



An assessment of community-based adaptation initiatives in the Pacific Islands

Karen E. McNamara¹✉, Rachel Clissold¹, Ross Westoby², Annah E. Piggott-McKellar¹, Roselyn Kumar³, Tahlia Clarke¹, Frances Namoumou⁴, Francis Areki⁵, Eugene Joseph⁶, Olivia Warrick⁷ and Patrick D. Nunn³

For the Pacific Islands, community-based adaptation activities are crucial, and yet it remains uncertain whether they are effectively promoting long-term adaptive capacity. Here we evaluate the performance of 32 community-based adaptation initiatives across 20 rural communities in the Pacific. We find that initiative appropriateness was a strength while sustainability was a consistent issue, locally funded initiatives and those implemented by non-governmental organizations were more likely to perform better, and climate awareness-raising initiatives and those integrated with ecosystem-based adaptation performed best. We also identify four multidimensional and interdependent optimization points for future community-based adaptation initiatives: local approval and ownership, shared access to and benefit from initiatives, integration of local realities, and systems-thinking and forward planning. Our analysis suggests the need for a praxis shift whereby adaptation is locally led, communities drive their own agendas, and donors and implementers become facilitators that resource the diverse capacities of communities and help achieve local objectives equitably.

Despite contributing little to global carbon emissions, the impacts of climate change on small islands are very real¹. With projections showing that island communities will continue to face worsening climate change impacts over the remainder of this century and beyond, understanding what successful adaptation looks like for island countries such as those in the Pacific is urgent². This imperative is furthered as the substantial funding that has flowed into the Pacific Islands region for climate change adaptation has made little progress towards intended objectives to date, and funding may dry up³.

With growing understanding of diminishing returns resulting from top-down climate change responses, assistance is increasingly being delivered at the local scale through bottom-up responses such as community-based adaptation (CBA)^{4,5}. CBA is a small-scale, place-based and grassroots driven approach that has synergies with broader development aspirations⁶. In principle, the local-scale focus of CBA provides an opportunity for adaptation to better acknowledge and integrate existing local knowledge, capabilities, priorities and context of the community and for impacts to be addressed at the scale at which they are experienced^{7,8}. Achieving effective and sustainable adaptation that promotes reflective engagement with the community ('ideal CBA')⁹, however, is not as straightforward as often implied¹⁰. Negative impacts can occur if CBA fails to adequately represent vulnerable populations and generate long-term social resilience^{11,12}.

Despite the range of CBA activity in the Pacific Islands region, uncertainty remains around whether these communities are becoming better prepared to cope in the long term^{13,14}. Bottom-up approaches such as CBA are important in Pacific islands as they can support and use traditional governance systems to help mobilize resources and better use traditional knowledge to support sustainable

adaptation^{15,16}. Further, the complementarity that bottom-up approaches often exhibit with cultural norms and connections to land and place in most Pacific islands is critical for socio-ecological resilience and influencing behaviour¹⁷. Given the importance of this approach to this region, good practice for bottom-up approaches such as CBA must be further developed and shared as a matter of urgency^{7,18}.

While high-performance adaptation stories are championed to ensure they can be scaled up and out in future programmes, stories of adaptation requiring work and improvement are rarely reported or exploited as a source of learning¹⁹. This is regrettable because these lessons are as salient as success stories for optimizing CBA, which has been increasingly implemented despite research on its efficacy being in its infancy^{20,21}. Previous studies that have evaluated CBA have largely been context-specific case studies^{18,20,22–24} offering in-depth insights in specific locations and for particular CBA initiatives but not always providing transferable learnings (although exceptions do exist^{25,26}). Further, adaptation research in small island developing states tends to focus on core or near-core areas of a country rather than rural, peripheral areas that are more difficult to access^{27,28}. By undertaking site evaluations on the success of CBA in increasing adaptive capacity across rural communities in the Pacific, this study tracks progress at a larger scale and addresses these shortcomings.

To evaluate CBA progress, we explore local perspectives and embedded experiences of rural community members across four Pacific Island countries: Fiji, Federated States of Micronesia (FSM), Kiribati and Vanuatu. While the selection of these countries to some extent reflected researchers' existing networks, it was intentional in that it included one atoll country (Kiribati), one mixed atoll and high-island country (FSM) and two high-island countries (Fiji and

¹School of Earth and Environmental Sciences, The University of Queensland, Brisbane, Queensland, Australia. ²Griffith Institute for Tourism, Griffith University, Gold Coast, Queensland, Australia. ³School of Social Sciences, The University of the Sunshine Coast, Sunshine Coast, Queensland, Australia. ⁴Pacific Conference of Churches, Suva, Fiji. ⁵World Wildlife Fund Pacific, Suva, Fiji. ⁶Conservation Society of Pohnpei, Pohnpei, Federated States of Micronesia. ⁷Red Cross Red Crescent Climate Centre, Port Vila, Vanuatu. ✉e-mail: karen.mcnamara@uq.edu.au

Table 1 | Definition of components of adaptation success and reasons for inclusion in study

Component of adaptation success	Definition	Reasons for inclusion in study
Appropriateness Similar to 'legitimacy' ^{57,58} and 'relevance' ⁵⁹	Overall relevance of the project and associated suitability of the initiatives in terms of community context, their priorities and their cultural and social ethos	<ul style="list-style-type: none"> •→This component is critical for CBA evaluation due to the nature of the approach as one that integrates local context, knowledge, capabilities and priorities⁷⁸ •→Successful CBA is more likely when CBA is relevant to existing social forms, effects change from within cultures and occurs as part of culture⁷
Effectiveness	Extent to which the initiatives have achieved intended objectives, and includes the products, capital goods and services that resulted directly from the intervention	<ul style="list-style-type: none"> •→Effectiveness was identified as a core aspect of most monitoring and evaluation studies/rubrics for deriving adaptation success^{50,57,58,60} •→This criterion for success is complemented by other evaluation components as relying solely on effectiveness is insufficient^{58,61}
Equity	Inclusion and benefit of initiatives for everyone within the community, specifically any marginalized groups	<ul style="list-style-type: none"> •→This component was considered critical as there are existing concerns and censures that community-based approaches rely on an assumed imagery of 'community' as devoid of intracommunal differences. Overlooking differences in power, access and control of resources can exclude the most vulnerable and entrench underlying social structures and power relations, thereby leading to inequitable outcomes that are counterproductive to successful adaptation^{4,40,62}
Impact	The wider direct or indirect, intended or unintended, long-term effects of the initiative, whether positive or negative	<ul style="list-style-type: none"> •→Understanding the impact of projects beyond specific climate-related objectives is important as CBA has become increasingly recognized as a 'pro-poor' and 'no-regrets' approach that has synergies with development (that is, fostering benefits regardless of future climate change scenario)^{24,39,50} •→Any adaptation has the potential to create unintended impacts across temporal and spatial scales, and these should be accounted for⁶⁰
Sustainability	Extent to which initiatives have been maintained post-project life cycle and the extent to which processes have continued once the initial inputs have ceased	<ul style="list-style-type: none"> •→This was selected as an important consideration in the Pacific context as CBA project cycles are short (average time frame of 3 yr) and long-term funding is a challenge to secure^{14,24}; with these issues, it is important to understand whether adaptation is occurring beyond project life cycles (for example, when funding and external support cease)

Vanuatu), with contrasting economic rankings, to sample a representative range of contexts among Pacific Island countries. Within each island country, rural communities were sampled along core-periphery gradients to capture differences in adaptation contexts, as earlier work shows exist^{27,29,30}. In Pacific Island countries, most rural communities are largely subsistence based, occupying land to which they have title and have done so for generations, and engage in livelihoods that are at least partly culturally grounded²⁹. While there are variations in the nature of such rural communities attributable to peripherality^{29,30}, their commonalities dominate, making site selection for this study more straightforward than would be the case elsewhere.

