Regional Environmental Change (2025) 25:107
https://doi.org/10.1007/s10113-025-02439-0

ORIGINAL ARTICLE

Bouncing back: recovery from the impacts of COVID-19 on human wellbeing in Kenyan coastal fishing communities

Sarah Sutcliffe[1,2,8] · Joshua Cinner[1,3] · Jacqueline Lau[1] · Innocent Muly[4] · Stephen Wanyonyi[4] · Emmanuel Mbaru[5,6] · Nyawira Muthiga[4] · Michele Barnes[1,7]

Received: 7 May 2024 / Accepted: 1 July 2025 / Published online: 5 August 2025

Abstract

The COVID-19 pandemic altered almost every aspect of people's lives and undermined human wellbeing. Now that restrictions have lifted, we need to identify the lingering effects of the pandemic to strategically direct the ongoing recovery process. We conducted a mixed-methods longitudinal analysis of material, relational and subjective wellbeing in five coastal fishing communities in Kenya before, during and after the implementation of COVID-19 containment policies. We drew on qualitative analysis of interviews and quantitative analysis of surveys conducted with 32 fishers at three time points to explore how the pandemic affected wellbeing during the first year of the pandemic. We then used surveys conducted with the majority of fishers in each community in 2016, 2019 and 2022 to determine the scale of the impact of the pandemic proportionate to the impacts of ongoing changes in the communities. We identified a range of wellbeing impacts during the pandemic but also found that communities appear to be recovering. Although there were meaningful differences between our indicators of wellbeing immediately prior to (2019) and after (2022) the pandemic, our analysis leveraging data from 2016 suggests that these differences align with a longer-term trend likely associated with ongoing social-ecological changes. In all but one indicator (work enjoyment), we were unable to identify any significant long-term impacts of the pandemic on any of our wellbeing indicators. Our research provides compelling evidence of the capacity of coastal fishing communities to "bounce back" from the impacts of COVID-19, which likely has relevance for future shocks.

Keywords Material wellbeing · Relational wellbeing · Subjective wellbeing · Small-scale fishing · COVID-19

Communicated by Paola Torres-Slimming

✉ Sarah Sutcliffe
sarah.sutcliffe@manchester.ac.uk

Joshua Cinner
Joshua.cinner@sydney.edu.au

Jacqueline Lau
jacqueline.lau@jcu.edu.au

Innocent Muly
innocentmuly@gmail.com

Stephen Wanyonyi
wanyosteve77@gmail.com

Emmanuel Mbaru
e.mbaru@lancaster.ac.uk

Nyawira Muthiga
nmuthiga@wcs.org

Michele Barnes
michele.barnes@sydney.edu.au

[1] College of Arts, Society, and Education, James Cook University, Townsville, Australia

[2] Environment and Sustainability Institute, University of Exeter Penryn Campus, Penryn TR10 9FE, Cornwall, England, UK

[3] Thriving Oceans Hub, School of Geosciences, University of Sydney, Sydney, Australia

[4] Wildlife Conservation Society, Mombasa, Kenya

[5] Kenyan Fisheries and Marine Research Institute, Mombasa, Kenya

[6] Lancaster Environment Centre, University of Lancaster, Lancaster, England, UK

[7] School of Project Management, Faculty of Engineering, University of Sydney, Sydney, Australia

[8] Global Development Institute, University of Manchester, Manchester, UK

Introduction

The COVID-19 pandemic is one of the most significant crises in modern history. In addition to the direct loss of life from the virus, we have seen significant increases in poverty, inequality and food insecurity (Laborde et al. 2021; Swinnen and Vos 2021; Mottaleb et al. 2022; Vos et al. 2022) and breakdowns in social relationships (Karantzas and Simpson 2022; Manda 2022; Kelley et al. 2023), all of which have had major psychological impacts (Chen et al. 2021; Hossain et al. 2021; Necho et al. 2021; Arora et al. 2022; Bello et al. 2022). The pandemic particularly affected already vulnerable populations, including people living in small-scale fishing communities. These communities often have poor infrastructure, low incomes, limited livelihood diversity, little to no access to credit and social support, and are facing an ongoing decline in the ecosystems which they are dependent on (Bennett et al. 2016, 2020; FAO et al. 2020). When faced with the COVID-19 pandemic, they experienced disruptions to food production and distribution chains, unemployment, increased food prices even as incomes declined, and increased social anxiety (Lau et al. 2021; Love et al. 2021; Nyiawung et al. 2022; Sutcliffe et al. 2023). In short, we know that the pandemic undermined human wellbeing in the days and months after case numbers started rising and restrictions were implemented. However, as most restrictions have now lifted and society has largely returned to normal, we also need to examine the medium-to-long term wellbeing impacts of the pandemic over the next few years to guide the ongoing recovery process.

What does it actually mean for people's wellbeing to be impacted? In their seminal work on multidimensional aspects of human wellbeing, McGregor (2007) defines wellbeing as "a state of being with others, where human needs are met, where one can act meaningfully to pursue one's goals, and where one enjoys a satisfactory quality of life". There are three core dimensions of wellbeing: material, relational and subjective (McGregor 2007; White 2008; McGregor and Sumner 2010). *Material wellbeing* incorporates the physical resources people can draw on, including assets, welfare, and standard of living (White 2010). *Relational wellbeing* focuses on the social relationships that people engage in which facilitate the pursuit of material and subjective wellbeing (Coleman 1988; Charles et al. 2012). It incorporates supportive relationships, trust, and belonging (Michaelson et al. 2009). *Subjective wellbeing* relates to how people think and feel about what resources and relationships they have and what they do with them (White 2010). It incorporates people's sense of identity, agency, and purpose; cultural values, ideologies, and beliefs; and their satisfaction and contentment (Aked et al. 2008; McGregor and Sumner 2010; White 2010).

All three dimensions are critical and must be considered when evaluating or seeking to improve people's wellbeing. For example, small scale fisheries are not only a key source of food and income for millions of people, and therefore closely tied to their material wellbeing (World Bank 2012; Béné et al. 2016), they are the foundation of complex social networks which facilitate reciprocal support systems and build social cohesion, i.e., relational wellbeing (Alexander et al. 2018; Gillam and Charles 2018; Baker et al. 2021). Fishing is also strongly associated with the culture and identity of fishers and is a significant source of happiness i.e., subjective wellbeing (Pollnac and Poggie 2008; Weeratunge et al. 2014; Holland et al. 2020). As such, anything which disrupts fishing activities could affect all three dimensions of wellbeing, and merely addressing one would not necessarily fulfill the other roles of fishing and restore people's overall wellbeing.

Wellbeing is closely linked to resilience and adaptive capacity, that is, people's ability to cope with and respond to change (Kofinas and Chapin 2009; Gillam and Charles 2018; Chaigneau et al. 2022). Things like wealth, relationships and agency, (respectively associated with material, relational and subjective wellbeing), are key to resilience and adaptive capacity as they provide access to key assets, facilitate knowledge sharing, social support and collective action, and motivate action through the belief it can produce desired outcomes, all of which are central to people's ability to respond to change (Cinner and Barnes 2019; Chaigneau et al. 2022). As such, examining the impacts of COVID-19 on wellbeing is not only important for informing the pandemic recovery process, but also for strategically directing efforts to build resilience to future shocks, including climate change. Additionally, understanding the wellbeing impacts of COVID-19, and if and how people have been able to recover from the impacts, may provide key lessons and insights for preparing for and responding to future similar shocks.

