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Developing and applying a five step process for mainstreaming climate change into local development plans: A case study from Zambia

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ABSTRACT

Climate change is a cross-cutting issue and, as such, is most effectively addressed when mainstreamed in development planning. Assessing climate risk and mainstreaming adaptation into development plans ensures that hard-won development gains are not undermined, and that future development interventions are resilient in the face of a changing climate. We outline a five step process to mainstream climate change into development plans. The five steps are: preparation; current and future gender-sensitive climate risk assessment; climate risk screening to see how proposed activities are affected by climate risk; options to adapt and enable climate-resilient development; and implementation, monitoring and evaluation. The process is underpinned by theory on climate risk assessment and robust decision making, and informed by participatory methodologies and expert elicitation. It was applied to District and/or Integrated Development Plans in 6 districts in Western and Southern province of Zambia under the Pilot Program for Climate Resilience. Findings show that it is a useful methodology that can be applied in data-constrained environments with minimally-trained expertise to assess climate risk and enable adaptation and climate-resilient development.

1. Introduction

Climate change is a cross-cutting issue that has implications across development sectors. As a result, mainstreaming climate change into development plans is likely to be more successful than addressing it in isolation through sectoral climate change policies or plans. Ensuring that climate change is taken into account in integrated development planning has two benefits. First, it ensures that development gains will not be undermined by climate risk. Second, it offers the opportunity to build adaptive capacity and resilience in the face of climate change, so that the risk of future adverse impacts is minimised.

Whilst there are many reasons for mainstreaming climate change into local development plans in sub-Saharan Africa, there are a number of barriers to the process (Benson et al, 2014). Global climate models are the mechanism through which we are able to project future climate conditions. Although they can be downscaled, the various approaches still have limitations in their ability to plausibly and accurately represent the multitude of micro-level influences on climate (Hewitson et al, 2014). Although there are development planners and sectoral planners at local level, there is unlikely to be the technical expertise that can discern between various climate projections (Pasquini et al, 2015, 2013; Shemdoe et al, 2015). Combined with insufficient technical expertise, lack of

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data also impedes the capacity for highly technical impact assessments (Girvetz et al., 2014). Despite these constraints, however, action cannot be postponed as climate change threatens to undermine hard-won development gains and exacerbate vulnerability of people and the environment. Instead it is necessary to use the information that exists and employ "good enough" methods in a risk management approach (Durose et al, 2017; Daron et al, 2015; IPCC, 2014). In order to address this need, a five step process for mainstreaming climate change into local development plans was developed and refined following use in Zambia.

2. Why mainstream climate change in development plans?

Like most cross-cutting issues, climate change poses a risk to many development sectors and thus addressing it cannot be achieved by placing it in a silo (Agrawal and Lemos, 2015; Reid and Huq, 2014). Instead it should be mainstreamed, or integrated, into existing priorities. There is a two way relationship between climate risk and development plans: i.e. climate risk may affect development plans; and development plans may affect climate risk.

On the one hand, the development goals in a plan may be affected by climate risk. Take, for example, a drought-prone district with the strategic objective of attaining food security using a programme of agricultural development which has, as a key project, the promotion of a water-intensive crop such as lowland rice. If the district is exposed to drought (as the climate hazard) there will be vulnerability, since lowland rice is dependent on adequate water supply. The likelihood of a negative impact (production losses) is high – resulting in high climate risk which threatens the attainment of the strategic objective of food security.

On the other hand, the development goals may affect climate risk by increasing vulnerability. Take, for example, a flood prone district with the strategic objective of increasing the availability of housing for a growing population, using a programme of low cost housing that will be implemented through a project that involves construction of 50 units of subsidised housing. If climate hazards are not considered, these houses may be planned to be built in an area which is likely to become regularly subjected to flooding. By placing additional people at risk of exposure to flooding, this development plan increases climate risk and raises the chances that the benefits of investments will be undermined.

Additionally, the development goals and programmes may increase climate risk through contributing to climate change (and thus the likelihood of a climate hazard). This is the case for activities that contribute to greenhouse gas emissions, for example through deforestation.

3. Theoretical underpinnings

3.1. Climate risk assessment

This method follows the IPCC's approach to risk assessment, where the risk of negative impacts of climate change is dependent not only on exposure to the hazard itself, but also vulnerability to that hazard and the extent to which vulnerability may be offset by adaptive capacity (IPCC, 2014). Building resilience comes from reducing risk, and thus can be done by reducing vulnerability or increasing adaptive capacity.

