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Enhancing stakeholder engagement in sustainable forest management: A multi-domain comparative analysis of forest-related beliefs, values, and behaviors of Canadian Aboriginal and non-Aboriginal groups

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Abstract

The study aims to understand the variations in the domain-specific pro-sustainable-forest-management behavior (PSFMBs) and their explanatory factors across ecological, economic, recreational, and Aboriginal domains and between Aboriginal and non-Aboriginal groups. A hybrid model of PSFMB, which integrates environmental psychology and resource economics perspectives, is conceptualized and estimated using multi-group path analysis and data from three Aboriginal and three non-Aboriginal communities in Ontario, Canada. Results show that both groups make substantial pro-SFM contributions, but the contributions and their influencing factors differ across domains and groups. For Aboriginals, environmental worldviews and assigned forest values are the only influencing factors, while for non-Aboriginals, income and forest environmental conditions play dominant roles. The findings confirm the fundamental differences in the roles of beliefs, values, and situational factors in influencing the PSFMB of Aboriginal and non-Aboriginal groups, highlight the need for theoretical lenses that account for cultural differences, and contribute to the development of inclusive policies that respect the unique values of different social groups.

KEYWORDS
environmental policy, environmental worldviews, pro-environmental behavior, stakeholder engagement, sustainable development, sustainable forest management

1 | INTRODUCTION

Global sustainability is the key to human well-being and the survival of humanity. A deeper understanding of pro-sustainability behavior (PSB—a behavior that supports and promotes sustainability), its influencing factors, such as beliefs and values, and their influencing mechanisms (direct versus indirect) is essential to design and implement sustainability interventions, specifically interventions to enhance stakeholders' engagement. Recently, PSB has attracted the attention of diverse scholars, including economists and psychologists. However, they have either focused on pro-environmental/green behavior (PEB) (Li et al., 2019; Steg & Vlek, 2009) or treated PSB and PEB as synonymous (Tölkes & Butzmann, 2018; Whitley et al., 2018); in this process, they have ignored at least two other domains of sustainability—social and economic. Many definitions of sustainability also focus on only one domain—environmental (Shrivastava, 1995), social (Carroll, 1999),

or economic (Van Marrewijk, 2003)—but sustainability is about the simultaneous pursuit of multiple domains (Amaruzaman et al., 2023; Elkington & Rowlands, 1999).

United Nations Sustainable Development Goals (SDGs) include environmental (i.e., life on land, life below water, and clean energy), social (i.e., education, health, and gender equity), and economic (no poverty, decent work, and sustainable consumption and production) goals covering respective aspects of human wellbeing. In brief, sustainable development or sustainability means the simultaneous sustenance of our environmental, economic, social, and cultural systems using a balancing approach among different systems/domains. Hence, PSB is a behavior that supports and promotes (which is pro) different domains of sustainability or pro an aggregate of all domains. PEB is only one of the many sub-sets of PSB—the one that relates to promoting sustainability of the environmental/ecological domain. The studies on PEB provide very important insights about a key dimension of sustainability but fail to capture the multi-domain nature of PSB. In this paper, we present a multi-domain analysis of PSB.

The Millennium Ecosystem Assessment identified the linkages between four categories of ecosystem services and human well-being (Reid et al., 2005). Similarly, the Frameworks of Criteria and Indicators (C&I) for Sustainable Forest Management (SFM) by different agencies such as the Canadian Council of Forest Ministers (CCFM) require the incorporation of multiple ecosystem services and values, such as social, and economic, and environmental, in SFM planning and management practices (Kijazi & Kant, 2003). The underlying goal of SFM Certification Systems, such as the Forest Stewardship Council (FSC) and the Sustainable Forestry Initiative (SFI), "is to promote forest practices that are environmentally, socially, and economically sustainable over the long term" (Hansen et al., 2006: 1). The concept of multiple domains in sustainability and SFM is, thus, well ingrained, and cannot be ignored in the studies of PSB.

A key domain that has not attracted so far the attention of PSB studies is Aboriginal[i] culture and the communities which are "the repositories of vast accumulations of traditional knowledge and experience that links humanity with its ancient origins" (WCED, 1987, p.114), from which the larger society "could learn a great deal from their traditional skills in sustainably managing very complex ecological systems." (WCED, 1987, p.115). Indigenous groups around the world, such as the Māori in New Zealand, the Haida in Canada, the Yawuru in Western Australia, and the Sami in Northern Europe, have developed various approaches like controlled burning, selective harvesting, and the protection of sacred sites, to manage forest resources sustainably (R. Miller et al., 2007). They hold a deep respect for forests, view forests as a provider of livelihoods, medicine, living space, and spiritual value, and recognize the need to maintain the vitality of forests for future generations. For many countries, including Australia, Canada, New Zealand, and the USA, the Aboriginal domain is among the crucial pillars of sustainability, specifically for sustainable natural resources, such as forests, due to their traditional rights and cultural traits (Sapic et al., 2009). Some cultural traits of Aboriginal people, especially respect and reciprocity-based relations with "Mother Earth," are commonly shared among 370 million indigenous people across 70 countries (Bartlett et al., 2007). The Aboriginal domain, therefore, should be an integral part of PSB studies focused on sustainable natural resource management.

The PEB models can be grouped into economic and environmental psychology models. The economic models are based on utility maximization theory and assigned values measured by revealed preference and stated preference techniques (SPT) (Kendal et al., 2015). One group of environmental psychology models is premised on the connections between held values and PEBs: examples include the norm activation (Schwartz, 1977), the cognitive hierarchy (Fulton et al., 1996), and the value-belief-norm (VBN) theories (Stern, 2000); another group of these models pays more attention to the constraints of contextual factors on behaviors: examples include the Theory of Planned Behavior (TPB) (Ajzen, 1991) and the Attitude-Behavior-Context (ABC) model (Guagnano et al., 1995). Most of these PEB models are premised on the economic rationality assumption, supported by the evidence of non-Aboriginal people's behavior related to recycling, waste management, and energy consumption.

In this paper, we are presenting a multi-domain analysis of PSB for sustainable forest management that includes Aboriginal, environmental, economic, and social domains. To highlight the specific sectoral target of our analysis, we name the PSB: pro-SFM behavior (PSFMB),[ii] defined as a behavior that supports/ promotes SFM activities related to any of the four domains (domain-specific PSFMB) or an aggregate of the four domains (aggregate PSFMB).

Compared to Euro-American people, Aboriginal people attach higher significance to collectivism, holism, and respectful, reciprocal, and harmonious relationships with nature (Beckford et al., 2010). The utilitarian rationale is problematic for Aboriginal people due to the priority of cultural and moral norms that guide their behavior (Abeysekera, 2023). Prior studies also rarely incorporated the contextual specificities of natural resource management leaving a gap in our understanding of the differences in motivations underlying the PSB of Aboriginal and non-Aboriginal groups. Our study attempts to fill this gap by incorporating cultural and contextual specificities of indigenous natural resource management in modeling pro-SFM behavior (PSFMB) of Aboriginal and non-Aboriginal groups of stakeholders of the same forests.

Many studies have confirmed a wide variation across stakeholders' ranking of the importance of assigned forest values associated with different domains of SFM (e.g., McFarlane et al., 2011; Tarrant et al., 2003). Similarly, the drivers of PEB with respect to different activities, such as waste management, energy conservation, and biking, have been found to be different (Stern, 2000). Therefore, variations in the influencing factors and influencing mechanisms of PSB in different sustainability domains and across non-Aboriginal and Aboriginal groups are expected. In a recent paper, Yiwen, Kant, and Vertinsky (2023), proposed and tested a hybrid model to explore the different theoretical explanations of Aboriginal people's PSFMB, and found strong support for the proposition that the differences were not only in the PSFMB and the influencing variables, but also in the process through which values and beliefs were linked to behavior

(see Section 2.2). The study, however, did not consider multiple domains and did not include key situational and demographic explanatory factors of PSFMB.

We aim to understand the variations in the domain-specific PSFMBs and their explanatory factors across four domains and Aboriginal and non-Aboriginal groups in Canada. In the process, we narrow the gaps in the literature by extending the scope and testing the validity of Yiwen, Kant, and Vertinsky's (2023) model to a multi-domain analysis of PSFMB. We selected SFM because Aboriginal people's settlements, livelihoods, and cultural activities often closely relate to forest ecosystems (Beaudoin et al., 2015), and they are actively involved in SFM planning and decision-making in areas close to their communities in Ontario, Canada. We examined four domains of PSFMB—economic, ecological, recreational, and Aboriginal, which were measured by people's voluntary contributions to pro-SFM initiatives focused on the specific domains, elicited by a field experiment. We included two belief factors—Environmental Worldviews focused on Forests (EWF) and Adverse Consequences of not Practicing SFM (ACP), one value factor—Assigned Forest Values (AFVs), and two situational and some demographic factors, as explanatory variables.

