Climate Risk Management 12 (2016) 83–99

Contents lists available at ScienceDirect

Climate Risk Management

journal homepage: www.elsevier.com/locate/crm

Scenario planning to leap-frog the Sustainable Development Goals: An adaptation pathways approach

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ARTICLE INFO

Article history:
Received 6 September 2015
Revised 24 October 2015
Accepted 6 November 2015
Available online 1 December 2015

Keywords:
Indonesia
Livelihoods
Mal-adaptation
Scenarios
Social learning
Transformation

ABSTRACT

Few studies have examined how to mainstream future climate change uncertainty into decision-making for poverty alleviation in developing countries. With potentially drastic climate change emerging later this century, there is an imperative to develop planning tools which can enable vulnerable rural communities to proactively build adaptive capacity and 'leap-frog' the Sustainable Development Goals (SDGs). Using an example from Indonesia, we present a novel participatory approach to achieve this. We applied scenario planning to operationalise four adaptation pathways principles: (1) consideration of climate change as a component of multi-scale social-ecological systems; (2) recognition of stakeholders' competing values, goals and knowledge through co-learning; (3) coordination of responses across multiple decision-making levels; and (4) identification of strategies which are 'no regrets', incremental (tackling proximate drivers of community vulnerability) and transformative (tackling systemic drivers). Workshops with stakeholders from different administrative levels identified drivers of change, an aspirational vision and explorative scenarios for livelihoods in 2090, and utilised normative back-casting to design no regrets adaptation strategies needed to achieve the vision. The resulting 'tapestry' of strategies were predominantly incremental, and targeted conventional development needs. Few directly addressed current or possible future climate change impacts. A minority was transformative, and higher level stakeholders identified proportionately more transformative strategies than local level stakeholders. Whilst the vast majority of strategies were no regrets, some were potentially mal-adaptive, particularly for coastal areas and infrastructure. There were few examples of transformative innovations that could generate a step-change in linked human and environmental outcomes, hence leap-frogging the SDGs. We conclude that whilst effective at integrating future uncertainties into community development planning, our approach should place greater emphasis on analysing and addressing systemic drivers through extended learning cycles.

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http://dx.doi.org/10.1016/j.crm.2015.11.003
2212-0963/

Introduction

For many rural communities in the developing world, change is occurring at an unprecedented rate, resulting in increasing uncertainty for their livelihoods (Scoones et al., 2007; Leach, 2008). Whilst the effects of drivers of change such as population growth and modernisation are already evident (Armitage and Johnson, 2006; Curry et al., 2012; Butler et al., 2014a), extreme climate change may only emerge later this century (Stafford Smith et al., 2011). Hence in many regions there is an 'adaptation window' of approximately three decades in which to build the adaptive capacity of vulnerable communities and other stakeholders to face potentially drastic change, but also high levels of uncertainty (Butler et al., 2014a).

This challenge can be framed as the necessity to 'leap-frog' the Millennium Development Goals (MDGs; United Nations, 2014) and their successors, the Sustainable Development Goals (SDGs; United Nations, 2015). 'Leap-frogging' implies the rapid development and adoption of affordable technology which can by-pass environmental impacts and accelerate poverty alleviation (Goldemberg, 1998). In terms of adaptation, it refers to investing in innovative 'green development' that is pre-adapted to the future (Palutikof et al., 2013). Whilst the MDGs are largely human development-orientated, focussing on poverty and hunger alleviation, education, gender equality and health, they will be expanded in 2015 by the SDGs to include stronger elements of environmental sustainability (Griggs et al., 2013). Leap-frogging the SDGs therefore requires rapid identification and implementation of innovations that achieve improved human and environmental outcomes (Leach et al., 2012; Griggs et al., 2014), generating a step-change in communities' adaptive capacity (Butler et al., 2014b).

To achieve this requires frameworks and tools which can mainstream anticipatory adaptation into development planning (Metz and Kok, 2008; Conway and Mustelin, 2014). By taking a systems approach, the recent construct of adaptation pathways provides a potentially useful decision-making framework (Wise et al., 2014) which is applicable to community development planning (Butler et al., 2014b). It combines four core principles for planning processes and outputs. First, climate change impacts and responses cannot be considered in isolation, but are components of dynamic, multi-scale social-ecological systems. Second, adaptation involves multiple stakeholders with competing values, goals and knowledge which must be recognised and negotiated. Third, responses to change must be coordinated across spatial scales, jurisdictional levels and sectors. Fourth, planning processes should design and implement incremental adaptation strategies to address proximate causes or symptoms of vulnerability, plus transformative strategies to tackle systemic causes, which in developing countries are often the institutional and political roots of disadvantage (Lemos et al., 2007; Pelling, 2011; Rodima-Taylor et al., 2012). Also, to avoid mal-adaptation (i.e. actions that impact adversely on or increase the vulnerability of other systems, sectors or social groups; Barnett and O'Neill, 2010), strategies should be 'no regrets' (i.e. yielding benefits under any future conditions of change: Hallegatte, 2009).

Scenario planning is a popular and flexible tool used to inform anticipatory adaptation (e.g. Ravera et al., 2011; Ruiz-Mallén et al., 2015). By providing descriptions, rather than forecasts or predictions of plausible futures that reflect different perspectives on development (van Notten et al., 2003), scenarios can help explore complexity and uncertainty in social-ecological systems (Wilkinson and Eidinow, 2008). When applied in multi-stakeholder processes, scenarios act as boundary objects to promote social learning, collective action, the co-production of knowledge and innovation, and to form reference points for development planning (Gidley et al., 2009; Chaudhury et al., 2013; Johnson et al., 2012; Foran et al., 2013; Oteros-Rozas et al., 2015). When linked, scenarios created by stakeholders from different administrative and social levels can provide opportunities for the inclusion of diverse knowledge and perceptions, enhancing understanding of cross-scale system interactions (Biggs et al., 2007; Kok et al., 2007; Özkaynaka and Rodríguez-Labajos, 2010). 'Back-casting' can also be applied to identify the strategies required to achieve a desired goal under future uncertainty (Kok et al., 2011; Robinson et al., 2011). Consequently scenario planning can potentially operationalise adaptation pathways principles by encouraging social-ecological systems analysis, engaging multiple stakeholders in a learning process, and back-casting to identify strategies required to achieve desired and adaptive development. However, few studies have attempted to integrate these principles and practices to enhance development decision-making (Vervoort et al., 2014).

In developing countries there are numerous challenges which may impede such integration, however. Stakeholders are often fatalistic (Wollenberg et al., 2000; van Aalst et al., 2008) and tend to focus on immediate development needs (Conway and Mustelin, 2014). Local level actors also tend to conceive the future in short time horizons (Bohensky et al., 2016). Exacerbated by limited formal education, these cognitive biases may constrain some stakeholders' concerns to current issues (Enfors et al., 2008), and thus only incremental or 'coping' strategies (Scoones, 2009). Including the knowledge of higher level stakeholders and science experts is then necessary to collectively identify systemic and long term issues, and related transformative strategies, but risks disempowering community members (Fazey et al., 2010; Butler et al., 2015a). Consequently planning processes must encourage participants, particularly those from local levels, to conceive the future over short and long time horizons, whilst mitigating potential power asymmetries associated with the involvement of higher level actors and their knowledge.

This paper has three primary objectives. First, we demonstrate a participatory approach which combines scenario planning and adaptation pathways principles to mainstream future uncertainty into decision-making for community development. As a component of a multi-stakeholder planning process in Nusa Tenggara Barat Province (NTB), Indonesia, we designed the approach to address the challenges of anticipatory futures planning in a rural development context. Second, we analyse outputs from the process to understand different stakeholders' perspectives of livelihoods and priority adaptation strategies. Third, we assess whether the strategies devised may enable communities to leap-frog the MDGs and SDGs, thus critiquing our approach.

