


The role of climate finance beyond renewables: Behavioural insights

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Abstract

The paper contributes towards filling a 'blind spot' in the field of climate finance by investigating the role of climate finance for behavioural insights in developing countries. The evidence review synthesises 71 high-quality studies and focuses on clean fuel adoption and household energy-saving behaviour in developing countries. The synthesis finds that there is a need for climate finance from developed countries that is more targeted towards interventions and measures that support household decision-making in developing countries by engaging with stakeholders that understand local attitudes, constraints and knowledge levels governing the perception of health and environmental risks associated with energy-consuming technologies.

KEYWORDS

aid, behaviour change, behavioural insights, clean fuel, climate finance, energy efficiency, energy services, sub-Saharan Africa

1 | INTRODUCTION

The Paris Agreement established a climate finance goal of USD 100 billion per year and primarily refers to the flows of public finance from developed countries to developing countries for climate change mitigation and adaptation (United Nations Framework Convention on Climate Change [UNFCCC], 2021). Whilst the definition of 'climate finance' remains contested in the academic and practitioner literature (reviewed in Warren, 2019), this paper is concerned with the definition as applied within the UNFCCC and the Organization for Economic Cooperation and Development (OECD). Reaffirming the financing obligations of developed countries to assist developing countries in

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implementing the objectives of the UNFCCC, the Paris Agreement embodies the principle of ‘common but differentiated responsibility’ under the Convention.

The paper builds on earlier work, outlined in Warren (2020, 2019), to explore key ‘blind spots’ in the thematic focus of international climate finance, particularly within the clean energy field. Whilst earlier studies focused on themes, such as carbon capture, usage and storage (CCUS) and sustainable cooling, other identified ‘blind spots’ (behavioural insights, international transport and industrial decarbonisation) have yet to be reviewed from an international climate finance perspective. Through a clean energy lens, this paper focuses on the role of climate finance for behavioural insights, which are two disciplines with extensive, separate bodies of academic literature that, to date, are rarely brought together in both academic and practitioner literature. Furthermore, much of the literature that does exist has primarily focused on developed countries rather than developing country contexts.

To narrow the focus, this review focuses on two areas of demand-side management in developing countries: household fuel choices and the challenge of clean household fuel adoption and motivating energy-saving purchases and behaviour. The key findings also aim to shed light on where international climate finance programming could be improved to better understand local dynamics of energy consumption in their design and implementation.

Section 2 outlines the methodological process employed for the evidence review. Section 3 then provides an overarching evidence map of the literature on behaviour change in relation to energy consumption in developing countries, revealing key patterns in the thematic and geographical focus of previous studies whilst justifying the paper’s focus on the two main themes of clean fuel adoption and energy efficiency. Sections 4 and 5 then discuss the key findings for these two themes respectively. Section 6 brings together the implications of the synthesis for international climate finance, and Section 7 provides the paper’s conclusions.

2 | SYNTHESIS METHODOLOGY

The evidence review methodology consisted of literature collection according to predefined inclusion criteria, mapping and analysis and synthesis. The review sought to identify academic peer-reviewed studies under two overarching inclusion criteria: firstly studies of behaviour change in developing countries explicitly linked to international climate finance; and secondly non-climate finance-specific studies. Under these criteria, which are discussed in further detail in this section, the review yielded 71 academic peer-reviewed studies, which formed the final sample for the synthesis. A secondary sample of practitioner literature (consisting of six papers from reputable institutions) informed the evaluation of existing interventions in Section 6. Table 1 contains the inclusion criteria used in this study.

Behaviour change research was identified using broad and narrow search terms around ‘behaviour’, ‘behaviour change’, ‘energy consumption’, ‘energy use’, ‘energy demand’, ‘energy poverty’ and ‘energy access’, and for climate finance-related studies, terms around ‘funding’, ‘investment’ and ‘finance’ for climate change were used. At the time of the review, this search yielded only one study that included behaviour change within demand-side interventions and climate finance (alongside other themes of focus) (Warren, 2019). As such, the remaining majority of the sample

TABLE 1 Inclusion criteria for evidence review

Literature category	Relevance criteria
Academic	<ul style="list-style-type: none"> Climate finance-specific studies of energy consumption behaviour in developing countries Non-climate finance-specific studies of energy consumption behaviour in developing countries
Practitioner	<ul style="list-style-type: none"> Behavioural insights reports from governments Behavioural insights reports from development banks and international organisations

fell under the category of non-climate finance-specific studies (which were identified using non-finance related search terms, as per the above). Whilst the lack of climate finance-specific studies of behaviour change in developing countries presented a weakness in the literature, it demonstrated a 'blind spot' of research explicitly grounded in both fields, thus reinforcing the purpose of this study to unify them. Further, including non-climate finance-specific papers in the evidence review facilitated a scoping exercise that allowed the research to map the epistemological and geographical extent of the existing knowledge base, thus aiming to provide a useful synthesis for climate finance practitioners and policymakers considering the design and implementation of behavioural-focused climate finance programmes in developing countries.

This paper's focus on financing environmentally sustainable behaviours in developing countries is grounded in wider calls for 'the reform of development cooperation practice' (Paolo et al., 2016), which meaningfully serves the multifaceted needs of households and communities. Studies of behaviour change for climate change mitigation in one developing country or several (e.g. through a case study approach) and of developing countries as a single unit (i.e. the 'Global South') were included in the sample using the definition of 'developing countries' as those that are eligible to receive Official Development Assistance (ODA) (as determined by the OECD's Development Assistance Committee List). Sampling under this definition captured countries and locales targeted by national or subnational behaviour change programmes with dual environmental and developmental aims.

The final sample was categorised by sector, energy service, country and regional area to systematically inform analysis of the literature. Sectors were defined under the list of NACE codes (Statistical Classification of Economic Activities in the European Community), which allowed the inclusion of studies that examined informal work (recognised by this review as an economic activity) rather than as a separate informal sector. Energy services were categorised to capture the 'functions performed using energy which are means to obtain or facilitate desired end services or states' (Fell, 2017, p. 137). This approach to categorisation supported a mapping exercise, in which key geographical, theoretical and empirical trends could be objectively identified and considered for their contribution to the field and practice of international climate finance.