There is no consensus on, and a lot of ambiguity around, what 'successful' adaptation is and how to measure it^{31,32}. On the basis of a review of literature about what constitutes 'successful' adaptation, five key evaluation components were deemed appropriate for this study: appropriateness, effectiveness, equity, impact and sustainability (see Table 1 for definitions). This study is based on participant perspectives of CBA performance considering each of these components. Perspectives were derived from 415 participants in 44 focus groups and 62 in-depth interviews between April 2017 and July 2019 (see Methods). Thus, this study relies on embedded and subjective experiences of participants involved. Understanding how individuals and communities perceive their own adaptation experiences is critical as cognitive aspects (for example, perceived self-capacity or perceived adaptation efficacy) are crucial to adaptation intention, community buy-in and adaptive capacity^{33–35}. Further, measuring perspectives of individuals towards their own situation allows for more meaningful comparisons within contexts and through time, especially when the metrics are meaningful to local people³⁶. Comparisons through time will be critical as it is too

early to accurately determine whether long-term adaptive capacity and vulnerability reduction will be achieved (even by initiatives perceived as high performing at the time of this study). Therefore, although this study still provides valuable insights, there remains a need for ongoing monitoring and evaluation to assess long-term impacts.

CBA in rural communities across the Pacific

Twenty rural communities participated in this study, which gave rise to 14 case study sites as some sites included multiple communities of place (that is, based on ties to a physical space³⁷) that were simultaneously involved in the same or similar initiatives. Exemplifying the miscellany of adaptive responses, this study evaluated 32 diverse CBA initiatives related to enhancing food security ($n=9$) or enhancing water security ($n=8$) or both simultaneously ($n=1$), prevention of land loss ($n=5$), relocation ($n=3$), climate change awareness-raising ($n=2$), marine resources protection ($n=2$), and enhancing financial security ($n=2$). Table 2 provides a summary of case study sites and CBA initiatives. Supplementary Table 1 describes the intended contributions to adaptive capacity of each type of CBA.

These initiatives are not each stand-alone projects but rather subset initiatives that can be aggregated into 15 overarching, broader projects. This paper is structured around subset initiatives rather than broader projects to capture the diverse experiences and outcomes that emerged for local participants, even within a single project. These initiatives were funded through 8 different funding bodies (3 international donors and 5 local sources) and implemented by 13 different agencies (9 government-related institutions/departments, 3 non-government organizations (NGOs) and 1 local university), some of which partnered to fund or implement initiatives jointly.

Table 2 | Overview of the 14 case study sites and 32 CBA initiatives with associated codes

Case study code	Country	Main climate change risks	Livelihoods context	Types of adaptation initiatives	Activities involved (as identified by participants)
F1	Fiji	Coastal pressures from tidal inundation and shoreline erosion	Coastal communities that are largely subsistence based, relying heavily on marine and terrestrial resources	F1: Prevention of land loss	F1: Construction of sea wall along coastline
F2	Fiji	Coastal pressures form tidal inundation, shoreline erosion and saltwater intrusion	Community livelihoods reliant on fishing, subsistence agriculture and cash from market sales of locally made crafts and fish or crop surpluses	F2: Relocation	F2: Planned village relocation where entire community is moved and resettled in less exposed area
F3	Fiji	Coastal intrusion and storm surge activity	Community relies heavily on subsistence fishing and crop agriculture with surplus sold for income	F3: Relocation	F3: Same as F2
F4	Fiji	Cyclones, periodic intense rainfall, flooding, coastal erosion and inundation	Subsistent community dependent on locally acquired marine resources supplemented by crops and kava sales	F4: Prevention of land loss	F4: Construction of river wall
F5	Fiji	Sea level rise, inundation and tropical cyclones	Subsistent community dependent on marine and coastal environments	F5: Relocation	F5: Same as F2 and F3
FSM1 (a, b, c)	FSM	Drought	Subsistent community based on farming with income also supplemented by selling sakau (kava)	FSM1a: Enhancing water security FSM1b: Enhancing food security FSM1c: Enhancing water security	FSM1a: Provision and installation of rainwater tanks for water harvesting FSM1b: Establishment of plant nursery and greenhouse to support and encourage crop growth FSM1c: Discourage deforestation and encourage reforestation to prevent pollution and sedimentation of drinking water supply
FSM2 (a, b)	FSM	Drought, shoreline erosion and inundation from rising sea levels, storm surges and high tides	Two-thirds of community engaged in subsistence livelihoods while remaining have income through formal employment or fish and sakau (kava) sales	FSM2a: Enhancing water security FSM2b: Prevention of land loss	FSM2a: Provision and installation of water tanks for water harvesting FSM2b: Construction of sea wall
FSM3 (a, b, c, d)	FSM	Drought, flooding and cyclones	Close-knit subsistent community dependent on marine ecosystems for food (many fish or plant together)	FSM3a: Enhancing water security FSM3b: Enhancing food security FSM3c: Enhancing financial security FSM3d: Marine resources protection	FSM3a: Provision and installation of rainwater tank for water harvesting FSM3b: Establishment of aquaculture sites for clam farming FSM3c: Establishment of piggeries, providing training on their management and creating opportunities to sell pigs and by-products FSM3d: Establishment of a marine park area to protect the ecosystem and limit use of marine resources
K1	Kiribati	Coastal erosion and saltwater intrusion	Decline of traditional subsistence activities due to reliance on imported foods and limited income opportunities; the main activities being selling copra (dried coconut kernel), surplus foods or handicrafts (although limited market access)	K1: Enhancing food security	K1: Trial of climate-resilient seeds, establishment of community plots, provision of pigs and relevant infrastructure as well as compost training
V1 (a, b, c)	Vanuatu	Cyclones, varying frequency and intensity of rainfall (drought to heavy downpours)	Largely subsistent community with food grown for consumption and main income streams related to livestock, forestry or selling copra	V1a: Enhancing water quality V1b: Enhancing food security V1c: Enhancing food security	V1a: Protection of harvested water from pollution and insect-borne diseases with appropriate covering V1b: Establishment of chicken coop and provision of training in chicken rearing for meat and eggs V1c: Establishment of fish farm demonstration site and provision of training in fish farming

Continued

Table 2 | Overview of the 14 case study sites and 32 CBA initiatives with associated codes (continued)

Case study code	Country	Main climate change risks	Livelihoods context	Types of adaptation initiatives	Activities involved (as identified by participants)
V2 (a, b, c, d, e, f, g)	Vanuatu	Storm surges, erosion, cyclones and drought	Subsistent communities dependent on marine ecosystems with main income streams being tourism, fishing, agriculture and overseas seasonal work	V2a: Enhancing food security V2b: Enhancing food security V2c: Prevention of land loss V2d: Marine resources protection V2e: Enhancing financial security V2f: Enhancing both food and water security V2g: Enhancing water security	V2a: Establishment of a plant nursery and provision of crop cuttings and agroforestry training V2b: Provision of solar food dryers to enable food preservation and livelihood diversification V2c: Establishment of tree nursery to protect foreshore from erosion V2d: Protection of coral ecosystems through training and the creation of incentives around crown-of-thorns starfish control V2e: Establishment of beehives and training on maintenance V2f: Installation of self-composting toilets to save water, protect groundwater supplies and improve soil nutrient deficiencies and fertility V2g: Establishment of water piping systems to provide water to villages
V3 (a, b)	Vanuatu	Tidal surges, coastal erosion, cyclones and drought	Subsistent community based on agriculture and fishing, although many are also seasonal workers and large portion of women make handicrafts to sell at market in Port Vila	V3a: Prevention of land loss V3b: Enhancing water security	V3a: Construction of a sea wall along coastline V3b: Provision of rainwater tanks for water harvesting
V4 (a, b)	Vanuatu	Drought, cyclones, heavy rain, storm surges, sea level rise	Largely subsistent communities reliant on crops from gardens, fish, fruit and some imported foods	V4a: Enhancing food security V4b: Climate awareness-raising	V4a: Establishment of demonstration plots for agriculture and training on nutrition and agricultural techniques V4b: Provision of participatory presentations, movie nights and animations about climate change, and distribution of noticeboards with information on climate change, disasters and weather updates
V5 (a, b, c)	Vanuatu	Cyclones, drought and flooding	Community livelihoods based on agriculture and/or semi-commercial fishing; some also import goods such as tinned food	V5a: Climate awareness-raising V5b: Enhancing water security V5c: Enhancing food security	V5a: Same as V4b, provision of disaster risk-reduction handbooks and tools, development and updating of community action plans V5b: Provision of awareness sessions, training in water-saving techniques and using water-usage diaries V5c: Same as V4a and provision of solar food dryer for food preservation

Overall initiative performance. We found that initiatives generally performed well in terms of appropriateness while sustainability required substantial improvement across almost all initiatives (see Extended Data Fig 1). Some initiatives had high performance across all five components of adaptation success except sustainability, highlighting how even when other components performed well, sustainability can be the most difficult to achieve because it needs to stand the test of time. On the basis of participant perspectives on CBA performance in terms of the five components, evaluated initiatives were placed along a scale from high to low performance (Fig. 1, based on Extended Data Fig 1).

