From Waste to Luxury
Fashion as Catalyst for Sustainable Development
Testimonial Track

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Abstract
This paper questions the potential use of fashion as catalyst for sustainable development through the presentation and analysis of fashion collections transforming waste to luxury. These collections, which have been designed by the author along with collaborators, are presented as case studies in order to extract insights about the frameworks needed to enable the use of fashion as a tool for social and environmental impact. The paper documents and analyses the design, prototyping, manufacturing and commercialization processes behind these fashion collections, in view of answering the research question: in contexts of multi-sectoral local and global crises, how can fashion be used as a catalyst of sustainable development?

Keywords
Sustainable Fashion, Social Entrepreneurship, Upcycling, Material Innovation, Conscious Luxury, Traditional Handcraft, Parametric Design, Digital Fabrication

Author Biography
Trained as an architect, Joanne Hayek is a multidisciplinary designer whose practice expanded into fashion design, urban planning, digital design and programming with an emphasis on sustainability and innovation. Joanne is an avid researcher whose studies focus on material remediation, parametric design, digital fabrication, real-time mapping, smart cities and interactive data visualization. Her work has been exhibited at international events such as the Venice Biennale of Architecture, Paris Fashion Week, and Expo 2020 among others. A social entrepreneur, she is the co-founder of sustainable fashion brand, Vanina, and An Open Studio, a collaborative practice promoting trans-disciplinary design research for sustainable futures. She is an Assistant Professor at the Dubai Institute of Design and Innovation and a senior lecturer at the American University of Beirut. She has given lectures and talks at various international universities, including the Massachusetts Institute of Technology, Columbia University and The London School of Economics.

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1. Introduction: context and methodology

This paper questions the potential use of fashion as a catalyst for sustainable development through the presentation and analysis of fashion collections transforming waste to luxury. These collections, which have been designed by the author along with collaborators, are presented as case studies in order to extract insights about the frameworks needed to enable the use of fashion as a tool for social and environmental impact. The paper documents and analyses the design, prototyping, manufacturing and commercialization processes behind these fashion collections, in view of answering the research question: in contexts of multi-sectoral local and global crises, how can fashion be used as a catalyst of sustainable development?

The projects selected consist of collections created by the fashion brand 'Vanina', co-founded by the author Joanne Hayek and her partner Tatiana Fayad. These projects include: a series of evening bags repurposing non-recyclable food packets through a process of handcrafted origami and parametric digital laser cutting ('Delicatesse', featured in paragraph 2.1), an upcycled fashion collection developed as a capacity building project within refugee camps in Lebanon ('Conserved', featured in paragraph 2.2), a jewelry series exploring waste-based sustainable 3d-printing ('Leaves', featured in paragraph 2.3), a line of evening bags transforming plastic waste into a versatile marble-like texture ('Les Eternelles', featured in paragraph 2.4), and a capsule collection handcrafted with the glass shattered by the 4th of August blast of Beirut ('The Light of Beirut', featured in paragraph 2.5). These case studies share a commonality: they all rely on material remediation. Through different craftsmanship techniques, they transform waste into luxury, thus offering alternative methods of waste management, and raising awareness about the latent potential and inherent value of discarded materials. Some of the materials featured in the study include items that are considered non-recyclable and harmful to the environment as they usually end up in landfills. The techniques of material transformation documented in the paper span from traditional handcraft to emerging digital fabrication techniques. The merging of these two approaches to making in the same supply chain open the door to innovative techniques of material remediation. The design frameworks employed in these projects adopt a collaborative cross-disciplinary approach to innovation: employing architectural design methods and algorithmic design tools, the process aims for a zero-waste transformation of the discarded materials. The business model supporting the research and development (R&D) of these projects is a social entrepreneurship model which relies on collaboration with local non-governmental organizations (NGOs) as well as international luxury stores to enable the creation and distribution of these sustainable fashion products. At a local scale, the social enterprise model allows to prioritize impact over profit, which proves to be useful to support the costly and lengthy process of

research and development needed to achieve sustainable material innovation in luxury fashion. At a global scale, appreciation and attention to sustainability, traceability and impact assessment of brands by the main luxury resellers is of prime importance to accelerate sustainable innovation in fashion. The example of Net-A-Porter's platform Net-Sustain, which curates and promotes sustainable fashion projects, is analyzed in the documentation of one of the case studies of the paper (paragraph 2.1).

