

**REVIEW**

Toward improved impact evaluation of community forest management in Indonesia

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Abstract

Many tropical countries continue to devolve forest management to forest-dwelling communities. The assumption is that local knowledge of forests and community engagement in forest management will attain multiple social and environmental co-benefits, such as poverty alleviation and reduced deforestation and fires. Evidence for this, however, is scant, commonly hampered by data availability and a lack of technical capacity for implementing statistically robust impact evaluations. Based on a practice-based review of policy implementation, impact evaluation of case studies and examples of counterfactual analyses from Indonesia, we demonstrate that it is increasingly feasible to determine the conditions under which community forest management will most likely achieve its social and environmental objectives. Adapting community forest management implementation based on feedback from accurate impact evaluation could lead to positive outcomes for people and environment in Indonesia, and across the tropical realm.

Erik Meijaard and Truly Santika should be considered joint first author.

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KEYWORDS

biodiversity, conservation, deforestation, forest, impact evaluation, poverty, tropical forest management, welfare

1 | INTRODUCTION

Devolution of forest management has been an important trend in the governance of global forest assets since the 1980s (Agrawal, Chhatre, & Hardin, 2008; Oldekop, Sims, Karna, Whittingham, & Agrawal, 2019). Governments increasingly engage rural communities in forest management with a view toward improving the sustainable use of forests, consolidating traditional use rights over land and resources, and reducing rural poverty (Hajjar et al., 2016). The philosophy is that a greater sense of forest ownership and long-term knowledge of local ecosystem functioning will result in more sustainable management of timber and other forest resources. This in turn aims to address global issues such as shortages of fuel wood, unsustainable forestry management, deforestation and forest degradation, biodiversity losses, climate change, poverty, and other sustainable development challenges (Dasgupta, 2017; Gilmour, 2016).

The extent to which such community-based forest management approaches have managed to tackle global challenges and what drives successes and failures, has been the focus of much recent study, especially in subtropical countries such as Nepal, Bhutan, India, Mexico, and Guatemala (e.g., Agrawal et al., 2008; Gilmour, 2016; Oldekop et al., 2019; Persha, Agrawal, & Chhatre, 2011). Initial impact studies in these regions focused on assessing different outcomes from state forest management versus community management, generally finding better environmental outcomes for the latter (Agrawal & Chhatre, 2007; Chhatre & Agrawal, 2008; Porter-Bolland et al., 2012). How these outcomes are shaped by underlying factors, such as socioeconomic conditions, market access, and biophysical location of villages remains, however, less well understood (Dasgupta, 2017; Gilmour, 2016; Hajjar et al., 2016; Min-Venditti, Moore, & Fleischman, 2017; Rasolofson, Ferraro, Jenkins, & Jones, 2015). Impact evaluations have been implemented in multiple countries to better understand the role of various drivers in generating positive environmental and social outcomes from community forest management, including in Madagascar (Rasolofson et al., 2015; Rasolofson et al., 2017); Peruvian Amazon (Schleicher, Peres, Amano, Llactayo, & Leader-Williams, 2017); Uganda (Jagger, Sellers, Kittner, Das, & Bush, 2018); Thailand (Janmaimool, 2016); Bangladesh (Chowdhury, Zahra, Rahman, & Islam, 2018); Kenya (Busck-Lumholt & Treue, 2018); and Indonesia (Maryudi et al., 2012; Nurrochmat, Dharmawan, Obidzinski, Dermawan, & Erbaugh, 2016).

Nevertheless, a review by Hajjar et al. (2016) of 697 cases of community forest management found that understanding about the impacts of community forestry remains limited, mostly because of three key trends. First, there are substantial data gaps linking population dynamics, market forces, and biophysical characteristics to environmental and livelihood outcomes. Second, most studies focus on environmental outcomes, and the majority that assess socioeconomic outcomes rely on qualitative data, making comparisons across cases difficult (for recent exceptions, see Gross-Camp, 2017; Oldekop et al., 2019). Third, there is a heavy bias toward studies on South Asian, subtropical forests. This is particular concerning for the translation of these results to tropical regions, where commercial exploitation of forests under state governance has continued much longer than in subtropical countries, possibly explaining a relatively late focus on community-led forest management. There is a need for better understanding of the drivers of community forestry dynamics in tropical areas, the conditions under which the policy objectives are best met, and the investments needed to optimize outcomes.

To address data gaps on the socioeconomic, environmental and biodiversity impacts of community forest management, especially in tropical regions, we conducted a practice-based review of the implementation of Indonesian policies on community forest management and recent studies on the impact of such management on forests, biodiversity, and community welfare in Indonesia. Based on our review, we highlight several studies in which counterfactual-based analyses provide an improved understanding of actual impact, compared to the many individual case studies such as those reviewed by Hajjar et al. (2016) that are not able to compare treatment versus non-treatment effects (Ferraro, Sanchirico, & Smith, 2019). In-depth case studies are undoubtedly beneficial for understanding the detailed dynamics of how community-based forest management programs are implemented, and for hypothesizing reasons for observed patterns at a regional scale, or developing mechanistic theories-of-change (Figure 1). This includes how social networks and hierarchies affect community forestry outcome and distribution of benefits (Friedman, Dean, Law, et al., unpubl. data), the role of qualitative methods in community conservation (Moon et al., 2019), and the use of socioecological information to better manage human-wildlife conflicts (Struebig et al., 2018). However, in small-scale case studies, there is always a chance the study area is—by intention or accident—a special case (e.g., because of prior knowledge or experience of researchers or enabling