Methods

Study area

NTB consists of two major islands, Lombok and Sumbawa (Fig. 1). The total population was 4.5 million in 2010, and projections suggest that this could increase by 44% to 6.5 million in 2050. NTB is one of the poorest regions in Indonesia. Poverty is most prevalent in rural areas, where 58% of the population live. In 2014 the poverty rate was 17.2% (Badan Pusat Statistik, 2015), and it is unlikely that the MDG target of 11.6% by 2015 will be attained.

NTB has a tropical climate with a monsoon season of December–April, and is affected by the El Nino Southern Oscillation, which generates a variable climate. Due to the orographic effects of the volcanoes Mount Rinjani on Lombok and Mount Tambora on Sumbawa, steep climate gradients exist across the islands (McGregor et al., 2016). Combined with variable soil types, culture, economic opportunities and human development, livelihoods vary markedly over short distances (Butler et al., 2014b). Based on the primary ecosystem services underpinning livelihoods, Rochester et al. (2016) categorised NTB's 105 rural sub-districts into seven types: fishing, fishing and seaweed, rice and fish ponds, diverse agriculture and forest use, rice and tobacco, diverse livestock and cropping, and diverse cropping and coastal activity.

Project and village development planning process

Poor coordination between government, donor and non-government investments in development, exacerbated by stakeholders' lack of awareness of potential future impacts of climate change and other drivers, maintains a high risk of maladaptive decision-making in NTB (Butler et al., 2014b). The institutional flux caused by a national process of decentralisation provided a window for the establishment of an alternative approach to rural development planning (Butler et al., 2016 a). Hence, in 2010–2014 a project was conducted to integrate adaptation pathways principles into development decision-making.

A multi-stakeholder process was designed to mimic the annual cycle of integrated top-down (i.e. government-led) and bottom-up (i.e. community-led) village development planning in Indonesia ('*musrenbang*'). Three stages of workshops were carried out, facilitated by a trained Indonesian facilitator and assisted by a multi-disciplinary Indonesian and Australian research team (see Butler et al., 2016b, 2015a). Stage 1 involved a 3-day scenario planning workshop which engaged stakeholders from the international, national and provincial levels, including government, non-government organisations (NGOs) and scientists. Five rural sub-district case studies (Janapria, Sape, Jerowaru, Terara and Bayan: Fig. 1) were then selected by the team to represent a range of vulnerable sub-district types. Stage 2 repeated the Stage 1 process, with 2-day workshops held in each case study engaging district, sub-district and village level stakeholders, including government, local NGOs, business and community representatives. Stage 3 integrated the Stage 1 and 2 workshop participants and their outputs to develop sub-district development plans.

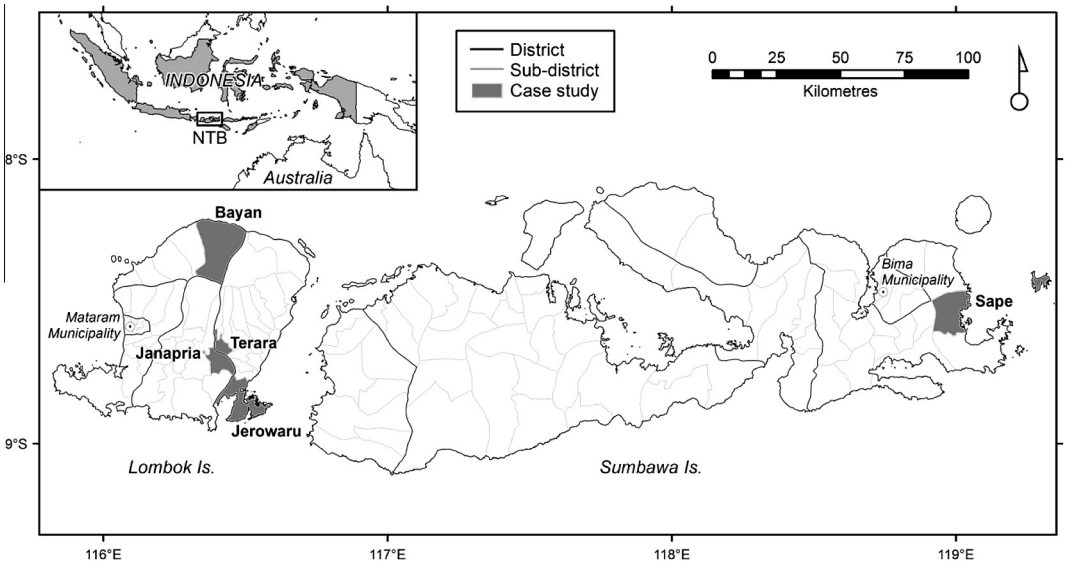

Fig. 1. Nusa Tenggara Barat (NTB) Province, Indonesia, showing the locations of the five rural sub-district case studies.

Stage 1 and 2 scenario planning workshop design

This section explains the conceptual foundations for the design of the Stage 1 and 2 scenario planning workshops. These operationalised the four core principles of adaptation pathways through a structured learning process, whilst accounting for the challenges of multi-stakeholder scenario planning in a developing country context.

Analysis of climate change as a system component

Many scenario planning approaches are focussed on a tightly defined issue, such as a sector (e.g. tourism: Bohensky et al., 2011) or a policy question (e.g. biodiversity conservation; Peterson et al., 2003). Others focus explicitly on one primary driver, such as regional governance, whilst holding others constant (e.g. Vervoort et al., 2014). However, the first adaptation pathways principle states that climate change and societal responses cannot be considered in isolation, but are components of dynamic, multi-scale social-ecological systems. In terms of rural development, climate change must therefore be assessed in relation to all contemporary and long term issues that influence communities and their livelihoods.

Due to cross-cultural barriers and stakeholders' generally limited scientific understanding, analysing social-ecological systems and applying the related lexicon can be problematic in developing countries (Folke and Fabricius, 2005; Béné et al., 2011). Consequently we adopted Burns (2012) Participatory Systemic Inquiry approach. Based on action research, it is proven to be effective in development contexts because it examines a system as the web of relations between issues that stakeholders are concerned about, and embedded within. Consequently, stakeholders can understand the system in their own terms, and take ownership of problems and solutions (Burns, 2012).

Co-production of knowledge amongst stakeholders

The second principle is that multiple stakeholders and their competing values, goals and knowledge must be mutually recognised and negotiated through collaborative learning and knowledge co-production. In NTB, distinct 'knowledge cultures' exist amongst stakeholder types (e.g. government, communities and NGOs), with differing perceptions of future time horizons, climate change and development priorities (Butler et al., 2015a; Bohensky et al., 2016).

To encourage co-learning and the integration of these knowledge cultures within each workshop, we adapted Brown's (2008) decision-into-practice learning spiral, which was developed specifically to catalyse collective action through community-based planning. The spiral's steps aim to generate social learning, whereby participants "move together in an interactive, iterative process in which everyone enhances the understanding of everyone else" (Brown, 2008, p. 48). Referring to the system and problem concerned, four successive questions are addressed: 'what is?' (identifying parameters of change), 'what should be?' (establishing guiding principles for change), 'what could be?' (identifying potential future change) and 'what can be?' (adjusting current practice). The workshop process posed these questions in terms of livelihoods and adaptation, allowing participants to complete one learning spiral (Fig. 2). The process was repeated to form a second learning spiral in the Stage 3 workshops (Butler et al., 2015a; Wise et al., 2016).

Musrenbang in NTB is often captured by high level political elites and government officials, marginalising community interests (Purba, 2011; Aswad et al., 2012). To mitigate these power asymmetries, we engaged the potentially more powerful national and provincial level stakeholders in the Stage 1 workshop separately from local level stakeholders in the Stage 2 workshops. This segregation also allowed the analysis of livelihoods and adaptation from the perspectives of different scales (i.e. provincial and sub-district), harnessing stakeholder groups' varying perceptions of drivers and adaptation priorities, which were subsequently compared and integrated in Stage 3.

