500 tons per year: from this enormous quantity, approximately 1700 tons of textile material could be obtained for the various industrial and artisanal sectors, with an enormous capacity for the development of new products. Currently, this wool is considered a waste from sheep and goat farming, as it is not competitive with more valuable

qualities (e.g. merinos) imported from Australia, New Zealand or Argentina, and is therefore buried in defiance of disposal regulations that entail excessive costs for farmers or exported below cost to foreign markets where it is destined to produce carpets (p.164).

Italian greasy wool¹, as extensively argued by Cariola et al., (2013), is exported below cost to countries such as India, China and South-Eastern European countries, where it is often mixed with synthetic fibers (Pagani, 2022), used to produce fibrous materials with little added value, such as padding, insulation or materials for industrial use (Cariola et al., 2013). This low profitability has pushed sheep farmers and related businesses to reinvent their business, moving towards more economically sustainable production and commercial chains (Cariola et al., 2013). The progressive depreciation of wool has led to a reduction in the profitability linked to its processing and transformation. Consequently, in many regions, this material is now perceived as a marginal by-product within the livestock industry. This dynamic has led to a transformation of sheep farming, with the progressive abandonment of medium and small-sized breeds, even when they produce fine or semi-fine wool, in favor of breeds selected for their high milk and meat productivity. This shift in priorities has led to a progressive disinterest in the quality of wool, which today struggles to find a reference market (Doyle et al., 2021).

In a primary sector increasingly oriented towards the production of meat and dairy products, wool is often considered a waste by-product, whose low economic value is not enough to even cover the costs of shearing. As a result, raw wool is frequently stored without a concrete use, abandoned in rural areas or disposed of in landfills, sometimes in a manner that does not comply with environmental regulations (Bhavsar et al., 2016).

This phenomenon is not isolated but represents a clear indicator of an inefficient natural resource management model, in which wool is not recognized as an economic resource or as a material with ecological potential. Its failure to valorize, reports Gaddi & Mastrolonardo, (2024), not only leads to a waste of raw material, but also raises issues that require a rethinking of integrated production chains and the valorization of

¹ As other wool is impregnated with fatty substances (mainly lanolin) and other impurities, baled immediately after shearing without being subjected to cleaning and washing processes.

the special characteristics of this raw material. Inefficiency in wool management not only generates significant waste of raw material, energy and water resources, but also raises environmental and regulatory issues. In Italy, this situation is accentuated, especially in some regions with a strong tradition of pastoralism, such as Sardinia and Abruzzo, where a significant part of the wool produced is abandoned or discarded. The abandonment and illegal disposal of wool contribute significantly to the loss of a precious resource (The European Parliament and the Council, 2009). If the wool is not collected from the farm, it must be disposed of as special waste², resulting in economic and management costs for the farmer (Camilli & Burgassi, 2012). This scenario highlights the need to develop strategies to valorize wool as a resource, reducing waste and promoting sustainable management practices (Gaddi & Mastrolonardo, 2024).

Yet wool has intrinsic characteristics that make it a unique and sustainable fiber. Natural and biodegradable, it has historically been appreciated for its insulating and durable qualities (IWTO, 2020). However, in the context of the transition to circular economy models, it takes on an even deeper meaning. In the context of the transition to a circular economy, wool can be reintroduced into a sustainable production system, enhancing its regeneration capacity and its integration with other resources in continuous cycles. From this perspective, wool considered rustic should not be considered a product destined for disposal, but a dynamic element, which reduces the environmental impact and promotes ethical and responsible practices (Fletcher & Tham, 2019) of an economy that wants to be increasingly integrated and sustainable. The integration of wool into a sustainable ecosystem (Alhamad, 2006), requires a transformation of the production chains, with greater attention to the biodiversity of sheep breeds and the morphological specificities of the fleece. Each breed has fibers with peculiar physical characteristics, influencing the quality of the finished product and its performance in use (Botha & Hunter, 2010). This has led to a progressive

disinterest in the quality of wool, making it difficult to valorize it on the market (Gaddi et al., 2024).

To reverse this trend, it is essential to develop new strategies for valorizing native wool, transforming it from a marginal material to a key resource for sustainable development. The recovery and reuse of wool in innovative and shorter production cycles can reduce waste and open up new opportunities for local supply chains. Innovation in manufacturing processes and the rediscovery of artisanal skills not only allow the preservation of cultural heritage, but also promote an inclusive development model, in which waste is regenerated into a resource. In this context, wool contains a set of special characteristics that can make it a driver of economic, social and environmental prosperity, contributing to collective well-being and territorial resilience.