3 | EVIDENCE MAP: BEHAVIOUR CHANGE FOR CLIMATE MITIGATION IN DEVELOPING COUNTRIES

The literature reveals a primary focus on transitions in household energy behaviour in developing countries. In terms of sectoral focus, the vast majority (72%, $n = 51/71$) of studies researched residential behaviour (Figure 1). This reflects the principal focus on household energy services, as shown in Figure 2. Although studies most commonly examined more than one energy service among those such as cooking, lighting, space heating or cooling, refrigeration or entertainment in the 'combined household services' category (38%, $n = 25/71$), a noteworthy secondary majority of studies examined cooking behaviour in isolation (31%, $n = 20/71$). The under-representation of other sectors, such as transport (3%, $n = 2/71$), food manufacturing (6%, $n = 4/71$), education (3%, $n = 2/71$), agriculture (6%, $n = 4/71$), tourism (1%, $n = 1/71$), wholesale and retail (1%, $n = 1/71$) and waste (1%, $n = 1/71$), accordingly translates into a smaller focus on associated energy services, such as environmental services (6%, $n = 4/71$), nutrition (5%, $n = 3/71$), mobility (5%, $n = 3/71$), learning (3%, $n = 2/71$), commercial processing (1%, $n = 1/71$), lighting (1%, $n = 1/71$) and sanitation (2%, $n = 1/71$). Mapping the focus on sectors and energy services therefore reveals that the majority of academic attention is currently allocated to behaviour change at the household level, focusing on the dynamics of household energy service demands and fuel transitions.

Geographically, 24 countries have been investigated in the academic literature, with China (15%, $n = 11/71$), India (14%, $n = 10/71$) and Kenya (10%, $n = 7/71$) receiving the greatest attention. Mapping the geographical focus of studies at regional level, however, shows that sub-Saharan Africa receives the greatest attention (30%, $n = 21/71$), followed by South Asia (18%, $n = 13/71$), Southeast Asia (16%, $n = 12/71$), East Asia (15%, $n = 11/71$), the Middle East and North Africa (MENA) (7%, $n = 5/71$), South America (6%, $n = 4/71$) and Central America (4%,

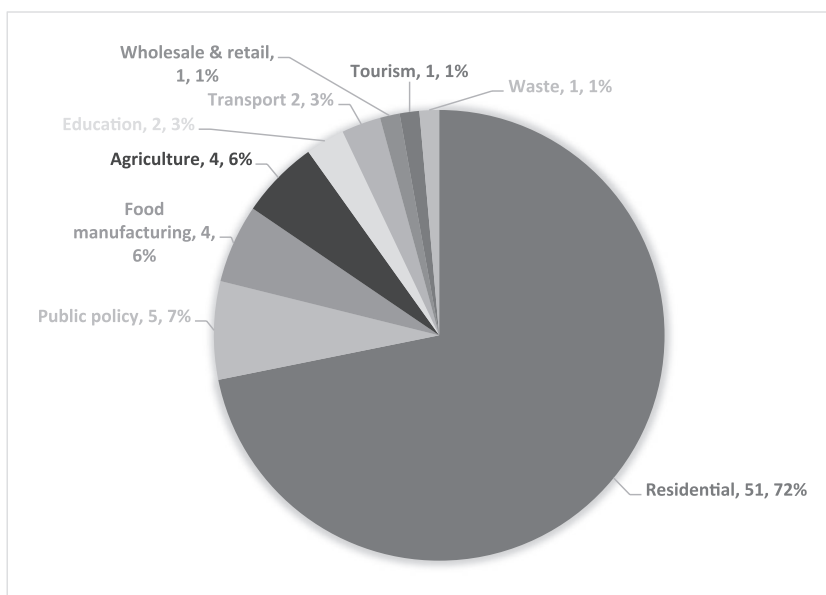


FIGURE 1 Studies of behaviour change for climate change mitigation in developing countries by sector

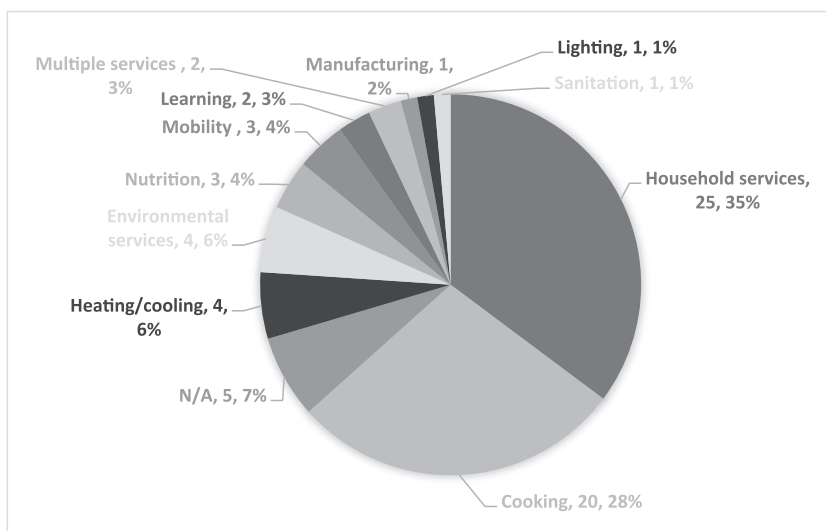


FIGURE 2 Studies of behaviour change for climate change mitigation in developing countries by energy service

$n = 3/71$) (Figure 3). Eight per cent ($n = 6/71$) of studies had an international focus: These discussed behaviour change for developing countries as a whole, highlighting common trends in household fuel use across the Global South (Amegah & Jaakkola, 2016) or proposing renewed theoretical approaches to studies of behaviour change in developing contexts (Day et al., 2016; Kar & Zerriffi, 2018).

