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Systematic Review

Efficacy Beliefs and Natural Resource Conservation: A Systematic Review and Meta-Analytic Investigation

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Abstract

Environmental degradation represents a critical global challenge. Given its profound impact on ecosystems and societies, understanding the psychological factors that motivate individuals to engage in natural resource conservation behaviors has become increasingly important. Because efficacy beliefs (i.e., self-efficacy, response efficacy, and collective efficacy) are key psychological drivers of both plans and actions, a meta-analytic approach was used to estimate the associations between efficacy beliefs and conservation-related intentions and behaviors. The moderating roles of data collection method, population type, culture, and participants' gender were also examined. Five meta-analyses synthesized the findings from 50 studies on conservation intentions and behaviors, revealing medium-sized positive associations with self-efficacy (intention, $r = 0.47$; behaviors, $r = 0.41$) and response efficacy (intention, $r = 0.36$; behaviors, $r = 0.34$), whereas the association with collective efficacy was small (single index, $r = 0.28$). Although substantial heterogeneity was observed, none of the tested moderators reached statistical significance, highlighting the need for future studies. Overall, these findings underscore the importance of strengthening individuals' beliefs in their ability to engage in conservation behaviors.

Keywords: environmental psychology; pro-environmental behaviors; efficacy beliefs; meta-analysis

1. Introduction

Environmental degradation poses an increasing threat to life on the planet, driven largely by the growing demand for natural resources associated with population growth and rising standards of living [1,2]. This unsustainable exploitation of natural systems accelerates land degradation and deforestation, aggravates water scarcity, and exacerbates biodiversity loss. Such environmental pressures undermine ecosystem functioning and translate into broader societal challenges, including food insecurity, poverty, and inequality [3]. Furthermore, the above-mentioned degradation processes—particularly deforestation—release substantial amounts of carbon dioxide (CO_2) into the atmosphere, destabilizing precipitation patterns and accelerating global warming [4,5]. As environmental degradation is one of the most urgent environmental issues [6], collective and individual conservation efforts are becoming increasingly critical. Through the adoption and promotion of conservation behaviors, people can play a crucial role in environmental protection.

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1.1. Conservation Behaviors

Conservation behaviors constitute a specific subset of pro-environmental behaviors, a broad category of actions that minimize harm to natural systems and/or improve the environment [7]. This macro category encompasses several subtypes. For instance, it is possible to distinguish consumption-related behaviors from those concerning transportation, recycling, and reusing, as well as behaviors focused on resource conservation [8]. Specifically, natural resource conservation behaviors (hereafter "conservation behaviors" for brevity) refer to those pro-environmental actions through which individuals directly manage, protect, or restore natural resources. Examples include increasing the number of trees and biological species by planting native plants, or leaving certain areas undisturbed and unmaintained to provide space for wildlife [9]. By engaging in conservation behaviors, individuals actively preserve natural resources and ecological areas through their interactions with the environment [10].

Given the central role of individual action in environmental protection, understanding the psychological processes that support the adoption and maintenance of conservation behaviors becomes critical. From a social-cognitive perspective, one of the key factors that regulates behavior choice, commitment, and persistence is efficacy beliefs—namely, self-efficacy, response efficacy, and collective efficacy [11,12]. Efficacy beliefs are acknowledged as vital predictors of pro-environmental behaviors across a range of models beyond Social Cognitive Theory, including Protection Motivation Theory [13], which addresses self-efficacy (defined as "performance efficacy") and response efficacy, and the Social Identity Model of Pro-Environmental Action [14], which encompasses collective efficacy. Consistent with these perspectives, many studies have examined the relationship between efficacy beliefs (self-, response, and collective efficacy) and conservation intentions and behaviors.

However, to our knowledge, no quantitative synthesis has yet combined these findings, with the only exception of a recent meta-analysis on the predictors of energy-saving behaviors [15]. The present study extends this line of research to other conservation behaviors, focusing on efficacy beliefs and updating their systematic literature search (dated back to February 2023).

1.2. The Role of Self-Efficacy in Conservation Intentions and Behaviors

Self-efficacy refers to an individual's conviction in their ability to perform recommended behaviors to achieve desired outcomes [11]. In the specific context of conservation behaviors, self-efficacy refers to people's confidence in their ability to perform conservation-oriented behaviors that use natural resources responsibly. For instance, research on water- and energy-related practices shows that self-efficacy plays an important role in shaping conservation intentions and the adoption of efficiency-related actions [16–18]. Moreover, in households where water conservation behaviors were implemented, residents reported a strong confidence in their ability to conserve water [19], suggesting a potential bidirectional relationship between self-efficacy and behavior. Baah and colleagues [19–21] further showed that when residents are not confident in their ability to save water, they also lack the intention to do so and are unlikely to engage in water conservation behaviors.

Consistent with these findings from residential contexts, higher self-efficacy similarly translates into conservation behaviors in agricultural settings. Specifically, greater self-efficacy supports farmers' engagement in behaviors that safeguard water bodies [22] and not only that, but it also promotes soil conservation practices, as farmers with strong self-efficacy tend to perceive these initiatives as feasible, which motivates them to engage in the protection of soil resources [23–27].

Further extending this pattern, research on energy conservation indicates that self-efficacy is positively associated with energy-saving intentions and behaviors among both

residents and employees. This suggests that, even in organizational contexts, fostering self-efficacy beliefs may contribute to achieving sustainability goals—particularly those related to reducing electricity consumption [28,29]. The convergence of evidence across residential, agricultural, and occupational settings illustrates how self-efficacy functions as a cross-domain motivator of conservation behavior.

Importantly, the influence of self-efficacy extends beyond utilitarian conservation settings and also emerges in the context of immersive nature experiences. Indeed, Clayton and colleagues [30] found that, among zoo visitors, self-efficacy was the strongest predictor of behavioral intentions to protect biodiversity and was correlated with existing conservation behaviors. Crucially, they reported that zoo visits incorporating conservation education can enhance self-efficacy, thereby strengthening the potential for future interventions. Similarly, among forest visitors, self-efficacy significantly predicted conservation intentions, highlighting opportunities for targeted awareness initiatives in recreational natural settings [31,32]. These studies emphasize that self-efficacy is relevant even in less structured, leisure-oriented environments, where direct engagement with nature may support pro-environmental action.

Additional insights into the mechanism linking self-efficacy to behavior come from studies that compare self-reported and objective conservation actions. Fielding and colleagues [33] observed significant—but modest—correspondence between what people say they do and what they actually do in their households. Notably, this correspondence strengthened among individuals reporting high levels of self-efficacy, suggesting that it may enhance individuals' sense of agency and behavioral self-regulation—core mechanisms described in Bandura's social cognitive theory [34]—thereby increasing the consistency between what people believe they do and their objectively observed actions. In this sense, strong self-efficacy may also reduce discrepancies between intentions, self-perceptions, and actual behavior, functioning as an alignment mechanism within the intention–behavior process. Complementing this, Lauren et al. [35] found that self-efficacy for relatively easy conservation behaviors (e.g., washing full loads) predicted engagement in more demanding actions (e.g., installing low-flow taps) after nine months. This pattern suggests a potential spillover process, whereby increasing self-efficacy for simple actions may lead to the adoption of more challenging behaviors over time.

1.3. Response and Collective Efficacy

Response and collective efficacy are other relevant predictors of conservation behaviors, although these constructs have received considerably less attention than self-efficacy. Response efficacy refers to the belief that a given behavior is effective in mitigating or preventing harm [36]. In the context of natural resource conservation, it reflects the extent to which individuals perceive their actions as capable of reducing the negative consequences of inappropriate exploitation. Recent studies show that response efficacy is an important determinant of behaviors aimed at protecting natural resources [26,37]. For example, it strongly predicted farmers' intentions to conserve water, highlighting the value of clearly informing them about the effectiveness of conservation practices [38,39]. Among residents, believing that water-saving behaviors are effective has similarly been associated with stronger intentions and actual implementation of conservation actions [19]. Other research reports that response efficacy predicts water conservation during drought conditions [24], biodiversity-related conservation intentions and behaviors [26], and intentions to engage in energy-saving practices [28].

As for collective efficacy, it refers to a group's shared conviction in its collective ability to perform actions required to achieve desired outcomes [12], which, in conservation contexts, translates into the perceived capacity of groups to effectively conserve the envi-

ronment. It should be particularly relevant because conservation behaviors often occur within shared community environments. Collective efficacy has been shown to influence pro-environmental actions such as biodiversity and forest conservation (e.g., compliance with rules in protected areas), suggesting its value as a lever for motivating collective environmental engagement [40,41]. Evidence further indicates that collective efficacy, alongside individual efficacy beliefs, contributes to water conservation behaviors among both farmers and residents, especially when environmental threats are perceived as shared community problems (e.g., drought or water pollution; [16,42]). However, mixed results emerged for certain outcomes, such as intentions to save energy [28].