The theoretical model was empirically estimated using data from surveys and field experiments conducted in three Aboriginal and three non-Aboriginal communities in Ontario, Canada, and using multi-group and multi-domain path analyses. In the process, we answered four key research questions: (i) Do ACP, AFVs, and individuals' allocations to PSFMB vary across four domains of SFM? (ii) Are Aboriginal people's ACP, AFVs, and individuals' allocations to PSFMB for different domains different than non-Aboriginal people? (iii) Are there differences in the influence and influencing mechanisms (direct and mediation effects) of EWF, ACP, and AFVs on PSFMB of Aboriginal and non-Aboriginal people across these domains? And (iv) Do the differences in PSFMB and their influencing factors and mechanisms across two groups and four domains suggest a need for a theory different than the rational agent theory?

This paper has five sections. The second section reviews the literature and proposes an analytical framework to explain PSFMB. The third section presents the methods used to collect and analyze the data. Results are presented in the fourth section. Discussions, conclusions, and limitations are in the fifth section.

2 | CONTEXT AND THEORETICAL FOUNDATIONS

2.1 | Research context and Aboriginal culture

The research context is SFM of public forests in Ontario, Canada. SFM is important for Canadians, as Canada's vast forest resources make significant contributions to the national economy through timber and tourism industries and play key roles in biodiversity conservation, climate regulation, and the preservation of Aboriginal culture (Bridge et al., 2005). SFM is integrated into the daily lives of Canadian citizens, as seen in the sustainable consumption of forest products like certified wood, recycled paper products, eco-friendly furniture, and bio-based products. The importance of forests is even greater for communities directly involved in forest-related activities or located near forested areas, especially Aboriginal communities. From a policy perspective, the CCFM Criteria & Indicator Framework has identified four attributes of SFM including the incorporation of multiple social, economic, and environmental values of stakeholders (Bridge et al., 2005). In Ontario, the CCFM Framework is translated into management plans and operations by the Crown Forest Sustainability Act and the Forest Management Planning Manual (FMPM), which mandate the incorporation of social, economic, environmental, and Aboriginal values with the inputs of stakeholders, for example local citizens, Indigenous communities, and the forest industry (Robson & Davis, 2015). Therefore, the principles of SFM are firmly embedded in Ontario's policy frameworks, reflecting a commitment to balancing ecological stewardship with the economic, social, and Aboriginal needs.

As per the 2021 census, Ontario has 406,590 Indigenous people—about 22.5% of the 1.8 million Canadian Indigenous population, which is about 5% of Canada's population (Statistics Canada, 2023). Similarly, 133 First Nations (22% of First Nations of Canada) are in Ontario, and 78% of them are in Northern Ontario. Various court decisions have recognized their rights to be consulted about forest management decisions (Fligg et al., 2022), and therefore legally they are a distinguished group with respect to SFM (Beaudoin et al., 2015). The Aboriginal worldview is characterized by collectivism, holism, and harmony with nature (Abeysekera, 2023; Miller et al., 2015; Veettil et al., 2013), compared to the Western worldview of individualism, atomism, and control over nature. The Aboriginal relations with natural resources are based on respect and reciprocity (Beckford et al., 2010), while Western society has exploitation-based relations. These cultural differences lead to Aboriginal people and Aboriginal organizations having the same ranking of AFVs, while the ranking of AFVs of Western people and organizations—corporations and governments—are different (Lee & Kant, 2006).

2.2 | Models of pro-environmental behavior

The environmental psychology models of PEB, mentioned in Section 1, are focused on the roles of subjective psychological factors such as values, beliefs, attitudes, and norms. Theories like the Norm Activation Model (Schwartz, 1977), the Cognitive Hierarchy Theory (Fulton et al., 1996), and the Value-Belief-Norm (VBN) theory (Stern, 2000), are premised on the unidirectional linear causality from held values to PEBs. These held values, which are internalized and culturally influenced, serve as the basis for environment-related attitudes and beliefs (Mi et al., 2020; Vighnesh et al., 2023). These attitudes and beliefs further influence individual and social norms, which determine which type of behavior is desired, and finally guide behaviors. Another stream of environmental psychology models emphasizes the impact of contextual factors on behaviors: examples include the Theory of Planned Behavior (TPB) (Ajzen, 1991) and the

Attitude-Behavior-Context (ABC) model (Guagnano et al., 1995). These models highlight that in addition to subjective psychological factors, external impetus or constraints as denoted by perceived behavioral control and subjective norms in TPB and contextual considerations in the ABC model can facilitate or hinder the translation of attitudes and intentions into actions.

Environmental psychology theories have been applied to explain mainly private-sphere pro-environmental activities such as green consumption (Nguyen et al., 2019) and payment for ecosystem services (Grammatikopoulou et al., 2021). In these applications, scholars have included not only psychological factors but also other explanatory variables, such as personal capacities—knowledge, power, and social status (Bamberg & Möser, 2007; Stern, 2000); situational factors—monetary incentives (Guagnano et al., 1995; Steg et al., 2014); and socio-demographic factors—gender and education (Dietz et al., 1998; Hines et al., 1987).

The resource economics literature is based on the rationality assumption and utility (profit) maximization under certain constraints (Turaga et al., 2010). These studies focus on the influence of personal endowments and situational factors—time, money, and institutions—on PEBs (Bamberg & Möser, 2007; Li et al., 2019; Steg & Vlek, 2009). These studies are founded on the preference-related concept of value and use assigned values (i.e. the relative importance of an object to a subject) (Camerer & Fehr, 2004), and both stated (intentions) and revealed (actual) pro-environment behaviors. The behavioral economics literature recognizes people's other-regarding (OR) preferences (Camerer & Fehr, 2004), which have been reported by field studies of PEBs (Bluffstone et al., 2020). However, the economic theoretical foundation of OR is still based on utility maximization, which means OR is still treated as self-regarding (SR). The economic models have ignored the subjective psychological factors.

The hybrid model of Yiwen et al. (2023) includes assigned forest values (AFVs) from the economics stream and two subjective factors from the psychology stream: Environmental Worldviews focused on Forests (EWF) and Adverse Consequences of not Practicing SFM (ACP). The focus of this study is on how AFVs may mediate the influence of EWF and ACP on PSFMB, and only attitudinal factors are incorporated into the model. However, it did not make a multi-domain analysis and could not visualize domain-specific PSFMB, AFVs, and ACP and variations in the direct and indirect effects of EWF, ACP, and AFVs on PSFMB. Other categories of factors that may influence PSFMB, such as demographic and situational factors, were also missing in this model. This paper will bridge these gaps. Next, we propose a multi-domain PSFMB model.

2.3 | Theoretical model for multi-domain analysis of pro-SFM behavior

In general, people may attach different importance to different domains of SFM. After the emergence of SFM, generally, people have assigned growing importance to ecological and recreational domains and declining importance to the economic domain of SFM (Xu & Bengston, 1997). Hence, we propose a theoretical model for multi-domain analysis of PSFMBs to analyze varied behavioral responses across domains.

In the proposed model, the dependent variable is PSFMB which is domain-specific and measured by individuals' voluntary contribution to support domain-specific pro-SFM activities (Further details are given in Section 3.2.3). Explanatory factors, to explain domain-specific behaviors, should include factors that are assessed in relation to the specific behavior and factors that capture the context of behavior (Ajzen, 1991). Our choice of explanatory factors captures these requirements.

Our proposed model is given in Figure 1, and the three categories of explanatory variables are explained next.

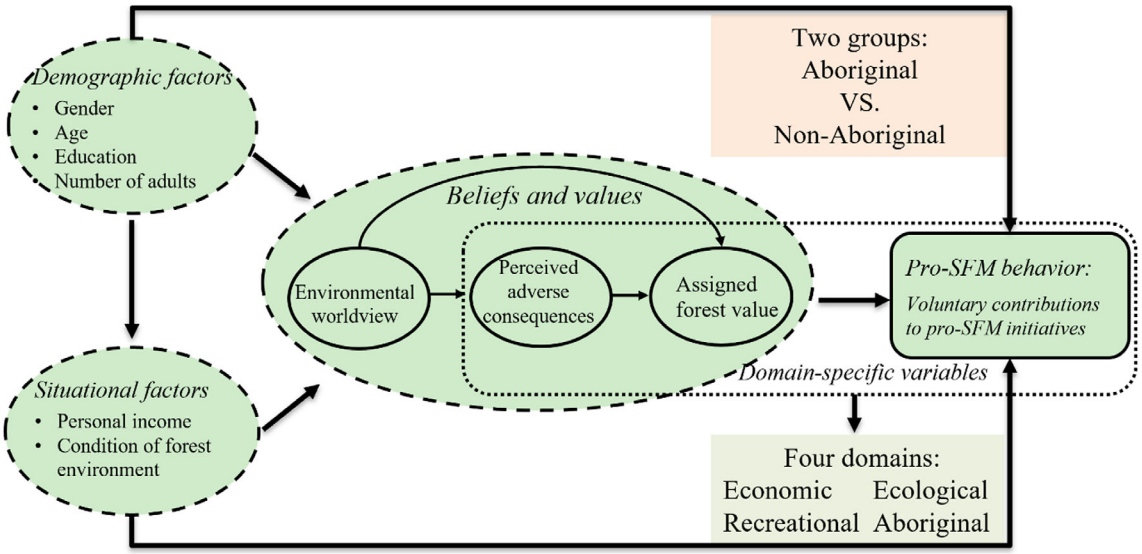

FIGURE 1 Theoretical model of multi-domain analysis of pro-SFM behavior.