The paper then expands with a description of the guidelines extracted from these case studies, proposed to enable the use of fashion as a catalyst for sustainable development and systemic change through practice and academia. The practice framework details the social enterprise model at a local scale, as well as the trade policy strategies which are recommended to help support sustainable shifts in the fashion industry at a global scale. The academic framework advocates for a cross-disciplinary research-driven design education, and cites the Dubai Institute of Design and Innovation's Bachelor of Design where the author is teaching as a case study to analyze educational models that foster a sustainable approach to fashion.

2. Projects: contexts and processes

This section describes the sourcing, design, manufacturing and distribution processes behind the five collections referenced in this paper.

2.1. Repurposing non-recyclable waste through luxury fashion: the 'Delicatesse' Collection

This first project, 'Délicatesse', is an eco-luxury fashion line proposing to transform non-recyclable food packets into a series of evening bags. Processed food packets such as chips bags are composed of a mix of aluminum and plastic layers that are difficult and costly to separate, thus leading to the landfilling and incineration instead of recycling. Through collaboration between the brand Vanina and local NGOs Arcenciel and La Voix de La Femme, these chips bags were collected at the source, washed, unfolded, flattened and sorted to prepare for a multi-step transformation process.

Figure 1: 'Délicatesse' bag by Vanina: the Vol-Au-Vent style, closed and open.

The 'Délicatesse' line was designed to enable a zero-waste transformation of the packets through a parametric design process that adapted the laser files to the varying sizes of sheets collected. Laser cutting files were generated using the Rhino3D plugin Grasshopper, a tool for algorithmic modeling, and allowed to transform the sheets into origami patterns through the piercing of holes and the opening of fold creases. The algorithm was developed by the team to simulate the three-dimensional folding, and establish the repartition of mountain and valley creases across the sheets. Several rounds of prototyping were conducted to optimize the dimensions of the holes and lengths of folds. The laser cutting was followed by a meticulous process of handwoven origami. Developed in-house, this technique allows to pleat the sheets into complex patterns without breaking the material. Driving inspiration from the traditional textile smocking technique, and following the laser-cut origami pattern, the flat sheets were transformed into three-dimensional pleated units. These units were then assembled using gold-plated brass structures. These gold-plated brass structures allowed to strengthen the origami pieces while

elevating their aesthetics through the mix of silver and gold surfaces. The same gold-plated brass material was used for the handles and the engraving of the brand's logo.

One 'delicatesse' bag upcycles between 10 to 32 packets of chips. Their manufacturing involves between 20 to 120 hours of meticulous handcraft, thus enabling the creation of new green jobs in collaboration with community development NGOs 'Arcenciel' and 'La Voix de La Femme'. The project, which was paired with environmental awareness campaigns and neighborhood-scale waste collection systems, involved capacity building and economic development through the training of women in handcraft.