1.4. Objectives

This paper aims to synthesize the results of multiple studies reporting correlations between efficacy beliefs and conservation intentions and behaviors. We aimed to estimate the overall effect size of the association between self-, response, and collective efficacy on the one hand, and conservation intentions and behavior on the other. We focused on these behaviors because of their potential to create a bridge between research and key stakeholders, such as farmers' associations or energy providers. Establishing common ground is crucial because it allows scientific findings to be translated into actionable strategies, facilitates stakeholder engagement, and ensures that interventions are both practical and contextually relevant. In addition, our focus on efficacy beliefs aims to understand how to promote these pro-environmental behaviors and how to increase public awareness of conservation.

We examined both intentions and behaviors because, according to Bandura [43], they represent two points along the same functional continuum: intentions are "a representation of a future course of actions to be performed" and "a proactive commitment to bringing them about" (p. 6), whereas a behavior reflects the actual enactment of those actions.

In addition to the primary aim of estimating the overall effect size of the association between efficacy beliefs and conservation intentions and behaviors, our secondary aim was to examine potential moderators of these associations.

1.5. Potential Moderators

To explain possible differences across the results of the studies included, we examined different types of moderators (see Supplementary Table S1).

Data collection method. We explored whether the magnitude of the effects varies by mode of administration: self-report questionnaires or structured face-to-face interviews. Indeed, these two modes of administration involve different psychological processes (e.g., cognitive burden or rapport with the interviewer; [44]), which allowed us to classify the studies into two distinct groups and test a potential moderation effect. Since the questionnaire is less affected by social desirability bias than the interview, this methodological choice could influence the way respondents estimate their engagement in desirable behavior as a self-presentation strategy [44]. When responding to an anonymous self-report, participants may feel free to admit that they do not regularly engage in conservation behaviors, despite perceiving themselves capable of doing so. In contrast, during face-to-face interviews, participants could feel greater pressure due to social desirability, increasing the tendency to report behaviors more consistent with their perceived abilities. This could strengthen the association between self-efficacy and conservation behaviors in the interviews compared to the self-report questionnaires.

Populations. As for populations, we divided the studies into two categories based on the context of their use of natural resources: the work-related group included individuals who directly interact with natural resources as part of their occupation or economic activity, such

as farmers and employees in any sector. The non-work-related group included individuals who interact with natural resources as consumers or in leisure contexts, such as residents, students, and visitors. In work-related situations, individuals may perceive economic pressures that discourage environmental engagement to avoid potential economic loss [45]. Therefore, since economic constraints can hinder individual pro-environmental actions [46], they may interfere with the relationship between self-efficacy and behavior, weakening the association between the two variables for the work-related group more than the other.

Culture. Although Social Cognitive Theory posits universal mechanisms linking efficacy beliefs to behavior, the relative weight of individual versus collective agency may vary systematically across cultural contexts [47]. Therefore, we expected that differences in cultural contexts could account for variation in effect sizes across studies. In an individualistic culture, independence and individual initiative are more strongly emphasized than in collectivist countries, where social identity and group solidarity are more highly valued [48]. Self-efficacy, as a personal belief, could play a more influential role in shaping behavior in individualistic cultural contexts; vice versa, collective efficacy may be more impactful in collectivistic rather than individualistic societies. Differences between individualistic and collectivistic cultures may call for different training strategies to foster efficacy beliefs and, consequently, conservation behaviors—individual training in the former and group training in the latter [47]. To investigate this potential moderator, we classified each country where the study was conducted according to the novel Individualism–Collectivism Index [48,49].

Gender. Research has consistently shown that women tend to report higher levels of environmental concern and stronger pro-environmental orientations than men (e.g., [50,51]). Because self-efficacy functions within a motivational context shaped by personal values and concern, it may exert a stronger influence on women's pro-environmental intentions and behaviors, as these attitudes are generally more salient and internalized among women compared with men. On the other hand, previous research also noted a weaker correlation between self-efficacy and some energy-saving behaviors in women rather than in men, mainly due to the different use of heating caused by greater indoor thermal discomfort [52]. Investigating how gender may moderate the effects of efficacy beliefs can inform policy guidelines and intervention strategies [52].

2. Method

2.1. Search Strategy and Inclusion Criteria

Operationally, we defined conservation behaviors as actions through which individuals directly reduce their consumption of natural resources (e.g., saving water or energy) or actively protect and restore them (e.g., planting trees). This definition excludes indirect or mediated behaviors (such as signing petitions). Only behaviors with a direct, proximal impact on natural resources were considered as conservation behaviors.

The systematic review and the meta-analyses were conducted in accordance with the PRISMA 2020 guidelines [53]. Relevant studies were identified using the following methods: (i) electronic databases (Scopus, PsycInfo, Psychology and Behavioral Science Collection, Web of Science, PubMed, Open Science Framework, and Prospero) were searched; (ii) reference lists of included articles were manually searched; and (iii) mailing lists of relevant societies or groups (European Association of Social Psychology, EnvPsy, and International Association of Applied Psychology) were used to request unpublished data.

The inclusion of unpublished data aimed to reduce publication bias by capturing studies with smaller or null effect sizes unlikely to appear in peer-reviewed journals.

The systematic selection process through electronic databases was conducted in the first half of March 2026 (2–16 March), using the following search string: ("self-efficacy" OR "response efficacy" OR "collective efficacy" OR "environmental efficacy") AND ("pro-

environmental behavio*" OR "green behavio*" OR "sustainable behavio*" OR "conservation behavio*" OR "eco-friendly behavio*") (in the abstract, title and keywords). The request via mailing list was distributed in the early days of April 2025 (1–6 April).

These searches generated 578 independent papers after duplicates were removed. Papers were subsequently screened according to the following inclusion criteria: (1) studies had to report results in English; (2) studies had to report quantitative measures for the relevant variables (i.e., efficacy beliefs and conservation intention, and/or efficacy beliefs and conservation behavior; when appropriate, consistently with Zawadzki et al. [15], we treated measures of perceived behavioral control [54] as equivalent to self-efficacy); (3) studies had to refer to direct actions related specifically to the conservation of water, energy, soil, forests, and biodiversity; studies using indirect measures, such as signing a petition, were therefore excluded; (4) the scales used in the studies had to measure exclusively conservation behavior; studies using mixed scales that also included other pro-environmental behaviors (e.g., sustainable eating, waste management, green mobility, recycling) were therefore excluded.

2.2. Selection of Studies and Data Extraction

Figure 1 shows the PRISMA flowchart outlining the eligibility and screening procedures. The titles and abstracts of 578 papers retrieved from scientific databases were independently reviewed by the first and second author to assess their potential relevance to the research question. After discussions with the other authors, the analysis of the abstracts led to the exclusion of 502 papers that did not meet our inclusion criteria. Three papers could not be retrieved (for instance, according to the websites, these papers had been removed at the request of the author, the website, or the rights holder); 73 reports were assessed in full; however, during the full-text analysis and data extraction phase, we found that many did not report the necessary data or did not provide Supplementary Materials that would allow us to extract this information beyond what was reported in the manuscripts. Consequently, corresponding authors were contacted to request the missing data. When Pearson's r was not available, beta coefficients or odds ratios were converted into r using calculators no. 13 and 15 at https://www.psychometrica.de/effect_size.html (accessed on 26 March 2026). Of the retrieved reports, for 44 we did not have the necessary data to conduct the meta-analysis. An additional 36 reports were identified through other sources (e.g., mailing lists, $k = 3$; Zawadzki et al.'s meta-analysis [15], $k = 15$: 12 on self-efficacy, 3 on response efficacy, and 1 on collective efficacy), of which 21 were eligible and included.

No imputation was performed for missing effect sizes; cases with missing values were excluded only from the specific analyses for which those values were required (e.g., an effect size lacking information on the percentage of female participants was excluded only from the moderation analysis involving gender).

No formal risk of bias assessment was conducted; however, publication bias was examined using Egger's regression test.

Materials, data, and analyses output for this meta-analytic investigation are publicly available on the Open Science Framework (OSF): https://osf.io/tdrf8/overview?view_only=7e1712ed2cc84c5bbb69a6cac1fc2342.