Although there were no particularly strong patterns in terms of the spread of variables across the scale (and thus no particularly strong influences from the variables on initiative performance), there were some noteworthy patterns. Locally funded initiatives were, for example, proportionately more evident among high- and medium-performing initiatives. Although internationally funded initiatives had a more even spread across the scale, they dominated the low-performing category due to locally funded initiatives performing proportionately higher. Similarly, initiatives

implemented by NGOs (whether with local or international funding) were proportionately more present within high- and medium-performing groups while those implemented by governments or universities had a more balanced spread across the scale or largely occupied medium-performing groups, respectively. Climate awareness-raising and marine resources protection (integrated with ecosystem-based adaptation (EbA)) initiatives also tended to have higher performances than others, while initiatives focused on preventing land loss had lower performances overall. There was a largely scattered spread of countries on the scale, except for FSM, which had proportionately more high- and medium-performing initiatives. Through latent content analysis, we also found that a series of factors related to initiative design and implementation shaped the perceived performance of initiatives; these common characteristics are discussed in detail in the following sections and summarized in Tables 3–5.

High-performing initiatives. Initiatives with high performance had several attributes in common (Table 3), one of which was the effective production of outputs linked directly to adaptive capacity.

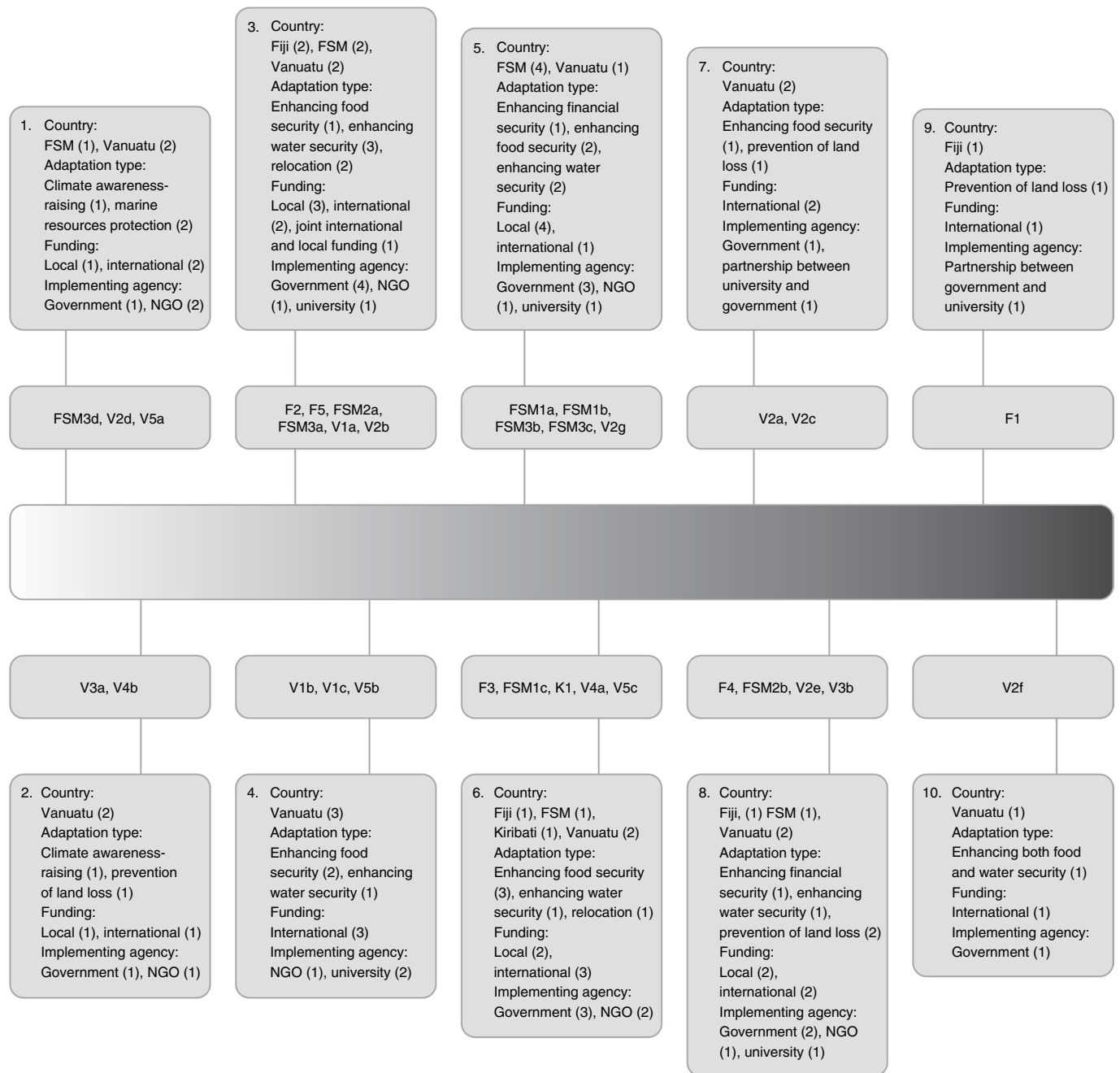


Fig. 1 | Groups of evaluated initiatives along a scale from high performance (white) to low performance (black). The relevant initiative codes for each group are displayed in the first layer of boxes closest to the scale, while the second layer of boxes breaks down the initiatives in each group by relevant country, adaptation type, funding body and implementing agency (with the number of associated initiatives displayed in brackets). Note 'government' as an implementing agency refers to both local and international government-related institutions.

Improvements in climate change awareness and knowledge, for example, enhanced abilities of community members to interpret experienced changes, thereby supporting disaster preparedness and enhancing perceived capacities to cope: "The awareness [sessions] are one thing that we learn a lot [from] ... it's [be]coming clear that, yes, our weather is changing" (Vanuatu-based participant, 2017). Many initiatives also proved appropriate to local context by being tailored to cultural specificities as well as community priorities, resources and livelihoods. In several cases, this nurtured a sense of local approval and positive sentiments around initiative sustainability. Despite many of these high-performing initiatives achieving local approval and appropriateness, the tendency to be top-down

in nature emerged as they were largely designed and implemented by external actors (rather than grassroots-driven as in 'ideal CBA'). The climate awareness-raising initiatives appeared to be somewhat co-driven by local communities as there were presentations from community members in local dialects. These initiatives, however, were also not wholly driven or shaped by local communities and their contexts as some participants (referring to V4b) pointed to the lack of focus on drought as their most perturbing livelihood concern.

