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Institutional adaptive capacities to promote Ecosystem-based Adaptation (EbA) to flooding in England

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Abstract

Purpose – The purpose of this paper is to assess the inherent adaptive capacities of multilevel flood management institutions in England that are necessary to espouse the concept of Ecosystem-based Adaptation (EbA).

Design/methodology/approach – This paper is based on an extensive assessment of flood management literature including European and English flood management policies, strategies, regulations and reports. First, an assessment protocol was developed from systematic literature search and, second, multilevel flood management policies and organizations were evaluated. A qualitative scoring method was applied at the assessment stage.

Findings – The protocol included 18 major assessment criteria under seven EbA principles. Application of the protocol showed that English national flood policies showed comparatively greater adaptive capacities than European- and local-level policies and local organizations. Specialized flood management policies such as Catchment Flood Management Policies at the local level and European Policies such as flood directives are among the lowest-scoring policy institutions. It was also identified that there is an emerging trend of stakeholder participation, catchment-based approach and knowledge-based adaptation planning at the national level which potentially can be the entry points of wider-scale EbA implementation. This paper recommends proactive roles of local executive organizations through improving institutional communication, consideration of catchment-scale planning with clear adaptation goals and valuing local knowledge base.

Originality/value – The research is important to identify the institutional aspects of adaptive capacity that require attention for promoting alternative adaptation measures such as EbA.

Keywords England, Institutions, Flood management, Ecosystem-based Adaptation

Paper type Research paper

1. Introduction

Globally, the emerging concepts of Integrated Flood Management (IFM), Integrated Water Resource Management (IWRM), Adaptive Management (AM) and Natural Flood Management (NFM) are leading a new paradigm of water and flood management

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(Hansson *et al.*, 2008; Pahl-Wostl *et al.*, 2007; Rouillard *et al.*, 2014; Schoeman *et al.*, 2014; Huq and Hugé 2012). All these concepts and approaches unequivocally acknowledge the contribution of the ecosystem's role in water management, especially for flood management also known as Ecosystem-based Adaptation (EbA). The Convention of Biological Diversity (CBD) defined EbA as "the use of biodiversity and ecosystem services (ES) as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change" (CBD, 2009, p. 41).

EbA is dependent on well-functioning ecosystems to continue providing ES as well as resisting and recovering rapidly from extreme weather events (Colls *et al.*, 2009; Huq *et al.*, 2013). Globally, EbA is a relatively new but emerging approach to reducing climate-induced disaster risks (Doswald *et al.*, 2014). Similar to other Disaster Risk Reduction (DRR) efforts, the success and sustainability of EbA approaches are largely dependent on institutional capacities, through the use of organizing, planning and the implementation of actions (Bettini *et al.*, 2015; Gupta *et al.*, 2010; Næss *et al.*, 2005). Based on the concept of institutional adaptive capacity, the paper aims to investigate the capacities of policy instruments and executive organizations to espouse and promote EbA at multiple levels of flood management in England. In doing so, the research developed and applied a protocol to assess EbA adaptive capacities for different policy instruments and organizations at different levels.

As an emerging concept in the field of global Climate Change Adaptation (CCA), the principles of EbA are constantly evolving and being (re)shaped. At present, only a small amount of scientific and grey literature has touched upon the principles and components of EbA (Doswald *et al.*, 2014). Critical in this endeavor are the early works of Andrade *et al.* (2011) and Travers *et al.* (2012) who outlined a number of principles which were subsequently used as the basis of EbA (Mercer *et al.*, 2012). Table I presents an outline of the major principles of EbA.

Andrade *et al.* (2011) and Doswald *et al.* (2014) suggested that the principles form the foundation of EbA in risk management strategies and planning. However, adaptation priorities are contextual, and the importance of specific principles could vary in different circumstances (Huq *et al.*, 2015).

Principle no.	Name of the principles
1	EbA promotes multi-sectoral approaches
2	EbA operates at multiple geographic scales
3	EBA integrates flexible management structures that enable adaptive management
4	EBA is based on the best available science and local knowledge and should foster knowledge generation and diffusion
5	EBA maximizes the benefits of development and conservation goals to avoid unintended negative social and environmental impacts
6	EBA is concerned with promoting resilient ecosystems and using nature-based solutions to provide benefits to people, especially the most vulnerable
7	EBA must be participatory, transparent, accountable, and culturally appropriate, while actively embracing equity and gender issues

Source: Mercer *et al.* (2012)

Table I.
Principles of EbA

Similar to other DRR and CCA interventions, EbA needs to be facilitated by appropriate formal and informal institutions. In this research, the term "institutions" refers to the classical meaning of institutions which include, conventions, norms and rules with appropriate regulative legitimacy, to simplify and regularize everyday life (Gómez-Baggethun *et al.*, 2012; Cashmore and Wejs, 2014). Næss *et al.* (2005) and Adger *et al.* (2005) emphasize that adapting all relevant institutions is fundamental to successfully adapt to climatic hazards. Yet, it should be noted that this largely depends on the institutional capacities to undertake and implement adaptation actions. Thus, the question is how the institutional capacities to promote a relatively new concept of EbA should be judged. To answer, a large body of climate change adaptation literature emphasized on "adaptive capacity" of institutions to formulate and implement policy instruments to promoting adaptation at a societal level (Crabbe and Robin, 2006; Tompkins and Adger, 2003).

The adaptive capacities of institutions can be understood as the manifestation of inherent and latent characteristics of institutions that serve to empower actors to respond reactively to climatic hazards, therefore enabling adaptation to happen (Gupta *et al.*, 2010; Bettini *et al.*, 2015). Bettini *et al.* (2015) also argued to include agency-oriented capabilities such as skills, resources and access as important adaptive capacity dimensions at the institutional level for adaptation to take place. Adaptation at the institutional level is a continuous process for the institution itself to be adaptive to accommodate the challenges of implementing adaptation at the community level (Diaz *et al.*, 2005). Yet, it should not be perceived as having the ability to reduce exposure to hazards. To assess the institutional adaptive capacities for EbA, the research developed an assessment protocol consisting of major criteria of adaptive institutions most fit for designing and implementing EbA. Multilevel English flood management policies and local organizations are tested and analyzed using the protocol for examining the adaptive capacity, to assess their readiness to undertake EbA to manage flood risk.