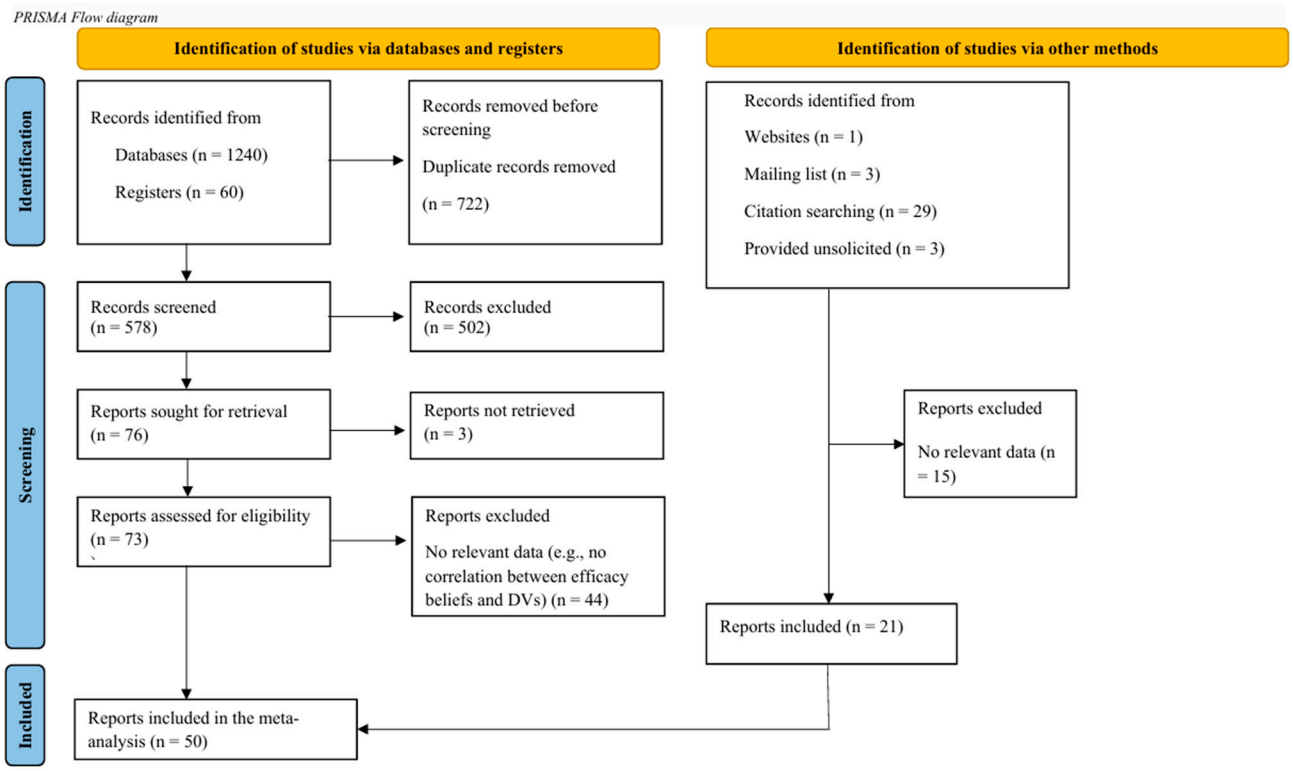

Figure 1. Prisma flow diagram.

2.3. Independence of Effect Size

The independence of the data is one of the fundamental assumptions of meta-analysis [55]. This is why, when studies reported more than one measurement for the same variable (e.g., two different time points) and the same sample, we computed a mean correlation to ensure the independence of effect sizes [56]. The mean calculation followed formula number 9 provided by Welz and colleagues [57]. Importantly, the values were transformed from *r* to *z*.

3. Results

In total, 50 articles were included in the meta-analyses and coded by the first and the second author (see Table 1 for study characteristics).

The analyses were carried out with SPSS Statistics, version 29 [58], using a random-effects model with Fisher *r*-to-*z* transformation. These analyses provided an estimate representing a weighted average of the observed correlations between efficacy beliefs and conservation intentions or behaviors.

Table 1. Studies characteristics.

Study Label	Type of Efficacy	Outcome	Conservation Target	Country	IC Index	Sample Size	Participants	% Women	Data Collection Method
Arjomandi et al. (2023) [38]	Response efficacy	Intention	Water	Iran	37.16	300	Farmers	0.00	Structured interview
Arjomandi et al. (2023) [38]	Self-efficacy	Intention	Water	Iran	37.16	300	Farmers	0.00	Structured interview
Ataei et al. (2024) [22]	Self-efficacy	Behavior	Water	Iran	37.16	361	Farmers	0.06	Questionnaire
Baah et al. *	Response efficacy	Behavior	Water	Australia	67.71	346	Residents	0.51	Questionnaire
Baah et al. *	Response efficacy	Intention	Water	Australia	67.71	346	Residents	0.51	Questionnaire
Baah et al. *	Self-efficacy	Behavior	Water	Australia	67.71	346	Residents	0.51	Questionnaire
Baah et al. *	Self-efficacy	Intention	Water	Australia	67.71	346	Residents	0.51	Questionnaire
Broomell et al. (2015) [18]	Self-efficacy	Intention	Energy	Worldwide		11,614	Residents		Questionnaire
Cakanlar et al. (2026) [59]	Response efficacy	Intention	Energy and water	USA	61.92	402	Residents	0.48	Questionnaire
Carmi & Mostovoy (2017) [60]	Collective efficacy	Behavior	Energy	Israel		116	Students	0.83	Questionnaire
Carmi & Mostovoy (2017) [60]	Response efficacy	Behavior	Energy	Israel		116	Students	0.83	Questionnaire
Chen et al. (2017) [61]	Self-efficacy	Intention	Energy	USA	61.92	248	Residents	0.70	Questionnaire
Choi & Hart (2021) [28]	Collective efficacy	Intention	Energy	Cross-cultural		42,627	Residents	0.49	Questionnaire
Choi & Hart (2021) [28]	Self-efficacy	Intention	Energy	Cross-cultural		41,279	Residents	0.49	Questionnaire
Choi & Hart (2021) Sample1 [28]	Response efficacy	Intention	Energy	Cross-cultural		43,078	Residents	0.49	Questionnaire
Choi & Hart (2021) Sample2 [28]	Response efficacy	Intention	Energy	Cross-cultural		40,925	Residents	0.49	Questionnaire
Clayton et al. (2017) [30]	Self-efficacy	Intention	Biodiversity	France	65.15	172	Visitors	0.59	Questionnaire
Díaz-Rodríguez et al. (2021) [23]	Self-efficacy	Behavior	Soil	Mexico	47.81	275	Students	0.62	Questionnaire
Díaz-Rodríguez et al. (2021) [23]	Self-efficacy	Intention	Soil	Mexico	47.81	275	Students	0.62	Questionnaire
Doran et al. (2022) [62]	Response efficacy	Behavior	Water	USA	61.92	381	Farmers		Questionnaire
Doran et al. (2022) [62]	Self-efficacy	Behavior	Water	USA	61.92	381	Farmers		Questionnaire

Table 1. *Cont.*

Study Label	Type of Efficacy	Outcome	Conservation Target	Country	IC Index	Sample Size	Participants	% Women	Data Collection Method
Erfanian, Maleknia & Azizi (2024) [31]	Self-efficacy	Behavior	Forest	Iran	37.16	456	Visitors	0.49	Structured interview
Erfanian, Maleknia & Azizi (2024) [31]	Self-efficacy	Intention	Forest	Iran	37.16	456	Visitors	0.49	Structured interview
Erfanian, Maleknia & Halalisan (2024) [32]	Self-efficacy	Behavior	Forest	Iran	37.16	409	Visitors	0.47	Structured interview
Erfanian, Maleknia & Halalisan (2024) [32]	Self-efficacy	Intention	Forest	Iran	37.16	409	Visitors	0.47	Structured interview
Fielding et al. (2016) [33]	Self-efficacy	Behavior	Water	Australia	67.71	1008	Residents	0.57	Questionnaire
Fu et al. (2022) [29]	Self-efficacy	Behavior	Energy	Pakistan	31.35	383	Employee	0.31	Questionnaire
Fujii (2006) [63]	Self-efficacy	Intention	Energy	Japan	59.69	341	Residents	0.62	Questionnaire
Haji et al. (2024) [64]	Response efficacy	Intention	Water	Iran	37.16	367	Farmers		Questionnaire
Haji et al. (2024) [64]	Self-efficacy	Intention	Water	Iran	37.16	367	Farmers		Questionnaire
Harland et al. (1999) [65]	Self-efficacy	Behavior	Energy and water	Netherlands	71.22	276	Residents	0.79	Questionnaire
Harland et al. (1999) [65]	Self-efficacy	Intention	Energy and water	Netherlands	71.22	276	Residents	0.79	Questionnaire
Hoppe et al. (2023) Sample1 [40]	Collective efficacy	Intention	Biodiversity	Germany	67.54	1009	Residents	0.51	Structured interview
Hoppe et al. (2023) Sample1 [40]	Self-efficacy	Intention	Biodiversity	Germany	67.54	1009	Residents	0.51	Structured interview
Hoppe et al. (2023) Sample2 [40]	Collective efficacy	Intention	Biodiversity	Germany	67.54	1056	Residents	0.51	Structured interview
Hoppe et al. (2023) Sample2 [40]	Self-efficacy	Intention	Biodiversity	Germany	67.54	1056	Residents	0.51	Structured interview
Janmaimool & Denpaiboon (2016) [10]	Response efficacy	Behavior	Biodiversity	Thailand	45.68	102	Residents		Structured interview
karimi et al. (2025) [66]	Collective efficacy	Behavior	Biodiversity	Iran	37.16	200	Farmers	0.58	Questionnaire
Lacroix et al. (2022) [67]	Collective efficacy	Behavior	Energy	USA	61.92	958	Residents	0.51	Questionnaire