For this research we sought to address three research questions: 1) what were the immediate impacts of COVID-19 on material, relational, and subjective wellbeing in coastal fishing communities? 2) Have people begun to recover from the subjective wellbeing impacts of the pandemic now restrictions have lifted? 3) How does the scale of the change in wellbeing, over the three-year period from immediately before the onset of the pandemic to shortly after restrictions eased, compare to changes in wellbeing in the three years prior? To address these questions, we utilise qualitative interviews ($N=35$) and short surveys conducted in 2020 and 2021 ($N=32$) to identify key changes in wellbeing over the first year of the pandemic. We then use surveys conducted in 2016, 2019 and 2022 ($N=627$) to compare changes in wellbeing in the three-year period from shortly before the onset of the pandemic through to after restrictions

lifted to the changes in the three years prior due to ongoing social, economic, and environmental processes.

Methods

We addressed our research questions through a longitudinal panel study in five coastal communities in southern Kenya before, during and after the peak of the COVID-19 pandemic and associated containment policies.[1] We drew on: 1) three rounds of a standardised survey covering the majority of fishers in each community, two before the pandemic in 2016 and 2019 (Barnes et al. 2019a, b; Barnes et al. 2019a, b), and one after COVID-19 restrictions were lifted in 2022 ($N=627$); and 2) three rounds of semi-structured interviews ($N=35$) and short surveys ($N=32$) with a sample population during the peak of the pandemic (2020–2021) (Table 1, Fig S1).

Study site description

The five study sites are located on the south coast of Kenya in Kwale and Kilifi counties either side of the city of Mombasa (Fig S1). The communities are relatively similar, with high dependence on fisheries for food and income, but with some differences in fishing methods, engagement in agriculture, and levels of reliance on tourism and informal work (Lau et al. 2021). In June 2020 the Kenyan government put in place a number of restrictions to limit the spread of COVID-19, which were strictly enforced by police. These included school closures, curfews, and limits on social gatherings, movement, and permitted business activities and county borders (Ministry of Health 2020). The movement restrictions and border closures meant the study communities were both socially isolated and cut off from the large fish markets in Mombasa where a large proportion of their fish catch is sold (Lau et al. 2021). The lack of tourism also led to a loss of industry jobs and reduced demand for high-end seafood (Lau et al. 2021). Curfew hours, social distancing requirements and movement restrictions all disrupted fishing and marketing activities. Overall economic decline in the region reduced demand and lowered prices for fish, resulting in reduced income for fishers and fish traders.

[1] Note that throughout this paper we refer to the surveys conducted in 2022 as conducted "after" the pandemic, though the World Health Organisation did not officially downgrade the pandemic until May 2023 (World Health Organization 2023). However, the majority of negative impacts people in the study communities experienced were related to stringent containment policies. By 2022, restrictions in Kenya had been lifted and participants self-identified that the worst of the pandemic and its immediate effects were over, and life had returned to normal, so that is the language we have used here.

Data collection

Surveys and interviews during COVID-19 restrictions (2020–2021)

We conducted three rounds of semi-structured interviews with 35 women, men, and community leaders during the peak of the pandemic in August-October 2020, November–December 2020, and January-March 2021, following the methods outlined in Lau et al. (2021) and Sutcliffe et al. (2023) (Fig. 1**,** Appendices 2–4). The same participants were interviewed in each of the three rounds of interviews. Interviews were conducted remotely by phone due to COVID-19 protocols. Potential interview participants were randomly selected from the list of participants in the 2016 and 2019 surveys. To capture the experiences of both men and women during the pandemic, in four of the communities where the majority of fishers, and therefore previous survey participants, were men, we asked previous survey participants to put us in contact with women in their families who would be willing to be interviewed and who were connected to fishing in some way, for example as fish traders. At the end of each interview, interviewees who had previously participated in the pre-COVID-19 surveys (i.e., the fishers but not female fish traders or community leaders) were asked survey questions to quantify their subjective wellbeing (Appendix 5). We also surveyed additional fishers as substitutes for female interviewees who we did not have pre-COVID-19 survey data for so as to be able to conduct a quantitative before-during-after analysis. The final sample for these surveys was 32 fishers (Fig. 1), though not all fishers participated in all three survey rounds due to inconsistent access to phones (See Appendix 1 and Table S2 for additional methodological details).

2019 and 2022 surveys

We drew on surveys conducted in 2016 and 2019, which we then repeated in 2022 following the same protocols which assessed changes in in multiple socio-demographic variables through time, including wealth indicators, social network data and three indicators of subjective wellbeing (Appendix 2) (See Barnes et al. 2019a and 2019b for further details). In the 2022 surveys, we also explicitly asked fishers if they had been affected by the pandemic and in what ways. Only respondents who participated in all three survey rounds were included in this analysis (627 fishers, ~ 68% of the estimated total fisher population of the five communities (Table S1)).

Table 1 Data source, timeline, indicators and analysis used to address research questions

Research question	What were the impacts of COVID-19 on material, relational and subjective wellbeing in coastal fishing?	Have people begun to recover from the subjective wellbeing impacts of the pandemic now restrictions have lifted?	How does the scale of the change in wellbeing, over the three-year period from immediately before the onset of the pandemic to shortly after restrictions eased, compare to changes in wellbeing in the three years prior?
Data source	Semi-structured interviews with a sample population ($N=35$) Socio-economic surveys with ~ 75% of fishers in each community	Surveys with a sample population ($N=34$)	Socio-economic surveys with ~ 75% of fishers in each community
Time period	*Interviews*: 3 rounds during the pandemic (August-October 2020, November–December 2020, January-March 2021) *Surveys*: before (2019) and after (2022)	- 2 rounds before the pandemic (2016, 2019) - 3 rounds during the pandemic (August-October 2020, November–December 2020, January-March 2021) - 1 round after the pandemic (2022)	2 rounds before the pandemic (2016 and 2019), and 1 round after COVID-19 restrictions were lifted (2022)
Indicators	*Interviews*: Content-organised responses based on material, relational and subjective wellbeing dimensions *Surveys/quantitative indicators*: *Material wellbeing*: - Material Style of Life (MSL) - Value of livestock owned by the respondent's household *Relational wellbeing*: - Social connectivity - Frequency of social interaction - Trust in peers - Trust in institutions *Subjective wellbeing*: - Livelihood satisfaction - Social cohesion - Work enjoyment	*Subjective wellbeing* - Livelihood satisfaction - Social cohesion - Work enjoyment	*Material wellbeing*: - Material Style of Life (MSL) - Value of livestock owned by the respondent's household *Relational wellbeing*: - Social connectivity - Frequency of social interaction - Trust in peers - Trust in institutions *Subjective wellbeing* - Livelihood satisfaction - Social cohesion - Work enjoyment *Control variables*: - Community - Age - Household size - Education level - Occupational diversity - Temporal change in occupational diversity - Held a community leadership position
Analysis	Non-parametric Friedman tests and post-hoc pairwise comparison Wilcoxin rank sum tests	Non-parametric Friedman tests and post-hoc pairwise comparison Wilcoxin rank sum tests	General linear mixed models

Description of quantitative wellbeing indicators

For our analysis of changes in wellbeing before, during and after the pandemic, we examined two indicators of material wellbeing, four indicators of relational wellbeing, and three indicators of subjective wellbeing from the 2016, 2019 and 2022 surveys. The two indicators of material wellbeing were Material Style of Life (MSL) and the value of livestock owned by the respondent's household. MSL is a wealth indicator based on an assessment of locally relevant assets owned by households (Cinner et al. 2009b) (see Appendix 1 for details). The second indicator of material wellbeing was the value of livestock owned by the respondents' household (in USD). This was both an indicator of overall wealth as they are an important asset for rural households in the region (Ngigi et al. 2021), and a potential indicator of financial hardship, as multiple interview participants reported being forced to sell productive assets during the pandemic for short term food and income relief.