2. Ecosystem- and nature-based flood management in England: an overview

Structural approaches of flood management have been historically dominant in England since the Second World War (Johnson *et al.*, 2007). Yet, recognition of non-structural approaches has only recently emerged through national policy. In the past decade, flood management in England has been decentralized to multiple governance tiers at different administrative levels (Benson *et al.*, 2015) with special priorities of ecosystem and nature-based soft approaches of flood management such as floodplain development, river restoration and plantation (POST, 2011). The impetus mainly comes from an array of European-level policies, such as European Union (EU) Water Framework Directives (WFD) (European Union, 2000) and EU Flood Directive (European Union, 2007), in addition to national policies, such as "Making Space for Water 2005" (Defra, 2005), Flood and Coastal Erosion Risk Management Strategy (Environment Agency, 2011) and Independent Pitt review (Pitt, 2008). These directives are legally backed up by the Flood and Water Management Act, 2010 (HM Government, 2010) and the Flood Risk Regulation, 2009 (HM Government, 2009).

In response to the policy measures, organizational responsibilities were changed, most notable was the changing of responsibilities of the Department of Environment, Food and Rural Affairs (DEFRA). DEFRA has the national responsibility of flood

management, e.g. funding the Environment Agency (EA) is in supervising responsibilities and the creation of Lead Local Flood Authority (LLFA) to manage the risk of flooding at the local level (Benson *et al.*, 2015). Local Catchment Flood Management Plan (CFMP), local flood risk assessment report and risk management strategy are also some of the outcomes of European and national policy measures.

Despite policy advancement, the potentials of ES are not significantly reflected in English flood management. Between the years 1990-2013, 160 pieces of evidence of ecosystem-based flood management have been received from various sources, whereas in the financial year 2015-2016, a total of 1,488 projects will take the forms of construction, structural development and pipeline management (Environment Agency, 2014; Barlow *et al.*, 2014). At the regional level, in the Cumbria region, five CFMPs proposed 141 flood management actions and only six of them are categorized as EbA, whereas 51 other EbA opportunities were identified by Natural England (Environment Agency, 2009d, 2009a, 2009b, 2009c, 2009e; Natural England, 2012, 2014c, 2013d, 2014b, 2013c, 2013a, 2014a, 2013b). Against these backdrops, one of the assumptions in this research is that lack of EbA-specific institutional adaptive capacities prevents institutions to undertake and implement EbA. The research is, thus, assessing institutional adaptive capacities for EbA at different levels of flood management.

3. Study area

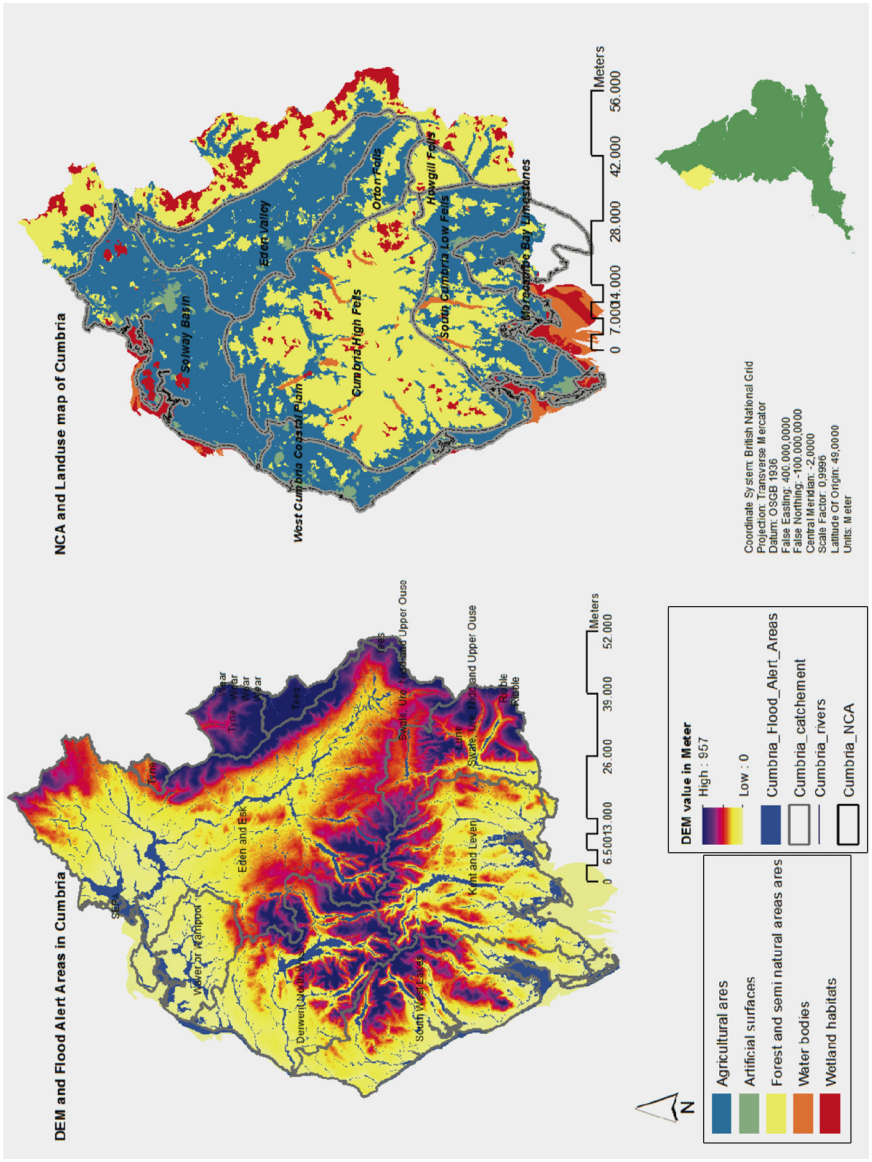
Cumbria is located in the northwest of England and is the second largest county in the country, covering an area of approximately 6,768 km^2 with a population of roughly 500,000. Cumbria has suffered from a number of well-documented historic floods: January 2005 and November 2009 being the most recent examples of extreme flooding (Davis *et al.*, 2013). The flood of 2009 was a one in a 550-year event and affected 2,239 properties and 80 per cent of businesses in Cockermouth. The tourism, agriculture and infrastructure industries throughout Cumbria were all significantly impacted, and the combined total cost of recovery from the two floods amounted to £276.5 mn (BBC, 2010; Davis *et al.*, 2013). Cumbrian landscape offers a wide variety of ES, notably in food, timber, water availability, biomass production, tourism and biodiversity benefits. However, EbA measures for flood management are very sporadic and disjointed. Figure 1 illustrates a map of Cumbria and its land-use.