Coordination amongst stakeholders

The third principle of enhancing stakeholders' coordination was implemented through three activities. First, stakeholder analysis was carried out to identify and invite 30 to 40 individuals with responsibility for and involvement in community development and natural resource management at the national and provincial level (Stage 1) and district, sub-district and community level (Stage 2). To achieve a gender balance, female stakeholders (e.g. women farmer's groups) were prioritised and encouraged to attend.

Second, the workshops applied Wilkinson and Eidinow's (2008) 'reflective interventionist multi-actor' approach. Unlike problem- and actor-orientated modes of scenario planning, this explicitly aims to change the way participants think about the future by including and challenging their differing perspectives and assumptions. To achieve this, participants developed explorative scenarios (i.e. multiple plausible futures described in words, numbers and/or images; van Notten et al., 2003) to encourage integration of their perceptions of livelihoods and adaptation.

Third, we used modelling to provide an expert-driven perspective against which stakeholders compared their assumptions about plausible futures (Shaw et al., 2009; Chaudhury et al., 2013; Vervoort et al., 2014). A participatory tool, the Assets Drivers Well-being Interaction Matrix (ADWIM) was developed to estimate impacts of climate change and population growth on ecosystem services and four linked constituents of human well-being that broadly reflected the MDGs: income, health, food security and culture (Skewes et al., 2016).

No regrets incremental and transformative adaptation strategies

The fourth principle states that no regrets incremental and transformative strategies must be designed. To identify no regrets adaptation strategies, stakeholders developed an aspirational vision for rural communities' livelihoods, and applied

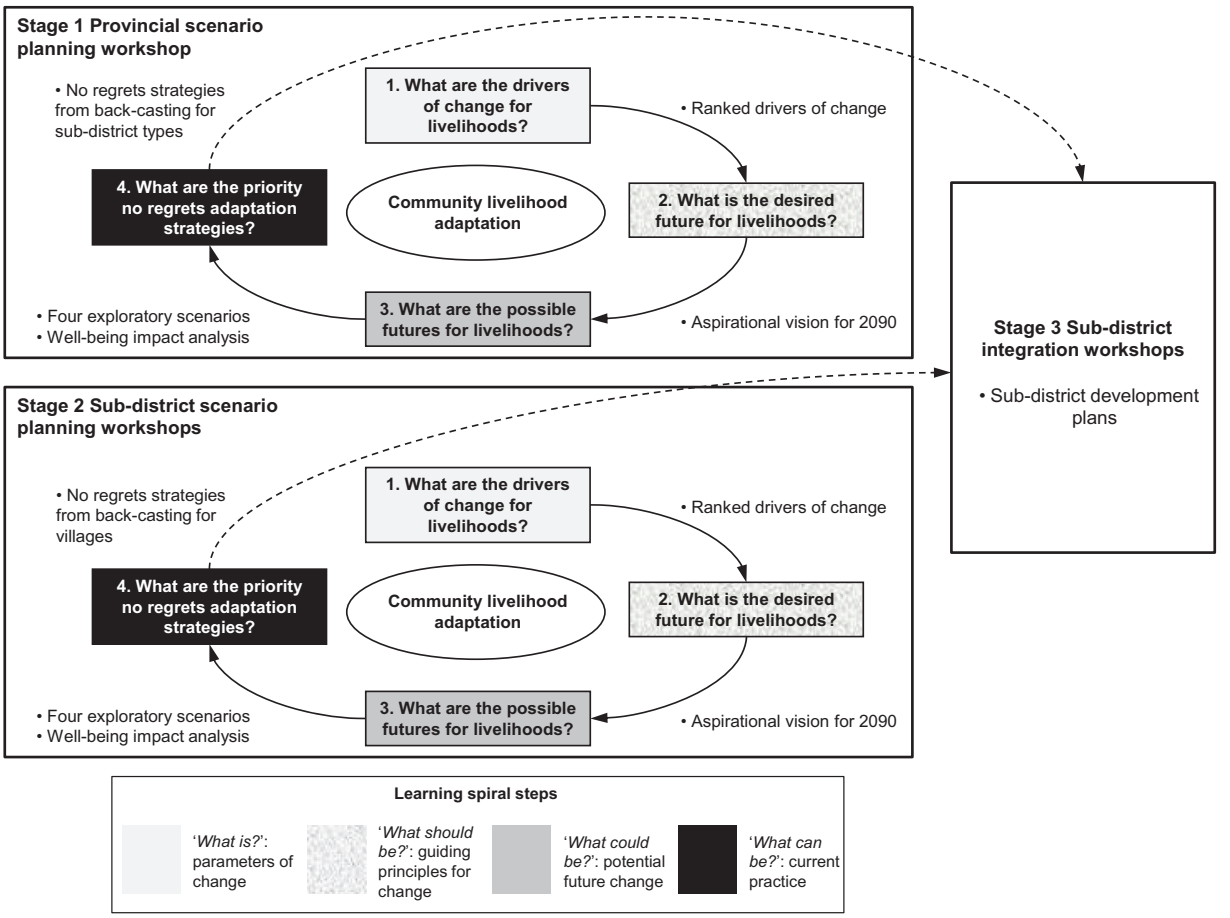

Fig. 2. Stage 1 and Stage 2 scenario planning workshop steps and primary outputs (bullets) relative to Brown's (2008) learning spiral. Also shown are the links to the subsequent Stage 3 sub-district integration workshops.

normative back-casting to identify the strategies required to achieve the vision. Back-casting examines different decision pathways required to navigate a range of explorative scenarios (Vervoort et al., 2014). However, this can generate a complex array of options that may confuse participants (Robinson et al., 2011), which was a risk for local level participants in the Stage 2 workshops. Hence we used the scenarios to represent plausible development outcomes, and strategies were considered to be no regrets if they were not mal-adaptive under all scenarios.

Incremental or coping strategies that address proximate drivers of vulnerability can be identified by diagnosing livelihoods at the household or community level (Scoones, 2009; Reed et al., 2013). This requires single loop learning (i.e. incremental improvement of actions without questioning the underlying assumptions; Pahl-Wostl, 2009; Reed et al., 2010). In developing countries, however, vulnerability is often maintained by systemic institutional and political factors, which must be addressed through transformative strategies (Lemos et al., 2007; Pelling, 2011; Rodima-Taylor et al., 2012). To identify and challenge these drivers requires consideration of alternative, long term development trajectories (Butler et al., 2014b), triggering deeper double loop (i.e. re-visiting of assumptions about cause and effect) and triple loop learning (i.e. re-assessing underlying values and beliefs, potentially resulting in changes to institutional norms; Pahl-Wostl, 2009; Reed et al., 2010). Workshop steps and activities (see Section Scenario planning workshop activities below) were designed to initiate single, double and triple loop learning, and thus the formulation of incremental and transformative strategies (Table 1).

Scenario planning workshop activities

This section summarises the sequential steps and activities in the Stage 1 and 2 workshops (see Appendix A for full details). Steps were couched as questions, based on Brown's (2008) learning spiral, and provided outputs which informed the subsequent step (Fig. 2). The process was depicted to participants sequentially as a 'roadmap' (Fig. 3) which formed the workshop agenda. To promote knowledge exchange and social learning, focus groups were formed consisting of mixed stakeholder types. Acknowledging that power dynamics are inherent amongst participants in any participatory process

Table 1
Workshop steps and activities designed to initiate single, double and triple loop learning, and thus the design of incremental and transformative strategies.

