Estimating the economic returns to community-level interventions that build resilience to flooding

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Abstract
Floods are among the largest economic costs of climate change and vulnerable communities in some of the poorest countries are particularly badly affected. Community-planned interventions to build resilience to floods following climate shocks and stresses play a role in major global development programmes but evidence on their costs and benefits is limited. This paper presents a way of combining evidence from participatory methods to understand changes that have occurred with more formal economic modelling and can be widely used for community-planned interventions to tackle flooding. We consider projects in flood-affected communities in Myanmar implemented as part of the Department for International Development-funded Building Resilience and Adaptation to Climate Extremes and Disasters programme and find estimated economic benefits over a 10-year period (based on 12–18 months of post-intervention data) are significantly greater than estimated costs. The highest returns accrue to relatively small-scale infrastructure investments planned with communities and local government, drawing on donor finance with community contributions of labour.

KEYWORDS
community-driven development, cost–benefit analysis

1 | INTRODUCTION

Floods were the most frequent type of disaster in the period 1994–2013, affecting more people than all other types of natural disaster put together (Guha-Sapir, Hoyois, & Below, 2015). This has a huge impact on the well-being of the poor (Hallegatte, Vogt-Schilb, Bangalore, & Rozenberg, 2017) and has led to an increased international focus on building the resilience of poor communities to climate shocks and stresses and natural disasters (SDG 13).

In principle, interventions to successfully build community resilience to flooding should result in avoided losses, increased economic activity and development benefits (Tanner et al., 2015). However, evidence of what happens as a result of interventions in the most severely affected regions (i.e., Asia and Africa) is limited. Part of the reason for this is that tools to capture benefits for interventions planned with communities should capture both economic and social values, the latter being “indicators of what is important to a local community, what they require and what they want” (Fitton, Moncaster, & Guthrie, 2015, p. 370). Traditional economic cost–benefit analysis (CBA)—has focused on the ex-ante appraisal of infrastructure projects (Atkins, Davies, & Kidney...
Bishop, 2017) and has often been unable to incorporate social values (Hunt & Taylor, 2009; Nicholson-Cole & O’Riordan, 2009).

This paper presents a way of combining evidence from participatory methods to understand changes that have occurred with more formal economic modelling using published data on the value of a statistical life (VSL), disaster risks, public health costs, and livelihood options. The method of CBA we apply can be widely used for community-planned interventions to tackle flooding and community-driven development (CDD) more widely. Although community-planned interventions to build resilience to flooding are a relatively new area, the CDD approach is widely used in programming. In the decade to 2017, the World Bank alone reportedly allocated close to $85 billion to local participatory development programmes (Björkman Nyqvist, de Walque, & Svensson, 2017). In this case, we consider projects in flood-affected communities in Myanmar implemented as part of the UK Government’s Department for International Development (DFID)-funded Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED) programme.

The next section provides some background to the community action planning process used to identify and prioritise interventions, including infrastructure investments. We then set out the techniques used to value costs and benefits, followed by results of the analysis from four case studies in different townships and discussion of their implications. The final section of the paper presents some concluding thoughts.

2 | BACKGROUND AND CONTEXT

Myanmar experiences multiple types of regular and serious natural shocks, scoring “very high” for natural hazards and exposure on the INFORM index for risk management and a maximum 10/10 for population exposed to flooding (Inform-Index, 2019). Its long, low-lying coastline on the Bay of Bengal makes the west of the country particularly susceptible to regular storm surges and cyclones (Union of Myanmar, 2009). Further inland, drought is common in the Central Zone comprising Mandalay, Magway, and Sagaing, but these and other areas also face seasonal riverine and flash flooding. The impact of cyclone Nargis in 2008 was the most visible recent demonstration of Myanmar’s vulnerability to extreme weather events. The cyclone devastated large areas of the Ayeyarwady Delta region, killing approximately 140,000 people (UNEP, 2009).

