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LA GOUVERNANCE DES SYSTÈMES SOCIO-ÉCOLOGIQUES

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Mémoire d'Habilitation à diriger des recherches présenté et soutenu publiquement par

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Liste des dix travaux les plus significatifs

Gouvernance des systèmes socio-écologiques

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Gouvernance environnementale régionale

Par Jon Marco CHURCH

Ecosystèmes Gouvernance Politiques environnementales Environnement Frontières Intégration régionale Territoires Transnational

Jeune diplômé en relations internationales, ma première expérience de travail portait sur un accord environnemental régional, à savoir la Convention alpine. Or non seulement il m'était difficile de comprendre de quoi il s'agissait - un traité international ? une organisation internationale ? une grosse organisation non gouvernementale écologiste ? -, mais mes collègues, qui pour la plupart avaient travaillé plusieurs années dans ce domaine, semblaient eux aussi avoir du mal à appréhender cet étrange objet (Churchill et Ulfstein 2000). Je me suis donc attelé à la lecture de publications scientifiques et je me suis rapidement rendu compte du flou qui régnait en matière de gouvernance environnementale régionale, nonobstant quelques ouvrages méritoires (Debarbieux 2012 ; Balsiger et VanDeveer 2012 ; Balsiger et Debarbieux 2011 ; Elliott 2011). Cette contribution vise donc à présenter de manière synthétique l'état de l'art, ainsi que les résultats de mes propres recherches et des réflexions tirées de mon expérience dans ce domaine (Church 2015, Church 2011). Dans une première partie, j'introduis les distinctions nécessaires à la compréhension du grand nombre et de la grande variété des processus environnementaux régionaux à l'œuvre dans différentes parties du monde. La deuxième partie porte sur les différentes approches qui ont été mobilisées pour étudier la gouvernance environnementale régionale. Enfin, une troisième et dernière partie est consacrée aux principaux défis qui se posent aux acteurs de la gouvernance environnementale régionale, tels qu'identifiés dans la littérature scientifique et dans la pratique

Distinctions, définitions : quelle région ? Quel environnement ? Quelle gouvernance ?

Selon Kenneth Conca (2012), le niveau régional serait l'échelle la plus pertinente pour la gestion des ressources communes et la diffusion des normes. Il avance que la gouvernance environnementale régionale pourrait réussir là où les efforts au niveau mondial ont échoué, et que ces réussites au niveau régional pourraient constituer des étapes vers une gouvernance environnementale mondiale. Mais de quoi s'agit-il exactement ? De quelle région est-il question ? De quel environnement ? De quelle gouvernance ? Chacun de ces termes nécessite d'être précisé.



Typologie de gouvernance environnementale régionale

Il faut tout d'abord distinguer deux « régions » idéaltypiques : les régions institutionnelles ou constitutionnelles d'un côté et les régions sectorielles ou fonctionnelles de l'autre (Debarbieux et al. 2013). Les régions institutionnelles correspondent à la fois à des subdivisions administratives des Etats - les régions infranationales telles que les régions françaises - et à des Etats appartenant à la même zone géographique, à savoir les régions internationales telles que l'Europe. Ce premier idéaltype de régions repose sur une vision emboîtée ou hiérarchique de l'espace, où chaque niveau administratif est complètement englobé dans le niveau supérieur, est parfaitement adjacent aux autres administrations du même niveau et contient la totalité des niveaux inférieurs. Les régions sectorielles se structurent quant à elle selon les dynamiques de chaque secteur d'activité. Par exemple, la région ou l'aire d'influence économique d'une grande ville s'étend souvent bien au-delà de ses limites administratives. Les régions environnementales, également appelées écorégions, biorégions ou encore provinces biogéographiques, renvoient pour leur part à des espaces naturels tels que le bassin versant d'un fleuve, une mer ou encore un massif. Ce deuxième idéaltype de régions correspond donc à une vision hétérarchique et polycentrique de l'espace, où chaque élément peut chevaucher d'autres espaces, ne correspond exactement à aucun autre élément et dont le périmètre est souvent flou et changeant (Balsiger 2012). Les dynamiques propres à la gouvernance environnementale régionale changent selon le type de régions impliquées, sachant que la typologie proposée est limitée à deux idéaltypes alors que les deux aspects - hiérarchique et hétérarchique - coexistent toujours dans la réalité.



Accords environnementaux régionaux, 1948-2014

Qu'entend-t-on par « environnement » ? La géologie, la biologie et les autres sciences naturelles renvoient chacune à des subdivisions distinctes de l'environnement. Chacune de ces subdivisions - qui ne correspondent normalement pas aux subdivisions administratives, mais qui figurent souvent parmi les facteurs considérés lors de la définition de ces dernières - peut être l'objet d'une gouvernance régionale spécifique, que nous pouvons appeler « subsectorielle » ou monothématique : une zone caractérisée par un type de roche particulier, une autre présentant une espèce rare, etc. L'identification d'unités environnementales cohérentes pour recomposer ces subdivisions procède souvent d'une prise en compte simultanée des facteurs biophysiques, comme les sols et les espèces, et géographiques, y compris les facteurs humains (Udvardy 1975 ; Turner et al. 1993). On identifie ainsi des écorégions, des grands écosystèmes et des systèmes couplés homme-environnement qui correspondent normalement à un élément géographique (un bassin fluvial, une mer, un lac, une vallée, un massif ou encore une forêt ou un récif). Ces unités sont l'objet de la gouvernance environnementale régionale proprement dite et sont censées favoriser des approches plus intégrées (Balsiger et VanDeveer 2010). Or, ces unités restent des subdivisions imparfaites. Elles se chevauchent et sont souvent imbriquées les unes dans les autres, comme dans les cas du massif des Alpes et du bassin du Rhône, et ont des logiques parfois divergentes. Leur gouvernance s'en trouve à la fois fragmentée et redondante. Le concept de développement durable pousse à la recherche d'approches nouvelles et plurielles, capables d'arbitrer ces différents défis (Mancebo 2009). Dans cette perspective, l'émergence d'une nouvelle science de la durabilité pourrait permettre de dépasser une conception encore très partielle des écorégions et de poser les bases d'une approche plus holistique des relations homme-environnement (Clark 2007).

De quelle « gouvernance » s'agit-il ? Dans la plupart des processus de gouvernance environnementale régionale, les Etats sont les acteurs dominants. La gouvernance environnementale régionale est fondamentalement le résultat non seulement de leurs rapports de force et d'interdépendance, mais aussi des visions politiques et des capacités institutionnelles qui leur sont propres. Cependant, elle est souvent ouverte à la participation, voire même à l'influence de plusieurs autres types d'acteurs, notamment les organisations internationales et les ONG écologistes. Certains processus peuvent même être guidés par ces dernières sur de longues périodes, comme dans le cas de la <u>Commission internationale pour la protection des</u> <u>Alpes</u> (CIPRA) créée en 1952. Par ailleurs, la dimension identitaire est un élément important de la gouvernance environnementale régionale. Des individus et des groupes peuvent s'identifier à une région environnementale comme la Méditerranée ou les Pyrénées, ce qui selon certains conduirait à des pratigues vertueuses en matière d'environnement (Debarbieux 2009, Elliott 2012). Depuis la fin du XIX^e siècle, certains militent même pour la redéfinition des subdivisions administratives en fonction des régions environnementales.



Régions physiographiques des États-Unis proposées par John Wesley Powell (1895)

Source : POWELL, J. W. 1895. Physiographic regions of the United States, New York, American Book Company.

Lorsque certains s'approprient une idée, comme celle qui consiste à calquer les subdivisions administratives sur les régions environnementales, pour remanier les structures existantes, le concept d'écorégion devient « écorégionalisme », c'est-à-dire une idéologie (<u>Church 2010</u>). L'écorégionalisme est souvent opposé au concept d'« écorégionalisation » qui désigne le processus d'émergence et de diffusion d'une organisation écorégionale de l'espace (<u>Balsiger et VanDeveer 2010</u>). Ces deux concepts présupposent que les acteurs concernés croient en l'existence physique du phénomène environnemental en question ainsi qu'en l'existence réelle d'un rapport de cause à effet entre la dimension environnementale et la dimension socio-économique, ce qui renvoie à une sorte de « néodéterminisme environnemental » (<u>Debarbieux 2012</u>).

Quelques exemples de gouvernance environnementale régionale

De ces différents concepts et définitions, il faut surtout retenir la distinction entre gouvernance régionale de l'environnement et gouvernance d'une région environnementale. La gouvernance régionale de l'environnement désigne par exemple les politiques environnementales mises en œuvre par des institutions régionales au sens international du terme, telles que l'Union européenne. La question qui nous intéresse ici est de savoir comment des processus d'intégration régionale se saisissent des questions environnementales. La gouvernance des régions environnementales renvoie quant à elle non seulement à la façon dont différents types d'acteurs gèrent des régions environnementales, mais aussi aux modalités qu'ils mettent parfois en œuvre pour s'organiser eux-mêmes autour des régions environnementales. Le cas le plus courant est celui d'un ou plusieurs Etats qui élaborent des cadres règlementaires et d'action pour la gestion d'une région environnementale tels que, par exemple, le plan de gestion d'un lac ou d'une forêt ou à la création d'un parc au niveau national ou la signature d'un accord pour la gestion d'un fleuve transfrontalier, d'un lac, d'une mer ou encore d'un massif au niveau

international. Ce type d'accords existe depuis le début du XIX^e siècle et leurs secrétariats représentent les exemples les plus anciens d'organisations internationales, à l'instar des commissions fluviales pour le Rhin et pour le Danube. Ce rappel nous semble important dans la mesure où l'on imagine souvent ces accords figés dans le temps. Les questions environnementales sont changeantes par nature et en fonction de l'évolution de nos connaissances en la matière. La quasi-totalité de ces accords ont donc donné naissance à des institutions régionales, notamment des conférences ministérielles, des comités permanents de hauts fonctionnaires, des groupes de travail d'experts et des secrétariats, qui se réunissent à intervalles réguliers quand ils ne sont pas permanents. Ces dispositifs permettent d'assurer une observation constante des phénomènes ciblés et de promouvoir l'adoption de mesures efficaces ou leur adaptation. A titre d'exemple, citons, pour les mers, la <u>Convention pour la protection de la mer Méditerranée contre la pollution</u> (Convention de Barcelone) de 1976 et, pour la montagne, la Convention alpine de 1991.