Table 1. *Cont.*

Study Label	Type of Efficacy	Outcome	Conservation Target	Country	IC Index	Sample Size	Participants	% Women	Data Collection Method
Landmann & Rohmann (2020) Sample 1 [41]	Collective efficacy	Intention	Forest	Germany	67.54	210	Activists	0.62	Questionnaire
Landmann & Rohmann (2020) Sample 2 [41]	Collective efficacy	Intention	Forest	Germany	67.54	221	Students	0.70	Questionnaire
Laudenslager et al. (2004) [68]	Self-efficacy	Intention	Energy	USA	61.92	307	Air Force members	0.15	Questionnaire
Lauren et al. (2016) Sample1 [35]	Self-efficacy	Behavior	Water	Australia	67.71	165	Residents	0.60	Questionnaire
Lauren et al. (2016) Sample1 [35]	Self-efficacy	Intention	Water	Australia	67.71	165	Residents	0.60	Questionnaire
Lauren et al. (2016) Sample2 [35]	Self-efficacy	Behavior	Water	Australia	67.71	473	Residents	0.51	Questionnaire
Lauren et al. (2016) Sample2 [35]	Self-efficacy	Intention	Water	Australia	67.71	473	Residents	0.51	Questionnaire
Lee & Tanusia (2016) [69]	Self-efficacy	Intention	Energy	Malaysia	42.13	194	Students	0.58	Questionnaire
Liu et al. (2021) [70]	Self-efficacy	Behavior	Energy and water	China	49.45	1119	Residents	0.44	Questionnaire
Liu et al. (2021) [70]	Self-efficacy	Intention	Energy and water	China	49.45	1119	Residents	0.44	Questionnaire
Mosavian et al. (2023) [24]	Response efficacy	Behavior	Water	Iran	37.16	285	Farmers		Questionnaire
Mosavian et al. (2023) [24]	Self-efficacy	Behavior	Water	Iran	37.16	285	Farmers		Questionnaire
Mura et al. ** Sample1	Collective efficacy	Intention	Energy	Italy	55.90	439	Mixed	0.51	Questionnaire
Mura et al. ** Sample2	Collective efficacy	Intention	Energy	Italy	55.90	612	Employee	0.57	Questionnaire
Pakmehr et al. (2020) [16]	Collective efficacy	Behavior	Water	Iran	37.16	251	Farmers	0.00	Structured interview

Table 1. *Cont.*

Study Label	Type of Efficacy	Outcome	Conservation Target	Country	IC Index	Sample Size	Participants	% Women	Data Collection Method
Pakmehr et al. (2020) [16]	Response efficacy	Behavior	Water	Iran	37.16	251	Farmers	0.00	Structured interview
Pakmehr et al. (2020) [16]	Self-efficacy	Behavior	Water	Iran	37.16	251	Farmers	0.00	Structured interview
Rainisio et al. (2022) [52]	Response efficacy	Behavior	Energy	Italy	55.90	155	Residents	0.52	Questionnaire
Santana et al. (2023) [71]	Response efficacy	Intention	Biodiversity	USA	61.92	299	Visitors	0.52	Questionnaire
Santana et al. (2023) [71]	Self-efficacy	Intention	Biodiversity	USA	61.92	299	Visitors	0.52	Questionnaire
Sapci & Considine (2014) [72]	Response efficacy	Behavior	Energy	USA	61.92	601	Residents		Structured interview
Savari et al. (2023) [26]	Response efficacy	Intention	Biodiversity	Iran	37.16	412	Farmers		Structured interview
Savari et al. (2023) [26]	Self-efficacy	Intention	Biodiversity	Iran	37.16	412	Farmers		Structured interview
Savari, Naghibeiranvand et al. (2022) [37]	Response efficacy	Behavior	Forest	Iran	37.16	415	Residents	1.00	Structured interview
Savari, Naghibeiranvand et al. (2022) [37]	Self-efficacy	Behavior	Forest	Iran	37.16	415	Residents	1.00	Structured interview
Savari, Yazdanpanah, Rouzaneh (2022) [25]	Self-efficacy	Behavior	Soil	Iran	37.16	300	Farmers		Structured interview
Savari, Yazdanpanah, Rouzaneh (2022) [25]	Self-efficacy	Intention	Soil	Iran	37.16	300	Farmers		Structured interview
Schaffner et al. (2017) [73]	Self-efficacy	Intention	Energy	Switzerland	68.81	1295	Residents	0.49	Questionnaire
Shahangian et al. (2022) [17]	Self-efficacy	Intention	Water	Iran	37.16	820	Residents	0.46	Questionnaire
Tajeri moghadam et al. (2020) [74]	Self-efficacy	Behavior	Water	Iran	37.16	235	Farmers	0.05	Structured interview

Table 1. *Cont.*

Study Label	Type of Efficacy	Outcome	Conservation Target	Country	IC Index	Sample Size	Participants	% Women	Data Collection Method
Trumbo & O'Keefe (2001) [75]	Response efficacy	Behavior	Water	USA	61.92	733	Residents	0.52	Structured interview
Trumbo & O'Keefe (2001) [75]	Response efficacy	Intention	Water	USA	61.92	733	Residents	0.52	Structured interview
Valizadeh et al. (2019) [27]	Self-efficacy	Behavior	Water	Iran	37.16	335	Farmers	0.07	Structured interview
Valizadeh et al. (2019) [27]	Self-efficacy	Intention	Water	Iran	37.16	335	Farmers	0.07	Structured interview
Valizadeh et al. (2025) [76]	Collective efficacy	Intention	Biodiversity	Iran	37.16	297	Farmers		Questionnaire
Valizadeh et al. (2025) [76]	Response efficacy	Intention	Biodiversity	Iran	37.16	297	Farmers		Questionnaire
van den Broek et al. (2019) [77]	Self-efficacy	Behavior	Energy	Western European countries		247	Mixed	0.70	Questionnaire
van den Broek et al. (2019) [77]	Self-efficacy	Intention	Energy	Western European countries		247	Mixed	0.70	Questionnaire
van der Werff & Steg (2015) [78]	Response efficacy	Behavior	Water	Netherlands	71.22	468	Mixed	0.49	Questionnaire
van der Werff & Steg (2015) [78]	Response efficacy	Intention	Energy	Netherlands	71.22	468	Mixed	0.49	Questionnaire
Wang et al. (2018) [79]	Self-efficacy	Behavior	Energy	China	49.45	320	Residents	0.53	Questionnaire
Wang et al. (2018) [79]	Self-efficacy	Intention	Energy	China	49.45	320	Residents	0.53	Questionnaire
Webb et al. (2013) [80]	Self-efficacy	Behavior	Energy	Australia	67.71	200	Residents	0.51	Questionnaire
Webb et al. (2013) [80]	Self-efficacy	Intention	Energy	Australia	67.71	200	Residents	0.51	Questionnaire
Wilson ***	Self-efficacy	Intention	Soil	USA	61.92	748	Farmers		Questionnaire
Wilson ***	Self-efficacy	Behavior	Soil	USA	61.92	748	Farmers		Questionnaire
Wittenberg et al. (2018) [81]	Self-efficacy	Behavior	Energy	Germany	67.54	185	Residents	0.08	Questionnaire
Yazdanpanah et al. (2015) [82]	Self-efficacy	Behavior	Water	Iran	37.16	360	Farmers	0.05	Structured interview

Table 1. *Cont.*

Study Label	Type of Efficacy	Outcome	Conservation Target	Country	IC Index	Sample Size	Participants	% Women	Data Collection Method
Yazdanpanah et al. (2015) [82]	Self-efficacy	Intention	Water	Iran	37.16	360	Farmers	0.05	Structured interview

Note. * Effect sizes from three studies were averaged because the sample was the same: Baah et al. [19–21]; ** Personal communication; *** Effect sizes from two studies were averaged because the sample was the same: Prokup et al. [83] and Beetstra et al. [84], where Wilson is the principal investigator.

3.1. Self-Efficacy

Figures 2 and 3 report the individual studies' results and the overall effect sizes for the association between self-efficacy and, respectively, intention and behavior. The *Z*-test was significant for both intention and behavior (respectively, $Z = 9.50$, $p < 0.001$; $Z = 9.61$, $p < 0.001$), allowing us to reject the null hypothesis that there were no correlations between self-efficacy and the outcomes. These analyses showed that approximately 22% of the variance in intentions and 17% of the variance in behaviors were attributable to self-efficacy beliefs. The summary correlation estimate (Pearson's *r*) was 0.47, 95% CI [0.38, 0.55] for the relationship between self-efficacy and intentions ($k = 30$), and 0.41, 95% CI [0.34, 0.48] (see Figure 3) for the relationship between self-efficacy and behaviors ($k = 24$). According to Cohen [85], these findings indicate medium-sized correlations.