Climate hazards include incremental change in temperature and various elements of rainfall variability (including distribution throughout the year), as well as extreme events such as droughts, floods, heat waves and storms. Vulnerability contains two elements: biophysical and social. Biophysical vulnerability reflects how the environment exposed to the hazard is affected by it. An increase in sea level of 50 cm will not reduce land on a sharp coastline in the same way it would on a gently sloping gradient. Social vulnerability reflects how the people and socio-economic systems exposed to the hazard are affected by it. Social vulnerability (and adaptive capacity) is dependent on financial, physical, social, natural and human capital (Brooks et al., 2005; Yohe and Tol, 2002; Adger and Kelly, 1999). At local level it may be that one village is exposed to a drought but that an elderly woman is at greater risk than a working age man. Her social vulnerability is higher because of her dependence on natural resources and poorer health means that her livelihood is vulnerable to a reduced availability of water; compared to the man who is better educated and mobile and earns his living through non-natural resource-dependent commercial enterprise (e.g. a shopkeeper). Social vulnerability is also contingent upon factors such as gender, ethnicity and age. To reflect this, gender-sensitive approaches to climate risk assessment are being advocated, and will also be followed here (Bunce and Ford, 2015; Morchain et al, 2015). Nuanced understandings of the nature of vulnerability are essential to identify how to build resilience through adaptive capacity, so that hazard exposure does not necessarily give rise to negative impacts.

3.2. Robust decision-making

The traditional approach to adaptation and building resilience was based on a top-down "predict-then-act" approach, relying on global climate model projections of future conditions. However, global climate models embody uncertainties. Whilst local planners are adept at dealing with uncertainty in spheres in which they are confident, in fields new to them – such as climate change – this can lead to confusion (Gottschick, 2015; Hallegatte, 2009). The lack of certainty in information impedes the identification of an optimal decision, and hence can cause delays in proactive adaptation. To overcome this challenge, the process of mainstreaming climate change is contingent upon an approach of robust decision making. Robust decision making (RDM) is an alternative evaluation tool where the focus is on identifying options that will be appropriate under a range of plausible future climate scenarios (Watkiss et al, 2015). RDM has been widely used in developed countries (Hallegatte et al, 2012; Lempert and Groves, 2010). However, it is also adaptable for use in developing countries, for example where stakeholder-led elicitation of vulnerabilities can substitute where data availability is a problem (Bhave et al, 2016; Daron, 2014). Here RDM is modified to be appropriate for the purposes of planning documents, so that the development plan vision and priorities for a district will be robust under a variety of plausible climate futures. Specific design standards and feasibility studies will clearly be undertaken prior to the implementation of individual (particularly infrastructure-related) activities.

4. Mainstreaming climate change into development plans in Zambia

The Pilot Program for Climate Resilience (PPCR), funded by the Climate Investment Funds through the World Bank, is being implemented by the Ministry of National Development Planning in the Barotse sub-basin of the Zambezi River in Zambia. The Barotse sub-basin covers 17 districts (16 in Western Province and one in Southern Province), 14 of which are target districts for the program. Since its commencement in 2014, PPCR has attempted to build awareness and understanding of climate change and its threats within these districts. It also provides funding for local level adaptation interventions. To ensure sustainability of these interventions, PPCR requires that districts mainstream climate change into their development plans at district and ward level. The five step process was developed to address this need.

Undertaking this process under the auspices of PPCR overcomes some of the typical barriers to mainstreaming climate change into development plans. Appropriate entry points have been scoped and collaborative partnerships have been built between the district government and the PPCR Secretariat (Cástan Broto et al, 2015a; Conway and Mustelin, 2014). Finance is also available, not just for the process (in terms of funding the community-based processes and facilitating the meeting of planners) but also for the implementation of adaptation interventions identified within the plan (ODI and UNDP, 2011; Fenton et al, 2014). The institutional context is also appropriate in that there are few conflicts between local and national level (Lawrence et al, 2015; Measham et al, 2011). Zambia is undergoing decentralisation, with a revised Decentralisation Policy in place since 2013, meaning that responsibilities and resources are in the process of being devolved to district level from national.