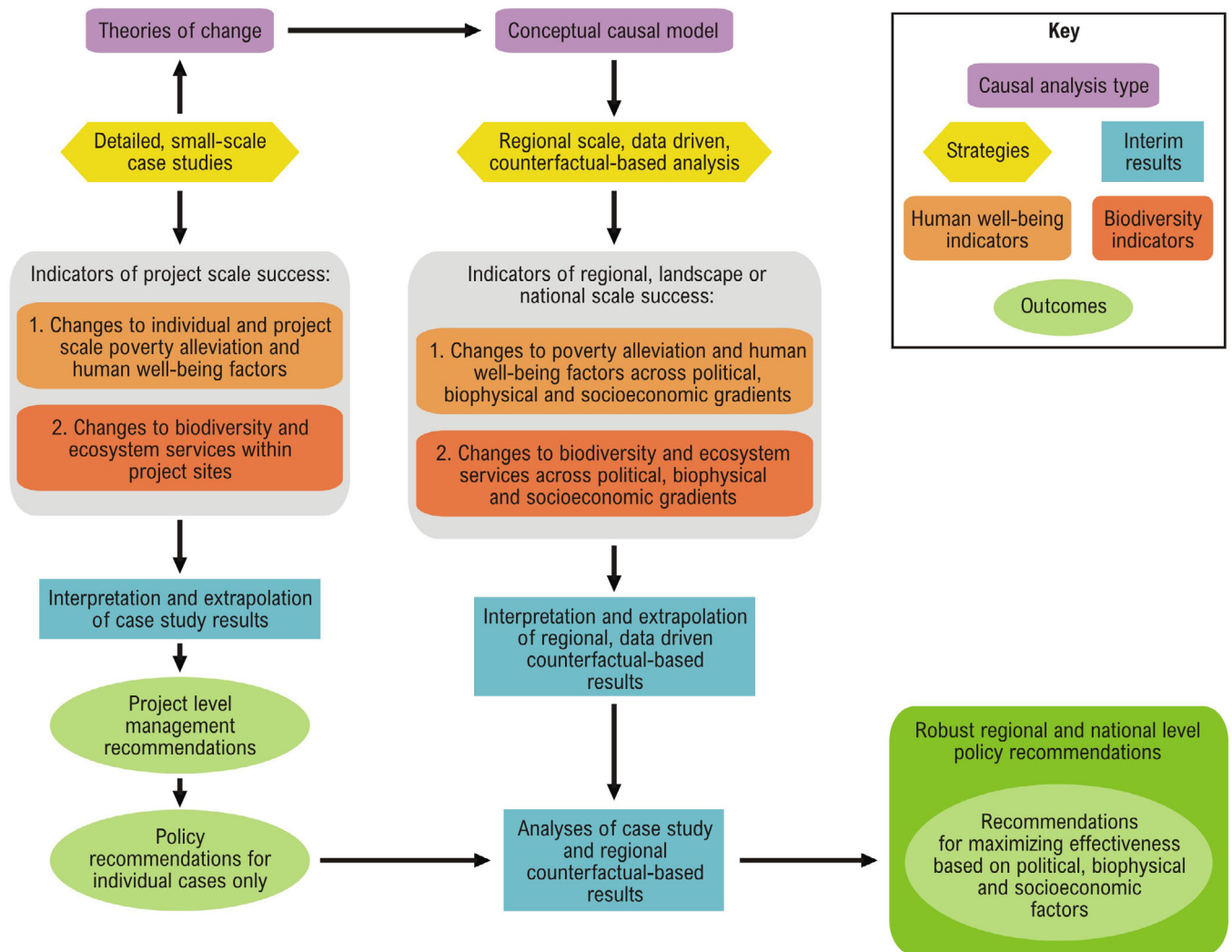


FIGURE 1 Theoretical framework of two different types of impact evaluation

nongovernmental organizations [NGOs] with the village). To robustly inform impact evaluation over jurisdictional scales or entire countries, we need to test hypotheses and consistency of expected outcomes over larger, and often more diverse areas (Figure 1). The need for this is exemplified in Indonesia, a vast archipelago of 17,000 islands and at least 300 ethnic groups, generating significant socioecological variation, and undergoing rapid forest degradation and loss and development of community forest management programs to counteract it.

In this contribution to the special section of Conservation Science and Practice, we evaluate community forest management impacts in Indonesia, with a focus on synthesizing and interpreting novel, robust, regional-scale analyses, interpreted with reference to detailed case-studies. We do so to illuminate the synergies and trade-offs between the ecological (i.e., environmental and biodiversity) and social outcomes (i.e., welfare, poverty) of community-based conservation more broadly. Indonesia-wide evaluations of

community forestry have not yet been attempted, but are critically important given the ambitious government agenda to scale up the country’s implementation of these schemes. Based on these new insights from Indonesia, we assess how further investments in community forest management could minimize risks and maximize benefits in other tropical contexts.

2 | METHODS

We reviewed Indonesia’s community forest management or “Social Forestry” programs as follows. First, we analyzed the Indonesian policies and plans for social forestry and their state of implementation until 2019. Next, we reviewed past evaluations of Indonesian social forestry projects through a literature search in Google Scholar, which captured both journal articles and working papers (e.g., those published by the Center for International

Forestry Research). From this review, we aimed to address three research questions: (a) how are past evaluations of community forest management in Indonesia distributed across different regions or islands, and how have these changed through time?; (b) what indicators or aspects have been commonly evaluated and how frequently have these studies reported positive or negative impacts of community forest management projects?; and (c) how often do these studies apply counterfactual approaches to assess impacts?

For the literature review, we used the syntax (“forest partnership” OR “social forestry” OR “community forest*”) AND “Indonesia” in the search through titles, abstracts, and full texts (where available). The initial search using this syntax yielded 960 studies relevant to community forest management, but many of them focused on the process for obtaining community land tenure licenses or improving community participation, general reviews of community forest management practices, regulatory frameworks, and challenges. We excluded these types of studies, yielding 45 studies (Table S1).

For these studies, we collected key information about: (a) the study area and island or region in which the study was conducted (i.e., Java, Sumatra, Kalimantan, Sulawesi, or Nusa Tenggara), (b) indicators of impacts measured, and (c) study design or methodology for assessing impacts. For indicators of impact, we categorized them into three dimensions following Maryudi et al. (2012), including (a) financial (poverty alleviation of direct forest users, for example, cash income, livelihoods); (b) environmental (improved environmental conditions, for example, forest cover or growth, biodiversity, soil conditions), and (c) social/Institutional (empowerment of direct forest users, e.g., access to information, community participation in decision-making, elite capture).