RIFIUTOCREATURA: PROSPERITY AND VALORIZATION OF POST-CONSUMER WOOL

Global change and resource depletion pose an urgent challenge, requiring a systemic approach to ensure a sustainable future (Rockström et al., 2009). The impact of the Fashion Industry on the Earth System, in terms of resource consumption and greenhouse gas emissions, is widely discussed; in particular, the production and disposal of waste, no longer seen as waste but as a resource, represents a significant challenge for the transition towards more sustainable models. The recovery and regeneration of textile fibers are fundamental strategies to reduce waste and promote a circular economy.

Pre- and post-consumer textile waste represents a strategic opportunity for the redefinition of production chains, encouraging the development of systems dedicated to its management, transformation and reintegration into the market. The implementation of recent EU directives on Extended Producer Responsibility³ (Brown & Börkey, 2024), together with the action of textile recycling consortia, is encouraging both cultural and economic evolution. This change is reflected in the adoption of circular economy models that promote the systematic recovery of waste and optimize its management, thus contrib-

² European regulation EC 1069/2009 classifies shorn wool as a by-product with a health and hygiene risk, requiring specific treatments for its marketing. This status imposes high costs for the transformation of wool into technical products intended for spinning. <https://eur-lex.europa.eu/legal-content/IT/TXT/?uri=CELEX:32009R1069> However, EC Regulation 510/2006 recognizes wool as an agricultural product, making it eligible for protection through PGI or PDO. http://www.agroqualita.it/_files/reg_ce_510_2006.pdf

³ As part of the European Green Deal, the EU Strategy for Sustainable and Circular Textiles (2022) was launched to make the textile sector more sustainable. This strategy promotes the introduction of extended producer responsibility rules for textiles, with the aim of improving collection and recycling, and reducing waste generation.

uting to a better sustainability of the textile sector.

There is a strong relationship between the fashion system and waste, determined by the fact that fashion is based on the development of new materials that simply replace old ones (Binotto & Payne, 2017). Therefore, it could be said that where fashion ends, waste begins (Torstensson, 2011). Every year, the fashion industry generates large volumes of textile waste, the ineffective management of which mainly leads to landfill disposal, rather than their reintroduction into production cycles. The abandonment of these materials as waste involves a considerable loss of resources, both material and immaterial, that go beyond the production process itself. In fact, considering the energy, raw materials and labor used not only during the production phase, but also in the preparation for production, a significant negative impact emerges in re-exploiting these resources. Added to this is the deleterious effect of carbon emissions along the entire supply chain, with direct repercussions on the environment and climate change. An adequate valorization and reintroduction of these wastes into the production system could contribute to the reduction of waste and the transition towards more sustainable and circular models (Binotto & Payne, 2017; Strähle & Matthaei, 2017). Textile waste management is a complex issue that requires integrated systemic solutions to effectively address the environmental impact and optimize the use of resources. As Marco Armiero (2021, p. 19) states, the current era of human beings is marked by a “techno-stratigraphy of waste materials” that accumulate on Earth, where, in recent decades, waste has transformed the environment into a real landfill. In this context, “discarding means deciding what has value and what does not” (Armiero, 2021, p. 20). The Wasteocene⁴ (Armiero & De Angelis, 2017) described by Armiero (2021) represents an era in which waste not only accumulates inert objects, but also involves living beings, knowledge, places and memories, creating an environmental, social and cultural crisis.

Despite this, initiatives such as wool recycling in the textile district of Prato offer an opportunity to develop circular economy models, reducing waste and improving the efficiency of natural resources (Furferi et al., 2022). However, the success of these practices depends

on a coordinated effort between institutions and industry to implement supporting policies that incentivize wool collection and treatment (Gaddi & Mastrolonardo, 2024).

In the Wasteocene era, waste is no longer just a sign of exhausted consumption, but a material waiting to be transformed. The concept of *Rifiuto-creatura*⁵ overturns the traditional vision of waste, recognizing its intrinsic potential for regeneration. No longer an object destined for landfill or incineration, but an entity in progress, capable of assuming new forms and functions through processes of sustainable innovation. Thanks to eco-design, advanced recycling and upcycling strategies, waste is transformed into *Rifiutocreatura*, gaining a new life within more virtuous production cycles. This change in both technical and cultural perspective implies a proposal to rethink materials, industrial processes and consumption habits, promoting a vision in which nothing is truly wasted, but everything can become a resource. *Rifiutocreatura*, therefore, is no longer the residue of a linear system, but the symbol of a creative and regenerative circularity, in which the end of one cycle is only the beginning of another.