The BRACED Myanmar Alliance was a three-year project (2015–2018) aiming to “build the resilience of 350,000 people across Myanmar to climate extremes.” The project worked in 7 states, 8 townships, and 155 communities and was implemented by three NGOs (Plan International, World Vision, and ActionAid) with cross-cutting support from three agencies (Myanmar Environment Institute, UN-Habitat, and BBC Media Action). The main impact for project populations was intended to be “improved well-being and reduced loss and damage despite climate shocks,” and the project sought to do this by addressing immediate hazard-related needs at community level while encouraging longer-term solutions driven and delivered by communities and subnational and national government.

Targeted communities were supported by the BRACED Myanmar Alliance to identify their own disaster risk and climate change adaptation priorities and plan interventions, with some funding from BRACED. Community assessment of climate shocks and stresses followed by action planning was central to identifying and developing BRACED Myanmar programme interventions. The project community planning process aimed to increase awareness of climate shock impacts and allow communities to discuss the relative merits of potential alternative small-scale infrastructure investments. In all four case studies, communities prioritised infrastructure interventions to reduce the incidence or mitigate the impact of regular annual flooding. However, the specific interventions varied given the local context, from an earthen embankment of more than a kilometre in rural Dalaban (Figure 1) to a pond wall, walkway and fencing to protect drinking water in a peri-urban ward of Mawlamyine township. Additional project activities such as village savings and loan associations (VSLAs), microfinance, and pig farming aimed to diversify and strengthen livelihoods to make community members more resilient to idiosyncratic shocks. Interventions are summarised by Table 1 in the valuation method section.

**FIGURE 1** Embankment built following community resilience planning in Dalaban, Myanmar
| Township     | Interventions                                      | Reported outcomes                                                                 | Financial modelling of each intervention using                                                                 |
|--------------|---------------------------------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Dalaban      | Earth flood protection embankment                 | Reduced loss of rice paddy to annual floods                                       | FGD and KII data, rice production model                                                                    |
|              |                                                   | Reduced loss of chickens to annual floods                                         | FGD and KII data                                                                                               |
|              |                                                   | Reduced loss of stored fuel wood and pots due to annual floods                     | FGD and KII data                                                                                               |
|              |                                                   | Reduced loss of paid workdays to annual floods                                    | FGD and KII data                                                                                               |
|              |                                                   | Reduced incidence of fatal snakebites following annual floods                     | FGD and KII data, Alirol, Sharma, Bawaskar, Kuch, & Chappuis, 2010, VSL estimates of Gibson et al. (2007) |
|              |                                                   | Reduction in hospitalised dengue & diarrhoea cases following annual floods         | FGD/public health data, Shepard, Undurraga, & Halasa, 2013                                                    |
| Pig breeding |                                                   | New/more resilient livelihoods                                                    | FGD and KII data, pig production model, Huynh, Aarnink, Drucker, & Verstegen, 2007, Psilos, 2007          |
| VSLAs        |                                                   | New/more resilient livelihoods                                                    | FGD and KII data                                                                                               |
| Ward 93      | School flood mitigation                           | Reduced closure of school during annual floods                                    | Data from teachers on transport costs to another school and extent of use                                    |
| Pig breeding |                                                   | New/more resilient livelihoods                                                    | FGD and KII data, pig production model, Huynh et al., 2007, Psilos, 2007                                    |
| VSLAs        |                                                   | New/more resilient livelihoods                                                    | FGD and KII data                                                                                               |
| Mawlamyine   | Drainage channel dredging                         | Reduced loss of paid workdays to annual floods                                   | FGD and KII data                                                                                               |
|              | Protection of drinking water storage pond         | Reduced food cost as fewer people in flood shelter                               | FGD and KII data                                                                                               |
|              |                                                   | Reduced boat hire cost for community                                              | FGD and KII data                                                                                               |
|              |                                                   | To access shelter                                                                | FGD and KII data                                                                                               |
|              | Microfinance                                      | Avoided repair costs to bamboo housing and contents                              | FGD and KII data                                                                                               |
|              | Community fire service pumps                      | Reduced child drowning risk                                                       | FGD and KII data, VSL estimates of Gibson et al. (2007)                                                      |
|              |                                                   | Reduced hospitalised dengue and diarrhoea cases following annual floods           | FGD/public health data, Shepard et al., 2013                                                                  |
| Nyaung TaPin | Rainwater storage                                 | New/more resilient livelihoods                                                    | FGD and KII data                                                                                               |
|              | Home gardens                                      | Reduced loss of bamboo houses to fire                                             | FGD and KII data                                                                                               |
|              | Self-help group (with microloans)                | Reduced cost of drinking water                                                    | FGD and KII data                                                                                               |
|              |                                                   | Reduced food purchase cost                                                       | FGD and KII data                                                                                               |
|              |                                                   | New/more resilient livelihoods                                                    | FGD and KII data                                                                                               |