The project was made possible through a collaboration with the brand's international distribution partner Net-A-Porter, who exclusively sold the collection on their platform 'Net Sustain', which curates and promotes sustainable fashion projects.
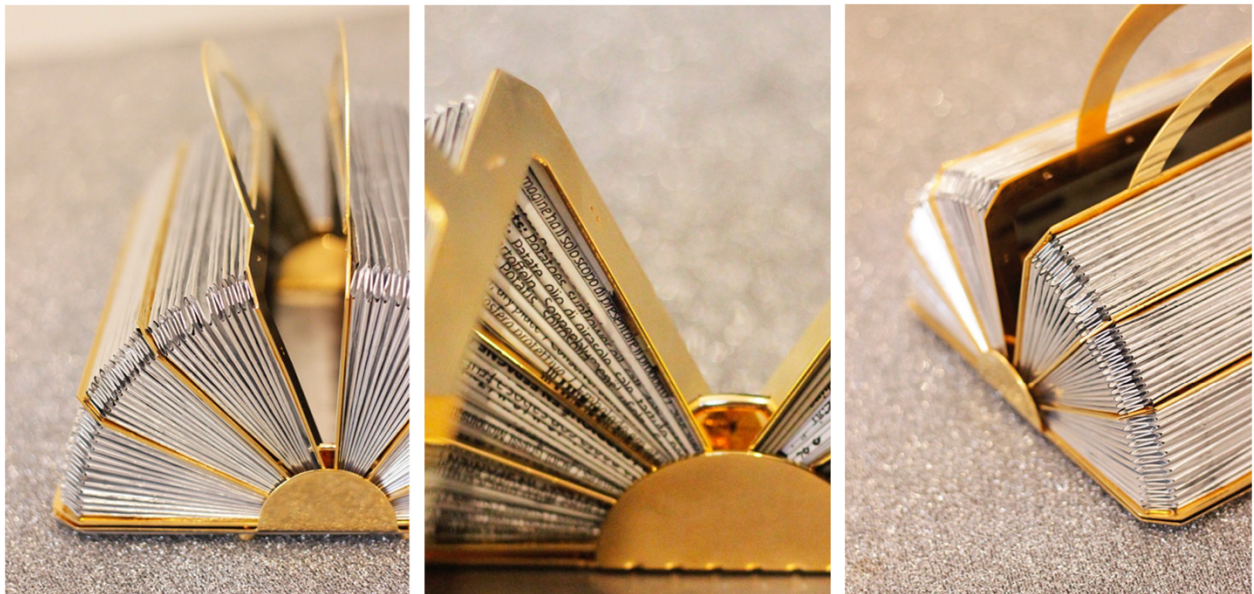

Figure 2: 'Délicatesse' bag by Vanina: the Madeleine style

The Délicatesse collection was formulated as an invitation to reflect on the obsolescence of single use packaging in the food industry, and the environmental and health issues linked to processed food. The pieces were accompanied with tags explaining the concept and describing the sourcing journey: the material, the collaboration with the NGOs, and the name of the artisan who created it. In terms of aesthetics, it was the designers' choice not to reveal the upcycling nature of the pieces on the outside. At first glance, one could believe it is made of metal, or any precious material. The materiality is only revealed on the inside of the bag. This mirrors the brand's approach to communication about its sustainable

strategies. Fashion is used here as a tool to drive interest to social and environmental issues through form and beauty, and not vice versa.

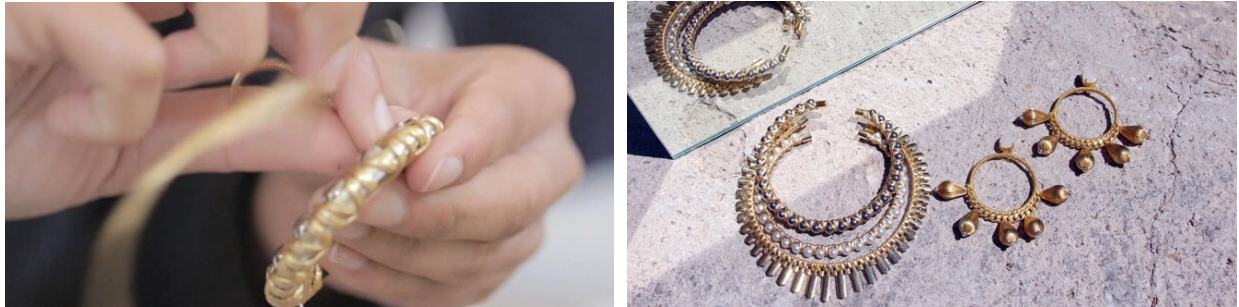*2.2. Fashion as a tool for community development: the 'Conserved' collection*

Figure 3: 'Conserved collection': process and jewelry samples.
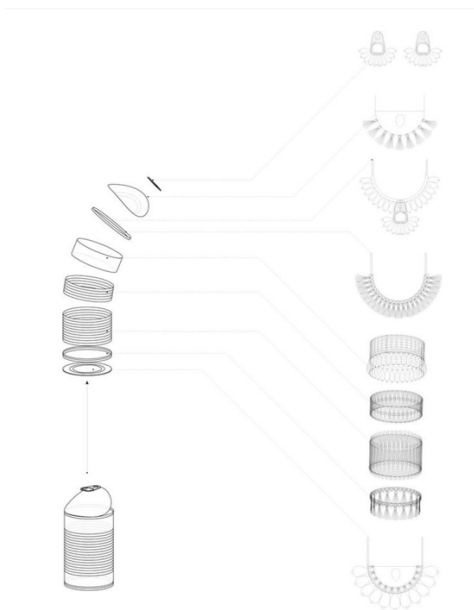

Figure 4: 'Conserved collection': the transformation of one tin can into bases for multiple accessories.