The study has identified the Americas and MENA regions, alongside non-residential sectors and energy services, as under-represented locations in the literature requiring further policy and academic research. Meanwhile, the higher volume of behavioural research on household energy patterns in Asia and sub-Saharan Africa usefully

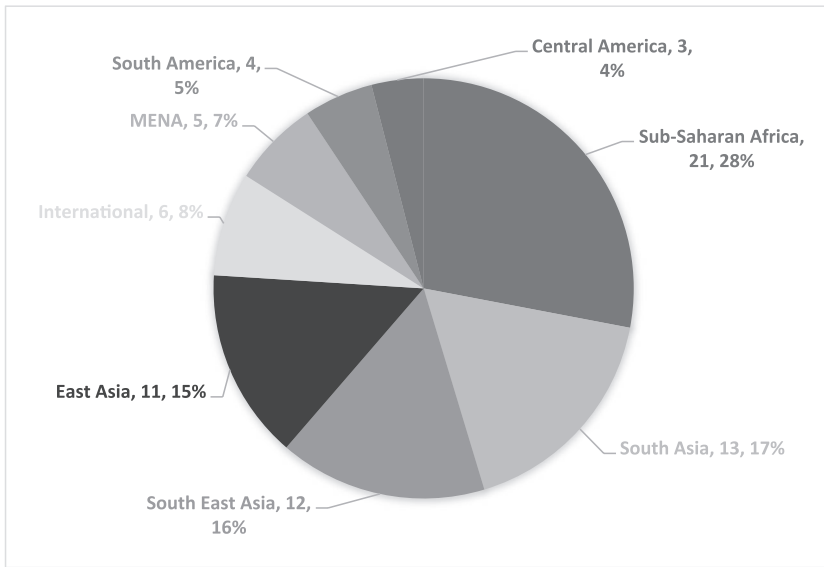


FIGURE 3 Studies of behaviour change for climate change mitigation in developing countries by region

identifies areas to which the informed allocation of international climate finance could provide additionality and foster bottom-up changes.

Two such research areas represent evidence of major challenges for international climate finance: the motivation of clean fuel adoption for basic household energy services and confronting energy-efficient technology adoption in the context of increasing energy consumption and rising wealth across sub-Saharan Africa and Asia. In doing so, it focuses on the household as an important site for the low-carbon transition in developing countries, whereby the relationship between energy consumption and well-being requires careful and systematic understanding (Day et al., 2016), as discussions of household energy transitions in developing countries position the motivation of low-carbon and energy-efficient behaviour as nested within associated and context-specific developmental challenges. These include both defining and eradicating energy poverty (Kumar, 2020; Nayan Yadava & Sinha, 2019), improving health through tackling household air pollution (Amegah & Jaakkola, 2016), empowering women (de Groot et al., 2017), transforming low-income and informal settlements (Debnath et al., 2019; Figueroa, 2016) and navigating dominant cultural preferences which may limit permanent clean energy adoption (Astuti et al., 2019; Jurisoo et al., 2019). Crucially, studies of households in developing countries also capture location-specific behavioural nuances most difficult to reach through top-down policy and international climate finance approaches grounded in utility maximisation. In exploring this in the following sections, the need for innovation in the allocation of private finance is highlighted.

4 | HOUSEHOLD FUEL CHOICES: CHALLENGE OF ‘CLEAN’ FUEL ADOPTION

The study of residential behaviour, which represents the majority (72%, $n = 51/71$) of academic studies on behaviour change for climate mitigation in developing countries, largely aims to broaden understanding of the determinants of fuel choices for vital energy services, such as cooking, lighting and space heating or cooling. Studies that examined the fuel choices underlying household energy services (51% of total sample) were accordingly categorised into the theme of ‘household fuel choices’. Geographically, the most commonly explored location under this theme

was sub-Saharan Africa (44%, $n = 18/71$), followed by South Asia (19%, $n = 8/71$) and Southeast Asia (15%, $n = 6/71$), as shown in Figure 4. Departing from theories of rational utility maximisation, these behavioural studies of household fuel choices seek to highlight non-income factors that govern fuel choices in developing contexts.

As the most commonly examined single energy service (26%, $n = 19/71$), findings around the determinants of cooking behaviour characterise the challenge of motivating clean fuel adoption within rural and urban communities. The continued use of traditional fuels such as biomass, coal, kerosene and inefficient cookstoves across developing countries poses a significant challenge to policymakers (Olang et al., 2018) through its links to resource depletion, slowing down energy access (Olang et al., 2018), maintaining a gender gap in labour markets (de Groot et al., 2017) and premature deaths related to exposure to household air pollution (World Health Organisation, 2018). Studies subsequently aim to identify drivers of ‘cleaner’ household fuel consumption practices through the adoption of improved cookstoves or fuels such as liquefied petroleum gas (LPG), grid electricity and solar power to address the multifaceted, ‘local, contextual, relative and symptomatic’ challenge of energy poverty (Kumar, 2020).

Limiting uptake of clean fuels and their associated benefits, however, is the complex and context-specific nature of local fuel choices underlying household energy services. To reflect this, academic investigations of cooking and lighting fuel choices have departed from theorising linear transitions of ‘traditional’ to ‘modern’ fuel use driven by increased household wealth, as postulated in the *energy ladder hypothesis* (Astuti et al., 2019; Karimu, 2015). Behavioural studies conversely find purely wealth-driven assumptions limited in their ability to capture local specificities (Astuti et al., 2019): The notion that energy users are rational utility maximisers with inherently ranked preferences for ‘modern’ fuels (being cleaner, safer to handle and better for environmental protection) over ‘traditional’ fuels overlooks the importance of ‘wider rationalities’ (Strachan & Warren, 2011), such as cultural norms and resource availability, which drive households’ conceptions of risks and benefits attached to fuels (Jewitt et al., 2020). Contrary to theories grounded in rational utility maximisation, behavioural studies acknowledge that despite the health, efficiency and convenience benefits of increasingly affordable modern energy, ‘there is no guarantee that modern fuels once available will be straightforwardly accepted and used’ (ibid, p. 2).