Abbreviations: FGD, focus group discussion; KII, key informant interview; VSL, value of a statistical life; VSLAs, VSL associations.
The community planning process was set out in a handbook (BRACED Myanmar Alliance, 2015) and was important for our analysis for two reasons. First, the community resilience planning exercise prioritises and costs resilience-focussed infrastructure investments that form a major part of the project intervention. Second, it generates an understanding of climate shocks and stresses within the community that made it much easier for us to use rapid participatory techniques to discuss these issues and changes that have resulted or will result from project interventions.

As part of the BRACED impact evaluation work, the authors piloted estimating the costs and benefits of interventions to build climate resilience in one community (within the Mawlamyne township). We were subsequently invited by the Asian Development Bank to expand this pilot in three other communities (Dalaban, Ward 93, and Nyuang Ta Pin) in separate parts of the country, and this paper draws on these results. Map 1 illustrates the areas of the case studies in relation to the project interventions. Case study sites were selected from a list of BRACED coastal and estuary sites. Field visits were organised by the BRACED Myanmar Alliance team and interviews were undertaken by independent local and international consultants.

In summary, the four case study sites are as follows:

Mawlamyine is the fourth largest city in Myanmar, 300 km southeast of Yangon at the mouth of Thanlwin River. The BRACED programme is working in five Wards within the township. The main climate shock is flooding and, over time, vulnerability to shocks has increased as poorer working people have moved into the township and, unable to afford established areas, live in bamboo huts in flood prone areas. Mawlamyine was also one of the townships hit by cyclone Nargis in 2008 and dry-season fires started in wooden homes have occasionally become widespread.

Dalaban is a village on a river estuary only 16 miles from Yangon but is isolated and households rely on arable agriculture. The community has high levels of poverty and is subject to regular annual flooding from seawater surges following storms. It was badly flooded by cyclone Nargis.

Ward 93 is a peri-urban area within Dagon Seikkan Township, located on the river estuary but closer to the sea than Dalaban. It used to be affected by annual floods and tidal surges, but this has been less of a problem since works implemented a few years ago (before the current project) to improve drainage. Nonetheless, regular
flooding continued to present problems for the secondary school. Nyaung Ta Pin is an isolated coastal village of approximately 760 people in the Ayeyarwady delta some 60 km south of Labutta township. This village was devastated by cyclone Nargis when more than 70 people (mainly children) died as a result of flooding. Seawater intrusion and land depression eradicated the previous livelihood of betel leaf growing. Today, households primarily rely on crab fishing in the mangroves surrounding the village. The community experiences regular flooding following storm surges in the rainy season and following saline intrusion, it has an on-going problem accessing drinking water.

