Conservation Biology

Essay

No net loss for people and biodiversity

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Abstract: *Governments, businesses, and lenders worldwide are adopting an objective of no net loss (NNL) of biodiversity that is often partly achieved through biodiversity offsetting within a hierarchy of mitigation actions. Offsets aim to balance residual losses of biodiversity caused by development in one location with commensurate gains at another. Although ecological challenges to achieve NNL are debated, the associated gains and losses for local stakeholders have received less attention. International best practice calls for offsets to make people no worse off than before implementation of the project, but there is a lack of clarity concerning how to achieve this with regard to people's use and nonuse values for biodiversity, especially given the inevitable trade-offs when compensating biodiversity losses with gains elsewhere. This is particularly challenging for countries where poor people depend on natural resources. Badly planned offsets can exacerbate poverty, and development and offset impacts can vary across spatial-temporal scales and by location, gender, and livelihood. We conceptualize the no-worse-off principle in the context of NNL of biodiversity, by exploring for whom and how the principle can be achieved. Changes in the spatial and temporal distribution of biodiversity-related social impacts of a development and its associated offset can lead to social inequity and negatively impact people's well-being. The level of aggregation (regional, village, interest group, household, and individual) at which these social impacts are measured and balanced can again exacerbate inequity in a system. We propose that a determination that people are no worse off, and preferably better off, after a development and biodiversity offset project than they were before the project should be based on the perceptions of project-affected people (assessed at an appropriate level of aggregation); that their well-being associated with biodiversity losses and gains should be at least as good as it was before the project; and that this level of well-being should be maintained throughout the project life cycle. Employing this principle could help ensure people are no worse off as a result of interventions to achieve biodiversity NNL.*

Keywords: biodiversity offsets, development, project-affected persons, social impacts, well-being

Sin Pérdida Neta para la Biodiversidad y las Personas

Resumen: *Los gobiernos, negocios y financiadores están adoptando el objetivo de biodiversidad sin pérdida neta (NNL, en inglés), el cual comúnmente se logra parcialmente por medio de compensaciones por biodiversidad dentro de una jerarquía de acciones de mitigación. Las compensaciones buscan balancear las pérdidas*

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residuales de la biodiversidad causadas por el desarrollo en una localidad con ganancias conmensuradas en otra localidad. Aunque los obstáculos ecológicos para alcanzar la NNL se debaten hoy en día, las ganancias y pérdidas para los accionistas locales han recibido menos atención. La mejor práctica internacional requiere compensaciones para que las personas no estén peor que antes de la implementación del proyecto, pero existe una falta de claridad con respecto a cómo lograr esto considerando el valor de uso o no de la biodiversidad por parte de las personas, especialmente dadas las compensaciones inevitables cuando se resarcen las pérdidas de biodiversidad con ganancias en otros lugares. Esto es un reto particularmente para los países en donde la gente pobre depende de los recursos naturales. Las compensaciones mal planeadas pueden exacerbar la pobreza, y los impactos del desarrollo y las compensaciones puede variar a lo largo de la escala espacio-temporal y por localidad, género, y sustento. Conceptualizamos el principio de no-peor-que en el contexto de la NNL de biodiversidad explorando para quién y cómo se puede lograr este principio. Los cambios en la distribución especial y temporal de los impactos sociales de un proyecto relacionados con la biodiversidad y sus compensaciones asociadas pueden resultar en una inequidad social e impactar negativamente el bienestar de las personas. El nivel de agregación (regional, aldea, grupo de interés. hogar, individual) en el que se miden y balancean estos impactos sociales también puede exacerbar la inequidad en un sistema. Proponemos que la determinación de que las personas no estén peor que antes, y de preferencia mejor que, después de un proyecto de desarrollo y de compensación por la biodiversidad debería basarse en las percepciones de las personas afectadas por el proyecto (evaluadas en un nivel apropiado de agregación); que su bienestar asociado con las pérdidas y ganancias de biodiversidad debería por lo menos ser tan bueno como era antes del proyecto; y que este nivel de bienestar debería mantenerse durante todo el ciclo de vida del proyecto. Si se emplea este principio, se podría ayudar a asegurarle a las personas que no estén peor que antes como resultado de las intervenciones para alcanzar la NNL de biodiversidad.

Palabras Clave: bienestar, compensaciones por la biodiversidad, desarrollo, impactos sociales, personas afectadas por proyectos

摘要: *世界各国的政府、企业和贷款机构都在努力实现生物多样性无净损失 (no net loss, NNL) 的目标, 这一目标一定程度上是通过分级减控行动中的生物多样性补偿实现的。补偿旨在平衡一个地区发展导致的生物多样性剩余损失与另一个地区的同等收益。虽然实现无净损失面临的生态挑战仍受到争议, 但当地的利益相关者的相应收益和损失受到的关注甚至更少。目前, 国际上的最优做法要求对人们的补偿应能够保证其生活水平不会比项目实施前更低, 但就人们对生物多样性的利用及非利用价值来说, 如何达到这一要求还不明确, 特别是考虑到用其它地方的收益来补偿生物多样性损失时所不可避免地产生的利弊权衡。而这一问题在贫困人口依赖自然资源生活的国家格外具有挑战性。计划不当的补偿可能会加剧贫困, 发展和补偿的影响还会随时空尺度、地点、性别和谋生方式而变化。我们在生物多样性无净损失的背景下, 通过分析无恶化原则将为谁实现、如何实现, 构建了该原则的概念。发展及其补偿所引起的生物多样性相关的社会影响在时间和空间分布上的变化, 会导致社会不平等, 并对人们的福祉产生负面影响。在何种聚合程度上 (地区、村庄、利益集团、家庭、个人) 衡量和平衡这些社会影响, 可能会再次加剧系统中的不平等性。我们认为, 发展及生物多样性补偿项目对人们生活水平影响 (不应比项目开展前更差, 最好有所改善) 的测定应建立在对受项目影响人群的理解和认识上, 即在一个合适的综合的水平上进行评估;另外, 人们与生物多样性收益及损失相关的福祉也至少要与项目实施前一样好, 且项目全程都保持这一水平。采用这个原则有助于确保实现生物多样性无净损失的干预不会导致人们生活水平下降。* ***【翻译: 胡怡思; 审校: 聂永刚】***