Another commonality among high-performing initiatives was the tendency to move away from archetypal parameters of 'communities', which are usually based on ties to physical space. These

Table 3 | Common characteristics among high-performing CBA initiatives

Groups of initiatives	Common characteristics	Details of initiative performance
Groups 1–3	1: Effective production of outputs that are linked directly to improved adaptive capacity	<ul style="list-style-type: none"> •→Maintenance of healthy marine ecosystem and fish stock to improve food security and support livelihoods related to tourism or fishing (FSM3d, V2d) •→Effective protection of land against tidal surges and erosion (V2d) •→Effectively increased climate change awareness and knowledge (V4b, V5a)
	2: Appropriateness to local context in terms of community culture, livelihoods, resources and priorities	<ul style="list-style-type: none"> •→New relocation site designed to reassemble cultural and material assets, which enhanced local approval and perceptions around initiative viability (F5) •→Information delivery in local dialects to ensure all community members could be involved (not just those who spoke Bislama or English) (V4b, V5a); V4b ranked slightly lower than V5a due to lacking targeted information around most pressing concern of drought •→Complementarity to traditional knowledge through: (1) helping to fill gaps where traditional knowledge was perceived as less reliable due to climate variability (V5a), (2) emergence of integrated knowledge systems (new and traditional knowledge) to either detect imminent cyclones (V4b) or optimize outputs from gardens (V4a) •→Based around a marine ecosystem that provides critical resources for community livelihoods (FSM3d, V2d) •→Integration of locally appropriate livelihood alternatives in new relocation site fostered local approval and positive perceptions around initiative viability (F2) •→New relocation site designed to imitate original site's proximity to ocean and food gardens so that livelihoods can be maintained (F5) •→Integration of local resources enabled community to easily source inputs and maintain implemented sea wall (V2) •→Responding to direct requests from local communities ensured that initiatives aligned with local priorities (FSM3d, V2d) •→Relocation implemented for communities that perceived it as necessary for the risks they were facing (F2, F5) •→Alignment with local priorities and concerns around drought (FSM2a, FSM3a) and finding an alternative to wells (FSM3a)
	3: Moving away from geographical parameters of a 'community'	<ul style="list-style-type: none"> •→'Whole of island' approaches based on a local ecosystem where all local communities on an island can be involved and perceive themselves as equally responsible for, and benefiting from, initiatives (FSM3d, V2d) •→Success of initiative largely attributed to unique ownership through a training centre. This minimized internal disputes and created a demonstration site through which community members could then transfer knowledge and skills to households (V1a) •→Initiative did not work within chosen community but retained widespread impact as one woman took ownership and provided training to others (that is, initiative succeeded with 'community' based on woman's networks, which are beyond confines of one island or province); she was subsequently employed to train others (V2b)
	4: Ability to simultaneously address climatic and non-climatic livelihood pressures	<ul style="list-style-type: none"> •→Benefits beyond reducing exposure to risk provided, which addressed non-climate-related pressures (for example, improved local housing, access to roads, markets, schools and health facilities) and enhanced local approval of initiative (F2) •→Positive impacts beyond water security (for example, improved health and sanitation) (FSM2a) •→Improved fiscal well-being by improving local access to water, which reduced need to purchase bottled water from other islands (FSM2a, FSM3a)
	5: Integration with EbA	<ul style="list-style-type: none"> •→EbA integrated by basing initiatives on the protection of local marine ecosystems, and their associated services, that are critical to livelihoods (for food, fishing and tourism) (FSM3d, V2d)
	6: Overlooking future trends	<ul style="list-style-type: none"> •→Implementers overlooked likelihood of longer drought intervals so water pumps (for when water tank levels fall below extraction lines) were not provided (FSM3a) •→Insufficient number of water tanks provided by overlooking rising population trends (FSM2a)

approaches enhanced the equity of initiatives by minimizing internal disputes and having more widespread benefit (for example, by being open to community members across an island or through encouraging information/skill transfers beyond those directly involved). This is not to say that initiatives based on geographic boundaries proved incapable of equity. The success of climate change awareness-raising initiatives (**V4b, V5a**), for example, was partly dependent on equitable modes of information transfer and delivery for those with low literacy and disabilities (for example, use of a projector for animations, pictures and presentations).

Several initiatives were also able to simultaneously address climatic and non-climatic pressures or issues for rural livelihoods,

thereby supporting an overall reduction in vulnerability across a relevant system (systems-thinking) and, in one case, fostering a sense of local approval and satisfaction. The positive sentiments that emanate from this characteristic are exemplified by the following statement related to an initiative that simultaneously addressed non-climatic concerns related to housing (**F2**): "We were very happy with the relocation ... it solved the problem where there was three, four generations [crowded] in one house [in the old village]" (Fiji-based participant, 2017).

The two top-performing initiatives were similar in their integrated approach where, although focused on a community scale, they were also based on the protection of a local ecosystem, which

Table 4 | Common characteristics among medium-performing CBA initiatives

Groups of initiatives	Common characteristics	Details of initiative performance
Groups 4–6	1: Appropriateness to local context in terms of community priorities	<ul style="list-style-type: none"> •→Responding to direct requests from local communities ensured that initiatives aligned with local priorities (FSM1a, FSM1b, FSM3b, FSM3c) •→Relocation appropriate for community that understood life in original location was unviable (F3) •→Local concerns and priorities around lack of water (V5b), pollution of drinking water (FSM1c) and food security addressed (K1, V4a, V5c)
	2: Women's empowerment and improved equity	<ul style="list-style-type: none"> •→Progressed gender equity in terms of participation, decision making and benefit (V4a, V5b, V5c); women have acquired leadership roles and noted growth in motivation and confidence while men acknowledge role and influence of women in decision making
	3: Inequity stemming from overlooking social and/or cultural considerations and dynamics	<ul style="list-style-type: none"> •→Attempted to provide equal opportunity but did not target specific groups based on underlying cultural and social differences, which hindered ability to be wholly inclusive (that is, equal but not equitable) (K1) •→Two villages (seemingly coherent with strong family links) united as one 'community', which gave rise to internal disputes resulting in one community being excluded while the other acquired considerable benefits for all members (V2g) •→Using 'community' parameters based on geography meant that a minority religious group that is scattered across these geographical 'communities' became marginalized and then excluded (V4a) •→Not adequately recognized that the distribution of a high-value cultural asset (not every member of community received pigs) could generate social status disparities (FSM3c)
	4: Initiatives not designed to promote the self-sufficiency of communities and ability to maintain initiatives long term	<ul style="list-style-type: none"> •→Plastic parts of provided equipment were not affordable or attainable for replacement and maintenance in communities with little available cash, rendering initiative unsustainable (V5b, V5c) •→Community unable to afford or source needed plant seedlings for maintenance of nursery stocks once funding ceased (FSM1b) •→Implementation of water tanks at high elevation made upkeep difficult and only one tank provided (that is, no reserve tank for when issues arose) (FSM1a) •→Proper maintenance of fencing deemed difficult as fences cemented into a soft calcareous sandy substrate (FSM3c) •→Poor design of new relocation site (that is, threat of landslides, houses leaking, poor drainage, erosion and health concerns due to limited number of septic tanks) generated negative perceptions around long-term viability of site, although there is some satisfaction with other facilities (for example, solar power, water tanks and flush toilets) (F3) •→Partly relying on stricter laws that are yet to be implemented and enforced (stop deforestation and rubbish dumping into waterways), rather than taking practical approaches such as empowering communities to change behaviour (FSM1c)

overlaps with EbA. Through this integration, these initiatives simultaneously occasioned several of the aforementioned common characteristics: appropriateness to local context (that is, based on ecosystems critical to rural livelihoods), moving away from geographical parameters (that is, basing the 'community' around those that use the ecosystem) and simultaneously responding to livelihood pressures that are not always directly linked to climate (for example, income and food security).

Although these are high-performing initiatives, several issues arose. Poor sustainability emerged and was largely due to poor future planning, where "no one factored in the future" (FSM-based participant, 2018), especially in terms of local trends in climate change and population growth. The tendency for some short-term benefit but poor long-term impact is depicted by one woman: "Water tanks have helped but there isn't enough for anything except cooking and drinking—we are still bathing in saltwater ... drought sees the water source dry up and the tank empty" (FSM-based participant, 2018).

Other issues that arose were more specific to certain initiatives and included delays in implementation processes, which engendered community resentment and disapproval (F5), the need for regular reinforcement of infrastructure (V2d) and some issues with equity and access to decision making (F2). The nature of the first issue further demonstrates how CBA tends to be top-down rather than grassroots driven. In terms of the latter issue, one of the community relocations (F2) was perceived as performing lower than the other (F5) as it had less-equitable decision-making processes for women. Positive aspects, however, outweighed these characteristics,

resulting in these initiatives being perceived as high performing. It is important to note that F5 is still an ongoing initiative and the community has yet to relocate despite appropriate, inclusive and sustainable planning; time will tell whether this initiative has a sustained positive impact in the long-term.