Workshop step	Activities	
	Single-loop learning/incremental strategies	Double- and triple-loop learning/transformative strategies
Step 1: What are the drivers of change for livelihoods?	Identification of proximate drivers	Identification of systemic drivers
Step 2: What is the desired future for livelihoods?		2090 time horizon for the vision
Step 3: What are the possible futures for livelihoods?	2030 time horizon for ADWIM impact analysis	2090 time horizon for scenarios; 2060 and 2090 time horizons for ADWIM impact analysis
Step 4: What are the priority no regrets adaptation strategies?	Adaptive capacity indicated by social, human, natural, financial and physical capitals; actors and organisations required to implement strategies from back-casting	Adaptive capacity indicated by political capital and formal and informal institutions; institutional barriers to adaptation identified from back-casting

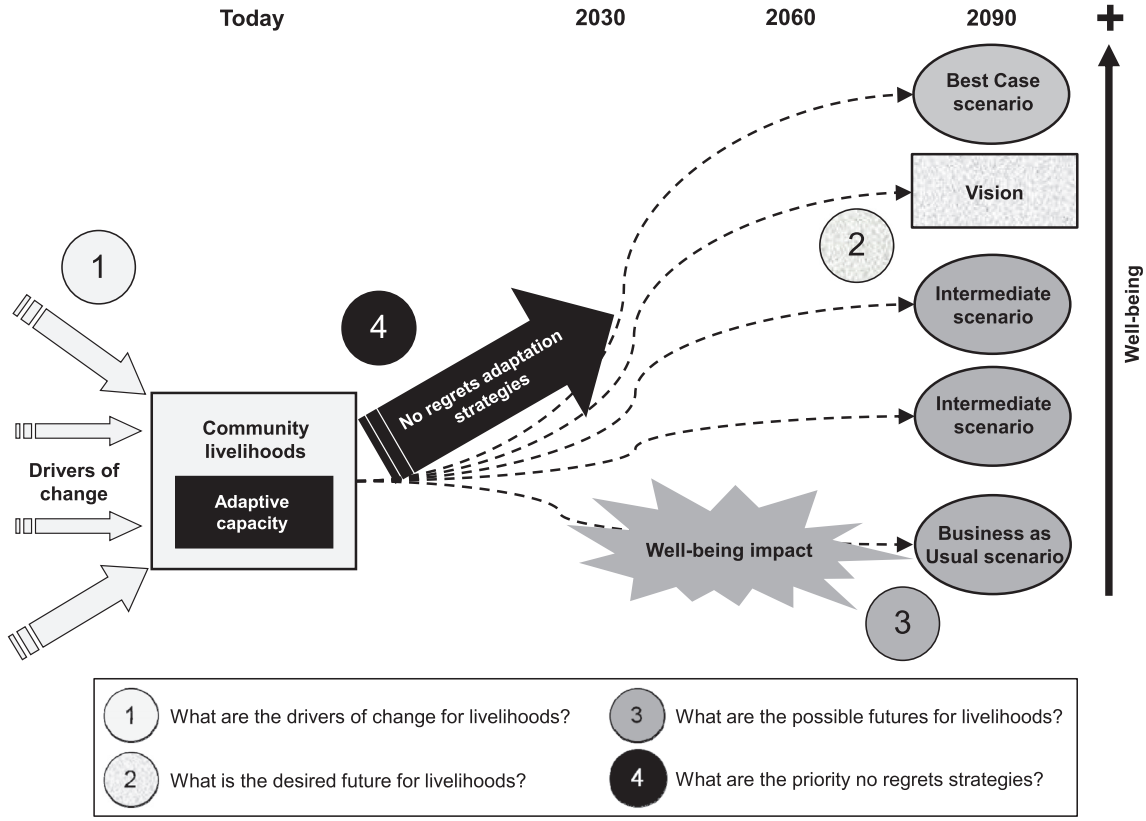

Fig. 3. The 'roadmap' used in the scenario planning workshops to explain the sequential learning steps. The step numbers and questions correspond to the learning spiral in Fig. 2.

(Ballard, 2005; Armitage et al., 2008), methods and facilitation were designed to minimise potential asymmetries and tensions (see Butler et al., 2015a).

Step 1: What are the drivers of change for livelihoods?

This opening session described the geographical focus of the workshop (i.e. province or sub-district), and the drivers of change that were influencing livelihoods in that location. Drivers were defined as causes of issues that participants were concerned about (see Appendix A). The research team gave briefings on relevant socio-economic and cultural characteristics and trends, population projections (Fachry et al., 2011) and downscaled climate and sea level rise projections under high global greenhouse gas emissions (Kirono et al., 2016; McGregor et al., 2016), which together highlighted short term and proximate issues (e.g. drought risk), and longer term and systemic issues (e.g. women's empowerment). Based on this

information and their own perspectives, focus groups then brainstormed and listed individual drivers considered to be most important for livelihoods. These were collated into themes and sub-themes, and participants ranked them by importance.

Step 2: What is the desired future for livelihoods?

Focus groups developed an aspirational vision for livelihoods in 2090. The agreement of a vision is a key step because it establishes a consensus amongst participants about their common values and desired development outcomes (Gidley et al., 2009), and provides a reference point against which scenarios can be compared (CIFOR and SEI, 2009). 2090 was pre-determined by the research team and explained to participants as a time horizon when their grand- or great grand-children would be adults, thus encouraging inter-generational awareness. The vision was described in terms of four constituents of well-being used in ADWIM: income, health, food security and culture.

Step 3: What are the possible futures for livelihoods?

From Step 1, the two highest-ranked driver themes were selected and the deductive 2-axes approach was applied (van der Heijden, 2005), framing a matrix of four development scenarios which reflected different levels of community well-being: 'Best Case', 'Business as Usual', and two intermediates (Fig. 3). Focus groups were assigned one scenario each and created a picture and narrative representing its outcomes in terms of well-being and livelihoods.

Using ADWIM, the potential impacts of the Business as Usual scenario on well-being were then explored. Participants listed and semi-quantitatively ranked ecosystem services and their contributions to income, health, food security and culture. A pre-prepared Excel spreadsheet computed potential relative impacts of population growth and climate change drivers on ecosystem services and well-being at the sub-district type (Stage 1 workshop) or sub-district scale (Stage 2 workshops) for 2030, 2060 and 2090. Results were presented in real-time as simple graphs and debated in plenary (see Skewes et al., 2016).

Step 4: What are the priority no regrets adaptation strategies?

This step involved two activities. First, the current adaptive capacity of communities was assessed. Following Brown et al. (2010), the five capitals from Ellis' (2000) sustainable livelihoods framework were applied to evaluate communities' adaptive capacity as social, human, natural, financial and physical assets. To incorporate systemic power issues we added political capital, which can provide entitlements to resources through political connections (Baumann, 2000). Formal (e.g. legislation) and informal (e.g. cultural norms) institutions were also assessed because they mediate the mobilisation of livelihood assets (Ellis, 2000), and hence adaptive capacity (Rodima-Taylor et al., 2012). Participants listed context-specific indicators for each capital and institutions to represent adaptive capacity. Sub-district types (in Stage 1) and villages (in Stage 2) were discussed in terms of the strengths and weaknesses of each indicator, and participants then ranked the sub-districts' and villages' overall adaptive capacity.

Second, based on the relative adaptive capacity and potential impacts under the Business as Usual scenario, vulnerable sub-district types (Stage 1) or villages (Stage 2) were selected for the development of adaptation strategies. These were identified through back-casting from the vision. In order to achieve the vision, strategies were prioritised to tackle the most important drivers identified in Step 1, and/or drivers of impacts identified by ADWIM for the Business as Usual scenario in Step 3, and/or adaptive capacity strengths or weaknesses. Following Wangel (2011) and Kok et al. (2011), participants also identified the actors required to implement the strategies, and the institutional barriers to implementation. Then, strategies were compared to the three other scenarios to test their no regrets status, and refined if necessary.

Analysis of outputs

After the workshops the outputs were collated and analysed. For drivers of change and adaptation strategies, comparisons were made between those identified by the Stage 1 and Stage 2 workshop participants.

Drivers of change

The prioritised driver themes and sub-themes used to create the 2-axis scenario matrices were categorised as proximate or systemic. Following Pelling (2011), proximate drivers were considered to be current symptoms of community vulnerability and risk, and systemic drivers were the root causes of vulnerability.