2.3.1 | Beliefs and values

Beliefs and values are used as influencing factors in both categories of PEB models, but different categories of beliefs and values are used in different models. Assigned values are most common in the resource economics literature. Assigned value is an outcome of the preference-related concept of value (Brown, 1984). As per this concept, a subject first establishes a preference relationship with an object (or its attribute) and later assigns a relative degree of importance to the object (or its attribute) based on the preference relationship established (Chapman et al., 2019); that value is known as assigned value, which is context, attribute, and relation specific. Assigned forest values (AFVs) refer to the relative values assigned by a subject to various attributes of forests.

In SFM, an object may have different assigned values for the different forest attributes associated with different domains. We, therefore, in the interest of making our model specific to multiple domain analysis and enhancing its applied aspects, include AFVs in our model. AFVs, being preference-relationship-based and context-dependent, have been reported to vary across different stakeholders (McFarlane et al., 2011). Lee and Kant (2006) reported the differences in people's own AFVs and their perceptions of the AFVs of their employers. Yiwen et al. (2023) found that in Ontario, Canada, both Aboriginal and non-Aboriginal people expressed higher AFVs from their community perspectives than their own/households' perspectives. Our focus is on the PSFMB of Aboriginal and non-Aboriginal people living in the vicinity of a forest to be sustainably managed, and we therefore use AFVs from people's own community's perspective. The extant research has revealed the direct influences of assigned values on individual behaviors (Brown, 1984). In the SFM context, AFVs reflect the preference relationship of a subject with various forest attributes. According to microeconomics theories, this preference relationship guides the subject's decision to allocate resources to specific SFM goals. For example, in determining resource allocations between sustained timber production and biodiversity conservation, a subject who has a higher preference for the economy compared to the ecological attributes of forests tends to contribute more to sustained timber production than biodiversity conservation. Therefore, AFVs tend to directly influence individuals' PSFMB. We use domain-specific AFVs as an explanatory factor of domain-specific PSFMB, and therefore the influence of AFVs should be positive on PSFMB for each domain.

In addition to AFVs, two belief factors—Environmental Worldviews focused on Forests (EWF) and Adverse Consequences of not Practicing SFM (ACP)—are other key influencing factors of PSFMB. Environmental worldviews are the fundamental beliefs and perspectives that individuals hold about human-nature relationships, and their impact on actual PEBs has been documented by abundant empirical studies (Hawcroft & Milfont, 2010). The awareness of the adverse consequences of lacking PEBs is also considered a key determinant of PEBs (Yang et al., 2020). In the TPB theory, behavioral attitude, which is one of the three determinants of behavioral intentions, mainly depends on the evaluation of likely costs and benefits of the behavior, a concept similar to ACP (Ajzen, 1991). Similarly, the Protection Motivation Theory proposes that the evaluations of costs and benefits related to specific actions influence threat appraisal and coping appraisal, and finally PEBs (Rogers & Prentice-Dunn, 1997). Moreover, as elucidated by the VBN theory, EWF directly influences ACP. Individuals with pro-environmental worldviews are more likely to recognize the threat of human activities to nature and be cognizant of the adverse consequences associated with the absence of PEBs, thus adopting more PEBs (Stern et al., 1999).

In addition to the direct influence, EWF and ACP may affect PSFMB indirectly via AFVs. EWF is the belief in the general consequences of human-driven environmental changes (Dunlap et al., 2000); therefore, EWF is supposed to precede ACP, which represents more narrowly focused beliefs on the specific negative consequences of lacking SFM. Moreover, ACP is supposed to precede AFVs because AFVs are shaped by individuals' knowledge and beliefs specific to SFM. Arguably, based on their knowledge and living experiences, people will develop beliefs about the ACP in certain domains; these beliefs further determine people's recognition of the values (AFVs) of various forest ecosystem services (R.M. Ford et al., 2017) and their final decisions on the amount of contributions to different sustainability domains to preserve certain forest values.

Given the nature of EWF being more general and ACP being more specific, we use the domain-specific measurements of ACP and a single measurement of EWF. Hence, the direction of the influence of EWF may vary across the domains while it should be the same for ACP. For example, higher EWFs may increase PSFMB in ecological and Aboriginal domains but may decrease PSFMB in the economic domain.

2.3.2 | Situational factors

Generally, people tend to incorporate their environmental values in their behavior when supported by situational factors or cues present in the situation of choices (Steg et al., 2014). In the context of human behavior, situational factors are also known as external factors that affect an individual's behavior, and these factors vary across the situations in which decisions are made. In the context of PSFMB, we propose that two situational factors—one ecological factor: the condition of the forest environment, and one economic factor: personal income[iii]—will be key influencing factors. The condition of the forest environment can influence PSFMB either way. For example, individuals surrounded by a poor forest environment may be motivated to contribute more to pro-SFM activities (Wang, 2023; Yang & Zhang, 2020) to improve the forest environment while people living in a better forest environment may contribute more to PSFMB to maintain better provision of ecosystem services from these forests (Ford et al., 2014). High personal income generally means higher affordability of goods and services and decreasing marginal utility of money, which means individuals may be willing to contribute more to PSFMB. Similarly, based on the environmental Kuznets curves, specifically in developed countries, it may be suggested that contributions to PSFMB may increase with income.

Moreover, situational factors may affect PSFMB indirectly by affecting beliefs and values as mediators. Individuals with higher incomes have been found to hold stronger pro-environmental worldviews (Sparks et al., 2020). The effects of forest environment conditions on SFM-related beliefs and values are mixed. A better forest environment makes individuals gain better experiences from interacting with forests, thereby fostering eco-centric worldviews, recognizing the need for SFM, and assigning higher values to forests (Khan, 2023; Wang & Lin, 2017). Therefore, the effect of forest environment conditions on EWF, ACP, and AFVs is positive. However, there is another possibility that individuals constantly living in good forest environments will take it for granted; therefore, they may not realize the negative consequences of not practicing SFM and cannot recognize the values of forests. On the contrary, those living in poor forest environments can learn from the failures of poor forest management and be inspired to hold stronger EWF, ACP, and AFVs (Wang, 2023; Yang & Zhang, 2020). Hence, it will be worth examining the indirect influence of these factors on PSFMB.

In addition, the effects of situational factors, especially personal income, on PSFMBs may be stronger in hedonic (i.e., economic and recreational) than Aboriginal domains because PSFMBs in hedonic domains are mainly driven by pragmatic considerations rather than faiths and cultures. Therefore, a multi-domain analysis allows for a more nuanced understanding of PSFMBs.

2.3.3 | Demographic factors

Similarly, four demographic factors—age, gender, education, and the number of adults in a household—may influence PSFMB directly or indirectly by affecting beliefs, values, and situational factors (Liere & Dunlap, 1980; Miller et al., 2015). Females and well-educated individuals have been found to adopt more PEBs (Jacobsen & Hanley, 2009; Miller et al., 2015), while the influence of age on PEBs is mixed. A greater number of adults in the household is associated with more resources and collective effort available, which may lead to a higher willingness to adopt PSFMBs. Moreover, studies have shown that females (Needham, 2010), younger generations (Vaske et al., 2011), and people with higher educational levels (Rickenbach et al., 2017) tend to have stronger pro-environmental values and beliefs; middle-aged, male, and well-educated individuals are more likely to have higher personal income; the elder and the female may have a more nuanced perception of forest environment conditions. Therefore, beliefs, values, and situational factors may serve as mediators between demographic factors and PSFMB.

2.3.4 | Specific features of the model

We endeavor to compare PSFMBs and their determinants between Aboriginal and non-Aboriginal groups. Aboriginal and non-Aboriginal groups may follow different behavioral logic when making PSFMB decisions and may give different weights to pragmatic, utilitarian, and rational considerations versus idealistic, emotional, and moral considerations. The proposed model has its roots in rational economic behavior, dominant among non-Aboriginal groups of Western cultures. However, the choice of explanatory factors incorporates the required flexibility to capture the differences in behavioral logic, and the direction and magnitude of the influences of various factors, specifically EWF, ACP, and AFVs, on PSFMBs.

To keep the expression of ideas concise, in Figure 1 we have not shown all the paths that are tested and reported in the results. The complete picture of estimated paths is given in Figure 2 in Section 3.3.