关键词: 生物多样性补偿, 社会影响, 福祉, 受项目影响的人群, 发展

Introduction

Governments, businesses, and lenders worldwide are adopting a no net loss (NNL) objective for biodiversity, often sought through biodiversity offsetting as the last stage of a hierarchy of mitigation actions. Offsets aim to balance residual losses of biodiversity caused by development in one location with commensurate gains at another location (Bull et al. 2013). Quantitatively and demonstrably achieving NNL goes beyond a general requirement to compensate for biodiversity losses from development. However, viewpoints on offsets differ (e.g., Curran et al. 2014; Quétier et al. 2015), and the validity of NNL is debated, including its technical challenges (Bull et al. 2013; Gardner et al. 2013; Maron et al. 2016; Maron et al. 2018), governance issues (Bull et al. 2013; Maron et al. 2016), and potential effectiveness (Lindenmayer et al. 2017; May et al. 2017).

Offsetting has received particular criticism for its reductionist nature (Robertson 2000; Apostolopoulou & Adams 2015; Spash 2015). Whether biodiversity offsetting captures all values associated with biodiversity (from genes to populations, species, and ecosystems) is also questioned (Table 1). Consequently, the appropriateness of offsets is debated, and political, economic, and ecological uncertainties affect the delivery of NNL as a conservation goal (Maron et al. 2016). Yet, biodiversity offsets are implemented worldwide at an increasing rate and some

Table 1. Values assigned to biodiversity and whether these values are captured by biodiversity offsetting.

Philosophical viewpoint toward nature	*Type of value*	*Description*	*Offsetting commentary*	*Reference*
Biocentric	intrinsic or inherent value (noninstrumental)	A living entity has value in itself, for what it is, independent of a valuer, and not only as a means to human ends. Biodiversity has the right to exist regardless of function, and it is morally right to conserve biodiversity aside from human interests.	Some disagreement with market-based conservation schemes because ethically the commodification of biodiversity for exchanges is incompatible with its intrinsic value. Some biodiversity trades may be seen as morally and ethically unacceptable (i.e., taboo). Biodiversity is valued for what it is, rather than what it does, thus it is not open to quantification or monetary transactions.	Daw et al. 2015; Ives & Bekessy 2015; Moreno-Mateos et al. 2015; Spash 2015; Sullivan & Hannis 2015; Maron et al. 2016; Bull et al. 2017
Anthropocentric	use or utilitarian (instrumental)	The uses humans have for biodiversity include consumptive uses (direct) (e.g., fuelwood and medicinal plants) and nonconsumptive uses (indirect) (e.g., recreation and ecosystem services [e.g., pollution control, flood control, nutrient cycling, and climate regulation]).	Characterizing biodiversity as a set of tradeable units or credits often narrows the focus to isolated ecosystem attributes. An ecosystem-services focus (e.g., based on ecosystem-valuation techniques) reduces biodiversity to a benefit provided for humans and represents a shift from compensating for ecological components (i.e., ecosystem attributes, habitats, and species) to the monetization of biodiversity, risking biodiversity loss. No single surrogate can entirely capture biodiversity because not all biodiversity attributes are measurable or substitutable. Offsetting does not account for social ties between people and particular habitats and ecosystems, meaning exchanges of ecological losses and gains can be divorced from ecological, cultural, socioeconomic, and political contexts.	BBOP 2009; Apostolopoulou & Adams 2015; Moreno-Mateos et al. 2015; Sonter et al. 2018
Anthropocentric	nonuse (noninstrumental)	Intangible, nonmaterial benefits people derive from biodiversity (spiritual, cultural, religious, aesthetic, artistic, educational, scientific, and sense-of-place) inspire deep attachment in human communities. Biodiversity is valued irrespective of human use, but the value is regarded as being to humans rather than regardless of human interests.	Reducing biodiversity to units that can be measured in offset metrics does not take into account the cultural or historic importance of place. Owing to their intangible nature, nonuse values, including cultural ecosystem services, are difficult to measure and thus cannot be quantified by, for example, ecosystem-service valuation. Qualitative valuation methods (including perceptions) can provide insight into their relationship with humans. Furthermore, these values are often linked with history and space, meaning the loss and re-creation of these values is often problematic because the value itself will be lost and the compensated value may not capture this value or target the same affected people.	BBOP 2009; Apostolopoulou & Adams 2015; Moreno-Mateos et al. 2015; Sullivan & Hannis 2015

authors highlight that offsets enable residual negative impacts from development, previously uncompensated and unmeasured, to be addressed (von Hase & ten Kate 2017).