4. Methodology

There are two interconnected but distinct phases of research. In the first phase, an assessment protocol was developed for assessing adaptive capacity to EbA. The second stage was an application of the protocol at European, national and local polices, instruments and organizations in Cumbria, England.

4.1 Developing assessment protocol

In developing the assessment protocol, the criteria for a major institutional assessment were, first, identified through a systematic literature search. Because of the lack of necessary literature on adaptive capacity for EbA, relevant disciplinary literature such



Source: Created by author

Figure 1.
Map of the study area

as natural resource management (NRM), CCA, socio-ecological system governance (SES), ecosystem management and common pool resource management were searched. Several search attempts were undertaken using two major literature index databases: Scopus and Web of Knowledge. A combination of search terms were used such as "Ecosystem-based Adaptation", "adaptive institutions", "adaptive capacity" and "climate change". As a first-order screening process, the title and abstracts of the search-generated papers were carefully studied, and relevant literatures were identified according to their relevance to the research purpose.

Those papers that were recognized as being relevant to the study were thoroughly examined. Major criteria for assessing adaptive capacity were identified and similar criteria were clustered together. The same criteria may appear in different names in different papers and subjects. The criteria were again grouped and assigned according to the suitable EbA principles. To amend this list with further EbA-specific criteria, grey literature on EbA published by the International Union for Conservation of Nature (IUCN) Commission on Ecosystem Management (Andrade *et al.*, 2011), Ecologic Institute of Berlin and Environment Change Institute of Oxford University (Naumann *et al.*, 2011) and United Nations Environment Programme (Travers *et al.*, 2012) were reviewed to identify the emerging concerns and issues of EbA. To assess the criteria, pertinent one to three questions for each criterion were also developed from the selected papers to assess the degree of presence and influence of a particular criterion. Grey literatures were particularly useful to formulate the assessment questions.

4.2 Application of the protocol

Majority of the existing works of adaptive capacity assessment qualitatively represent the institutional capacities with some extent of quantifications of the relevant indicators and criteria. Examples include, Gupta *et al.*'s (2010) "Adaptive Capacity Wheel (ACW)" framework, Klostermann *et al.*'s (2010) assessment of Dutch water institutions, Grothmann *et al.*'s (2013) extended ACW for a wide range of institutional settings and Milman *et al.*'s (2013) assessment of trans-boundary river basin institutions. Other studies concerned with water sector institutions, such as Crabbe and Robin (2006); Huitema *et al.* (2009); and Ploeg (2011), assessed institutional adaptive capacities in a descriptive manner based on certain frameworks, principles and attributes such as institutional norms, participation or flexibility. In terms of evaluating the institutions, scoring of indicators and criteria is a common method of assessing adaptive institutions that is applied in this research as well.

Data are collected for each criterion mostly through content analysis of the policies, strategies, regulations and acts. Organizational data were also collected through relevant organizational reports. In addition, during July-December 2013, a field study was conducted in Cumbria County, in cooperation with local host university research group as part of a community resilience research project against natural hazards. A total of 45 key informant interviews collected during the whole research period provided an insight on perceptions about the local flood risk management organizations. An overview of major data sources and their uses in the research is provided in the Table II.

Key informant interviews were conducted between two major groups of stakeholders:

(1) 31 local non-government stakeholders; and

(2) 14 government stakeholders from local authorities.

An initial focus group discussion assisted in identifying some of the key contacts as well as information on local socio-ecological issues. A snowballing strategy was adopted to identify potential new contacts. Among others, experts from different stakeholders including representatives of community flood action groups, farmer representatives, NGOs, government agencies and local county council representatives were identified as key informants (KIs). Interviews were detailed but included an open-ended discussion on different aspects of flooding, mostly one-on-one basis, and their duration varied from 1 to 2 h. The interviews were recorded, transcribed and coded using MaxQDA qualitative data analysis software.

Although the research is primarily based on the content analysis, the key informant's views assisted to qualitatively assess the local organizational policies, actions and composition as well as analyze the policy and regulatory instruments of English flood management. The contents were analyzed using a simple weighting factor as used by Gupta *et al.* (2010) and Grothmann *et al.* (2013). The scoring method used the following criteria (Table III).

First, the organizational contents were thoroughly analyzed according to the criteria and assessment questions and a score was given for each criterion. The scoring is first based on the author's own judgments, experiences of fieldwork, interviews with the KIs and expertise in flood risk management and CCA. The author first put arithmetic values ranging from −2 to +3 for each of the criteria following the scoring techniques of Grothmann *et al.* (2013) and Gupta *et al.* (2010). For example, a score +3 was assigned for any criterion if its presence in the analyzed document is highly visible and importance is

Information type	Information sources	Uses in research
Primary	Local informants	Local organizational adaptive capacity; Perceptions on policy instruments
Secondary	European Union Directives	EU-level EbA adaptive capacity
	National flood strategies, policies and regulation	EbA adaptive capacity of national policy
	Local flood and water management policies	
	Local flood management strategies and organizational reports	Local organizational adaptive capacity

Table II.
Types, sources and uses of information

Explanation for content analysis	Score	Aggregated scores for principles and overall adaptive capacity
Highly positive	3	2.01 to 3.00 (Highly adaptive to EbA)
Positive	2	1.01 to 2.00 (Adaptive to EbA)
Slightly positive	1	0.01 to 1.00 (Slightly adaptive to EbA)
No effect	0	0.00 (Not adaptive to EbA)
Slightly negative	−1	−0.01 to −1.00 (Slightly negative adaptive)
Negative	−2	−1.01 to −2.00 (Negative adaptive)

Source: Adapted from Gupta *et al.* (2010)

Table III.
Scoring criteria used to evaluate institutions

underscored. In the organizational case, the author looked at whether the criterion currently exists in flood management practices.