3 | METHODS

3.1 | Data collection

This study was approved by the Research Ethics Committee of the university and the Band Offices of involved First Nations in northwest Ontario. Forests around these communities are all owned by the government. For data collection, we, first, used purposive sampling to select three pairs of one First Nation and one non-First-Nation community with each community having more than 50 households; two communities in each pair are adjacent to the same forests, and community members are actively involved in forest use and management. Second, data collection in each community was organized on a predetermined day decided in consultations with respective community leaders. All members of each community were informed by a community announcement about the project, the venue, the date, and the time of data collection. The members were informed that data collection will have two parts—completion of a questionnaire and a public good game, and all members are welcome to participate. Third, on the data collection day, arrangements were made for the venue of data collection—a community hall or a local school, and interested members came to the venue. On arrival, a participant first completed a structured questionnaire that included questions on the demographic and socio-economic variables of respondents and their households, the condition of the forest environment, EWF, ACP, and AFVs. After that, a public goods experiment was conducted to elicit respondents' voluntary contributions to pro-SFM initiatives (Details are in Section 3.2.3).

3.2 | Measures

3.2.1 | Demographic and situational factors

Gender, age and the number of adults (16 years or older) in a household have straightforward measures. Education and personal income were measured by a 5-level and an 11-level ordinal scale, respectively. The condition of the forest environment was measured by a 4-point Likert scale ranging from 1 “poor” to 4 “very good.”

3.2.2 | Beliefs and values

EWF was measured by the revised, 15-item New Ecological Paradigm (NEP) scale using a 5-point Likert scale ranging from 1 "strongly disagree" to 5 "strongly agree." The mean of all 15 items was used as the measure of EWF. The NEP scale seems the best scale to measure EWF in the context of SFM because it measures "the degree to which people view humans as part of nature" (Schultz & Zelezny, 1999). The scale includes questions focused on five sub-categories: anti-anthropocentrism, the fragility of nature's balance, the possibility of an eco-crisis, the reality of limits to growth, and rejection of exceptionalism (Dunlap, 2008), and therefore it provides a non-domain-specific measure of EWF.

ACP was measured by a scale consisting of statements about how the absence of SFM will lead to adverse consequences in economic, ecological, recreational, and Aboriginal domains, and therefore it is a domain-specific measure. Some examples are *Employment and income sources will be unsecured (economic), and Rare and vulnerable habitats will be destroyed (ecological)*. The key attributes of all statements are in Table A1. The same 5-point Likert scale, used for EWF, was used for ACP.

AFVs were measured by a scale, based on the studies by Ford et al. (2017) and Kumar and Kant (2007), which includes a set of forest ecosystem services belonging to economic, ecological, recreational, and Aboriginal domains. Some examples include *Forests providing the opportunity for employment (economic)* and *Forests providing the opportunity to see and experience nature as our ancestors did (Aboriginal)*. All ecosystem services included are given in Table A1. Respondents used a 7-point Likert scale (1 "not important at all" to 7 "very important") to respond.

For ACP and AFVs, the mean scores of items in each domain were used in the analysis. Moreover, the mean scores of items in all domains were used as a measure of aggregate sustainability.

3.2.3 | Pro-SFM behavior

Pro-SFM behavior (PSFMB) is measured by an individual's voluntary contribution (VC) to pro-SFM initiatives elicited through a field experiment—Public Goods Game—a Revealed Preference Technique. The public good game is an experimental economic game where all participants are given an option to contribute part of their private endowments to a public good and the returns from public good are shared equally among all participants irrespective of their contributions; therefore, it simulates the scenario where individuals face the trade-off between personal gains versus collective benefits (Croson, 2007). The public good game often uses real payment and can be designed to incorporate real-world contexts, leading to more genuine responses and behaviors of individuals. It has been widely adopted to measure individuals' pro-social and pro-environmental preferences, and individuals' experimental contributions have been found to predict their real-world PEBs well (Bluffstone et al., 2020; Fehr & Leibbrandt, 2011; Kumar & Kant, 2016). Therefore, it is a very good and established method to measure PSFMBs.

In our experiment, each subject was told that their task was to allocate Can$20 given to them by the researcher between a private account and an SFM account. Their private account allocation will be directly given to them, and the SFM account allocation will be used for pro-SFM activities in the forest near their community, which will be beneficial to all members of their community. Subjects were asked to allocate the money under four scenarios, in which certain SFM activities will be conducted to enhance SFM goals in four different domains: boosting timber production and creating jobs (economic), enhancing ecological services and wildlife habitat (ecological), facilitating recreational activities (recreational), and preserving traditional Aboriginal values (Aboriginal). On the completion of four domain-specific allocations, the subject was asked to randomly pick a chit from four chits indicating one of the four domains. The subject was paid the dollar amount that he/she allocated in the private account for the randomly picked domain.

3.3 | Data analysis

The first step in data analysis was testing the reliability and validity of scales used to measure EWF, ACP, and AFVs. After that, the data analysis included two parts. The first was to conduct a multi-group and multi-domain comparative analysis of ACP, AFVs, and PSFMB. More specifically, T-tests were used to investigate the first two research questions: (a) for a specific sustainability domain, whether relevant variables significantly differ between Aboriginal and non-Aboriginal groups; and (b) for a specific group, whether relevant variables significantly differ between any two of the four domains. Bonferroni correction was used to address the multiplicity issue and reduce the Type-I error (Armstrong, 2014).

The second part was to analyze the influence of determinants of PSFMB in each domain for both groups—Aboriginal and non-Aboriginal to answer the last two (third and fourth) research questions. Correlation analysis was conducted to gain a basic understanding of the linear relationships between variables. Then, the multi-group path analysis method, which is good for investigating mechanisms (direct and indirect) of effects, was used (Collier, 2020).[iv] It included the following steps. First, data were used to fit the proposed model given in Figure 1 for each of the four domains and each group separately. Model fitness was checked by CMIN/DF, CFI, SRMR, RMSEA, and PClose, which are less vulnerable to sample size compared to the chi-square test (Hu & Bentler, 1999). After finding acceptable model fitness, we examined standardized regression weights and made comparisons across the models of domains and groups.

Figure 1 includes three types of paths, and we dealt with them in different ways. The direct effects of demographic, situational, and beliefs and values variables on PSFMB, as well as the indirect effects of EWF and ACP, represent our analytical focus; therefore, these effects (path loadings) were estimated and reported regardless of statistical significance. For the remaining indirect effects on PSFMB and interactions between variables, a relationship was retained only if it

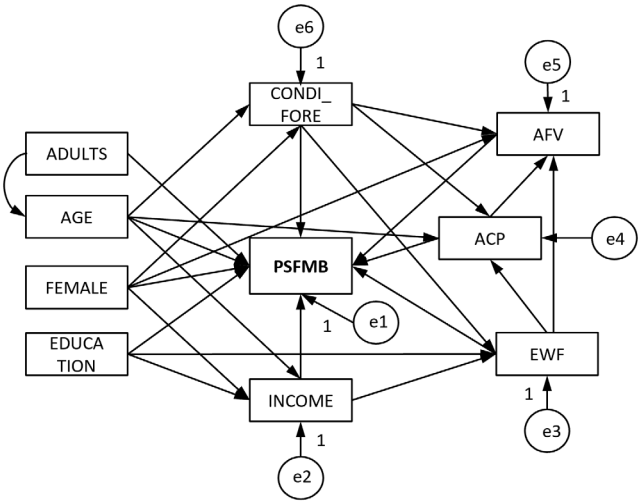

FIGURE 2 Path graph for the estimation of theoretical model of multi-domain analysis of pro-SFM behavior. Meanings of all variables are given in Table 1.

was significant for at least one group and in one domain and could be meaningfully interpreted. The final path graph used for estimations is shown in Figure 2.

Second, for each domain, a multi-group analysis was made between Aboriginal and non-Aboriginal groups to test differences between the two groups. Only if the whole model was significantly different, did we compare the regression weights between the two groups (Collier, 2020; Kline, 2015). The bootstrap method, which provides a more accurate estimate of a parameter compared to the estimates from any one of the n samples (Preacher & Hayes, 2008), with 2000 resamples was used to examine the statistical significance of effects.

4 | RESULTS

In the data collection, 435 (250 Aboriginal and 185 non-Aboriginal) people participated, but 4 Aboriginal and 19 non-Aboriginal responses were incomplete. Hence, the data from 412 (246 Aboriginal and 166 non-Aboriginal) participants were used.

The results of the reliability and validity tests of the EWF, ACP, and AFVs scales are given in Table A2, which demonstrate that the three scales have good reliability and validity. The results of correlation analysis, given in Table A3, provide correlations among different variables.

4.1 | Multi-group and multi-domain analysis of beliefs, values, and Pro-SFM behavior

In this section, we present the analysis to answer the first and second questions. The means and standard deviations of all variables, as well as the differences in the means and their statistical significance between the two groups, are given in Table 1. T-test results for the differences of ACP, AFVs, and PSFMB across four domains and two groups are given in Table 2.

As per Table 1, compared to the Aboriginal group, the non-Aboriginal group has significantly higher education, income, proportion of females, and adults, and better forest environments. Moreover, Aboriginal people have stronger pro-environmental worldviews of forests (higher EWF) than non-Aboriginal people.