The 'Conserved' project, created by Vanina between 2015 and 2017, was realized in partnership with SDAID, 'SAWA for Development and Aid', a non-profit civil organization focusing on the support to Syrian refugees in Lebanon. Through the creation of luxury fashion accessory pieces out of transformation of household waste, the collection was designed as a community development project that allowed to train unemployed youth in handcraft and alternative waste transformation processes and employ them for the manufacturing of the collection.

In a similar conceptual framework than 'Delicatesse', 'Conserved' proposed to transform left-over packaging of processed food, in this case tin cans, into handcrafted statement fashion accessory pieces. The pieces were collected by the artisans, were sanitized and cleaned, and transformed by means of mechanical cutting into bases for creation of handcrafted pieces of jewelry and handbags. The line aimed for a zero-waste transformation process of the tin cans, allowing to use them in their entirety as indicated in figure 4. One tin can could end up being used as base for up to four different pieces of jewelry. Once cut and polished, the pieces were transformed using a hand-weaving technique developed by the brand along with its master artisans. These master artisans, who have been with the brand since its debut in 2007, evolved to become teachers and led workshops to train apprentice artisans through the collection. The line particularly focused on the empowerment of refugees in the rural area of the Beqaa valley, who, at the time, were suffering from lack of access to basic supplies, education and employment potential. Conducted in partnership with SDAID, these workshops aimed to enable capacity building and autonomy to the youth.

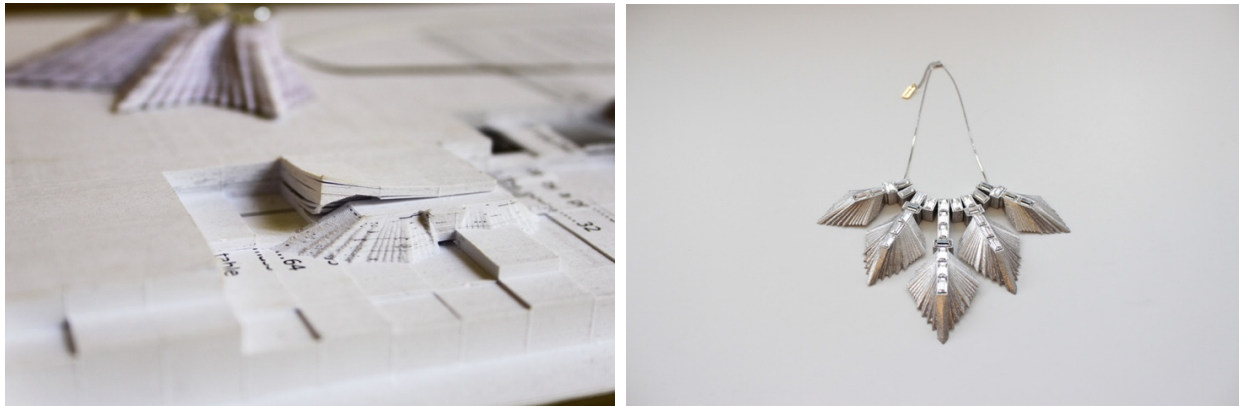*2.3. Waste-based 3d printing of fashion accessories: 'Leaves' collection*

Figure 5: 'Leaves' collection by Vanina: 3d-printing process of jewelry using used paper (1), one of the 'Leaves' necklaces (2).

The third case study, 'Leaves', is a collection of jewelry pieces created by Vanina in 2015, 3d-printed using used paper. Launched in partnership with the Irish company MCOR technologies and their local partners MTP (more than printing) and APP (the Arab Printing Press), the pieces were married with Swarovski crystals and painted with metallic coating. The 3d-printing process consists of progressive layering of the papers, and specific deposition of water-based glue in the areas that need to be solidified. The pieces derived inspiration from the fractal geometries of tree leaves, and were accompanied by a card explaining

the concept and materiality of the collection. By transforming used-paper into a durable wood-like texture, the collection invites to explore regenerative design and manufacturing methods through fashion. It was designed using architectural 3d-modeling software and involved the use of parametric systems to optimize the nesting of the pieces within the A4 paper block to limit waste and maximize energy efficiency. The line exemplifies how the incorporation of innovative ecological technologies in the manufacturing process of fashion pieces could lead to sustainable alternatives.