Adaptation strategies

Strategies were categorised as incremental or transformative. Incremental strategies work within the incumbent system or processes in the short term (Park et al., 2012) by tackling proximate drivers, or enhancing livelihood capitals. In terms of strategies linked directly to climate impacts, they were "extensions of actions and behaviours that already reduce losses or enhance the benefits of natural variations in climate or extreme events" (Kates et al., 2012, p. 7156). For livelihood capitals, they "identified ways capital can be used to cope in the short term" (Reed et al., 2013, p. 68). Examples included diversifying or intensifying current agricultural production, enhancing skills and education, or improving infrastructure.

Transformative strategies tackled systemic drivers with a focus on institutions, policies and power which determine individual, household and communities' rights and participation (Lemos et al., 2007; Pelling, 2011). In terms of climate change, they are new to a region or resource system, and although often technological, "they are also behavioural, affecting how

individuals and society make decisions and allocate resources" (Kates et al., 2012, p. 7156). In terms of adaptive capacity they address "the institutions that constrain and shape social behaviour and the rules that affect negotiation and the performance of power" (Reed et al., 2013, p. 68). Hence transformative strategies "promote fundamentally alternative forms of development from those described for each site as dominant" (Pelling, 2011, p. 140), creating a new system or process (Park et al., 2012). Examples are new production systems, and modified or new formal and informal institutions, including markets.

To provide a detailed example, strategies developed in Stage 1 for the rice and tobacco sub-district type were compared with those developed in Stage 2 for Janapria, a case study in this type (Fig. 1). The strategies developed by the Stage 1 and all Stage 2 workshops were also aggregated and categorised.

No regrets status of strategies

Although all final strategies were considered to be no regrets, there was debate about the mal-adaptive risk of some. These were collated to illustrate the types of strategies and locations where uncertainties arose.

Results

Drivers of change

Human development was selected as the most or second-most important driver theme by all six workshops (Table 2). Natural resources were selected in four workshops and climate change in three (once in combination with natural resources). In Stage 1, climate change and human development were prioritised, whilst in the Stage 2 workshops three different combinations of driver themes were selected: human development and natural resources (three times), climate change and human development (once) and climate change/natural resources and human development (once).

Of the 58 driver sub-themes (Table 2), 35 (60%) were proximate, and 23 (40%) were systemic. Of the 10 Stage 1 sub-themes, seven (70%) were proximate and three (30%) were systemic. Of the 48 Stage 2 sub-themes, 28 (58%) were proximate and 20 (42%) were systemic. All workshops prioritised both proximate and systemic drivers. Overall, 22 different proximate driver sub-themes were identified, and education and/or health-related issues were the most frequently listed (four times). Thirteen systemic sub-themes were listed, and population growth was the most frequently identified, being listed by all workshops except Sape.

Adaptation strategies

Detailed examples

Stage 1 provincial workshop: Climate change and human development were the most important driver themes. Sub-themes for climate change were temperature increase, wet season rainfall, drought risk, rainfall intensity, sea-level rise and wind and storm severity. For human development, sub-themes were population growth, corruption, community empowerment, education and health (Table 2, Fig. 4).

The combined vision for 2090 included statements for each of the constituents of well-being. For example, for income it was 'achieving community income per capita that can meet their basic needs, housing, health, education and ability to save money'. Four scenarios represented potential development outcomes in 2090 (Fig. 4). ADWIM analysis was carried out for all sub-district types under the Business as Usual 'Jungle Law' scenario. Due to variations in population density and micro-climates, in some sub-district types climate change will drive more substantial impacts on well-being, whilst in others population growth will have the largest impact (see Skewes et al., 2016).

Participants identified 18 indicators of adaptive capacity under the livelihood capitals, including access to information and trustworthy leaders (social), income and remittances from migrant workers (financial), education, health and work ethic (human), quantity and quality of water (natural), irrigation, road and electricity infrastructure (physical), effective community representation by leaders (political), plus representation of women in decision-making and credit schemes (institutions). Participants then ranked sub-district types according to these indicators, but this proved difficult to interpret due to the large numbers of sub-districts in each type, encompassing diverse cultural and human development contexts.

Despite this, adaptation strategies were developed for four vulnerable types. For the rice and tobacco type, four strategies were identified (Table 3). The priority was climate projection information to support farmer decision-making, followed by improving cropping patterns and varieties, establishing Payments for Ecosystem Services (PES) markets for water, and the diversification of non-rice crop production to improve food security. One of these was transformative (i.e. PES), and three were incremental. Three were explicitly designed to address potential impacts of climate change, due to a possible 20% decline in rainfall in the late wet season by 2060, and greater climate variability. None addressed the systemic drivers of population growth, corruption or community empowerment (Table 2), or the political and institutional indicators of adaptive capacity (effective community representation by leaders, women's representation in decision-making, and credit schemes).

Stage 2 Janapria workshop: Janapria is an inland sub-district, with a relatively wet climate and fertile soils. In addition to rice and tobacco, livelihoods are based on livestock and vegetable production. In 2010 Janapria had a population of 68870 in nine villages, with a high average density of 883 people/km^2. Downscaled climate projections indicate a reduction in average annual rainfall of 3%, with possible 20% declines in the late wet season by 2060.

Table 2
Prioritised driver themes and sub-themes selected for the 2-axis scenario matrices in the Stage 1 provincial and Stage 2 sub-district workshops. Driver sub-themes are categorised as proximate or systemic.

Scenario planning workshop	Driver themes	Driver sub-themes	Proximate/systemic
Stage 1 provincial	1. Climate change	Temperature	Proximate
		Wet season rainfall	Proximate
		Drought risk	Proximate
		Rainfall intensity	Proximate
		Wind and storm severity	Proximate
		Sea level rise	Proximate
	2. Human development	Population growth	Systemic
		Corruption	Systemic
		Community empowerment	Systemic
		Education and health	Proximate
Stage 2 Janapria	1. Climate change	Temperature	Proximate
		Wet season rainfall	Proximate
		Drought risk	Proximate
		Wind and storm severity	Proximate
	2. Human development	Population growth	Systemic
		Community empowerment	Systemic
		Education	Proximate
		Science and technology	Proximate
Stage 2 Sape	1. Human development	Education and health	Proximate
		Work ethic	Systemic
		Training and skill levels	Proximate
Stage 2 Jerowaru	1. Human development	Population growth	Systemic
		Education	Proximate
		Mortality rates	Proximate
		Social cohesion	Systemic
		Women's empowerment	Systemic
	2. Natural resources	Ecosystem condition	Systemic
		Water availability	Proximate
		Soil fertility	Systemic
		Land ownership rates	Systemic
Stage 2 Terara	1. Natural resources	Land ownership rates	Systemic
		Tobacco quality	Proximate
		Water availability	Proximate
		Agricultural technology	Proximate
		Fertiliser use	Proximate
		Agricultural pollution	Proximate
		Agricultural product processing	Proximate
	2. Human development	Population growth	Systemic
		Work ethic	Systemic
		Divorce rate	Systemic
		Youth skills and training	Proximate
		Women's empowerment	Systemic
Stage 2 Bayan	1. Climate change and natural resources	Temperature	Proximate
		Wet season rainfall	Proximate
		Flooding risk	Proximate
		Natural disasters	Proximate
		Soil fertility	Systemic
		Forest condition	Systemic
	2. Human development	Population growth	Systemic
		Employment	Proximate
		Credit schemes	Systemic
		Poverty rates	Proximate
		Food security	Proximate
		Levels of well-being	Proximate

As for Stage 1, participants selected climate change and human development as the most important driver themes. Human development sub-themes included two systemic drivers: population growth and community empowerment (Table 2, Fig. 5). The vision statement for 2090 was 'the realisation of physical and spiritual prosperity for Janapria society'. The four scenarios represented other possible development outcomes in 2090 (Fig. 5). ADWIM showed that under the 'Hard Life' Business as Usual scenario, in 2030 population growth would have the primary impact on well-being, whilst declining annual rainfall would have a greater impact by 2060 and 2090.