Nombre d'accords environnementaux régionaux, 1948-2011

Les Etats ne sont pas les seuls acteurs à participer à la gouvernance des régions environnementales. Des organisations internationales comme les Nations unies et des processus d'intégration régionale comme l'Union européenne - dont les membres sont bien des Etats, mais dont le secrétariat et la Commission ont une remarquable capacité d'initiative - ont ainsi développé des programmes dédiés à des régions environnementales, tel le Programme pour les mers régionales initié par le Programme des Nations unies pour l'environnement (PNUE) en 1974 et certains sous-programmes du volet transnational du programme européen de coopération territoriale INTERREG, à l'instar des programmes opérationnels « Espace alpin » ou « Espace méditerranéen » de l'UE. Ces programmes soutiennent la mise en œuvre de projets spécifiques de coopération, tels que la promotion de la continuité écologique ou l'étude d'un polluant émergent, mais ils peuvent aussi conduire au développement de cadres institutionnels et stratégiques plus généraux, tels que la Convention de Barcelone et son Plan d'action pour la Méditerranée, soutenus par le PNUE, ou la Stratégie macrorégionale pour la Baltique, lancée par I'UE en 2009. Par ailleurs, plusieurs ONG écologistes ont focalisé leur action sur certaines écorégions, à l'instar de la CIPRA pour les Alpes et du Consortium pour le développement durable de l'écorégion andine (CONDESAN) pour les Andes ou ont lancé des programmes sur une base écorégionale. Par exemple, au début des années 2000, le World Wild Fund (WWF) a épousé l'idéologie écorégionaliste à tel point que son modèle organisationnel a transféré toute une série de compétences des bureaux nationaux aux programmes écorégionaux, à l'instar du bureau du Programme Danube-Carpates.

Approches, cadres : comment étudier la gouvernance environnementale régionale ?

De nombreuses approches et cadres conceptuels ont été mobilisés pour analyser la gouvernance environnementale régionale. Ils peuvent être classés en trois catégories : les approches épistémiques ou centrées sur la connaissance, les approches sociologiques et les approches orientées vers la gestion (Elliott 2012). Les premières s'intéressent aux modalités de connaissance et donc aux processus d'appropriation de ces territoires, notamment par les savants (Raffestin 1986). Elles présupposent une certaine maîtrise - souvent en termes de connaissance scientifique – des dynamiques propres à une écorégion. Une fois acquise, celle-ci permettrait de faire émerger des solutions en matière de gouvernance. Cette approche se caractérise donc par la correspondance entre le cadre et les limites des connaissances disponibles et le cadre et les limites de cette gouvernance. Dans notre cas, il s'agit de s'interroger sur le type d'interaction qu'il y a entre ces dynamiques écorégionales et les connaissances et la gouvernance qui les entourent. Par exemple, comment des connaissances sur le changement climatique acquises au niveau mondial sont-elles utilisées à l'échelle d'un territoire spécifique comme la Méditerranée ou encore comment la Convention alpine interagitelle avec l'Union européenne ? De plus, il est difficile de caractériser ces interactions en raison de l'imprécision et de la fluctuation du périmètre des écorégions et des problématiques environnementales en général. Les conditions du passage d'un niveau (local, national, mondial) à l'autre et d'une échelle (spatiale, temporelle, administrative, etc.) à l'autre est donc un élément fondamental pour comprendre tout processus de gouvernance environnementale régionale (Young 2002 ; Fourny 2013 ; Debarbieux 2012 ; Cash et al. 2006).

Les approches sociologiques proposent des outils théoriques, qui prennent souvent la forme d'analogies, pour mieux comprendre l'émergence et la persistance de la gouvernance environnementale régionale en tant que norme. La plus connue est certainement celle du champ bourdieusien (Bourdieu 1994 ; Fligstein et McAdam 2012). Le champ de la gouvernance environnementale régionale serait doté d'un certain nombre d'attributs comme par exemple une relative autonomie par rapport à d'autres champs, des limites poreuses ou encore des agents capables de se détacher des intérêts externes, d'être reconnus par leurs paires, de se distinguer en tant que professionnels, d'accepter ce qui est en jeu et de jouer selon les règles internes au champ. C'est en étudiant ces attributs et le positionnement des agents dans le champ, qui résulteraient de trajectoires historiques, que l'on peut comprendre les dynamiques propres à la gouvernance environnementale régionale. Or, dans une perspective bourdieusienne, l'enjeu porte toujours sur des valeurs symboliques et donc indépendantes de l'existence réelle des problématiques environnementales. Intégrer des facteurs matériels dans une approche sociologique de la gouvernance environnementale régionale nécessiterait de croiser la notion de champ avec la théorie de l'acteur-réseau, qui considère les objets inanimés (des arbres aux ordinateurs) comme acteurs d'un réseau, concept finalement très proche de celui de champ (Latour 2005).



Objets des accords environnementaux régionaux et mondiaux, 1945-2005

Enfin, les approches orientées vers la gestion se distinguent par leur objet : certaines portent sur l'efficacité de la gouvernance environnementale régionale, c'est-à-dire la capacité des mécanismes étudiés à atteindre leurs propres objectifs, indépendamment de la nature de ces derniers. Cela se traduit souvent par une série de variables descriptives de ces processus et de leurs contextes, qui sont en cours de normalisation. De grandes bases de données relatives aux accords environnementaux multilatéraux ont été créées et sont exploitées statistiquement dans le but d'établir des corrélations significatives (Breitmeier et al. 2011 ; Balsiger et Prys 2014). D'autres approches s'intéressent à la durabilité des systèmes couplés homme-environnement et donc à la capacité d'assurer une gestion des ressources naturelles en tant qu'éléments nécessaires à la vie, ainsi qu'une gouvernance des sociétés humaines qui permette à la fois de préserver les ressources naturelles et de garantir le développement humain. L'objectif principal est ici d'identifier les conditions d'un développement durable des systèmes couplés hommeenvironnement, et donc d'élaborer un cadre général qui intègre les propriétés des systèmes de ressources, des ressources en question, des systèmes de gouvernance et des citoyens-usagers de ces ressources territoriales (Ostrom 2009 ; Church 2015). Compte tenu de la diversité de ces facteurs, l'analyse intégrée des régions environnementales du point de vue de leur durabilité et sa normalisation impose une approche pluridisciplinaire reposant sur une théorie fondamentale des systèmes couplés homme-environnement et intégrant les connaissances de la pratique (Clark 2007).

Quels défis pour la gouvernance environnementale régionale ? Vers une gouvernance des écosystèmes

Nous avons vu dans la première partie de cette contribution que, selon Kenneth Conca (2012), le niveau régional serait l'échelle d'action la plus pertinente et les nombreux processus de gouvernance environnementale régionale à l'œuvre ou à venir pourraient être considérés comme autant d'étapes vers une meilleure gouvernance environnementale mondiale. Toutefois, il est le premier à reconnaître qu'on ne peut pas encore affirmer que le niveau régional a démontré une meilleure efficacité en pratique par rapport au niveau mondial et le fait que la gouvernance environnementale régionale est à l'œuvre depuis déjà deux siècles nous invite à considérer cette affirmation avec prudence. Depuis une dizaine d'années, rares sont les nouveaux accords environnementaux multilatéraux à avoir vu le jour, que ce soit au niveau régional ou mondial.

Période	Nombre total d'accords multilatéraux et de leurs modifications 187		Nombre total		
		Accords multilatéraux	Amendements multilatéraux	Protocoles multilatéraux	bilatéraux et de leurs modifications
1990-1994		97	62	28	204
1995-1999	155	55	63	37	264
2000-2004	136	52	60	24	60
2005-2011	75	17	48	10	15

Nombre d'accords environnementaux multilatéraux signés

Il est difficile d'identifier les raisons de cette « fatigue verte » (VanDeveer 2003). Une première hypothèse suggère que tous les instruments nécessaires à ce jour ont déjà été créés, ce qui ne signifie pas qu'ils sont parfaits et définitifs. Une deuxième, qui est confortée par la pratique, est que les Etats estiment qu'avant de lancer des nouveaux processus, il est de leur devoir de mettre en œuvre de manière satisfaisante les accords déjà conclus. C'est par exemple la position du gouvernement français au sujet des nouveaux protocoles de la Convention alpine. On peut aussi penser que cet essoufflement est attribuable aux effets combinés du scepticisme ambiant sur l'efficacité de l'approche scientifique et juridique qui a caractérisé les initiatives environnementales lancées dans les années 1990, telles que le Protocole de Kyoto, et des tentatives infructueuses - européennes et américaines - de déclencher une « croissance verte » en réponse à la crise financière et économique actuelle. Une dernière hypothèse, qui reste encore à vérifier, est que, contrairement au postulat de Conca, la crise de la gouvernance environnementale mondiale a freiné le lancement de nouveaux processus régionaux, et non l'inverse. Le fait, par exemple, qu'un grand nombre de fleuves transfrontaliers ne se sont toujours pas dotés d'une commission internationale, comme le préconise la guasi-totalité des acteurs au niveau mondial, tend à donner du crédit à cette dernière hypothèse.