People's use and nonuse values associated with biodiversity should be considered when designing, implementing, and maintaining offsets, but these topics have received less attention in the literature than ecological issues (Benabou 2014; Bidaud et al. 2016; Maron et al. 2016). The potential social impacts of offsetting have been noted, particularly in low-income countries, where local people depend on natural resources (Bidaud et al. 2015; Sonter et al. 2018). Offsets can cause social disparity and inequity (BenDor et al. 2008) as well as benefits such as alternative livelihood options (Gardner et al. 2013). International guidelines, such as those produced by the Business and Biodiversity Offsets Programme (BBOP), advocate that biodiversity offsets should achieve NNL and preferably a net gain in biodiversity without making local people worse off and preferably ensuring they are better off (BBOP 2012). This no-worse-off principle is implicitly equivalent to an NNL requirement, applied to people rather than biodiversity, but it is not clearly defined in a social context and it is not clear who is responsible for deciding which costs and benefits to people are acceptable. This leads to concerns about environmental justice, especially with respect to the distribution of costs and benefits. For example, sometimes the poor pay a disproportionate cost for biodiversity conservation, whereas the wealthy secure benefits (Martin et al. 2013). Moreover, there is a lack of clarity on how to achieve this no-worse-off principle with regard to people's localized use and nonuse values for biodiversity, which are often associated with specific geographic areas. Fulfilling the no-worse-off principle is particularly challenging in cases where poor people depend on natural resources, badly planned offsets can exacerbate poverty, and the impacts of developments and their associated offsets can vary across spatiotemporal scales and by location, gender, and livelihood. The challenge therefore is demonstrably to fulfill the no-worse-off principle when seeking NNL for biodiversity.

We devised a framework to address this challenge. We explored the implications of ensuring people are no worse off, and preferably better off, in the context of NNL of biodiversity and proposed a way to demonstrate that the no-worse-off principle has been fulfilled when seeking NNL of biodiversity. We based our approach on the achievement of NNL of biodiversity throughout the mitigation hierarchy as a whole, rather than focusing on biodiversity offsets. Despite movement in policy and academic discourse to address the social impacts of offsetting (Bidaud et al. 2016; Rogers & Burton 2017; Bull et al. 2017), the no-worse-off principle cannot be fulfilled until it is determined specifically what *no worse off* means and who should be no worse off.

Conceptualizing the No-Worse-Off Principle for NNL of Biodiversity

Maron et al. (2016) group controversial aspects around biodiversity offsetting into 4 broad categories, one of which is social challenges (i.e., how to capture the values of biodiversity held by society and ensure they are reflected in biodiversity trades). They suggest that 3 questions need answering; NNL of what, NNL for whom, and NNL relative to what?

We considered how each of these questions can be answered within a framework that ensures people are no worse off, and preferably better off, after a development and offsetting project that seeks to achieve NNL of biodiversity than they were before the project (hereafter no worse off).

A range of different people may be directly or indirectly, and locally or more distantly, affected by actions to achieve biodiversity NNL at the project, landscape, or policy levels. We focused on actions to achieve NNL of biodiversity at the project level and on impacts on local people (i.e., individuals living near the project and potential offset sites, including indigenous people, local communities, people pursuing livelihoods based on farming, fishing, ecotourism, and other biodiversity-related activities and those with cultural associations with biodiversity [BBOP 2009]). These people are likely to be most severely affected by NNL biodiversity activities, including offsets, especially marginalized and voiceless people in developing countries (Bidaud et al. 2016).

NO WORSE OFF WITH RESPECT TO WHAT

Social impacts are "social and cultural consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organize to meet their needs and generally cope as members of society" (Burdge & Vanclay 1996). They can be positive (benefits or gains) or negative (costs or losses). Negative impacts from development and conservation (including offsets) create a need to compensate local people for hardships they endure (Pechacek et al. 2013). Existing models for compensation include using cash or goods to compensate for losses of livelihoods, income, property, and health (Pechacek et al. 2013). Also used are performance- or incentive-based compensation payments, such as payments for ecosystem services (Pechacek et al. 2013).

Biodiversity offsets are a specific type of compensation for the residual biodiversity losses incurred after applying the rest of the mitigation hierarchy. The distinction between offsetting and other compensation measures is that offsets aim to quantifiably and demonstrably reach NNL of biodiversity by fully compensating for any residual impacts on biodiversity (BBOP 2009). We focused on social impacts caused by losses and gains in biodiversity under

an NNL strategy, not all the social impacts a development might have.

Demonstrably fulfilling the no-worse-off principle means the social gains associated with the changes in biodiversity caused by a development and accompanying offset must be at least equal to any social losses. This requires measuring the social impacts so that the mitigation hierarchy can be applied to first avoid and then minimize negative effects on people's use and nonuse values of biodiversity. As a last resort, residual impact must then be compensated for so that people are no worse off as a result of achieving NNL of biodiversity.

Economic tools (e.g., stated-preference approaches) can be used to assess the impacts of development and offsets on local people's biodiversity-based incomes, livelihoods, and amenities (BBOP 2009). Some metrics are used to assess progress toward more equitable conservation (e.g., the Gini coefficient, the Thiel index, and the 20:20 ratio [Law et al. 2017]). However, these equity metrics tend to measure inequality and do not consider fairness or distributive justice (Law et al. 2017). Also, economic approaches are less able to capture the cultural and social dimensions of people's relationships with biodiversity and may miss how these are affected by biodiversity-related impacts from a development project and its offset.