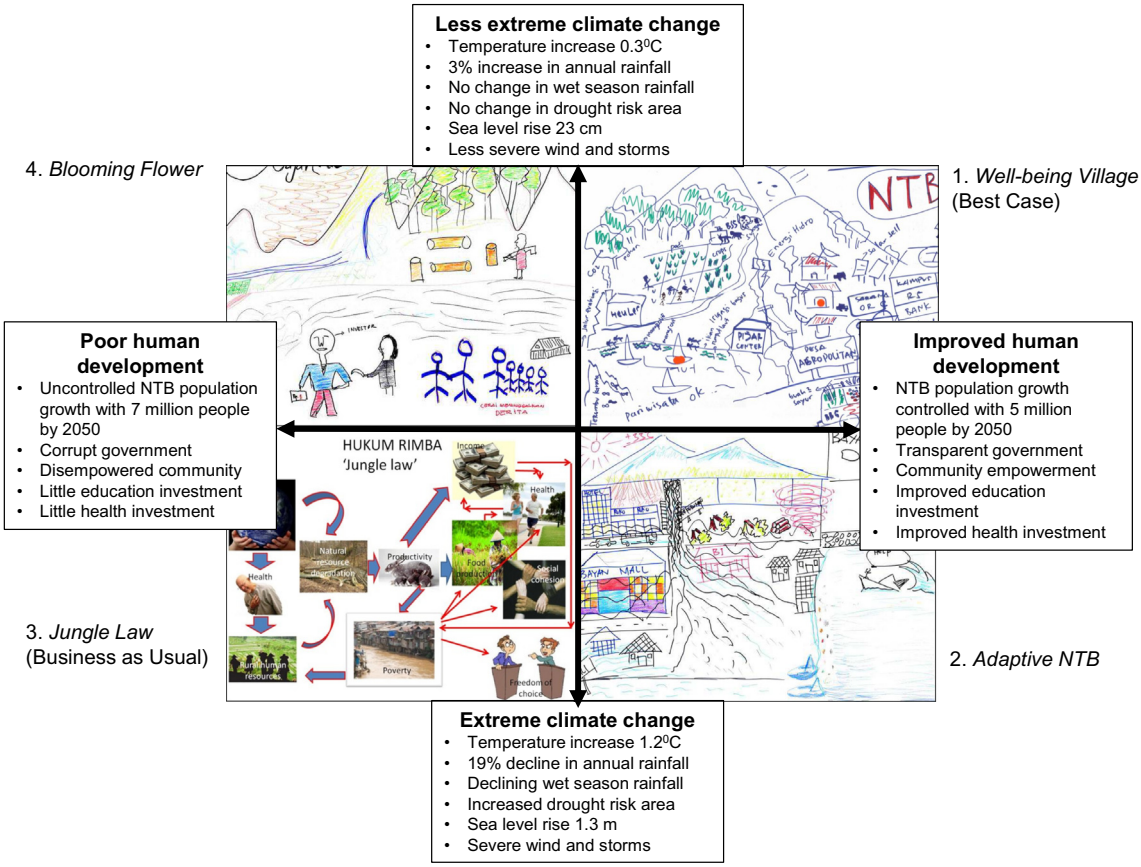

Fig. 4. Driver themes, sub-themes and exploratory scenarios for 2090 from the Stage 1 provincial workshop.

Participants identified 24 indicators of adaptive capacity under the six livelihood capitals, including population density, health, education and skills (human), income and remittances (financial), gender equity and local wisdom (social), and traditional mutual assistance practices, credit schemes and land ownership (institutions). Four vulnerable villages were selected by participants for the development of adaptation strategies.

Strategies varied widely between villages (Table 3). The highest priority strategies for all villages were incremental, focussing on road access, tobacco oven fuel, intensification of agricultural production and diversification of income. Secondary strategies were also incremental, targeting diversification of agricultural production and skills-building for farmers. Of all 16 strategies, 13 were incremental. Three were transformative (establishment of credit schemes, improved tobacco markets and re-establishment of traditional institutions and knowledge). Although none addressed the systemic drivers of population growth and community empowerment (Table 2), two of the institutional indicators of adaptive capacity (credit schemes and traditional mutual assistance practices) were targeted as third and fourth priorities, but the third (land ownership) was not. Only one strategy explicitly targeted climate change impacts, the establishment of Climate Field Schools for farmers.

Aggregated workshop strategies

Of the 15 strategies identified by the Stage 1 workshop, 67% were incremental and 33% were transformative (Fig. 6a). Of all 87 strategies identified by the Stage 2 workshops, 84% were incremental, and 16% were transformative (Fig. 6b). Overall, 81% were incremental and 19% were transformative.

No regrets status of strategies

None of the Stage 1 and eight (9%) of the Stage 2 strategies were potentially mal-adaptive (Table 4). All were incremental strategies that either built infrastructure (e.g. irrigation, sea walls, ports), or diversified or intensified agriculture and fisheries. Six strategies related to uncertainties regarding climate change and sea level rise, including implications for port, sea wall and irrigation infrastructure. Six related to one case study, Bayan (Fig. 1), a coastal sub-district on the slopes of Mount Rinjani in Lombok, where the most extreme rainfall change in NTB is projected to occur. Of the eight cases, only one was a first priority strategy.

Table 3
Prioritised no regrets adaptation strategies identified for rice and tobacco type sub-districts by the Stage 1 workshop, and for four villages (A–D) in Janapria sub-district by the Stage 2 workshop. Strategies explicitly addressing climate change impacts are marked *.

Rice and tobacco		Janapria	
Strategy	Incremental/ transformative	Strategy	Incremental/ transformative
Priority 1		*Priority 1*	
Climate projection information to support farmer decisions*	Incremental	A. Improve village road access	Incremental
		B. Diversify tobacco oven fuel	Incremental
		C. Intensify agricultural production and product quality	Incremental
		D. Diversify income sources	Incremental
Priority 2		*Priority 2*	
Improve cropping patterns and varieties*	Incremental	A. Diversify agricultural systems	Incremental
		B. Build skills of tobacco farmers	Incremental
		C. Establish Integrated Pest Management Field Schools	Incremental
		D. Provide education and training for farmers	Incremental
Priority 3		*Priority 3*	
Establish Payments for Ecosystem Services markets for water in catchments	Transformative	A. Establish credit schemes	Transformative
		B. Establish improved tobacco markets	Transformative
		C. Establish Climate Field Schools for farmers*	Transformative
		D. Improve electricity infrastructure	Transformative
Priority 4		*Priority 4*	
Diversify non-rice production to improve food security*	Incremental	C. Improve community education and skills	Incremental
		D. Re-establish traditional institutions and knowledge	Transformative
		Priority 5	
		C. Improve community health and welfare	Incremental
		D. Improve road and irrigation infrastructure	Incremental

Discussion

In developing country contexts, planning for future uncertainty faces numerous challenges. A primary issue is that stakeholders cannot easily conceptualise long time horizons and systemic causes of vulnerability, potentially biasing them towards single loop learning and therefore only the identification of symptoms and incremental responses. Our process attempted to overcome this through several activities designed to encourage double and triple loop learning (see Table 1). This began in Step 1 with the presentation and discussion of socio-economic and cultural trends, plus population and climate change projections, which highlighted both short term or proximate issues, and longer term or systemic issues. The fact that 40% of all driver sub-themes prioritised by Stage 1 and Stage 2 workshops were systemic indicates that this activity may have been effective. Furthermore, 48% of those identified by the local level stakeholders in Stage 2 workshops were systemic. This is notable considering that community stakeholders are most likely to focus on their immediate needs (Conway and Mustelin, 2014) and coping strategies (Scoones, 2009), and in NTB these actors tend to view the future in shorter time horizons than those from higher levels (Bohensky et al., 2016.