To highlight the complexity of transitioning to cleaner fuels and cookstoves, many studies cite the practice of ‘fuel stacking’, whereby households adopt more than one fuel for household energy services in a given time, including the wealthiest, to suit varied needs (Astuti et al., 2019; Israel-Akinbo et al., 2018; Jewitt et al., 2020;

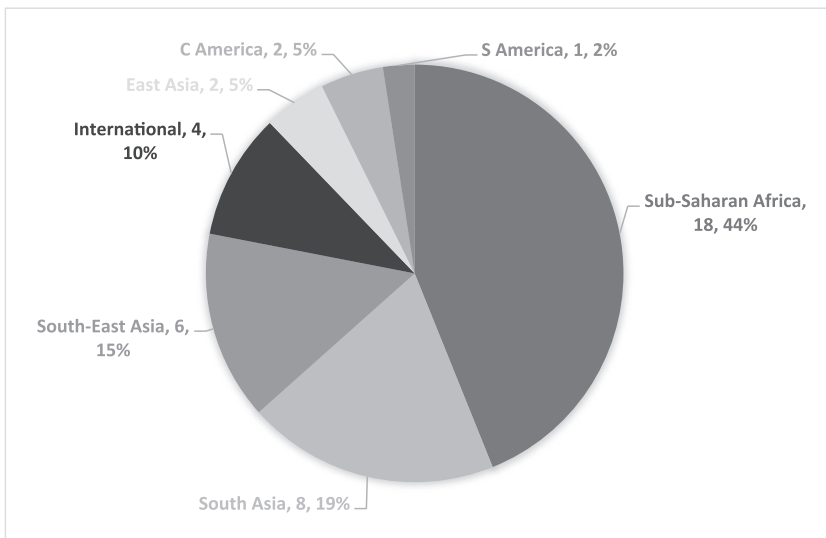


FIGURE 4 Geographical focus of studies examining household fuel choices in developing countries

Kumar, 2020; Sole & Wagner, 2018; Thoday et al., 2018; Treiber et al., 2015). Here, fuel choices are framed within alternative theories accounting for the complexity of household decision-making. Applying the *multiple fuel model* to the choices of 320 households in three Kenyan regions, one study showed energy diversification, where 58% of households used more than one cooking fuel despite the provision of modern cookstoves through successive German international development programmes, as driven by perceptions towards the technical characteristics of cookstoves and local cultural preferences for traditional cooking methods (Treiber et al., 2015). Where sociocultural norms drive reliance on traditional cookstoves in Zambian households, Jurisoo et al. (2019) applied the *energy cultures framework* (Stephenson et al., 2010) to justify the study's use of participatory research approaches to capture community-wide beliefs limiting clean fuel uptake. A corollary is that the determinants of fuel choices are multifaceted household demands that require alternative theories of decision-making to highlight the context-specific nature of cooking behaviour at the household level.

Mirroring the complexity and 'multitude of socio-economic determinants, product-specific factors and decision environment attributes' that affect fuel adoption, Kar and Zerriffi (2018) advocate the 'CI-CHANGE framework of cooking transition' as useful through its situation within three theories of technology adoption. Firstly, the *theory of planned behaviour* (Ajzen, 1991), which understands behavioural intention as dictated by attitudes, social norms and perceived behavioural control (the extent to which an individual feels they can engage with the action), provides a behavioural framework of decision-making but lacks technology-specific inputs into cookstove adoption. Secondly, the *unified theory of acceptance and use of technology* from information systems research subsequently enriches the framework with further predictors of adoption specific to advanced technologies, such as 'performance expectancy' and 'effort expectancy', which measure the perceived gains and ease of use, thereby deepening Ajzen's (1991) concept of perceived behavioural control for the study of cooking technology adoption. Thirdly, they apply the *trans-theoretical model* (Prochaska et al., 2008) from health behaviour psychology, which sees the transition from existing to changed behaviour as a multidirectional and iterative five-step process, including pre-contemplation, contemplation, preparation, action and maintenance. Within one theoretical framework of behaviour change, the theories account for the drivers and processes of decision-making for household fuel transitions, which also explain why only some individuals successfully or permanently change their behaviour (Kar & Zerriffi, 2018).

To complement the role of internal cognitive drivers of cookstove and fuel choices, the field theorises individuals' choices as products of external factors, such as resource availability and lack of knowledge. Cooking behaviour in urban Uganda, for example, is described as formed between within locally specific dynamics between natural resources, resource use and governance structures (Mguni et al., 2020). Emphasising the vulnerabilities to food insecurity, energy poverty and unsafe drinking water in informal settlements, the authors frame cooking behaviour within the *water-energy-food nexus*, as a vital but 'precarious' social practice vulnerable to interrupted resource flows. Meanwhile, mixed quantitative and participatory approaches revealed practices of fuel stacking and 'backsliding' in rural Nigeria, whereby cookstove users reverted back to firewood after adopting cleaner fuels (Jewitt et al., 2020). Here, non-linear shifts between clean fuels and traditional biomass were affected by interactions between non-income factors, such as seasonal rainfall, cultural nuances and varying risk perceptions, which favoured biomass. Seasonal rainfall, which increased smoke exposure through burning wet wood, only encouraged the purchase of improved cookstoves among some households but rendered others who possessed little understanding of household air pollution risk to 'put up with' increased smoke, coughs and impaired vision (ibid, p. 5). Otherwise, focus groups and semi-structured interviews revealed positive attitudes among some local communities towards the ability to cook larger meals, which are associated with higher socio-economic status with wood-fuelled cookstoves than improved cookstoves. Whilst examining environmental factors (such as intermittent local resource availability) represents a necessarily widened approach to studying the drivers of fuel choices, it is the cultural factors that are presented as the greatest challenge to lasting adoption of clean cooking fuels and stoves. Behavioural insights approaches can help to understand and integrate these drivers to design and implement more impactful policies and international climate finance programming.