Both groups agree that lacking SFM will lead to adverse consequences in all four domains (means of ACP ≥3.5). The between-group difference is significant only for the Aboriginal domain (Aboriginals mean = 4.04 and non-Aboriginals mean = 3.55), which seems natural. As per Table 2, the ACP of Aboriginals is significantly higher in ecological and Aboriginal domains than in recreational and economic domains while for non-Aboriginals, it is the highest in the ecological and the lowest in the Aboriginal domains.

Both groups also believe that all four domains of forests are important to their communities (Mean AFVs ≥5), but significant differences exist between Aboriginals and non-Aboriginals. The means of ecological, recreational, and Aboriginal domains are significantly higher while the mean of the economic domain is significantly lower for Aboriginal than non-Aboriginal people, indicating that two groups assign different values to four domains. In short, Aboriginal people attach significantly lower importance to the economic domain than the other three domains; in contrast, non-Aboriginals consider economic and ecological domains the most important and the Aboriginal domain the least important.

As for PSFMB, both groups contributed an average of about half of the endowed money ($20). Aboriginal people made the highest contributions to ecological and Aboriginal domains and the least to economic domains. In comparison, the decreasing order for non-Aboriginal people of PSFMB contributions was ecological, recreational, Aboriginal, and economic domains. Table 1 also shows that non-Aboriginals made significantly higher contributions to PSFM activities than Aboriginal people in economic and recreational domains.

To sum up, both groups agree on the ACP, acknowledge the values of forests to their communities, and are contributing significant endowments to pro-SFM activities. The two groups, however, show different interests in the four domains of pro-SFM activities. Aboriginal people pay the most attention to the ecological and Aboriginal domains and the least to the economic domain. Non-Aboriginal people also pay the highest attention to the ecological domain; however, they have significantly less concern for the Aboriginal domain and more concern for the economic domain compared to Aboriginal people. Hence, in brief, the responses to the first two questions are affirmative.

4.2 | Multi-domain and multi-group analysis of the determinants of Pro-SFM behavior

The analysis presented in this section answers the third and fourth research questions. The PSFMB model's estimation results are given

TABLE 1 Means, standard deviations, and differences in means for all variables for Aboriginal and non-Aboriginal people.

Variable	Meaning	Aboriginal		Non-aboriginal		Difference in means
		Mean	Std.	Mean	Std.	
FEMALE	Female = 1, male = 0	0.55	0.50	0.66	0.48	−0.11**
AGE	Age of respondents	41.09	15.77	39.49	15.98	1.60
EDUCATION	Grade school = 1; High school = 2; College = 3; Bachelor = 4; Graduate degree = 5	2.60	0.91	2.90	1.06	−0.31***
ADULTS	Number of adults 16 years or older in household	1.97	1.18	2.38	1.15	−0.41***
INCOME	Annual personal gross income: 1 = no personal income; 2 = under $20,000; 3 = $20,000 to $29,999; 4 = $30,000 to $39,999; 5 = $40,000 to $49,999; 6 = $50,000 to $59,999;7 = $60,000 to $69,999;8 = $70,000 to $79,999;9 = $80,000 to 89,999;10 = $90,000 to $99,999;11 = above 100,000	3.91	2.48	4.55	2.80	−0.64**
CONDI_FORE	Condition of forest environment: poor = 1, neither poor nor good = 2, good = 3, very good = 4	2.67	0.92	3.37	0.64	−0.70***
EWF	Environmental worldviews (1–5 Likert scale)	3.58	0.59	3.45	0.53	0.13**
ACP_AVER	Perceived adverse consequences of not conducting SFM: average of four domains (1–5 Likert scale)	4.02	0.94	3.85	0.82	0.17*
ACP_ECON	Perceived economic consequences of not conducting SFM	3.83	1.03	3.89	0.89	−0.06
ACP_ECOL	Perceived ecological consequences of not conducting SFM	4.14	0.98	4.02	0.86	0.12
ACP_RECR	Perceived recreational consequences of not conducting SFM	3.92	1.11	3.77	1.09	0.15
ACP_ABOR	Perceived Aboriginal, traditional, and spiritual consequences of not conducting SFM	4.04	1.03	3.55	1.06	0.49***
AFVs_AVER	Assigned forest values to your community: average of four domains (1–7 Likert scale)	5.81	1.37	5.37	1.27	0.44***
AFVs_ECON	Economic importance of forests to your community	5.08	1.67	5.80	1.42	−0.72***
AFVs_ECOL	Ecological importance of forests to your community	5.97	1.56	5.69	1.49	0.27*
AFVs_RECR	Recreational importance of forests to your community	5.96	1.47	5.44	1.47	0.52***
AFVs_ABOR	Aboriginal importance of forests to your community	5.95	1.51	4.92	1.68	1.03***
PSFMB_AVER	SFM account contributions: average of four domains (0-$20)	10.78	6.95	11.83	6.46	−1.04
PSFMB_ECON	Contributions to Timber production: To enhance Intensive Timber Management that will increase timber production and harvesting and timber-related jobs	9.26	7.72	11.09	7.31	−1.82**
PSFMB_ECOL	Contributions to Ecosystem service: To enhance the production of ecosystem services such as biodiversity, wildlife habitat, water quality, and carbon sequestration	11.82	7.62	12.62	6.92	−0.80
PSFMB_RECR	Contributions to Recreational functions: To enhance recreational activities such as hiking, camping, recreational hunting, and trapping	10.56	7.80	12.08	7.36	−1.52**
PSFMB_ABOR	Contributions to Aboriginal values: To enhance Aboriginal forest values including food gathering; traditional hunting, fishing, and trapping; and cultural and spiritual activities	11.48	7.83	11.51	7.44	−0.02

Note: Sample size is 246 and 166 for the Aboriginal and the non-Aboriginal group.
*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

in Tables 3 and A4, and the model fit indices show that all five (four domains and one for aggregate SFM) models have excellent fits. P-values of global tests show that there are significant differences between Aboriginal and non-Aboriginal groups at the model level. Therefore, it is desirable to examine differences in the specific path loadings between the two groups for each domain and the aggregate SFM models. Detailed results are discussed next.

4.2.1 | Determinants of Pro-SFM behavior

In general, beliefs and values are good predictors of PSFMB. Table 3 shows that the total/direct effects of AFVs on PSFMB are significant and positive in all domains for Aboriginals and in the economic and Aboriginal domains and aggregate SFM for non-Aboriginals, indicating that higher AFVs lead to higher levels of PSFMB. The

TABLE 2 Comparative analysis of domain-specific values of adverse consequences of lacking SFM (ACP), assigned forest values (AFVs), and pro-SFM behavior (PSFMB).

		Aboriginal people			Non-aboriginal people		
Factor	**Domain**	**Economic**	**Ecological**	**Recreational**	**Economic**	**Ecological**	**Recreational**
ACP	Ecological	0.0000***			0.0041**		
	Recreational	0.0417	0.0000***		0.0427	0.0002**	
	Aboriginal	0.0000***	0.0065**	0.0019**	0.0000***	0.0000***	0.0019**
AFVs	Ecological	0.0000***			0.4085		
	Recreational	0.0000***	0.9019		0.0077**	0.0081**	
	Aboriginal	0.0000***	0.7366	0.7332	0.0000***	0.0000***	0.0000***
PSFMB	Ecological	0.0000***			0.0003**		
	Recreational	0.0040**	0.0000***		0.0139*	0.1425	
	Aboriginal	0.0000***	0.1687	0.0022**	0.3805	0.0020**	0.2384

Note: In superscript are *p*-values of *t*-tests that show whether one variable is significantly different between two domains. Bonferroni correction was made to address the multiplicity issue.
*$p < 0.100/6 = 0.0167$; **$p < 0.050/6 = 0.0083$; ***$p < 0.001/6 = 0.00017$.

indirect effects of ACP on PSFMB are significantly positive in all domains for Aboriginal people, while the total effects of ACP on PSFMB for Aboriginal people are not significant in all domains. For non-Aboriginals, the total effects of ACP on PSFMB are significant and positive in the aggregate, the economic, and the Aboriginal domains. The total and direct effects of EWF on PSFMB are not significant in the economic domain for both Aboriginal and non-Aboriginal groups, indicating that pro-environmental worldviews are neutral in terms of impacting PSFMB with economic purposes. For Aboriginal people, the total effects of EWF on PSFMB are significantly positive in all, except economic, domains and the aggregate SFM, and they are mainly comprised of direct effects, while for non-Aboriginal people, the total effects are significant only in the aggregate SFM and the ecological domain, and the sizes of effects are smaller than those of Aboriginal people.

As for situational factors, INCOME and CONDI_FORE have a stronger impact on the PSFMB of non-Aboriginals than Aboriginals. For non-Aboriginals, the total effects of INCOME on PSFMB are significant and positive for the economic and recreational domains and the aggregate SFM and mainly comprise direct effects. In contrast, for Aboriginal people, the total and direct effects of INCOME are not significant for all domains. The total and direct effects of CONDI_FORE on PSFMB are significant and positive for non-Aboriginal people but not significant for Aboriginal people for all domains. This means CONDI_FORE plays a more significant role in influencing the PSFMB of non-Aboriginals.