The first two relational wellbeing indicators were based on knowledge-exchange social network data. Respondents were asked to list with whom they shared information and advice about fishing, fish marketing and fisheries management, which we refer to as "fishery-related social ties"; and how often they spoke to them (Barnes et al. 2019a, b; Barnes et al. 2019a, b). The two indicators included in this analysis were 1) social connectivity, captured here as normalised out-degree centrality which calculates how many fishery-related social ties they had, scaled by the size of the full network; and 2) frequency of social interaction, calculated as normalised out-degree centrality weighted by the frequency of communication with each fishery-related social tie. The size of people's support networks and frequency of social interactions have been linked to higher life satisfaction, mental health status, and the provision of instrumental and emotional support (Seeman and Berkman 1988; Pinquart and Sörensen 2000; Chan and Lee 2006; Van der Horst and Coffé 2012; Fuller-Iglesias 2015). The isolation imposed by

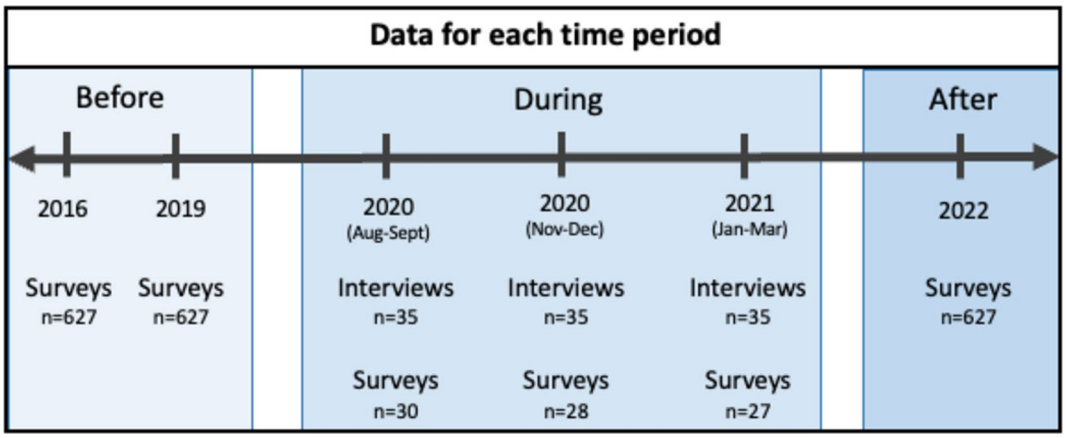

Fig. 1 Timeline showing what data was collected for each time period including sample sizes

lockdowns, border closures and social distancing requirements are likely to have disrupted these relationships. The second two indicators measure levels of trust in peers (bonding social capital) and in institutions, measured on 5-point Likert scales. Trust in peers was calculated as the average of how much they trusted other fishers, and how much they trusted people in their village. Trust in institutions was calculated as the average of their level of trust in local leaders, government, the fisheries department, and police. Both interpersonal and institutional trust are associated with psychological health and consequently physical health and overall wellbeing (Hudson 2006; Schneider et al. 2011), and are likely to have been affected by the social isolation and substantial government interventions during the pandemic.

Subjective wellbeing was captured using three indicators of people's perceptions of different aspects of their lives measured on 5-point Likert scales: satisfaction with their food and income situation (i.e., "livelihood satisfaction"), satisfaction with their social relationships (i.e., "social cohesion"), and job satisfaction, or how much they enjoy their job and consider it important to their identity (i.e., "work enjoyment"). These three indicators were selected based on the three most important indicators of subjective wellbeing identified in a previous in-depth wellbeing assessment in Kenyan coastal fishing communities (Abunge et al. 2013).

Analysis

Overview of immediate wellbeing impacts

To get a basic overview of people's experiences during the pandemic, we first evaluated the proportion of respondents in the 2022 post-COVID survey who stated they were positively, negatively, or not affected by the pandemic, and what they said the most significant impacts were. We then conducted a thematic analysis of the 35 key informant interviews to develop a more detailed understanding of the immediate wellbeing impacts.

Analysis of changes in subjective wellbeing before, during and after the pandemic

We then used non-parametric Friedman tests and post-hoc pairwise comparison Wilcoxin rank sum tests to identify changes in the three subjective wellbeing indicators for the 32 survey participants before (2016 and 2019), during (2020 and 2021) and after (2022) COVID-19 restrictions were in place (See Appendix 1 for additional details). Due to the already limited sample size, all available data was included in the analysis of changes in subjective wellbeing before, during and after the pandemic, even for respondents who could not be contacted for all three survey rounds during the pandemic due to phone access issues.

Quantitative analysis of material, relational and subjective wellbeing before and after the pandemic

We then compared differences in all nine quantitative wellbeing indicators from before and after the peak of the pandemic (2016, 2019 and 2022) for all 627 survey respondents, and used Friedman tests and post-hoc pairwise comparison Wilcoxin rank sum tests to identify changes between the three time periods.

Comparison of scale of wellbeing impacts due to COVID-19 with the impacts of ongoing social-ecological processes

Many indicators associated with wellbeing have been shown to vary through time due to other ongoing process of social-ecological change; both in general and in this region and context (e.g. climate change impacting the health of the reef and consequently marine livelihoods; the implementation of

conservation interventions; and infrastructure developments) (Cinner et al. 2015; Waters and Adger 2017; Mbaru et al. 2021; Cheng et al. 2022). As such, we sought to determine if the change in wellbeing across the three-year period from before to after the peak of the pandemic was disproportionate to the change in the proceeding three-year period. In other words, we attempted to account for the variation due to other ongoing processes in order to better understand the specific impact of the pandemic (Borkowska and Laurence 2021). We used general linear mixed models (GLMMs) to compare the relative change in each of the nine indicators in the three years prior to the onset of the pandemic (T1: 2016–2019) to the change from immediately before to shortly after the pandemic (T2: 2019–2016). We also controlled for several co-variates known to influence wellbeing (Mbaru et al. 2021), which may have changed due to the pandemic or mediated its effects. Specifically, we accounted for respondents' age, household size, education level, occupational diversity, temporal change in occupational diversity, and whether they held a community leadership position, drawing primarily on the 2019 surveys (Cinner et al. 2009a; Kristoffersen 2018; Kimbu et al. 2022). (The change in occupational diversity was a composite variable measuring the level of change in occupational diversity between 2019 and 2022 relative to the level of change between 2016 and 2019, again designed to account for baseline variability). Individual IDs and community were included as random effects in these GLMMs to account for the hierarchical nature of the data and the effect of using repeated measures. However, community was excluded from the models for trust in peers and trust in institutions, as model validation checks indicated overparameterization of random effects when community was included (i.e., the model was too complex for the available data).