Transcribed and coded interviews were subsequently used for validity checking and to reaffirm the scoring, especially for local organizations and policies. In some instances, the interview statements were direct according to the criteria and assessment questions. In some instances, responses were indirect and, therefore, the author's subjective judgments were used to interpret the response to assist scoring. Once, scoring was completed, arithmetic means for all individual criteria were calculated. In the second step, arithmetic means for criteria belonging to each of the principles were calculated using the following formula:

$$\left(\text{Score of a principle} = \frac{criterion\ 1 + criterion\ 2 + \cdots ..... criterion\ n}{n}\right)$$

Finally, calculating arithmetic means of all principles were used to generate one score of a specific organization or policy instruments to demonstrate its ability to promote and encourage EbA approach. The author applied the protocol list to empirically examine the English flood management organizations to investigate the research question and assumption as well. The initial results of the analysis were presented before an expert group of global water sector researchers for further consultation, and modifications were done in terms of adding, removing and re-scoring some of the criteria.

It should be mentioned that the protocol could not be objectively applied; values for criteria are subjected to researchers and other experts' judgment and interpretation. In the increasing level of aggregation, Gupta *et al.* (2010) mentioned that details could be lost. The equal scoring approach also carries a risk of producing misleading results through the oversimplification of a complex problem (Gupta *et al.*, 2010; Lonsdale *et al.*, 2010). The present research is also characterized by some of the inherited risks and limitations such as interdependence and overlaps between the criteria which is common in such frameworks where criteria can reinforce each other (Gupta *et al.*, 2010). Huntjens *et al.* (2012) commented that character of some attribute might emerge during the adaptation process. Thus, there can be tension or conflict between criteria with conflicting interests such as clear principles and flexible management, financial resources and cost effectiveness (Gupta, 2009; Huitema *et al.*, 2009; Huntjens *et al.*, 2012). On the other hand, this kind of exercise might also overlook some of the aspects of adaptive capacity. For example, an institution is connected and heavily dependent on many different organizations that create a favorable institutional environment (Lonsdale *et al.*, 2010); however, the influence of other institutions is beyond the scope of this research. The application of this exercise is context dependent. Many of the criteria and principles might be more or less relevant according to the wider socio-ecological context.

5. Results

5.1 Adaptive capacity criteria: through EbA lens

Initial literature search confirmed that:

- There is an absence of literature on "adaptive institutions for EbA".
- The term "adaptive institutions" has variations between different knowledge disciplines, e.g. adaptive governance for natural hazards, adaptive management and co-management of NRM and SES governance and institutional adaptive capacity to climate change.

- Same criteria appear in the literature in different appellations which could be clustered together as common criteria (Gupta *et al.*, 2010), e.g. the component "participation" appeared as "local participation", "user engagement", "participatory" and "stakeholder engagement".

Similar criteria were clustered together; a list of total 18 criteria was generated. Similarly, the author assigned the criteria according to the EbA principle. In summary, institutions which encourage multisectoral approaches; operate at multiple geographic scales; integrate flexible management structure; foster knowledge generation and diffusion through scientific and local knowledge; consider development and conservation for avoiding intended social and environmental impacts; promote resilient ecosystems; and encourage participatory, accountable and culturally appropriate governance can be considered as having the necessary internal "adaptive capacity" to formulate, organize and implement EbA. Table IV shows the complete protocol of the adaptive capacity assessment including the principles, criteria and analysis questions of adaptive institutions for EbA identified in this study, while the following sections refer to these principles in more depth.

The protocol of Table IV presents the criteria list, an elaboration of the assessment questions and its literature reference. Limited number of EbA publications generated four criteria: mal-adaptation, the impact of development intervention on ecosystems, ecosystem resilience and ES.

5.1.1 Principle 1: multisectoral working approaches. ES are generated in different landscapes and locations and serve different groups of stakeholders (Andrade *et al.*, 2011). Therefore, it is imperative to adopt a multidisciplinary and multiagency working approach with institutions, involving multiple stakeholders to strengthen efforts for adaptation and increase community and ecosystem resilience (Lonsdale *et al.*, 2010; Wilby and Vaughan, 2011). Among the 18 criteria, stakeholder involvement and institutional collaboration are found as the two most relevant criteria. Participation of a wide range of stakeholders such as communities, local informal and formal institutions and NGOs ensures that institutions devise the most suitable environment for implementing adaptation (Andersson and Ostrom, 2008; Larson and Soto, 2008; Nagendra and Ostrom, 2012; Grantham *et al.*, 2011). Institutional collaboration facilitates stakeholder engagement and promotes shared learning through horizontal, vertical or inter-sectoral communication (Wilby and Vaughan, 2011; Dixit *et al.*, 2012).

5.1.2 Principle 2: works at multiple geographic scales. EbA should not be confined by political or administrative boundaries, as their drivers span across a broader geographic scale (Andrade *et al.*, 2011; Colls *et al.*, 2009). It is, thus, important to consider all geographic and administrative regions under similar ecological characteristics in adaptation strategies (Andrade *et al.*, 2011; Colls *et al.*, 2009). This requires extensive and effective partnerships among the different institutions working in the same landscape zone, as well as with organizations in the zone influencing the area of intervention (e.g. catchment and sub-catchment interventions), despite different administrative identities (Reed, 2008).