We summarized the selected studies in our literature review into three categories: (a) comparisons between programs and non-programs such as within-study comparisons of before versus after an intervention (i.e., single-difference before-after approach, including those based on rigorous data collected before and after intervention or perceived change in outcome obtained from interviews); (b) within community program areas versus outside (i.e., single-difference control-treated approach); (c) a combination of (a) and (b) (i.e., double-difference approach); or (d) no comparison was made (none). Among these methods, the double-difference approach is the most robust as it evaluates the impact of community forest management projects based on comparing the difference in the change in the outcome or indicator observed in the treatment group with the change observed in the comparison group. This method therefore removes selection bias resulting from time-invariant unobservables (White & Raitzer, 2017).

Finally, to determine biodiversity impacts of community forest management, we conducted a wider literature because insufficient studies were found to address this in Indonesia. We use this review outcome to recommend new approaches that could help address the data gaps on evaluating biodiversity impacts in forests managed by communities.

3 | RESULTS

3.1 | Overview of Indonesian policies and plans for social forestry

As of 2010, Indonesia had 128 million ha (mha) of tree cover, equivalent to 68% of its land area and 4.0% of the global total (Global Forest Watch, 2019), but also some of the highest deforestation rates in the tropical realm (Turubanova, Potapov, Tyukavina, & Hansen, 2018). Increasingly, in this country, there is a shift from industrial-scale drivers of deforestation (e.g., oil palm and timber plantations) to fire-driven conversion of forests to grasslands and, in some parts of the country, deforestation for small-scale agriculture and plantations (Austin, Schwantes, Gu, & Kasibhatla, 2019; Gaveau et al., 2019). This suggests that rural communities play a bigger role in deforestation than in the past, indicating the need to more closely involve these communities in forest management and to better understand what causes variation in environmental outcomes of community forest management.

In the indigenous community forest case of 2013, Indonesia's Constitutional Court invalidated provisions of the country's 1999 Forestry Law under which the central government had assumed ownership over forest land that people had occupied and used for generations (Butt, 2014). Currently, one-third of Indonesia's 180 mha land base is titled (Ebener, 2018; Fay & Denduangrudee, 2016), and the Court decision required that the Indonesian Government took steps to increasingly recognize and guarantee land and natural resource use rights for rural communities. The government subsequently announced a plan to allocate some 12.7 mha of land, or about 16% of the country's forest estate, to communities between 2015 and 2019 under the Social Forestry program (Republic of Indonesia, 2014). An additional 28 mha of land may be officially claimed as customary or *adat* territory (Butt, 2014; Fay & Denduangrudee, 2016), which, if all implemented, would bring some 21% of Indonesia's land area under customary control. Given its high deforestation rates, a possible shift from large to small-scale drivers of deforestation, and recent policy changes with regard to community forest and natural

resource use rights, Indonesia is a key testing ground for community forestry amongst tropical countries.

The Indonesian Ministry of Environment and Forestry licenses five different types of social forestry: village forest (*Hutan Desa*) (1,280,364 ha licensed in 2019); Community Forest (*Hutan Kemasyarakatan*) (619,165 ha); Community Plantation Forest (*Hutan Tanaman Rakyat*) (332,226 ha); Customary Forest (*Hutan Adat*) (27,951 ha); and Forestry Partnership land (*Kemitraan Kehutanan*) (249,893 ha) (Directorate of Social Forestry, 2019). Three other management types exist, but are less commonly implemented:

Conservation Partnership, Permits for Social Forestry (*Izin Pemanfaatan Hutan Perhutanan Sosial*), and the Recognition and Protection of Forestry Partnership (*Pengakuan Perlindungan Kemitraan Kehutanan*) (the latter two only apply to the island of Java). At the end of the initial implementation period in 2019, the government had allocated 2.5 mha of social forestry land, achieving only 19.7% of its overall target. This total may even be an overestimate: in September 2018, it was thought to be 1.85 mha rather than 2.51 mha (Hadiyantono, 2018). Since the 12.7 mha target was missed by the end of 2019, there is a risk that the