PECORE ATTIVE AND MANTECO: SUSTAINABLE REGENERATION OF WOOL TEXTILE WASTE

In relation to what has been discussed so far, there are numerous Italian companies that forcefully emerge as excellence in the field of sustainability, contributing significantly to the development and responsible management of resources. The case of Manteco and Pecore Attive (Camilli et al., 2013) as virtuous examples of eco-innovation, demonstrate how sustainable innovation can be effectively applied in the wool textile sector, transforming waste and local resources into valuable products, and at the same time promoting environmental protection and the socio-economic development of the territories involved.

Pecore Attive is an initiative dedicated to the recovery and enhancement of native wool from Puglia, with the aim of restoring value to the territory of Alta Murgia Barese and its communities. For over a decade, the association has acted as a catalyst for the development of products and experiences related to the wool

⁴ The term “Wasteocene” was introduced into the cultural debate in 2017 by Marco Armiero and Massimo De Angelis through an article published in *South Atlantic Quarterly*.

⁵ Thought developed during the critical elaboration of the research concepts by Elena Pucci for the National PhD Program in Design for Made in Italy: Identity, Innovation, and Sustainability.

textile sector, promoting the use of sustainable and local materials. A central element of Pecore Attive's work is research into the valorization processes of sheep wool. This includes the use and application of traditional and manual processing and transformation techniques such as carding, spinning, weaving and felting, to create innovative products that combine tradition and contemporary design. The history of Pecore Attive is closely intertwined with that of the cultural territory of the Alta Murgia upland of Bari, an area rich in rural heritage and historical identity (Saviano et al., 2018). The encounter between human work and nature in this territory is fundamental to the vision of the association, which aims to build a local ecosystem based on shared knowledge, resources and skills.

This approach promotes a new interconnected wool economy, supporting local breeders and valorizing native sheep breeds, such as the Gentile di Puglia, whose wool is appreciated for its qualitative characteristics in the fashion sector (Sardaro & La Sala, 2021). Pecore Attive is also committed to building human values, aiming to improve society by strengthening the territorial fabric and creating solid foundations of trust between people. The association supports local producers in enhancing their skills and production, contributing to environmental sustainability and the well-being of the involved communities (Fig. 01).

Next, the analysis of the Manteco⁶ case study highlights a virtuous model of circular economy in the textile sector. The company, based in the textile district of Prato⁷, has developed an innovative production system based on the reuse of wool, transforming textile waste into new high-quality raw materials. Through the use of advanced recycling technologies and careful management of resources, Manteco has obtained significant environmental benefits. Compared to the production of conventional virgin wool, M Wool[®] reduced its water and energy consumption by about 17% and ReviWool[®] has reduced its resources by around 37%. The CO₂-eq emissions usually produced by the company have been

6 Since 1943, Manteco has established itself in the production of fine wool fabrics, combining innovation and environmental responsibility to limit the ecological impact. Among the most advanced solutions developed by the company are ReviWool[®], a low-impact virgin wool, and M Wool[®], an evolution of recycled wool.

7 "The Prato textile district extends over a geographical area of 7,000 sq km. Currently, it counts 46166 total employees in Textile Clothing, 6805 companies, a full production value estimated at 7,500 million euros over an export value at 2540 million euros." (Tufarelli et al., 2022; Confindustria Toscana Nord, 2020)



Fig. 01

reduced in 2023 by around 37% (Manteco Sustainability Report 2023, 2023).

Among the most relevant initiatives in the field of circular economy, Manteco is actively involved in Project43, a program aimed at eliminating waste through the recovery of waste generated by clothing manufacturers that use its fabrics. These residues are transformed into new high-end fabrics, ensuring a process with a reduced environmental impact. Manteco's textile production is mainly oriented towards mono or bifibre fabrics, a characteristic that facilitates mechanical recycling to obtain new M Wool[®] fibres, the new generation of recycled wool, subsequently used in the production of high-quality circular fabrics. Furthermore, the waste generated along the entire production chain - from pre- and post-consumption recovery to spinning, and from weaving to finishing - is collected and divided according to composition and colour tone, to be reintroduced into the production cycle in the form of new resources. Thanks to M Wool[®], in 2023, Manteco (Manteco Sustainability Report 2023, 2023) achieved significant environmental savings:

Water: 18.05 hm³ saved, with a decrease of

17.43% compared to 2022.