Other interesting findings synthesised from the evidence review include the local preference for the taste of food cooked with firewood, which demonstrates the challenges of in-grained social norms on clean fuel adoption (Astuti et al., 2019; Gould & Urpelainen, 2018; Jewitt et al., 2020; Jurisoo et al., 2019; Kumar, 2020; Treiber et al., 2015). In Kenya, for example, Treiber et al. (2015) found a preference for the smoky flavour of firewood and charcoal, which limited the full and permanent adoption of cleaner cookstoves implemented through international development programmes. In another example, an evaluation of Indonesia's nationwide LPG stove rollout programme (*Zero Kero Programme*) also found indifference among some households towards the benefits of faster cooking with LPG in favour of slower cooking times with firewood, which suited traditional dishes (Astuti et al., 2019). Another study based in Lusaka, Zambia, found a preference for traditional coal-fired stoves as slower cooking times enabled some women to complete other household tasks alongside cooking, working against the promoted benefit of detaching women from household responsibilities (Jurisoo et al., 2019). In addition to taste preferences, interviews subsequently revealed the symbolic meaning attached to using traditional cookstoves, which connected individuals to the 'roots' of Zambian culture (Jurisoo et al., 2019).

Of all 36 studies examining household fuel choices and perceptions for different end uses (51% of total sample), 11 analysed these in response to behaviour change interventions. The most common intervention is cookstove distribution programmes, which are evaluated in four studies in the synthesis (Astuti et al., 2019; Bensch & Peters, 2015; Thoday et al., 2018; Treiber et al., 2015). The distribution of free improved cookstoves or LPG stoves successfully reduced the use of kerosene and firewood among households: National-level data in Indonesia showed, for example, that kerosene consumption fell by 92% between 2006 and 2015 from 10 million to 0.8 million kilolitres after the *Zero Kero Programme*, which initiated in 2007 (Thoday et al., 2018). However, data collected at household level in all three studies showed persistent fuel and cookstove stacking practices despite shifts in primary fuels due to seasonal availability of alternatives, sociocultural cooking preferences and low awareness of the health risks attached to household air pollution. Indeed, a key criticism of these supply-side interventions is their insufficient approach to addressing local attitudes and awareness levels towards cleaner fuels (Bensch & Peters, 2015; Thoday et al., 2018). This evidence further the need for behaviourally focused international climate finance programmes to be local context-specific with a strong understanding of the populations of focus within countries and subnational localities.

Accordingly, interventions in household fuel choices should aim to understand and inform attitudes and local preferences towards cleaner technologies to facilitate meaningful behaviour change. Measures that increase awareness about the risks of traditional stoves and fuels as well as the benefits of shifting to cleaner fuels can contribute to tackling rigid cultural norms and attitudes among communities (Lindgren, 2020). Education can play an important role, as shown in the positive relationship between household education level and the adoption of LPG (Gould et al., 2020; Karimu, 2015) and solar panels (Guta, 2020). However, as has been highlighted throughout this section, the findings show that this is not simply an information issue, thus disproving the *information deficit model* in the context of clean fuel adoption in developing countries.

Behaviour change communication techniques that target specific behaviours and habits at the household level have proven effective in shifting attitudes and perceptions towards cleaner fuels. Notably, two studies evaluated the effectiveness of *Samba Chef* in Kenya, a reality TV programme launched by the Clean Cooking Alliance and the Mediae Company and funded by the former UK Department for International Development, in which hosts visited homes to discuss the value of clean cookstoves for improved nutrition, health, financial savings and reputation in the community (Evans et al., 2018, 2020). Evans et al. (2018) found the entertaining format of the programme, which ran recipe demonstrations with well-known chefs, 'cook-off' competitions between neighbours, to increase awareness of efficient wood, charcoal and LPG stoves and intentions to purchase. The success of *Samba Chef* was grounded in reframing the practice of cooking and pursuing legitimate local cultural nuances, such as 'family pride' (ibid).

In contrast to top-down supply-side models of improved cookstoves distribution programmes, behaviour change communication techniques like *Samba Chef* embody opportunities to transform awareness levels and sociocultural norms from the bottom-up. As argued by Lindgren (2020), behaviour change communication techniques (such as TV

and radio programmes, technology demonstrations and workshops and visits from community health workers) must also use participatory approaches to create dialogue with stakeholders and gain specific knowledge about their views on cleaner technologies. In turn, interventions can effectively build positive attitudes towards changing fuels to facilitate purchase intentions (Pakravan & MacCarty, 2020). Combined with supply-side interventions, such as stove distribution programmes or subsidies that address vital supply-side issues of availability, ease of use and affordability, these techniques of social acceptance strengthen pathways towards long-term transitions in household fuel choices by addressing inherently set individual and cultural preferences and conceptions of risk (Table 1).

5 | ENERGY EFFICIENCY: MOTIVATING ENERGY-SAVING PURCHASES AND BEHAVIOUR

In contrast to highlighting the influence of cultural factors, the study of energy-saving opportunities in aid-eligible countries responds to growth trends in wealth and energy consumption, which present a significant decarbonisation challenge to policymakers. Studies under this theme (27%, $n = 19$) focused on motivating energy efficiency behaviour through broad changes in lifestyle and, more specifically, the purchase and use of energy-saving technologies. Geographically, studies of energy-saving lifestyles and technologies are predominantly based in Asia, in contrast to the principal focus on sub-Saharan Africa in studies of household fuel choices (Figure 5). This alludes to the pattern of studies in energy efficiency within developing countries being centred in emerging economy contexts where energy consumption is rising rapidly alongside incomes. As such, studies of energy consumption, energy efficiency and changing energy service demands are comparatively more guided by discourses of social processes driven by wealth. However, such a discourse does not play out at the expense of cultural considerations, which are characteristic of behavioural studies.