The PSFMB behavior also varies with some demographic factors, specifically with respondents' gender and the number of adults in the household, but the effects are different for the two groups. The total and direct effects of FEMALE on PSFMB are significantly positive for Aboriginals in all but recreational domains but are not significant for non-Aboriginals in any domain. The total/direct effects of ADULTS on PSFMB are significantly negative for non-Aboriginals but not significant for Aboriginals in all domains. The total and direct effects of AGE and EDUCATION on *PSFMB* are not significant in most domains for both groups.

Table 4 presents the importance of ranking (based on the path coefficients of the estimated model) of influencing factors (only beliefs, values, and situational factors). For Aboriginal people, generally, EWF is the dominant and AFVs are the second significant influencing factor of PSFMB while the influences of two situational factors (INCOME and CONDI_FORE) are not significant; in addition, the significant effect of EWF is always direct. The ACP has significant indirect but marginal effects, and its total effect is not significant in any domain of Aboriginal people. For non-Aboriginal people, generally, two situational factors (INCOME and CONDI_FORE) are the dominant factors, and beliefs and values (EWF, ACP, and AFVs) are also significant in some cases. However, the direct effect of EWF is never significant, and the direct effect of ACP is significant only for the Aboriginal domain. Hence, generally, EWF and ACP influence the PSFMB of this group indirectly through AFVs.

4.2.2 | Relationships between demographic and situational factors, beliefs, and values

The results of these relationships are given in Table A4. The results show that the total/direct effects of EWF on ACP and of ACP on AFVs are significant and positive for both groups in all domains. The total effects of EWF on AFVs, for both groups, are not significant in economic and generally significant and positive in the remaining three domains and mainly comprise indirect effects. These results suggest that stronger EWF leads to higher ACP and higher AFVs.

Beliefs and values are also influenced by situational and demographic factors. The total/ direct effects of INCOME and CONDI_FORE on EWF are significant and positive for non-Aboriginals but are not significant for Aboriginals. The total effects of CONDI_FORE on AFVs are significant and positive for Aboriginals in all domains and are

TABLE 3 Results of the estimation of multi-domain PSFMB models: effects on PSFMB.

		Overall		Economic		Ecological		Recreational		Aboriginal	
Effects		**Abo**	**Non-Abo**	**Abo**	**Non-Abo**	**Abo**	**Non-Abo**	**Abo**	**Non-Abo**	**Abo**	**Non-Abo**
AFVs→PSFMB	Total/direct	0.166**	0.166**	0.208***	0.155**	0.125*	0.099	0.154**	0.048	0.214***	0.154**
ACP → PSFMB	Total	−0.035	0.185**	−0.012	0.138*	−0.001	0.093	−0.055	0.136	−0.085	0.286***
	Direct	−0.093	0.135	−0.053	0.108	−0.042	0.069	−0.112	0.124	−0.158**	0.24***
	Indirect	0.058**	0.050**	0.041***	0.030**	0.041*	0.023	0.057**	0.011	0.073***	0.046**
EWF → PSFMB	Total	0.184***	0.124*	0.000	0.105	0.214***	0.166**	0.233***	0.050	0.213***	0.120
	Direct	0.204***	0.043	0.035	0.051	0.215***	0.121	0.248***	−0.002	0.245***	0.030
	Indirect	−0.020	0.081**	−0.035	0.054*	−0.002	0.044	−0.015	0.052*	−0.032	0.09***
INCOME→PSFMB	Total	0.044	0.169**	0.034	0.210**	0.022	0.119	0.083	0.214**	0.014	0.083
	Direct	0.027	0.148	0.034	0.192**	0.003	0.091	0.062	0.206**	−0.005	0.062
	Indirect	0.017	0.021*	0.000	0.018*	0.020	0.028**	0.022	0.008	0.020	0.02*
CONDI_FORE→PSFMB	Total	0.031	0.212***	0.070	0.186***	0.011	0.205***	0.021	0.193***	0.010	0.163**
	Direct	0.010	0.183**	0.038	0.165**	−0.002	0.170**	0.007	0.183**	−0.015	0.135*
	Indirect	0.022	0.029*	0.032**	0.021	0.013	0.035**	0.014	0.010	0.025	0.029*
ADULTS→PSFMB	Total/direct	0.026	−0.182**	0.053	−0.171**	−0.005	−0.155**	0.017	−0.145*	0.024	−0.145*
AGE→PSFMB	Total	0. 109	−0.001	0.086	−0.004	0.121*	0.020	0.095	0.025	0.097	−0.030
	Direct	0.105	−0.092	0.087	−0.105	0.116*	−0.037	0.081	−0.084	0.106*	−0.086
	Indirect	0.004	0.091**	−0.001	0.101***	0.004	0.057*	0.013	0.109***	−0.008	0.057
EDUCATION→PSFMB	Total	0.037	0.119	−0.043	0.124	0.029	0.119	0.064	0.031	0.093	0.153**
	Direct	−0.009	0.038	−0.053	0.024	−0.015	0.060	−0.003	−0.071	0.051	0.112
	Indirect	0.046*	0.081**	0.010	0.100**	0.044*	0.059	0.066**	0.102**	0.042*	0.041
FEMALE→PSFMB	Total	0.131**	−0.006	0.121*	−0.054	0.126*	−0.026	0.078	−0.04	0.141**	0.112
	Direct	0.142**	0.031	0.128**	0.007	0.132**	0.022	0.092	0.024	0.148**	0.120
	Indirect	−0.011	−0.037	−0.007	−0.06*	−0.006	−0.048*	−0.014	−0.065*	−0.007	−0.008
Global test: P-value											
		0.012		0.007		0.110		0.004		0.002	
Model fit measures											
CMIN/DF		1.269 Excellent		1.304 Excellent		1.430 Excellent		1.300 Excellent		1.285 Excellent	
CFI		0.969 Excellent		0.955 Excellent		0.950 Acceptable		0.962 Excellent		0.967 Excellent	
SRMR		0.058 Excellent		0.059 Excellent		0.060 Excellent		0.057 Excellent		0.060 Excellent	
RMSEA		0.026 Excellent		0.027 Excellent		0.032 Excellent		0.027 Excellent		0.026 Excellent	
PClose		0.986 Excellent		0.981 Excellent		0.952 Excellent		0.982 Excellent		0.984 Excellent	

Note: Abo: Aboriginal group; non-Abo: non-Aboriginal group. Standardized estimates are reported. Meanings of all variables are given in Table 1. Thresholds of model fit measures are shown in the appendices (Appendix A5).

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

TABLE 4 Ranking of the influencing factors of pro-SFM behavior by sustainability domains and groups.

	Overall		Economic		Ecological		Recreational		Aboriginal	
Rank	Abo	Non-abo	Abo	Non-abo	Abo	Non-abo	Abo	Non-abo	Abo	Non-abo
1	EWF	CONDI_FORE	AFV	INCOME	EWF	CONDI_FORE	EWF	INCOME	AFV	ACP
2	AFV	ACP		CONDI_FORE	AFV	EWF	AFV	CONDI_FORE	EWF	CONDI_FORE
3		INCOME		AFV						AFV
4		AFV		ACP						
5		EWF								

Note: Based on the significance of total effects. Meanings of all variables are given in Table 1. Rankings are from the largest to the smallest according to the size of effects. Abo: Aboriginal group; non-Abo: non-Aboriginal group.

mainly indirect, while the total, as well as direct effects of CONDI_FORE on AFVs, are not significant for non-Aboriginals. The total, mainly direct, effects of EDUCATION on EWF are significantly positive for Aboriginals, while these effects are not significant for non-Aboriginal people. The total effects of AGE on ACP are significant for Aboriginals in the Aboriginal domain, while the same effects are significant for non-Aboriginal people in all but the Aboriginal domain. The total effects of FEMALE on AFVs are not significant for Aboriginals but are significant for non-Aboriginal people in recreational and ecological domains and aggregate SFM, and they mainly comprise direct effects.

5 | DISCUSSION AND CONCLUSION

5.1 | Discussion

Sustainability is not limited to environmental and economic issues but includes all aspects of human well-being. Most sustainability issues have emerged due to our heavy dependence on myopic, narrow, and exclusive lenses of economics, environmental science, and other disciplines. As Albert Einstein observed—"we can't solve problems by using the same kind of thinking that created them," we need a different lens—a sustainability lens, which has a balancing vision across multiple dimensions of disciplines to address sustainability issues (Kant, 2019). In this paper, we make a move in that direction by developing a lens that integrates the environmental psychology and economics lenses of pro-sustainability behavior (PSB), and its vision can recognize the fundamental differences between the PSFMB (pro-SFM behavior) of Aboriginal and non-Aboriginal people. Our lens attempts to recognize and analyze the observed differences instead of imposing the uniform vision of the lens itself as done by the traditional disciplinary lenses.