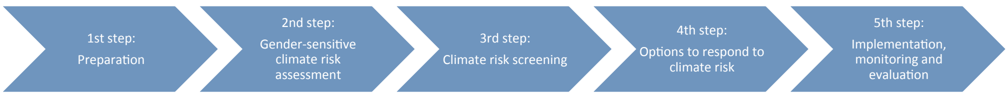
Zambia's planning framework also is conducive to integration of climate change. One of the objectives in the National Climate Change Policy, approved by Cabinet in April 2016, is "To promote mainstreaming of climate change into policies, plans and strategies at all levels in order to account for climate change risks and opportunities in decision making and implementation". The Revised Sixth National Development Plan (2013–16) and Seventh National Development Plan (2017–21) also both highlight the importance of addressing climate change. Currently there are two planning instruments in place at district level. District Development Plans are socio-economic plans under the Ministry of National Development Planning (prepared by all development sectors in the district) that are produced every five years to feed into, and reflect, the five-year National Development Plans. Integrated Development Plans are spatial plans produced every ten years under the Ministry of Local Government, as prescribed in the Urban and Regional Planning Act of 2015; they are the 10-year umbrella for the 5-year District Development Plans. In the future it is possible that these plans will be streamlined in line with the National Planning and Budgeting Policy.

5. A five step process for mainstreaming climate change into development plans

5.1. Method

A five step process for taking a gender-sensitive approach to mainstreaming climate change into development plans was developed, based on good practice around addressing climate risk, climate proofing existing plans, and ensuring adaptive development (Fig. 1) (UNFCCC, 2014).

The process is based on participatory methods and scenario development (Oteros-Rozas et al, 2015; Bizikova et al, 2014; Chambers, 1994). Participatory methods offer several advantages. They enable inclusion of local knowledge and contextual specificity (Naess, 2013). As a result of including the stakeholders whose lives will be affected by the decisions, they also tend to have better likelihood of effective implementation (Bisaro et al, 2015; Cástan Broto et al, 2015b; CARE, 2014a). Participatory methods



Purpose	To ensure structures in place for effective climate change mainstreaming	To identify the nature of current and future climate risk	To determine climate risk to the Development Framework (in Zambia known as key issues and priorities) and to the Implementation Programme	To ensure that the Development Framework (key issues and priorities) and Implementation Programme address climate risk, support adaptation to climate change and enable climate-resilient development	To ensure, through appropriate monitoring and evaluation, that implementation of the plan is supporting adaptation to climate change and enabling climate-resilient development

Fig. 1. Five step process for mainstreaming climate change into development plans.

have been used in adaptation planning in the global North (Campos et al, 2016; Wachsmuth, 2015) and also adapted for use in data-constrained environments with limited climate change technical knowledge (Girvetz et al., 2014). The process draws upon methods and guidance for vulnerability risk assessment and participatory planning from various NGOs (Morchain and Kelsey, 2016; CARE, 2009, 2017, 2014b).

The process was designed to mainstream climate change within the existing process that is in place to develop local plans. However, in this case development plans were in existence already, and so the method was adapted to "retrofit" existing plans. After preparation as the first step; the second step entails gender-sensitive climate risk assessment taking into account both current and future climate risk; the third step involves climate risk screening; the fourth step involves options to respond to climate risk; and the final step requires that appropriate monitoring and evaluation procedures are put in place to ensure effective implementation. It was trialled in 6 districts of Western Province through a hands-on combined training and technical backstopping approach to mainstream climate change into their existing District and/or Integrated Development Plans. Here we outline the process from scratch.

5.2. First step-preparation

The first step of the process is to undertake appropriate preparation. This would be aligned with the existing preparation process for developing either District or Integrated Development Plans. Since climate change is a cross-cutting issue, the process of mainstreaming requires involvement of several individuals. The planning team should ensure that climate change mainstreaming is central to the process, and ensure that it is appropriately represented in any timelines and work plans to develop the plan. Where possible, it is helpful to nominate a task team or individual, with sufficient background and experience in climate change issues, to act as champion.