However, whilst a high proportion of prioritised driver sub-themes were systemic, we have no evidence that double or triple-loop learning was responsible for this result. Ex-post evaluation of participants using questionnaires (Butler et al., 2015a) and interviews (Butler et al., 2016b) showed that the workshops had encouraged systems thinking, appreciation of diverse perspectives, cross-scale social networks, new partnerships, and innovative solutions, all of which are outcomes indicative of an effective social learning process (Johnson et al., 2012), and enhanced adaptive capacity (Armitage et al., 2008). Unfortunately the methodology was unable to discern in detailed the triggers and characteristics of individual and social learning within the workshops. Consequently, it was impossible to identify with any certainty the extent of single, double or triple loop learning, and its causal influence on outputs. In future, more nuanced methods (e.g. Cundill and Fabricius, 2009; van Epp and Garside, 2014) should be applied within workshops to track learning and the activities or debates responsible. These could also be applied after workshops to follow subsequent learning (Fazey et al., 2014), and to generate further reflection and action amongst participants (Butler et al., 2015b, 2016b).

In NTB, marginalisation of community members by political and government elites is commonplace in *musrenbang* (Purba, 2011; Aswad et al., 2012). This was also reflected by the Stage 1 and 2 workshops, which identified community

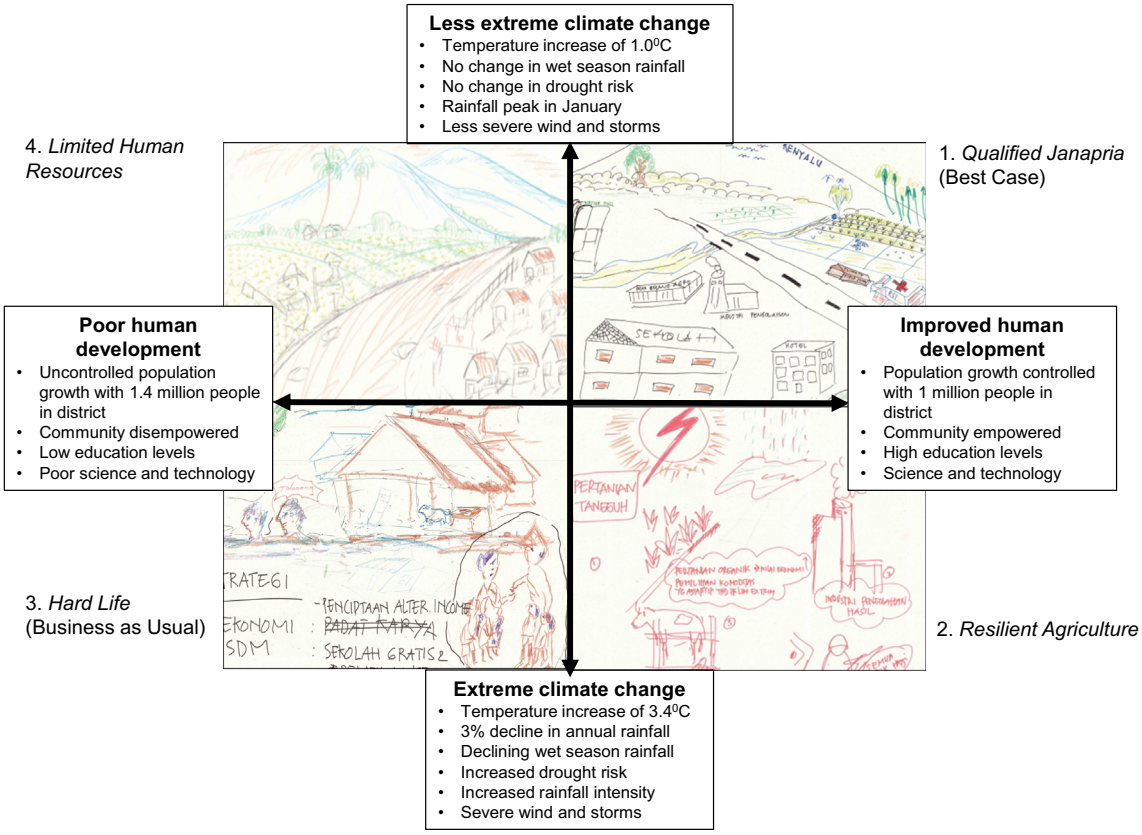

Fig. 5. Driver themes, sub-themes and exploratory scenarios for 2090 from the Stage 2 Janapria sub-district workshop.

and women's empowerment as systemic issues (see Table 2). To mitigate these power asymmetries, our approach engaged national, provincial and local level stakeholders separately, and methods were used within workshops to further manage potential power dynamics amongst participants. In addition, particular emphasis was placed on ensuring representation by women stakeholders to achieve a gender balance in discussions. Ex-post evaluation suggested that community level stakeholders felt empowered by this process (Butler et al., 2015a), and women in particular (Butler et al., 2016b), and consequently this systemic issue was possibly mitigated within the workshops. However, our evaluation methods were not sufficiently sophisticated to expose power dynamics, or to pinpoint their influence on the learning process and its outputs. As discussed above, more sensitive methods should be developed and applied if this critical aspect of scenario planning practice and adaptation pathways principles is to be better monitored and managed.

The segregation of stakeholders also enabled analysis of community adaptation and development from different perspectives, which can generate a diversity of perceptions, systems understanding and options for intervention (Biggs et al., 2007; Kok et al., 2007; Özkaynaka and Rodríguez-Labajos, 2010). The Stage 1 workshop examined livelihoods more broadly at the provincial scale, whilst the Stage 2 workshops analysed individual sub-districts. This captured a wide range of 22 proximate and 13 systemic driver sub-themes. Whilst activities did not explicitly define drivers' scales of origin, it was evident that multiple scales were recognised. For example, in Janapria sub-district, local (e.g. community empowerment), regional (e.g. population growth) and global (e.g. science and technology) drivers were prioritised by participants, and these were also identified by higher level stakeholders in Stage 1. However, there were differences in the adaptation strategies designed at the different scales. Perhaps because of the difficulty of assessing community adaptive capacity for sub-districts aggregated into types, the Stage 1 participants tended to design more technical strategies (e.g. PES and improved cropping varieties for rice and tobacco sub-districts). The Stage 2 workshops enabled a more detailed analysis, with the differing combinations of priority driver themes reflecting the spatial heterogeneity of climate and potential climate change impacts, population densities and projections and livelihoods typical of NTB's island geography. These localised perceptions enabled the design of strategies tailored to local scale contexts and drivers, including village level adaptive capacity, and subsequently formed the basis of the sub-district development plans formulated in the Stage 3 integration workshops (Wise et al., 2016).

Overall, 81% of adaptation strategies were incremental. However, Stage 2 participants favoured incremental actions to a greater degree than Stage 1 participants. Overall, 84% of all Stage 2 workshop strategies were incremental, versus 67% of Stage 1 strategies. For Janapria sub-district (i.e. Stage 2), 13 (81%) were incremental, versus three (75%) for rice and tobacco

