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Article

A Framework to Navigate Eco-Labels in the Textile and Clothing Industry

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Abstract: Considering the increasing demand for more sustainable products across many industries, eco-labels are a useful tool for communicating the sustainability-related performance of a product to the eco-conscious consumer. However, the abundance of different eco-labels and a lack of harmonization concerning their assessment methods can hamper their effectiveness. To address these shortcomings, this paper considers the methods employed by eco-labels in the textile and clothing industry to assess the sustainability-based performance of products. Using a sample of 10 eco-labels from the Ecolabel Index, a new framework for classifying eco-labels based on their assessment methods is developed. The framework includes two categories of label assignments ((i) binary and (ii) different levels of performance) and six types of assessment methods. These types are characterized according to the decision support features employed by the labels, such as lists of mandatory criteria, minimum (average) scores, percentage scores, and the weighting of sub-categories. The proposed framework shows the benefits of cascading decision science notions in the eco-labeling domain. It provides a harmonized vocabulary of components (i.e., a roadmap) to perform a consistent and traceable advancement of eco-labels. Consequently, it can be expanded at present to allow for the classification of other eco-labels in the textile and clothing industry and beyond.

Keywords: eco-labels; sustainability-related performance; textile and clothing products; assessment methods; framework; classification

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1. Introduction

In light of the growing demand for more sustainable and socially fair products in recent years [1,2], eco-labels (also called sustainability labels) allow producers to communicate information about products' sustainability features to consumers [3,4]. Hereby, eco-labels aim to tackle the concerns raised regarding asymmetrical and incomplete information on the sustainability-related implications of fashion products [5]. Consumers often have incomplete or a lack of knowledge about the production process of a product and therefore cannot internalize the environmental externalities in their purchasing choices [6]. Especially in industries with global supply chains involving multiple tiers and stages, a third-party assessment can reduce sustainability-related uncertainty [7]. By identifying products that fulfil a set of pre-set sustainability criteria, companies can use eco-labels to provide (credible) signals about their production processes. Thus, consumers wishing to make more responsible consumption choices can differentiate between more- and less-sustainable products [8].

Eco-labels are considered type-I environmental labels as established by the International Organization for Standardization (ISO) standard ISO 14024:2018 [9]. They "award a mark or logo to products or services upon fulfilling a set of criteria" [10] (p. 6). These voluntary eco-labeling schemes first establish a set of certification criteria in a consultation process with different stakeholders. Once established, products or companies can be awarded an eco-label if they provide the necessary documentation to prove their compliance with the criteria and pay an annual license fee. As opposed to self-declared environmental claims (type-II environmental labels), such as ‘compostable’ or ‘recycled content’, type-I labels are certified through a third-party program. Moreover, while type-III environmental labels use life-cycle data to portray quantified environmental information without assessing how the given product performs in comparison with similar products, type-I labels allow the comparison with other relevant products by identifying the most sustainable product choice [11].

1.1. Eco-Labels in the Global Economy

Since the 1990s, there has been a large increase in the number of eco-labels throughout many industries and sectors [12]. Perhaps most prominently, eco-labels are used in the food sector to signal factors such as organic contents or fair working conditions. The food sector has consequently been the focus of many scientific studies [13–17]. Beyond this, eco-labels have been established for many other industries, such as forests [18], steel [19], construction [20], as well as book binding [21], and have been proposed for additional sectors, such as the airline industry [22,23]. While some eco-labels cover a multitude of product groups (e.g., food, paper, and clothing), such as the EU Ecolabel or the Blue Angel in Germany, others have been developed for a specific product group, such as the Forest Stewardship Council (FSC) [24] or the Marine Stewardship Council (MSC) for fishing [25].

Overall, it has been found that (type-I) eco-labels are generally correlated with improved product sustainability [26]. Moreover, they increase consumers’ perceptions of the product’s quality and safety [27,28] and perceived behavioral control through their purchasing decisions [29,30]. Naturally, households’ considerations of eco-labels in product choices and thus willingness to pay for eco-labeled products is not only related to environmental awareness, but depends on their income level [31]. Nonetheless, many consumers are generally willing to pay for eco-labeled products [32–34]. However, the effectiveness of eco-labels is often impeded by factors, such as consumer confusion, information overload, and a lack of trust [35], as well as perceived quality [36], which creates a gap between the environmental attitudes and actual purchasing behavior [37].

1.2. Eco-Labels in the Textile and Clothing Industry

The textile and clothing industry (TCI) is one of the most polluting industries in the world [38]. Estimates for the share in global carbon emissions range from 3% [39] to 10% [40]. Moreover, the sector produces vast amounts of waste, is characterized by high water use, and employs many toxic chemicals [41]. Beyond these environmental impacts, the TCI is known for its poor working conditions, which have temporarily caused international outrage in the face of disasters, such as the 2013 factory collapse in Bangladesh [42]. Despite this, current production practices are sustained by clothing consumption patterns in western countries, which entail a high demand for so-called fast fashion: cheap, low-quality clothing with short longevity that is rapidly replaced, and purchased at a high frequency [43]. The uneven geographical distribution of consumption and production constitutes an outsourcing of the industry’s environmental and social burden from higher-income to lower-income countries, where labor is cheap and workers’ rights are less established [44].

These severe sustainability impacts and their implications for social justice issues highlight the necessity of addressing sustainability in the TCI. However, this can be a challenging undertaking due to the industry’s highly decentralized and complex structure. It is characterized by global supply chains with a variety of different industries, such as agriculture, the chemical industry, and service providers, involved [45]. This generates a lack of accountability and responsibility for negative externalities, which is maintained by the absence of international regulations addressing the environmental and social issues [46]. Moreover, the involvement of many different countries poses challenges for data collection and consistency [47].

Nonetheless, there have been increased efforts to transition the industry towards more sustainable practices in line with the sustainable development goals and the triple bottom line approach. This includes, for example, environmental management practices [48], the 3R model (reduce, reuse, recycle), or circular economy practices [49]. In Europe, the emergence of circular and slow fashion has been institutionalized in the EU Strategy for Sustainable and Circular Textiles [50]. On the consumer side, an elevated awareness of the industry's harmful effects has led to an increased demand for sustainably produced fashion [51–53]. In addition to the purchasing of second-hand clothing to reduce resource consumption and promote circularity [54], eco-labeling plays an important role in consumers' purchasing decisions. In a consumer survey conducted by Fashion Revolution in 2020, 80% of respondents indicated that they considered sustainability certifications when choosing which brands to buy from [55]. Thus, the use of eco-labels constitutes a significant opportunity for communicating and improving sustainability and circularity in the TCI.

1.3. Consumer Uncertainty and the Current Issues of Eco-Labels

Certification processes must be transparent, clear, and reliable in order to communicate effectively with consumers [56]. However, the current use of eco-labels faces certain shortcomings, which generate confusion and uncertainty on the consumer side and can hereby impede the credibility and effectiveness of eco-labels. The model developed by Walsh et al. [57], which conceptualized consumer confusion proneness in the face of increasing amounts of information in the marketplace, can be applied to the market of eco-labels. The authors differentiated between similarity, overload, and ambiguity confusion. Similarity confusion arises from the similarity of stimuli, such as design or branding, so that products are easily confused. Overload confusion results from the volume and diversity of available information by a large number of brands, so that consumers cannot consider all the relevant information for their purchasing decision. Ambiguity confusion is based on the multiple possible interpretations of a product's quality due to complexity, ambiguity of information, false product claims, or a lack of transparency. Consumers in the market of eco-labels are exposed to all three types of confusion due to three main shortcomings in established eco-labels.

Firstly, consumers face a large number of different eco-labels. The Ecolabel Index—the largest international database on eco-labels—currently lists 104 eco-labels in the textile and clothing sector [58]. Moreover, the logos of eco-labels are often similar in design, which makes it harder for consumers to differentiate between them [59]. These two factors can generate similarity confusion for consumers as they face many options that generally have the same aim of signaling sustainability. In a consumer survey conducted by Fashion Revolution and Ipsos MORI, consumers identified the number of eco-labels as a major barrier to buying fair trade products, making "the topic [. . .] just too complicated" [60] (p. 28).

Secondly, there is a lack of standardization in the assessment methods and criteria among different eco-labels. Labels assess different aspects of sustainability, such as climate change, pollution, or ethical working conditions, with different methods and varying complexities. For example, Liu et al. [61] found that carbon eco-labels employed many different methodologies and standards for their certifications. In the TCI, Goncalves and Silva [62] found "no common and widespread methodology for calculating fashion product sustainability" (p. 17) while reviewing the sustainability reports of the top-ten global apparel retailers. Therefore, consumers do not only face a range of available options for their purchasing decisions, but the available alternatives also inhibit the vast differences in content and complexity. Consequently, consumers who wish to educate themselves on the different eco-labels are subject to overload confusion due to the volume and diversity of the available information.

Lastly, individual eco-labels' sustainability assessment methods often inhibit the shortcomings. Credible eco-labels require robust and comprehensive methods of assessment, which should be reliable and verifiable to ensure the maintenance of quality claims. They should be based on life-cycle considerations, thus considering a product's impacts from the extraction of raw materials to the end-of-life phase. In practice, labeling schemes often employ criteria that lack transparency and inhibit subjectivity, and employ simplified approaches considering only certain life-cycle stages (LCSs) [63]. Horne [64] found that eco-labels predominantly employ "what is considered practical performance aspirations" instead of "any systematic consideration of environmental carrying capacity" (p. 178). Moreover, eco-labels should consider the trade-offs between the environmental, social, and economic dimensions of sustainability [65]. However, eco-labels often narrowly consider environmental impacts while disregarding the social and socio-economic aspects [66]. This ambiguity in assessment methods makes it difficult for consumers to interpret the information presented to them and thereby gives rise to ambiguity confusion.