5.1.3 Principle 3: flexible management structures. A flexible management structure allows local institutions to integrate complexities and adapt to the future needs for adaptation through resource management (Cundill and Fabricius, 2010;

Principle no.	Criteria	Assessment questions	Literature references
1	Multi-stakeholder involvement and participation	Involvement of variety of stakeholders in flood management decision-making	1,2,3,4
	Institutional collaboration and coordination	Presence of intra-institutional partnerships of flood management authorities Presence of partnership between flood authority and other authorities for flood management	5,6,7,8,9
2	Landscape and catchment-based approach	Presence of landscape-scale flood management planning Implementation of landscape scale approach of flood management	1,3,10
3	Decentralize management	Existence and provision of multiple institutional tiers to facilitate adaptation	5,6,7,9,10,11
	Autonomy	Existence of autonomous decision making in flood management	4,6,12
	Clear planning principles	Presence of clearly defined EbA policy and objectives	8,13,14,15,16
	Monitoring and evaluation	Presence of monitoring and evaluation framework for flood management actions	1,17
4	Facilitating knowledge-generation and -sharing networks	Existence of active (community) knowledge-sharing networks	18,19
	Using best scientific and local knowledge	Presence of organizational practices for incorporation of local and expert knowledge in local flood planning Use of updated scientific information and models for local planning Diverse human resources for planning	10,13,20,21,22
	Fostering learning	Evidence of changes in assumption Evidence of changes in underlying framework	4,11,23
5	Cost effectiveness	Example of cost-effectiveness in flood management project	24,25
	Contribution to broader development framework	Presence of "natural option" of flood management in other development plans, e.g. urban planning	18,26,27
	Preventing Mal-adaptation	Practice of impact analysis of adaptation intervention on society and ecosystems	16,28
6	Managing ecosystems	Consideration of ecosystem management in development planning	14,29
		Provision of community and local stewardship for ecosystem management	1,3
	Generating co-benefits	Existing practices consider economic, social and environmental co-benefits in development and adaptation planning	25,1

(*continued*)

Table IV.
Protocol for assessing institutional adaptive capacities o EbA

Principle no.	Criteria	Assessment questions	Literature references
7	Accountability	Existence of institutional accountability to local communities in flood management procedures	30,31,32
		Provision of accountability in policy documents	
	Legitimacy	Provision of EbA in major regulatory documents	1
	Equity	Participation of specialized and marginalized groups in decision-making	2,4

Sources: 1 = Andrade *et al.* (2011); 2 = Lonsdale *et al.* (2010); 3 = Travers *et al.* (2012); 4 = Gupta *et al.* (2010); 5 = Andersson and Ostrom (2008); 6 = Larson and Soto (2008); 7 = Nagendra and Ostrom (2012); 8 = Wilby and Vaughan (2011); 9 = Stankey *et al.* (2005); 10 = Colls *et al.* (2009); 11 = Cundill and Fabricius (2010); 12 = Cook *et al.* (2010); 13 = Campbell *et al.* (2009); 14 = CBD (2009); 15 = Heller and Zavaleta (2009); 16 = Watson *et al* (2012); 17 = Hale *et al.* (2009); 18 = Vignola *et al.* (2009); 19 = UNFCCC (2013); 20 = CARE International (2009); 21 = Mercer *et al.* (2012); 22 = Munroe *et al.* (2011); 23 = Pahl-wostl (2006), 14 = Grantham *et al.* (2011); 25 = Pérez *et al.* (2010); 26 = Girot *et al.* (2012); 27 = Jones *et al.* (2012); 28 = Pramova *et al.* (2011); 29 = Haines-Young and Potschin (2009); 30 = Dodman and Satterthwaite (2008); 31 = Tanner *et al.* (2009); 32 = Huntjens *et al.* (2012)

Table IV.

Stankey *et al.*, 2005). Institutions with a high degree of flexibility in decision-making perform more effectively in climate risk management (Berkhout *et al.*, 2006). Literature revealed that decentralization autonomy clear planning principles and monitoring and evaluation are the most relevant criteria to assess management flexibility for promoting adaptation.

Decentralization is a political process for transferring power from central authorities to lower authorities. Decentralization involves multiple stakeholders and avoids the negative consequences of centralized governance such as marginalization and maladaptation (Agrawal, 2001; Larson and Soto, 2008; Nagendra and Ostrom, 2012; Tanner *et al.*, 2009). Autonomy is closely linked to the decentralization process which expresses the degree of independence within the institution. Autonomy facilitates institutional capacity to follow and improvise planning for pursuing adaptive approaches (Cook *et al.*, 2010). Institutions also require well-defined, understandable and implementable adaptation principles, strategies and objectives for avoiding maladaptation, incorrect risk assessment and inaccurate problem identification (Campbell *et al.*, 2009; CBD, 2009; Heller and Zavaleta, 2009; Watson *et al.*, 2012). Monitoring and evaluation (M&E) is another important component of a flexible management structure, as it fosters learning processes through the reflection cycle (Mercer *et al.*, 2012).

5.1.4 Principle 4: fostering knowledge generation and diffusion through scientific and local knowledge. Knowledge creation and management is clearly linked with learning processes for adaptive institutions. Knowledge creation and management are a vital consideration for effective implementation of EbA to confront uncertainties of climate models. Multiple knowledge sources from multiple stakeholders and experimental frameworks, e.g. local and expert's knowledge are of great value (Colls *et al.*, 2009;

Munroe *et al.*, 2011; Travers *et al.*, 2012). Three major criteria are found to assess this principle:

- knowledge-sharing networks to accommodate the heterogeneous knowledge needs of the community (UNFCCC, 2013) and help the community to prevent short-sighted "solutions" that produce maladaptive outcomes which undermine local adaptive capacity (Watson *et al.*, 2012);
- using best available scientific and local knowledge for powerful, effective, locally suitable and informed decision-making (Vignola *et al.*, 2009, 2015); and
- institutional learning mechanism for promoting adaptive management through iterative step-wise processes such as single-, double- and triple-loop learning (Gupta *et al.*, 2010; Pahl-wostl, 2006).

5.1.5 Principle 5: integrated development whilst minimizing maladaptation. Integration of adaptation into development and conservation is a growing demand (Eriksen *et al.*, 2007; Sietz *et al.*, 2011). However, the risk of disproportional benefits, increasing adaptation cost and maladaptation are also increasing concerns which EbA could significantly minimize by providing simultaneous benefits including increased livelihood assets, biodiversity conservation and increased water and food security (Andrade *et al.*, 2011; Pérez *et al.*, 2010). Therefore, institutional capacities to consider tradeoffs, cost-effectiveness, consideration of maladaptation and mainstreaming policies are important.