Sustainability includes multiple domains (Amaruzaman et al., 2023), and social groups may perceive and value these domains differently. An understanding of these variations is critical for developing a broader, inclusive, and balancing vision to foster effective engagement and collaboration among stakeholders (Kant, 2019). Premised on this sustainability lens, this study provides a nuanced understanding of the variations in SFM-related values, beliefs, and behaviors across domains and between groups. For example, as per Table 1, non-Aboriginals make significantly higher contributions than Aboriginals in economic and recreational domains, and more differences are visible in the domain-specific and group-specific analyses of AFVs (assigned forest values) and ACP (adverse consequences of not practicing SFM). These variations, however, cannot be captured by aggregate SFM contributions. The variations across domains and two groups complement many past studies (e.g., Kant & Lee, 2004; Kumar & Kant, 2007; S. Miller et al., 2015) focused on the AFVs of multiple stakeholders, but this study enriches the literature by extending the focus to beliefs and PSFMBs.

This study reveals some distinguishing features of the influencing factors of PSFMB between Aboriginal and non-Aboriginal groups. As discussed in Section 4.2.1, the PSFMB of Aboriginal people is significantly affected by EWF (environmental worldviews focused on forests) and AFVs rather than situational factors, while INCOME and CONDI_FORE (the condition of forest environment) are the dominant factors for non-Aboriginal people. This empirical evidence confirms that the PSFMB of Aboriginals is mostly driven by their environmental worldviews and not by economic factors like income and price; in contrast, the PSFMB of non-Aboriginals may be more influenced by their instrumental values rather than beliefs and other intrinsic values. Similarly, INCOME and CONDI_FORE have significant positive influences on EWF for non-Aboriginals but not for Aboriginals, which reconfirms that Aboriginal's EWF is foundational and deeply rooted in their cultural attributes, including relationships with Mother Earth and consideration of Seven Generations, while EWF of non-Aboriginals depends on their current context. The influence of CONDI_FORE on AFVs is positive and significant for Aboriginals but not significant for non-Aboriginals, which indicates that Aboriginals are sensitive, while non-Aboriginals are not, to CONDI_FORE in assigning their AFVs. These results resonate with the findings of Yiwen et al. (2023) related to the moral and pragmatic considerations underlying the aggregate PSFMB of Aboriginals and non-Aboriginals, but this study adds key nuances and evidence by extending the analysis to multiple domains.

The insights from this study complement existing environmental psychology and resource economics models. Our discussions on how PSFMBs are influenced by AFVs enrich existing environmental psychology studies, which generally focus on context-free and abstract-held values but ignore context-specific assigned values (e.g., Rickenbach et al., 2017; Steg et al., 2014; Stern, 2000).

Moreover, the average contributions to pro-SFM activities in our public goods game are about 50% of endowments for both groups, which resonates with many resource economics studies (e.g., Camerer & Fehr, 2004; Croson, 2007; Kumar & Kant, 2016) highlighting other-regarding preferences with respect to PSFMB. However, the dominance of EWF as an influencing factor of Aboriginals and the emergence of beliefs as significant influencing factors of non-Aboriginals for ecological and Aboriginal domains raise serious questions about the validity of economic rationality—the foundation of economics. In addition, an average of 23% of Aboriginals and 14% of non-Aboriginals made zero contributions while 27% of Aboriginals and 29% of non-Aboriginals contributed full endowments ($20) to pro-SFM activities, and the contributions were generally higher for ecological and Aboriginal domains for both groups. These results suggest that many people may have other-regarding preferences due to their beliefs rooted in social well-being rather than their own selfish utility maximization.

The use of the sustainability lens, as well as the domain- and group-specific analysis, in this study, benefits from an integration of environmental psychology and resource economist models, which highlights the need to accept the plurality and complementarity of theoretical foundations of pro-sustainability behavior across diverse stakeholders and contexts. Some key findings of this study—such as beliefs and values as dominant influencing factors for Aboriginals and contextual factors for non-Aboriginals PSFMB—are possible only with an integrated model and not with either of the two categories of existing models. Such findings indicate the need for the integration of different disciplines—inter- and trans-disciplinary approaches—to understand PSB across stakeholders and address sustainability issues (Hakkarainen et al., 2022). In other words, a comprehensive understanding of multi-dimensional aspects of sustainability is possible only through a sustainability lens that integrates a diversity of theoretical foundations from different disciplines. The examination of direct and indirect influencing mechanisms is also very important to have a holistic vision of sustainability issues and should be a part of the sustainability lens.

5.2 | Conclusion

The study examines the variations in beliefs, values, and PSFMB (pro-SFM behavior) across four sustainability domains and between Aboriginal and non-Aboriginal groups. An integrative PSFMB model is proposed and estimated using multi-group path analysis and data from three Aboriginal and three non-Aboriginal communities. On average, more than half of the endowed money is contributed to pro-SFM initiatives by the members of both groups, but substantial variations are observed in ACP (adverse consequences of not practicing SFM), AFVs, and PSFMB across four domains and two groups. Specifically, the ecological domain is considered important by both groups; however, compared to non-Aboriginals, Aboriginals assign higher importance to the Aboriginals and lower importance to the economic and recreational domains. In general, the PSFMB of Aboriginals is driven by their EWF (environmental worldviews focused on forests) and AFVs, while INCOME and CONDI_FORE (forest environment condition) are the main drivers of non-Aboriginals' PSFMB, but beliefs and values are also important influencing factors in their ecological and Aboriginal domains.

These results confirm the importance of multi-domain and multi-stakeholder analysis and the need for culture- and context-sensitive theories of pro-sustainability behavior. Our findings related to the roles of "beliefs and values" and "pragmatic" considerations in the PSB of Aboriginals and non-Aboriginals, respectively, confirm different basic motivations underlying the PSB and the deeper cultural variations between the two groups and challenge the use of dominant rational choice theory across cultures (Zander & Straton, 2010). Our integrative approach underscores the necessity of a multidimensional lens in sustainability research and advocates for the inclusion of diverse theoretical perspectives to fully grasp the complexity of pro-sustainability behaviors across different cultural and social contexts. The findings indicate the need for cross-cultural validity prior to the generalization of theories and inclusion of culturally and morally desirable preferences, including normative views of human-nature relations, in PSB models (Abeysekera, 2023).

The results can be used by forest managers and policymakers to design SFM interventions. For example, the other-regarding preferences across two groups can be used to design SFM-focused voluntary mechanisms. The very high importance assigned to the ecological domain by both groups can provide a common ground to design ecologically sound practices. Moreover, our findings underscore the importance of culturally sensitive approaches in forest management. To design PSFMB-enhancing strategies for non-Aboriginal people, resource managers should focus on contextual factors, and economic incentives and awareness programs about the multiple values of forests might be more effective. In contrast, for Aboriginal people, resource managers will have to integrate Aboriginal traditional knowledge into policymaking and modify forest management systems according to the EWF, due to their enduring nature, of Aboriginal people. These insights could be incorporated into training programs for forest managers and practitioners.

The study, being the first on multi-domain analysis of PSFMB and a sustainability lens, opens many avenues for future research. First, similar studies need to be conducted with many other Aboriginal and non-Aboriginal groups in many countries to investigate the generalizability of our findings. Second, to better understand and incorporate unique cultural attributes, such as worldviews, beliefs, and values, of Aboriginal people, field-based qualitative research should complement quantitative studies. Third, future research should expand the horizon of sustainability lens by incorporating basic tenets of PSB from disciplines such as Indigenous culture and science, anthropology, philosophy, politics, positive psychology, and sociology.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflict of interest to declare.

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ENDNOTES

[1] This paper uses Aboriginal, First Nation, and Indigenous people interchangeably; however, there are nuanced differences in their meanings and usages. In Canada, "Aboriginal" is a broader term which encompasses three groups—First Nation, Inuit, and Métis. However, the First Nation group is the largest (about two-third of the Aboriginal peoples) among the three groups, and therefore "Aboriginal" and "First Nation" are used interchangeably. "Indigenous" is a much broader term, used globally, to refer to the original inhabitants of a land and their descendants. In Canada, only "Aboriginal" people are "Indigenous" people.

[2] Examples of domain-specific activities are economic domain—boosting timber production, ecological domain—enhancing biodiversity, Aboriginal domain—preserving Aboriginal values, and social/recreational domain—maintaining/creating recreational trails and facilities.

[3] As we stated, the determination or classification of factors as a situational factor is situation specific. Some authors may like to call personal income as economic/social/demographic factor. In the context of PSFMB, we prefer to call these two as situational factors, and our results for these two factors are independent of the terminology being used. In addition, situational factors are external to the internal attributes of a person, such as beliefs and values, whose behavior is being researched, but not external to the whole environment in which the subject is behaving. Hence, some interactions between situational factors and demographic factors are possible.

[4] Path analysis is similar to a multivariate regression analysis. "In a path analysis model, the causal effect between two variables includes the direct causal effect between the two variables, and the indirect causal effect through other mediating variables. The sum of the direct causal effect and the indirect causal effect is the total causal effect." (Hua et al., 2021). Path analysis has been widely used to explain the causal effects of explanatory variables on PEB (i.e., Hua et al., 2021), and we extended its use from PEB to PSFMB.