Medium-performing initiatives. Medium performing initiatives were perceived as having mixed positive and negative aspects. Some key characteristics (Table 4) echo those discussed in the preceding section. First, the importance of producing outputs is re-emphasized here as one initiative demonstrated how the inadequate generation of outputs impedes community motivation to maintain activities (that is, they will return to traditional ways) (V4a). Second, the importance of simultaneously catering to climatic and other (potentially non-climatic) livelihood pressures is negatively reinforced in two initiatives that lacked a systems-thinking approach, meaning that other sources of vulnerability (and any associated externalities) were overlooked. In one initiative, this impeded effectiveness and sustainability (V5c): "with the continuous disaster of the volcano ... it's hard to achieve the [adaptation] goals" (Vanuatu-based participant, 2017). This was because ash fall continuously destroyed provided climate-resilient crops and equipment. Similarly, although F3 (as the lowest-performing relocation initiative) was initially approved of by the community, the tendency among implementers to overlook other sources of vulnerability hampered perceptions around the long-term viability of the new site: "We were delighted with the move to the new houses, but we are still worried about the

landslide because the houses are on the hill” (Fiji-based participant, 2017). Parallel hazards can perpetuate vulnerability in the system regardless of climate scenario.

Most medium-performing initiatives tended to be appropriate to the local context in terms of community priorities. Three initiatives, however, demonstrated how adaptation can be appropriate in terms of catering to priorities while having other contextual applicability issues (K1, V5b, V5c). These initiatives only partly integrated contextual aspects by focusing on the broad livelihood priorities but then also either relying on external resources (V5b, V5c) or overlooking more-specific yet related needs such as improved market access and water for irrigation (that is, the wider vulnerability context) (K1). These generated issues for sustainability as external resources were difficult for communities to replace for maintenance (V4b, V5c), and crops did not grow well (K1): “The biggest failure is the provision of the water. They said they would provide water that would spray the plants but they didn’t, so most of the crops die” (Kiribati-based participant, 2017). In Kiribati, having another poorly performing initiative has increased people’s stress and community scepticism about externally sponsored adaptation activities. These kinds of issues point to the problematic tendency for these initiatives to be designed and implemented by external actors, rather than being grassroots driven (as in ideal CBA).

In terms of equity, there was a nearly equal number of initiatives that had high performance as those that had issues. Several initiatives in FSM were perceived as equitable in terms of members being informed and consulted (FSM1a, FSM1b, FSM1c). This is a likely result of substantial outreach work on equity by NGOs but also the existence of matriarchal lineages, which ensures decision making around cultural, political and social community dynamics is largely gender neutral. A more-specific characteristic to note was the ability of some initiatives (V4a, V5b, V5c) to advance women’s empowerment and gender equity. As one female participant stated, “At first, I was shy and scared of talking but when [implementing agency] did more activities and training and involved us, this is where I started to build up confidence and become involved ... I began to speak up for myself” (Vanuatu-based participant, 2017).

Initiatives with poor equity and exclusive tendencies in this group were largely a result of overlooking social and/or cultural considerations and dynamics. Two initiatives (V2g, V4a), for example, did not implement appropriate ‘community’ parameters for the cultural context and social dynamics, thereby giving rise to exclusion. One initiative (V2g) that merged two villages as one ‘community’ (for initiative purposes), for example, gave rise to internal disputes that resulted in one village being excluded: “it [initiative] was working for a couple of months [but] is now only serving the other community ... we’re all related, both villages, but they’re a bit strong-headed” (Vanuatu-based participant, 2018). One participant (from V4a) suggested that establishing ‘community’ parameters on social characteristic boundaries, such as gender or religion rather than geography, may be more equitable. This reiterates the aforementioned potential for different ‘community’ parameters to be more equitable and impactful, but also highlights how the nature of these actions has been shaped by what may be more convenient and suitable for external actors. Local communities were not involved in designing and shaping the initiative to what might be most suitable to them and their local contextual factors, especially in terms of social and cultural considerations and/or dynamics when delineating ‘community’ boundaries. It is important to also note here that V4a illustrates how holistic equity is hard to achieve: although there was exclusion of a religious group, there were also progressions in gender equity and women’s empowerment for those involved.

Using the appropriate ‘community’ parameters to have more impact is not enough on its own. We found performance varied among initiatives that were all implemented through a district training centre as an atypical ‘community’. Two initiatives (V1b,

V1c) were ranked lower than V1a (high-performing initiative), and this was largely because the former two required ongoing inputs and upkeep, which became difficult when the leader of the training centre changed. Further, a drought and concomitant lack of water rendered the fish farm (V1c) difficult to maintain, connoting the limited contextual appropriateness of the initiative.

Despite initiatives being appropriate to local priorities (for example, FSM1a, FSM3c) or effective in the short term (for example, FSM1b, FSM1c, V5b), several initiatives were not designed in ways (due to being designed by external actors) to promote and empower the self-sufficiency of communities and their abilities or motivations to sustain initiatives beyond project lifespans (that is, when funding and external support ceased). This included the reliance on external resources, which made it difficult for communities to source and replace equipment parts, as well as poor design elements, which rendered maintenance more difficult than necessary. In terms of the former, one participant asserted that it would “be better if you could take something that is already inside of the community and use that” (Vanuatu-based participant, 2017). Promoting community self-sufficiency is critical for better forward planning and initiative sustainability.

Low-performing initiatives. Low-performing initiatives represent initiatives that local communities perceived as having more issues than not, albeit most were still appropriate to local context in terms of community priorities and aspirations. Among these initiatives, some characteristics emerged (Table 5) that reiterate key findings presented in the preceding sections. Low-performing initiatives, for example, further underscore the problem with overlooking future trends as several initiatives became ineffective because of poor planning around, and consideration for, future climatic changes at the local scale. Two initiatives also further illustrate the importance of ensuring community self-sufficiency and/or integrating locally available resources for sustainability: V2e had unmanageable high costs, which rendered the community unable to achieve self-sufficiency; V3b had a heavy reliance on external resources (for example, expertise and construction material) so that when difficulties emerged, there was a lack of local technical capacity and funds to sustain the initiative. One community member stated: “we should use local experience in design because we know the context ... instead of getting someone to come in and then it doesn’t work” (Vanuatu-based participant, 2018). It is apparent that using existing labour and skills is critical for forward planning. This again demonstrates the top-down tendencies of CBA, where initiatives are being designed and implemented by external actors with external resources rather than driven by the community and their situated resources (as in ‘ideal CBA’).

Initiatives focused on preventing land loss generally had lower performances, and this largely stemmed from the tendency to be ineffective in preventing encroachment or inundation in the long term (FSM2b) and/or sidelining community approval and ownership in several ways. Lacking approval and/or ownership emerged from poor alignment with contextual factors (for example, perceived climate risk) due to being a top-down approach with little to no community input or consultation (F4), being privately managed (V2c) and having maladaptive outcomes (F1, F4). One initiative (F1) demonstrated how a lack of forward planning (overlooking future intensification of local climate impacts) resulted in maladaptation, thereby creating new vulnerabilities and disapproval in the community: it became “a liability to our children’s safety, it damages our nets [and] our livelihoods are being affected” (Fiji-based participant, 2017).

It is not solely prevention-of-land-loss initiatives that lacked local approval, ownership and/or consultation. Due to being designed and driven by external actors rather than the community, the lowest-performing initiative (V2f) also overlooked contextual