In summary, consumers face a high degree of similarity, overload, and ambiguity confusion regarding eco-labels, which can be attributed to the number of available eco-labels, an overload of information due to non-standardized methods and criteria, and a lack of transparency due to shortcomings in the assessment methods. This uncertainty is reflected in consumer perceptions of eco-labels. For example, in a survey conducted among Slovenian consumers by Zurga and Tavcer [67], almost two-thirds of the respondents did not know what the EU Ecolabel signaled, with an even higher percentage (72%) for Blue Angel, and slightly better results for the OEKO-TEX® standard (49%). Similarly, a study among consumers in the UK by Henninger [68] found that consumers often did not have a good understanding of eco-labels' meanings or were not aware of them.

Consumer uncertainty can impede the effectiveness of eco-labels as the credibility of eco-labels is hampered. Harbaugh et al. [69] found that the proliferation of different eco-labels in the face of consumer uncertainty reduced the informativeness of individual labels and thus companies' incentives to become certified. Moreover, consumer misperceptions can incentivize greenwashing and reduce "greener" firms' abilities to convey their superior sustainability attributes [70]. Thus, the increased complexity and proliferation of eco-labels can reduce consumer trust in the face of a lack of credibility. Considering that consumer trust is a major factor for the use of eco-labels [71], the effectiveness of eco-labels might be impeded.

1.4. Main Contribution of the Paper

In the face of these shortcomings concerning the use of eco-labels at present and the resulting implications for their effectiveness, some efforts have been undertaken to tackle consumer uncertainty. For example, online platforms, such as the German website "Siegelklarheit", offer information on, and evaluation of, some eco-labels. Moreover, some studies have proposed tools for standardizing eco-labels, such as a framework for scoring the sustainability performance of specific labels [72], a "traffic light" rating [73], or an A–E scoring on eco-label reports [74]. However, there has been no widespread implementation of such initiatives. Therefore, it remains crucial to improve consumer (access to) information on the different eco-labels and their developments.

This study examines the development of decision recommendations by eco-labels in terms of the criteria and methodologies they employ. The main contribution is the development of a methodological framework based on eco-labels' assessment approaches, which is validated using a sample of eco-labels. Considering the global relevance of the industry, this study specifically focuses on the TCI. However, the framework can similarly be applied to eco-labels in other industries.

The paper is structured as follows. Section 2 presents the materials and methods used for the analysis, which contains a three-stage process. Section 3 reports the results, including the categories of criteria and LCS covered by the sample of eco-labels, and the framework depicting their methods of assessment. Section 4 entails the discussion of the results, including the limitations and avenues for future research, and Section 5 presents a brief conclusion.

2. Materials and Methods

The development of the framework for conceptualizing eco-labels in the TCI was inspired by the Design Research Methodology (DRM) approach by Blessing and Chakrabarti [75]. This research process has commonly been adopted for developing frameworks and methods in recent studies [76–79]. For the purpose of this study, it included three stages: observation and research clarification (Section 2.1), theory building and framework conceptualization (Section 2.2), and framework testing and validation (Section 2.3). The three stages of the methodological process are summarized in Figure 1, which was adapted from Lamperti et al. [76].

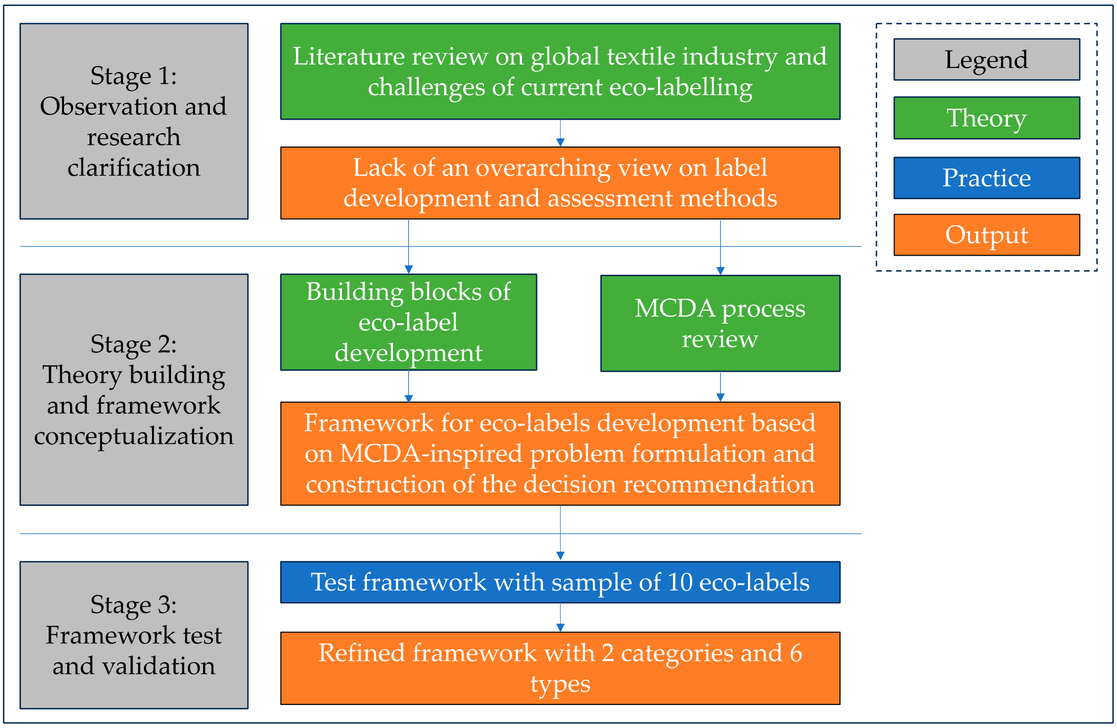

Figure 1. The three stages of the DRM applied to the methodological approach of this study.

2.1. Observation and Research Clarification

The first stage (observation and research clarification) of our methodology corresponded to the first two phases of the DRM, namely, research clarification and descriptive study I. It included the identification of a relevant research aim and clear goal of the study.

The literature review presented in the previous section highlighted the global relevance of the TCI as well as the potentials and challenges for improving sustainable production and consumption through eco-labeling. Evidently, consumers would benefit from increased information and an improved overarching view on existing eco-labels in order to make more informed and confident consumption choices. Therefore, evaluating the assessment methods used by eco-labels constituted a crucial issue.

Some studies have been conducted to identify and determine the frequency of the criteria and LCS used by eco-labels in the TCI [62,68,80,81]. However, the methodologies employed to assign (or not assign) the eco-label to a certain product have, to the best of the authors' knowledge, not been systematically researched. Hence, there is a lack of an overarching view on how eco-labels in the TCI are developed. A systematic approach to classifying the methodological approaches of different eco-labels in the TCI has not been developed yet, and this paper aims to start this process. To address this research gap, the main aim of this study was the development of a methodological framework to explore eco-labels in a systematic manner.

2.2. Theory Building and Framework Conceptualization

The second stage (theory building and framework conceptualization) of our methodology corresponded to the third phase of the DRM, namely, prescriptive study. It involved the creation of an adequate model/framework for pursuing the research aim. To do so, the main building blocks of eco-labels were considered from a multiple criteria decision analysis (MCDA) perspective. This highlighted the benefits of an MCDA-driven framework for the categorization of eco-labels.

MCDA is a methodology used for managing decision-making problems involving multiple alternatives, which are evaluated based on a set of criteria and the preferences of the decision maker [82,83]. Based on such preferences, MCDA develops models to assist decision makers in making complex decisions and provides a decision recommendation [84]. Evidently, MCDA displays strong parallels to the structure of eco-labels. In fact, the purpose of eco-labels is to assist a decision maker (the consumer) in choosing the most desired alternative (available products) according to a set of evaluation criteria (which are used to rate the performance of the alternatives). More specifically, the two domains overlap in terms of their two main building blocks.

The first building block of eco-labels are the criteria used to perform the sustainability assessment. Eco-labels address different aspects of a product's sustainability performance, which depend on the aim and scope of the labeling scheme. Thus, the relevant criteria for awarding the eco-label need to be identified. This corresponds to the first phase of MCDA, namely, problem formulation, which entails the examination of the decision-making problem at hand and the identification of the criteria used to assess the alternatives [85]. In addition, this phase also requires the selection of the types of decision recommendations to be provided to the decision maker. In MCDA, there are four types of decision recommendations [85]:

1. *Choice* of most preferred (sub-set of) alternative(s);
2. *Ranking* of alternatives from the best to worst;
3. *Sorting* of alternatives to preference-ordered classes;
4. *Clustering* of alternatives based on similar attributes or preference relations.

In the eco-labeling industry, the final decision recommendation can either employ the assignment (or not) of the eco-label itself to the clothing product, which constitutes the *choice* of the most preferred alternative. In more elaborate approaches, it can be the allocation of the clothing product to a preference-ordered class of performance, which implies a *sorting* of alternatives. In both cases, the most preferred alternative within a particular product category is identified.

The second building block of eco-labels are the aggregation strategies used to provide the decision recommendation. Type-I eco-labels usually consider more than one evaluation criterion, so that different criteria need to be assessed, and sometimes aggregated, for awarding the eco-label class or performance level. To do so, they require the choice of a method of integrating the information provided by the selected criteria. This corresponds to the second phase of MCDA, namely, the construction of the decision recommendation [85]. This phase in MCDA is performed according to three main families of aggregation functions: scoring functions, outranking, and decision rules. Similarly, products under the eco-labeling scheme can either receive a final score, be assessed in relation to other products, or be chosen according to a decision rule.

Given these similarities between the use of MCDA for providing decision recommendations and those supplied by eco-labels, the approach for developing the framework is based on the examination of the main building blocks that constitute the eco-labels. This entails (i) the main criteria used for the assessment and (ii) the type of aggregation strategy employed to assign the label, either in a binary (yes/no) manner or by assigning the product to different performance levels. By applying MCDA terminologies and processes to eco-label development, the framework provides a bridge between the two domains.