2.4. Development of new material using waste plastic: 'Les Eternelles' collection

Figure 6: Extract of bags from 'Les Eternelles' collection by Vanina featuring the handcrafted transformation of waste plastic into new marble-like lightweight texture.

The fourth project documented in this paper explores how fashion can be used as a tool to develop new recycling methodologies that promote the advancement of handcrafted artisanal methods. Released in

2021 by Vanina, 'Les Eternelles' is a line of evening bags based on a handcrafted plastic recycling process developed by the brand and its collaborators. Created in partnership with skilled artisans specialized in metal casting and lost-wax molding techniques, the line proposes to transform plastic scraps and pebbles into new multi-colored versatile textures. The forming is created through the recycling process: as the plastic melts to form a new texture, the three-dimensional shape is molded by hand. Each product is thus slightly different from the other as it bears the traces of the variety of the waste products that compose it as well as the handcrafting process. This collection exemplifies the need for brands to invest into their own material innovation processes in order to be able to turn waste products into luxury pieces.

2.5. Eco-luxury as engaged art: the 'Light of Beirut' capsule collection

Figure 7: 'The Light of Beirut' capsule collection by Vanina: non-commercialized series of evening bags created using the glass shattered by the 4th of August port of Beirut explosion as a tribute to the city.

Figure 7: 'The Light of Beirut' capsule collection by Vanina: the Daraj Bag.

The fifth project presented consists of a series of evening bags created by Vanina at the wake of the Beirut blast of August 4th 2020, handcrafted with the glass shattered by the explosion, proposed as a tribute to the heritage of the city. The pieces were designed using 3d architectural software and molded using digital fabrication, followed by an artisanal process of casting the glass debris in hand-polished transparent resin. The translucent material composite was married with gold-plated brass which served as handles as well as closure mechanisms. The line was initially envisioned as a limited-edition series with parts of the proceeds destined to contribute to the Beirut Heritage Initiative supporting the preservation of heritage buildings at the wake of the blast. However, following its launch, the brand decided not to commercialize the pieces due to the traumatic symbolic value that the glass pieces held in Lebanon following the explosion. The collection exemplifies the cultural significance and symbolic value of waste materials, and the memory and social significance that they hold. Fashion, in many ways, is a form of engaged art that can express cultural messages and statements in material and visual forms.

3. Frameworks to enable the use of fashion as a tool for social and environmental impact

This section extracts findings from the above-mentioned case studies, in order to inform the potential frameworks to follow to enable the use of fashion as a tool for social and environmental impact.

3.1. Material remediation through innovative craftsmanship: merging traditional handcraft with emerging digital fabrication technologies

As the projects described above exemplify, fashion has the potential to offer an afterlife to discarded materials while raising awareness about the problematic systems leading to their waste, and in many cases, landfilling and incineration. This transformation from waste to resource is enabled through the development of innovative craftsmanship techniques that drive inspiration from traditional handcraft, while making use of cutting-edge digital design and fabrication technologies. The use of advanced design tools such as parametric 3d-modeling software allow to reduce waste during the material transformation process by means of nesting, packing and mass customization. This cross-disciplinary approach, borrowing from other disciplines such as architecture and creative coding, allows to compose a new form of sustainable fashion derived from the use of discarded materials. Furthermore, the reliance on handcraft for the assembly process of the digitally transformed waste pieces offer the possibility to contribute to community development through the valorization of craftsmanship and environmental awareness. This also serves to preserve the intangible cultural heritage present in areas such as Lebanon, rich in its history of traditional handcraft and manufacturing techniques.