5.3. Second step – Gender-sensitive climate risk assessment

The purpose of gender-sensitive climate risk assessment (GCRA) is to determine current and likely future climate risk that the district will face and ensure that this is recognized within the plan. It is important for planning purposes to identify the spatial and social nature of climate risk and ensure that key projects and activities in the development plans incorporate those risks for two reasons: to ensure that particular plans will not be at risk from climate change; and to identify vulnerability to climate hazards that otherwise might be overlooked and would need to be addressed within the plan to reduce climate risk. Typically the process of developing plans requires some kind of status assessments (known as planning survey reports and situational analyses in Zambia's Integrated Development Plans and District Development Plans respectively). GCRAs involve determining hazard exposure, vulnerability and adaptive capacity, with a particular emphasis on how vulnerability and adaptive capacity differs between men and women.

Bearing in mind that climate risk is dependent on hazard exposure, vulnerability and adaptive capacity, all three elements need to be considered. GCRAs are a participatory methodology and should be conducted at the relevant levels of administration (community, ward and district level in Zambia) with local residents and/or district staff with location-specific expertise, with each level informing the one above it. It is important to bear in mind local power relations and take an inclusive approach, ensuring that voices of marginalized members of communities are also included. In particular, this approach increases the likelihood that women's voices will be heard, and thus the gender differences in vulnerability and adaptive capacity can be determined. Table 1 outlines the steps that need to be undertaken to conduct a GCRA, and outlines some of the qualitative tools that can be used for data collection (for more information, see Vincent and Cull, 2015). The qualitative data from a GCRA should be supplemented with scientific data on current and future climate risk. Local information adds context to scientific data and, where this data does not exist, this methodology offers a plausible alternative.

5.3.1. Current climate risks

Hazard exposure can be determined using observational data from weather stations, for example of temperature and rainfall. New climate information products that combine station records with satellite data can now provide insights into past weather conditions across Zambia (Dinku et al, 2016). When observational data is not available, memories of recent trends in key climate variables can be a substitute.

Expert recall of climate trends (for example those outlined below) can be used to supplement scientific data.

- Temperatures (trends, hot days/nights, cold days/nights).
- Rainfall (length of rainy season and distribution of rains, e.g. frequency and lengths of dry spells within the rainy season).
- Groundwater availability.
- Extreme events (heat waves, droughts, floods, fires, storms).

The key is to determine changes in trends – as opposed to the characteristics themselves, with as much detail as possible. Similarly determining biophysical and social vulnerability should be done through participatory exercises at local level, supplemented by expert recall from district officials. Spatial mapping of the effects of past hazards can highlight where negative impacts of past exposure have been felt, whilst examination of who was most affected, and in what way, highlights social vulnerability. Understanding gendered differences in vulnerability enables the design of effective adaptation options/highlights where it is necessary to build adaptive capacity in order to reduce risk and enable gender-equitable climate-resilient development.

Table 1
Steps in, and potential tools for, conducting Gender-sensitive Climate Risk Assessment.

Steps in conducting the GCRA									
Steps/methods to obtain information		Potential tools[1]							
		Focus group on gender norms	How the community brings up boys and girls	Changes in seasonal calendar	Daily calendar	Livelihood ranking	Historical timeline	Risk/ vulner-ability matrix	Transect walk
Current climate risks									
1	Ensure you are familiar with gender roles and relations	√	√	√	√	√			
2	Determine the hazard exposure and how it has changed over time			√			√	√	√
3	Determine the sensitivity/ biophysical vulnerability								
4	Determine the social vulnerability/adaptive capacity						√		
5	Validate existing risks								
Future Climate Risks									
6	Determine future climate risks								
7	Future visioning								
8	Identify long list of adaptation options								
9	Consolidate short list of adaptation options								
10	Finalise list of adaptation priorities								

Steps in conducting the GCRA										
Steps/methods to obtain information		Potential tools[1]								
		Community resource map	Risk map	Focus groups	Impact chains	Community meeting	Interviews	Participato-ry scenario generation	Future seasonal calendar	Matrices of evaluation criteria against adaptation options
Current climate risks										
1	Ensure you are familiar with gender roles and relations									
2	Determine the hazard exposure and how it has changed over time									
3	Determine the sensitivity/ biophysical vulnerability	√	√							
4	Determine the social vulnerability/adaptive capacity		√	√						
5	Validate existing risks			√	√	√	√			

(*continued on next page*)

Table 1 (*continued*)

Steps in conducting the GCRA										
Steps/methods to obtain information		Potential tools[1]								
		Community resource map	Risk map	Focus groups	Impact chains	Community meeting	Interviews	Participatory scenario generation	Future seasonal calendar	Matrices of evaluation criteria against adaptation options
Future Climate Risks										
6	Determine future climate risks			√				√		
7	Future visioning			√					√	
8	Identify long list of adaptation options			√	√					
9	Consolidate short list of adaptation options			√						
10	Finalise list of adaptation priorities			√						√–>

[1] The tools should be used in separate groups for men and women (and, where appropriate, boys and girls), to avoid dominance of one gender, e.g. men in a patriarchal community.