2.3. Framwork Test and Validation

The third stage (framework test and validation) of our methodology corresponded to the fourth phase of DRM, namely, descriptive study II. It entailed the validation of the conceptual framework through a practical application. Given that MCDA is a discipline developed for the specific purpose of providing decision recommendations using criteria and preferences, the validation stage in this study involved testing whether the stages of the MCDA process mentioned above (problem formulation and construction of the decision recommendation) were applicable to a sample of eco-labels. Thus, the criteria assessed (problem formulation phase) and the methods of aggregating the product's sustainability based on these criteria (construction of the decision recommendation phase) were closely examined during this stage. This involved the selection of a suitable sample of eco-labels (Section 2.3.1) and the refinement of the conceptual framework based on the analysis of the sample (Section 2.3.2). While the sample of eco-labels used in the conducted analysis was limited to 10, the contribution of the paper was the conceptualization of the framework, which could be gradually expanded as more labels were included in the analysis.

2.3.1. Identifying a Sample of Eco-Labels

The selection of a sample of suitable eco-labels for the analysis was shaped using a systematic process. It was based on the common approach for systematic literature reviews according to Siddaway et al. [86] and structured as performed by van Weelden et al. [87]. Inspired by the systematic inclusion schemas applied in systematic literature reviews, the exclusion criteria for the selection of the target eco-labels were defined ex ante. These addressed two tiers. Tier-1 exclusion criteria were formulated based on the scoping of the existing literature and aimed to make the sample of eco-labels comparable. Tier-2 exclusion criteria considered the previous research and publications and aimed to choose eco-labels that were commonly used and relatively well-known in the industry. The tier-1 and -2 exclusion criteria used to determine eligible eco-labels for the analysis, their justification, and frequency are listed in Table 1.

Table 1. Exclusion criteria for the screening process.

Tier	Nr.	Exclusion Criterion	Explanation/Justification	Frequency
1	1	Eco-label used primarily outside of Europe	Due to the wide range of available eco-labels, the analysis focuses on eco-labels most commonly used in Europe.	37
	2	Not a type-I environmental label (eco-label)	To make the different assessment methods more comparable, only type-I labels are considered.	1
	3	Eco-label focuses on one impact category (e.g., carbon emissions)	Eco-labels should aim for a holistic sustainability assessment. Thus, only eco-labels measuring more than one impact category of sustainability are included.	18
	4	Eco-label only applicable to specific product groups within textile industry	Eco-label should be applicable to a wide range of products throughout the TCI e.g., not only for leather or footwear.	10
	5	Eco-label established by specific company only for own products	The eco-label should be used by different producers and brands.	5
2	6	Limited availability of information	Sufficient information on the eco-labels' criteria and assessment method must be publicly available.	2
	7	Limited relevance of eco-label	Eco-labels should be either a) frequently mentioned in previous academic research on the subject, b) frequently mentioned on websites recommending eco-labels to consumers, and c) with GEN (Global Eco-labelling Network) membership [88] (Supplementary Information SI1, sheets 4 and 5).	22

The methodological approach for identifying the eco-labels included in the analysis is presented in Figure 2.

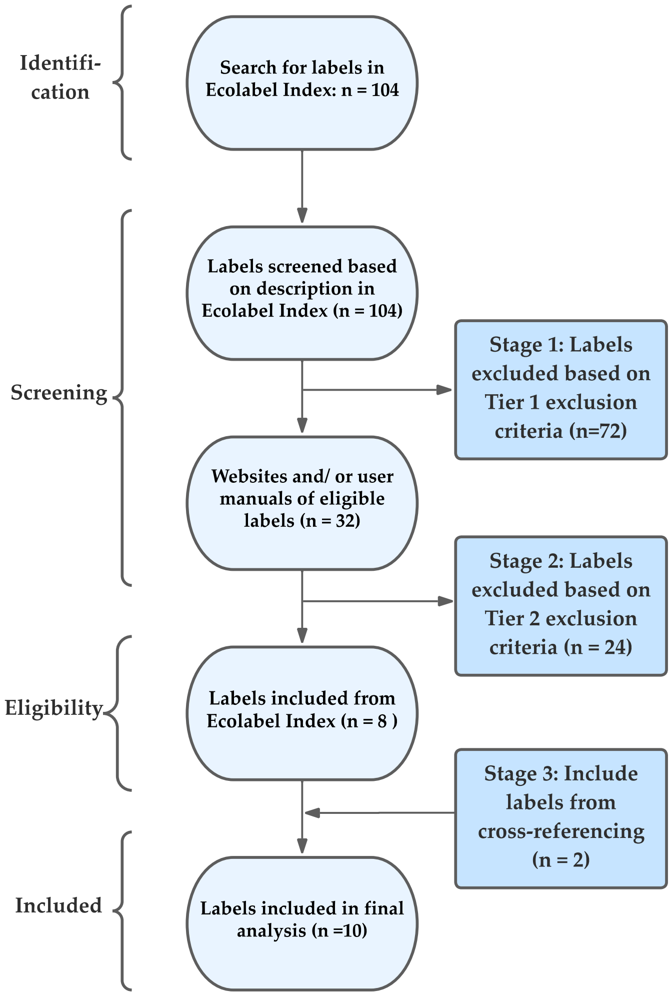

Figure 2. Methodological approach for identifying a suitable sample of eco-labels.

In the "Identification" phase, the database Ecolabel Index [58] was used as a starting point for identifying suitable eco-labels in the "textiles" category. This list contained both eco-labels specific to the TCI and eco-labels applied to multiple product types and sectors. The search in the Ecolabel Index yielded 104 results.

In the "Screening" phase, the results underwent a two-stage process to determine the eligibility of eco-labels based on the exclusion criteria. The screening process is reported in the Supplementary Information SI1. During the first stage, eco-labels were screened for potential inclusion based on the description given by the Ecolabel Index according to the tier-1 exclusion criteria. During this stage of the screening process, 72 eco-labels were excluded. The 32 eligible eco-labels deemed eligible in stage 1 proceeded to stage 2 of the screening process. Here, they were screened based on the eco-labels' websites and user manuals according to the tier-2 exclusion criteria. During this stage of the screening process, 24 eco-labels were excluded.

The eight eco-labels that were not excluded during the "Screening" phase reached the "Eligibility" phase. This was followed by stage 3, where two additional eco-labels were included through cross-referencing (Green Button from Blue Angel and STeP from OEKO-TEX®). This resulted in an overall sample of 10 eco-labels. Table 2 presents an overview of the analyzed eco-labels.

Table 2. Overview of the ten eco-labels used for the analysis.

Eco-Label	Summary	Link to Website
Blue Angel	Established by the German government more than 40 years ago, this eco-label is awarded to "environmentally friendly products and services". It covers a wide range of products and promises high standards for environmental protection and consumer health [89].	https://www.blauer-engel.de/en (accessed on 18 September 2023)
bluesign®	Developed by textile industry actors, this certification sets environmental standards and consumer safety criteria for companies and their products along the textile manufacturing path. The bluesign® PRODUCT certification requires production sites to be certified as bluesign® SYSTEM. Producers need to comply to bluesign® CRITERIA and materials need to be bluesign® APPROVED [90].	https://www.bluesign.com/en (accessed on 18 September 2023)
Cradle to Cradle Certified®	Assessing the impact categories of material health, circularity, air and climate protection, water and soil, and social fairness, this eco-label identifies products that perform well in circularity and safety aspects and are responsibly made [91]. Cradle to Cradle Certified® is a registered trademark of the Cradle to Cradle Products Innovation Institute.	https://c2ccertified.org/ (accessed on 18 September 2023)
EU Ecolabel (Ecoflower)	The official eco-label by the European Union (EU) was launched in 1992 to establish a single effective eco-label in the EU [92]. This eco-label identifies products that have a reduced impact on the environment throughout their life cycles. It covers a range of product groups, including textiles [93].	https://environment.ec.europa.eu/topics/circular-economy/eu-ecolabel-home_en (accessed on 18 September 2023)
Fair for Life	A textile eco-label with a focus on social responsibility and fair trade. This eco-label indicates the respect for human rights and fair working conditions, respect for the ecosystem and promotion of biodiversity, and respect for and betterment of local impacts [94].	https://www.fairforlife.org/pmws/indexDOM.php?client_id=fairforlife&page_id=home (accessed on 18 September 2023)
Fairtrade	While Fairtrade is known for its promotion of ethical trade in the food sector, the Fairtrade textile standard specifies criteria for clothing products that support small-scale producers in developing countries through several mechanisms [95].	https://www.fairtrade.net/ (accessed on 18 September 2023)
GOTS (Global Organic Textile Standard)	GOTS is the worldwide leading textile processing standard for organic fibers. Covering ecological (e.g., chemical inputs) and social criteria, it aims to unify the existing standards and define worldwide recognized criteria for organic textiles [96].	https://global-standard.org/ (accessed on 18 September 2023)
Green Button	Recently launched in 2019, this eco-label produced by the German government aims to provide a clear and simple indicator of the environmental and social sustainability performances of a product, while requiring responsible business behavior by companies. Conformity with the environmental and social criteria are assessed exclusively based on the existing certifications of the product or company through other eco-labels. These include Blue Angel, Fairtrade, GOTS, OEKO-TEX®, and Cradle to Cradle Certified® [97].	https://ww.gruener-knopf.de/en (accessed on 18 September 2023)
Nordic Swan Ecolabel	Established in 1989 as the official eco-label of the Nordic countries Denmark, Iceland, Finland, Norway, and Sweden, this eco-label works to reduce environmental impacts from production and consumption, setting strict sustainability criteria throughout the life cycle of a product [98].	https://www.nordic-swan-ecolabel.org/ (accessed on 18 September 2023)
STeP by OEKO-TEX®	A certification for environmentally friendly production sites by the testing institute OEKO-TEX®. While OEKO-TEX® Standard 100 tests and evaluates materials for chemicals and other harmful substances, STeP (Sustainable Textile and Leather Production) provides a comprehensive assessment of the environmental and social sustainability performances of companies [99].	https://www.oeko-tex.com/en/our-standards/oeko-tex-step (accessed on 18 September 2023)

2.3.2. Refinement of the Conceptual Framework Based on the Sample of Eco-Labels

Once the target eco-labels were identified, the required information on their development was retrieved from the corresponding eco-labels' websites, user manuals, and other publicly available documents. A detailed record of the relevant documents used for the analysis can be found in SI2.