La gouvernance environnementale régionale embrasse de nombreux phénomènes et implique une multitude d'acteurs, ce qui a pu engendrer une certaine confusion non seulement dans la théorie mais aussi dans la pratique. Pour mieux définir la gouvernance environnementale régionale « proprement dite », à savoir la gouvernance des mers, des bassins, des massifs, etc., nous avons vu qu'il était important d'opérer un certain nombre de distinctions que nous nous sommes appliqués à opérer dans ce texte. Et pour mieux l'appréhender, nous pensons qu'il est préférable de parler de « gouvernance des écosystèmes ». Le concept d'écosystème est en fait quasi identique à celui d'écorégion, mais il présente moins d'ambiguïté tout en conservant cette idée d'un espace au périmètre flou et fluctuant, susceptible de chevaucher d'autres espaces. Une fois le phénomène clairement défini, il pourrait être étudié en profondeur par la suite. Depuis une dizaine d'années, on observe la prolifération de travaux d'orientation épistémique et de travaux portant sur l'efficacité des processus existants. Mais c'est surtout du côté des approches sociologiques et des approches focalisées sur la durabilité qu'un réel besoin d'approfondissement et de recherches novatrices se fait sentir. Par ailleurs, si les monographies de cas spécifiques sont désormais nombreuses, c'est la dimension comparative qui fait défaut. Afin de structurer ce champ de recherche, des cadres généraux permettant d'analyser la gouvernance des écosystèmes commencent à émerger (Ostrom 2009 ; Church 2015). Leur perfectionnement et leur application systématique devraient permettre une meilleure compréhension du phénomène.

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Cette contribution vise à présenter de manière synthétique et systématique l'état de l'art dans le domaine de la gouvernance environnementale régionale, un aspect de la gouvernance environnementale peu connu mais central. Les questions écologiques sont en fait souvent territorialisées avec des dynamiques spécifiques aux différents écosystèmes. Dans une première partie, nous introduisons les distinctions nécessaires à la compréhension des processus environnementaux régionaux nombreux et variés à l'œuvre dans différentes parties du monde. La deuxième partie porte sur les différentes approches qui ont été mobilisées pour étudier la gouvernance environnementale régionale. Enfin, une troisième et dernière partie est consacrée aux principaux défis qui se posent aux acteurs de la gouvernance environnementale régionale, tels qu'identifiés dans la littérature scientifique et dans la pratique. Ils tiennent surtout au ralentissement du développement de la gouvernance environnementale multilatérale et à la nécessité d'une meilleure définition de la gouvernance environnementale régionale, raison pour laquelle nous préférons parler de gouvernance des écosystèmes.

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106-3 | 2018 Trajectoires de vulnérabilité des territoires de montagne face aux changements globaux

Trajectoires d'adaptation face au changement climatique : analyse et transformation du système de gouvernance du massif ardennais

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Trajectoires d'adaptation face au changement climatique : analyse et transformation du système de gouvernance du massif ardennais

Jon Marco Church

Introduction

- À cheval entre France, Allemagne, Belgique et Luxembourg, les Ardennes sont un massif forestier au cœur de l'Europe. S'il s'agit de petite montagne non couverte par la Loi montagne, le territoire est bien montagneux. Il est caractérisé par des enjeux partagés avec d'autres zones de montagne tels qu'un écosystème fragile, un couvert forestier important, de l'agriculture de montagne, une ruralité tridimensionnelle, une démographie changeante et des paysages culturels significatifs. Ce territoire présente des ressources en eau importantes, ainsi qu'une certaine exposition aux risques naturels et de la vulnérabilité au changement climatique. De plus, les Ardennes sont éloignées des pôles urbains et traversées par des axes et des flux de transport et touristiques, ainsi que par des frontières. Ces caractéristiques ne sont pas propres uniquement aux Ardennes, mais sont partagées par bien d'autres régions de montagne en Europe (Debarbieux, Price, & Balsiger, 2013 ; Debarbieux & Rudaz, 2010).
- Les Ardennes sont situées dans une zone climatique globalement tempérée qui compte un grand nombre de microclimats entre forêts et prairies. Comme dans d'autres territoires comparables, les changements climatiques actuels se traduisent essentiellement par une augmentation de la fréquence des phénomènes météorologiques intenses, une élévation des ceintures de végétation, une modification des habitats et de la biodiversité, ainsi qu'une altération des régimes hydrologiques et une intensification des processus hydrogéologiques (Golobic, 2006). Les projections climatiques sur les cent ans à venir dans l'ensemble des Ardennes tablent sur une augmentation de 2 à 3 °C de la température

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moyenne annuelle dans la région et le régime des précipitations serait lui aussi fortement modifié (Terlinden, 2011). Il est fondamental pour le territoire de pouvoir anticiper ces changements et leurs impacts, compte tenu de la possibilité d'impact sur un couvert végétal particulièrement sensible déjà à l'horizon 2050 et des investissements dans un secteur agro-sylvicole spécialement important du côté français, dont l'amortissement dépasse souvent les 30-40 ans.

Figure : Le périmètre géologique et humain des Ardennes et la croissance de la population (2006-2015)



Réalisation : Sébastien Piantoni, EA 2076 HABITER, Université de Reims Champagne-Ardenne.

- ³ Or, les approches scientifiques existantes ne sont pas encore capables d'anticiper avec précision les impacts des changements climatiques, notamment à l'échelle territoriale (GIEC, 2014). L'une des raisons est que plusieurs approches reposent surtout sur des dynamiques biogéophysiques en négligeant la dimension sociale (Folke, 2007 ; Liu *et al.*, 2007 ; Redman, Grove, & Kuby, 2004).¹ Cela est particulièrement problématique pour les Ardennes, où correspond à une biogéomorphologie relativement uniforme une situation démographique particulièrement contrastée avec un décrochage important du côté franco-allemand et une croissance marquée dans la partie belge-luxembourgeoise. L'usage d'approches qui reposeraient exclusivement sur des dynamiques biogéophysiques risquerait de mésestimer, par exemple, l'impact différentiel des changements climatiques de part et d'autre des frontières.
- 4 Dans ce sens, la gouvernance joue un rôle fondamental (Matson, Clark, & Andersson, 2016, pp. 83-104). C'est notamment à travers des systèmes de gouvernance que les connaissances sur les impacts du changement climatique sont co-produites par différents acteurs, notamment scientifiques, et qu'elles circulent ; c'est à travers ces systèmes que des choix collectifs peuvent être effectués et contribuer ou pas à l'adaptation des

territoires au changement climatique. Ces choix dépendent des relations entre les acteurs et peuvent donner lieu à des mesures et à des politiques visant à anticiper et éventuellement contrer les effets de la dérégulation climatique. Il est donc important d'étudier le système de gouvernance des Ardennes et voir lesquelles parmi ses caractéristiques sont plus ou moins propices à faciliter l'adaptation au changement climatique de ce territoire. Nous suggérons donc que ces caractéristiques de la gouvernance ardennaise peuvent agir en tant que levier ou frein par rapport à une plus grande adaptabilité. Pour répondre à cette question, de nombreuses approches peuvent être mobilisées.

Tout d'abord, cette contribution se penche sur l'identification de trajectoires d'adaptation 5 par rapport au changement climatique. Nous interrogeons donc les méthodes de recherche transformationnelle en matière de durabilité (Wiek & Lang, 2016) par le biais d'un cadre méthodologique original issu de cette approche. Illustré ci-dessous, ce cadre a été développé pour intégrer les différentes méthodes les plus communément utilisées en recherche transformationnelle. L'une de ces méthodes est le cadre général pour l'analyse de la durabilité des systèmes socio-écologiques (SSE) développé par Elinor Ostrom. Cette approche a été développée notamment pour l'étude des biens communs (Ostrom, Burger, Field, Norgaard, & Policansky, 1999) et intègre non seulement les interactions des éléments biogéophysiques, tels que les unités et les systèmes de ressources et les écosystèmes, mais aussi des facteurs sociaux, tels que les acteurs et les systèmes de gouvernance, ainsi que le contexte social, économique et politique, pour en analyser les résultats en termes d'impact sur le SSE (Ostrom, 2009 ; Ostrom, Janssen, & Anderies, 2007) . Un grand nombre d'études de cas ont été produites ces dernières années suivant ce cadre. Dans cet article, nous utilisons une version du cadre d'Ostrom (Church, 2016, 2019), adapté spécifiquement aux systèmes socio-écologiques de grandes dimensions comme les Ardennes. Dans l'économie de ce texte, nous allons considérer comme des synonymes les deux concepts de « système socio-écologique » et de « région environnementale » (Church, 2015).

Vers une recherche transformationnelle pour les Ardennes

⁶ Le changement climatique est censé avoir des impacts bien au-delà de la variabilité observée précédemment. L'adaptation au changement climatique demande des transformations profondes. Plusieurs approches proposent des cadres théoriques et méthodologiques pour envisager ces transformations. Dans cet article, nous employons un cadre qui a été développé et adapté sur la base du cadre méthodologique TRANSFORM, proposé par Wiek et Lang (2016, pp. 31-41). Nous mobilisons ici le concept actif de transformation, qui permet de mettre en avant le rôle de différents acteurs sur les territoires et qu'on retrouve aussi dans les derniers rapports du GIEC (2014), plutôt que la notion plus passive de transition.



Figure : Cadre d'analyse des transformations d'un système socio-écologique

Réalisation : redessiné et adapté par l'auteur sur la base de Wiek et Lang (2016, p. 38).