Underlining the importance of appliance use as a field of study is changing energy service demands associated with rapid growth in emerging economies (International Energy Agency, 2015). With India set to experience the largest growth in energy demand globally, two studies have highlighted the interaction between behavioural drivers of appliance use and urban infrastructure transformation as a vital area of focus. More specifically, low-income housing is argued to represent a crucial transition in energy service demands. For example, ranking 700 government-built low-income households in the city of Rajkot by asset ownership allowed Khosla et al. (2019) to stratify energy-related

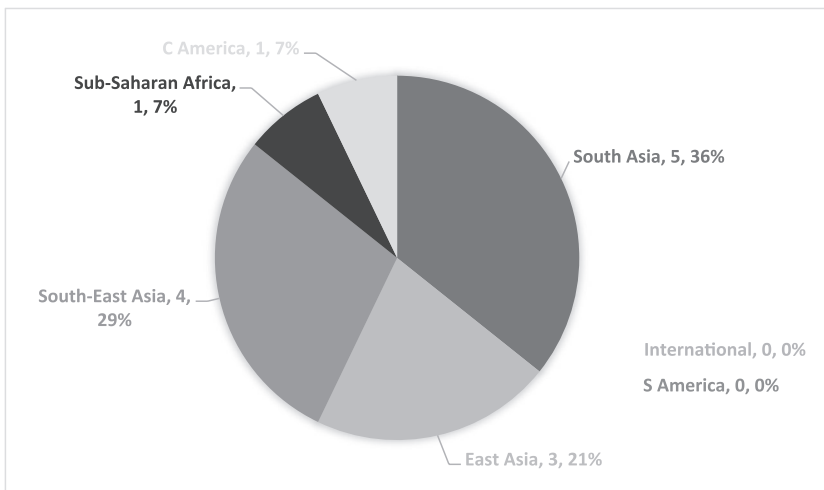


FIGURE 5 Geographical focus of behavioural studies examining energy efficiency in developing countries

behaviours according to appliance ownership. Whilst low-scoring households demonstrated energy-saving behaviour through using streetlamps to illuminate homes or sharing one room to utilise a single fan, high-scoring households demonstrated increased consumption of energy services with aspirations to buy large televisions. The purchase of technologies with high energy consumption after shifting to Slum Rehabilitation Housing (a public-private endeavour which developed slums into high-rise social housing) in the state of Maharashtra further elucidates energy service demand transitions in India: Significant increases in television, refrigerator, washing machine and branded appliance ownership mirror the loss of communal household activities in horizontal slums (viz. cooking and washing) in favour of individual leisure and 'social aspiration' associated with ownership of technology and permanent housing in the city (Debnath et al., 2019).

Studies of appliance ownership in emerging economies emphasise the importance of wealth as a determinant of household energy transitions. Reflecting the approach of Khosla et al. (2019), an investigation across socio-economic groups in Mexico determined the wealth-related factors associated with appliance ownership profiles instead of analysing income and energy consumption as aggregated variables (Castillo & Peña, 2017). Echoing energy patterns in India, mid-level household energy consumption profiles represented the fastest growth in appliance ownership compared to high-consumption profiles whose appliance ownership stagnates. The authors show that this illustrates differences between the energy service demands of large high-income households of the established urban elite and the lower-income rural-urban dwellers experiencing material gains (ibid). Studies of appliance ownership patterns in emerging economies, such as Mexico and India, subsequently direct policy attention towards the equity challenge of decoupling rising standards of living and material welfare with energy consumption. Whilst Debnath et al. (2019) demand a broader policy focus on low-income housing, including more community-focused, accessible and energy-saving infrastructure designs, Castillo and Peña (2017) and Khosla et al. (2019) call for energy efficiency improvements for small, but pervasive, technologies to mitigate future emissions from unavoidable growth in appliances.

The recognition of wealth as a key driver of efficient appliance use in emerging economies is usefully met with behavioural conceptions of changing consumption practices seen throughout the synthesis of largely Africa-based household fuel choices. To understand behavioural intentions for technology adoption, Ajzen's (1991) *theory of planned behaviour* is applied to highlight three central elements of behavioural intention: attitudes, social norms and perceived behavioural control. *Behavioural attitudes* concern the extent to which an individual is in favour of using the technology; *social norms* concern social pressures exerted on the individual; and *perceived behavioural control* is the extent to which the individual feels in able to engage with the technology (Ahadzie et al., 2020). The explanatory capacity of this framework has been strengthened for appliance use by combining it with theories of technology adoption. Whilst Ali et al. (2020) integrated the *technology readiness* model (Pasuraman, 2000) into their study of energy-saving purchase intentions in Pakistan, Hua and Wang (2019) employed the *technology acceptance model* to a study of consumers in China. This allowed, in both studies, for key cognitive determinants of technology adoption, such as perceived usefulness and ease of use to explain attitudes towards energy-efficient technologies in efforts to develop robust behaviour change strategies for energy-saving lifestyles.

Such theoretical approaches to behaviour change invite a mutual aim of ensuring technology design answers to consumer needs whilst shifting individuals' intentions away from the status quo (van der Heijden, 2020). Broadly, the field addresses two obstacles to energy-efficient behaviour in the face of rapidly growing energy demand in the Global South: user perceptions of energy-efficient technologies (viz. their perceived ease of use and usefulness) on the one hand and deficiencies in awareness and motivation towards energy-saving choices and lifestyles on the other hand. The proposed solutions to these obstacles in the literature accordingly fall into two categories: technology design and behaviour change strategies.

Behaviour change communication techniques for energy efficiency in developing countries are relatively understudied, with just two academic studies in the evidence review specifically evaluating interventions, which tackled awareness, knowledge and attitudes towards energy-efficient products and lifestyles. An examination of the Mumbai Energy Awareness Campaign, a 3-month educational programme funded by a public-private partnership, used survey data of participating households to show the campaign's success in promoting reductions in energy consumption

whilst also highlighting the need for reminders and feedback mechanisms to encourage long-term changes in behaviour (Dalvi et al., 2016). In efforts to build a 'low-carbon community' at Fudan University in China, an online collaborative platform allowed students and staff to share knowledge and experiences of saving energy, create public pledges and display dormitory energy consumption data. Although its effectiveness was not reviewed in the study, the platform represents a solution based on conformism from a behavioural perspective, whereby individuals can adjust their own behaviour based on their perceptions of social norms (DellaValle, 2019). More broadly, a study of 'GetGreen Vietnam', a sustainable lifestyle training programme funded by the 'EU Switch Asia Programme', emphasised the importance of 'social pressure' and 'social relief' in influencing sustainable behaviour and purchases (de Koning et al., 2016). Participants found behaviour change more achievable whilst being part of a community, particularly in making energy and food consumption more sustainable.