Table 2
Determining potential sectoral and social impacts of a scenario of increasing temperature in Nalolo district (with severe impacts shown in bold).

Impacts (Sectors)							
Agriculture	Forestry	Livestock	Fisheries	Infrastructure	Water and sanitation	Education	Health
Reduced crop production (All Crops)	Low regeneration of some tree species in forests	**Decrease in animal productivity (all livestock)**	Reduced fish catch (All rivers)	**A lot of cracking on roads resulting in the reduction in lifespan of the bituminous road (Mongu Senanga road)**	Surface water sources for animals and people dry up due to excessive evaporation (e.g. Shekela ward)	Pupils will be affected by the diseases hence there will be increased absenteeism.	There is an increase of disease such as chicken pox, measles throughout the district.
Some arable land becomes unviable along the plains (Muoyo, Kataba, Makoka, Lukolo, Nanjucha) and in upland dambos (Shekela, Silowana and Muoyo)	Increase in occurrence of forest fires resulting destruction of vegetation	Complete loss of pasture in the uplands resulting in reduced stocking density	Mortality of certain fish species e.g. red breasted bream	Affects corrosion protection and paints on steel structures (roofs)		Pupils become malnourished hence they stop attending school.	
Reduces available water for irrigation	Reduced Flora	Increase in occurrence of livestock diseases e.g. anthrax in cattle, NCD in Chickens	**Complete drying out of certain water bodies (Muoyo, Shekela, Silowana)**	Wood structures are prone to members bending			
	Timber processing is affected in that it becomes difficult to control drying process		Low growth of certain planktons	Increase maintenance cost on (mechanized) infrastructures			
Social impacts							
Both men and women are involved in different aspects of crop farming, but responsibility for food insecurity typically rests with women putting them at greater risk of effects of reduced agricultural production	Potential loss of employment in the timber industry, mainly affecting working age men	**Men are particularly affected by effects on large livestock, women are particularly affected by effects on small livestock**	Potential loss of employment for working age men who trade in fish; potential food and nutrition insecurity particularly for women and children	Working age men tend to have larger spatial mobility, so would be most affected by degradation of roads; both men and women affected by deterioration of houses (although men have responsibility for construction and maintenance); children affected by damage to schools and healthcare facilities	**Greatest impact on women who bear responsibility for fetching water and may have to travel further**	Biggest risk for children, with girl children typically de-prioritised for school attendance when resources are tight (as a result of impacts on other sectors)	Biggest risk for children

5.3.2. Future climate risks

Global climate models give indications of the nature of anticipated future climate, and various portals exist whereby countries can access relevant projections[1]. However, as outlined in Section 5.3.1, there are rarely high resolution climate projections and, where they exist, they are subject to the same limitations as those at global level. Looking at the past is not a sufficient indicator of the future in its own right. Climate change has the potential to expand the range and rate of change. However, combining broad projections from climate models with the nature of climate exposure trends (taking into account future expansion of these trends), as identified above, gives an indication of the future that is sufficient for planning purposes.

Future climate risk is dependent on hazard exposure and impacts (reflecting biophysical and social vulnerability and adaptive capacity). Many impact studies exist to assess what these projected changes in climate variables will mean for resources and sectors at lower resolution, for example in National Communications to the UNFCCC. When the broad trends are contextualised based on the particular geography and observed trends to date, there is a more robust picture for determining future hazard exposure and biophysical vulnerability for the purposes of planning. Take the example of the start of the rainy season. The norm might be for the rainy season to start in October, but recent trends are for it not to start until November. Scientific understanding of climate change tells us that we are likely to see more variability and thus, combining this with observed trends to date, we can plan for a future where the rainy season regularly starts later (e.g. in November), than it used to and be aware that there may be occasions where it starts even later than that.