3 | ECONOMIC VALUATION OF CDD INTERVENTIONS TO ADDRESS FLOODING

In the United Kingdom, CBA is routinely used to assess flood alleviation investments (Vickerman, 2007). In a developing country context, CBA has been used to appraise large climate adaptation infrastructure investments and assess macro level adaption costs and benefits (Margulis & Narain, 2010) but this work is complex and resource intensive (Watkiss & Hunt, 2016). This cost and complexity has restricted CBA use for community-level interventions, although a review by Chadburn, Anderson, Cabot Venton, and Selby (2013) found 23 studies that applied CBA to assess community-based disaster risk reduction and climate change adaptation projects. Most of these studies used project data to undertake ex-post analysis of costs and benefits. Participatory research has been widely used to plan and prioritise community-level interventions, including flood alleviation (Fitton et al., 2015) and inspired community valuation of plant, forest and animal resources (IIED, 1997; Richards, Davies, & Yaron, 2003). Subsequently, this stakeholder-focussed approach has been applied to the planning and evaluation of adaptation to climate change, with the process of applying stakeholder-focussed CBA including one or more of the following activities: Involving stakeholders in analysing the costs and benefits of an initiative; reflecting on the costs and benefits ascribed to different stakeholders in the analysis; or assessing the weight that different stakeholder groups place on different costs and benefits (Chambwera et al., 2012). This paper draws on both community-level CBA and stakeholder CBA approaches—using participatory identification of changes to be valued combined with external, technical calculation of the associated economic costs and benefits.

4 | THE VALUATION METHOD

4.1 | Participatory assessment of project interventions’ emerging and expected impact

4.1.1 | Identifying participants for focus group discussions

The BRACED Myanmar Alliance implementing organisations undertook an extensive community planning process (BRACED Myanmar Alliance, 2015) and project activities emerged from this. Field staff from implementing NGOs organised focus group discussions (FGDs) with community members who had been actively engaged in project activities. This is a relatively quick and low-cost approach. Focusing in on what project participants saw as the biggest gains in resilience allows us to capture the big wins for those successfully reached. However, this excludes certain types of project benefits and beneficiaries. For example, some project interventions focussed on building community disaster risk reduction capacity through training and better engagement with local government planning. As there had not been a disaster-type shock over the life of the project, FGD participants did not identify benefits associated with these interventions. We also did not seek out less engaged beneficiaries that only had received training or received information provided widely across the township. In practice, this means the total costs of implementing community-based resilience building are compared with the major benefits accruing to hundreds of households in each township rather than the thousands per township targeted by the project.

As a low-cost means of comparing major project benefits to costs this is a reasonable approach. However, it does not tell us about project impact on a representative sample of townships nor how particular groups in society have shared in these benefits. These latter questions were addressed using household surveys within a quasi-experimental impact evaluation (Yaron, Wilson, Murphy, & Dumble, 2018).

Twelve FGDs were held across the four communities—with two to four half-day FGDs per community, depending on the range of project interventions and citizens reached. Each was facilitated by an experienced external facilitator with a translator and a note taker. Each FGD had 8–15 participants. Although we tried to organise separate FGDs for women in half the cases, this was only successful in three meetings. In a further three, the local field teams were asked to organise female only groups but the groups organised around pig breeding and microfinance each decided that it would be...
appropriate to include one man who had been involved with the project activity from the outset.

4.1.2 | FGD discussions and triangulation

To begin with, we focussed on identifying climate shocks and stresses without the project intervention. This was an important element of the earlier BRACED Myanmar Alliance community planning process—developing a resilience assessment framework (BRACED Myanmar Alliance, 2015). Consequently, FGD participants were familiar with the issues and quickly reached a consensus. The FGD approach was very effective in identifying the impacts of localised regular annual flooding, but we also triangulated this evidence with key informant interviews (KII) with community representatives, local technical specialists, government officials and project staff, as well as BRACED impact evaluation baseline survey data.

We then asked FGD participants to consider which had been the most important project interventions in terms of helping to build resilience to the climate shocks they had identified. With this in mind, we asked what had changed as a result of these interventions over the 12–18 month period they had been operating (see Table 1). Their discussion overwhelmingly focussed on changes in livelihoods and health outcomes resulting from project interventions that mitigated the impact of annual flooding.