Table 5 | Common characteristics among low-performing CBA initiatives

Groups of initiatives	Common characteristics	Details of initiative performance
Groups 7-10	1: Appropriateness to local context in terms of community priorities and desires	<ul style="list-style-type: none"> ●→Water insecurity as the key concern addressed (V3b) ●→Storm surges and foreshore erosion as key concerns addressed (V2c) ●→Sea wall was perceived as needed by local community (FSM2b) ●→Catered to community desires to have beehive (community had heard that this livelihood alternative had worked effectively elsewhere) (V2e)
	2: Overlooking future climatic trends	<ul style="list-style-type: none"> ●→Beehive became unsustainable for several reasons, including its high susceptibility to climate extremes (V2e) ●→Trees planted along coastline required replenishment as tidal surge frequency increased (V2c) ●→Overlooking future intensification of climate impacts resulted in maladaptive outcome (water rising above sea walls and becoming dammed) (F1)
	3: Focus on preventing land loss	<ul style="list-style-type: none"> ●→Four out of five prevention-of-land-loss initiatives in this study ranked poorly (F1, F4, FSM2b, V2c); this was due to either more generally being ineffective in preventing erosion and inundation (FSM2b) or a range of other issues related to poor local approval and/or ownership and lacking community consultation (see below)
	4: Poor local approval and/or ownership	<ul style="list-style-type: none"> ●→Lack of genuine ownership as initiative was privately owned and individuals paid to manage it; initiative ceased due to inefficiencies from turnovers and land tenure issues (V2c) ●→Communities perceived coastal inundation/erosion as growing source of risk, but river walls implemented, which ultimately caused erosion of the river channel and local disapproval (F4) ●→Community disapproval stemming from maladaptation (water levels rise over sea walls and become dammed inside village), which increases vulnerability (F1) ●→Poor ownership and approval stemming from poor alignment with community desires and sociocultural context in terms of having a self-composting toilet and using human waste as fertilizer (V2f)
	5: Poor consultation	<ul style="list-style-type: none"> ●→Insufficient consultation with local communities meant initiatives were not aligned with sociocultural context and local desires (V2f) as well as key climate risks to livelihoods (F4) ●→Although the community (leaders and local school executives) was consulted in early stages, NGOs were not, which was perceived as problematic as they might have had differing opinions regarding design of sea wall and materials used in construction (FSM2b)

factors and community desires, which generated local disapproval and poor ownership: the “idea was not welcome” and “people were not comfortable” (Vanuatu-based participant, 2018). The community consequently lacked any motivation to maintain the initiative long term, and there was no desire to implement similar initiatives in the future.

Four interdependent points for optimization

Analysis of the characteristics of high-, medium- and low-performing initiatives suggest four points for optimizing future CBA. Across our sample, these optimization points, which are multidimensional and interdependent in nature, were both negatively and positively reinforced as key factors supporting initiative success.

Local approval and ownership. The importance of local approval and ownership is that it encourages higher levels of participation⁷ and ensures activities are not resisted but sustained beyond the end of the (funded) initiative^{24,38}. Factors that contributed to local approval and ownership included the ability of initiatives to protect livelihoods, respond to direct requests from communities, blend in with local realities and produce benefits beyond reducing exposure to climate risk in the system (that is, address other critical livelihood pressures simultaneously). The latter two demonstrate the interdependencies with other optimization points and how they can influence each other. In particular, the importance of local legitimacy (through integrating local realities) for fostering community support and participation has been noted elsewhere^{7,17,24}. The top-performing marine resources protection initiatives (integrated CBA–EbA initiatives), for example, fostered local approval by being based on, and appropriate to, ecosystems that are critical and relevant to the livelihoods of rural communities. Systems-thinking, in which

the wider vulnerability context is recognized³³, can similarly enthruse local approval and ownership over initiatives by simultaneously catering to the community’s other pressing livelihood concerns and baseline aspirations that are not climatic (thereby being ‘pro-poor’^{24,39}). We found that some low-performing initiatives did not acquire genuine local approval and ownership because of a range of issues: inadequate consultation and tendency for initiatives to still be top-down in nature, attempts to ‘buy’ ownership, maladaptation and indifferent alignment with contextual realities. In several cases, this resulted in initiative demise after funding ceased, thereby negatively reinforcing the importance of this optimization point and demonstrating its criticality to sustainability and forward planning (as another optimization point)^{24,38}. Instead of external actors attempting to foster local approval and ownership (as seen in this study), initiatives need to be driven by the community, where approval and ownership are inherent.

Shared access to and benefit from initiatives. CBA that challenges entrenched intracommunity inequalities and supports shared access to and benefit from initiatives is critical for sustainability⁴⁰. In this study, aspects that supported shared CBA included adequate consultation with all community members, the focus on an ecosystem that can benefit and is accessible to all, and improving gender equality in decision making. The latter is crucial as social transformations have been emphasized as critical to CBA²⁵ and gender-based exclusion was a key concern that has emerged in CBA literature^{4,7,23,24,41}. Another important consideration that emerged here was the need to reconsider the geographic scale of ‘community’ as the most appropriate entry point for shared and equitable adaptation. This is because alternative scales may be critical for building social capital and optimizing shared access and/or benefit (for example,

approaches based on landscape, ‘whole-of-island’, ecosystems, local institutions or particular population groups)^{42,43}. Basing initiatives on geographic community parameters (which was most common) occasionally excluded certain groups and/or inflamed internal disputes. This reminds us of the elusiveness of ‘communities’ and how the ‘framing’ of a ‘community’ imposed by external actors may not equally benefit intended participants^{42,43}. ‘Community’ boundaries and scales should be understood as complex and contextually dependent^{24,40}, and uncritical assumptions about ‘community’ homogeneity should be avoided^{4,30,40}. External actors must strive for CBA that is driven by the local community as this would ensure that it is communities themselves who delineate their own ‘community’ boundaries on the basis of nuanced social/cultural dynamics and other contextual factors (thereby integrating local realities as another optimization point). This could help avoid the creation of new inequalities (for example, through internal disputes, exclusions or marginalization as seen in this study). External actors should, however, be wary of, and be prepared to help communities address, any other entrenched inequalities within the chosen ‘communities’ to avoid exacerbating them⁴⁰.

Integration of local realities. Integrating local realities and existing social forms (for example, culture and its shared beliefs, shared metaphors and folklore) improves the likelihood of success for CBA initiatives^{7,25,44}. In this study, as noted elsewhere⁷, compatibility with local context in terms of culture, priorities, resources, knowledge and livelihoods ensured that activities were not resisted and thereby sustainable. The importance of this optimization point was negatively reinforced in this study by initiatives involving the use of non-local resources as, regardless of any local approval or ownership, this generated difficulties for long-term maintenance and sustainability (that is, forward planning, as discussed in the following section). Undue dependence on external resources has previously been noted as unsustainable and potentially harmful to livelihood futures in such contexts⁵. Further, overlooking contextual realities more generally can also result in poor ownership, outcomes and sustainability as initiatives may not adequately integrate local processes or be appropriate to key livelihood risks and concerns (for example, constructing a river wall when a sea wall was needed). Local knowledge is critical here as it ensures a better understanding of local processes in the system¹⁵. These kinds of issues underscore the importance of having adaptation that is wholly driven by the community rather than external implementers who may overlook these contextual nuances and situated resources. In summary, this optimization point cuts across all other optimization points by playing a crucial role in ensuring community approval and ownership^{7,24}, supporting shared adaptation in terms of benefit and access (for example, by ensuring a better understanding of social dynamics and appropriate community ‘parameters’), as well as being critical to systems-thinking and forward planning (for example, by integrating local resources and understanding the local processes in the wider vulnerability context).

Relevant here is the higher performance among locally funded initiatives compared with those funded internationally. This may be because locally funded initiatives are more likely to be designed and driven by people familiar with local contexts and sociocultural nuances, as opposed to outsiders who may have prescriptive funding conditions^{43,45,46}. This is still, however, one step away from being driven by communities themselves.

Systems-thinking and forward planning. The last optimization point describes the ability of initiatives to have impacts beyond project aims, particularly in terms of addressing vulnerabilities across the relevant system and having long-term impacts (involving changes to accustomed practice). It became evident that bypassing a system approach in which dynamic pressures are viewed as

part of a larger, interrelated system or context^{47,48} can contribute to ineffectiveness and unsustainability. Two initiatives, for example, demonstrated how overlooking parallel sources of vulnerability in adaptation can perpetuate overall vulnerability irrespective of climate scenario because rural livelihoods are challenged by multiple dynamic pressures⁴⁹.

Other initiatives positively reinforced this optimization point by producing development-related benefits that were beyond climate-related aims, thereby actualizing a key attribute of ‘ideal CBA’ (that is, a ‘no-regrets’ approach embedded within broader development goals^{6,39,50}). A key characteristic that contributed to the high performance of the two top-performing integrated CBA–EbA initiatives, for example, was the abatement of environmental degradation, which then minimized indirect negative socio-economic impacts (for example, in terms of finance and food security) from climate change. The capacity for CBA–EbA integration to combine adaptation and sustainable development has been recognized elsewhere^{51,52}. This is critical as most adaptation-related needs may not be directly related to climate but involve laying the foundations for empowering individuals and communities to pursue adaptation outcomes that they value (for example, through developing capabilities)³⁶. An understanding of local context, including priorities and knowledge, will ensure that the most critical adaptation-related needs in a specific context are addressed. In summary, there is a greater need for systems-thinking approaches to ensure that externalities are foreseen, that adaptation is delivered in a way that encourages recipients to act on their own³³ and that activities are sustainable⁴⁷.