All quantitative analysis was conducted using R (R Core Team 2022), RStudio (RStudio Team 2022) and the glmmTMB package (Brooks et al. 2017). Model diagnostics were performed using the DHARMa package (Hartig 2022). Examination of Variance Inflation Factors indicated no significant multicollinearity.

Results

Short-term impacts on material, relational and subjective wellbeing during COVID-19

In the 2022 survey, 545/627 (87%) of respondents said that overall, the impacts of COVID-19 on their lives were negative, and 82 (13%) reported no impact (a statistically negligible single person reported an overall positive impact). 532 people (85%) reported disruptions to fishing and fish trading, which reduced their income, and 75 (12%) stated that their social relationships had been negatively affected.

In interviews conducted when stringent restrictions were in place, respondents described multiple ways in which their material wellbeing was negatively affected. Many people lost their jobs, meaning less money was circulating in the community, which reduced demand for fish. With the international borders closed, there were no tourists to buy high-value seafood in hotels, and county border closures prevented people from taking fish to major city markets. The combination of these factors significantly reduced income for fishers and fish traders. Consequently, fishers and fish traders were unable to meet many of their material needs, including buying sufficient healthy food, investing in supplementary livelihoods, home-building, and school fees once schools re-opened. As one respondent said, "The most pressing thing was to do with daily bread because you cannot do anything if you have nothing in your stomach." (M, 48, community B). Respondents reported having to use savings, consume assets like livestock or sell them at low-cost, get loans, and cut non-essential expenditure. Others could not afford to buy inputs for farming, reducing the harvest and further undermining their income.

Respondents also described how social distancing requirements impacted their relational wellbeing by preventing regular social interaction. As one person said, "People were not allowed to go to churches, mosques or participate in sports. It was impossible and it was terrible," (M, 45, community B). The inability to gather together was particularly challenging in the context of the livelihood disruptions, as people were unable to support and learn from each other while trying to adapt to the changes to their livelihoods.

> "There are things you may want to enquire from someone, how to do them better, but you are not allowed to be in a sitting of 3-4 people, so you are forced to do things your way and this is difficult" (M, 48, community B).

Respondents repeatedly stated that the impacts of the pandemic undermined their perceived quality of life (i.e., subjective wellbeing). They reported general feelings of uncertainty and disempowerment; stress and anxiety about their financial situation; concern about contracting COVID-19; isolation from their support networks; and dissatisfaction with how their regular way of life had been disrupted. People felt that COVID-19 was preventing them from progressing and achieving their personal goals. Respondents talked about loneliness and frustration due to forced isolation and being stuck at home indefinitely: "How can you be happy when you don't even have space for breathing?" (F, 29, community C). One of the people who was separated from their family said "If my wife is not around, what will I do? I don't have any happiness completely in my life. I don't know when all

this will end," (M, 30, community D). One participant talked about the guilt and distress that came from not being able to help others in the community.

> "Right now, when someone comes and kneels down and tells you that 'brother or grandpa, I have a problem to solve. Please help me with 500 or 1000 KSH [Kenyan shillings]', will he not be like playing the guitar for a goat? Can the goat really dance? It cannot dance. So, you remain there with your heart suffering because you want to help but you cannot…he came to you to help but you have nothing to help with. Even when you look at your own family you want to cry because you can't sustain yourself" (M, 69, community D).

The impacts of the pandemic on people's wellbeing varied based on their personal circumstances. People's level of wellbeing before COVID-19 restrictions were put in place influenced how resilient they were when restrictions were implemented. For example, those who, prior to the pandemic, had a larger asset base (i.e., higher level of material wellbeing) were less vulnerable to food insecurity; and those with more social capital (relational wellbeing) had more access to support. For example, single mothers found it particularly difficult to support their families, especially when they did not receive aid or remittances:

> "I don't have a husband and am suffering with children. When schools open it is on me to go around so that my children can go to school. Now, when support like that has come but we're not seeing any benefits, we're just hearing that it came, and some people are already getting it every week…maybe some people are more concerned with the support than others? Or other people are so important that they need to eat, but not us?" (F, 46, community C).

Temporal analysis of subjective wellbeing

Our analysis comparing the three indicators of subjective wellbeing for the 32 respondents who participated in surveys before, during and after the pandemic showed that COVID-19 had a significant impact on livelihood satisfaction (Friedman test, X^2 (5) = 16.21, $p = 0.006$) and work enjoyment (Friedman test, X^2 (5) = 11.53, $p = 0.042$) (Fig. 2, Table S4, S5). Specifically, post-hoc analysis with Wilcoxin rank sum tests (Table 2) indicated livelihood satisfaction and work enjoyment were both stable from 2016 to 2019 ($p = 1$ and $p = 0.790$ respectively) but declined significantly from 2019 levels during 2020 ($p = 0.001$ and 0.018 respectively in Aug-Oct 2020; $p = 0.011$ and $p = 0.003$ respectively in Nov-Dec 2020). However, both livelihood satisfaction and work enjoyment largely "bounced back" to pre-COVID levels once the most stringent restrictions were lifted. That is, there was no significant difference between 2019 and 2022 for either livelihood satisfaction ($p = 1$) or work enjoyment ($p = 0.377$). A similar but not statistically significant pattern was also observed in social cohesion (Friedman test, X^2 (5) = 9.40, $p = 0.094$). Together, our results suggest that while there was a short-term impact of COVID-19 on subjective wellbeing, people recovered relatively quickly and there does not appear to be a medium-term effect on the dimensions we measured.

Comparison of material, relational and subjective wellbeing in 2016, 2019 and 2022

We found statistically significant differences in all indicators of wellbeing across 2016, 2019 and 2022, except for the value of livestock and livelihood satisfaction (Friedman tests, Fig. 3**,** Table 3**,** S6, S7). However, in multiple indicators, wellbeing in 2019 and 2022 was more similar than in 2016 and 2019 (Wilcoxin Rank Sum Tests, Fig. 3, Table 3). Only two indicators of wellbeing in 2022 were significantly different to both 2016 and 2019. The frequency of social interactions significantly increased after COVID-19 from an average composite score of 8.6 and 9.2 in 2016 and 2019 to 10.2 in 2022 ($p = < 0.001$ for 2016–2022 and 2019–2022) (Fig. 3, Table 3, S7). Work enjoyment decreased from an average score of 3.1 in 2016 and 3.6 in 2019 to 3.3 in 2022 ($p = 0046$ for 2016–2022, $p = < 0.001$ for 2019–2022) (Fig. 3, Table 3, S7).

Considering all the indicators across the three dimensions together, we did not find a clear pattern in material wellbeing. In contrast, according to our analysis it appears that overall, relational wellbeing in 2022 after the pandemic was lower than in 2016, but higher than in 2019 immediately before the pandemic, whereas subjective wellbeing was overall slightly lower in 2022 than in both 2016 and 2019 (Fig. 3, Table 3, S7).