Most project interventions were well suited to participatory impact assessment as the bulk of focus group members had personally experienced changes from new activities (such as village savings and loans) or by comparing agricultural production after building an earth embankment to production in previous years in which the only significant difference was regular flooding. We distinguish between impacts that affected respondents and their families directly (the large majority of changes) and those reported for the wider community. In both cases, we triangulated FGD findings against multiple sources of evidence, which is good practice (Alexander & Bonino, 2014). Where respondents talked about their own experience the purpose of triangulation was to check our understanding rather than finding alternative sources of evidence. This approach identified one significant discrepancy, which was resolved by going back to the group via the project field worker. Where benefits were said to accrue to the broader community (a reduced incidence of Dengue fever, diarrhoea, drowning, and snakebites), we derived lower and upper bounds to impact based on the FGD findings and those of KII with local people such as health workers, teachers, or village leaders with an overview of broader community impacts. The differences do not change any conclusions but, to err on the side of caution, we took the lower bound estimates of change (which were from the KII).

The FGD findings on avoiding loss of life from snakebites following annual floods proved the most difficult issue to triangulate. Historical data on deaths from drowning could be cross-referenced with local health officials but the incidence and mortality of snakebites in rural communities in South Asia is poorly recorded (Alirol et al., 2010; Gutierrez, Theakston, & Warrell, 2006). Reduced incidence of snakebites was important in one community—Dalaban—in which a kilometre-long earth embankment had significantly reduced risks to farmers in the flooding season. In this case, we compared reports from multiple FGDs and cross-checked with regional estimates of snakebite morbidity and mortality (Alirol et al., 2010). FGD findings indicated three lives were saved over a 10-year period, while the estimate from the literature was two lives. Ultimately, we used the more conservative estimate.

4.2 | Quantifying economic costs and benefits

Project costs were provided by BRACED project implementing NGOs. To this, we added the cost of community contributions—with inputs such as cement valued at market prices and labour valued at local wage rates. This includes initial construction costs and estimated maintenance costs over a 10-year period. For example, the earth embankment shown in Figure 1 above is maintained with community labour and community leaders had scheduled between 300 and 600 person days per year for maintenance. Where government provided machinery, capital costs and implied usage costs were estimated from the literature. Each project (case study) site was allocated an equal share of total programme management costs.

It was relatively straightforward to identify financial benefits from reduced damage to assets, working days lost, reduced drinking water purchases, or reduced crop losses brought about by the project in the past 12–18 months using FDGs and KII. Discussion of the gains from project-funded infrastructure such as building embankments or dredging flood channels covered the value of bamboo houses that no longer had to be rebuilt each year, fewer work days lost due to flooding preventing travel or crop production saved from floods. In one community, the simple addition of a concrete walkway and sand-filling a depression allowed the secondary school to stay open during annual flooding.
Previously, the school closed for an average of 10 days a year. Although we were not able to value the increase in school attendance, we used data on the additional transport costs paid by parents to send children to another local school when the assisted school was closed. All benefits and costs were projected over a 10-year period.

The above are examples of avoided losses, that Tanner et al. (2015) refer to as the “first dividend of resilience.” The main challenge of valuing these types of avoided losses using participatory methods is to ensure that the value of reduced losses given by those in the FGDs applies specifically to the losses avoided as a result of the project.

The economic value of some avoided losses—lives saved in particular—had to be calculated using published results from economic models in nearby countries but using an accepted method to transferring these to Myanmar. This “benefits transfer” method is widely used in the environmental economics literature (Johnston, Rolfe, Rosenberg, & Brouwer, 2015). In estimating the VSL in Myanmar, we were able to draw on the OECD meta-analysis of the VSL (Biausque, 2012) and to use the published VSL estimates for rural Thailand (Gibson et al., 2007). The VSL for our case study areas in Myanmar was the VSL for rural Thailand adjusted for the GDP difference with Myanmar. This was multiplied by the estimated number of children who saved the lower bound of the FGD and KII estimates to produce an estimate of economic benefits.