To gain an understanding of the first building block (problem formulation), the most prevalent categories of criteria and the LCS assessed by each eco-label were recorded (Section 3.1). While the relevant LCS for the assessment were derived from the previous literature (see SI4), the criteria and their groupings into categories were partly based on previous studies in the domain and complemented by the criteria commonly assessed by the sample of eco-labels.

To examine the second building block (construction of the decision recommendation), each eco-label's method of aggregating the performance criteria and developing a decision recommendation was studied in detail (Section 3.2). The newly gained insights from this analysis were used to refine and diversify the basic structure of the conceptual framework. While the main differentiation between the binary assessment (yes/no) and assessment of different levels were applied to all eco-labels, various sub-groups within these two categories were identified. Moreover, different types of assessment methods were established, which presented more details of the development process and thus allowed for a more comprehensive and distinguished classification of the eco-labels.

3. Results

The categories of criteria and LCS were presented first as part of the problem formulation stage (Section 3.1). This was followed by our framework that allowed for the navigation of eco-labels in a systematic manner (Section 3.2).

3.1. Categories of Criteria and LCS

The first part of the analysis consisted of the examination of the problem formulation, i.e., the impact categories and LCS addressed by the sample of eco-labels.

To identify the relevant impact categories, the various criteria used by the sample of eco-labels were grouped into categories within different dimensions. While previous studies have focused on the environmental criteria of eco-labels in the TCI, this analysis considered all the relevant dimensions of sustainability. Thus, the dimensions were based on the three pillars of sustainability, which represented the consideration of environmental, social, and economic aspects. While the environmental dimension assessed ecological impacts, such as pollution or resource use, the social dimension addressed the impacts on people's welfare (both employees and consumers) and the economic dimension assessed the operational and strategic impacts on society [100]. These three dimensions are commonly incorporated into sustainability assessments [101–103] and have previously been applied in the TCI [104,105]. A fourth dimension, circularity, was added to account for the criteria that addressed the reduction in and recirculation of natural resources, an important aspect for the increased sustainability of consumption and production practices [106]. This aspect was considered in previous studies on the TCI [107,108] and was discussed as a new sustainability focus beyond the three dimensions [109,110]. Circularity criteria hamper the impacts on all three dimensions of sustainability and reduce the overall demand for new products or materials. Additionally, the "circularity" dimension addresses the management of the product rather than the production process. Therefore, it is adequate to establish a separate dimension. Within these four dimensions (environmental, social, economic, and circularity), the categories of criteria are based on the criteria found in previous studies and complemented by criteria commonly assessed in the sample of eco-labels.

For the environmental dimension, the study by Ranasinghe and Jayasooriya [80] identified environmental criteria used by European TCI eco-labels listed in the Ecolabel Index, which constituted the basis for the two categories of criteria. The first category, "Resource use", refers to the assessment of water use as well as energy use, sources, and efficiency. For example, bluesign® specifies a minimum percentage of renewable energy use [111,112]. Cradle to Cradle requires that water use is quantified in facilities for final manufacturing purposes [113]. The second category, "Pollution", refers to the assessment of the use of toxic chemicals, as well as emissions released into the air and water, and waste management. For example, multiple labels employ a restricted substances list [113–115]. Similarly, bluesign®, and Cradle to Cradle have their own systems for assessing chemical hazards [90,116]. The EU Ecolabel sets restrictions on the pH value and temperature of wastewater [115]. Fair for Life entails criteria for the storage of hazardous waste [117] and bluesign® lists maximum values for air emissions [111,112]. The last category, "Materials", refers to the assessment of the use of organic/eco-friendly materials, recycled materials, and the biodegradability of materials. For example, GOTS employs a list of limit values for chemical residues in materials [118]. Blue Angel requires a percentage of recycled and biodegradable materials [119].

For the social dimension, some criteria have been included in previous analyses. Based on the most prominent keywords displayed on the websites of 15 eco-labels in the UK's fashion industry, Henninger [68] identified sixteen commonly used attributes, which also included human rights and working conditions, as well as fair trade. Goncalves and Silva [62] listed the "Materials and products from suppliers with reduced social risks" and "Reduce or eliminate materials from social risky sources" criteria (see Table S3 in the Supplementary Materials). Thus, human rights and working conditions were included as categories of the criteria in the social dimension. The first category, "Human rights" refers to the regulations on human rights issues, such as child labor, forced labor, abuse, and discrimination. For example, STeP sets a minimum employment age [114], while Fair for Life sets criteria for the absence of forced labor [117]. The second category, "Working conditions", refers to the compliance to standards on, e.g., working hours, rights to association and bargaining, fair wages, as well as health and safety measures. For example, Fair for Life requires a written health and safety policy [117] and STeP sets a maximum overtime figure per week [114]. In both categories, a common tool for assessing social sustainability is the core labor standards by the International Labor Organization (ILO). Based on the 1998 Declaration on Fundamental Principles and Rights at Work, these standards include four main categories, namely, (1) freedom of association and the effective recognition of the right to collective bargaining, (2) the elimination of forced or compulsory labor, (3) the abolition of child labor, and (4) the elimination of discrimination in respect to employment and occupation [120].

In the economic dimension, the categories of economic criteria had to be added by the author due to the absence of clear indicators in the previous studies. They were derived from the common use of criteria in the sample of eco-labels that considered the impact of business conduct and strategies on local communities, as well as the degree of accountability and transparency. The first category, "socio-economic justice", refers to the assessment of ethical business behavior in terms of the positive impacts on local communities. For example, Fair for Life requires that companies provide job opportunities for local employment and engagement in social, cultural, and educational projects [117]. The second category, "Monitoring and strategy", refers to the assessment of intentions and strategies for future improvements, as well as the existence of an infrastructure for quality and compliance assurance. For example, Cradle to Cradle and Fairtrade require the existence of an environmental management system (EMS) [113,121]. Cradle to Cradle moreover demands a strategy for the implementation of environmental policies and efforts for continuous improvement [113].

Lastly, the criteria for the circularity dimension were based on Goncalves and Silva's criteria on the use of labeling information to increase product life, disposal/recycling instructions, and waste management. The first category, "Durability", refers to the assessment of efforts to increase the durability of products in relation to consumer use. For example, EU Ecolabel sets percentage limits on the loss of fiber fragments and dimensional changes during washing [115]. Nordic Swan requires producers to print a text on the product label, which incentivizes consumers to reduce the number of washes [122]. The second category, "Recycling and reuse", refers to the assessment of the implementation of reuse and recycling practices. For example, Cradle to Cradle specifies a minimum cycling rate and the implementation of a program to increase the cycling rate [113]. Moreover, it requires that the design of a product allows easy disassembly for cycling.

The analysis of these categories of criteria in the environmental, social, economic, and circularity dimensions is documented in SI3. Figure 3 portrays the frequencies per category graphically. Within the environmental dimension, all eco-labels include one or more criteria belonging to the "Pollution" category and 90% do the same for the "Resource Use" and "Materials" categories. Moreover, all eco-labels assess both categories of social sustainability criteria (i.e., "Working conditions" and "Human rights"). Half of the eco-labels also assess economic sustainability in terms of the "Socio-economic justice" category and 80% of the eco-labels cover the "Monitoring and strategy" category. For assessing circularity, 60% of the labels cover the "Durability" category and 30% assess "Recycling and reuse", rendering it the category least frequently assessed by the sample of eco-labels.

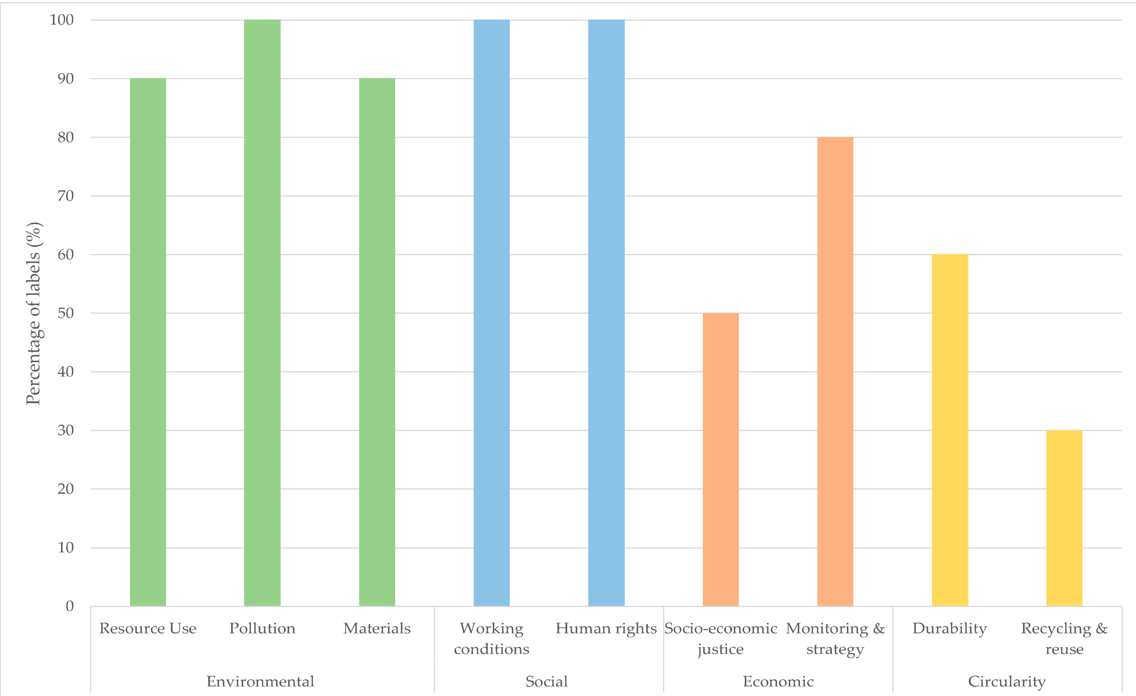

Figure 3. Frequencies of the categories of criteria in the sample of eco-labels (n = 10) considering environmental, social, economic, and circularity dimensions.