Change in wellbeing in the three years prior to COVID-19 vs three years after the onset of COVID-19.

We then compared the degree to which each indicator of wellbeing changed in the three years prior to COVID-19 (2016–2019) to the three years from immediately before to after the peak of the pandemic (2019–2022) to see if the magnitude of the net wellbeing change from before to after the pandemic was more or less than the baseline impacts of ongoing social and ecological processes seen in the three years prior. There was a general pattern of non-significant decline in material wellbeing, an increase in relational wellbeing (significant in three out of four indicators) and a mixed pattern in the three indicators of subjective wellbeing (Fig. 4, Table S8). This suggests that people

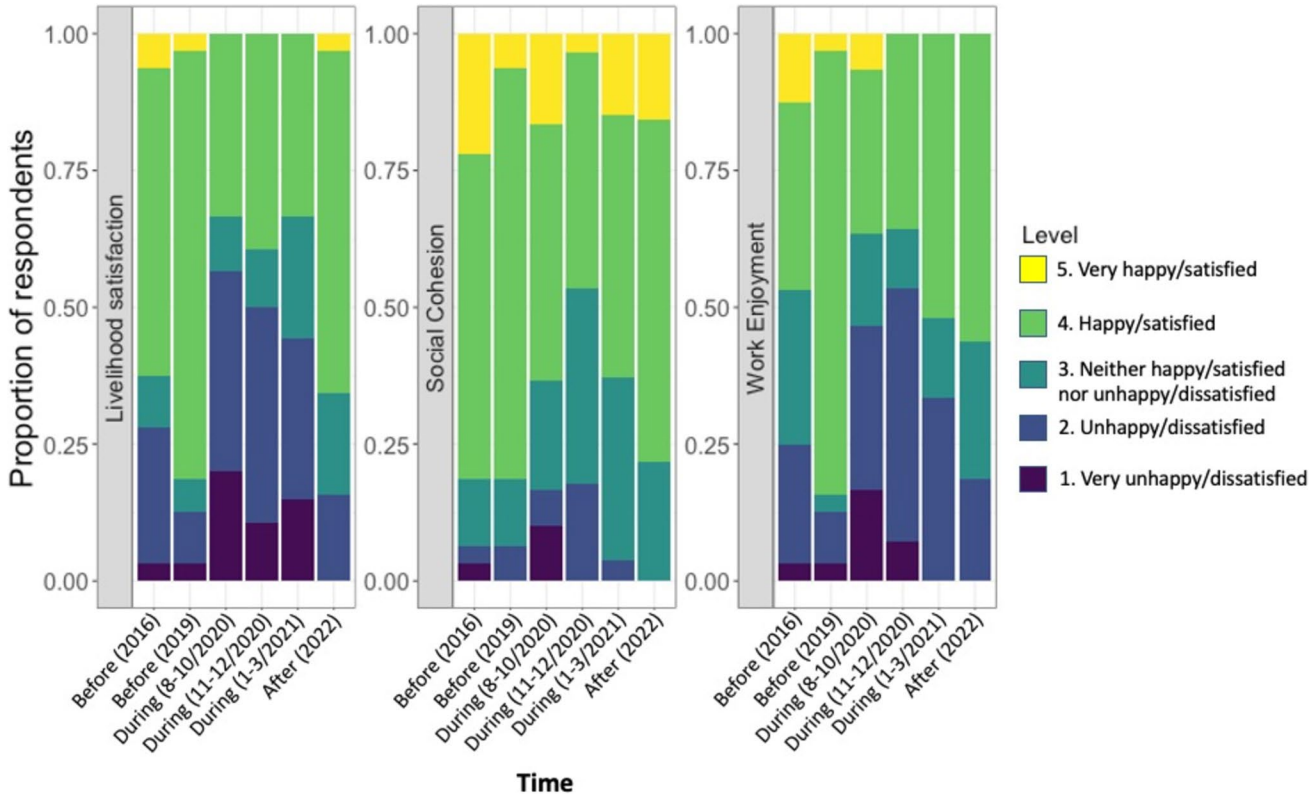

Fig. 2 Changes in subjective wellbeing before, during and after the COVID-19 pandemic, based on level of livelihood satisfaction, social cohesion and work enjoyment as measured on a 5-point Likert scale from very unhappy/dissatisfied to very happy/satisfied. The mean level of livelihood satisfaction and work enjoyment was significantly lower during 2020 than during 2016, 2019 and 2022. $N = 32$

Table 2 Results of post-hoc pairwise comparisons using Wilcoxon rank sum tests comparing livelihood satisfaction and work enjoyment before, during and after COVID-19, as measured on a 5-point Likert scale from very unhappy/dissatisfied to very happy/satisfied. Post-hoc analysis of social cohesion is not included as the base Friedman test indicated no statistically significant differences. * Indicates $p < 0.005$. $N = 34$

	2016	2019	Aug-Oct 2020	Nov-Dec 2020	Jan-Mar 2021
Livelihood Satisfaction					
2019	1.000				
Aug-Oct 2020	0.102	0.001 *			
Nov-Dec 2020	0.591	0.011 *	1.000		
Jan-Mar 2021	0.387	0.004 *	1.000	1.000	
2022	1.000	1.000	0.015 *	0.115	0.064
Work Enjoyment					
2019	0.790				
Aug-Oct 2020	1.000	0.018 *			
Nov-Dec 2020	0.772	0.003 *	1.000		
Jan-Mar 2021	1.000	0.155	1.000	1.000	
2022	1.000	0.377	0.7511	0.2655	1.000

felt differently about how COVID-19 impacted different aspects of their lives. In all but one indicator (work enjoyment), we found either no significant difference in the level of change, more of an improvement, or less of a decline from 2019–2022 than from 2016–2019 (Fig. 4**,** Table 4, S8, S9). That is to say, in general there was little evidence that there was more of a net decline in wellbeing from shortly before to shortly after the peak of the pandemic than the communities experienced in the three years prior due to other ongoing social and ecological changes.

There was a significantly larger increase in social connectivity from 2019 to 2022 than in the three years prior ($p = < 0.01$) (Fig. 4, Table 4, S8, S9). Trust in peers and trust in institutions increased in the three years during and after COVID-19, where prior to the pandemic they had a