Egger's regression test did not reveal significant asymmetries that could signal the presence of a publication bias ($p \geq 0.459$). The two funnel plots are reported in Supplementary Figures S1 and S2.

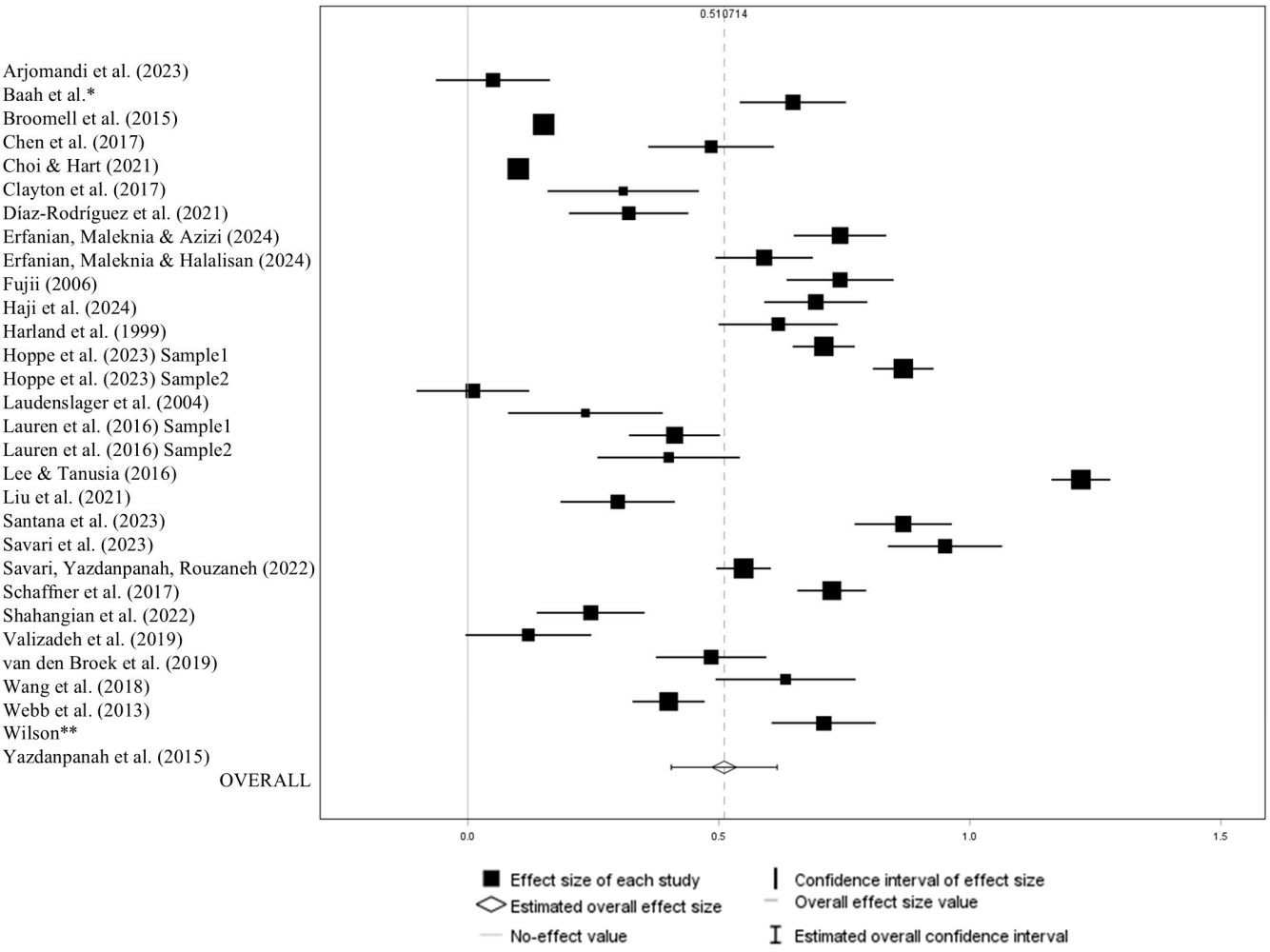

Figure 2. Forest plot of the relationship between self-efficacy and conservation intentions. Note. Effect sizes are reported in Fisher's *z*. * Effect sizes from three studies were averaged because the sample was the same: Baah et al. [19–21]. ** Effect sizes from two studies were averaged because the sample was the same: Prokup et al. [83] and Beetstra et al. [84], where Wilson was the principal investigator.

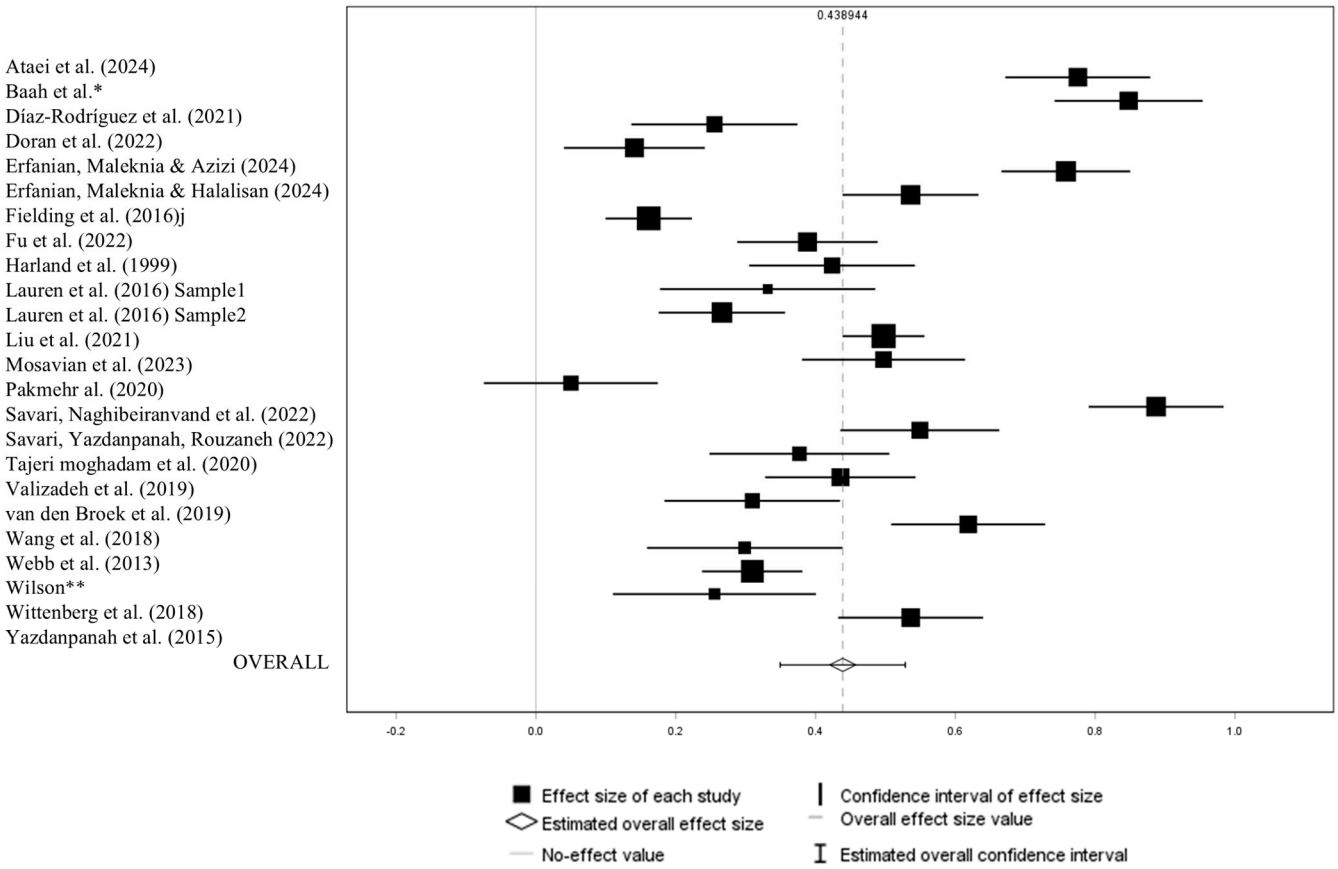

Figure 3. Forest plot of the relationship between self-efficacy and conservation behaviors. Note. Effect sizes are reported in Fisher's *z*. * Effect sizes from three studies were averaged because the sample was the same: Baah et al. [19–21]. ** Effect sizes from two studies were averaged because the sample was the same: Prokup et al. [83] and Beetstra et al. [84] where Wilson was the principal investigator.