Measures of human well-being can be used to tease apart the multifaceted impacts that a development project's biodiversity NNL strategy may have on people's lives. Well-being moves away from externally defined unidimensional indicators (such as income) that do not reflect people's priorities toward a multidimensional approach, thereby allowing a wider spectrum of costs and benefits to be accounted for (Milner-Gulland et al. 2014; Woodhouse et al. 2015). Well-being is "a positive physical, social and mental state" (Summers et al. 2012; Woodhouse et al. 2015) that encompasses the objective, material aspects of people's lives (housing, income, livelihoods, health, and the environment), relational aspects (community networks and empowerment), and subjective components that capture individuals' assessments of their own circumstances (i.e., how happy they are with their current situation [Woodhouse et al. 2015]). Ecosystem services—the benefits people obtain from nature—are essential for human well-being (Millennium Ecosystem Assessment 2005). Daw et al. (2016) use the term *ecosystem service elasticity* to describe how well-being changes in response to increases or declines in ecosystem quality. Activities that affect biodiversity may directly affect well-being; directly affect the flow of ecosystem services, with indirect effects on well-being; or affect social relations, inducing secondary effects on other components of well-being (Stephanson & Mascia 2014). Well-being has already been applied in an offsetting context (Bidaud et al. 2016).

To determine whether local people are no worse off in terms of their well-being as a result of a development's biodiversity NNL strategy, all 3 well-being dimensions (material, subjective, and relational) must be considered. Although focusing on the tangible costs and benefits to well-being and who benefits or incurs the costs (distributional equity) is important, people's attitudes toward the development project and offset are also important because perceptions of unfairness are reflected in reduced well-being. This can be addressed by including local people in the decision-making process (procedural equity) and ensuring that their rights, interests, concerns, and grievances are addressed (recognition equity); both are advocated for in international best practice guidelines on biodiversity NNL (e.g., BBOP 2012). Soliciting local people's preferences for different offset activities can help inform the design of an NNL and offset policy and ultimately influence its social acceptability (Burton et al. 2016; Rogers & Burton 2017).

Several frameworks exist for evaluating well-being impacts, including the Happy Planet Index, Wellbeing in Developing Countries (WeD) framework, and Voices of the Poor (VoP) (Agarwala et al. 2014; Woodhouse et al. 2015). These frameworks draw on environmental sciences, economics, psychology, sociology, and anthropology, and each has strengths and limitations (Agarwala et al. 2014). We propose using the interdisciplinary framework described by Woodhouse et al. (2015) for evaluating impacts on well-being from losses and gains in biodiversity caused by an NNL strategy. This framework combines objective and subjective valuation. Moreover, the framework links VoP well-being domains with perspectives from WeD and provides a structured guide to evaluating well-being, making it accessible to practitioners (Woodhouse et al. 2015). The VoP domains provide a checklist of themes to consider when evaluating well-being, and the 3-dimensional perspective of WeD (objective or material, subjective, and relational) helps delineate the questions asked and type of data collected to evaluate well-being (Woodhouse et al. 2015). The framework also emphasizes the need for both quantitative and qualitative understandings and presents 9 guiding principles for social impact evaluation. This framework, in combination with the economic valuation tools suggested by BBOP (BBOP 2009), can answer the of-what question when achieving no worse off, by identifying how different components of well-being might be affected by biodiversity NNL strategies and by informing designs for biodiversity NNL that enhance well-being (Woodhouse et al. 2015).

WHO IS NO WORSE OFF

The distribution of costs and benefits is vital to consider when evaluating social impacts of biodiversity NNL. Equitably designed NNL activities, including offsets,

need "the sharing among stakeholders of the rights and responsibilities, risks and rewards associated with a project and offset in a fair and balanced way, respecting legal and customary arrangements" (BBOP 2013). However, even with technical processes in place to calculate ecological equivalence, offsets can create outcomes that are socially, spatially, and temporally uneven (Apostolopoulou & Adams 2015; Mandle et al. 2015). We propose quantifying and assessing social impacts of biodiversity NNL in terms of local people's well-being. We define *local people* according to the *World Bank Guidelines* and the World Bank's Third Phase of Environmental Program. These guidelines use the term *project-affected persons* (PAPs) in relation to social impacts in general (i.e., people who will be physically displaced or whose source of income and standard of living would be negatively affected by a restriction of access to the natural resources affected by projects funded by the World Bank [World Bank 2015]). We propose the use of PAPs because the World Bank guidelines are well recognized and accepted in academic and practitioner circles and are widely incorporated into thinking on NNL of biodiversity (e.g., International Finance Corporation [IFC] Performance Standard 6). Furthermore, in line with the social safeguards of World Bank-funded projects, the documentation specifies the need to pay particular attention to poor and vulnerable groups (including indigenous people) who could be marginalized. The PAP households can be divided into major or minor. People in the former rely on natural resources (in the affected area) as their main or only source of livelihood, and people in the latter are not dependent on natural resources as their main source of livelihood.

We interpret PAPs as people affected directly or indirectly (either positively or negatively) by losses and gains in biodiversity from NNL strategies. Project-affected people may fall within the *area of influence* (AOI) specified in a project's Environmental and Social Impact Assessment (ESIA). According to IFC Performance Standard 1, an AOI encompasses areas that are directly affected by a project's activities and areas where the project's activities indirectly affect the biodiversity and ecosystem services on which people's livelihoods depend (IFC 2012*a*). However, operationalizing this concept requires ensuring that people affected by biodiversity NNL strategies are identified and appropriately compensated, which can be difficult. For example, experience from a REDD+ (Reducing Emissions from Deforestation and forest Degradation) project in Madagascar demonstrated that the households that were sociopolitically powerful, more food secure, and less remote were more likely to be identified for compensation (Poudyal et al. 2016).