5.1.6 Principle 6: resilient ecosystems and maintain ecosystem services. CBD (2009) underlined the importance of maintaining, conserving and promoting ecosystem and ecosystem services not only to promote biodiversity but also to address increasing disaster risk and enhancing social, environmental and economic co-benefits such as livelihood management. Local institutions need to show their strong commitment toward ensuring that ecosystems are highly resilient to disaster risk. There are two major criteria identified for the principle:

(1) contribution to manage the ecosystems; and

(2) generation of co-benefits.

Adaptation should be planned and implemented in a way that ensures the flow of ecosystem services and functions are maintained (CBD, 2009; Haines-Young and Potschin, 2009). At the same time, CBD (2009) stressed the need for considering co-benefits in the planning, design, implementation, monitoring and evaluation of EbA activities.

5.1.7 Principle 7: ensuring governance aspects such as accountability, legitimacy and equity. The characteristics of good governance – decentralization and autonomy; transparency and accountability; responsiveness and flexibility are all vital in boosting the resilience to disasters and climate change (Dodman and Satterthwaite, 2008; Tanner *et al.*, 2009). Gupta *et al.* (2010) stated that institutions support adaptive capacity when they meet fair governance criteria. Three major criteria, i.e. accountability, legitimacy and equity, reflect the necessary governance qualities to increase institutional adaptive capacity to implement EbA. Local institutional flexibilities and autonomies for EbA should be accompanied by greater accountability as a central way of "arriving at delivery by public institutions and other actors of their functions" (Newborne, 2008, p. 5).

At the same time, legitimate presence of adaptation (EbA in this case) in regulation, laws, acts or strategic outlines is also important for the institutions to indicate the provision of legitimate forms of power vested in any given institutions (Gupta *et al.*, 2010). To ensure a positive adaptation outcome, institutions should strive to bring maximum equity in action and outcomes (Andrade *et al.*, 2011; Huntjens *et al.*, 2012).

The review assisted to develop the assessment protocol including 7 principles and 18 major criteria for assessing inherent institutional capacities to plan, undertake and implement EbA (Table IV). The author argues that internalizing the criteria can facilitate institutions to embrace and overcome the challenges of the EbA process. In the next part, an empirical evaluation is conducted to check the current state of adaptive capacity of major policy instruments and local flood management organizations in the English context.

5.2 Results and discussions of policy instruments and organizational analysis

The protocol evaluated the institutional EbA adaptive capacities of four different flood governance levels, i.e. European polices, English national polices, local Cumbria County policies and local organizations. Among the four different levels of flood governance, the national policies demonstrated higher EbA-adaptive capacities than local and European polices. Similarly, the two local organizations exhibited relatively less adaptive capacities. Table V shows a general picture of the overall EbA adaptive capacities of examined policy instruments and organizations.

5.2.1 European policies. Two European-level policies such the WFD and the Flood Framework Directives (FFD) demonstrated "slight positive adaptive capacities" (Table V), meaning that there are some elements which encourage the EbA approach. The WFD and FFD, respectively, contribute to the introduction of the catchment-based approach to water management and participatory risk management planning involving all potential sectors. The contributions could be acknowledged as important reference points for developing national- and local-scale flood management planning.

5.2.2 National policies. Two policy instruments such as Making Space for Water (MSW) and the National Flood and Coastal Erosion Risk Management Strategy (FCERM) and one independent but influential review "The Pitt Review" demonstrated "good adaptive capacity" to promote EbA. The Pitt review and the FCERM exhibited better adaptive capacities and touched upon most of the criteria including governance paradigm that is often ignored by other assessed policies and institutions. The MSW, often credited as the beginning of new flood management regime in England, and, on the other hand, the FCERM, were very encouraging in some aspects, especially landscape-scale arrangement of flood management.

5.2.3 National regulations. Within the limited scope, two pieces of regulations such as the Flood Risk Regulation 2009 and the Flood and Water Management Act 2010 emphasized on the management aspects of flooding including decentralization, autonomy, clear management goals and monitoring of progresses. Although, these aspects are not directly related to EbA, however, it is important to internalize for any executive organization which, in turn, can be entry points for EbA.

5.2.4 Local policies. Contents of four studied CFMPs in Cumbria demonstrated "slightly positive adaptive capacity" for EbA promotion. All four CFMPs were very similar in nature in suggesting future flood actions, mostly aligned to heavy infrastructural investment with a few exceptions in green technology such as

Level	Policies or institutions	Characteristics	Adaptive capacity score
European policies	WFD 2000	European Union guideline to ensure water quality for member states	0.87
	FFD 2007	Flood risk management strategies for the European Union Member States	0.80
National policies	Making Space for Water 2005	First institutional policy document allowed space for flood water as a natural approach	1.20
	The Pitt Review, 2008	Government-commissioned independent review following the summer floods in 2007 for future flood management	1.63
	The FCERM, 2011	Government strategy for flood and coastal erosion risk management	1.39
National regulation	Flood Risk Regulations 2009	Localized version of FFD for England. Provides decentralized management of flooding	0.69
	Flood and Water Management Act 2010	Imposed clear roles and responsibilities for flood management authorities	0.81
Local policies	River Eden Catchment Management Plan	Catchment-based flood planning for the Eden catchment	0.40
	River Derwent Catchment Management Plan	Catchment-based flood planning for the Derwent catchment	0.37
	Kent Leven Catchment Flood Management Plan	Catchment-based flood planning for the Kent Leven catchment of Cumbria	0.40
	South West Lakes Catchment Flood Management Plan	Catchment-based flood planning for the Southwest lakes catchment of Cumbria	0.40
Local institutions	The EA (Cumbria)	The main statutory consultee for all flood management activities	0.82
	CCC (LLFA)	Lead Local Flood Authority for Cumbria County	0.48

Table V.
Comparative content analysis to EbA using the protocol

sustainable drainage system. All four CFMPs showed a degree of sensitivity toward a landscape-scale approach and multi-sectoral planning but did not focus much on aspects like flexible management, ecosystem management and governance.

5.2.5 Local organization. Local flood executive organizations demonstrated less adaptive capacity (slightly positive) for EbA process than the policies. In particular, the Cumbria County Council was found to have a very poor level of adaptive capacity, especially in ecosystem management and landscape-scale approach of EbA, whereas the EA of Cumbria, which is in charge of providing a supervisory role and plan preparation, demonstrated a better adaptive capacity, but it is also less adaptable to the need of ecosystem management and integrated development (Table V and Figure 2).