- Ce cadre a été développé pour intégrer les différentes méthodes les plus communément 7 utilisées en recherche transformationnelle. Par rapport à une situation et un point d'intervention donnés, ce cadre permet de combiner l'analyse diagnostique, l'analyse prospective, l'analyse rétrospective, les approches interventionnistes, ainsi que les approches réflexives et critiques, qui font défaut dans le cadre originel. Par exemple, pour contribuer à résoudre un problème de durabilité d'un SSE et proposer des solutions, nous nous intéressons d'abord à la phase diagnostique, qui est fondamentale pour cadrer le problème et identifier les forces motrices ; puis à la prospection dans le futur, c'est-àdire à comment le problème pourrait être résolu ; ensuite, nous engageons un travail de rétrospection, à savoir quelles sont les solutions possibles ; enfin, nous proposons une démarche à la fois réflexive et critique à chaque étape. Chaque composante de ce cadre, qui correspond aux rectangles dans la figure ci-dessus, indique trois éléments : le type d'action (en gras : analyse, étude, mise en scénario, mise en œuvre, cadrage, critique) ; les objets des actions (sans format : configurations, plans, pratiques); les mouvants des actions (entre parenthèses : problèmes, solutions). Chaque élément répond donc à une question précise : quelle action ? Sur quoi ? Pourquoi ?
- Par rapport à notre point d'intervention, qui peut être la volonté de certains acteurs de 8 transformer le système de gouvernance ardennais, le point de départ dans une démarche de recherche transformationnelle est l'analyse et le diagnostic du territoire. Cette analyse vise à identifier les configurations actuelles et passées. Cela est une étape fondamentale, car les SSE présentent souvent des problèmes complexes avec un grand nombre de variables qui interagissent entre eux de manière non-linéaire, adaptative et parfois inattendue. Dans notre cas, il s'agit du diagnostic du système de gouvernance que nous présentons ci-dessous. Sur cette base, l'étape suivante consiste en deux démarches parallèles d'analyse prospective et rétrospective : d'un côté, les études prospectives établissent les configurations durables dans lesquelles le problème serait résolu dans le long terme ; de l'autre, les scénarii indiquent les configurations futures des solutions possibles au problème dans le court, moyen et long terme. Les scénarii sont toujours multiples et présentent normalement un scénario tendanciel, un scénario optimiste, un scénario pessimiste et un ou deux scénarii intermédiaires, si besoin (Lane & Montgomery, 2014 ; O'Neill et al., 2017 ; Van Vuuren et al., 2014). Ils permettent d'étudier la faisabilité

des différentes options et d'augmenter la pertinence des actions envisagées, mais ils reposent aussi sur de nombreuses hypothèses qui reposent sur les connaissances limitées et les biais de ceux qui les réalisent et qui peuvent être plus ou moins partagés (van Ruijven *et al.*, 2014). Leur construction et leur évaluation sont donc particulièrement importantes.

- Ces deux démarches parallèles contribuent ensuite à la conception et à l'expérimentation q d'interventions. Dans le cas ardennais, un exemple d'intervention serait l'adoption d'une convention internationale pour la protection et le développement durable des Ardennes sur le modèle de la Convention alpine et de celle des Carpates. Cela se traduit normalement par des plans et des stratégies d'intervention qui peuvent inclure des expériences de mise en œuvre sur le territoire, visant à préparer la mise en œuvre des interventions. Il s'agit de l'étape préalable à l'intervention proprement dite de la part des acteurs, qui peut certes s'inspirer de la recherche transformationnelle, mais qui va suivre des logiques pratiques qui ne dépendent pas uniquement des connaissances scientifiques, mais aussi des conditions matérielles de réalisation et d'autres connaissances. Cette phase de mise en œuvre, au même titre que toutes les autres étapes identifiées jusqu'ici, nécessite donc un travail de cadrage et de définition des enjeux qui porte sur les pratiques épistémiques des acteurs concernés, car leur perception et leur représentation du problème joue un rôle fondamental dans la construction des solutions proposées, comme nous l'avons vu pour le cas des scénarii. Toute phase nécessite aussi des études critiques sur les pratiques délibératives, car la construction et l'appropriation de solutions dépendent aussi des acteurs et de leurs relations de pouvoir (Epstein, Bennett, Gruby, Acton, & Nenadovic, 2014).
- À cet égard, l'une des limites de l'approche proposée est le fait qu'elle se focalise uniquement sur la recherche nécessaire pour engendrer des transformations et ne distingue pas les acteurs de cette recherche transformationnelle. Un cadre qui permet d'identifier le travail de frontière (en anglais : *boundary work*) (Clark *et al.*, 2011) entre scientifiques et praticiens dans une perspective de recherche transformationnelle est le modèle conceptuel d'un processus de recherche transdisciplinaire ci-dessous, qui a été développé par Lang *et al.* (2012). Ce cadre ne se limite pas à étudier l'interaction entre plusieurs disciplines scientifiques, mais il essaie de combiner pratiques sociétales et pratiques scientifiques dans un souci d'intégrer les connaissances scientifiques avec les connaissances issues de la pratique. Dans une démarche transformationnelle, la coproduction des connaissances est importante pour l'appropriation des solutions par les acteurs dans une perspective de mise en œuvre et donc d'intervention.



Figure : Modèle conceptuel d'un processus de recherche transdisciplinaire

Réalisation : redessiné par l'auteur sur la base de Lang (2012, p. 28).

11 Un processus de recherche transdisciplinaire part de problèmes sociétaux et scientifiques. Ils ne correspondent pas forcement. Le cadrage du problème et la constitution de l'équipe qui va s'atteler à identifier des solutions est donc très important, car le partage du problème et la légitimité à la fois scientifique et sociétale de l'équipe sont fondamentales pour le processus de co-production de connaissances transposables et orientées vers la solution de problèmes. Celui-ci est un processus non-linéaire qui vise à l'appropriation et à la mise en œuvre des connaissances co-produites. Ensuite, ces résultats peuvent être, d'un côté, utilisés dans les pratiques sociétales et, de l'autre, contribuer aux pratiques scientifiques. Ils alimentent donc les discours à la fois sociétaux et scientifiques. Ce processus itératif nous ramène au point de départ avec de nouveaux défis. Cette recherche transdisciplinaire contribue à ce que certains auteurs qualifient la gouvernance adaptative (Gupta et al., 2010 ; Karpouzoglou, Dewulf, & Clark, 2016 ; Webster, 2009) et est une variable-clé de tout système de gouvernance d'un SSE.

Le cadre général d'Ostrom

12 Afin d'illustrer nos propos, nous présentons ici un cas d'étude sur le système de gouvernance du massif ardennais. Dans cet article, nous nous limitons à amorcer une analyse diagnostique. Un programme de recherche transdisciplinaire sur les Ardennes beaucoup plus vaste serait nécessaire pour contribuer à un processus de recherche transformationnelle sur ce territoire et contribuer à la durabilité de ce massif forestier au cœur de l'Europe. Pour faire cela, nous allons mobiliser le cadre général pour analyser la durabilité des SSE qui a été proposé par Ostrom (2009 ; 2007). Nous avons choisi ce cadre d'analyse, car il est probablement le plus apte pour caractériser les interactions entre sociétés et environnement (Binder, Hinkel, Bots, & Pahl-Wostl, 2013). Selon Claudia Binder et ses coauteurs, il s'agit du seul cadre d'analyse qui prend en considération les systèmes sociaux et écologiques de manière presque également approfondie et qui est capable de produire des analyses plus ou moins spécifiques à travers la différentiation de

plusieurs niveaux. Le cadre général d'Ostrom met tout d'abord en relation le SSE étudié, par exemple le massif ardennais, avec son contexte social, économique et politique, ainsi qu'avec les écosystèmes associés, à l'instar du système climatique. Puis, le cadre identifie quatre sous-systèmes : les systèmes de ressources, les unités de ressources, les systèmes de gouvernance et les acteurs. Le cadre général d'Ostrom invite donc à étudier les interactions entre ces sous-systèmes et leurs résultats en termes par exemple de durabilité. Enfin, il intègre aussi les boucles de rétroaction entre ces résultats et les composantes du SSE, comme il est mis en évidence dans le schéma ci-dessous.

Figure : La structure du cadre général pour analyser la durabilité des systèmes socio-écologiques



Contexte social, économique et politique (S)

Source : Ostrom 2009, p. 419, (redessiné et traduit par l'auteur).

- Ostrom propose ensuite un certain nombre de variables de deuxième niveau pour chaque sous-système (2009, p. 420). Ces variables ont été identifiées sur la base d'un grand nombre de cas d'études conduits pendant une trentaine d'années. Il s'agit de cas notamment de SSE de petite dimension, caractérisés par la présence d'une seule ressource principale en régime de propriété commune. Ce cadre nécessite donc d'être adapté pour être utilisé par rapport à des systèmes de grandes dimensions (Cox, 2014; Fleischman *et al.*, 2014) et d'autres régimes de propriété. Pour ces raisons, depuis plusieurs années, nous développons une liste de variables de troisième et quatrième niveau pour mieux caractériser la gouvernance des SSE de grandes dimensions, à l'instar du massif ardennais (Church, 2016). Ces variables ont été identifiées sur la base de six cas d'études représentatifs d'écosystèmes terrestres, marins et d'eau douce à travers le monde. Ce cadre adapté a donc été utilisé pour produire l'analyse ci-dessous.
- 14 Les sources d'information pour l'analyse du SSE ardennais et notamment de son système de gouvernance sont multiples. Nous avons d'abord encadré en 2013 un atelier de la deuxième année du master en urbanisme durable et aménagement de l'Université de

Reims Champagne-Ardenne sur la trame verte et bleue avec le Parc naturel régional des Ardennes, qui a été suivi par la réalisation de quatre mini-mémoires sur la région environnementale ardennaise par des étudiants de la même promotion.² Nous avons ensuite organisé en 2014 un séminaire international à Sedan sur le partage d'expériences entre zones de montagne transfrontalières, notamment les Alpes et les Ardennes, en collaboration avec l'Université de Reims, le Parc naturel régional des Ardennes et la Présidence italienne de la Convention alpine. En 2015, nous avons donc pu échanger avec de nombreux acteurs, à l'instar de l'ex-président de l'ancienne Région Champagne-Ardenne, ainsi que le président, le directeur et le personnel du Parc naturel régional des Ardennes et le directeur du Parc naturel Viroin-Hermeton en Wallonie : nous avons aussi dirigé un mémoire de master sur la gouvernance de la forêt wallonne dans les Ardennes.³ La même année, nous avons participé également à un colloque organisé par Virginie Joanne-Fabre dans le cadre du projet CNRS PEPS ARDIHES, intitulé « Le massif ardennais face aux changements climatiques : modélisation mathématique d'un système socioécologique ». Enfin, nous avons organisé en 2016, en collaboration avec le réseau néerlandais de centres de recherche sur l'environnement SENSE, une journée de terrain dans les Ardennes dans le cadre de l'école d'été internationale de niveau doctoral GOSES sur la gouvernance des SSE. Cet atelier associait des praticiens et des scientifiques avec l'objectif de co-produire des connaissances sur le système de gouvernance ardennais et apporter des solutions. Il a utilisé le cadre d'Ostrom afin de co-produire certains éléments-clé de l'analyse ci-dessous.