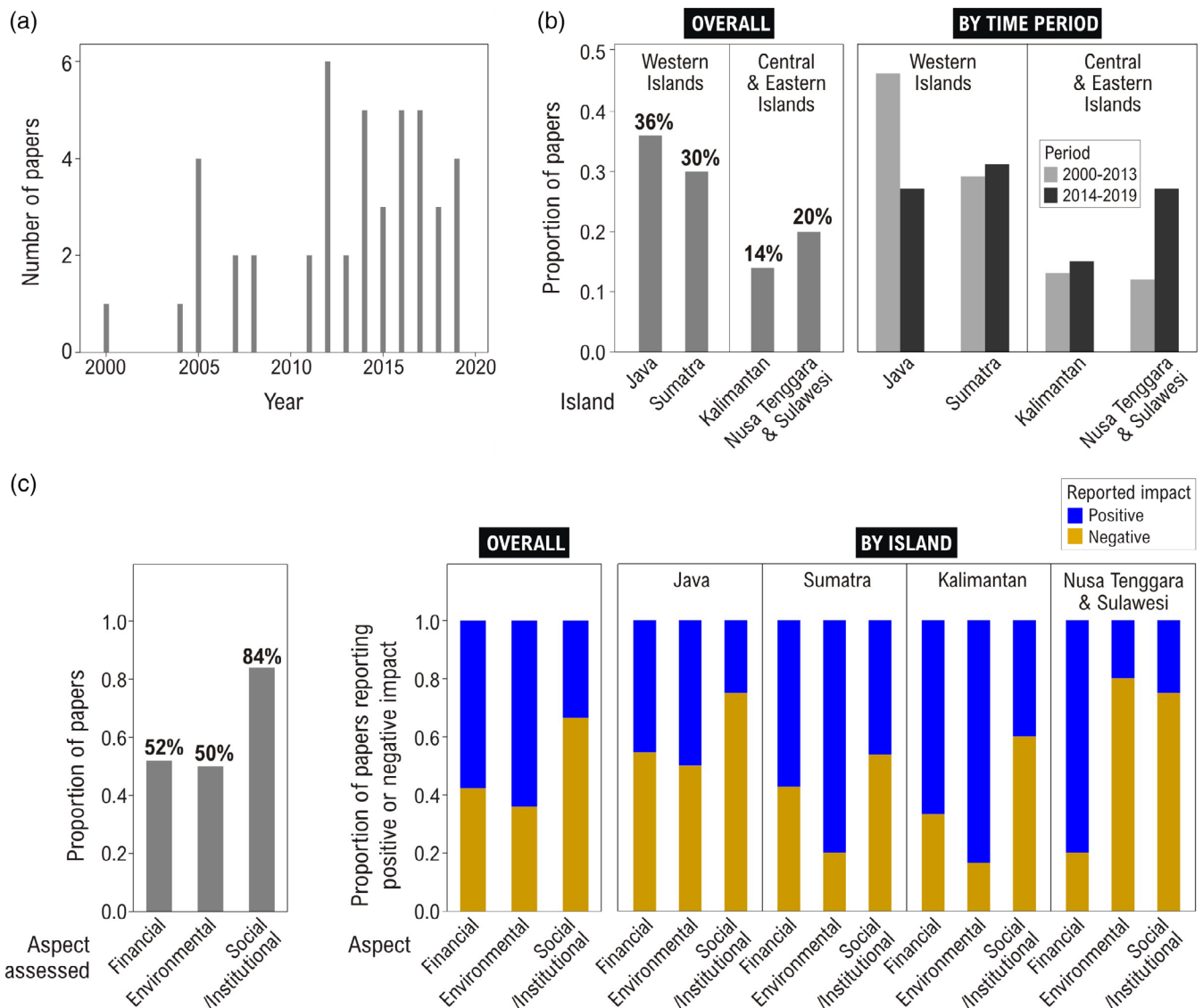


FIGURE 2 (a) Number of papers evaluating the impact of social forestry in Indonesia between 2000 and 2019, with a linear regression line showing an increasing trend through time. (b) Proportions of paper by island (i.e., Java and Sumatra in the western part, and Kalimantan, Nusa Tenggara and Sulawesi in the central and eastern part), and by island and time period (i.e., 2000–2013 and 2014–2019). The cutting point for the time period was based on the median distribution of the papers. (c) Proportions of papers assessing the financial, environmental, or social/institutional aspects, and the proportions of studies reporting positive or negative impacts of community forest management on financial, environmental, and social/institutional aspects across Indonesia and by region. For details on the studies, see Table S1

policy process is rushed with large numbers of social forestry applications approved with little scrutiny. This is important because most impact analyses have featured successful examples of social forestry slowly developed in collaboration with competent nongovernmental and governmental partners. Faster implementation may undermine this success.

3.2 | Indonesian studies of social forestry impacts

Our review (Table S1) indicated that the number of studies evaluating the impact of social forestry projects in Indonesia increased between 2000 and 2019 (Figure 2a). Geographically, the focus of these studies was on the western part of Indonesia (i.e., 36% of studies are from Java and 30% from Sumatra) with fewer in the central and eastern part of the country (i.e., Kalimantan, Nusa Tenggara, and Sulawesi) (Figure 2b). However, studies from the latter regions are increasing. Among the three dimensions, the social or institutional impacts are the most commonly evaluated (84%) (Figure 2c). Comparatively, only 52 and 50% of the studies have looked into the financial or environmental impacts respectively.

Overall, across Indonesia, 67% of the studies reported poor performance of community forest management on social or institutional aspects, 64% reported a positive impact on the environment, and 58% reported a positive impact on community finance (Figure 2c). Thus, the overall trend is that the greatest benefits are environmental, with mixed outcomes for financial aspects, and a generally negative outcome for social and institutional aspects. These figures, however, differ across the country, where the overall benefits of community forest management on the island of Java are lowest compared to the other parts of Indonesia. On Java, the complexity and numerous actors involved in community forestry programs may lead to overall poor institutional performance. Further, intense pressure on land, given the scarcity of forested areas, may lead to sub-optimal financial benefits.

3.3 | Counterfactual studies of social and environmental of Indonesian social forestry

Only 4 out of 45 studies, we reviewed applied a rigorous counterfactual method (i.e., based on double-difference approach). These include studies by Pender, Kerr, and Kato (2007) (in the Sumberjaya watershed in Lampung,

Sumatra), Putraditama, Kim, and Sánchez Meador (2019) (across all community forest villages in Lampung), and the regional studies by Santika, Kusworo, Hutabarat, et al. (2017); Santika, Wilson, Budiharta, et al. (2019) (across all Village Forests in Kalimantan and Sumatra). Other studies mostly aimed to understand the process and challenges underlying implementation of community forest management programs, but without providing insights about the impacts of these programs compared to the counterfactual (i.e., the absence of such programs), or the underlying drivers of such impacts. We highlight the findings from the counterfactual studies as they provide a statistically more robust overview of the impacts of community forest management.