In Zambia future exposure and impact scenarios were created by district planners and government field staff during the climate change mainstreaming workshops in order to identify a number of future scenarios of change. In ideal circumstances, participatory methods at community level should also be used to inform this process (Table 1). Some of the future climate scenarios identified were universal across all districts. Increasing temperatures, for example, is virtually certain based on the outputs of Global Climate Models with high confidence. In terms of changes to the rainy season, some districts identified the later start as problematic, whereas for others the greater risk came from a shorter duration. Some districts identified frost as a risk, reflecting their particular geography (biophysical vulnerability of low-laying moist ground). As a complement to, or in place of, quantitative impact studies, an indication of potential climate risk can be obtained by systematically analysing the likely impacts of identified future scenarios on different sectors; for example, education, health, infrastructure, agriculture, forestry, fisheries, water and sanitation, and how those changes will affect men and women.

Table 2 highlights future impact scenarios developed for Nalolo district for a future climate scenario of increased temperatures. This is an expert judgement reflecting both biophysical and social vulnerability. These impacts can then be categorised into serious, moderate, and minimal to identify the priorities to address. For social vulnerability, participatory methods and/or expert judgement can be used to assess what challenges the future climate scenarios will present for current livelihoods, and the extent to which those challenges will be felt by certain members of the community.

When serious potential impacts are recognised, options to adapt can be included in the plan. These adaptation options refer to the interventions that help to achieve the desired future vision in a climate-resilient manner (such that the benefits will not be undermined by climate change). Various approaches can be applied to reduce the long list to a short list, using various levels of sophistication, including economic appraisal, technological feasibility, consideration of social and gender equity and normative goals, or multi-criteria analysis (Nay et al, 2014; UNFCCC, 2011). Criteria for this assessment can be district-specific. In this case they reflect the importance of a particular sector in the district's economy or the level of risk to different groups of people for a potential impact, and are underpinned by robust decision making, in which options are effective under a range of future conditions. Irrigation, for example, is not widely practiced (Nalolo district is in part of the Zambezi floodplain and its upland) so, although increasing temperatures would affect irrigation, it is not a large problem. For crop production, on the other hand, all crops were identified as heat-sensitive and some were considered to be at the margins of their tolerance. Since agriculture is the primary industry and source of livelihood for the district, the impact of increased temperature is judged to be severe.

5.4. Third step – Climate risk screening

The results of the GCRA undertaken at the second step should ensure that high current and future risks are adequately reflected in the development of the plan, and that interventions that support adaptation and enable climate-resilient development should be prioritized. However, even if the plan has been designed taking into account the future climate risk, it is still important to cross-check to ensure that nothing will inadvertently increase risk through creating or increasing vulnerability.

This process of climate risk screening involves asking two questions:

- How are interventions in the plan affected by climate risk? This takes into account that risk is dependent on exposure to a hazard, and vulnerability to that hazard.
- Has the assessment of current and future climate risk highlighted needs for additional interventions to support adaptation to climate change and enable climate-resilient development?

To identify if and how interventions are at risk of climate change, they should be systematically checked against the future climate

[1] See, for example, the Climate Impacts Portal (University of Cape Town), Climate Explorer (Royal Netherlands Meteorological Institute) and the Climate Change Knowledge Portal (World Bank).

Table 3
Example of climate risk screening for interventions on education in Mongu district.

Key Project	Activity	Climate risk screening					
		Increased temperatures	Later onset of the rainy season	Dry spells in the rainy season	Increased incidence of floods	Increased incidence of droughts	Increased frost
Infrastructure development	Construction of boarding secondary school in Kasima	Yes	No	No	No	No	No
	Construction of primary classrooms and staff houses	Yes	No	No	Yes	No	Yes
Awareness campaigns	Conduct educational awareness campaigns	Yes	No	No	Yes	No	Yes

Table 4
Example of climate change-mainstreamed infrastructure interventions in Mongu district (modifications for climate adaptation in light of identified climate risks shown in bold).