Energy: 162.63 TJ saved, with a reduction of 14.9% compared to 2022.

CO₂-eq: 98,267 tons saved, with a reduction of 17.43% compared to 2022.

These results were obtained by comparing the use of M Wool® with the use of generic virgin wool fibers. Furthermore, thanks to Project43, Manteco recovered 253,660 kg of industrial wool waste, with an increase of 17.78% compared to 2022. Of these, 79.4% was reused in the production cycle, marking an increase of 11.05% compared to the previous year. Finally, through the same project, the company recovered 69,067 kg of packaging waste, with an increase of 22.39% compared to 2022 (Manteco Sustainability Report 2023, 2023). These data demonstrate Manteco's commitment to promoting sustainable practices and adopting a circular economy model, significantly contributing to reducing the environmental impact in the textile sector, but also the financial sustainability that projects of this type can bring to an industry capable of transforming itself to the concept of Rifiutocreatura and adapting to new social needs (Fig. 02, Fig. 03).

A further study conducted by Manteco, in collaboration with the University of Leeds, has analyzed the recycling potential of wool in a closed loop system, providing fundamental scientific data for the implementation of circular economy strategies in the textile sector. Published in the Journal of Cleaner Engineering, the research shows that wool can be recycled up to six times through carded spinning, maintaining high mechanical performance and a reduced environmental impact (Glasper et al., 2024).

The study examined the durability and recyclability of wool fiber, highlighting that fiber length, textile structure and recycling machine settings are determining factors. Shorter wools, such as merino wool, are more vulnerable to fragmentation, while knitted fabrics better preserve fiber integrity. Furthermore, optimizing recycling processes has a significant impact on the mechanical properties of fibers. Tests have shown that recycled wool fibers maintain over 92% of their original tensile strength, confirming the durability of the material even after repeated recovery cycles. When fibers become too short to be reused in the closed cycle, they can be recycled in an open system, finding application in other sectors or in lower-quality textile materials (Glasper et al., 2024),



Fig. 02



Fig. 03

justifying the research developed in industries such as Manteco, which argues (Manteco Sustainability Report 2023) that the results of their study reinforce the role of wool as a strategic resource for the transition to a circular textile model. The same researchers from the University of Leeds highlight how optimizing recycling processes could significantly expand the value of recycled wool in sustainable supply chains. This research represents an essential scientific contribution for the textile sector, demonstrating that the adoption of recycled materials does not compromise the quality of the final product and promotes a reduction in the environmental impact of the fashion sector.

CONCLUSIONS

Wool, one of the oldest natural fibers used by man, is today in a critical position between economic devaluation and new prospects for sustainable valorization. On the one hand, the progressive loss of value of wool is linked to the predominance of synthetic fibers that ensure a constant and a controlled transversal cut in relation to natural fibers, to the fragmentation of local supply chains and to the lack of adequate infrastructures for its recovery. On the other hand, pre- and post-consumer textile waste represents a strategic opportunity for the circular economy, where waste can be transformed into a valuable resource through innovative processes of regeneration and reuse. The current marginalization of wool, especially local wool, and its dispersion as a waste reflect a production system that is still too linear, unable to fully recognize the value of available resources and the needs, on the one hand of sheep producers and on the other of environmental sustainability needs. Wool has intrinsic characteristics as – biodegradability, thermal insulation, mechanical resistance, flame retardant – that make it a unique and ideal raw material to be reintroduced into a more sustainable production model. To overcome the current crisis, it is necessary to rethink wool valorization strategies, develop new recovery chains and promote the diversification of its applications, applying integrated concepts such as those associated with a Rifiutocreatura, to new design areas, as a of sport performance, where wool is gaining incredible visibility nowadays. Technological innovation, the strengthening of local chains and the integration of artisanal skills can contribute to the construction of a wool ecosystem in which production, consumption, recovery and recycling

are closely interconnected and valorized. From this perspective, wool is not just a material, but a dynamic element that, if adequately valorized, can become a driver of economic, social and environmental prosperity. This condition implies an urgency for radical change in our relationships with the world, underlining how waste management – including those that could be seen as resources, such as post-consumer wool waste – becomes a crucial point for the future. In fact, just as plastic and waste materials weigh more than all living beings put together, discarded wool could also be recovered, reworked and valorized as a resource, rather than being abandoned as waste. The crisis we are experiencing, therefore, is not only environmental, but also a crisis of economic and cultural vision that leads us to discard and forget what could be reused and regenerated. This scenario requires a profound transformation of our ways of thinking and acting, in which respect for life and sustainability become the foundations for a world capable of recognizing waste not only as a failure, but also as an opportunity for creativity and regeneration.