An analysis of policy and organizational contents showed that "flexible management", "multi-sectoral" and "multiple geographic" approaches of EbA are among the better scoring principles of EbA (Table V and Figure 2). Recent flood risk management approaches at the European and national levels contributed to include "flexibility" and "multi-sector" approaches as key components. However, principles such as "governance", "integrated development" and "ecosystem maintenance" were not

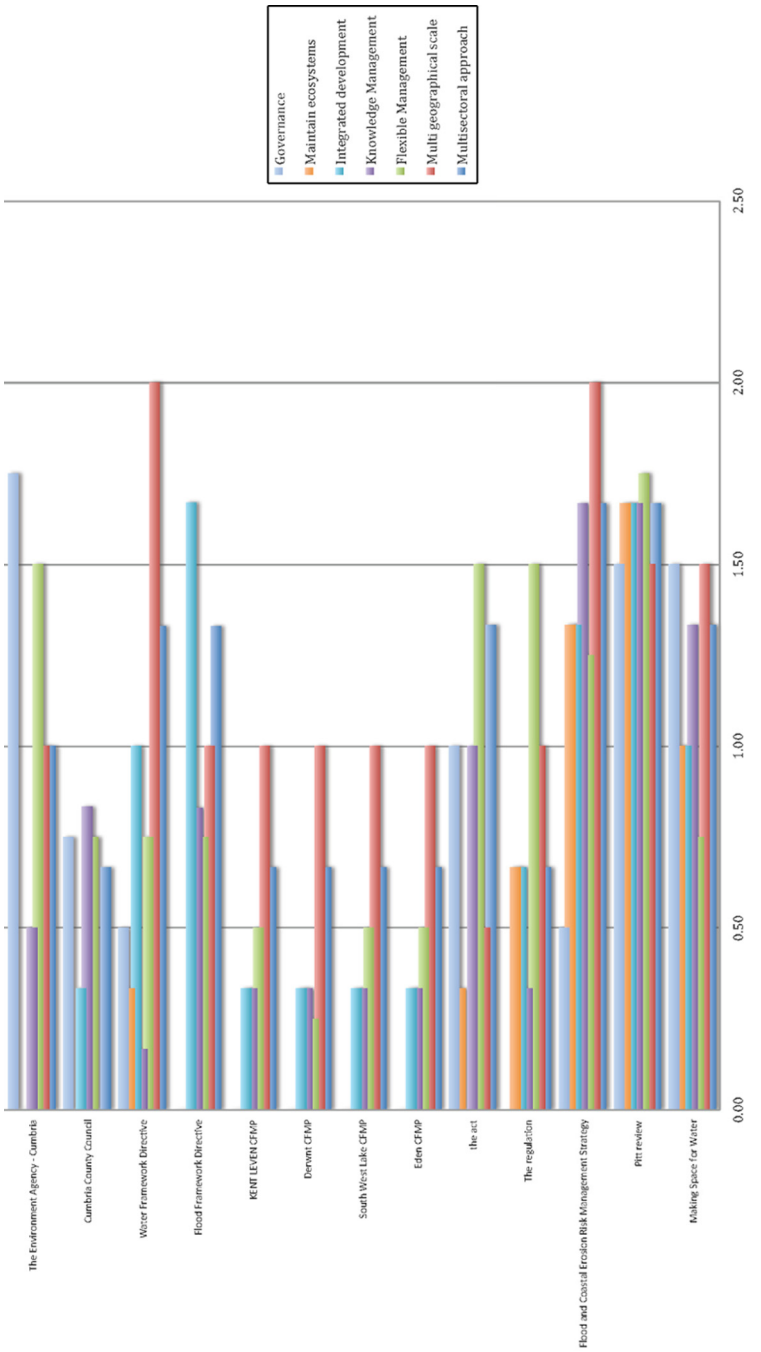


Figure 2.
Comparative scores of content analysis

always revealed as an automatic consideration for flood management. Nevertheless, many of the reviewed policies recognized nature-based approach of flood management in varying extent and proposed measures accordingly.

The assessment of the policies and organizations at the different levels of flood governance made one thing clear; there are, to some extent, arrangements within the present institutional and policy framework to support EbA initiatives. Among the 18 criteria, a few that are very highly visible imply "very high consideration" by the current policy instruments (Figure 3). These criteria are: stakeholder participation, catchment-wide planning and autonomous local authorities. Many criteria that are highly visible imply "high consideration" such as: institutional collaboration, clear planning goals and objectives, using scientific knowledge, encouraging to adapt learning cycle and consideration of maladaptation. Most importantly, the consideration of maladaptation, cost-effectiveness, local knowledge and co-benefit generation is a very important prerequisite for EbA planning, and these criteria are emerging. The bottom line is that the increasing consideration of criteria at the national policymaking level is happening, which may lead to flourish the EbA approach at the local level. At the same time, often-ignored criteria (Figure 3) such as a consideration of ecosystem management, as well as the promotion of equity in the local knowledge and experts in decision-making, would certainly benefit toward increasing the adaptive capacity of institutions and organizations (Source: Own survey with KIs, 2013).

It appeared from the analysis that at the national policy level, there is an emergence of nature-based approaches such as EbA. Many of the policy instruments embraced components for increasing organizational capacities to cope with natural disasters like flooding. This represents a major policy shift in the context of England, which has previously been criticized for its technocratic dependencies, ineffective inclusion of