The identification of relevant LCS for the TCI was based on the existing academic literature. A description of the individual LCSs and their justifications based on the literature can be found in SI4. The analysis of the LCS is recorded in SI3. Figure 4 portrays the frequencies per LCS graphically. The most prominent LCSs assessed are "Raw material extraction", "Manufacturing of textiles", and "Fabric production", which are covered by all eco-labels. Least considered by the eco-labels is the "End-of-life" stage (10%), followed by "Retail" (20%) and "Transport/distribution" (30%). Half of the eco-labels consider the "Use" phase, and 70% consider the "Packaging" stage.

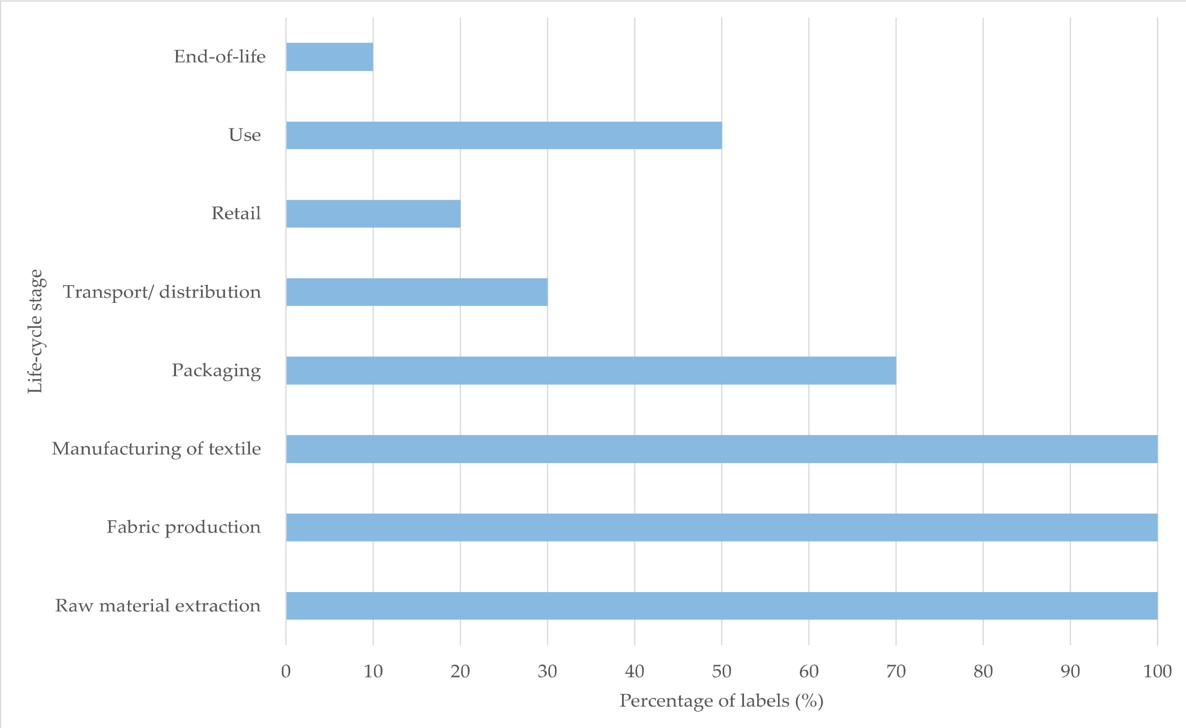

Figure 4. Frequencies of life-cycle stages addressed by the sample of eco-labels (n = 10).

3.2. The Framework to Navigate the Eco-Labels

The second part of the analysis consisted of the examination of the construction of the decision recommendations by the eco-labels, i.e., their aggregation methods. Based on this, the methodological framework for categorizing the eco-labels according to their assignments of the eco-label and/or the allocations to preference-oriented levels was refined in more detail. The framework is shown in Figure 5.

The framework entailed two main categories: binary label assignment (category 1) and label assignment on different levels (category 2). Additionally, the eco-labels can be classified into different types according to the methodologies used for assessing the performance of a product and thus deciding whether the product qualifies for the eco-label (and, if applicable, which level of certification it receives). Overall, six different types of assessments were identified in the research. Category 1 included type-1 and -2 methods, while category 2 contained type 3–6 methods.

3.2.1. Category 1 Eco-Labels

Category 1 consisted of eco-labels that were assigned in a binary manner. This constituted a simple Yes/No approach: the eco-label was either assigned to a product or not. While individual criteria might be rated using multiple levels of performance or compliance, there is no distinction between the different levels of the overall performance in the final certification. This implies the choice of one alternative. Category 1 included two types:

- Type 1: a list of mandatory criteria that all needed to be fulfilled;
- Type 2: mandatory criteria and a minimum score.

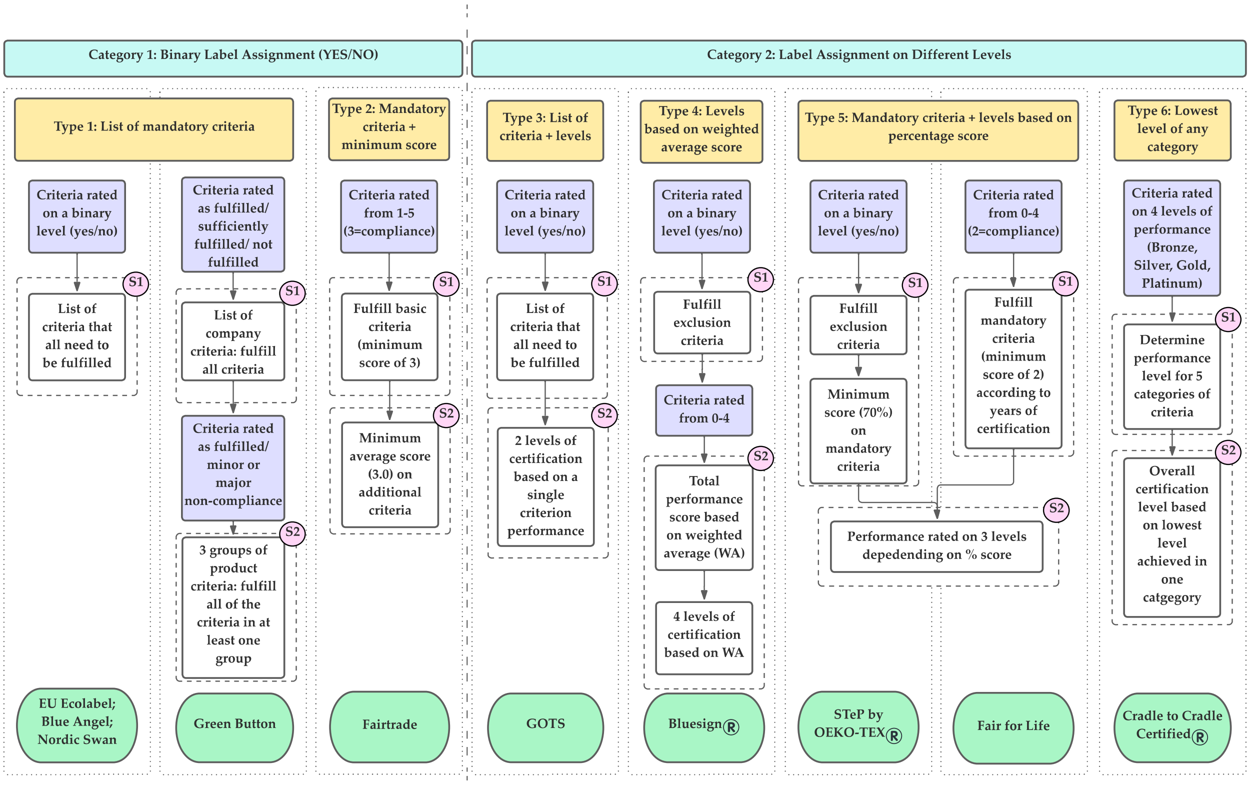

Figure 5. Framework for classifying the eco-labels. The six types are in yellow, within two main categories (in blue). The pink circles S1 or S2 signal the stages of the assessment process. Purple boxes contain information on how individual criteria are assessed. Green boxes entail the eco-label(s) that fit in each type.

Type-1 Eco-Labels

Type-1 eco-labels employ a list of criteria that must all be fulfilled by the product or company. Type 1 includes EU Ecolabel, Blue Angel, Nordic Swan, and Green Button. They employ either a one-stage (EU Ecolabel, Blue Angel, Nordic Swan) or a two-stage certification process (Green Button).

EU Ecolabel lists 28 criteria for textile products that all need to be fulfilled for certification (S1 in Figure 5) [115]. They cover six different categories: textile fiber criteria—material composition (9 criteria), components and accessories (3 criteria), chemicals and processes (4 criteria), fitness for use (9 criteria), corporate social responsibility (2 criteria), and supporting information (1 criterion).