3.2. Social entrepreneurship model enabling sustainable R&D

The business model supporting the research and development of these projects is a social enterprise which relies on collaboration with local non-governmental organizations as well as international luxury stores to enable the creation and distribution of these sustainable fashion products. At a local level, the self-funded social enterprise model allows to prioritize impact over profit, which proves to be useful to support the process of research and development needed to achieve sustainable material innovation in luxury fashion. Through close collaboration with local NGOs, these collections enabled the implementation of community development projects, which helped expand the brand's decentralized network of artisans in Lebanon.

The projects featured, such as 'Conserved' and 'Délicatesse', engage communities in underprivileged neighborhoods, and promote their sustainable development through trainings in handcraft as well as the

implementation of alternative waste management systems managed in partnership with humanitarian organizations.

3.3. Glocal framework

Another important factor behind the implementation of these collections is the glocal framework in which they were created. Design, sourcing and manufacturing took place at a local level, which allows to reduce carbon emissions related to material sourcing, while contributing to the development of the local green economy. At the same time, the global network is key in ensuring the minimum volume needed for the implementations of these projects. This is achieved through wholesale partners that the brand meets every season during Paris Fashion Week. Operating in a local context of economic crisis and political instability, international markets are of key importance for a brand such as Vanina to ensure its sustainability and consistency in offering work opportunities to its network of artisans. At the same time, the multiplicity of its wholesale partners distributed across different continents helps sustain business in challenging global crisis such as the pandemic. During the Covid 19 lockdown, countries were affected differently and asynchronously; while some areas were closing up on imports, others were picking up and opening again, leading to a slower decrease of volume. Meanwhile, the local sourcing of raw materials and handcraft also allows fashion brands to remain resilient and continue manufacturing during unexpected global crisis and lockdown such as the pandemic.

3.4. Ethics and aesthetics of sustainable fashion

Moreover, the paper questions the potential for waste-based materials to be considered luxury by the consumer and the industry. An analysis of the retail prices of the products studied affirms that carefully collected and selected waste can viably regain value through meticulous innovative craftsmanship: the evening bags collections cited in this paper have retail prices that range between USD250 and USD1000, which falls in the range of mid to high luxury. Furthermore, as some of the case studies exemplify, the marriage of the new upcycled materiality with conventional precious elements such as high-quality crystals and gold-plated metal contribute to this revaluation. What are the ethics and aesthetics of fashion sustainability? The following paragraph describes the visual, textural, symbolic and commercial characteristics of this conscious form of luxury.

One of the commonalities between all the case studies is that at first sight, the products do not reveal the fact that they were created out of waste. Similarly, the marketing, positioning, packaging, and distribution channels of the collections are following conventional luxury standards. Meanwhile, the upcycled

materials are used in a way to provide the highest aesthetical qualities possible in order to suggest a level of preciousness: silver shining and pleating in the case of 'Délicatesse', marble-like textures in the case of 'Les Eternelles,' metallic painted fractal shapes in the case of Leaves, and shimmery translucent materiality in the case of 'The Light of Beirut'.

At the same time, the aesthetic of abundance and repetition, as seen in 'Délicatesse' and 'Conserved', celebrates a sense of time and encourage an appreciation of the handcraft that led to the product by revealing the intricacy of craftsmanship behind the piece. Furthermore, the marriage of handcraft and digital fabrication allows for consistency and precision, which is key to enable wholesale distribution. However, the production remains different from mass production methods, and instead, mass customization processes are adopted to adapt to the variety of the waste material collected, and allow for artisanal variations.

A new type of ecological opulence emerges from these practices: a form of renewable preciousness, celebrating social and environmental impact rather than the rarity of earth-extracted materials.

3.5. Need for trade policy strategies to support the promotion of sustainable alternatives

Although not precious-looking in their initial state, these waste materials are, in many cases, costly to source and transform, which limits their use to high end products and luxury items. In order for these processes to see the light at a wider scale and for everyday pieces, support from governmental agencies should take place as well as partnerships with academia for research advancement. At a global scale, trade laws could help support sustainable practices through incentives or taxes (such as the carbon tax for instance) that favor impact. Furthermore, with recent advancements in blockchain, full product traceability can now be enabled, and conscious trade systems could be implemented at local, regional and global levels.