Having impact over time emerged as a key weakness. Several initiatives focused too closely on present-day conditions and hazards, which, although often effectively reduced short-term vulnerability, overlooked the potential for change. This tendency to apply adaptation to everyday climate-related challenges rather than future issues is a problem recognized across most documented adaptation in small island developing states³⁸. These initiatives were not ‘future-proofed’ to deal with the dynamism of vulnerability and enhance long-term resilience⁵³, thereby occasionally resulting in maladaptation. One initiative that was not flexible to future changes involved the construction of sea walls. This highlights one of the major issues with infrastructural developments that sometimes unintentionally create trajectories that are path dependent and difficult to change⁵⁴. Having adaptation that is community driven and integrates local resources also proved important here as the inability to replace or maintain non-local resources meant communities were not able to be self-sufficient in the long term, especially after funding and external support ceased. Approaches that are flexible to both present conditions and longer timescales (forward planning) are critical⁵⁵ for building long-term resilience and for avoiding these short-term (sometimes maladaptive) implications.

Discussion

We found mixed performance among CBA in 20 communities across four Pacific Island countries. While appropriateness was largely positive, sustainability was an area requiring considerable improvement. Initiatives that are locally funded, implemented by NGOs, focused on climate awareness-raising and integrated with EbA were also more likely to be high performing. The latter illustrates why CBA–EbA integration is often promoted^{5,52}. Collaborative learning between the two approaches may be critical for optimizing adaptation^{5,51}, especially in rural communities where livelihoods are inextricably linked to local ecosystems. Despite high performances among these initiatives at the time of this study, it is critical to remember that long-term improvements in adaptive capacity will become clearer over time.

Four multidimensional and interdependent optimization points were identified as key contents of the tool box for improving future

CBA. They also point to the need to rethink CBA as not merely being 'based' in communities with some level of consultation or input but, instead, as something that is wholly 'led' by local people and local institutions⁴³. This is critical as, despite genuine attempts to better integrate contextual specificities, initiatives across high- to low-performing groups demonstrated a tendency to still be driven by external actors (that is, top-down in nature). Despite being based in communities, initiatives are not driven or co-designed by them. This gave rise to a range of issues that hindered CBA performance: community stress and resentment, initiatives having contextual applicability issues (for example, relying on unsustainable external resources), initiatives being designed in ways that do not empower or promote community self-sufficiency, imposed 'community' boundaries and local disapproval or lack of ownership.

Rather than experiments in communities to improve their adaptive capacity deficit, communities would, in community-led adaptation, build on their strengths and design/drive their own adaptation aspirations on the basis of local knowledge, experiences and coping mechanisms. With communities leading their own adaptation agendas, numerous aspects of the optimization points would probably be autonomously incorporated: the wider vulnerability context and its local processes will be accounted for; local context will be underpinned, which means important priorities, resources and knowledge will be more appropriately used; and a stronger sense of local approval and ownership will be fostered. These factors, in turn, support sustainability (as the key area requiring improvement) as initiatives, being rooted in community aspirations and local context, will be self-sufficient over time. Related to this, a community-led approach may be better 'future-proofed' through the integration of local resources and local knowledge (for example, in terms of observed trends in local processes) that were often overlooked.

The role that implementers and donors should and can play is to become 'facilitators' of the desired adaptation aspirations for communities, rather than 'doing' adaptation 'to communities' under the guise of CBA⁴³. External actors should resource and equip communities with any additional skills, resources and knowledge (that is, develop capabilities) that may optimize self-sufficiency and help communities achieve local objectives equitably and effectively³⁶. This means moving beyond imposed standardized outcomes and, instead, focusing on empowering individuals and communities to pursue the adaptation outcomes they value³⁶. Through such a process, implementers would support and empower 'communities' in their diversity of expressions but also guide them in certain processes (for example, supporting shared adaptation in terms of access and benefit or empowering women in leadership positions). Through local facilitators 'guiding' the resources and supporting participatory processes with holistically targeted equity framings, deeper understanding of any contextual idiosyncrasies related to inequality and power may overcome critiques of community-driven development⁵⁶.

Ultimately, the role of implementers and donors is to prepare and support communities to lead their own adaptation because, as we have seen, implementers have left not long after the project has been implemented, and adaptation funding may ultimately dry up⁷. Despite the supposed development deficit that is projected on communities from the outside, such communities have always been resilient, and there is still much that the CBA field can learn from traditional governance systems, coping strategies and Indigenous knowledge¹⁵. Our findings suggest that it is time to support these communities' diverse capacities and allow their situated and tacit resources to flourish.

Online content

Any methods, additional references, Nature Research reporting summaries, source data, extended data, supplementary information, acknowledgements, peer review information; details of

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Methods

Methods justification. This study involved a field-based qualitative approach using focus groups and interviews to explore the multiple perceptions, attitudes and values that people hold in relation to implemented CBA initiatives. Focus groups were used because of the rich understandings that emanate from their ability to mitigate researcher influence, allowing local participants to own discussion spaces^{53,64}. Group sessions are also particularly useful when working with communal societies like those in the Pacific Islands⁶⁵. Focus groups were split by gender or age where possible to limit influences from entrenched hierarchies. Individual semistructured interviews, structured to focus conversation yet also flexible to optimize the potential for knowledge production⁶⁶, were also conducted to acquire information that may not have been disclosed in group settings⁶⁷. This multimethod enquiry facilitated data completeness and confirmation in support of more-coherent understandings⁶⁸. Where researchers were not competent in preferred vernaculars, gatekeepers were used for translations and for providing trusted access to rural communities^{69,70}.

Focus group and interview design. To elicit a robust understanding around the performance of initiatives in reducing vulnerability and to ensure community sites were evaluated according to the same criteria, an evaluative framework was developed. This framework comprised of five key components that constitute 'successful' adaptation: appropriateness, effectiveness, equity, impact and sustainability. These were selected on the basis of a review of literature on monitoring and evaluation indicators and rubrics^{50,57,59,71,58,60–62,72} that was conducted at the initial stages of this research project. Although a range of components was found, only those that were considered relevant and appropriate for the study participants as well as the specificities of CBA were selected (Table 1). The focus group guides and interview schedules were structured by these components and, through a research project inception workshop, were also developed in consultation with eight partner organizations that have long histories of working with communities at the grassroots level. This ensured contextual relevance and the optimization of overall impact by aligning with the needs of their work.

The focus group and interview guides had clear and logical structures: introductions and verbal or written consent, an icebreaker to foster rapport, questions/activities around livelihood threats, climate experiences and responses, questions/activities relevant to each evaluation component, and opportunity for final remarks⁶⁹. Activities involved creating ranked lists of livelihood threats and creating time lines showing major climatic events and details of what communities did to respond to these changes and impacts.

Data collection. Forty-four focus groups and 62 semistructured interviews were conducted by seven researchers, who are authors on this paper, across 20 rural communities in Fiji ($n = 6$), FSM ($n = 3$), Kiribati ($n = 2$) and Vanuatu ($n = 9$) between April 2017 and July 2019. The selection of communities was dependent on two factors: (1) the research team's networks and partner organizations as this was deemed the most appropriate avenue for trusted access to communities and (2) the ability to best represent different points along core-periphery gradients.

The total number of focus groups can be disaggregated into 18 all-male groups, 20 all-female groups, four mixed groups and two youth groups. All 415 participants across the focus groups and interviews were involved to some extent in CBA initiatives implemented by external agencies (that is, by government, NGOs, university or a combination of these). A majority of the participants were local community members, although government officials and representatives from donor or regional organizations were also interviewed. As our sampling strategy was largely based on expediency, this study may be limited in its capacity to be representative of all diverse groups. Attempts to capture diverse viewpoints, however, have been made by selecting communities across core-periphery gradients and implementing some level of quota sampling to ensure that participants of diverse age and gender were included.