CAPTIONS

[Fig. 01] Project created with native wool preserved by the Pecore Attive association. Photograph is available on their website. <https://www.pecoreattive.it/about>

[Fig. 02] Sorting post-consumer waste at the Manteco company. Photograph kindly provided by the authors

[Fig. 03] Manteco regenerated textile fiber. Photo courtesy of the authors

REFERENCES

- Alhamad, M. N. (2006). Ecological and species diversity of arid Mediterranean grazing land vegetation. *Journal of Arid Environments*, 66, 898–715. <http://dx.doi.org/10.1016/j.jaridenv.2006.01.001>
- Armiero, M. (2021). *L'era degli scarti: Cronache dal wasteocene, la discarica globale*. Passaggi Einaudi
- Armiero, M., & De Angelis, M. (2017). Anthropocene: Victims, narrators, and revolutionaries. *South Atlantic Quarterly*, 116(2), 345–362. <https://doi.org/10.1215/00382876-3829445>
- Barlucchi, A., & Franceschi, F. (Eds.). (2022). *L'industria della lana in Casentino: Produzione e lavorazione dal Medioevo all'età contemporanea*. Associazione di Studi Storici Elio Conti.
- Bellini, A., & Leonardi, L. (2020). Prato: The Social Construction of an Industrial City Facing Processes of Cultural Hybridization. In D. Edler, C. Jenal, & O. Kühne (Eds.), *Modern Approaches to the Visualization of Landscapes* (pp. 547–570). Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-30956-5_30
- Bhavsar, P., Zoccola, M., Patrucco, A., Montarsolo, A., Mossotti, R., Rovero, G., Giansetti, M., & Tonin, C. (2016). Superheated water hydrolysis of waste wool in a semi-industrial reactor to obtain nitrogen fertilizers. *ACS Sustainable*