Positive and negative impacts on well-being as a result of losses and gains in biodiversity can be experienced at both the development and offset locations. Offsets may create land-use restrictions and exclude local communities from accessing the offset site, thereby negatively affecting their well-being. In contrast, benefits may arise from the offset through, for example, the creation of employment opportunities and ecotourism (Koh et al. 2014). Therefore, people negatively affected by a biodiversity NNL strategy might not be the same people who receive benefits.

Offset designs can exacerbate social inequality by not considering how location affects the biodiversity people rely on (Mandle et al. 2015). For example, when offsets are close to the development (Fig. 1a), PAPs affected by the offset are often the same as those affected by the development. When offsets are located farther away (Fig. 1b), PAPs affected by the development project may lose access to biodiversity, whereas PAPs hosting the offset may benefit, for example, from job opportunities and improved ecosystem services, but may sustain losses such as restricted access to natural resources.

Koh et al. (2014) recommend that the distance between the development and offset sites be minimized to ensure that the same PAPs live at both sites. However, because this is not always feasible or the best decision in ecological terms, safeguards are needed to ensure the equitable distribution of costs and benefits between spatially separated PAPs. As spatial exchanges in biodiversity are central to biodiversity offsetting, trade-offs with social equity implications will be, to some extent, unavoidable (Maron et al. 2016). This raises a key ethical concern; how to address the disparities between gains and losses to PAPs associated with spatial exchanges in biodiversity, and how to ensure PAPs in all affected areas are no worse off.

The level (individual, household, interest group, village, or region) at which social gains and losses are balanced affects whether, and at what level, people are no worse off as a result of NNL of biodiversity. Communities are not static, homogenous, and generalizable entities (Blom et al. 2010). Evaluating social impacts incurred from losses and gains in biodiversity at the regional level will not show effects on an individual's well-being, especially if aggregating by village (Fig. 2a) or household (Fig. 2b; Daw et al. 2011), or show variations between individuals and subgroups of a particular socioeconomic status, gender, age, location, or ethnicity. This is especially important where disadvantaged and vulnerable individuals (such as those living in poverty, the landless, the elderly, women- and child-headed households, ethnic minorities, and those reliant on natural resources) could experience more severe adverse impacts from the proposed activities than others (IFC 2012*b*). Evaluating social impacts at the household level, thereby aggregating by individuals in a household (Fig. 2c), or at the individual level with no aggregation (Fig. 2d) could overcome these issues. However, measuring and policing no-worse-off at the individual level would be challenging and costly and is unlikely to be feasible in most cases.