3.1.1. Heterogeneity

Following the indication provided by Borenstein et al. [86], heterogeneity was assessed. For both the relationship between self-efficacy and conservation intention, Q (29) = 3815.02, $p < 0.001$, and the relationship between self-efficacy and conservation behavior, Q (23) = 454.60, $p < 0.001$, we can reject the null hypothesis that the true effect size is the same across all these studies. The I^2 statistic indicates that 99.1% and 94.8% of the variance in observed effects reflects variance in true effects rather than sampling error. The variance of true effect sizes (τ^2) was 0.08 for intentions and 0.05 for behaviors. Assuming that the effects are normally distributed, we estimated that the prediction interval ranged from −0.09 to 1.11 in the first case and from −0.02 to 0.90 in the second. This suggests that the correlations between self-efficacy and conservation intentions or conservation behaviors greatly vary across populations: since the interval includes zero, these associations may be absent in some populations, while the upper bound indicates that they can be substantial in others.

3.1.2. Moderation Analyses

We explored some moderators potentially accounting for the strong heterogeneity among effect sizes. The criterion of including moderators only when there were at least five studies for each level was followed [87]. First, we tested administration type (questionnaires vs. interviews) as a potential moderator: the difference between subgroups, assessed using the Q statistic, was not significant for either the relationship between self-efficacy and intentions ($Q = 2.40$, $p = 0.121$) or the relationship between self-efficacy and behaviors ($Q = 1.36$, $p = 0.244$), indicating that this methodological factor did not account for the heterogeneity observed among effect sizes.

We then examined population type as a moderator; also in this case, the difference between work-related and non-work-related groups was not statistically significant ($Q = 0.21$, $p = 0.651$; $Q = 0.37$, $p = 0.541$). Similarly, cultural context did not significantly moderate the relationships under investigation (SPSS meta-regression; $t = -0.80$, $p = 0.429$; $t = -1.76$, $p = 0.092$).

Finally, a meta-regression was conducted to evaluate whether the percentage of women in the sample moderated the effects. This analysis did not support the hypothesis of gender differences in the association between self-efficacy and either conservation intentions or behaviors ($p \geq 0.347$).

3.2. Response Efficacy

Figures 4 and 5 report the individual studies' results and the overall effect sizes for the association between response efficacy and, respectively, intention and behavior. Response efficacy significantly correlated with intention and behavior (for both outcomes, $Z = 4.44$, $p < 0.001$) and explained approximately 13% of the variance in the former (intention) and 12% in the latter (behavior). The summary correlation estimate (Pearson's r) was 0.36, 95% CI [0.21, 0.49] for the relationship between response efficacy and intentions ($k = 11$), and 0.34, 95% CI [0.20, 0.47] for the relationship between response efficacy and behaviors ($k = 11$), which correspond to medium-sized effect sizes [85].

Egger's regression test did not reveal significant asymmetries that could signal the presence of a publication bias ($p \geq 0.091$). The two funnel plots are reported in Supplementary Figures S3 and S4.

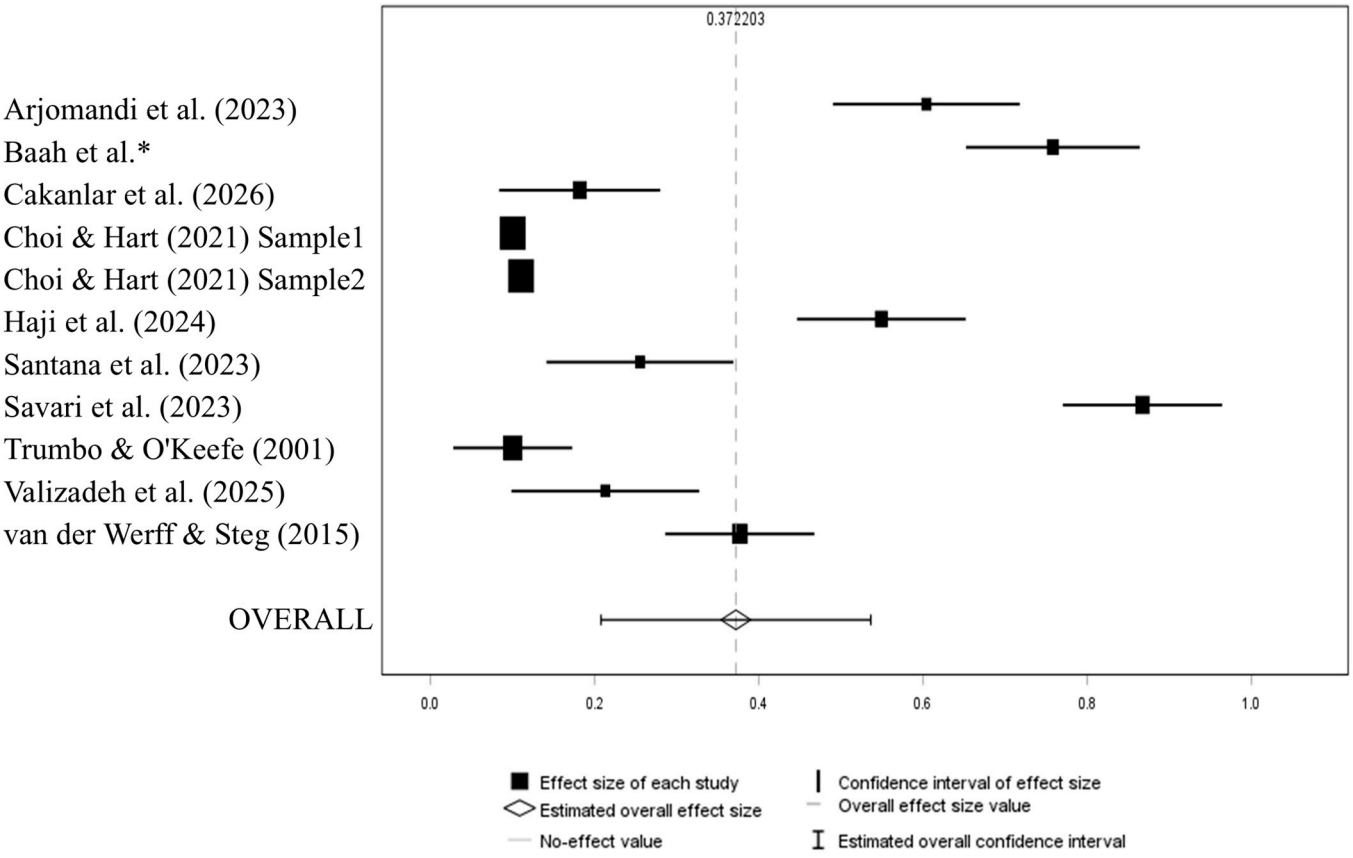

Figure 4. Forest plot of the relationship between response efficacy and conservation intentions. Note. Effect sizes are reported in Fisher's z. * Effect sizes from three studies were averaged because the sample was the same: Baah et al. [19–21].