Key project	Activity	Climate risk screening					
		Increased temperatures	Late onset of the rainy season	Dry spells in the rainy season	Increased incidence of floods	Increased incidence of droughts	Frost
Development of a modern road network and storm water drainage system **using heat protective bitumen or interlocking pavers for surfacing, using water to cure concrete and appropriate earthworks for adequate drainage**	Construction of new bituminous roads in Kasima **with storm drains that are adequately designed and maintained to effectively carry the runoff**	Yes	No	No	Yes	Yes	No

scenarios that have been identified. In Zambia, to do this a table was created and populated with the existing priority programmes and key projects/activities, and the identified future climate exposure. Each priority programme and key project/activity was then taken in turn and cross-checked with each future scenario, placing a “yes” in the box if it will be affected by that scenario, or a “no” if it will not. To ensure that vulnerability is also being taken into account, this was done in conjunction with the previous step that determined potential risk of the climate scenarios on different sectors, and how those changes will affect men and women. This screening was particularly important in Zambia given that mainstreaming climate change was taking place into existing plans, as opposed to those being developed from scratch. In the case of the latter, current and future climate risk should have been amply taken into account in the generation of the priority programmes and key projects/activities, in which case this step should merely be a cross-check.

Table 3 gives an example of climate risk screening for education interventions. In this case, construction of a secondary boarding school at Kasima may be affected by high temperatures if they impede capacity of construction staff to work. However construction is unlikely to be affected by changes in the rainy season or drought. In addition, Kasima is not in a location that is likely to be exposed to floods nor droughts so these are not risks. In the activity to construct primary classrooms and staff houses, the same risk of high temperature applies. However, because the locations of these classrooms and staff houses are not mentioned in the plan, there could be potential risk of floods and frost.

Climate screening highlights the need for climate proofing, but there is also a need to cross-check against the sectoral and social analysis of current and future risks (e.g. Table 2) to see if additional interventions are required to address some of the identified risks. For example health projects may have been screened and modifications made to climate proof (e.g. spraying for malaria later in the season reflecting a later start to the rains). However climate change may pose new risks, for example the outbreaks of diseases. In addition risk may show gender differences. For example the GCRA may have identified that women would be particularly vulnerable to the potential for a particular bridge to be washed away by flooding, as that bridge connects them to the clinic, without which they and their children may be particularly vulnerable to outbreak of disease. Without an analysis of the gender differences in risk, that may not arise as a priority, and thus could be overlooked as an essential intervention to enable adaptation of women to climate change. If climate risk has been determined at the appropriate stage in the development of the plan, all such risks should have been considered and thus the need for additional interventions should be minimised. However, if climate change mainstreaming is taking place through retrofitting an existing plan, the addition of interventions to address risks may be necessary.

5.5. Fourth step – Options to respond to climate risk

The output of the third step is identification of where climate poses a risk to the achievement of the development plan. The fourth step is to identify interventions that reduce risk, support adaptation to climate change and enable climate-resilient development. In the case of retrofitting, as was done in Zambia, this required taking those interventions identified to be at risk and systematically determining how they should be modified. Here the RDM approach is important. Given that this methodology can be applied in data-constrained environments with minimally-trained expertise, future climate risk is identified on a “good enough” basis. Thus when undertaking development planning, a precautionary approach of interventions that will be robust under a variety of plausible future climates is more sustainable then attempting to identify the optimal option.

Future climate risk may have implications for *where* the activity takes place, *when* it takes place, or the *nature of the project/activity* itself. If there is a plan to build a public facility, such as a school or clinic, in a location that has been identified to be at risk of flooding, this plan would need to be modified to reduce the likelihood of the development gains being undermined by climate change. If anti-malaria spraying campaigns are most effective when they take place immediately prior to the onset of the rains, then the risk of a later onset of the rainy season would mean that the timing of this spraying would need to be delayed in order to maintain optimal benefits. If a livelihood improvement project based on maize production is planned for an area that is at risk of increasing incidence of droughts and dry spells, it may be that promoting a drought-tolerant crop, such as sorghum or millet, would yield better development outcomes in the context of a changing climate. Livelihood improvement projects should pay particular attention to gender differences in risk, since men and women typically engage in different livelihood activities. If an agricultural intervention aims to increase production, for example, the nature of its support should be gendered such that it does not end up differentially reducing risk for men at the expense of women.