Les défis socio-économiques et écologiques du massif ardennais

- 15 Les Ardennes sont un massif forestier partagé par quatre pays: France, Belgique, Luxembourg et Allemagne. Aucune ville de grande dimension ne se trouve à l'intérieur de son périmètre. Quatre villes d'une certaine dimension se trouvent cependant à ses portes : Charleville-Mézières, Liège, Luxembourg et Cologne. Son périmètre change selon les éléments qu'on prend en considération, comme illustré dans la carte ci-dessus (figure 1): forêt, géologie ou facteur humain. La concentricité de ces différentes définitions montre bien la cohérence du SSE et son lien étroit avec le massif forestier.
- Les Ardennes font face à de nombreux défis écologiques. Pour ce qui concerne le climat, elles sont situées dans une zone climatique globalement tempérée qui compte un grand nombre de microclimats entre forêts et prairies. Selon les projections climatiques, la température moyenne annuelle sur les cent ans à venir devrait augmenter de 2 à 3 °C dans l'ensemble des Ardennes. Une augmentation de la fréquence des phénomènes météorologiques intenses, ainsi qu'une altération des régimes hydrologiques et une intensification des processus hydrogéologiques sont donc prévues. Une forte modification du régime des précipitations est aussi attendue (Terlinden, 2011). Cela est particulièrement important par rapport au bassin de la Meuse, qui traverse les Ardennes jusqu'à la pointe de Givet en territoire français avant de passer en Belgique et puis aux Pays-Bas. Les Ardennes constituent donc un goulot d'étranglement pour ce fleuve transfrontalier, ce qui s'est traduit par un certain nombre d'inondations. Un système de barrages a été mis en place pour réduire le risque d'inondation et est actuellement en cours de renforcement et d'automatisation du côté français. Cela se fait non-seulement à cause de la vétusté des installations existantes et donc de leur inaptitude pour faire face

au changement climatique, mais aussi pour réduire le risque de dispute autour de ces eaux transfrontalières. De plus, la Commission internationale de la Meuse veille depuis 1994 à la protection et à la gestion intégrée de ces ressources en eau partagées entre plusieurs pays. Cependant, il est important de noter qu'une partie des Ardennes du côté luxembourgeois et allemand se trouve hors du bassin de la Meuse et que celui-ci va bien au-delà du massif ardennais. Par rapport à la flore et à la faune, les projections climatiques se traduisent par une élévation des ceintures de végétation et par une modification des habitats et de la biodiversité (Golobic, 2006). Il s'agit d'un écosystème particulièrement sensible déjà à l'horizon 2050.

17 Les Ardennes font face à de nombreux défis socio-économiques. Il est probable que le changement climatique aura un impact important par exemple sur l'activité forestière en Belgique, vu que la forêt ardennaise est celle avec le taux de boisement le plus élevé de Wallonie (Gameren, 2014) et que l'amortissement des investissements dans le secteur sylvicole dépassent souvent les trente ou quarante ans. D'après une étude de la Région wallonne (2011), il semblerait, en revanche, que la plupart des acteurs de la sylviculture wallonne prennent déjà des mesures pour faire face aux effets du changement climatique, même si cela se fait d'une manière qui n'est pas toujours consciente. Le secteur touristique est aussi important. Les Ardennes sont parfois considérées comme la « Côte Azur » pour les Belges. Les impacts du changement climatique sur le secteur touristique, développé notamment du côté belge, sont difficiles à évaluer. Les différents impacts auraient lieu sur le fond d'une situation démographique particulièrement contrastée, avec un décrochage important du côté franco-allemand et une croissance marquée dans la partie belge-luxembourgeoise, trainée par le dynamisme de l'économie du Grand-Duché. La figure 1 met en évidence un effet de frontière marqué entre les quatre pays.

Éléments de diagnostic du système de gouvernance du massif ardennais

À partir de visites de terrain et d'un état des lieux du système de gouvernance ardennais (Church, 2016), nous avons donc identifié de façon participative, dans le cadre de de l'école d'été internationale GOSES sur la gouvernance des SSE déjà mentionnée⁴, les variables des autres sous-systèmes qui correspondent aux défis écologiques, économiques et sociaux du massif ardennais par rapport au changement climatique. Ces évaluations ont fait l'objet d'une discussion approfondie et prennent en compte les considérations d'une pluralité de types d'acteurs de la gouvernance des Ardennes qui ont participé à cet exercice. Dans une expérience mentale, nous avons ensuite réfléchi collectivement sur l'interaction entre ces variables et celles du système de gouvernance. Cela a permis d'établir si des caractéristiques du système de gouvernance de notre cas d'étude aurait eu un impact positif, neutre ou négatif sur le développement durable du SSE à l'horizon 2050, défini en tant que « capacité d'améliorer le bien-être humain tout en préservant les systèmes qui soutiennent la vie sur la planète dans la longue durée » (Matson *et al.*, 2016, je traduis). Cela comprend aussi l'adaptation au changement climatique. Figure : Diagnostic du système socio-écologique ardennais



Source : élaboration originale de l'auteur (2016)

- Nous avons illustré ces impacts du changement climatique de façon synthétique dans un graphique de grandes dimensions, redessiné et reproduit dans la figure 5. Les éléments en orange correspondent aux trois composantes fondamentales de l'analyse : les dynamiques climatiques, le système de gouvernance et les résultats en termes de développement durable. Les éléments en gris correspondent aux variables des autres sous-systèmes qui nous apparaissent plus impactés par le contexte et jouer un rôle important dans l'interaction avec le système de gouvernance et les dynamiques climatiques dans une perspective de durabilité. Nous nous sommes donc concentrés sur les variables qui nous semblent les plus pertinentes. Par rapport au système de gouvernance, nous avons souligné en jaune les variables qui auront un impact vraisemblablement positif sur le développement durable des Ardennes à l'horizon 2050 dans un contexte de changement climatique et qui pourraient constituer des leviers. Au contraire, certaines variables sont en rouge, car nous estimons qu'elles risquent d'avoir un impact probablement négatif.
- 20 Cette analyse du système de gouvernance du massif ardennais et de son adaptation par rapport au changement climatique identifie des limites du système actuel. L'absence d'observatoire du SSE des Ardennes dans son ensemble, l'absence de dialogue intersectoriel structuré et la capacité d'agir limitée des collectivités territoriales et de la société civile, entre autres, représentent, à l'issue de ce travail collectif, des obstacles pour faire face au changement climatique sur la globalité du territoire ardennais. Cependant, dans le processus de co-production, nous avons identifié aussi des éléments positifs, notamment l'alignement politique partiel qu'on observe actuellement et le potentiel du tourisme et de la Marque Ardenne, qui est un projet de marketing territorial de nombreux acteurs du secteur touristique français, belge et luxembourgeois fédérés

depuis 2014 dans le cadre du Groupement européen d'intérêt économique (GEIE) « Destination Ardenne ». Ce dernier pourrait représenter le noyau d'un système de gouvernance qui intègre d'autres secteurs, à l'instar de la ressource en eau, mais aussi des secteurs sylvicole et résidentiel.

Conclusion

21 Dans le cadre d'un processus de recherche transformationnelle, ces éléments de diagnostic peuvent représenter un point de départ pour des analyses prospectives et rétrospectives qui puissent envisager des éventuelles solutions et leur faisabilité. Ces éléments sont cependant loin de pouvoir représenter des éléments de stratégie pour contribuer au développement durable de ce territoire. Seulement après la réalisation d'analyses prospectives et rétrospectives on pourra mettre en place des stratégies de transformation, tout en prenant en compte les limites des pratiques délibératives et épistémiques en place et à venir. En même temps, ces processus sont aussi des processus de recherche transdisciplinaire, qui donnent lieu à une co-production de connaissances par les acteurs scientifiques et sociétaux. Dans cet article, nous suggérons que ce type de processus de recherche transformationnelle et transdisciplinaire peut contribuer à une plus grande adaptation au changement climatique.