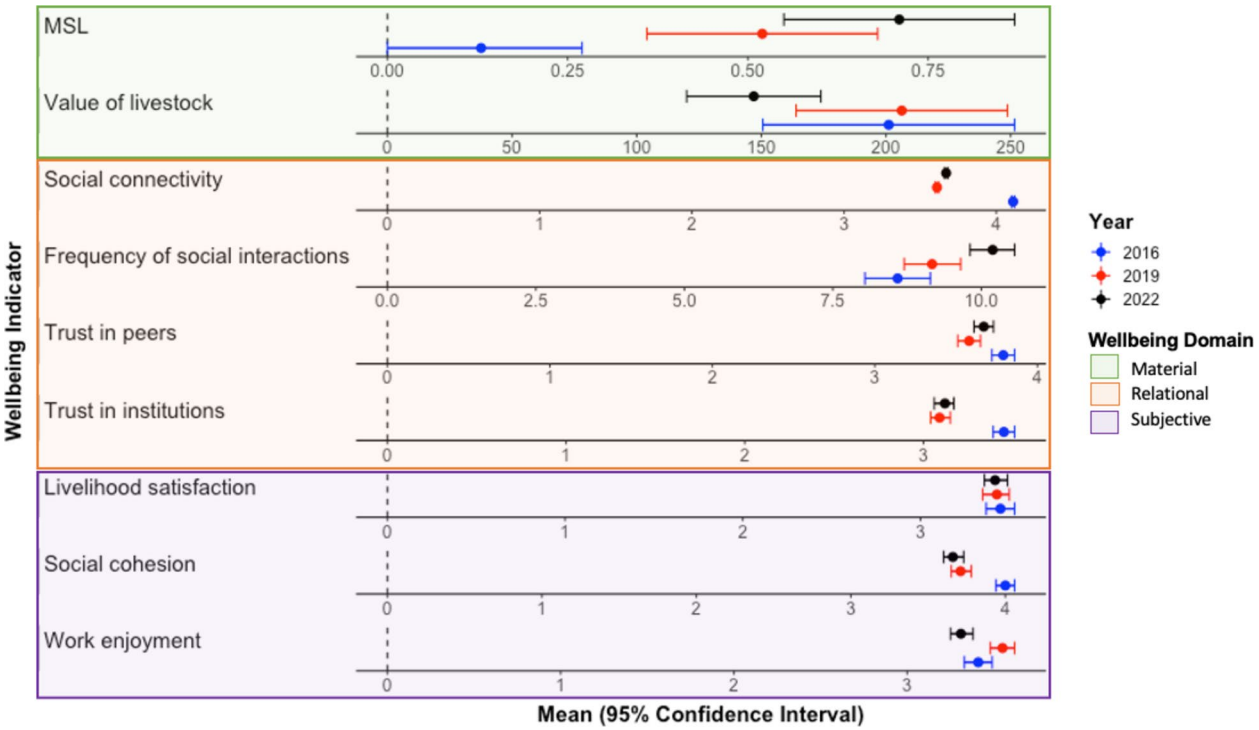

Fig. 3 Mean levels of wellbeing indicators in each year. See Table S7 for summary statistics. Error bars represent 95% confidence intervals. (Note that the social connectivity points do include confidence intervals but are difficult to see as they are very narrow.)

Table 3 Results of post-hoc pairwise comparisons using Wilcoxon rank sum tests comparing material, relational and subjective wellbeing indicators before and after COVID-19. Note that post-hoc tests were only performed for indicators where initial Friedman tests indicated significant differences between years, i.e., the tests were not run for the value of livestock or livelihood satisfaction. $N=627$, * indicates $p<0.05$

Indicator	2016/2019	2016/2022	2019/2022
Material wellbeing			
MSL	0.006*	<0.001*	0.203
Relational wellbeing			
Social connectivity	0.005*	<0.001*	0.85
Frequency of social interactions	0.014*	<0.001*	<0.001*
Trust in peers	<0.001*	0.09	0.013*
Trust in institutions	<0.001*	<0.001*	0.44
Subjective wellbeing			
Social cohesion	<0.001*	<0.001*	0.45
Work enjoyment	0.069	0.046*	<0.001*

decreased ($p=<0.01$ for both). Only work enjoyment decreased significantly from 2019 to 2022, reversing a previous increase ($p=<0.01$).

Few socio-demographic factors were associated with differences in the level of change in the two time periods. Changes in the value of livestock was negatively associated with both age (2.9 USD less difference in value per year of age, $p=0.04$) and education (0.93 USD less difference in value per year of education, $p=0.02$); and a larger increase in the frequency of social interactions (0.87, $p=0.05$) and smaller decline in social cohesion (0.23, $p=<0.01$) were associated with holding a community leadership position (Table 4, S9).

Discussion

Our analysis of surveys and interviews from 2020 and 2021 demonstrate multiple negative impacts on material, relational and subjective wellbeing. However, our analysis comparing multiple indicators of wellbeing before and after restrictions were implemented then lifted showed minimal evidence of ongoing negative impacts on the aspects of human wellbeing we measured. In fact, our results suggest that people experienced an increase in relational wellbeing (Figs. 3 and 4), and in eight out of nine indicators the overall change in wellbeing between 2019 and 2022 was either not significantly different to, or an improvement on, the change in the three years before the pandemic (Fig. 4). This demonstrates the capacity for people to "bounce back" or rapidly

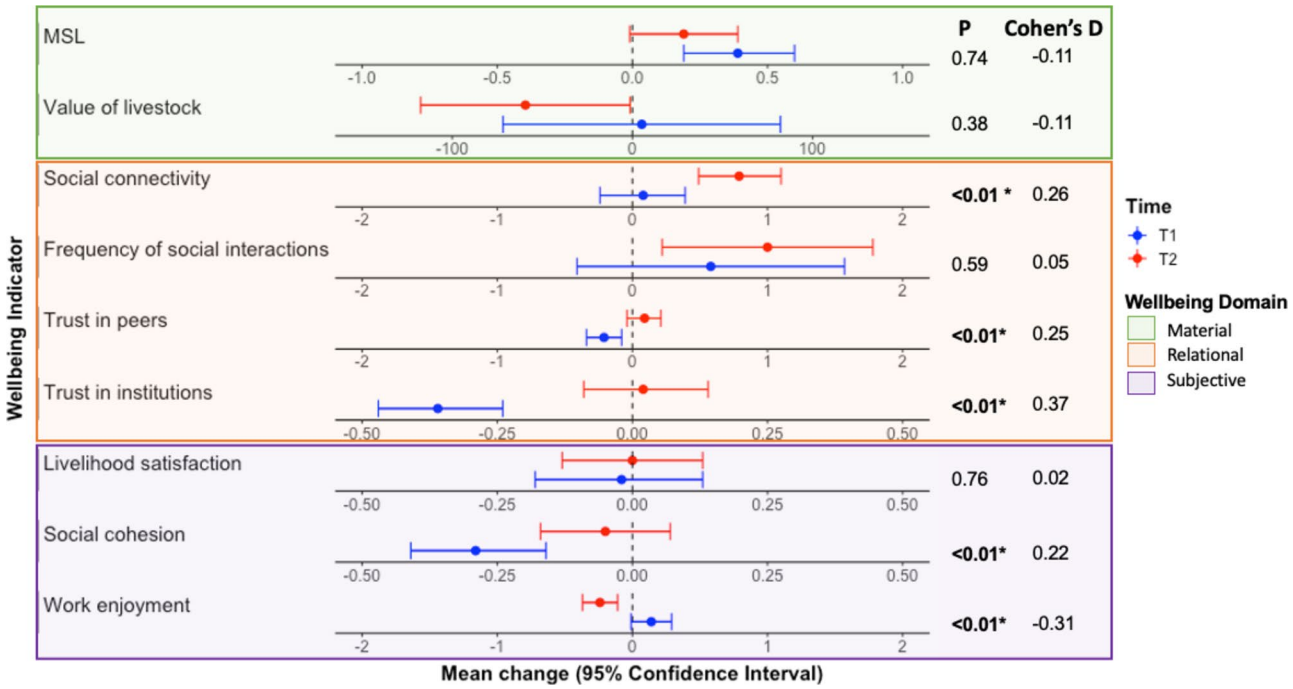

Fig. 4 Change in wellbeing in Time 1 (2016–2019) vs Time 2 (2019–2022). Points represent the mean change in each 3-year time period. Error bars represent 95% confidence intervals. See Table S8

recover from the impacts of COVID-19 on their wellbeing, and potentially also future exogenous, episodic shocks.