The estimated benefit from the small reduction in the incidence of dengue and diarrhoea cases requiring children to be hospitalised also utilises the benefit transfer method—in this case, model parameters from neighbouring countries from Shepard et al. (2013). We have local evidence on the small reduction in hospitalisation rates, local costs of transport, and carer payment rates where hospitalisation occurs (from the lower bound of FGD and KII findings) and adjust this for under-reporting identified by Shepard et al. in their review of data from 12 South East Asian countries.

One community had changed their farming practice to take advantage of reduced losses from regular flooding. Unfortunately, we were not able to get multiple sources of evidence for this example of what Tanner et al., 2015 term the “second dividend of resilience” and have not included it in our analysis. However, we were able to put economic values against improvements in agricultural livelihoods brought about by the project—described by Tanner et al. (2015) as development co-benefits or the “third dividend of resilience.” This involved modelling the net financial returns from pig breeding and village savings and loans based on the evidence of project impact to date. We were able to check that reported returns to smallholder pig breeding from project communities were comparable to those for neighbouring countries (Huynh et al., 2007; Psilos, 2007). The financial benefit of project VSLAs for community members involved was calculated from the actual interest saving over the previous year from substituting informal money lending that had previously been used.

To calculate whether the returns to society as a whole justify project investments, all costs and benefits should reflect the opportunity cost of resources (HM Treasury, 2018). Hence, costs should ideally be calculated net of any subsidies on inputs. We have not done this because any subsidies on purchased inputs are small compared to total costs. Benefits include some non-market benefits (e.g., the VSL) but we have not identified and priced any broader environmental impacts.

All the project interventions that we consider are intended to produce benefits over a number of years and may involve future financial costs (such as loan repayments) or imply community labour costs—for infrastructure maintenance, for example. Interventions that rely on loan repayments had proven to be viable over multiple loan cycles and the VSLA model is well-established (Singer, 2007). Project supported livelihood diversification—primarily for pig breeding—had faced challenges such as animal loss due to sickness and the experience in the first 18 months was taken to be a reasonable reflection for future groups that would be formed from loan repayments.

The standard approach to investment appraisal considers forecast revenue and cost streams over the life of an asset (HM Treasury, 2018). This aspect of CBA applies here, but as we are further along in the project cycle we can draw on actual costs and benefits from the past year or two to help estimate future revenue and cost streams. The time horizon for the CBA calculation is influenced by the expected lifetime of community infrastructure investments with periodic maintenance. Yet, the further we look into the future, there is increasing uncertainty over the sustainability and use of project-funded infrastructure. In practice, we have used a payback period of 10 years, which is at the lower end of the range for infrastructure but has been used by CBA appraisals of community infrastructure investments in developing countries (Buncle et al., 2013).

We used evidence from local implementing partners and the communities themselves to estimate future maintenance costs. Community labour is the main cost driver and has to be undertaken if assets are to last for 10 years. Feedback from the FGDs and KIIs suggests that benefits are perceived to justify this investment in time and maintenance is very likely to be undertaken.
Benefit and cost streams are discounted back to values at the start of the project with a base case discount rate of 12%, reflecting public discount rates in developing countries (Juzhong, Liang, Lin, & de Guzman, 2007). We also run sensitivity tests using a discount rate of 6%—as a recent major donor review (ADB, 2017) suggest this lower social discount rate is appropriate for donor funding of social sector and environmental projects such as flood control. A lower discount rate favours projects where costs are borne up front and benefits accrue in future years.

In order to assess whether interventions make economic sense, standard practice is to consider the net present value (NPV) of discounted benefit and cost streams and also the benefit to cost ratio (BCR) of these discounted benefits and costs (HM Treasury, 2018). The two measures are slightly different: NPV is the present value of benefits less the present value of costs and provides a measure of overall impact. BCR is the ratio of the present value of benefits to the present value of costs and provides a measure of benefits relative to costs (HM Treasury, 2018).