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NOTES

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RÉSUMÉS

Les Ardennes sont un massif forestier au cœur de l'Europe. Il est fondamental pour ce massif de pouvoir anticiper le changement climatique et ses impacts prévus. Dans cet article, nous nous intéressons particulièrement au système de gouvernance des Ardennes. Nous mobilisons d'abord les méthodes de recherche transformationnelle en matière de durabilité par le biais d'un cadre méthodologique qui intègre différentes méthodes. Dans ce contexte, nous procédons avec une analyse diagnostique de la durabilité du système de gouvernance ardennais. Cette analyse a été développée à partir d'une version du cadre général pour l'analyse de la durabilité des systèmes socio-écologiques développé par Ostrom. Elle a été adaptée à un système de grandes dimensions et appliqué dans le cadre d'un processus de recherche participative. Cela a permis d'identifier trois vulnérabilités principales : l'absence d'un observatoire du système socio-écologique dans son ensemble, l'absence d'un dialogue intersectoriel structuré et la capacité d'agir limitée des collectivités territoriales et de la société civile. Nous suggérons donc de mettre en place des analyses prospectives et rétrospectives afin d'identifier des trajectoires d'adaptation du système de gouvernance par rapport au changement climatique. Cela devrait permettre de concevoir et expérimenter des interventions pour transformer la gouvernance de ce système socio-écologique de grandes dimensions vers une plus grande durabilité.

The Ardennes are a mountain forest area in the heart of Europe. It is fundamental for this mountain area to be able to anticipate climate change and its expected impacts. In this article, we are particularly interested in the Ardennes governance system. We first use transformational sustainability research methods through a methodological framework that combines different methods. In this context, we proceed with a diagnostic analysis of the sustainability of the Ardennes governance system. This analysis was developed from a version of the general framework for the analysis of the sustainability of socio-ecological systems developed by Ostrom. It was adapted to a large system and applied as part of a participatory research process. This identified three main vulnerabilities: the absence of an observatory of the socio-ecological system as a whole, the lack of a structured intersectoral dialogue, and the limited capacity to act of local authorities and civil society. We therefore suggest conducting prospective and retrospective analyses to identify adaptation paths of the governance system in relation to climate change. This should make it possible to design and experiment interventions to transform the governance of this large socio-ecological system towards greater sustainability.

INDEX

Keywords : Ardennes, socio-ecological system, sustainability, governance, transformational research

Mots-clés : Ardennes, système socio-écologique, durabilité, gouvernance, recherche transformationnelle

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Synthesis

Action-orientated research and framework: insights from the French longterm social-ecological research network

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ABSTRACT. Many social-ecological system(SES)-based approaches have been proposed to address environmental problems. Most social-ecological frameworks developed to date, however, lack clear operational linkages between humans and nature to efficiently guide SESs toward resilience. A conceptual framework designed to be operational is therefore necessary, as well as a network of research platforms with which to apply it. We defined explicit coupling processes that can be used as leverages to pilot an SES toward sustainability. We proposed to formalize an SES as a dynamic entity composed of two coupling interfaces, i.e., adaptive management and ecosystem services, both set within a landscape context to provide an actionable framework. These interfaces describe the way various actors, including scholars, benefit from and manage complex and changing interactions between the biophysical and social templates. Understanding the key processes underlying the interaction dynamics, especially those leveraging adaptive management processes, would help identify adaptive pathways for practices and collective actions, provide a crucial knowledge base for policy makers, and foster operationality as a requisite of an SES research agenda. Using several examples, we explained why long-term social-ecological research platforms provide an ideal operational network of research infrastructures to conduct place-based action-orientated research targeting the sustainability of SESs.

Key Words: adaptive governance; ecosystem services; landscape; LTER; management; practices; research infrastructure; social-ecological systems; sustainability

INTRODUCTION

In the Anthropocene (Lewis and Maslin 2015), humankind's global footprint in terrestrial ecosystems gradually increased from 5% to more than 50% in just 3 centuries (Ellis et al. 2010). Already, human impacts on ecosystems worldwide have resulted in a dramatic decline in biodiversity (Pimm et al. 2014), with measurable consequences for ecosystem services (ESs; Balvanera et al. 2014). Ecosystems will be even more intensively used in the future because the human population is still growing rapidly (Carpenter et al. 2009). Altogether, increased human pressure on ecosystems, global change, finite resources, and economic instability urge decision makers to frame new paradigms for sustainable development to achieve human well-being for all (Ellis 2015). Locally relevant indicators of the system's state were developed to prompt public action (e.g., Dearing et al. 2014), but the analysis of the relationship between social and biophysical conditions at broader scales, e.g., the landscape scale, as a tool to foster changes in management from a system dynamics perspective is still lacking.

Environmental problems result from social, technical, economic, and ecological variables that not only form complex systems on their own, but also can interact to create wicked problems with intricate causes and consequences. Solving them calls for a new research posture, shifting from monodisciplinary approaches to transdisciplinarity (Jahn et al. 2012). The latter allows accounting for various and diverging viewpoints and involves explicit stakeholder knowledge, as well as cooperation between science and society (Spangenberg et al. 2015, Church 2018). Interdisciplinary and transdisciplinary research that links social and ecological systems as an integrated science-policy research agenda (Folke 2006, Ostrom 2009) also requires a dedicated research infrastructure (RI). We argue that long-term socialecological research (LTSER) platforms are such RI, sharing a

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Table 1. Description of the 14 research platforms of the French long-term social-ecological research	(LTSER) network. I	LTER,
international long-term ecological research; SES, social-ecological system.		

LTSER Name	ILTER Code	Size (km ²)	Main Ecosystem	Main Stakeholders	SES Objective
Alpes	LTER_EU_F- R_001	100,000	Alpine pastures, heathlands, and mountain forests	National and regional parks, farmers, foresters, public administrations and collectivities, and researchers	Trajectories and functioning of socioeconomic environments in a context of climate change and territorial changes
Arc Jurassien Antarctique	LTER_EU_F- R_012 LTER_EU_F-	13,500 7700	Grasslands, forests, karstic hydrosystems, wetlands, Herb field, fell field, and polar	Farmers, public bodies, NGOs, cheese sectors, and researchers Researchers, administration, and fishing	Sustainable management of midmountain landscapes Biodiversity conservation
Armorique	LTER_EU_F-	6750	Grassland, urban, forest, and	Farmers, public bodies, and citizens	Biodiversity conservation in agricultural and urban area
Bassin du Rhône	LTER_EU_F- R_006	96,500	Rivers, streams, lakes, and catchments	Public administrations and collectivities, hydropower companies, citizens, and NGOs	Sustainable process-based management, long-term SES observation, and scientific federation
Brest Iroise	LTER_EU_F- R_007	6690	Land-ocean interface, coastal zone, estuaries, streams, and watersheds	Public bodies, fishers, farmers, scientists, NGOs, and watershed and coastal zone managers	Facilitating transformation toward sustainability of the Bay of Brest and the adjacent Iroise Sea, facing increasing coastal risks (erosion and submersion), eutrophication, and decreasing biodiversity
Environne- ment Urbain	LTER_EU_F- R_005	3000	Urban and periurban	Citizens, local researchers, public bodies (town and regional authorities and air- quality and environmental local agencies), NGO, and enterprises (buildings enterprises, planners, energy providers, etc.)	Urban sustainable development considering environmental systems
Hwange (Zimbabwe)	LTER_EU_F- R_010	15,000	Wooded semiarid savanna and subsistence agriculture	National park staff, public bodies, farmers, foresters, NGOs, and tourism	Sustainable ecosystem service delivery from the protected area for promoting the resilience of the SES
Loire	LTER_EU_F- R_008	117,000	River hydrosystems, forest, grasslands, intensive agriculture, urban, and periurban	Public bodies (state, water and biodiversity agencies, regional and local authorities, etc.), environmental NGOs, users (farmers, tourists, fishers, etc.), and citizens	Functioning and dynamics on the Loire system and understanding components (abiotic, biotic, and socio-systemic) and their interactions over the long term
Moselle	LTER_EU_F- R_003	16,500	Forest, mixed farming systems, cities, and industries	Water agency (Rhin-Meuse), public bodies, farmers, and forestry	Water quality and human pressure: state, improvement, and remediation
Plaine & Val de Sèvre	LTER_EU_F- R_009	450	Intensive agriculture and villages	Farmers, NGOs, citizens, and public bodies	Landscape agroecology for sustainable agriculture
Pyrénées Adour Garonne	LTER_EU_F- R_014	16,073	Agroecosystems (mountains and valley)	Farmers, state agency, and NGO	Resilience of SES from upstream to downstream of a large river

unified and operational framework. We propose pathways to develop such a framework, which makes explicit the coupling interfaces between social and ecological templates to use leverage tools and promote action for active social-ecological system (SES) stewardship (Chapin et al. 2010). We analyze the case of the French LTSER RI, currently composed of 14 highly diverse research platforms (Table 1), and further argue that the RI should be organized as a network. At the local level, i.e., sites or platforms, social-ecological feedbacks can be monitored, experimented with, and predicted, whereas at the network level they can be formalized and generalized.

KEY DRIVERS OF THE SOCIAL-ECOLOGICAL SYSTEM INTERFACE: CONCEPTUAL FRAMEWORK

Most natural ecosystems have been colonized and exploited by humans, becoming SESs. SESs combine interdependent social and ecological dynamics that involve multiple interactions and feedbacks between the human and ecological components (Collins et al. 2011), are adaptive (Folke et al. 2005, Levin et al. 2013), and loop into co-occurring complex (Holling 2001) and cross-scale (Levin 1998, Cash et al. 2006) dynamics. Addressing solely the social dimension of resource management without ecosystem dynamics or focusing only on the biophysical processes as a basis for decision making for sustainability both lead to narrow conclusions that may result in unexpected outcomes and **Fig. 1**. The conceptual framework of the social ecological system (SES) within the French long-term socialecological research platforms. The SES as an entity is composed of two coupling interfaces, the adaptive management interface and the ecosystem services interface, both set within an explicit landscape context. The originality in this framework is the emphasis on explicit components that will directly contribute to changing the trajectory of the SES.



even the collapse of SESs, e.g., the Aral Sea. The system therefore needs to be considered as a whole because of the tight couplings among components and across scales (Redman et al. 2004).