Material wellbeing

The initial disruptions to material wellbeing which we identified, primarily reduced income and consequently food insecurity, are broadly consistent with patterns that occurred in the wake of the pandemic across other small-scale fishing and rural communities in Kenya and around the world. However, here, we provide qualitative evidence that many respondents' food and nutrition security improved as restrictions eased. Moreover, our quantitative analysis showed an overall increase in Material Style of Life from 2019–2022, which seems to indicate that on average, people were able to recover from short term declines in material wellbeing. This pattern of a strong initial impact followed by recovery is generally consistent with research from other fishing communities in Kenya and rural communities in Africa more broadly. For example, Upton et al. (2021) also identified a process of relatively quick return to (still quite high) pre-pandemic food insecurity levels in fishing communities around Lake Victoria as early as the second half of 2020, after movement restrictions eased there. (Note that case rates were lower and restrictions around Lake Victoria were less stringent than in our study communities on the south coast (Ministry of Health 2020), meaning the specific impacts and timeline of events were different, which could account for the slightly faster recovery). They did, however, identify that anxiety about COVID-19 increased again in late 2020 when the re-opening of schools caused a spike in cases. In contrast, Okronipa et al. (2023)'s research, also around Lake Victoria, found little evidence of food security impacts of the pandemic, though almost all households were already food insecure and simply remained at a stable low level. Sharp increases and then declines in food insecurity were also observed in Burkina Faso, Ethiopia, Malawi, and Nigeria, with rural communities experiencing a larger increase in food insecurity than urban populations (Rudin-Rush et al. 2022).

Relational wellbeing

We found that while relational wellbeing was negatively impacted by the social distancing, movement restrictions, and reduced ability to provide mutual support during the peak of the pandemic, it appears people were largely able to recover to or build on their 2019 levels of relational wellbeing by 2022. It appears that overall people's levels of trust institutions and peers in general, which had previously been declining, increased between 2019 and 2022. Some early research from the pandemic matches our findings and suggests that experiencing strong government interventions in the face of the pandemic resulted in increased trust in institutions and community cohesion

Table 4 GLMM results comparing changes in material, relational and subjective wellbeing between T1 (2016–2019) and T2 (2019–2022). Note that only the effect of time and significant co-variates are included here; see Table S9 for full model results). $N = 627$, * indicates $p < 0.05$

	Estimate (S.E.)	z	*p*
Material wellbeing			
MSL			
Time period	0.03	0.33	0.74
Value of Livestock (USD)			
Time period	2.05	0.87	0.38
Age	−2.87	−2.07	0.04 *
Education	−0.93	−2.25	0.02 *
Relational wellbeing			
Social connectivity			
Time period	0.53	4.01	< 0.01 *
Frequency of social interactions			
Time period	0.22	0.56	0.59
Leader	0.87	1.99	0.05*
Trust in peers			
Time period	0.29	4.52	< 0.01 *
Trust in institutions			
Time period	0.38	6.65	< 0.01 *
Subjective Wellbeing			
Livelihood satisfaction			
Time period	0.23	3.88	0.76
Social cohesion			
Time period	0.23	3.88	< 0.01 *
Leader	0.23	3.88	< 0.01 *
Work enjoyment			
Time period	0.38	−5.51	< 0.01 *

(Sibley et al. 2020). However, most literature to date has focused on the role of social networks and trust in stopping the spread and mitigating the impacts of COVID-19, rather than how COVID-19 has impacted relational wellbeing in turn (Borgonovi and Andrieu 2020; Elgar et al. 2020; Lofredo 2020; Varshney and Socher 2020; Bartscher et al. 2021; Bhowmik et al. 2021; Negură et al. 2021; Wu 2021). With respect to people's personal social networks, the frequency with which people were interacting with others was significantly higher after the pandemic (Fig. 3), and people increased the size of their networks from 2019 to 2022 even though they had decreased between 2016 and 2019 (Fig. 4). It is likely that following the pandemic people were increasingly relying on support from others, and the lack of interaction during lockdowns may have made people value interaction more. The broader literature on the effects of shocks on relational wellbeing is mixed; with some research showing that the stress of shocks can undermine interpersonal relationships and sense of community, and other research suggesting that crises can bring people together and increase trust and cohesion, though often only temporarily in the immediate aftermath during a "honeymoon" period before disillusionment and long-term negative relational wellbeing effects set in (Kutak 1938; Bonanno et al. 2010; Townshend et al. 2015; Prayag et al. 2021). For example, Prayag et al. (2021) found that many people felt an increased sense of community and solidarity following earthquakes in Canterbury, New Zealand as people came together to deal with the immediate aftermath; but also experienced breakdowns in relationships over time as some people moved away or moved on while others were still recovering. It may therefore be that the high level of relational wellbeing we noted after the restrictions were lifted in 2022 compared to 2019 (Sect."Comparison of material, relational and subjective wellbeing in 2016, 2019 and 2022", Figs. 3 and 4) will only be temporary. Further longitudinal analysis is needed to explore the long-term feedbacks between relational wellbeing impacts and the recovery process.

Subjective wellbeing

Work enjoyment was one of only two indicators which was significantly lower in 2022 than in 2019 and 2016, and where there was a significantly more negative net change from before to after the pandemic compared to the three years prior. Our before-during-after analysis did show that the level of work enjoyment in 2022 was still an improvement on what it had been during the peak of the pandemic. Other than changes to diets, changes in livelihood activities were the most common impacts and responses participants described in the interviews we conducted. The satisfaction, enjoyment and sense of identity that they get from fishing has been self-identified as one of the most important aspects of wellbeing for fishers in the region (Abunge et al. 2013). Fishing is a way of life and a core part of the cultural, relational and personal identity of small-scale fishers, meaning it cannot simply be replaced by alternative livelihood activities which merely replicate the supply of food and income (Pollnac et al. 2001; Oleson et al. 2015; Gillam and Charles 2018; Johnson 2018; Holland et al. 2020). As such, it is unsurprising that ongoing disruptions to fishing as their core livelihood activity would continue to be a source of discontentment even as their material needs were met through modified fishing practices or alternative food and income sources.