5 | RESULTS AND DISCUSSION

The values shown in Table 2 are in British pounds using the January 2017 exchange rate.

| Case study  | 12% discount rate (base case) | 6% discount rate (sensitivity test) |
|-------------|-------------------------------|-----------------------------------|
|             | NPV                           | BCR                              | NPV                        | BCR                          |
| Dalaban     | £736,196                      | 10.89                            | £972,154                   | 10.6                         |
| Ward 93     | £513,959                      | 2.43                             | £788,207                   | 2.46                         |
| Mawlamyine  | £227,413                      | 4.47                             | £371,611                   | 5.33                         |
| Nyaung Ta Pin | £607                         | 1.07                             | £7,203                     | 1.30                         |

Abbreviations: BCR, benefit to cost ratio; CBA, cost–benefit analysis; NPV, net present value.

Using a 6% discount rate, typically increases estimated NPV by approximately 50%, as a lower discount rate makes development projects with high up-front costs and benefits spread over a 10-year period more attractive. This further strengthens the economic justification for funding the project interventions. However, we note that the benefit: cost ratio is typically only slightly higher at the lower discount rate—reflecting the difference in the NPV and BCR measures.

The CBA findings justify undertaking project interventions to build resilience to annual flooding in all case study sites. However, the ratio of discounted benefits to costs ranges from a modest 1.07 to nearly 11, and the reasons why some community-planned interventions produced much greater economic returns than others are illustrated in Figures 2–5.
Project infrastructure investments that combined with community and local government inputs to prevent targeted communities suffering regular annual flooding (Dalaban—with an earth embankment and Mawlamyine—with flood channel dredging), produced the highest ratio of benefits to costs. In these cases, at least 75% of benefits came from avoiding the loss, damage and economic disruption of flooding, with a quarter or less from new or improved livelihoods. However, in Dalaban and Mawlamyine, the mix of benefits within the avoided loss and damage or livelihoods categories depend on the local context. For example, the reduction in snakebites was a major benefit in Dalaban but was not identified in Mawlamyine. What we can say, is that interventions that reduce risk of loss of life across the community will tend to dominate the valuation. This was reflected in the type of projects initially prioritised by the communities themselves—a new flood shelter in Nyaung Ta Pin, for example, emerged as the clear priority but it could not be supported as the estimated cost was beyond the project budget.

In Ward 93 and Nyaung Ta Pin, the cost of infrastructure required to reduce annual flooding or mitigate catastrophic risk was beyond the funding capacity of the project and local, township government partners. This was a weakness of the project community-based planning approach as, despite devolution in Myanmar, responsibility for disaster planning lay at higher levels than township administrations and the latter did not have a specific budget for this work (Gee, 2018). Hence, the project focus in these two communities was primarily on building development co-benefits. These were sufficient to justify the interventions (as shown in Table 2) but BCRs were lower than the cases with a greater community-planned infrastructure component.

6 | CONCLUSIONS

We have presented a method for undertaking CBA of that combines evidence from participatory methods to understand changes that have occurred with more formal economic modelling. This approach can be used to compare the costs and benefits of CDD projects more widely.

Applying this method to the BRACED resilience-building project in Myanmar found that interventions planned with the community generated benefits for those closely involved that significantly outweighed project costs. The returns to limiting the impact of regular annual flooding with small scale infrastructure and improving livelihood opportunities seen during the project life and projected for up to 10 years were much larger than the costs over this period—even taking the wider community share of national project costs into account.

The net returns were greatest in the two case study sites where community-planned small-scale infrastructure was used to limit regular annual flooding (generating the first dividend of resilience) in addition to improving livelihood opportunities (the third dividend of resilience). In these cases, small-scale infrastructure work such as building an earthen embankment or dredging flood channels was enabled by a joined-up response from the donor-funded project, community and government. In the other cases, neither the local township government involved in the planning nor the project had the DRR funding to meet community priorities for admittedly slightly larger flood-related infrastructure. More work is required to get higher levels of government in Myanmar to buy into community-based planning for small-scale infrastructure for flood mitigation or prevention. This will be much easier if it can be demonstrated that the economic returns from this resilience building significantly exceed costs, and the tools presented in this paper are part of this process.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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