Going beyond Collins et al.'s (2011) conceptual framework, we suggest that SES key elements can be coupled into two processbased interacting interfaces, each comprising three core items: the (1) "ecosystem services interface" with functions, goods, and benefits/values; and the (2) "adaptive management interface" with collective action and colearning, multiple resource uses, and practices. Both interfaces are set within a given landscape (Fig. 1). We consider these six core items as leverages influencing the dynamics of the SES, though they differ in scale and nature. The two interfaces and their core coupling elements share characteristics despite having their own variables, methods, analytic tools, vocabulary, and semantics (Abson et al. 2014, Rissman and Gillon 2017). Having many meanings, their use conveys concepts with dialectically vague frontiers. As such, they can be seen as boundary objects that can promote opportunities for transdisciplinarity (Schröter et al. 2014).

The ES interface and its elements have already been clearly identified and discussed as coupling agents in social-ecological processes (e.g., Reyers et al. 2013, Hamann et al. 2015). Conversely, the core elements of the adaptive management interface were less often considered as coupling forces in the SES, except in Ostrom's SES framework (Ostrom 2009) and, more recently, for collective action (Barnaud et al. 2018) or practices (Lescourret et al. 2015). Links between collective action and multiple resource use were also recognized to contribute to fostering adaptive governance in a context of adaptive management or comanagement (Kofinas 2009). We therefore need to specify these core elements of the adaptive management interface and their interplay in the context of our framework.

Subsequently, we provide an overview of the framework, mainly based on theoretical considerations and literature review. Then, in *Operationalizing the conceptual framework within research infrastructures*, we provide examples from the French LSTER network.

The adaptive management interface

This interface, in which institutional arrangements and ecological knowledge interplay at various levels, is central to SES dynamics and their study (Folke et al. 2005). The transitions from the three core elements of this interface, i.e., collective action, multiple resource use, and practices, can be considered fuzzy (Fig. 1). Indeed, collective action can be seen as the social dimension of managing multiple uses of SESs (e.g., see Kofinas 2009), whereas individual or collective practices stem from these arrangements but are filtered through value systems and mental models. This interface thus describes a form of adaptive management of the focal SES, or even comanagement in more advanced coupling initiatives (Olsson et al. 2004). In some of the SES literature, this interface is also referred to as adaptive governance (Folke et al. 2005, Chaffin et al. 2014), which describes the links between societies and ecosystems not only as end products but also as at the very heart of social-ecological coupling. Adaptive governance focuses on experimentation and learning, bringing together research on institutions and organizations for collaboration, collective action, and conflict resolution in relation to natural resource and ecosystem management (Kofinas 2009). In many ways, adaptive governance can be considered an ideal model for SES governance (Chaffin et al. 2014).

Collective action

The concept of collective action (Olson 1971, Ostrom 1990) is used to describe the processes through which "two or more individuals cooperate to accomplish a goal they cannot achieve individually" (Matson et al. 2016:85). Within the SES framework, collective action and social relations are framed with regard to the biophysical, particularly facing environmental uncertainty, and the socio-economic contexts, in particular, public policies and market economy. It implies decision making or deliberation (Rosenberg 2007), which can be blocked or distorted by power relations, existing incentives, and limited knowledge. Implementation and evaluation processes around the policies are intended to achieve the goal of collective action, such as resilience (Mazé et al. 2017). In such a process, different communities of scientific experts, knowledge holders, and decision makers interact through different kinds of boundary objects (Brand and Jax 2007, Clark et al. 2016).

Multiple resource use

Natural resources, including land and, by extension, ESs, are used in multiple ways and, in most cases, by multiple agents. Agents can act individually or collectively and belong to different user groups (as defined by Ostrom et al. 2007). This situation of multiple use by multiple agents requires complex processes of negotiation and regulation providing rules at different levels, particularly property rights, self-organization rules, and policy outputs, among different agents for the implementation of decision making (Lascoumes and Le Gales 2007). We hold the view that the study of multiple uses can be employed not only as an analytical tool but also as a way to contribute to the management of the multiple uses of multiple natural resources. The latter can, directly or indirectly, e.g., through a common driver, interact with each other, echoing in a way the idea of a bundle of ESs that need to be considered simultaneously rather than separately (Bennett et al. 2009). We also draw attention to collective uses stemming from negotiation and local arrangements by including them in the framework, because practical collective management has received proportionally less emphasis in adaptive management theories (but see Berthet et al. 2012).

Practices

Practices are defined as actions and measures motivated by background knowledge, cultural and technical heritage, perception, beliefs, and states of emotion (Feldman and Orlikowksi 2011). They are the primary interactions between human beings and their supporting ecosystem and happen from fine (field, neighborhood) to coarse (regions, cities) scales. Practices are effect-producing phenomena within the SES affecting the SES coupling (Lescourret et al. 2015). They directly affect a complex set of biophysical, ecological, and social features required to deliver ESs, hence impacting the resilience and sustainability of ES provision (Bennett et al. 2009). For example, in agricultural landscapes, the delivery of multiple ESs (agricultural production, pollination, and landscape aesthetics) derives from agricultural practices, such as crop species sown, the use of inputs or ploughing, and the size of fields (Tancoigne et al. 2014). In semiarid savannahs of the LTSER Hwange, animal distribution (directly related to water use), trampling, and safari experience are all conditioned by pumping practices in protected areas (Chamaillé-Jammes et al. 2007).

INTEGRATING SOCIAL-ECOLOGICAL CONCEPTS

WITHIN LONG-TERM ECOLOGICAL RESEARCH SITES Despite a few operational tools and practical guidelines that exist (Anderies et al. 2004, United Nations Development Programme 2015), SES research has remained mostly theoretical, generic, and qualitative (Nassl and Löffler 2015). The theory-to-practice gap to implement sustainable transformation is further blurred by the fact that most often, social and ecological components are not treated equally profoundly and reciprocally (Binder et al. 2013), and most of the time, the research process is considered disconnected from the system's trajectory. Although the societal component of SESs has been hardly surveyed in these areas in the long term, the ecological component has often been monitored for decades with dedicated research platforms, particularly within the long-term ecological research (LTER) network. LTER is an initiative that arose in several countries more or less simultaneously, but which really took the format of an organized network first in the United States in the 1980s (Callahan 1984). LTER sites now number almost 1000 worldwide (Mirtl et al. 2013). They were primarily chosen in natural landscapes without human activities. They were small in size and focused on monitoring physical, chemical, and biological processes. However, human and social aspects eventually gained interest, with more and more sites involving human activities (see the review by Folke et al. 2005). A very similar convergence appeared in Europe, even though the European LTER network officially started later and in a different form (Haberl et al. 2006, Mirtl et al. 2013). LTSER is a combination of SES research and LTER approaches. It emerged more or less simultaneously on the two continents (Mauz et al. 2012).

Fig. 2. Current research investment of the 14 research platforms of the French long-term social-ecological research network for each core coupling element of the two interfaces. Several research approaches are used: formalism, observation, experimentation, and modeling. The colors indicate the levels of investment (green = high, yellow = medium, and orange = low) of each platform, i.e., 14 color rectangles per table cell. The resulting color mosaic per cell gives an overview of the current research strength and needs of the network. Goods and ecosystem services are split into mono- or multiecosystem services. Monetary and nonmonetary valuations of benefits are considered.



The emergence of social-ecological perspectives within the LTER initiative emerged from the integration of land-use perspectives, the inclusion of new disciplines, particularly from the social sciences and humanities, and the development of interdisciplinary research (Collins et al. 2011). The propulsion of SES theoretical background within the LTER network led to at least five major changes: (1) anthropogenic drivers, initially perceived as "disturbances" that should be minimized in LTER, became of special interest in LTSER with their own dynamics and feedback loops (Mirtl et al. 2013); (2) the complexity of the systems under study increased dramatically, as ecosystems and SESs are both complex adaptive systems (Folke et al. 2005, Levin et al. 2013); (3) conceptual frameworks included explicit interactions between the social and ecological/biophysical elements leading to new research questions, e.g., citizen viewpoints (Mirtl et al. 2013); (4) scientists eventually shifted from being perceived as objective, detached experts delivering knowledge in LTER sites to being stakeholders among the many that learn about and contribute to managing complex adaptive systems, because they are often involved in the decision-making process in the LTSER platforms and sites (Waltner-Toews et al. 2003); and (5) in LTSER, policies became hypotheses, and management actions represented ongoing learning experiments to test these hypotheses (Ostrom 2009).

However, we believe that moving from LTER to LTSER has not been fully achieved: current SES frameworks are not explicit enough to tackle present challenges. We need further tools to develop policies enhancing the sustainability and resilience of SESs. Beyond theoretical frameworks that are already available (Folke et al. 2005, Daily et al. 2009), we need operational frameworks that provide an adequate overview of the problems, associated causes, and resulting effects, thus helping to "organize diagnostic, descriptive, and prescriptive inquiry" as suggested by McGinnis and Ostrom (2014). In SES frameworks, the widely used notion of "driver" is challenged: land-use change is traditionally seen as a "human" driver, whereas it can result from social-ecological processes (Lambin et al. 2001); the resulting landscape should be considered as the holistic context and provides indicators of social-ecological interactions (Wu and David 2002, Benoît et al. 2012). Similarly, even though ESs are commonly present within most SES frameworks, the links between SESs and ESs are seldom explicit (Binder et al. 2013, Förster et al. 2015), and so are the human dimensions of ESs (Spangenberg et al. 2015).