All three analyses show that livelihood satisfaction and social cohesion do not seem to have been significantly negatively impacted in the medium term, and there is evidence that work enjoyment is also on a recovery trajectory. This rapid recovery pattern in subjective wellbeing aligns with an extensive (though somewhat contested) body of literature around the homeostatic tendency of subjective wellbeing,

known as *set point theory,* which suggests that people have a baseline level of subjective wellbeing (Diener et al. 2006; Luhmann and Intelisano 2018). Significant life events can temporarily alter happiness and satisfaction levels, but people tend to return to their personal "set point" as they adapt to their new circumstances (Luhmann and Intelisano 2018). However, there is significant variation in the literature regarding how long it takes to recover from negative subjective wellbeing impacts following major disasters like earthquakes or floods, on a scale of a few months to several years (Bonanno et al. 2010; Prayag et al. 2021). Additionally, many scholars claim that sufficiently significant changes can result in long-term shifts in subjective wellbeing (Diener et al. 2006; Lucas 2007). The recovery pattern we identified seems to be an example of rapid return to a subjective wellbeing set point. To date there is very limited longitudinal data available showing potential medium-term recovery trends in diverse indicators of subjective wellbeing following the pandemic, so we do not yet know if our findings were exceptional or the norm in this context. There have been some related-but-not-synonymous psychological mental health assessments, primarily in developed country contexts, which have detected similar patterns of declines in mental health and wellbeing in the initial period of the pandemic, which improved over the following months (O'Connor et al. 2021; Pierce et al. 2021; Murphy and Elliot 2022). It is important to note, however, that while most people in a community may exhibit a high level of psychological resilience and only experience transient subjective wellbeing impacts following a shock, a statistical minority of people may still experience severe and lasting subjective wellbeing impacts (Bonanno et al. 2010).

Differences and similarities in experiences

The lack of significant covariates in the relative change in wellbeing models across all three domains is unexpected, as it has been well-documented, even in early COVID-19 research, that crises often differentially affect different demographic groups, often disproportionately effecting already marginalised groups (Bottan et al. 2020; Patel et al. 2020; Gupta et al. 2021). For example, Borkowska and Laurence (2021) found significant effects of age, education, wealth and ethnicity on social cohesion during 2020. Muir et al. (2023) and Geng et al. (2022) found negative associations between household size and food security during the pandemic. This is additionally supported by our interview analysis, which did indicate substantial variation in people's experiences. For example, some of the people we interviewed from poorer households were disproportionately affected by a reduction in their already limited material wealth, and found it harder to break out of a downward poverty cycle and recover again after restrictions eased; and women were generally the ones expected to take on the additional care burden (physical and emotional) of having children home from school during lockdowns due to cultural gender norms.

Limitations, caveats, and future directions

The fact that we were able to identify intersectional differences in experiences from our interviews which were not reflected in our statistical analysis (i.e. very few of the socio-demographic covariates included in our models were significant), highlights the value of supplementing the analysis of large-sample quantitative wellbeing indicators with qualitative data (White 2015), or with more detailed models and outlier analysis in addition to evaluating mean effect levels. It is possible, even likely, that other socio-demographic variables that were not accounted for in the models would explain some of the observed variance, and that there was a significant negative wellbeing effect for some people which was lost in our aggregated analysis. A major gap in our analysis is that while we interviewed and surveyed both women and men during the pandemic, the surveys conducted before and after the pandemic in 2016, 2019 and 2022 were designed for a research project specifically focused on fishers rather than fishing communities more broadly, and in this context means that the overwhelming majority of surveys are with men and women are not well represented in the before and after quantitative analysis, and we were not able to disaggregate the data and determine differential gender impacts. Future research targeting both men and women and utilising larger sample sizes should include more disaggregated data analysis and more complex models which can account for variation in baseline wellbeing levels between groups. The limited sample size we were able to obtain for the surveys we conducted during the pandemic due to the challenges of remote research is a particular limitation of our study. While 35 interviews are a more than adequate sample for qualitative analysis, it did mean we were unable to perform more rigorous statistical tests of our quantitative data to unpack what was happening during the peak of the pandemic and potential differences in people's experiences.

It is important to note that the baseline level of wellbeing against which we compared 2022 levels was already fairly low; and many indicators were already declining in the three years prior. The landscape of ongoing social and ecological processes influencing wellbeing in the region which we was attempting to account for includes high levels of poverty (Degen et al. 2010; Kabubo-Mariara et al. 2011), corruption (Sulemana et al. 2017), political violence (Bennett et al. 2015; Klaus 2020), terrorism events (Masinde and Buigut 2018; Kamau 2021), lack of access to water and sanitation (UNICEF 2017), environmental degradation (Abunge et al. 2013), development (Abunge et al. 2013), and significant changes to marine resource management practices (Harker

et al. 2022), among others. As such, it is not that COVID-19 had negligible impacts on an otherwise stable, high quality of life, but rather that in the medium term the effects were not disproportionate to the ongoing processes which were already affecting people's wellbeing in the region. These processes are context specific, and as such the relative scale of the effects of COVID-19 and how well people can recover from it may be comparable in areas facing similar issues but not generalisable across all contexts.

Conclusion

Our research shows that people in coastal Kenyan fishing communities experienced a diverse range of negative impacts on all three domains of human wellbeing during the peak of the pandemic, but provides compelling evidence that communities are already beginning to recover and "bounce back". This is clearly good news, but what does it mean for the future? Many people have hypothesised that studying COVID-19 could provide insights how well individuals, local communities and the global community might respond to future shocks, particularly climate change (Klenert et al. 2020; Manzanedo and Manning 2020). Like COVID-19, climate change will impact almost every aspect of people's lives, and addressing it will require both individual, collective, and institutional action (Jordan and Palmer 2020; Klenert et al. 2020). The ability of fishing communities to maintain wellbeing in the face of shocks like COVID-19 suggests that they are relatively resilient and may be similarly able to withstand future climate shocks.

However, a key difference between COVID-19 and climate change is that COVID-19, while an extreme shock, was relatively acute and immediately evident, but the ongoing effects of climate change and the fight against it will be protracted and it is somewhat intangible in its early phases (Fuentes et al. 2020). This has shaped how people perceived and responded to the pandemic vs. climate change (Fuentes et al. 2020; Jordan and Palmer 2020). While similar recovery patterns to what we have observed here may be repeated following individual climate-driven natural disasters, climate change will result in both progressive and recurrent shocks which may be harder to recover from without time to recoup before being exposed to the next event (Carter and Barrett 2006; Barrett et al. 2007; Berhanu 2011; Guillaumont and Simonet 2011). Similarly, later developments in set point theory suggest that while people can recover from the subjective wellbeing impacts of isolated shocks, long-term changes in circumstances can lead to long-term changes in subjective wellbeing (Diener et al. 2006; Lucas 2007; Luhmann and Intelisano 2018). As such, while our findings are encouraging in that they indicate that people have been able to recover relatively quickly from the multi-dimensional wellbeing impacts of COVID-19, this should not mean that we become complacent to the long-term risks of climate change.

Supplementary Information The online version contains peer-reviewed but unedited supplementary material available at https://doi.org/10.1007/s10113-025-02439-0.

Acknowledgements We acknowledge and thank Wildlife Conservation Society Kenya for providing logistical support for data collection. We would also like to thank all the participants for their time and insights. The development of the methodology for this work was supported by the CGIAR Research Program on Fish Agri-Food Systems (FISH) led by WorldFish. The program is supported by contributions from the CGIAR Trust Fund. The research was funded by the Western Indian Ocean Marine Science Association- Marine Science for Management Grant MASMA/CP/2020/01 and the Australian Research Council (CE140100020, FT160100047). Human ethics approval for this research was obtained from the James Cook University Human Ethics Panel (approval numbers H8109 and H7603). Authors declare that they have no competing interests.

Data Availability Summary data is provided in the SI. Access to raw data is restricted to protect participant privacy under our ethics agreement; but deidentified data may be made available on request to the authors.

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