Similarly, Nordic Swan provides a list of 104 criteria that must all be fulfilled for certification (S1 in Figure 5) [122]. These concern, among others, fiber production (18 criteria), the chemicals used for textile production (11 criteria), and energy and water consumption levels (1 criterion).

Meanwhile, Blue Angel lists 80 criteria in 11 categories that must be fulfilled for certification (S1 in Figure 5) [119]. These include criteria for textile fibers (12 criteria), general criteria (32 criteria), fitness for use (10 criteria), and packaging (1 criterion). To fulfill the standards concerning the working conditions, the products must meet the criteria of Green Button, a new German eco-label, which functions as follows.

Green Button differs from other eco-labels as it is partly awarded based on previous certifications of a product. It thus constitutes an initiative to standardize and simplify the communication of sustainability information to German consumers by assessing a textile product's sustainability performance using previously awarded certifications. Products labeled with Green Button must contain only approved fibers and materials [123]. Green Button certification consists of two stages (S1 and S2 in Figure 5). The first stage requires the fulfillment of "Corporate due diligence" criteria, which relate to the company business strategy and all need to be fulfilled by companies (S1 in Figure 5). These criteria are structured hierarchically; they consist of five core elements containing 13 criteria: "Policy and responsible business conduct" (3 criteria), "Analysis and prioritization of risks and adverse impacts" (3 criteria), "Prevention and mitigation" (3 criteria), "Public reporting and communication" (2 criteria), and "Grievance mechanisms and remedy" (2 criteria). The criteria are in turn assessed through a list of 54 indicators. All indicators specify the minimum requirements for the initial evaluation, while 33 indicators also specify more advanced requirements for the second surveillance evaluation. The level of compliance with individual indicators is rated on three levels: "not fulfilled" (nonconformity), "sufficiently fulfilled" (need for improvement), or "fulfilled" [124]. The second stage entails social and environmental criteria for products and production processes through the recognition of previous certifications (S2 in Figure 5). To be recognized by the Green Button, a certification must meet all the "recognition criteria" in at least one of three groups of criteria. The groups include (1) social criteria for the manufacturing production stage (38 criteria), (2) environmental criteria for the wet-processing production stage (22 criteria), and (3) criteria for fiber and material use, which contain ten sub-categories according to different kinds of fibers. In group 3, eco-labels must meet all of the criteria in one sub-category [125]. If recognition criteria are not sufficiently fulfilled according to the compliance indicators, it constitutes a minor or major non-compliance. Minor non-compliances can be resolved within a defined period of time and the conditional approval of the certification can be performed. In the case of major non-compliances, the certification is not recognized under the Green Button Standard.

Type-2 Eco-Labels

The type-2 eco-label certification process consists of two consecutive stages that differentiate between two types of criteria. In stage 1, a set of mandatory criteria need to be fulfilled (S1 in Figure 5). In stage 2, the minimum scores for a second type of criteria are required (S2 in Figure 5).

Fairtrade was the only type-2 eco-label from the sample. The criteria for the label were set by the certification body FLOCERT, and included "core" and "development" criteria [121]. They were grouped in the sub-categories "general requirements and commitment to Fairtrade" (54 criteria), "social development" (8 criteria), "labor conditions" (168 criteria), "environmental responsibility" (27 criteria), and "trade" (53 criteria) [126]. To assess the level of compliance for each criterion, Fairtrade employed descriptive indicators that correlated to a scale from 1–5, where 1–2 signaled non-compliance, while 3–5 signaled compliance. This could either mean that ranks 1 and 2 signified no fulfillment and ranks 3–5 signified fulfillment, or there were qualitative descriptions for each rank. During the first stage, all the mandatory criteria, so-called "core" criteria, needed to be fulfilled, meaning that a minimum score of 3 was required (S1 in Figure 5). During the second stage, the applicant needed to reach an average score of a minimum of 3.0 on the second type of criteria ("development") to qualify for certification (S2 in Figure 5) [127].

3.2.2. Category 2 Eco-Labels

Category 2 consisted of eco-labels that were assigned using different levels of certification. Based on the overall performance for multiple (sets of) criteria, they sorted products in preference-ordered levels. This category included four types:

- Type 3: a list of mandatory criteria and different levels of certification based on a single criterion;
- Type 4: overall performance level based on a weighted average score across different sub-categories of criteria;
- Type 5: mandatory criteria and different levels of certification based on a percentage score;
- Type 6: different levels of certification based on the lowest level achieved in one sub-category of criteria.

Type-3 Eco-Labels

Type-3 eco-labels employ a list of criteria in a similar fashion as type-1 eco-labels, where all criteria must be fulfilled. Subsequently, two levels of certification can be allocated according to the evaluation of the performance for a single criterion. The certification process thus consisted of two stages.

The Global Organic Textile Standard (GOTS) was the only type-3 eco-label from the sample. It certifies products that have a minimum share of organic content and are produced according to social and environmental standards. GOTS goods must be produced by GOTS Certified Entities (which can include processors, manufacturers, traders, and retailers) [118].

The eco-label is awarded in a two-stage process. In the first stage, it employs a list of mandatory criteria that companies must adhere to in terms of their production processes (e.g., environmental management), as well as the attributes of final products (e.g., limit values for chemical residues) (S1 in Figure 5). Moreover, GOTS criteria entail "general requirements for chemical inputs in all processing stages", "specific requirements and test parameters", as well as social criteria (71 criteria) and criteria for ethical business behavior (8 criteria).

In the second stage, the eco-label allows for a subdivision into two label grades, depending on the minimum percentage of content certified as organic (S2 in Figure 5). Products must contain a minimum of 70% certified organic fiber. The certification of the fiber as organic is conducted by a third-party certification program under the IFOAM Family of Standards [128]. Products with at least 70% certified content may be labeled as "made with x% organic (in-conversion) materials". Products may be labeled as "organic" or "organic in-conversion" if at least 95% of the fiber content (according to weight) is of organic content. This certification approach is summarized in Table 3 (adapted from [118]).

Table 3. Levels of certification for *GOTS*.

Condition	Level of Certification
Any of the mandatory criteria not met (including < 70% organic content)	Not certified
Mandatory criteria met + 70–94% organic content	Labeled as "made with [x]% organic materials" or "made with [x]% organic in-conversion materials" *
Mandatory criteria met + 95–100% organic content	Labeled as "organic"/"organic in-conversion"

* "In conversion" applies to agricultural practices transitioning towards organic [128].

Type-4 Eco-Labels

Type-4 eco-labels employ a two-stage process that includes a set of exclusion criteria (S1 in Figure 5) and the assignment of an overall performance level based on a weighted average score (S2 in Figure 5). To determine such a score, type-4 eco-labels use qualitative and/or quantitative information to assign a rating between 0 (worst) and 4 (best) for each criterion. Then, the average of the individual ratings is calculated for each sub-area and the main areas. The overall score is achieved by multiplying the scores from different areas with pre-determined weighing factors, depending on the type of production entity. Based on this average score, the applicant is classified on four levels.

Bluesign® was the only type-4 eco-label in the samples. It certifies production sites as bluesign® SYSTEM PARTNERS, based on a set of criteria and guidelines. These system partners can issue bluesign® PRODUCTS, which must additionally contain a minimum share of bluesign® APPROVED fabrics. To be certified as a system partner, the production sites are first evaluated against a set of exclusion criteria, of which none can be met (S1 in Figure 5) [129]. Consequently, the production sites are rated based on the assessment of different areas and sub-areas, and an overall performance level is determined (S2 in Figure 5). The specific criteria differ for chemical suppliers (CS) and manufacturers (M). Overall, there are 58 criteria for chemical suppliers and 55 criteria for manufacturers. These cover the management areas (11 criteria for M, 10 criteria for CS), product stewardship (12 criteria, only CS), input stream management (5 criteria, only M), resources (6 criteria for M, 4 criteria for CS), environment (25 criteria for M, 24 criteria for CS), occupational health and safety and emergency preparedness (7 criteria, respectively), and share of bluesign® approved chemicals (not considered in the initial assessment) [111,112].

Based on these criteria, the overall level of performance is determined (S2 in Figure 5). For each criterion, the criteria for the four different levels of performance (foundational/developing/progressive/aspirational) are specified, either qualitatively or quantitatively. Depending on the level of performance, a score between 0–4 (only integer points) can be assigned for each criterion. While 0 implies that foundational criteria have not been met, the scores of 1–4 refer to the four levels of performance (0 = not met; 1 = foundational; 2 = developing; 3 = progressive; 4 = aspirational). Based on this score, the average values for the next-highest sub-area and finally for the main areas of assessment were calculated [130]. The total performance score was a weighted average based on specified weighting factors. Thus, the score achieved in each of the seven areas was multiplied by the corresponding weighting factors shown in Table 4 (Source: [130]) to determine the overall performance level of the production sites. The points from the areas were added up and divided by 100 to derive the average score.

Table 4. Weighting of areas used by bluesign® during stage 2 of the certification process. The numbers portray the % share of the total score that each area depicts.

	Management	Product Stewardship	Input Stream Management	Resources	Environment	OH&S + Emergency Preparedness	Share of Approved Chemicals
Chemical supplier	20	20	-	10	20	20	10
Manufacturer	15	-	15	20	15	15	20

Based on this weighted average score, the overall performance of the production site was rated on four levels, which corresponded to the previous performance levels as portrayed in Table 5 (Source: [130]). If the score in one or more areas was below 0.5, it constituted a critical underperformance that risked the partnership with bluesign®. Thus, the minimum score of 0.5 for the lowest level of performance defined the threshold score for certification. Companies should aim to reach the "Developing" level until the first (re-)assessment [130].

Table 5. Rating of overall performance levels according to the weighted average score as employed by bluesign® during stage 2 of the certification process.