Pender et al. (2007) assessed the economic impacts of a Community Forest (*Hutan Kemasyarakatan*, HKM) program in a Sumatran watershed comprising 640 forest plots. They found that Community Forest permit holders were poorer on average than owners of private land, but had comparable wealth to other nonpermit land users. The study also found that permit holders are better educated, are more involved in producer organizations, and have better access to markets, roads, and technical assistance compared to eligible nonparticipants. Permit holders perceived further benefits with regard to tenure security, land values, land investments, and incomes, although econometric analysis and propensity score matching methods using the survey data provided only limited support for these perceptions. The Community Forest program provided clear environmental benefits with the plots under Community Forest licensed having more planted trees (coffee, timber, and others) than other plots in the watershed. These findings indicate that the Community Forestry program had potentially important pro-poor benefits, though realization of these benefits appeared limited by lack of access to necessary human and social capital, markets and technical assistance, lack of awareness about the program, and program restrictions that require planting of timber trees but prohibit timber harvesting. The study by Putraditama et al. (2019) also assessed the environmental impacts of Community Forest (HKM) in a part of Sumatra, with a propensity scoring approach showing that deforestation rates between 2007 and 2016 in HKM concessions were higher than in protected areas (e.g., National Parks) but lower than in similar forests without Community Forest management.

Santika, Kusworo, et al. (2017); Santika et al. (2019) evaluated the social and environmental impacts of Indonesia's village forest (*Hutan Desa*) programs across larger regions than the previous two studies. To assess environmental impacts, they used annual data on deforestation rates between 2012 and 2016 in Sumatra and Kalimantan (Indonesian Borneo), where most village forest licenses

have been awarded (Santika, Kusworo, et al., 2017). Across a total extent of intact forest within village forest boundaries of 4,793 km², 455 km² of deforestation was avoided, mirroring the findings of Pender et al. (2007) and Putraditama et al. (2019). Santika et al.'s data translate into a mean annual avoided deforestation rate of 0.6 ha/km² for Sumatra and 0.4 ha/km² for Kalimantan. The latter figure, however, excluded deforestation in 2015, a severe El Niño year with major forest fires (Field et al., 2016). This points to an important caveat regarding the environmental performance of Indonesian community forests. Extremely dry conditions during drought years and concomitant vulnerability to fire outbreaks resulted in higher deforestation rates in village forest areas, compared to similar forest areas not under community forestry management, particularly on peatland.

Impacts on deforestation rates were further dependent on prior land use types. Community forest areas can only be given out in the national Forest Estate, which covers a number of different land use types including protected areas and watershed protection forest, forestry production areas, and forestry plantations. In Sumatra, two-thirds of the intact forest areas within village forest boundaries were granted in forestry production areas without current industrial logging concessions (to avoid overlapping forest use licenses). In such areas, sustainable extraction of timber remains possible if communities obtain the appropriate license. In Kalimantan, on the other hand, more than half of the intact forest area in Village Forests was granted in areas set aside to protect watersheds, where no timber extraction is allowed. The type of forest area in which Village Forests are allocated thus determined the extent to which communities could generate income from timber or from other natural resources (e.g., nontimber forest products). These findings are similar to those from studies in Madagascar, where it was found that the extent to which communities could commercially use the forests that were allocated to them strongly determined deforestation rates, with community forestry areas in which commercial forest use was allowed having increased deforestation (Rasolofoson et al., 2015). In Indonesia, this effect was present but less pronounced with avoided deforestation rates in Village Forests allocated in watershed protection forests (where no timber can be harvested) being similar to areas in which commercial forest use was possible (Santika, Kusworo, et al., 2017): situating Village Forests in areas legally earmarked for conversion and tree plantation development resulted in overall higher avoided deforestation, although the performance was highly heterogeneous and depended strongly on drought conditions and inherent vulnerability to fire.

3.4 | Trade-offs between social welfare and environmental benefits

Santika et al. (2019) compared two approaches used to assess poverty levels and well-being in villages with village forest status to see how welfare and environmental indicators changed simultaneously in Kalimantan. The study was based on spatial data within the government's *Potensi Desa* (PODES) village census dataset. A matching method was used to assess the extent to which deforestation had decreased and village well-being had improved as a result of Village Forests. Five dimensions of well-being were assessed: basic (living conditions), physical (access to health and education), financial (income support), social (security and equity), and environmental (natural hazard prevention).

Of the 41 cases assessed, 18% were true “win-win” outcomes, in which community forest management was associated with positive outcomes for both forest conservation and well-being improvement. Thirty-three percent were win-no-loss cases, with a positive outcome for one aspect and negligible for the other. Just over half the cases incurred no losses (Santika, Wilson, et al., 2019), while 3% of the cases had “loss-loss” outcomes for environment and social welfare (Figure 3). Trade-offs between environmental and welfare benefits are thus common, while negative environmental or welfare outcomes also occur. Win-wins occur particularly in areas set aside to protect watersheds, which are dominated by subsistence-based forest livelihoods. Here, community forestry provided significant improvements in welfare through improved land tenure, as well as some avoided deforestation. Trade-offs mainly occur in production forest and forestry plantation areas, where the greatest forest protection benefits were achieved, but welfare improvements were minimal. These areas saw living conditions and environmental well-being decline as land became scarce and pressure to intensify agriculture production increased.

3.5 | Determining biodiversity benefits from community forest management

Our review found few studies that specifically assessed the impacts of community forest management on biodiversity (Dasgupta, 2017; Sayer, Margules, & Boedhihartono, 2017), presumably because measuring such impacts using appropriate counterfactuals is methodologically challenging (Pattanayak, 2009). Assuming that forest presence is a proxy for wider biodiversity, as is sometimes done, is problematic, especially if hunting results in “empty forests” (Redford, 1992). Exceptions include studies in