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APPENDIX A

TABLE A1 Attributes of measuring domain-specific assigned forest values (AFVs) and adverse consequences of not practicing SFM (ACP).

Dimension	Questions
Attributes of domain-specific AFVs	
Economic	Opportunity to get timber and timber products such as pulp, paper, and lumber Opportunity for employment
Ecological	Forests provide habitat for wildlife Forests are home of biodiversity
Recreational	Opportunity to maintain or regain physical health or mental well-being through contact with nature Opportunity to think creatively and be inspired by nature Opportunity to experience the wilderness landscape Opportunity to enjoy the beauty of nature
Aboriginal	Opportunity to hold ceremonies & family events Opportunity to get closer to the Creator or obtain other spiritual experiences through contact with nature Opportunity to see and experience nature as our ancestors did Opportunity to learn more about nature & life from the elders
Attributes of domain-specific ACP	
Economic	Timber harvesting will not be sustained Employment and income sources will be unsecured Natural disturbance events (e.g., fire, insect attack) will result in huge economic loss
Ecological	Rare and vulnerable habitats will be destroyed, and some species might be distinct Forest ecosystem health will be disturbed Soil condition and productivity of forests will degrade Water quality and flow will degrade It will have a negative impact on climate change
Recreational	Recreation resources, opportunities, and experiences will not be sustained
Aboriginal	Local First Nation economy relied on forests will become vulnerable First Nation's customary and legal rights will not be well recognized and respected The Aboriginal people's traditional way of life will be changed

TABLE A2 Reliability and validity tests of scales that measured EWF, ACP, and AFVs.

		Aboriginal				Non-aboriginal			
Domain	Construct	Cronbach's α	CR	AVE	MSV	Cronbach's α	CR	AVE	MSV
Economic	ACP	0.852	0.854	0.662	0.119	0.800	0.800	0.576	0.348
	EWF	0.741	0.786	0.482	0.119	0.720	0.729	0.412	0.348
	AFV	0.791	0.809	0.684	0.032	0.880	0.886	0.796	0.063
Ecological	ACP	0.934	0.938	0.754	0.335	0.890	0.893	0.627	0.354
	EWF	0.741	0.785	0.482	0.335	0.720	0.728	0.412	0.354
	AFV	0.937	0.940	0.887	0.101	0.881	0.898	0.816	0.086
Recreational	ACP	–	–	–	–	–	–	–	–
	EWF	0.741	0.788	0.484	0.059	0.720	0.732	0.414	0.056
	AFV	0.964	0.965	0.872	0.059	0.906	0.903	0.701	0.056
Aboriginal	ACP	0.854	0.855	0.663	0.293	0.862	0.862	0.676	0.211
	EWF	0.741	0.785	0.481	0.293	0.720	0.729	0.412	0.211
	AFV	0.958	0.959	0.853	0.143	0.915	0.915	0.731	0.105

Note: Meanings of variables are shown in Table 1. Reliability and validity tests are not applicable to ACP in the recreational domain because it only has one measurement indicator. These results demonstrate that the three scales that are used to measure EWF, ACP, and AFVs have good reliability and validity. More specifically, for all of the three scales in four domains, CR (composite reliability) is larger than 0.7, and Cronbach's α (internal consistency reliability) is larger than 0.7, indicating good reliability of scales; AVE (Average of variance extracted) is larger than 0.4, indicating good convergent validity of scales; MSV (maximum shared squared variance) is smaller than AVE, indicating good discriminate validity of scales.

TABLE A3 Correlations between variables.

	FEMALE	AGE	EDUCATION	ADULTS	INCOME	CONDI_FORE	AFVs_AVER	EWF	ACP_AVER	*PSFMB_AVER*
Aboriginal group										
FEMALE	1.00									
AGE	0.17***	1.00								
EDUCATION	0.25***	0.02	1.00							
ADULTS	−0.08	−0.16**	0.02	1.00						
INCOME	0.03	0.25***	0.29***	0.01	1.00					
CONDI_FORE	−0.15**	−0.15**	0.07	−0.04	−0.01	1.00				
AFVs_AVER	−0.01	0.02	0.08	0.01	0.09	0.12*	1.00			
EWF	0.03	0.04	0.20***	0.04	0.14**	0.00	0.13**	1.00		
ACP_AVER	0.09	0.12*	0.07	0.03	0.12*	−0.06	0.33***	0.44***	1.00	
PSFMB_AVER	0.15**	0.13**	0.08	0.01	0.09	−0.00	0.16***	0.19***	0.08	1.00
Non-Aboriginal group										
FEMALE	1.00									
AGE	−0.05	1.00								
EDUCATION	−0.02	0.10	1.00							
ADULTS	−0.03	−0.31***	−0.13*	1.00						
INCOME	−0.27***	0.37***	0.50***	−0.11	1.00					
CONDI_FORE	−0.10	0.05	0.13*	0.01	0.18**	1.00				
AFVs_AVER	0.19**	0.07	0.01	0.06	0.04	0.03	1.00			
EWF	0.05	0.13	0.12	−0.07	0.21***	0.22***	0.14*	1.00		
ACP_AVER	0.12	0.20***	0.16**	−0.12	0.14*	0.06	0.32***	0.47***	1.00	
PSFMB_AVER	0.03	0.08	0.18**	−0.18**	0.21***	0.23***	0.22***	0.21***	0.25***	1.00

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

TABLE A4 Results of the estimation of multi-domain PSFMB models: Interactions between influencing factors of PSFMB.

		Overall		Economic		Ecological		Recreational		Aboriginal	
Effects		**Abo**	**Non-Abo**	**Abo**	**Non-Abo**	**Abo**	**Non-Abo**	**Abo**	**Non-Abo**	**Abo**	**Non-Abo**
Influences on beliefs and values											
EWF → ACP	Total/direct	0.441***	0.447***	0.291***	0.385***	0.485***	0.442***	0.351***	0.357***	0.426***	0.344***
EWF → AFVs	Total	0.127*	0.124*	−0.093	0.081	0.146**	0.141**	0.16***	0.157***	0.166**	0.049
	Direct	−0.027	−0.011	−0.151**	0.006	−0.013	0.036	0.029	0.072	0.021	−0.055
	Indirect	0.154***	0.135***	0.057***	0.074***	0.159***	0.105***	0.131***	0.085***	0.145***	0.103***
ACP → AFVs	Total/direct	0.35***	0.301***	0.197***	0.192**	0.328***	0.237***	0.372***	0.238***	0.340***	0.300***
CONDI_FORE→AFVs	Total	0.140**	0.058	0.157**	0.027	0.122*	0.068	0.103*	0.042	0.127**	0.051
	Direct	0.141**	0.036	0.156**	0.012	0.123**	0.042	0.104*	0.013	0.129**	0.042
	Indirect	−0.001	0.023*	0.001	0.015	−0.002	0.026*	−0.002	0.029**	−0.002	0.009
INCOME→EWF	Total/direct	0.093	0.167*								
CONDI_FORE→ EWF	Total/direct	−0.010	0.185**								
EDUCATION→EWF	Total	0.204***	0.094								
	Direct	0.175***	0.015								
	Indirect	0.028	0.079*								
AGE→ACP	Total	0.111	0.176**	0.083	0.21***	0.095	0.134*	0.100	0.258***	0.137*	0.101
	Direct	0.100*	0.148**	0.076	0.186***	0.083	0.106	0.091	0.236***	0.127**	0.080
	Indirect	0.011	0.028*	0.007	0.024*	0.012	0.027*	0.009	0.022*	0.011	0.021**
FEMALE→ AFVs	Total	−0.038	0.149**	0.004	0.064	−0.036	0.008	−0.039	0.166**	−0.039	0.182**
	Direct	−0.019	0.160**	0.023	0.070	−0.019	0.020	−0.025	0.177**	−0.021	0.189**
	Indirect	−0.019**	−0.011*	−0.019*	−0.006	−0.016**	−0.013*	−0.014*	−0.011	−0.017**	−0.007
Influences on situational factors											
AGE→INCOME	Total/direct	0.253***	0.316***								
EDUCATION→INCOME	Total/direct	0.307***	0.471***								
FEMALE→INCOME	Total/direct	−0.091	−0.252***								
AGE→ CONDI_FORE	Total/direct	−0.130**	0.049								
FEMALE→ CONDI_FORE	Total/direct	−0.125**	−0.099								

Note: Abo: Aboriginal group; non-Abo: non-Aboriginal group. Standardized estimates are reported. Meanings of all variables are given in Table 1. Some paths are the same across five models; therefore, only the results in the overall model are reported.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

TABLE A5 Model fit measures and thresholds.

Measure	Terrible	Acceptable	Excellent
CMIN/DF	>5	>3	>1
CFI	<0.90	<0.95	>0.95
SRMR	>0.10	>0.08	<0.08
RMSEA	>0.08	>0.06	<0.06
PClose	<0.01	<0.05	>0.05