- able Chemistry & Engineering, 4(12), 6722–6730. <https://doi.org/10.1021/acssuschemeng.6b01631>
- Binotto, C., & Payne, A. (2017). The poetics of waste: Contemporary fashion practice in the context of wastefulness. *Fashion Practice*, 9(1), 5–29. <https://doi.org/10.1080/17569370.2016.1226604>
- Botha, C., & Hunter, T. (2010). The characterization of wool and its processing into finished products. *Textile Research Journal*, 80(10), 927–935.
- Camilli, F., & Burgassi, T. (2012). La lana: Rifiuto o risorsa? *Agriregionieuropa*, 8(28), 75–80. <https://agrireregionieuropa.univpm.it/it/content/article/31/28/la-lana-rifiuto-o-risorsa>
- Camilli, F., Nunziatini, V., Fattorini, T., Attili, C., Fabbri, F., Giorgetti, A., Sargentini, C., Tocci, R., Guercini, S., Ranfagni, S., Mauro, A., Predieri, S., Medoro, C., Di Leonardo, S., & Bacci, L. (2013). La filiera sostenibile delle lane autoctone in provincia di Grosseto: Produzioni green per la valorizzazione del territorio. CNR IBIMET.
- Cariola, M., Moiso, V., & Pagliarino, E. (2013). Da rifiuto a valore aggiunto: La costruzione di una filiera del tessile sostenibile e il caso della lana rustica. *Culture della sostenibilità*, 6(12), 163–173. <https://doi.org/10.7402/CdS.12.026>
- Doyle, E. K., J. W. V. Preston, B. A. McGregor, and P. I. Hynd. 2021. The Science Behind the Wool Industry. The Importance and Value of Wool Production from Sheep. *Animal Frontiers* 11 (2): 15–23. <https://doi.org/10.1093/af/vfab005>
- ERSAF Lombardia. (2023). Razze autoctone della Lombardia: Valorizzazione e conservazione. Ente Regionale per i Servizi all'Agricoltura e alle Foreste. <https://www.ersaf.lombardia.it/wp-content/uploads/2023/11/razze-autoctone.pdf>
- Fletcher, K., & Tham, M. (2019). Earth Logic: Fashion Action Research Plan. The J J Charitable Trust.
- Furferi, R., Volpe, Y., & Mantellassi, F. (2022). Circular economy guidelines for the textile industry. *Sustainability*, 14(17), 1–20. <https://doi.org/10.3390/su141711111>
- Gaddi, R., & Mastrodonato, L. (2024). Micro-reti locali per la transizione verde della filiera della lana: Local micro-networks for green transition of the wool supply chain. *AGATHÓN*, 15, 344–353. [10.19229/2464-9309/15292024](https://doi.org/10.19229/2464-9309/15292024)
- Glasper, M. J., Picerno, G., Tausif, M., & Russell, S. J. (2024). Closed loop mechanical recyclability of post-consumer waste wool fabrics based on fibre length retention. *Cleaner Engineering and Technology*, 12, 100720.
- International Wool Textile Organisation (IWTO). (2019). IWTO market information: Statistics for the global wool production and textile industry. Poimena Analysis & Delta Consultants.
- IWTO (2020). Recycled wool. https://iwto.org/wp-content/uploads/2020/04/IWTO_Recycled-Wool.pdf
- Lipovetsky, G. (2010). O Império do Efêmero: A moda e seu destino nas sociedades modernas. Dom Quixote.
- Lokas, I., Petrović, R., & Rakonjac, I. (2023). The Essence of Place: Understanding Genius Loci Through Phenomenology. Challenges in Design. On Architecture, Belgrade.
- Manteco Sustainability Report 2023 (p. 65). (2023). [Sustainability Company Report]. Bolzano University. <chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://manteco.com/wp-content/uploads/2024/09/Manteco-2023-Sustainability-Report.pdf>
- Naebe, M., B.A. McGregor, P. Swan, & D. Tester. (2015). Associations between the physiological basis of fabric-evoked prickle, fiber and yarn characteristics and the Wool ComfortMeter value. *Text. Res. J.* 85(11):1122–1130. [10.1177/0040517514527372](https://doi.org/10.1177/0040517514527372)
- Pagani, V. (2022). Lana italiana: una filiera da riscoprire in ottica circolare. *Renewable Matter*. Retrieved from <https://www.renewablematter.eu/lana-italiana-una-filiera-da-riscoprire-in-ottica-circolare>
- Rast-Eicher, A., and L. B. Jørgensen. 2013. “Sheep Wool in Bronze Age and Iron Age Europe.” *Journal of Archaeological Science* 40(2): 1224–1241. <https://doi.org/10.1016/j.jas.2012.09.030>
- Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., Lambin, E., ... Foley, J. A. (2009) Planetary Boundaries: Exploring the Safe Operating Space for Humanity. *Ecology and Society*, 14(2), Article 32. <https://www.stockholmresilience.org/download/18.8615c78125078c8d3380002197/1459560331662/ES-2009-3180.pdf>
- Rosso, I. (2021). Le strade della lana—Il distretto tessile biellese tra crisi e opportunità di sviluppo [Master Dissertation, Torino Polytechnic]. <http://webthesis.biblio.polito.it/id/eprint/19215>
- Wilson, R. H. B., Macleod, M. A., & Hogarth, M. (2021). Sustainability and Heritage in Practice; The Case of Harris Tweed Hebrides. In L. Rienda, L. Ruiz-Fernández, L. Drylie Carey, & I. García-Medina (Eds.), *Firms in the Fashion Industry* (pp. 47–66). Springer International Publishing. https://doi.org/10.1007/978-3-030-76255-1_4
- Sardaro, R., & La Sala, P. (2021). New value to wool: Innovative garments for preservation of sheep landraces in Italy. In *Sustainable management in small/medium scale animal farms*. *Animals*, 11(3), 731. <https://doi.org/10.3390/ani11030731>
- Saviano, M., Di Nauta, P., Montella, M. M., & Sciarelli, F. (2018). Managing protected areas as cultural landscapes: The case of the Alta Murgia National Park in Italy. *Land Use Policy*, 76, 290–299. <https://doi.org/10.1016/j.landusepol.2018.03.052>
- The European Parliament and the Council. (2009). Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation), document 32009R1069. EUR-Lex. <https://eur-lex.europa.eu/eli/reg/2009/1069/oj/eng>
- Trivellin, E. (2022). Dalla filiera alimentare al textile design. MD Journal Dossier, Design e fibre naturali. https://sfera.unife.it/retrieve/7d0f8004-b880-4f80-ad2f-e995f4a15282/TRIVELLIN_MDJ_Dossier_Design_fibre_nat_compressed.pdf
- Torstensson, R. (2011). A new player in the accelerating textile industry—Upcycled textile products [Master's thesis, University of Borås]. University of Borås DiVA Portal.