3.6. Challenges and limitations of the framework

This paragraph looks at the challenges and limitation of sustainable fashion derived from waste, in view of identifying the gaps in the current ecosystem. As mentioned above, in many cases, the cost of access and transformation of discarded material requires a high-level positioning to ensure the financial viability of the collections. This in turn demands a minimum standard of luxury in terms of aesthetics, which, in many cases, results in the pairing of these waste-driven materials with other precious-looking ones. The problem is that frequently, these complementary materials such as crystals and plated metals lack full product traceability and sustainability. In order to ensure viable alternatives to these luxury standards,

organizations should invest in research and development in order to offer alternatives. Examples of such approaches are carbon-extracted diamonds, sustainable gold extracted from electronic waste, sustainable leathers out of mycelium, etc. These approaches are extremely promising yet are still at their infancy: access to these regenerative alternatives to standard material is still difficult, restricted to some brands which are partnering with the labs, and quite costly. As mentioned in the previous paragraph, trade policy strategies supporting sustainable alternatives would help accelerate the shift.

Furthermore, another challenge of the waste to luxury approach is the time it takes to implement sustainable and consistent systems of waste collection and transformation. Given the high-speed seasonal calendars of fashion distribution, meeting deadlines of wholesale deliveries is sometimes challenging. For instance, in the case of 'Délicatesse', the quantities of discarded packets that were needed to supply the wholesale order exceeded the speed of deployment of the alternative waste management system that was established in partnership with the NGOs, which was challenging and required ad-hoc systems of collection to be deployed at community levels. Identifying circular systems of collection and transformation, and embracing the non-seasonality of slow fashion, are key steps to enable the further development of such initiatives.

Another challenge of this approach is the fact that the research and development phase of material remediation through luxury is a costly process that encompasses a long phase of trial and errors and quality control. Support from research institutions through partnerships with between academia and public sector is key to enable such innovation. The following paragraph looks into the advancement academic models in fashion, design and innovation.

3.7. Importance of collaboration and cross-disciplinarity

As elaborated in the above paragraphs, collaborative and cross-disciplinary frameworks are key to enable the use of fashion as catalyst for social and environmental impact. These frameworks, which are needed in the business realm, can start at the level of the school. Some emerging methodologies of fashion education are promoting such transversal approaches, and thus are leading to sustainable innovation. The example of the Dubai Institute of Design and Innovation, where the author teaches, provides valuable insights regarding cross-disciplinary design frameworks anchored around innovation. The students are enrolled in a four years Bachelor of Design, that is particular for its cross-disciplinarity. After completing a foundation year common to all, students choose two of four cross-disciplines from: product design, fashion design, multimedia design strategic design management. This leads to the creation of lateral thinkers that explore fashion in non-traditional forms. For instance, the students are introduced to

methods of material design, and experiment with the creation of bio composites and bio plastics through their projects. Paired with advances in 3d-printing techniques and robotic fabrication that they explore in the product design disciplines, they are able to ideate and test new methods of material transformations. Furthermore, the pairing with strategic design and management allows to bridge academia with industry, and fosters an entrepreneurial mindset within the students, who are offered the possibility to engage in an incubation process at the end of their education. Furthermore, the pairing of fashion design and multimedia design formations also enable the development of new, digitally-supported, methods of fashion design. Bridging the boundaries between the virtual and the physical and adopting computational methods into the process of design.

4. Conclusion

As studied in the paper, when explored in tandem with research and cross-sector collaborations, fashion can be a tool for social and environmental impact. As the case studies exemplify, fashion has the potential to turn waste into luxury, thus providing sustainable alternatives to discarded by-products of the everyday currently considered detrimental to the environment. These alternative waste transformation processes, create value by means of upcycling instead of recycling or downcycling. At the same time, this transformation process allows to contribute to community development through the creation of green jobs and the preservation of craftsmanship heritage. Furthermore, with recent advances in digital technologies, this shift can be accelerated by investing in innovation through cross-disciplinary frameworks that lead to sustainable material transformation techniques as well as supply chain traceability and impact measurement systems. And finally, current contexts of socio-economic crisis, paired with global environmental challenges, are in dire need for alternative approaches that can serve as catalyst of sustainable development. As the case of Lebanon demonstrates, cross-sector collaboration between fashion brands and humanitarian organizations, through the social entrepreneurship model, enables an organic growth of a decentralized network of manufacturing that aims to engage in social and environmental development.