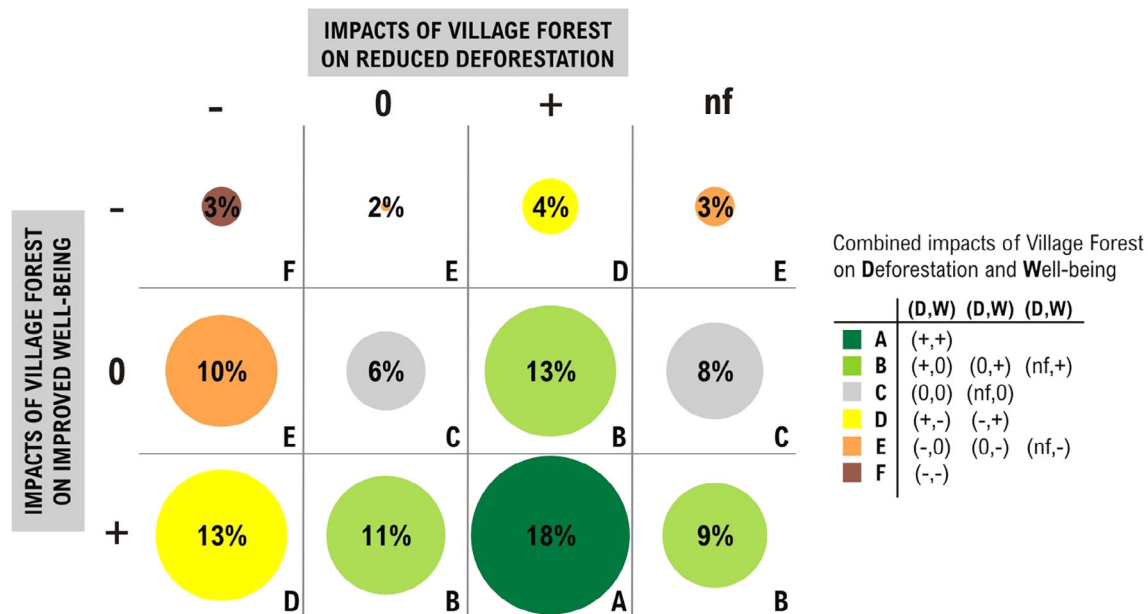


FIGURE 3 Proportions of village forest areas with varying effects on deforestation and welfare. Positive, negative, or negligible effects of Village Forests on deforestation imply that deforestation rates within Village Forest areas are considerably lower or higher than or similar to those outside Village Forest areas with similar baseline biophysical characteristics. Positive, negative, or negligible effects of Village Forest on welfare implies that improved welfare in villages with village forest occurs considerably faster, slower or at a similar pace, respectively, as those in villages without village forest but with similar baseline biophysical and socioeconomic characteristics. A total of 41 village forest management areas were assessed for welfare outcome and 32 village forest areas were assessed for deforestation (as intact natural forest was lacking in nine village forest areas before tenure = “nf”). Redrawn from Santika et al. (2019)

Nepal that revealed declining biodiversity in community managed forests (Shrestha, Shrestha, & Shrestha, 2010), and one study in Indonesia indicating the opposite with bird species diversity increasing following reforestation in a community forest area (Helms, Woerner, Fawzi, et al., 2018).

Robustly determining impacts on biodiversity requires population trend data (pre- and post-intervention) of selected species, measured across a sample of community forests and compared to a large enough sample of similar forests without licensed community forest management. Given the difficulty of reliably determining population trends of even the most-intensively studied species (e.g., orangutans, see Santika, Ancrenaz, et al., 2017; Voigt, Wich, Ancrenaz, et al., 2018), it may be practically impossible to study biodiversity trends in relation to community forestry using such statistically robust methods. Instead, case studies may be needed to establish the best management approaches for maintaining or enhancing biodiversity in different community and forest contexts.

One solution to addressing the challenge of monitoring biodiversity impacts may be participatory wildlife monitoring. These methods are part of emerging tools for biodiversity monitoring and have been studied in various community forestry settings (e.g., Lawrence, Paudel, Barnes, & Malla, 2007; Sheil, Boissière, & Beaudoin, 2015; Shrestha et al., 2010). Success rates have been low,

however, and such monitoring programs often depend on external funding and tend to collapse once funding runs out (Garcia & Lescuyer, 2008, but see Sheil et al., 2015). Getting communities to decide which species their biodiversity management and monitoring should target could increase their buy-in. This might mean that communities decide to manage for species that they find important (e.g., wild pigs, medicinal plants or fish), rather than what the international conservation agenda prioritizes (e.g., orangutans) (Chua, Harrison, Cheyne, et al., 2020; Meijaard et al., 2013; Thornton, 2017). It would ensure, however, that community forest management objectives align with local biodiversity goals and the means to monitor them (Garcia & Lescuyer, 2008).

4 | DISCUSSION

How do our review findings inform policies and practices aiming to scale up community forest management? One insight was obtained from semistructured interviews with government, nonprofit and community sectors in Indonesia (Sherman, 2019), which indicated a general belief that the timeline for implementation of Indonesia's community forestry plan was too fast (i.e., the original government plan to scale up community forestry to 12.7 mha by the end of the

2019). Reportedly, each community forestry village needs 5–10 years to develop and implement an effective community forestry program, and communities need management skills, development, and guidance to realize poverty alleviation and deforestation improvements (Gilmour, 2016). Successful community forest villages are often funded at a rate of some \$200,000 per village during the initial start-up phase (Ardiansyah, personal communication), which indicates the need for hundreds of millions of USD for scaling up to the several thousands of villages currently targeted in Indonesia. If programs are implemented too fast, and community management and licenses are given out without sufficient investment in building institutional capacity to manage these forests well, both socioeconomic and environmental losses could occur. Most project implementation in Indonesia is largely based on external or overseas funding (see Li, 2015), so unless government starts to fund project implementation or external funding is significantly increased, a lot of new community forestry projects will not have the financial means to aid effective program implementation.

Our findings highlight the spatial and contextual variation in impacts of community forestry policies on poverty alleviation and forest conservation outcomes and the kind of conditions under which community forestry is most likely to achieve its objectives. The most successful community forest management programs in Indonesia have been in forests on mineral soils (Santika et al., 2019; Santika, Kusworo, et al., 2017), with strong community involvement (Friedman et al., unpubl. data). For example, one project in West Kalimantan has a strong reliance on their 1,070 ha village forest for water supply and non-timber forest products. People fought hard to prevent the area being converted to oil palm. Payments set up with NGOs via REDD+, enabled regular activities and monitoring, giving further incentive (albeit small) to protect the forest. This resulted in both positive environmental and welfare outcomes, although it is not clear whether the management also translated into biodiversity benefits (Kusworo, Indrawan, Hutabarat, et al., 2018). It seems that such successes occur in areas with a long history of community use in forests and strong facilitation by NGOs. The projects work especially well in large forested landscapes but community forest can also work in agricultural landscapes if there are sufficient incentives (e.g., REDD+) for protection (Kusworo et al., 2018).