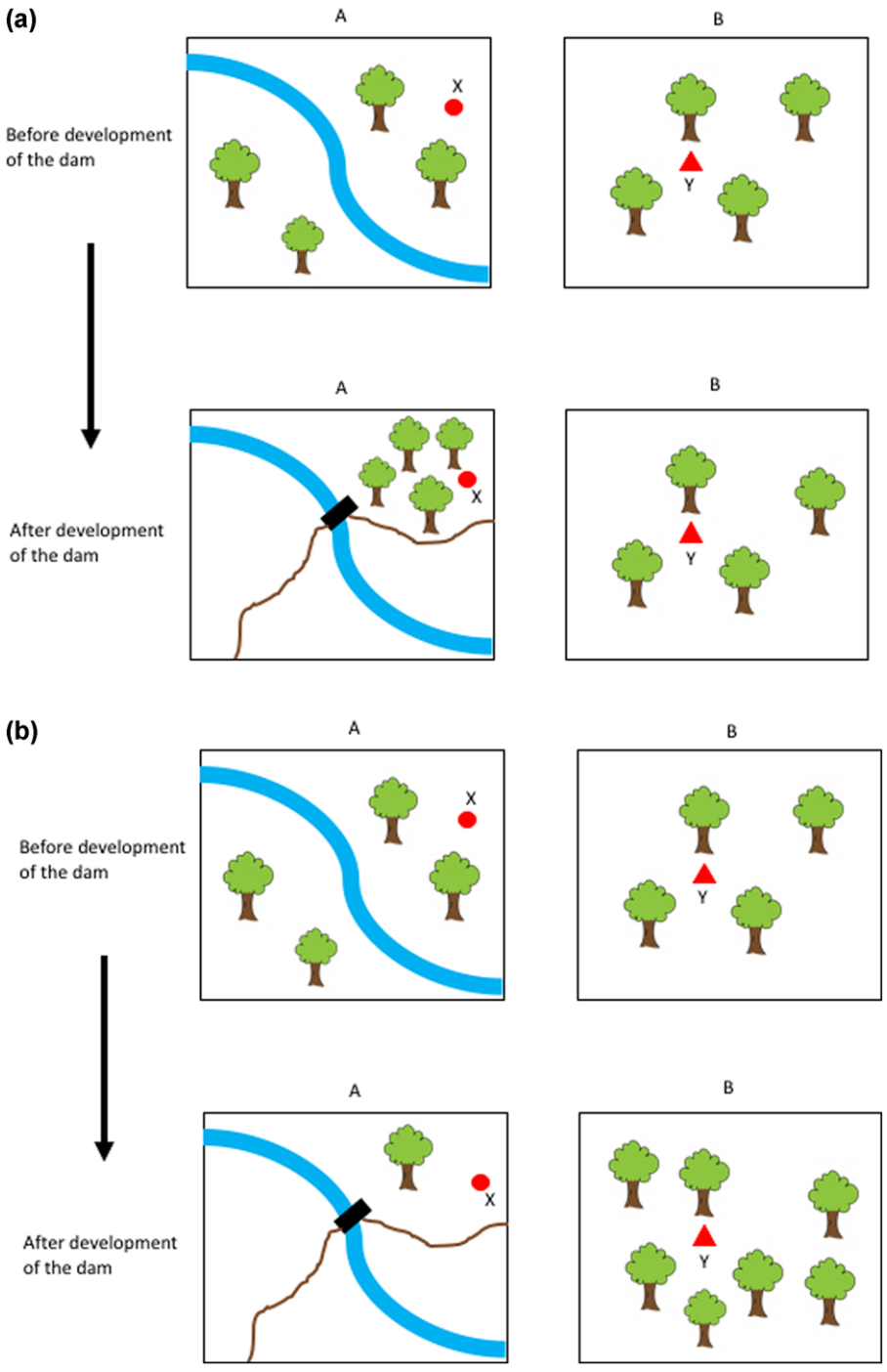

Figure 1. Spatial distribution of gains and losses from development and biodiversity offsetting and its effect on social inequity (X and Y, villages; A, dam development site; B, forest reserve [offset site]): (a) X is affected by losses in biodiversity by development of the dam and gains equivalently from the offset because the offset is established nearby, and Y is not affected; (b) X is affected by loss of biodiversity as a result of the development of the dam but does not experience any gains in biodiversity because the offset is established at an alternative geographical location (B), causing Y to receive the gains from the offset despite not being subject to the losses from the dam development.

Daw et al. (2011) suggest that the greater the inequality in a system, the more fundamental the issues relating to the unequal distribution of gains and losses are, thus the greater the need to disaggregate. We propose, therefore, that first the identity of the PAPs and the existing inequality in the system should be understood. Baseline assessments form part of ESIAs and usually involve a random sample of households. This information can be used to assess the potential impacts experienced by different PAPs (e.g., different ages, gender, livelihoods, and reliance on natural resources) and to identify the appropriate level of aggregation to measure and assess social impacts from biodiversity NNL strategies. Thereafter, the appropriate aggregation units can be chosen transparently, reflecting the main groupings of gain and loss profiles. For example, if gains and losses associated with NNL of biodiversity vary between villages but not within them, aggregating at the village level may be acceptable. However, should certain groups of PAPs (e.g., different genders or livelihoods) experience the gains