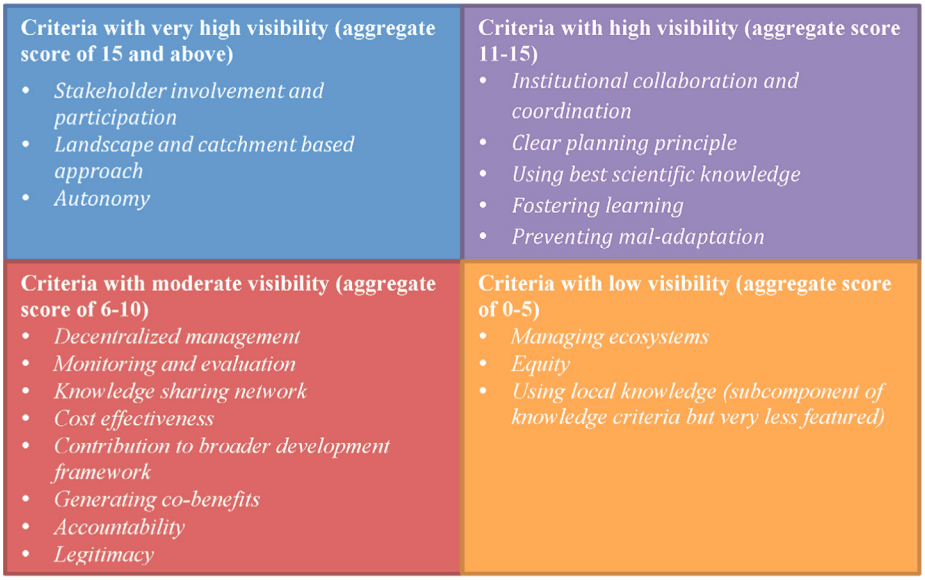


Figure 3.
Presence of criteria in the assessed policies and organizations

grounded knowledge and a failure to disseminate an appropriate message to wider audiences for flood management (Brown and Damery, 2002; Sayers *et al.*, 2002).

Multilevel flood governance has become increasingly important for disaster resilience building at local levels that involves a decentralized but co-management approach (Vedeld *et al.*, 2015; Ostrom and Janssen, 2004). Studies on multilevel flood governance often arrive at the findings that local management is more interested in short-term economic goals over long-term risk reduction mechanism, e.g. EbA (Stevens and Hanschka, 2013; Vedeld *et al.*, 2015). Flood governance in England is experiencing decentralization to some extent (Figure 3). In decentralized governance, local-level management is expected to carry out proactive flood management responsibilities in an independent manner to improve flood resilience, particularly alternative approaches like EbA. The findings show that EbA consideration at national policy level is largely evident. Consequently, one of the major challenges of flood governance is to reflect the policies at the local flood management level. These policies can potentially be lead by county councils and the local EA. For new flood management policies, county councils play a major role in emergency management, coordination, local flood management plan and local adaptation, whereas the EA uptakes more of a supervisory role.

The application of the adaptive capacity criteria showed that while policies showed larger commitments toward EbA, organizations such as the county councils and the EA are showing relatively minor progress of adapting the changes through their institutional practices and actions (Table V). The reason could be attributed to the introduction of new roles and the re-distribution of responsibilities by the Act and Regulations. For example, county and unitary councils were restructured as the LLFA who were traditionally dependent on technological and infrastructural flood management (Johnson and Priest, 2008; Krieger, 2013). LLFA is a relatively new body, well equipped for emergency management, whereas the EA are traditionally dependent on computer-aided models and benefit cost analysis for flood management decision-making with very limited scope of participation, local knowledge, equity, ecosystem concerns and integrated development (Source: Own survey with KIs, 2013).

Scoring exercise for the local-level organizations demonstrated very insignificant presence of the criteria such as "institutional collaboration and coordination", "landscape and catchment-based approaches", "clear planning principles", "monitoring and evaluation", "incorporating local knowledge" and "learning mechanism" for local-scale flood management. Presence of these criteria at local-scale flood governance not only allows organizations to embrace robust approaches like EbA, but is also necessary for greater effectiveness of multi-level flood management at the local level (Vedeld *et al.*, 2015; Ostrom and Janssen, 2004; Vinogradov *et al.*, 2013). Although, evidence is emerging of considering natural approach and empowering local community groups for sustainable and cost-effective flood management (Environment Agency, 2010, 2012), nevertheless, more researches need to be done to investigate how local implementing organizations can quickly adapt the policy changes. The research shows that using such a protocol provided qualitative and quantitative dimensions of institutional internal capacities to espouse alternative flood management strategies such as EbA. The protocol allows determining which adaptive capacity criteria need more attention at different flood management scale for promoting alternative and nature-based approaches of flood management like EbA. It is necessary to mention that all criteria should not be equally applicable at every level of flood governance; however,

the protocol provides important understanding about the current consideration of EbA principles across the whole vertical and horizontal spectrum of flood management.

6. Conclusion

This paper details a method to assess the inherent characteristics of institutions to promote their capacity to adapt to climate change. The method applied is moldable to suit the context and interests of the study. The research could also be viewed as a reference point for institutional assessment, in comparing social indicators and policies, as well as to propose necessary changes to strengthen adaptive capacity. In the case of England, the EbA institutional capacity assessment criteria assisted assessment of the present institutional capacity for undertaking EbA for flood risk management. This paper has analyzed the current flood management regime through the lens of adaptive institutions for EbA. The major findings from the empirical evaluation at multiple levels of flood governance in England revealed that:

- English national policy instruments showed greater level of adaptive capacities of developing the EbA approach than at the local and European levels.
- Local policies and implementing organizations are among the least adaptive institutions to EbA.
- There are considerable developments being made in incorporating landscape-scale flood management as well as the inclusion of diverse stakeholders at the national policy level. However, in practice, these developments are not necessarily reflected in the local-level policies and implementation.
- Inadequate consideration of ecosystems in flood management planning and ignoring local wisdom and knowledge are two generally neglected dimensions throughout the different levels of flood governance.

The low EbA adaptive capacity of local organizations and policies could be the underlying cause of low number of EbA and nature-based flood management measures at the local level. However, greater research is required to determine the reason of such a low number of EbA. The implications of the findings of this paper are significant in local-level flood management which is key for determining effective adaptation in multilevel flood governance structures. Whilst the top tiers of flood governance in England showed greater commitment toward alternative approaches like EbA, it is equally necessary that local organizations and policies follow suit and embrace alternative approaches. Some of these approaches include: better institutional communication, development of landscape-scale management plans with clearly stated flood management goals and targets, as well as an emphasis on learning-based planning, that incorporate local knowledge bases. Further, flood management requires an integrated ecosystem approach, with an inclusion of local community members such as farmers as well as a financial decentralization to local organizations. In addition to the current regulative provision of flood management, the national government should promote alternative flood management approaches like EbA, by providing appropriate regulative and legitimate provisions to local governments.

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