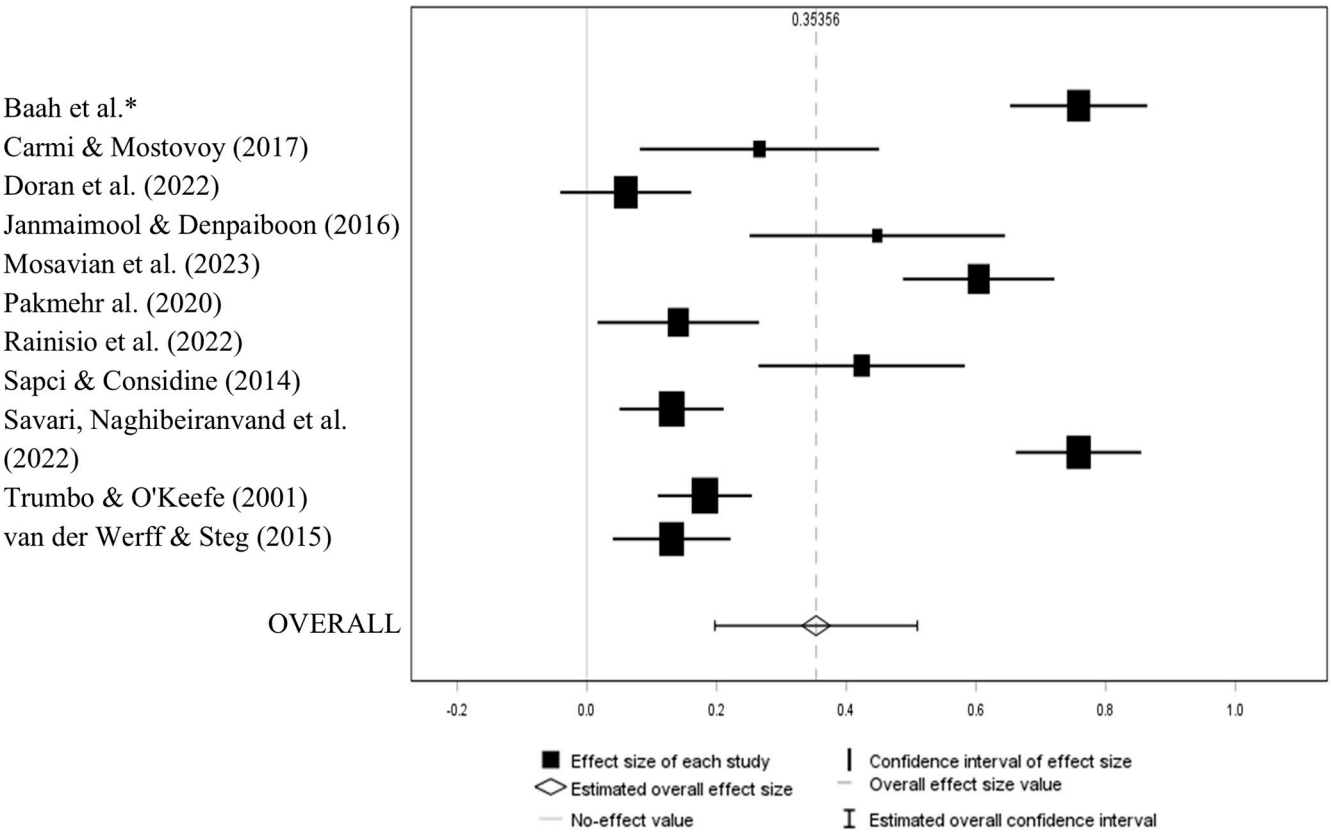

Figure 5. Forest plot of the relationship between response efficacy and conservation behaviors. Note. Effect sizes are reported in Fisher's z. * Effect sizes from three studies were averaged because the sample was the same: Baah et al. [19–21].

3.2.1. Heterogeneity

For both the relationship between response efficacy and intention, Q (10) = 565.15, $p < 0.001$, and the relationship between response efficacy and conservation behavior, Q (10) = 256.74, $p < 0.001$, we can reject the null hypothesis that the true effect size is the same across all these studies. The I^2 statistic indicates that 99.7% and 95.7% of the variance in observed effects reflects variance in true effects rather than sampling error. The variance of true effect sizes (τ^2) was 0.08 for intentions and 0.07 for behaviors. Assuming that the effects are normally distributed, we estimated that the prediction interval ranged from −0.28 to 1.02 in the first case and from −0.25 to 0.96 in the second. This suggests that the correlations between response efficacy and conservation intentions or conservation behaviors greatly vary across populations: since the interval includes zero, these associations may be absent in some populations, while the upper bound indicates that they can be substantial in others.

3.2.2. Moderation Analyses

Following the criterion of including moderators only when at least five studies for each level were available [87], we could test the potential moderating role of administration type (questionnaires vs. interviews) for the association between response efficacy and behavior, but not for the one involving intention. The effect size did not substantially vary according to this factor (Q = 0.70, p = 0.792). Assuming to violate this criterion, the same finding was replicated on intention (Q = 0.74, p = 0.388).

We could not assess the moderating role of population type (work-related vs. non-work-related groups) due to a lack of studies.

Neither cultural context ($p \geq 0.296$) nor the percentage of women in the sample ($p \geq 0.219$) significantly moderated the relationships under investigation.

3.3. Collective Efficacy

Collective efficacy was the least frequently examined construct in the reviewed literature, and fewer than 10 studies were available per outcome (i.e., intention and behavior). Therefore, given the overlap observed between intention and behavior in the effect sizes for self- and response efficacy, in this case, we conducted a single meta-analysis (all meta-analyzed studies reported correlations between collective efficacy and either intention or behavior only; therefore, no issues of statistical dependence emerged).

Figure 6 reports the individual studies' results and the overall effect size. The association between collective efficacy and the conservation outcome was significant ($Z = 5.11$, $p < 0.001$) and explained approximately 8% of the variance in the outcome ($k = 12$). The summary correlation estimate (Pearson's r) was 0.28, 95% CI [0.17, 0.38], which can be considered a small effect [85].

Regarding the specific associations, the summary correlation estimate (Pearson's r) between collective efficacy and intention ($k = 8$) was 0.29, 95% CI [0.18, 0.41]; whereas the association between collective efficacy and behavior ($k = 4$) was 0.24, 95% CI [0.02, 0.45].

Egger's regression test did not reveal significant asymmetries that could signal the presence of a publication bias ($p = 0.382$). The funnel plot is reported in Supplementary Figure S5.

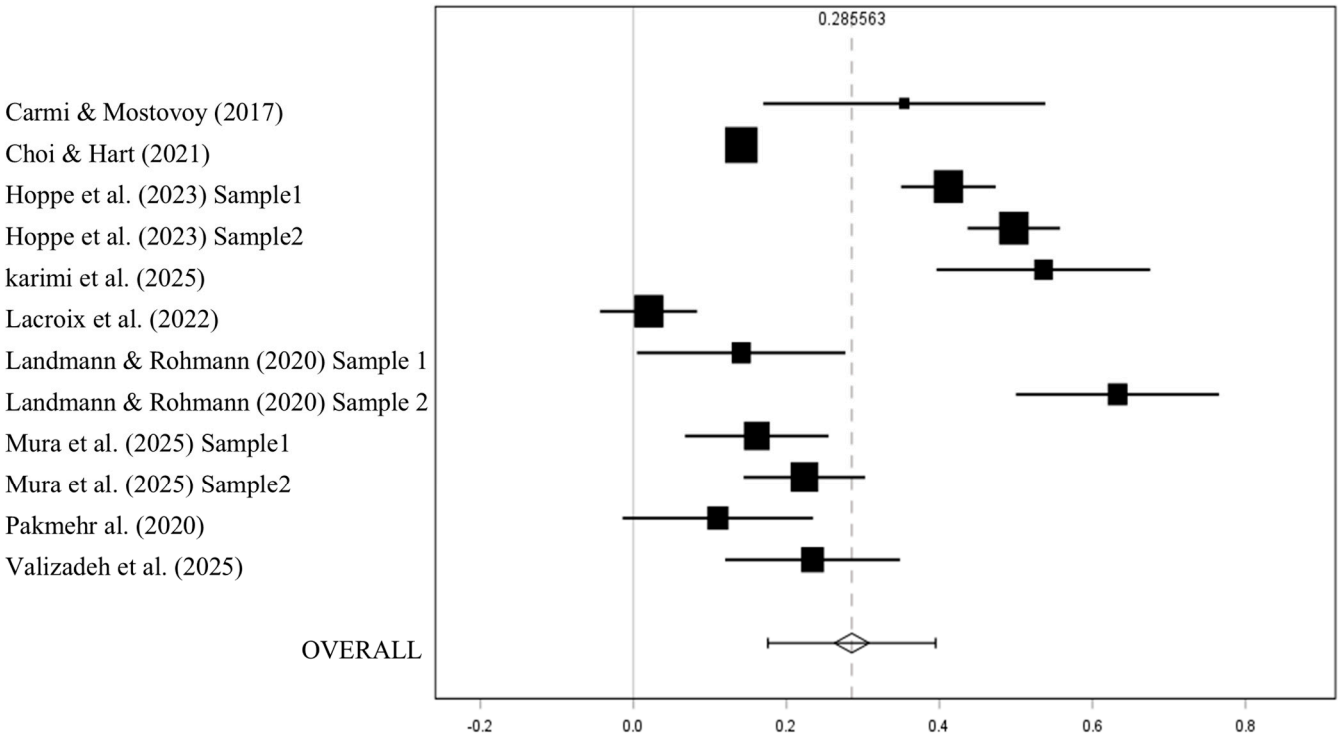

Figure 6. Forest plot of the relationship between collective efficacy and conservation intention/behavior. Note. Effect sizes are reported in Fisher's *z*.

3.3.1. Heterogeneity

We can reject the null hypothesis that the true effect size is the same across all these studies, Q (11) = 303.26, $p < 0.001$. The I^2 statistic indicates that 96.9% of the variance in observed effects reflects variance in true effects rather than sampling error. The variance of true effect sizes (τ^2) was 0.04. Assuming that the effects are normally distributed, we

estimated that the prediction interval was from −3.20 to 7.67. This suggests that the effect in a new study could be negative, null, or positive.

3.3.2. Moderation Analyses

We could not assess the moderating role of administration type (questionnaires vs. interviews) or population type (work-related vs. non-work-related groups) due to the insufficient number of studies available.

None of the continuous moderators (i.e., cultural context and percentage of women in the sample) explained the observed heterogeneity ($p \geq 0.197$).

4. Discussion

This work reports five meta-analyses estimating how efficacy beliefs relate to conservation intentions and behaviors. Regarding the primary objective of the present study, namely the estimation of the overall association between efficacy beliefs and conservation intentions and behaviors, we found medium-sized positive associations between self-efficacy, response efficacy, and conservation intentions and behaviors, and a small-sized positive association with collective efficacy. In other words, the more individuals are confident in their ability to perform conservation behaviors and believe that their individual or collective conservation behaviors will be impactful, the more inclined they are to engage in them. As for the translation of findings into actionable strategies for key stakeholders, these observed associations suggest that organizations directly involved in natural resource management—such as policymakers, farmers' associations, energy and water providers, and nature-accessible sites—can meaningfully target efficacy beliefs as levers for behavior change.