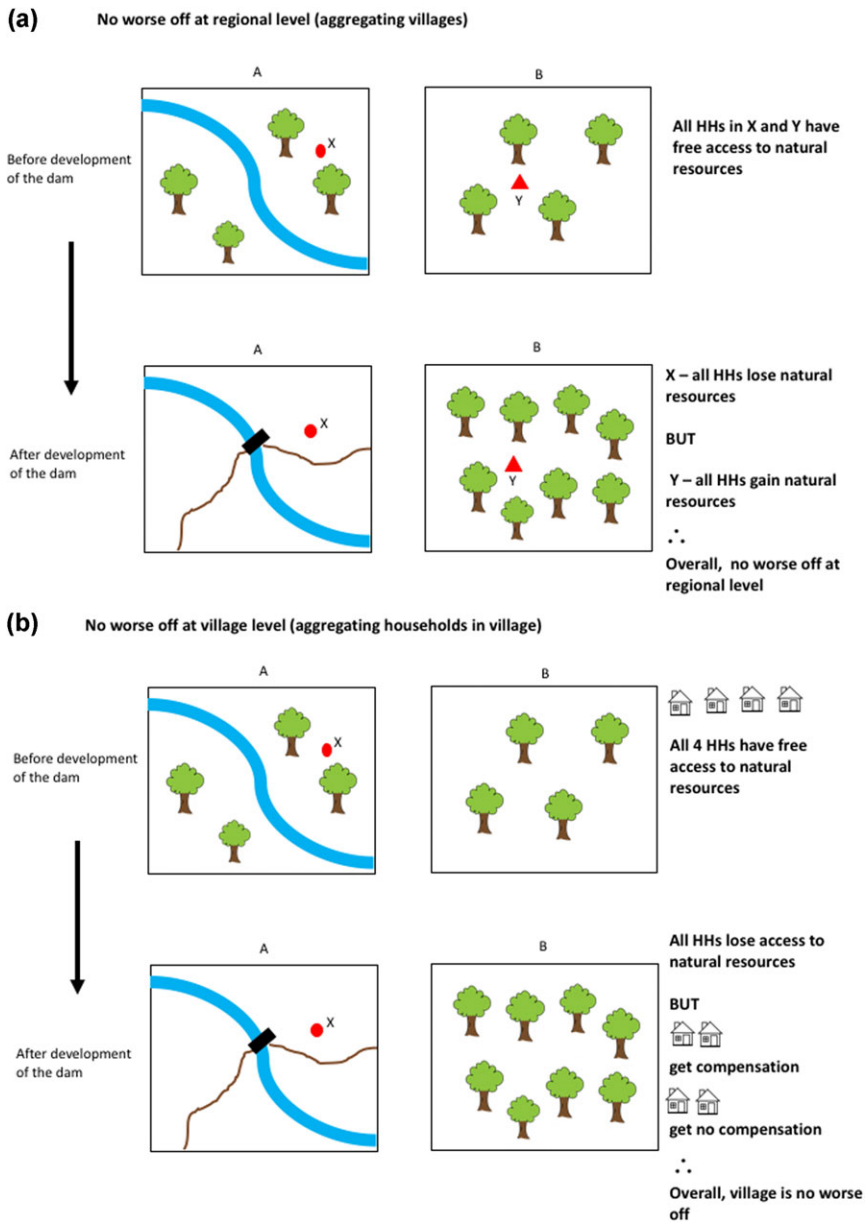

Figure 2. Different levels of aggregation at which social impacts from gains and losses in biodiversity from a combined development and biodiversity offset project can be measured to assess whether people are no worse off as a result of the project (X and Y, villages; A, dam development site; B, forest reserve [offset site]): (a) social impacts are balanced at the regional level with impacts aggregated at the village level, (b) social impacts are balanced at the village level with impacts aggregated at the household level, (c) social impacts are balanced at the household level with impacts aggregated at the individual level, (d) social impacts are balanced at the individual level (e.g., an individual loses access to natural resources but gains employment at the dam). In (d) if employment balances out the loss of access to natural resources, the individual will be no worse off after the combined development and offset project than before. Temporal considerations are left out of this example.

and losses from NNL strategies differently, aggregating at the interest group or demographic group is more appropriate.

If an offset is created after development commences, there will be a temporal gap between biodiversity losses from the development and biodiversity gains accruing from the offset (Bull et al. 2013). Biodiversity loss from development is therefore guaranteed, whereas future gains may be realized late or not at all (Bekessy et al. 2010; Bull et al. 2013; Gardner et al. 2013). Even if an offset is developed immediately, it may take time to mature and for the gains to accrue, meaning that people experiencing biodiversity loss could be negatively affected for some time.

People tend to place more value on what they have now than what they may have in the future and to be risk averse, meaning people weight immediate losses of biodiversity much more strongly than future biodiversity gains (Bull et al. 2017). For example, people living near Ambatovy in Madagascar perceived that the donation of fruit tree seedlings would potentially benefit their community but only after the trees had matured. In the meantime, they were negatively affected by land restrictions that were put in place immediately (Bidaud et al. 2016). Temporal aspects therefore must be considered when ensuring that people are no worse off from biodiversity NNL. We therefore recommend that developers compensate PAPs for the biodiversity-related loses they

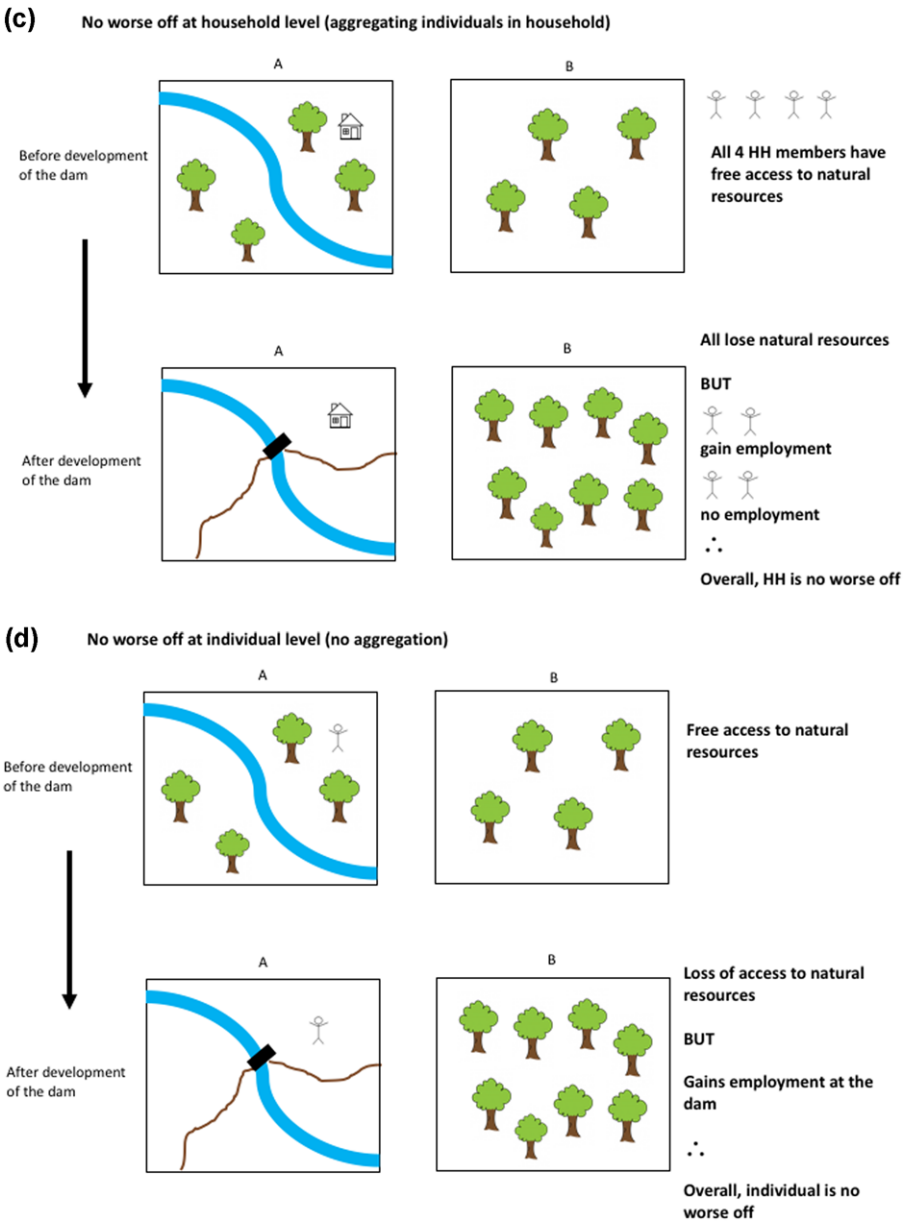

Figure 2. Continued.

experience from the biodiversity NNL strategy throughout the project's life cycle. Activities to fully compensate for negative impacts incurred by PAPs from biodiversity NNL strategies should be identified with the participation of the people concerned (e.g., using choice experiments; Pienaar et al. 2014).