Table 4 highlights how a road infrastructure intervention was "climate proofed" following the process of climate risk screening. Developing climate-resilient infrastructure is essential and there are a number of design principles that can be reflected in development planning standards so that they apply to all infrastructure-related plans (Cervigni et al, 2015). Since all districts will be exposed to increasing temperatures, the orientation and design of buildings should be done to maximise shade and ventilation (this may include options such as planting trees and using green building materials). Options for solar power and rainwater harvesting should be explored. If infrastructure is planned for areas that will be exposed to floods, and it is not possible to modify their location (e.g. relocate to higher ground), they must be constructed to withstand floods, for example as raised structures (e.g. on a plinth or stilts) or reinforced. In the case of roads, adequate elevation (height) and drainage must be incorporated.

Designing priority programmes from a GCRA-informed issues analysis should ensure that climate risk is considered. That said, it is important to check the overall development plan with the climate risk identified during the second step. Climate proofing planned activities is one thing. However, it is also necessary to ensure that the plans are accounting for all major identified risks. Existing project activities could be modified to respond to drought, for example, but drought may cause additional challenges for which there are no activities planned to enable adaptation and climate-resilient development.

5.6. Fifth step – Implementation, monitoring and evaluation

The fifth step in the process of mainstreaming climate change is to develop a framework of indicators and outputs that appropriately monitors progress towards reducing risk and enabling adaptation and climate-resilient development. As well as indicators linked to interventions, there is the option to add in additional indicators that monitor changes in risk within the district/ward based on vulnerability and adaptive capacity. This is particularly useful to monitor the successes of building adaptive capacity and to identify gender differences which may need to be rectified.

6. Conclusion

Mainstreaming is the best way to deal with climate change since it is a cross-sectoral issue. Mainstreaming climate change into development plans is particularly important to ensure sustainability of small-scale adaptation practices, and to ensure that hard-won development gains are not undermined by climate change. However, mainstreaming climate change into development plans is often difficult, reflecting challenges such as a lack of technical expertise in climate change, and poor data availability. These issues are particularly acute in developing countries.

A five step process to mainstream climate change into development plans was developed, informed by theory on climate risk assessment and robust decision making. Participation and expert elicitation are key foundations of the process, and ensure applicability in data-constrained environments. That said, the process is flexible and supports the principle of best-available knowledge, meaning that scientific data and climate projections can be incorporated where they are available. Similarly more resource and technology-intensive approaches to impact modelling and prioritisation of activities (e.g. through econometric modelling) can be incorporated – but the outcome is not impeded by their absence.

The five step process was presented to sectoral planners in 14 districts in the Western and Southern provinces of Zambia, and applied in a workshop setting to the District and/or Integrated Development Plans of 6 of those districts. As outlined above, the plans were already in existence, and so this methodology was used to retrofit them to address climate change. This involved screening and, where necessary, modifying activities, and adding additional activities to ensure that the gendered nature of climate risk was addressed. In this case, the availability of data was poor. Most districts had previously conducted at least some participatory GCRAs at community and ward level which were used as inputs. The district level risk assessment took place during the workshops and was based on these inputs and the expert inputs from sectoral planners. Small refinements were made to the detail of the five step process, but not the structure, based on the experience of the training and technical backstopping.

The application in Zambia showed the utility of the five step process to mainstream climate change into development plans. Here the methodology was used at sub-national level, which is important in the context of decentralisation in which local level plans are gaining prominence and are seen as the basis for national level development planning. However, the steps are equally applicable for use at national level (albeit the process of application would be different reflecting the different scale). It can also easily be transferred to other sub-Saharan African countries with similarly data-constrained environments and minimally-trained expertise. Having such a process to mainstream climate change is necessary to provide a framework to enable achievement of adaptation commitments enshrined in Nationally Determined Contributions, National Adaptation Plans, and climate change policies.

There are also ancillary benefits to participants in the process – in this case the district level sectoral planners. Participatory processes build capacity by fostering three types of learning: cognitive; normative; and relational. Cognitive learning relates to the acquisition of new, or the structuring of existing, knowledge. In this case, participants in the five day climate change mainstreaming workshops were given opportunities to gain additional knowledge on climate change and the risks and opportunities that it poses. It also facilitates normative learning, which concerns a shift in viewpoints, values or paradigms – which was evident from comments and evaluations. Last but not least, the participatory process enables relational learning, or an improved understanding of others' mindsets, enhanced trust and ability to cooperate (Baird et al, 2014). The knowledge and skills gained thus not only improve the likelihood of adaptation and climate-resilient development in districts, but also contribute to strengthening of district level capacity which benefits wider governance.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.crm.2018.04.005.

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