However, improving the design and usability of technologies tackles individuals' 'perceived behavioural control' or perceived ability to use them (Ajzen, 1991). To achieve this, studies have suggested integrating users' perspectives into the technology design stage: Product development that harnesses usability testing under a 'user-centred design' framework allows energy-efficient devices to match the preferences of targeted consumers by physically involving them in design activities (such as brainstorming workshops) (Odeh & Voskerjian, 2017). To motivate active changes in energy consumption, energy efficiency interfaces (such as smart meters) can simplify energy saving by providing feedback, reminders and rewards for users, as shown in a field experiment among Chinese university students whose behaviour responded most significantly to the provision of peers' power usage information (Chiu et al., 2020). These design measures address issues of present bias, as examples of 'commitment devices' which help individuals execute plans and objectives by giving negative consequences (reputational or financial loss) and encouraging dedication through reminders (DellaValle, 2019). This draws parallels with the findings in the vast literature on the topic in advanced economies.

It is evident that establishing new habits and transforming behaviour from the status quo in developing countries requires enhancing opportunities both offered by technology design strategies and behaviour change communication techniques. Instead of binary supply-side or demand-side thinking, studies examining technology design underline the need for suppliers of energy-efficient technologies to incorporate the multifaceted preferences and knowledge levels of potential users to ensure maximum adoption. Moreover, behaviour change communication techniques that increase awareness and motivation towards sustainable purchases and lifestyles are necessary to maximise the market penetration of energy-efficient technologies. Additionally, an urban-focused academic debate on issues of energy efficiency in emerging economies, as seen in studies of Mumbai, Rajkot, Mexico City and Vietnamese cities, demands governance of behaviour change at the city level (van der Heijden, 2020). As urban populations in the Global South continue to expand, urban governance informed by behavioural insights should aim to manage rapidly changing urban housing configurations in response to rising income levels, which have significant impacts on determining energy consumption pathways.

6 | IMPLICATIONS FOR INTERNATIONAL CLIMATE FINANCE

As Sections 4 and 5 highlight, the literature on developing countries shows both similarities and differences with the vast literature on energy consumption and behaviour change in advanced economies. There is an important need for international climate finance programmes (ODA) to be designed and implemented based on a strong understanding of local cultural contexts both nationally and subnationally to avoid reducing the expected impacts of aid spending or leading to unintended consequences. In particular, there is an important role for technical assistance, particularly the pillars of 'policy and advisory' and 'capacity building' (Warren, 2019), to develop the necessary in-country knowledge, skills, infrastructure and policies to facilitate behavioural insights-informed approaches.

However, without good quality data and the infrastructure to obtain, maintain, quality-assure and update data, such international climate finance approaches may fail to reach transformational change in achieving behavioural

TABLE 2 Summary of interventions in household fuel transitions and energy efficiency

Behavioural theme	Interventions	Opportunities	Drawbacks
Household fuel transitions in developing countries	Improved/clean cookstove distribution programmes	Distribution of free cookstoves most effectively addresses access and affordability constraints, e.g. Senegal (Bensch & Peters, 2015), Indonesia's 'Zero Kero' Programme (Thoday et al., 2018; Astuti et al., 2019 and German Gesellschaft für Internationale Zusammenarbeit Programme in Kenya (Treiber et al., 2015)	Inadequately addresses local awareness of health risks associated with traditional fuels May encourage reliance on donor funding, which may not be continuously available Insufficient focus on local cultural norms that favour traditional fuels Supply-focused objectives result in lack of measurement and monitoring of household impact indicators, such as household air pollution exposure Can be expensive to implement
	Behaviour change communication techniques (TV and radio programmes, educational programmes or workshops, community or household demonstrations, training)	Brings about longer-term desired behavioural shifts through building knowledge and social acceptance of new technologies and lifestyles Grounded in participatory approaches that engage multiple stakeholders and societal roles Relatively low cost	Does not address supply-side barriers of access to cleaner technologies or affordability
Energy-saving technologies and lifestyles in developing countries	Consumer-informed technology design strategies Housing development programme Behaviour change communication techniques (educational programmes, sustainable community-building projects)	Stakeholder integration ensures fully usable technologies (addressing 'perceived behavioural control' (Ajzen, 1991) or expected ease of use) Sustainable low-income housing designs can reduce the need for high consumption for key energy services (e.g. lighting, cooling and entertainment) Participants encouraged to change behaviour based on perception of others behaviours within the community Increased awareness of low-carbon consumption and motivation	May not achieve full coverage of stakeholder groups and preferences Large-scale housing development programmes may 'lock in' emissions through construction and high energy consumption pathways in infrastructure design Housing programmes may not ensure homeownership, thus disincentivising investments in efficiency improvements Does not address supply-side barriers of access to cleaner technologies or affordability

shifts in developing countries aligned to the goals of the Paris Agreement. As a result, a necessary part of designing geographically targeted aid programmes is to provide research and development (R&D) support to build the data infrastructure to collect, quality-assure and sustain good quality data to inform behavioural insights-informed policies (such as the establishment of Behavioural Insights Units similar to those set up in a number of advanced economies, such as the United States, the United Kingdom, Japan and Ireland, or Centres of Excellence, to inform government policy).

Table 2 summarises some of the key implications for international climate finance programming from the synthesis that arise from linking the extensive literature on household clean fuel adoption and energy efficiency with the limited existing academic literature and climate finance programmes focused on behavioural insights. The table is a representative summary of the key findings from the synthesis.

The overall benefits and drawbacks of previous interventions in household fuel transitions hold important lessons for ongoing and future international climate finance programmes contributing to household energy transitions. For example, the UK Government's Transforming Energy Access (TEA) aid programme aims to scale up the production and use of affordable and innovative clean energy technologies with a focus on the African continent. The programme has supported 116 technologies and business models and granted 58 patents within its 'Stimulating Technology Innovation' component, whilst the TEA Learning Partnership under the 'Developing Local Skills and Expertise' component has facilitated TEA-related postgraduate degree courses across eight universities in Africa. In light of the findings of the evidence review, the former component should ensure that it is designed to support user-friendly household technologies to decarbonise basic household services with which inexperienced households can easily engage. With regard to the latter component, this contrasts with some of the findings from the evidence review. Whilst tertiary education is necessary for longer-term development of expertise, it overlooks the need for training and education in urban and rural communities in relation to the risks and benefits of household fuel choices, which can thereby transform cultural attitudes in favour of clean fuels and cookstoves.