NO WORSE OFF RELATIVE TO WHAT

Answering this question requires an explicit counterfactual scenario (Bull et al. 2014; Maron et al. 2016). The balance of power between interest groups may determine whether an externally or internally valid approach to specifying counterfactuals is taken (i.e., one that makes sense to external parties or to the local people directly affected) (Palmer Fry et al. 2017). Following currently accepted international industry best practice, for example, the Equator Principles and IFC Performance Standards, developers may decide that no worse off can be demonstrated with respect to an externally valid counterfactual. Quasi-experimental designs using control groups (households or villages selected based on their similarity to the study group) are one way to assess the magnitude of an intervention's impact on well-being from an external perspective (e.g., Clements & Milner-Gulland 2015). However, people affected by biodiversity NNL strategies may compare themselves to their own perceptions of change relative to a relevant other group, which will determine whether they feel better or worse off as a result of the biodiversity NNL strategy (Woodhouse et al. 2015).

Based on these considerations, we recommend that the baseline and counterfactual used to assess change in

well-being should be acceptable to external parties and reflect PAPs' experiences. This requires consultations and qualitative assessments that include the relational and subjective elements of well-being. Particularly for PAPs whose well-being has been affected severely and negatively and for vulnerable groups, perceived well-being must be used to assess no-worse-off rather than partial, or externally derived, assessments of objective well-being (such as change in income).

Defining No Worse Off in the Context of Biodiversity NNL

We propose the following definition for *no worse off* in the context of development projects seeking to achieve NNL of biodiversity:

Project-affected people (appropriately aggregated) should perceive the component of their well-being associated with biodiversity losses and gains to be at least as good as a result of the development project and associated biodiversity offset, throughout the project life cycle, than if the development had not been implemented.

This definition answers the questions regarding no worse off in terms of what (perceived well-being as a result of biodiversity losses and gains from an NNL strategy); who (PAPs appropriately aggregated); and relative to what (if the development had not been implemented). The "throughout the project life cycle" caveat refers to ensuring temporal lags and uncertainties are accounted for, and "at least as good as a result of the development project and associated biodiversity offset" refers to how no worse off is evaluated (i.e., relative to an appropriate baseline and counterfactual).

Discussion

There are international calls to address social impacts when seeking to achieve biodiversity NNL (BBOP 2012; Bidaud et al. 2016; Maron et al. 2016). We propose an approach to operationalize the requirement that biodiversity NNL should be achieved without making local people worse off.

The potentially inequitable distribution of gains and losses from biodiversity conservation, and associated environmental justice issues, are well documented (Balmford & Whitten 2003; Martin et al. 2013) and have received attention in the biodiversity offsetting literature (Bidaud et al. 2016; Maron et al. 2016; Bull et al. 2017). The resulting social consequences can create both positive and negative feedbacks for conservation interventions (Pascual et al. 2014). For example, negative impacts on equity (e.g., the elite capture of benefits) can trigger negative feedbacks that erode a scheme's legitimacy, reduce stakeholder participation, and cause conflicts that undermine ecological outcomes (Travers et al. 2017). Conversely, positive feedbacks (e.g., local empowerment and increased resource access) can improve ecological outcomes by enhancing a scheme's legitimacy, increasing local buy-in and participation, and increasing accountability. Engaging local people at the start of the development lifecycle is vital to thoroughly understanding their use of, and cultural values associated with, biodiversity and how these affect their well-being. This will provide insight into their perspective on the severity of impacts and thus inform the design of fairer and more effective biodiversity NNL projects.

It is important that the no-worse-off principle is seen as additional to, rather than as an alternative to, the need to ensure biodiversity NNL. PAPs may be no worse off if other benefits accrue from an environmentally destructive project. Conversely, a development plus offset might achieve NNL of biodiversity, but the associated losses of access to biodiversity could negatively affect the well-being of PAPs. Thresholds are already part of biodiversity NNL theory and are used to determine which impacts are not acceptable and must be avoided under the mitigation hierarchy (Bull et al. 2013). Common examples are the extinction of a species or a habitat considered irreplaceable. The use and nonuse values PAPs place on biodiversity components affected by a development and offset project could similarly be used as the basis for specifying social thresholds when implementing and maintaining biodiversity NNL activities.

Clarifying the social impacts from gains and losses in biodiversity may tempt implementers to monetize people's relationships with biodiversity. However, it is vital to capture the full range of values (use and nonuse) associated with biodiversity, which are often context specific and place based; some are not amenable to quantitative measurement. This is particularly important when balancing potentially competing values for biodiversity during the design and implementation of an NNL strategy.

International policy, country-specific legislation, and the academic literature call for people to be no worse off, and preferably better off, when seeking to achieve NNL of biodiversity. However, to date, there has been no concrete description of this no-worse-off principle in the context of biodiversity NNL. As a first step, we have clarified the elements required for an equitable and socially acceptable biodiversity NNL project and proposed a framework for applying this definition in practice. The next steps are to operationalize this framework for real-world case studies and to scale it up to the policy level to address the challenging issues involved in measuring and balancing change in well-being among PAPs in time and space.

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