These findings dovetail with previous correlational meta-analyses in other domains, which have shown that self-efficacy and outcome expectancy are significantly associated with desired behavioral outcomes, such as energy saving, physical activity, or other health behaviors (e.g., [15,88,89]), supporting the relevance of efficacy beliefs across different behavioral contexts. Extending this body of work to natural resource conservation behaviors, the present study provides a novel contribution by simultaneously examining multiple efficacy constructs—self-efficacy, response efficacy, and collective efficacy—across a broad range of domains, offering a unique and comprehensive understanding of how different forms of efficacy beliefs relate to conservation intentions and behaviors.

We found no substantial differences between the correlations with intention and behavior, further aligning with Bandura's self-efficacy theory [11], which posits that self-efficacy directly influences both the formation of behavioral intentions and the enactment of behavior, thus leading to comparable effect sizes across the two outcomes. These results suggest that efficacy-enhancing interventions are relevant not only for motivating initial engagement (i.e., intention) but also for sustaining behavioral implementation over time.

Another purpose of the present study was to investigate moderating factors. The need for such analyses was supported by the substantial variation in effect sizes across studies. However, none of the expected moderators explained this strong heterogeneity.

The absence of a significant moderating effect of data collection method suggests that the association between efficacy beliefs and conservation outcomes is robust across administration formats; future studies and applied assessments can therefore choose between self-report questionnaires and structured interviews based on practical considerations—such as the characteristics of the target population or the accessibility of the research context—without expecting this choice to substantially affect the observed relationships.

The non-significant moderation by population type (work-related vs. non-work-related) and gender suggests that efficacy-enhancing interventions may need to target other individual characteristics.

Finally, the lack of significant cultural moderation suggests that the relevance of efficacy beliefs for conservation may be relatively consistent across individualistic and collectivistic contexts, supporting the case for global, cross-cultural stakeholder efforts to promote conservation behaviors through efficacy-enhancing strategies.

One potential source of the observed variability may have been the lack of measurement standardization. An examination of the studies included in the meta-analyses indicates that most relied on ad hoc scales or combinations of items drawn from different instruments, which may complicate cross-study comparisons and have contributed to the heterogeneity observed in effect sizes. This limitation of existing research underscores the need for future studies to develop and adopt standardized measures of efficacy beliefs as well as conservation intentions and behaviors. However, an important challenge will be to balance standardization with the need for instruments that can be meaningfully adapted to diverse conservation behaviors, such as water resource conservation or soil protection.

In line with the results from previous research [52] and with Community-Based Social Marketing [90], we strongly believe the domain of conservation behavior, and even the specific conservation behaviors in the same domain, might be one of the most relevant sources of the observed heterogeneity. Currently, there are not enough studies to investigate the moderating role of this factor, which should be further explored in future research.

Another limitation of the reviewed literature concerns the shortage of longitudinal studies capable of capturing how the relationship between efficacy beliefs and conservation intentions and behaviors unfolds over time. Such studies would provide valuable insights into the stability of self-efficacy and its long-term impact on environmental actions.

4.1. Limitations and Strengths

Some of the meta-analyzed studies were authored by the same researchers. Consequently, some effect sizes may derive from similar samples, constructs, designs, and procedures. This might have introduced a bias in our results [91], although we tried to preserve studies' independence by averaging correlation coefficients derived from the same sample.

Although this procedure preserves the independence assumption required by standard meta-analytic models, current best practice favors multi-level meta-analysis, which explicitly models the nested structure of effect sizes without discarding information through aggregation (e.g., [15]). The averaging approach used here may therefore underestimate sampling variability and introduce a degree of bias in heterogeneity estimates. However, when the number of studies and effect sizes is small, as in the present work, multilevel meta-analysis can yield inflated Type I error rates and biased estimates of between-study variance and its standard error [92]; for this reason, we preferred the aggregation approach.

Even though we tested several potential moderators, we were unable to account for the heterogeneity observed among effect sizes. This may partly reflect the lack of standardized measurement tools identified earlier, as differences in how efficacy beliefs and conservation intentions or behavior are assessed across studies can introduce additional noise into effect sizes. Future research adopting more uniform and validated measures will be crucial for clarifying the sources of heterogeneity and improving the comparability of findings across studies.

The remaining variability also suggests that additional moderators—related, for instance, to contextual factors or the specific conservation domain or even behavior considered—may influence the relationship between efficacy beliefs and environmental

actions and should be examined in future research. We were unable to test the moderating role of behavior type or behavioral target (e.g., water, energy) due to the limited number of available studies (i.e., fewer than five studies per category). Future meta-analyses should address this issue once a sufficient body of evidence becomes available.

Given the small number of available studies on collective efficacy, it was not possible to compute separate effect sizes between this variable and conservation intentions or behaviors. Once a larger body of evidence becomes available, future meta-analyses should differentiate these key constructs.

Finally, this work was not pre-registered, and no protocol was prepared.

Despite these limitations, several strengths should be acknowledged. First, the systematic literature search was complemented by calls for unpublished data, thereby reducing the risk of publication bias. Second, in the database extraction, we employed a broad search string to capture as many relevant studies as possible on conservation behaviors, specifically to retrieve relevant studies even when these behaviors were not explicitly labeled as such. As with many meta-analyses, the proportion of studies meeting all inclusion criteria was relatively small (50 out of 578 initially identified). This is partly a consequence of this broad search strategy. However, it should be noted that 59 reports were excluded because the necessary statistical information could not be extracted (see Figure 1). This highlights the critical importance of open data practices and transparent reporting for the cumulative advancement of scientific knowledge.

4.2. Implications

The present findings have implications for interventions aimed at promoting conservation behaviors through enhancing individuals' efficacy beliefs. These results could help different stakeholders involved in natural resources management identify a shared objective on which to focus their efforts. Organizations such as companies, groups that depend on natural resources (e.g., farmers), service providers (e.g., electricity and water suppliers), and those responsible for publicly accessible natural areas (e.g., zoos, reserves, forests, and beaches) could direct their strategies toward promoting conditions that strengthen people's efficacy beliefs for conservation.

According to Bandura [11], self-efficacy can be enhanced through vicarious learning and mastery experiences. It is therefore essential to make clear which conservation behaviors are needed—whether in the workplace, at home, or in natural settings—and to provide individuals with opportunities to practice these behaviors so that they can develop and refine their conservation skills. Self-efficacy can also be supported through persuasive communication, particularly when such communication provides credible modeling, step-by-step guidance, and realistic strategies for overcoming common barriers—mechanisms identified as key sources of efficacy beliefs [11]. For example, messages that show how similarly others successfully perform conservation actions, that offer concrete feedback about progress, or that break behaviors down into manageable steps (e.g., [35]) can enhance people's confidence in their ability to act, thereby promoting both intentions and behavior.

A large-scale "intervention tournament" showed that pro-environmental response efficacy can be enhanced by asking participants to write a letter to future generations describing their aspirations and efforts to ensure that they will inherit a habitable planet, or a list of personal benefits arising from engaging in pro-environmental behaviors over the following months [93]. Additional effective strategies seem to be informing individuals about the cumulative impact of their efforts [94] and combining efficacy feedback with mental imagery tasks. For instance, participants may be prompted to first visualize the destruction of a valued natural place and subsequently imagine engaging in pro-environmental behaviors to prevent such an outcome [95].

Finally, interventions aimed at strengthening collective efficacy have also shown promise. These approaches include peer-to-peer counseling [96], exposure to positive examples of successful collective initiatives [97], and framing environmental problems as challenging yet solvable [98].

5. Conclusions

The present study identified the overall effect sizes of the correlations between efficacy beliefs and conservation intentions and behaviors, showing small or moderate associations in both cases. The observed medium effect sizes suggest that self-efficacy and response efficacy are relevant psychological variables linked to conservation intentions and behaviors, and may function as important facilitators of behavioral implementation. Collective efficacy may also be relevant, although its effect size was small.

Although these findings are encouraging, they should be interpreted with caution due to the high heterogeneity observed. Future research should investigate why the association is stronger in some cases than in others by also considering individual differences, thus optimizing the design of interventions promoting conservation behaviors by enhancing efficacy beliefs.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/su18115307/s1, Table S1: Potential moderators; Figure S1: Forest plot for the association between self-efficacy and conservation intentions; Figure S2: Forest plot for the association between self-efficacy and conservation behaviors; Figure S3: Forest plot for the association between response efficacy and conservation intentions; Figure S4: Forest plot for the association between response efficacy and conservation behaviors; Figure S5: Forest plot for the association between collective efficacy and conservation intentions/behaviors.

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