Community forest management schemes in environmentally fragile areas (e.g., peatlands) are more difficult, but not impossible to manage. For example, a 411 ha peatland village forest also in West Kalimantan, comprises peat forest, shrub, and open wetland. Surrounding the area are oil palm plantations, bauxite mining, and small-scale agriculture, while a canal made for road construction

had lowered the water table. The area was severely degraded by fire and much of the original forest had burnt. The community applied for village forest status to reduce threats and fund canal blocking, peat rewetting, fire-free agriculture, and protection of an orangutan population and other biodiversity benefits. Social welfare analysis, however, indicated that the community had not (yet) benefited from the project (Kusworo et al., 2018).

The findings in this study indicate that it is possible to use public data for identifying common features of institutional adaptation at local scales that take into account different community characteristics and primary livelihood systems, provided context-specific proxies are justified. For the case of Indonesia, legalized land use zones can be used as a proxy for community livelihood systems and features (i.e., the extent of market influence, the dependency of communities on forest and natural environment, and the extent of the community's social exclusion and marginalization) (Figure 4). Watershed protection forests are often occupied by the most marginalized communities who are essentially being pushed to isolated areas due to urbanization and face increasingly fierce urbanized market competition (Putraditama et al., 2019). In the absence of nearby industries, these communities typically rely heavily on forest resources to sustain their life in a subsistence manner (i.e., staple food crops farming, fishing, hunting, and gathering). Limited production forests are usually occupied by subsistence communities with some employment from the logging industries. Permanent or convertible production forests are usually occupied by plantation communities (either being tied to companies or independent smallholders). Because different communities can be shaped from fundamentally different livelihood systems and baseline circumstances, and therefore face different challenges, applying a one-size-fits-all policy (accounting for equality but ignoring equity and fairness) could potentially lead to further marginalization of some groups. The Indonesian government seems to be aware of the need for equity in social forestry across different land use zones, as reflected by different regulations on timber harvest in community forestry granted in watershed protection forest (where timber harvest is prohibited) and in production forest (timber harvesting allowance to up to 50 m³ annually). However, we assert the need to focus investments in different land use zones that systematically capture and encapsulate different community livelihood characteristics, baseline socioeconomic features, and challenges, encouraging more inclusive and equitable policies. With that, the government would also need to take into account that similar levels of observable outcomes (e.g., avoided deforestation or improvement in welfare) from community forestry in different land types may require different efforts. Zero deforestation in a watershed protection zone and zero