Studies of interventions for energy-efficient technologies and energy-saving lifestyles highlight the importance of stakeholder-informed technology design for behaviour change and behaviour change communication techniques to ensure full motivation towards energy-efficient technology uptake, which is important element of sustainable lifestyles aligned with the goals of the Paris Agreement. The UK Government's Low-Energy Inclusive Appliances (LEIA) aid programme currently aims to support and scale up technological innovation for affordable technologies for use in developing countries. Although the programme's focus on the supply of energy-efficient technologies responds to the lack of affordable devices in low-income contexts in developing countries, such as refrigerators, water pumps, fans and televisions, more evidence is needed on the inclusion of stakeholders in the design and usability-testing stages. The programme's focus is also potentially at risk of overlooking the increase of knowledge and motivation needed to ensure the adoption or purchase of efficient technologies when they come to market. This is an important part of ensuring longer-term transformational change in behavioural shifts beyond the lifetime of the programme. R&D and technical assistance focused on in-country behavioural insights interventions could help to reduce these risks.

7 | CONCLUSION

In conclusion, this paper aimed to bring together the disciplines of behavioural insights and climate finance (through a clean energy lens) to synthesise the current evidence base on clean fuel adoption and motivating household energy-saving purchases and behaviour in developing countries. The underlying central argument of the paper is that technology-focused programmes alone are insufficient to meet climate mitigation and adaptation challenges in developing countries if they are not complemented by behavioural-focused programmes, including, but not limited to, how those technologies are provided, purchased and used. The evidence review had a sample size of 71 documents that passed the quality assessment process and analysed the two main themes separately.

The review found that there is a markedly higher volume of behavioural research on the residential sector and household energy services in Asia and sub-Saharan Africa than in other regions of focus for international climate finance. Non-residential sectors and energy services comparably received limited academic attention with Latin America and MENA particularly under-represented outside of the practitioner literature.

The synthesis on clean fuel adoption in developing countries found that there is significant use of behavioural theories to capture the determinants of household fuel choices beyond income-related factors. As a result, this highlights the highly context-specific and complex nature of decision-making around fuel consumption. Crucially, perceptions of health risks and environmental risks are affected by individual preferences that are motivated by social and cultural norms in favour of traditional biomass. Such preferences are shown to limit the full and permanent adoption of cleaner fuels. This was best exemplified in examples of fuel stacking, whereby individuals and households used both inefficient and clean fuels at a given time. For example, a Kenya-based study cited preferences for the taste of food cooked with firewood as a driver of fuel stacking (Treiber et al., 2015), whilst a Zambia-based study presented cooking with traditional stoves as a symbolic practice, linking some local communities to the 'roots' of local culture (Jurisoo et al., 2019).

From an international climate finance programming perspective, this review found that clean stove distribution programmes successfully address supply-side obstacles (particularly access and cost), but often overlook more nuanced demand-side obstacles to permanent clean stove or clean fuel adoption at the local and household level. For example, Indonesia fell short of achieving full kerosene eradication through its nation-wide *Zero Kero Programme*, which was criticised for lacking an explicit strategy to tackle sociocultural preferences for traditional stoves, allowing fuel-stacking practices to persist (Astuti et al., 2019).

In contrast, behaviour change communication programmes that directly engage with local knowledge and sociocultural nuances embody participatory approaches with greater potential for shifting attitudes towards clean fuels and clean stoves. For example, *Samba Chef*, a TV programme that aired in Kenya, successfully increased the awareness and adoption of clean cookstoves by encouraging local communities to consider their functional and social benefits.

The synthesis on motivating energy-saving purchases and behaviour found that studies of energy-efficient technologies and lifestyles is primarily focused on developing countries in Asia. They are contextualised by the challenge of decoupling rising standards of living and material welfare with energy consumption. Despite the recognition of wealth as a driver of energy consumption patterns, particularly decisions to adopt and purchase electrical appliances, these studies employ behavioural theories to understand individuals' readiness or willingness to adopt new efficient household technologies. This is positively affected by perceptions of energy-efficient technology usability and social norms in favour of energy-saving lifestyles.

To decouple rising living standards from high levels of energy consumption, studies have called for user-centred technology design to ensure ease of use and education to increase knowledge of the benefits of energy-efficient technologies and lifestyles.

The findings from the review have implications for international climate finance programming. Firstly, programming should aim to be geographically targeted with an improved understanding of subnational and local cultural contexts and social norms, which may impact the transferability of support within programmes between different localities and countries. This may increase the complexity of programmes but is likely to enhance their positive impacts and their potential for achieving transformational change.

Secondly, the limited data available on energy-using behaviour and the impacts of behavioural interventions in many developing country contexts highlight the important role of R&D support to build the data infrastructure required for behavioural insights-inspired interventions. This includes sustainable infrastructure for collecting, quality-assuring, maintaining and updating data.

Thirdly, due to the primarily non-capital-intensive nature of this 'blind spot' in climate finance, there is a greater role for technical assistance-based interventions, particularly the 'policy and advisory' and 'capacity building' pillars of the technical assistance framework to support the development of behavioural insights-informed policies and interventions in-country (such as through establishing Behavioural Insights Units or Centres of Excellence), which draw on local knowledge and expertise.

Overall, this paper argues that there is a need for climate finance that is more targeted towards interventions and measures that support household decision-making in developing countries by engaging with stakeholders that understand local attitudes, constraints and knowledge levels governing the perception of health and environmental risks associated with energy-consuming technologies. Further research could aim to quantify the negative impacts of not addressing adoption and transitions considerations effectively through behavioural insights-focused climate finance programmes.

DATA AVAILABILITY STATEMENT

The data that support the findings of this review are available from the primary author and the corresponding author upon reasonable request.

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