Average Weighted Score	Level of Overall Performance
0.5–1.4	Level 1: foundational
1.5–2.4	Level 2: developing
2.5–3.4	Level 3: progressive
3.5–4.0	Level 4: aspirational

Type-5 Eco-Labels

Type-5 eco-labels are assigned in a two-stage process. Firstly, a set of mandatory criteria (or a fixed share thereof) must be fulfilled (S1 in Figure 5). Secondly, three different levels of performance can be assigned based on the percentage scores (S2 in Figure 5). Type 5 contains two eco-labels from the sample: STeP and Fair for Life.

STeP by OEKO-TEX® certifies production facilities along the TCI supply chain. Applicants fill out an online form on the OEKO-TEX® website, followed by an on-site audit at the facility [114]. The questions of the web-based assessment tool cover six different modules, each of which are weighted equally (1/6 of total percentage of 100%). It thus employs a hierarchical structure. Within each module, the performance criteria are assessed by answering two types of questions: basic and advanced. Basic questions are mandatory and must be answered as a condition for the certification process. Advanced questions are voluntary and allow facilities or companies that strive for "best practice" to document and verify additional details about their production procedures [114].

In the first stage of the certification process, applicants must fulfil all exclusion criteria and need a minimum score of 70% for the basic questions (S1 in Figure 5). The exclusion criteria are included in the basic questions [114]. Overall, there are 94 exclusion criteria covering the six modules: chemical management (5 criteria), environmental performance (27 criteria), environmental management system (5 criteria), social responsibility (30 criteria), quality management (6 criteria), and health and safety (21 criteria). In the second stage, the overall performance of the facility is rated on three levels, based on the percentage of basic and advanced questions fulfilled (S2 in Figure 5). Table 6 portrays the performance levels according to the percentages (adapted from [99,114]).

Table 6. Assignment of certification levels by STeP by OEKO-TEX® certification.

% Score on Basic and Adv. Questions	Level of Overall Performance
Any exclusion criterion not fulfilled OR <70% on basic questions	Not passed
All exclusion criteria met + at least 70% of points on basic questions + <34% on advanced questions	Level 1: entry level ("Compliance with the entry level specifications")
All exclusion criteria met + all basic questions met + 34–66% on advanced questions	Level 2: good implementation ("Good implementation with further optimization potential")
All exclusion criteria met + all basic questions met + 67–100% on advanced questions	Level 3: exemplary implementation ("Ideal implementation in the sense of best practice examples")

Fair for Life employed a similar assessment on three performance levels as SteP but applied a different approach during the first stage. It listed 47 criteria in the categories "fair trade policy management" (2 criteria), "social responsibility" (12 criteria), "environmental responsibility" (7 criteria), "local impact" (3 criteria), "fair trade in supply-chain management" (10 criteria), "empowerment and capacity building" (4 criteria), "respect for the consumer" (6 criteria), and "managing certification and performance" (3 criteria). It depended on the size of the company or entity whether the criterion applied [117]. To rate the level of compliance, the eco-label used a numeral scale that could range from 0–2 to 0–4 (the maximum points for each criterion could be 2, 3, or 4) where a score of 2 signaled the "norm for good practice" and the minimum score for compliance. Thus, for each criterion, the product was assigned a numerical score. The scale is defined as shown in Table 7 (Source: [131]).

Table 7. Scale used by Fair for Life to evaluate criteria.

Numerical Score	Meaning
0	Very poor performance/not compliant at all
1	Not yet sufficient, but already positive developments towards the norm for good practice
2	Defined as the norm for good practice, i.e., compliance
3	Voluntary performance higher than norm, beyond the norm for good practice
4	Exceptionally high performance; outstanding, far beyond the norm for good practice

In the first stage of certification, the product must fulfill mandatory criteria that increase with advanced levels of aspired performance ratings (S1 in Figure 5). There were three types of criteria, KO (mandatory), MUST (expect rapid correction measures), and BONUS (optional). The criteria that were needed for certification depended on the years of certification and are listed in Table 8 (Source: [131]). While the KO criteria must always be met, for the MUST criteria, it was determined when they must be met. For example, MUST year 0 signals that it must be fulfilled before the initial audit and thus correspond to the eligibility criteria. MUST year 1 criteria must be fulfilled before the first-year certification, and years 2, 3, or 4 after that many years of certification.

Table 8. Types of criteria applicable for certification according to years of certification for Fair for Life.

Current Certification Year	Criteria To Be Fulfilled (Minimum Rating = 2)
Year 1	All KO + MUST year-0 and -1 criteria
Year 2	All KO + MUST year-0, -1, and -2 criteria
Year 3	All KO + MUST year-0, -1, -2, and -3 criteria
Years 4 and over	All KO + MUST year-0, -1, -2, -3, and -4 criteria

In the second stage of the process, an overall performance level was determined based on the points achieved for the criteria (S2 in Figure 5). Thus, the specific points achieved mattered only in stage 2 of the certification process. The overall performance score was attained based on the percentage of achieved points using the formula (Source: [131]):

$$\frac{Total\ number\ of\ points\ obtained\ (KO,\ \ Must\ \&\ Bonus\ criteria)}{Maximum\ possible\ points\ on\ KO\ \&\ Must\ criteria} \tag{1}$$

Both the numerator and denominators were thus a sum of points that consist of different ranges, according to the years of certification. Consequently, the overall performance was rated at three levels, as shown in Table 9 (adapted from [131]).

Table 9. Assignment of certification levels from Fair for Life.

Overall Performance Score
Less than 60% of overall performance
Between 60% and 80% of overall performance
More than 80% of overall performance

Type-6 Eco-Labels

Type-6 eco-labels assign the level of certification based on the minimum level of performance in different (sub-)categories. The level of certification was assigned in two stages. Firstly, the benchmark for each performance level was specified for each criterion. Based on this, the product was awarded the lowest level achieved for any of the criteria within each category of criteria (S1 in Figure 5). Consequently, the overall certification level was based on the lowest level achieved in a category (S2 in Figure 5). This implies that a product must meet the criteria for a performance level in at least the lowest category to be assigned the label. Thus, type-6 eco-labels employ a hierarchical structure of criteria.

Cradle to Cradle Certified® was the only type-6 eco-label from the sample. It uses a four-level scale (bronze, silver, gold, and platinum) for assessing the performances of individual criterion as well as the final levels of certification. For each criterion, different benchmarks were specified for the four levels. In addition to general criteria concerning systems for ensuring certification compliance and the assessment of environmental risks, 47 criteria were considered and grouped in five main categories. These were material health, where materials were classified into the risk-based performance levels A, B, C, X, or GREY [116] (9 criteria); product circularity (9 criteria); clean air and climate protection (8 criteria); water and soil stewardship (10 criteria); social fairness (11 criteria); and packaging and/or animal welfare, if applicable [113]. Within each of these categories, the product was awarded one of the four levels, if it met all the individual criteria for that level (S1 in Figure 5).

To assign the overall level of certification, the product must achieve the desired level in all of the categories. Similar to type-1 eco-labels, all criteria need to be fulfilled for a given level of certification. Thus, to be certified, a product must meet at least all the bronze-level criteria. The overall level of certification of the product corresponded to the lowest level achieved in one of the five categories (S2 in Figure 5). Products may be certified at the bronze level for a maximum of four years [113].

4. Discussion

4.1. The Sustainability Criteria Assessed by the Eco-Labels

The first part of the research examined the problem formulation i.e., the criteria and LCS addressed by the eco-labels. Section 3.1 briefly investigated the frequencies of the categories of criteria covering a range of impacts, and the LCS assessed by the sample of eco-labels. Concerning the categories of criteria, a strong focus on the environmental and social dimension of sustainability was observed, as almost all eco-labels assessed every category in these two dimensions. Notably, the unanimous representation of the "Pollution" category can be explained by the fact that eco-labels are often concerned with consumer health and safety, thus demanding the elimination of toxic chemicals used along the supply chain. Moreover, there was a relative neglect of the assessment of circularity attributes, especially concerning reuse and recycling efforts. The only label that presented elaborate criteria and specific instructions for increasing the circularity characteristics of a product was Cradle to Cradle Certified®. While it must be noted that the environmental impacts of recycling textiles are ambiguous due to the resource intensity of the process [132,133], the domain of circularity, especially reuse and extending a product's lifespan, can play a significant role in reducing resource consumption and thus constitutes an important pathway towards a more sustainable economy [134]. Lastly, the widespread representation of the "Monitoring and strategy" category highlighted the practical necessity of strategic interventions and adequate managing systems to monitor, implement, and track changes for realizing improvements towards greater sustainability.

Concerning the LCS, all the eco-labels focused on the production stages of the product's life cycle, namely, the extraction of raw materials, the production of fibers and fabrics, and the manufacturing of the final textile product. Furthermore, the limited consideration of the post-production LCS as observed in the low frequencies of transportation, retail, use, and end-of-life corresponded to the previous research [135] and the neglect of circularity attributes as observed above. This can partly be attributed to the methodological difficulties [136], which are exacerbated by the unpredictability of decisions made by consumers and the decentralized nature of transport and retail processes.

4.2. The Framework as a Roadmap for Consistent Eco-Labeling

The second part of the research consisted of analyzing the construction of the decision recommendation by eco-labels, i.e., their aggregation methods. Section 3.2 closely examined and provided a conceptualization of the approaches used by the eco-labels to account for and aggregate the performances for the individual criteria. Based on this result, the MCDA-based methodological framework was refined and diversified to allow for a detailed classification.

Although a variety of diverse assessment methods were observed, we found that the framework was suitable for all the eco-labels of the sample, resulting in the allocation within one of the two categories. Additionally, six types of methods for assessing the sustainability-related performance of a product were identified during the analysis: a list of mandatory criteria (type 1), mandatory criteria and a minimum score (type 2), a list of criteria and levels of performance based on a single criterion (type 3), levels of performance based on a weighted average score (type 4), mandatory criteria and levels of performance based on a percentage score (type 5), and the lowest level of any category (type 6).