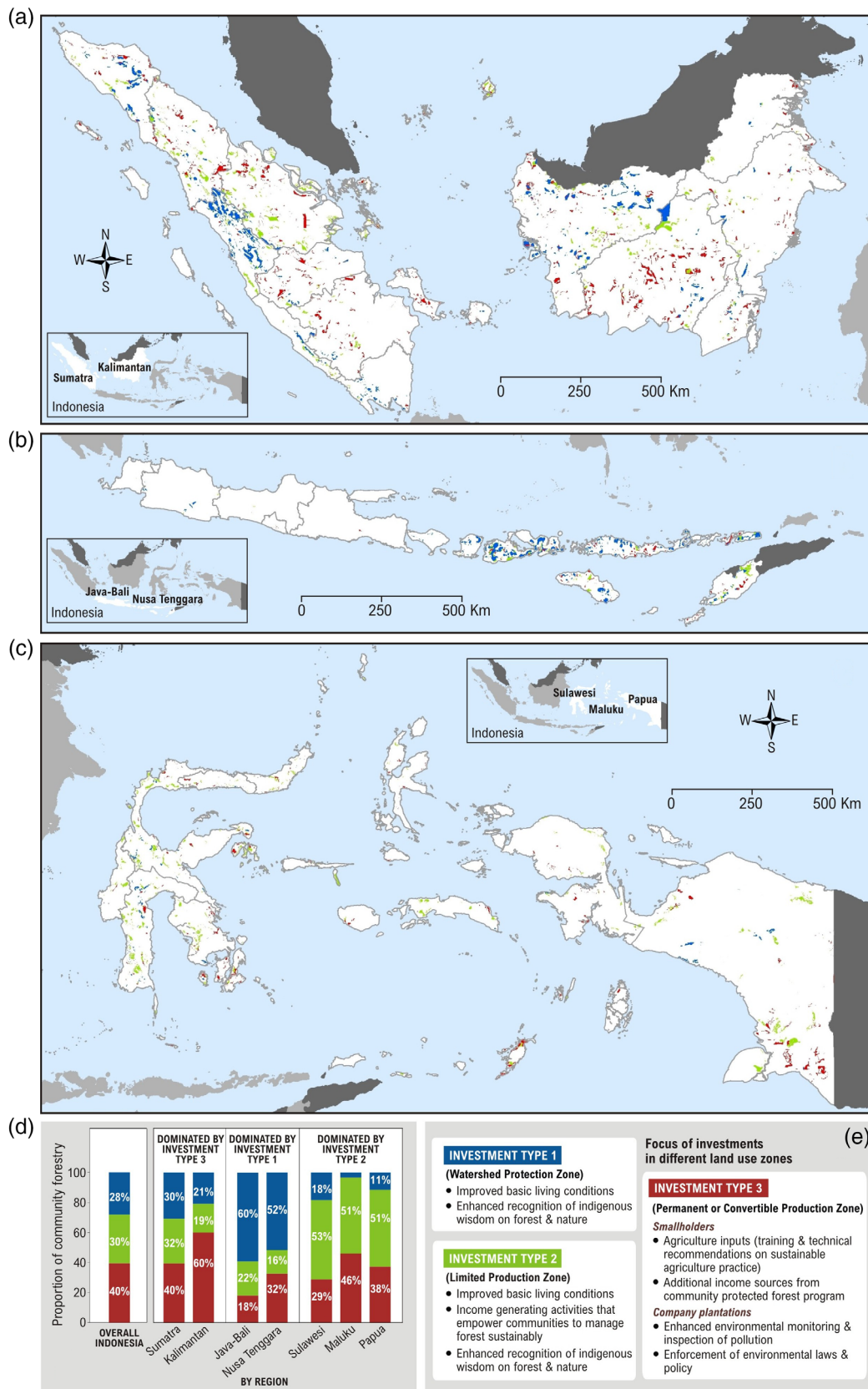


FIGURE 4 Example of a simple investment guidance based on state forest zones in Indonesia. Investment Types 1, 2, and 3 are associated with the focus of investment for watershed protection zones, limited production zones, and permanent or convertible production zones, respectively. For each investment type, we describe what projects could focus on to maximize environmental and social outcomes of community forestry. Potential community forest areas extracted from Indonesia's national database (PIAPS, *Peta Indikatif Alokasi Perhutanan Sosial*)

deforestation in a permanent or convertible production zone as a result of community forest management can fundamentally reflect different levels of effectiveness or associated efforts. Conversely, improved welfare is likely to be easier to achieve in community forest management in a watershed protection zone (as a result of tenure clarity and the fact that the baseline socioeconomic welfare is also relatively low) than those in permanent or convertible production zone (where baseline welfare is relatively higher overall, although there might be unequal distribution of welfare among communities). Hence, there is a need to be realistic on what can be feasibly and sensibly achieved as outcomes through community forestry in different land use zones.

Our findings indicate that governments in Indonesia and other tropical countries can optimize community forest management programs by targeting investment into areas where the likelihood of positive socioeconomic and environmental outcomes is highest. Alternatively, they can provide specific guidance or increased investment in areas with particular risks (e.g., fire-prone land such as peatlands). Government personnel are not always aware of the biophysical and sociopolitical characteristics that determine likelihood of success of community forestry in addressing deforestation and poverty alleviation (Sherman, 2019). Impact evaluation can help change such thinking. Through our review, we demonstrate that statistically robust impact assessments in community forestry are feasible, using cheap, publicly available data, such as deforestation and fire trends (e.g., Rasolofoson et al., 2015; Santika et al., 2019; Santika, Kusworo, et al., 2017). It may be more difficult to assess the welfare impacts, because not every country will make their socioeconomic census information available as spatial data (Bowler et al., 2012). Where such data are available, derisking options for community forestry can be delineated spatially (Figure 4). Resulting maps and simple investment guidance are useful if they are further socialized at national and regional government levels, and among NGOs. For example, 40% of the overall community forestry area is located in permanent or convertible forest zone (Figure 4d), but in Kalimantan, the proportion allocated to this zone is highest (60%), whereas in other islands, the proportions are considerably lower, for example, 29% in Sulawesi and 38% in Papua. Thus, the implementation challenges and possible solutions may differ greatly between the eastern parts of the country, and the western parts where evaluation activities have focused to date.

5 | CONCLUSION

Our practice-based review indicates that positive environmental and social outcomes are not a given in Indonesian

community forest management and that specific investment and guidance is needed to ensure that objectives beyond the recognition of land rights are met. This requires specifically adapted strategies in line with local land use types, livelihoods, and other characteristics rather than a one-size-fits-all approach. It also requires sufficient funding to ensure that management conditions are adequate, which would ensure that communities obtain sufficient benefits from their forests and stay supportive of policies and practices. Providing land rights to communities but not giving them the effective means to turn these rights into improved social, economic, and environmental welfare could result in overall losses to these communities, or to the most marginalized within those communities.

Our examples from Indonesia indicate some of the pitfalls that other tropical countries may encounter when rolling out community forest management. Indonesia's current policy goals of reaching 12.7 mha may not be met without significantly more investment. A lack of funding for their time and involvement was a frequently mentioned barrier in interviews with members of community forestry management institutions (Sherman, 2019). Each new community forest program requires a certain amount of training, capacity building, and planning for effective implementation. With insufficient guidance, recognition of land titles and transfer of forest management authority to communities may fail to attain overall environmental and social objectives. This was also found in Ecuador, for example, where counterfactual-based analyses indicated that land titling only had no clear impact on reducing deforestation (Buntaine, Hamilton, & Millones, 2015). In Indonesia, similar concerns have been expressed that the formal titling of land could result in land speculation, increased inequality, and conversion of forest to agriculture (Andersson et al., 2018; Tolo, 2018). As deforestation in parts of Indonesia is increasingly driven by smallholder agriculture rather than large plantations (Austin et al., 2017; Austin et al., 2019), these trends require vigilance and further study. Where this concerns deforestation in protected areas and watershed protection forests, it could undermine Indonesia's global biodiversity and environmental commitments and lead to societal losses.

All this indicates that more monitoring of the social and environmental impacts of community forest management is required. Such monitoring programs based on appropriate counterfactual methods are currently not consistently implemented by other governmental or nongovernmental groups, undermining the ability to adaptively manage these policy programs across the tropical realm.

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CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

AUTHOR CONTRIBUTIONS

E.M., T.S., K.A.W., A.K., J.A.H., S.B., F.A.V.J., and M.J.S. developed the initial concept for the study, and wrote the initial draft of the manuscript. T.S., R.F., T.P.I., and J.S. collected and analyzed data used in the review. E.A.L., J.S., F.A.V.J., M.J.S., and S.B. provided input on various text revisions.

DATA ACCESSIBILITY STATEMENT

Data used in the current are available in the Supporting Information.

ETHICS STATEMENT

Our analysis is based on a review of published information from other studies. No ethical approval was required for this research.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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