Gatekeepers, who were employees of partner organizations or from our networks in these countries, were used for translations in preferred vernaculars. Gatekeepers were additionally critical for providing necessary introductions and inviting participants to be involved. Most focus groups and interviews were recorded using a digital recorder, or in cases where recordings were not taken, detailed notes were taken. As a study involving human participants, a series of ethics approvals was provided by the School of Earth and Environmental Sciences committee at the University of Queensland (nos. 20170302, 20170503 and 20170601), the University of Queensland central committee (no. 2018001985) and the University of the Sunshine Coast central committee (no. A/16/796). All participants were provided with detailed information about the study before providing verbal or written informed consent to participate in these voluntary focus groups and interviews. We also obtained permits to undertake research in each of the four countries.

Data analysis. The recordings of focus groups and interviews were transcribed verbatim, and all primary researchers were involved in two layers of latent content analysis, which is an interpretive technique employed for its ability to code social

data and derive both surface and underlying meanings⁷³. First, to understand participant judgements on the performance of CBA initiatives against the chosen evaluation components, a coding system was used. This involved analysing the language and sentiments around each initiative and categorizing them by four broad analytical codes⁷⁴ under each evaluation component: high, neutral (that is, no perceived effect), medium (that is, with both high- and low-performance aspects) and low performance (see Extended Data Fig 1). Each initiative was given a total score by receiving three points for every high-performing component, two points for every neutral or medium-performing component and one point for low-performing components. From this, the overall performance of each initiative could be derived, and these fell neatly into ten separate groups, with each group containing the initiatives that had the same total scoring count. These results have been placed along a scale from high to low performance (Fig. 1). The second layer of analysis involved transforming findings under all evaluation components into key 'themes', which are groups of content that share common underlying meanings on an interpretive level⁷⁵. This gave rise to the common characteristics outlined in Tables 3–5 and the four optimization points.

Simple measures of proportion were also used to identify any potential patterns in the spread of variables across the performance scale (Fig. 1). This involved calculating how many initiatives of a specific country, adaptation type, funding body or implementing agency were present in the high- (Groups 1–3), medium- (Groups 3–6) and low- (Groups 7–10) performing groups in relation to their total count (across all groups). For example, there were 13 locally funded initiatives in this study, of which five were high performing, six were medium performing and two were low performing compared with the 18 internationally funded initiatives, which saw five high performing, seven medium performing and six low performing.

Reporting Summary. Further information on research design is available in the Nature Research Reporting Summary linked to this article.

Data availability

The data that support the findings of this study are not publicly available due to them containing information that would compromise research participant confidentiality and anonymity.

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Author contributions

K.E.M., P.D.N., A.P.-M., R.C., F.N., E.A., E.J. and O.W. conceived and designed the research. K.E.M., R.C., R.W., A.P.-M., R.K., T.C. and P.D.N. collected data. R.C., K.E.M., R.W., A.P.-M., R.K. and P.D.N. analysed the data. R.C., K.E.M., R.W., A.P.-M., R.K. and P.D.N. wrote the paper.

Competing interests

The authors declare no competing interests.

Additional information

Extended data is available for this paper at <https://doi.org/10.1038/s41558-020-0813-1>.

Supplementary information is available for this paper at <https://doi.org/10.1038/s41558-020-0813-1>.

Correspondence and requests for materials should be addressed to K.E.M.

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Group	Country	Adaptation Type	Appropriateness	Effectiveness	Equity	Impact	Sustainability
1	FSM	Marine resources protection (FSM3d)					
	Vanuatu	Marine resources protection (V2d)					
		Climate awareness-raising (V5a)					
2	Vanuatu	Prevention of land loss (V3a)					
		Climate awareness-raising (V4b)					
3	Fiji	Relocation (F2, F5)					
	FSM	Enhancing water security (FSM2a, FSM3a)					
	Vanuatu	Enhancing water security (V1a)					
		Enhancing food security (V2b)					
4	Vanuatu	Enhancing food security (V1b, V1c)					
		Enhancing water security (V5b)					
5	FSM	Enhancing water security (FSM1a)					
		Enhancing food security (FSM1b, FSM3b)					
		Enhancing financial security (FSM3c)					
	Vanuatu	Enhancing water security (V2g)					
6	Fiji	Relocation (F3)					
	FSM	Enhancing water security (FSM1c)					
	Kiribati	Enhancing food security (K1)					
	Vanuatu	Enhancing food security (V4a, V5c)					
7	Vanuatu	Enhancing food security (V2a)					
		Prevention of land loss (V2c)					
8	Fiji	Prevention of land loss (F4)					
	FSM	Prevention of land loss (FSM2b)					
	Vanuatu	Enhancing financial security (V2e)					
		Enhancing water security (V3b)					
9	Fiji	Prevention of land loss (F1)					
10	Vanuatu	Enhancing food and water security (V2f)					

Extended Data Fig. 1 | Ranking of initiatives and performance under each evaluation component. White is high performance, light grey is neutral performance (that is no perceived effect), dark grey is medium performance (that is with high and low performance aspects) and black is low performance.

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Software and code

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Data collection

Primary, qualitative data was collected from 44 focus groups and 62 semi-structured interviews as part of fieldwork in 20 rural communities in four Pacific Island countries.

Data analysis

Following focus groups and interviews, recordings were transcribed verbatim. All primary researchers were involved in two layers of latent content analysis, which is an interpretive technique employed for its ability to code social data and derive both surface and underlying meanings.

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Study description	The study is a mega-assessment on the performance of community-based adaptation initiatives across four Pacific Island countries, and involves a field-based qualitative approach with a series of focus groups and semi-structured interviews.
Research sample	The study sample involved community members who participated in a range of externally-implemented community-based adaptation initiatives across 20 rural communities. These communities can be found in four Pacific Island countries: Fiji (n=6), Federated States of Micronesia (FSM) (n=3), Kiribati (n=2) and Vanuatu (n=9). In total, 44 focus groups (18 all-male groups, 20 all-female groups, four mixed groups and two youth groups) and 62 semi-structured interviews were conducted with 415 participants. Most participants were local members of rural communities, although some government officials and representatives from donor or regional organizations were also interviewed.
Sampling strategy	The 20 communities of focus in this study were selected by the research team's networks and partner organizations as this was deemed the most appropriate avenue for trusted access to communities. Additionally, within each island country, rural communities were sampled along core-periphery gradients to capture differences in adaptation contexts. Our sampling strategy to select participants was largely based on expediency, which may mean the study is limited in its capacity to be representative of all diverse groups. Attempts to capture some diverse viewpoints, however, have been made by selecting communities across core-periphery gradients and implementing some level of quota sampling to ensure that participants of diverse age and gender were included.
Data collection	Data collection involved multi-method inquiry, with a series of focus groups and semi-structured interviews. The research team used focus group and interview guides, which had clear and logical structures: introductions and verbal consents, icebreakers to foster rapport, questions/activities around livelihood threats, climate experience and responses, questions/activities relevant to each evaluation component constituting adaptation 'success' (appropriateness, effectiveness, equity, impact and sustainability), and opportunity for final remarks. Where researchers were not competent in preferred vernaculars, gatekeepers (who were employees of partner organizations or from our networks in these countries) provided translations. Most focus groups and interviews were recorded using a digital recorder or, in cases where recordings were not taken, detailed notes were taken.
Timing	The overall study was conducted between April 2017 and July 2019. Individual fieldwork trips were conducted as follows: Fiji (Nov/Dec 2017, Jan 2018, Sep 2018, Jan 2019, Jun/Jul 2019), FSM (Jul 2017, Sep 2018, Mar/Apr 2019), Kiribati (April 2017) and Vanuatu (Aug 2017, Nov/Dec 2018).
Data exclusions	No data were excluded from the analysis.
Non-participation	No participants dropped out or declined participation.
Randomization	Participants were not allocated into experimental groups.

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Recruitment

See above 'Sampling Strategy' and 'Data collection'. Further to this, local gatekeepers were critical for providing necessary introductions and inviting participants in each of the communities to be involved.

Ethics oversight

As a study involving human participants, a series of ethics approvals were provided by the University of Queensland and the University of the Sunshine Coast. All participants gave informed consent to participate in these voluntary focus groups and interviews.

Note that full information on the approval of the study protocol must also be provided in the manuscript.