Half (5) of the eco-labels employed a binary label assignment (category 1), which included type-1 and -2 aggregation methods. They provided a decision recommendation in the form of the choice of one option, which was the assignment or not of the eco-label. Type-1 eco-labels employ an "if. . .then. . ." rule-based assignment: "if products satisfy all the listed criteria, they are awarded the certification". This approach belongs to the decision rule modeling as presented by Greco et al. [137]. Notably, the eco-labels provided by governmental institutions (Nordic Swan in Nordic countries, Blue Angel and Green Button in Germany, EU Ecolabel) all used the type-1 method. While type-1 eco-labels employ a one-stage process, type-2 eco-labels use a two-stage process by firstly applying a decision rule model for core criteria (i.e., fulfill all mandatory criteria) followed by an average minimum score for development criteria. This was the case of the Fairtrade eco-label, which did not provide an explanation for the choice of such non-compensatory and fully compensatory aggregation models.

The other half of the eco-labels employed a distinction of different levels of performance (category 2), which contained types 3–6. They provided a decision recommendation in the form of the sorting of alternatives into pre-defined, preference-ordered levels based on their sustainability performance. Here, all types of eco-labels employed a two-stage process. A type-3 eco-label's assessment method includes a decision rule (fulfill list of mandatory criteria) and sorting into two performance levels based on a mono-criterion (in the case of GOTS, the percentage of certified organic content). A type-4 eco-label's assessment method consists of a set of exclusion criteria and a weighted average, which is used for sorting a product into four performance levels. Then, a type-5 eco-label's assessment method consists of a decision rule (fulfill mandatory criteria) and sorting into three performance levels based on the percentage score. Moreover, Fair for Life allows for the implicit weighting of criteria by assigning maximum scores (2,3,4) for each criterion. Lastly, type-6 eco-labels employ a sorting into four performance levels, where the criteria are specified for each level of performance. The overall certification level is assigned according to the lowest score achieved in any of the categories of criteria.

When cascaded in the MCDA domain, the main commonality among these eco-labels is the use of a decision rule approach as the main driver for the assignment of the eco-label or for the allocation of a certain level of the overall performance. This type of modeling implies the implementation of a strong concept of sustainability, since there is no compensation accepted between the performances of the criteria [138,139]. In addition to the decision rule approach, some of the eco-labels then apply other aggregation strategies, more specifically the additive weighted average (types 2 and 4), which, in contrast to the decision rule approach, implies the use of the weak concept of sustainability, as full compensation is accepted between the assessment criteria [140].

The main contribution of this research was the resulting framework for navigating eco-labels according to their approaches used for assessing the sustainability of a product or company and assigning (or not) the label or different levels of certification. The use of the MCDA terminology allowed us to adopt a systematic approach for considering the evaluation of alternatives and the provision of decision recommendations. This harmonized vocabulary of components used to perform the formulation of the decision-making problems provided a roadmap for the consistent and traceable advancement of eco-labels. The developers of the eco-labels can use the framework in two steps. Firstly, they should describe the criteria that they use as the basis for the assessment, clarifying the measurement units for each criterion (i.e., qualitative, quantitative, and semi-quantitative). Secondly, they should reflect on whether the aggregation approach they envision to assign (or not) the label or different levels of certification fits within one of the six types of strategies in the proposed framework. If this is the case, they have a suitable repository for their new label. If this is not the case, they have a justified reason for adding another type of eco-label to the framework.

This research has further shown that eco-labels in the TCI employ different decision support strategies that belong to the MCDA domain, without explicitly mentioning it in their reporting. In addition, there was limited focus on providing a justification for the choices of the aggregation algorithms used to develop the decision recommendations (i.e., label assignment or not, classification in a performance class). Overall, the decision support elements employed in the eco-labels were limited in relation to the MCDA process proposed in the existing literature on MCDA. As MCDA methods are specifically tailored to support the development of decision recommendations, future developments of current or new eco-labels in the TCI could make use of the MCDA Methods Selection Software (MCDA-MSS). MCDA-MSS is a taxonomy-based decision support system developed by Cinelli et al. [141], which helps analysts to identify the most appropriate MCDA method considering the features of the decision-making problem at hand. It contains 205 MCDA methods and uses a set of 156 features to describe decision-making problems. This decision support system can provide guidance for eco-labels developers who are tasked with choosing the most suitable method for the aggregation of information on the sustainability-based performance of a clothing product.

The implications of this study in the context of the fashion industry are two-fold. Firstly, as described above, the developed framework lays the foundation for a more structured approach for the examination of eco-labels' current assessment methods. When combined with other MCDA tools, it moreover allows for the adaptation of a more systematic and contemplated strategy in the choice of assessment methodologies for future eco-labels. Hereby, the conceptualization conducted in this study can contribute to the improved development of new or existing eco-labeling practices.

Secondly, the variety of identified eco-labeling approaches highlights the previously described lack of standardization among eco-labels in the TCI, specifically the lack of common sustainability assessment methods as pointed out by Goncalves and Silva [53]. This enhances the overload confusion for consumers, as they face a high degree of complexity and would have to invest considerable time and effort to research and comprehend the large amount of information necessary to make an informed decision. Additionally, the partial neglect of economic and circularity dimensions and LCS beyond the production stage further enhances ambiguity confusion, as consumers cannot be sure of what an individual eco-label represents. In combination, these two effects imply that the lack of standardized assessment methods can lead to increased consumer uncertainty, which can impede their trust and credibility, and thereby the effectiveness of eco-labels. This implies that eco-labels would benefit from a more coherent and traceable approach to shaping labels, which our proposed framework can contribute to. In fact, our framework provides an initial clustering of strategies for developing eco-labels. This enables developers of such labels to justify the choices made to select the criteria for the assessment and the aggregation methods to reach the final decision recommendation (either granting the label or a certain level of performance).

4.3. Challenges, Limitations and Avenues for Future Research

This study faced several challenges. The assessment of the considered LCS by each eco-label was arduous as most eco-labels did not specify the LCS that their criteria applied to, which demanded assumptions and deductions of applicability by the authors. An exception to this was Green Button, which specified that its social criteria referred to the manufacturing stage (cutting and sewing), while the environmental criteria referred to wet processes (bleaching, dyeing, and impregnating of textiles), and moreover identified the LCS the company criteria referred to. A further challenge was the lack of dedicated explanations in the methodological sections of the eco-labels, without a provision of the rationale for the selection of the chosen aggregation methods to assign (or not) the label or a suitable performance level. This required the authors to "dig" through the reference materials and perform a mapping of such information to the conceptual components needed for the labeling.

The main limitation of the study was the sample size. While the contribution of the paper was of a conceptual nature, it must be acknowledged that the developed framework was only the result of the analysis of 10 eco-labels in the TCI, out of a total of 104. Even though the 10 eco-labels were selected based on a transparent set of exclusion criteria, no generalizability could be claimed for the framework. Therefore, future research should assess and classify more eco-labels in the TCI and in other sectors, so that the framework developed in this study can be expanded. This could be a first step in evaluating the generalizability of the framework in the TCI and beyond.

Another limitation of the framework was that it did not include in its assessment any considerations about the interpretability, understanding, trust, and awareness of the eco-labels from the side of the consumers. Hence, future research should examine consumer perceptions of eco-labels more closely. Here, the framework can be used as a starting point for analyzing the relevance of different attributes for consumer recognition and the understanding of eco-labels. More specifically, it could be studied how or whether consumers' perceptions of eco-labels, including the level of associated trust and credibility, are related to the type and complexity of eco-labels' assessment methods, as well as the number of different impact categories and LCSs covered by eco-labels. Moreover, it can be identified how consumers respond to diverse approaches of reporting information on the products' sustainability performance. For example, whether they prefer an aggregated portrayal in the form of an A–F scale, which combines all impacts in a single index, or a disaggregated portrayal in the form of bar charts depicting the individual performances of the product in different impact categories. Another point of interest is whether consumers prefer eco-labels that report products' performances in absolute numbers or those reporting relative scores in comparison to conventionally produced products.

To conduct the proposed inquiries in a real-world setting, the developed framework can be tested with a subset of consumers to determine the features of the methodological approaches and other criteria consumers value. For example, this can be implemented in a mixed-method research study with a combination of interviews and focus groups, while including different income levels and geographical locations. Therefore, a harmonized set of features that should be prioritized when being exposed to eco-labels can be developed. The results from these studies should subsequently be aligned with labeling bodies to assess the opportunities for implementing these attributes. This can provide important insights into the improvement of current or future eco-labels.

5. Conclusions

This study highlighted that consumers in the clothing market at present not only face a large number of eco-labels assessing different criteria and LCSs, but that these eco-labels also display significant differences in their assessment methods. The presented framework allowed for the classification of various methods of assessing the sustainability-related overall performance of clothing products in a systematic manner. This showcased how MCDA could contribute to the conceptual mapping of eco-labels' assessment methods by providing the appropriate terminology to assist in dealing with the recurrent components needed to assess performances and provide decision recommendations, namely, the criteria and the aggregation methods. Considering the necessity for more comprehensive and standardized assessment methods by eco-labels in the TCI, MCDA tools can hereby assist in choosing the most adequate methods for the current and future developments of eco-labels. These insights can be complemented in future studies by further investigations of consumer perceptions and trust concerning eco-labels according to the various attributes of the methods and their portrayal to consumers. This will contribute towards a more consistent and transparent communication of clothing products' sustainability performances, thus reducing the uncertainty currently faced by the eco-conscious consumer.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su151914170/s1, SI1: Screening process; SI2: Documents used for analysis; SI3: Analysis of the eco-labels; SI4: LCS descriptions [11,47,62,67,135,142–147].

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