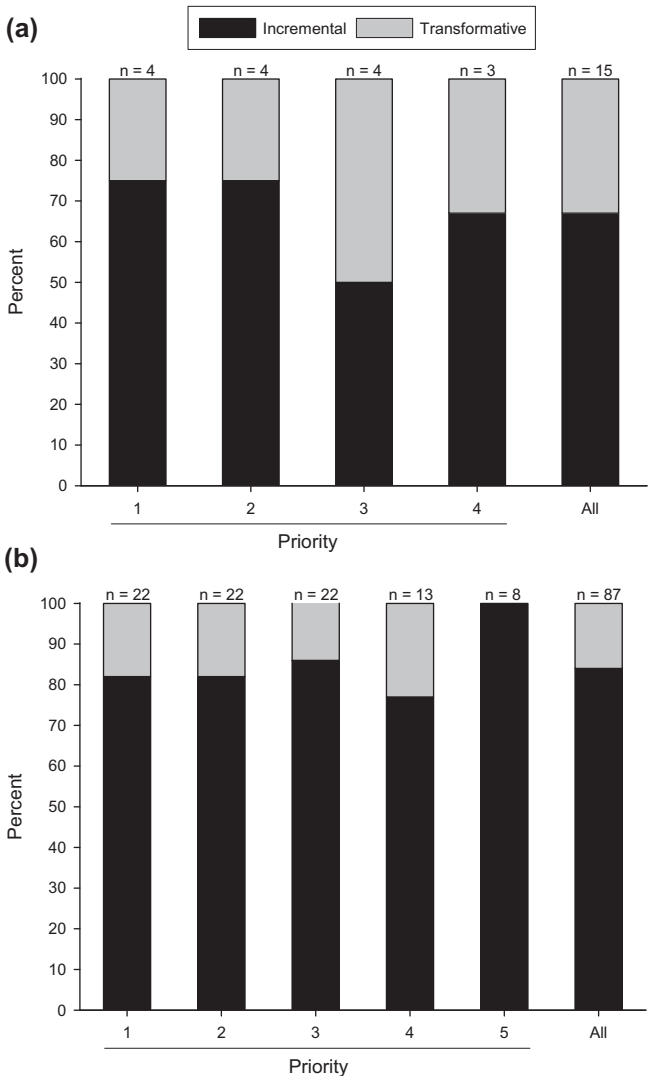

Fig. 6. Adaptation strategies (n) categorised as incremental or transformative, presented by priority, for (a) sub-district types assessed in the Stage 1 workshop, and (b) for villages within the case study sub-districts assessed in the Stage 2 workshops.

Table 4
Characteristics of adaptation strategies identified by Stage 2 sub-district workshops as potentially mal-adaptive, listed by priority.

Sub-district	Strategy	Incremental/ transformative	Priority	Issue discussed
Bayan	Intensify rice production	Incremental	1	With declining rainfall may need to transform out of rice production
Bayan	Develop eco-tourism and cultural tourism	Incremental	2	Risk of tourists being discouraged by social unrest and insecurity
Bayan	Intensify coastal fisheries	Incremental	2	Risk of climate impact on coastal fisheries
Bayan	Port development	Incremental	3	Risk of sea level rise and storm waves for port infrastructure
Bayan	Diversification into livestock production	Incremental	3	Risk of lack of fodder due to land use conversion, and cattle theft
Bayan	Diversification into agro-forestry	Incremental	4	Risk of landslides due to extreme rainfall
Janapria*	Improve irrigation infrastructure	Incremental	5	With less rainfall may need to transform out of irrigated rice production
Sape	Build sea walls to combat sea level rise	Incremental	5	Potential wasted investment if sea level rise does not occur

* See Table 5 in Appendix A for further detail.

sub-districts (i.e. Stage 1). This difference may be attributable to the higher level stakeholders having greater awareness of longer term and systemic issues (Enfors et al., 2008; Scoones, 2009), and thus the need for transformative interventions. However, it may also have been a function of their limited ability to analyse community adaptive capacity for aggregated sub-districts, resulting in a lesser focus on incremental actions targeting livelihood capitals.

The examples of strategies derived for rice and tobacco sub-districts and Janapria within this type illustrate the wide range of interventions regarded as necessary. Pelling (2011) identified two adaptation themes, the nature of adaptation action and its scope of impact, which together generate a 'tapestry' of potential responses. Similarly, McGray et al. (2007) categorised adaptation actions as lying along a continuum from a vulnerability focus (addressing the drivers of vulnerability) to an impact focus (exclusively confronting climate change). These spectrums were evident in NTB. For rice and tobacco sub-districts, where climate change was selected as the priority driver, three of the strategies were a direct response to future climate impacts, but in Janapria, where climate change was also selected, only one of the 16 strategies was a direct response. The remaining strategies focussed on building livelihood capitals (e.g. enhancing farmers' skills, improving health and road access), and in a minority of cases addressed institutions that can mobilise capitals (e.g. PES markets, establishing credit schemes), and hence adaptive capacity.

However, the tapestry of strategies seems unlikely to enable rural communities in NTB to leap-frog the SDGs imminently because only a minority was transformative. For rice and tobacco sub-districts, population growth, corruption, community empowerment, effective community representation by leaders, representation of women in decision-making and credit schemes were identified as systemic drivers or institutional factors mediating adaptive capacity. Yet establishing PES was the only transformative strategy, and this was also the solitary example of an intervention with an explicit link to environmental sustainability. In Janapria, where population growth, community empowerment, land ownership, credit schemes and traditional mutual assistance practices were identified as systemic issues, only two were addressed by transformative strategies (credit schemes and the re-establishment of traditional institutions and knowledge), and neither were a first priority. Instead, the majority of strategies in both examples were incremental and targeted conventional development needs (e.g. improved road access, intensification of agricultural production and product quality). Nonetheless, both Kates et al. (2012) and Park et al. (2012) stress that incremental actions are a prerequisite to building capacity and opportunities for transformation, and this can take years or decades to emerge (Feola, 2015).

Despite the lack of transformative strategies, none of the Stage 1 and only 9% of the Stage 2 strategies were potentially mal-adaptive. This indicates that if implemented, the vast majority will yield benefits under a range of future development and climate change scenarios, and would therefore be no regrets. Of the potentially risky strategies, six were related to uncertainties in climate change impacts on infrastructure, and most occurred in a coastal sub-district in north Lombok which climate projections suggest will experience the most marked rainfall changes in NTB (Kirono et al., 2016; McGregor et al., 2016), plus sea level rise. This indicates that risks of mal-adaptive outcomes are greatest for infrastructural development in coastal areas exposed to sea level rise, and where the magnitude of future climate change is highest. This finding matches that of Stafford Smith et al. (2011), who identified decisions about infrastructure as having extended 'consequence times', and should therefore be delayed until future risks are better understood. However, this may not be feasible in a developing country context where infrastructure is a prerequisite to delivering 'soft' strategies (e.g. health, education, access to markets) that can build community adaptive capacity (Wise et al., 2016). Consequently, some level of mal-adaptive risk may be necessary to enable communities to leap-frog the SDGs.

Conclusions

This study illustrates how, when operationalised through scenario planning, adaptation pathways principles can enable multiple stakeholders to mainstream no regrets responses to future uncertainty, including climate change, into community development planning. In this way adaptation planning can question and potentially redress potentially mal-adaptive development trajectories and outcomes (Pelling, 2011). In addition, our approach facilitates the tailoring of adaptation to local livelihood contexts, which is important in island geographies such as NTB. However, the predominance of incremental strategies indicates that the process did not adequately address the root causes of community vulnerability, although numerous systemic drivers, political and institutional issues were identified. This was perhaps because our brief 3 or 2-day workshops provided insufficient learning spirals for participants to analyse these issues and revise their strategies accordingly. The precise explanation is difficult to establish, however, because our evaluation methods could not pinpoint the activities or power dynamics which enabled or constrained effective double and triple loop learning (Butler et al., 2016b).

As highlighted by Chaudhury et al. (2013) and Vervoort et al. (2014), in a developing country context where capacity of all stakeholders is generally low, scenario planning exercises should be seen as only the first stage of a long term capacity-building process which must be maintained to enable decision-makers to reflect and learn iteratively. Ideally this process must include the on-going implementation, evaluation and refinement of adaptation strategies, and in NTB the annual *musrenbang* cycle of village development planning offers an ideal vehicle for this (Butler et al., 2016b). Nonetheless, our approach could potentially become a transformative social innovation because it empowers community members and provides a forum for the exchange of knowledge and ideas (Butler et al., 2015a). If sustained, such grass roots platforms can catalyse and implement transformation (Berghout et al., 2010; Leach et al., 2012; Fook, 2015), and ultimately enable vulnerable communities to leap-frog the SDGs.

Acknowledgements

We acknowledge funding support from the Australian Government's Department of Foreign Affairs and Trade-CSIRO Research for Development Alliance. We thank two anonymous reviewers and Peter Brown for their comments which greatly improved the paper.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.crm.2015.11.003.

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