OPERATIONALIZING THE CONCEPTUAL FRAMEWORK WITHIN RESEARCH INFRASTRUCTURES

To develop our LTSER approach in the French network, we initially used Collins's framework (Collins et al. 2011) as a basis, distinguishing between the social and biophysical templates. However, given the prominence of the biophysical template in many sites of our network, we focused our efforts on the social template (Fig. 2). For instance, values are often neglected in the

Fig. 3. Use of the social-ecological system framework developed for the French LTSER network (Zones Ateliers) to illustrate the diversity of components underlying human-elephant coexistence issues, based on examples drawn from a long-term research in and around Hwange National Park (Zone Atelier Hwange, http://www.za-hwange.cnrs.fr), western Zimbabwe. The area, classified as agro-ecological region IV and V, is characterized by low fertility soils (mostly Kalahari sands) and erratic low annual rainfall (606 mm, inter-annual CV = 25%). The current climatic trend of increasing drought severity (Chamaillé-Jammes et al. 2007) is constraining faring options and forcing adaptive land-use option. In a context of proximity to protected areas. The villagers rely essentially on subsistence farming and natural resource harvesting. HNP, a key protected area from the Kavango-Zambezi TFCA, hosts one the highest densities of free-ranging African elephants (A) in the world (Chamaillé-Jammes et al. 2009). (B) Ecosystem services provided by elephant as perceived by local communities living with them (positive services, 74%, shown in bright darker colours, negative ones in lighter colours) (Guerbois 2012). Data was extracted from anonymous essays written by 54 village heads in nine villages on the edge of Hwange National Park. (C) Level of damage on crops from 30 intensively monitored fields in Magoli (De Garine-Wichatitsky et al. 2013). Overall, the level of livestock damages superseded those from elephant, clustered near the PAs. (D) Problem Animal Control (PAC) of elephant as a conventional response to crop raiding, and meat sharing as an advertised benefit. (E) The Social Network Analysis of the stakeholders association forum, showing an attempt to foster collective action and adaptive governance (Guerbois et al. Unpublished ms). (F,G) Farmers' field damage level strongly depends on the guarding activity of their neighbours, combined with their own effort (Feff) and the presence of well-used elephant path close to the field (Guerbois et al. 2012). (H) Seasonal variations in space use by elephants (orange kernels) at the edge of the farming area mainly constrained by surface water availability (blue dots) and human disturbance, here exemplified by herding strategies inside the Forest area (Purple kernel) (Vall-Fox et al. 2018). Conventional approaches to HEC focus on why elephant move in farming land (H), the level of damage (C) and the efficiency of active mitigation measures (D), though follow-up of the distribution process is rare. We advocate that the roots for coexistence are often present in local communities and that effort should be put on promoting the positive services (B) and existing collective actions and local governance initiatives (F) rather than mitigating negative services. A better comprehension of stakeholders interactions should facilitate adaptive governance (E). The SES lense is a useful tool to explore the diversity of linkages defining the interface between human and wildlife, and exposes alternative options to the 'commandand-control' approach to mitigating conflicts, focusing on endogenous processes, social cohesion, soft-edges and adaptive comanagement.


SES literature (Jones et al. 2016), particularly relational values that bind humans with ecosystems beyond the intrinsic and instrumental values of ecosystems. Values are also a fundamental aspect of cognition, so mental models should provide key insights into the social dimension of coupled SESs (Lynam and Brown 2011). In fact, sense of place (Chapin et al. 2012) and place attachment (Gosling and Williams 2010) are shown to be critical in explaining conservation-minded behavior and ecosystem stewardship. In the Hwange LTSER, we found that people rooted in the area had fewer conflicting views on wildlife and conservation than those who moved to the area in search of direct benefits from the protected areas or the natural resources (Guerbois et al. 2013). The explicit position of knowledge, values, and worldviews in our framework aims at underlining their crucial role in designing action-oriented research and thus addressing sustainability and conservation issues (Tengö et al. 2017). It is also a reminder that some knowledge and value systems (mostly indigenous) may have intrinsic elements and principles of environmental stewardship, emphasizing the need for some hybridization to foster innovation (Clark et al. 2016). Local rules for natural resource harvesting can thus be derived from negotiation between traditional authorities, economic actors, scholars, and local government services and result in new practices that can be inspired by traditional practices, as in the case of the Sikumi Forest in the Hwange LTSER (Guerbois et al. 2012, Guerbois and Fritz 2017).

A second major way to operationalize the framework is to apply it to landscapes that act both as contexts and outcomes (Fig. 1). This means using RIs that operate at the landscape level. Indeed, landscapes both condition and result from social and ecological interactions (Lambin et al. 2001). Moreover, through feedbacks, they contextualize and support SES dynamics. Landscapes are often seen as a societal outcome of land-use decisions (Ostrom et al. 2007). They may also be viewed as cultural (Haberl et al. 2006), as well as social-ecological products, emerging from coevolutionary interactions between people and ecosystems in ways that maintain biodiversity and provide humans with goods and services necessary for their well-being (Gu and Subramanian 2014). In the Rhône River LTSER, thanks to strong interactions among multiple stakeholders over decades, models were run to predict the ecological impacts of a unique river restoration program while taking into account social values and public expectations in several riverine landscapes. In return, restoration measures benefited the ecology of the river, improved generic ecological knowledge, deeply renewed social links with the river, and influenced future management plans and practices (Lamouroux et al. 2015). In our framework, we consider landscapes not only as evolving social-ecological contexts but also as the nucleus of social-ecological dynamics across scales (see Fig. 3 for an example). We thus use all dimensions of landscapes, i.e., material, resource based, immaterial, cultural, functional, and scenic, to support place-based research. Landscapes are spatially nested hierarchies and can be effectively studied as such (Wu and David 2002). Including landscape in our conceptual framework allows it to become a flexible and integrative object for actors at all scales. In SESs, as in most complex systems, scale is a critical issue, including both temporal and spatial scales, as well as both patterns and processes (Redman et al. 2004). These scale issues occur in both social and ecological components, but they are critically contingent to adaptive management because cross-scale interaction mismatches may lead to SES vulnerability (Redman et al. 2004, Cumming et al. 2013). Therefore, scale should be a primary focus of any study on SES adaptive management or transformation. We suggest in our framework that the use of a landscape lens should (1) help reduce the likelihood of scale mismatches and (2) allow us to explicitly address causes and consequences of landscape changes, which is crucial to render research useful for sustainability science. For instance, when addressing farmer/elephant (Loxodonta africana) coexistence in LTSER Hwange, the emphasis should not just focus on field damage or on mitigation strategies at the ward or district levels, but also integrate dynamics across scales, i.e., the household, farmland, and village scales (Guerbois et al. 2012). Other aspects of the human-elephant relationship, such as its significance for the community, the true cost of damage for livelihoods, local perceptions of elephants, and the value of elephants for the human community of interest, should also be taken into account (Guerbois et al. 2012). A shift toward sustainability will thus require considering not only the ecological landscapes but also social and political landscapes where the issues are raised (Fig. 3). This calls for rethinking the role of research and of an RI rooted in SESs where social-ecological processes are simultaneously studied. Such an RI must be deeply connected with institutions, must engage in public/collective actions with stakeholders and citizens, and should, in addition, be running for decades to identify the long-term dynamics of ecological and social processes, to address the conditions of well-being for all, across generations.

The third specificity of our framework that makes it operational is that the French LTSER platforms endorse an operational definition of ESs. We acknowledge that ESs are not simply a byproduct of ecosystems, but rather the result of a coproduction process, in which human societies attribute values and use human capital and technology to modify ecosystem processes and goods (see Collof et al. 2017), even unintentionally (Harrington et al. 2010, Mace et al. 2015). The second interface of our conceptual framework depicted in Figure 1 is the ES interface. The ES cascade formally links the two templates (Fig. 1) and makes the interdependencies between humans and natural systems explicit (Collins et al. 2011). Even if the ES concept has been widely criticized (Schröter et al. 2014), ESs were found by Binder et al. (2013) to be an explicit part of all SES frameworks. ESs are often seen as the central part of a cascade, with ecosystem properties (biophysical structure, natural capital, or stock) producing ecosystem functions (flows), which provide goods and services that impact human livelihoods (benefits or costs), in a specific value system (Haines-Young and Potschin 2010, Mace et al. 2015). ESs are also a normative way to identify enhanced socialecological interactions (Abson et al. 2014). However, despite the fact that the ES concept is widely used, it sometimes fails to deliver relevant knowledge for policy making, developing financial mechanisms, and operational decisions (Laurans et al. 2013). In addition, decision makers, governments, businesses, and the public are rarely taken into consideration when analyzing ESs (Daily et al. 2000, 2009). We argue that LTSER sites provide a perfect tool not only to operationalize the ES concept and use in policy making (Colloff et al. 2017), but also to share focus, terminology, and system representations among research fields and disciplines and with the various stakeholders present within the boundaries of a given LTSER site or platform (Collins et al. 2011). Detailed analyses of the ES cascade were carried out, for instance, in the LTSER Plaine & Val de Sèvre (Bretagnolle et al. 2018), linking land use and pollinator abundance and distribution (Bretagnolle and Gaba 2015), the role of wild and domestic bees in crop pollination (Perrot et al. 2018), crop yield (Perrot et al. 2019), farmers' income (Catarino, Bretagnolle, Perrot, et al., unpublished manuscript), and pollinator socio-cultural value (Montoya et al. 2019). We also need a better understanding of linkages within bundles of ESs and particularly of how they are affected by policy (land-use policies especially) and decisionmaking processes of individual stakeholders. This approach was used successfully in several French LTSER sites and platforms to bring together various stakeholders and elaborate collectively innovative landscapes, focusing on bundles of ESs (Berthet et al. 2019). Viewing ESs through the SES lens imposes considering ESs as a tool for assessing a mission-oriented discipline (Cowling et al. 2008) with a policy aim in mind, whether it is produced on request from decision makers or not. We therefore plead for an explicit SES-based approach of ESs, embedding a systemic view of social, economic, and ecological processes taking place in LTSER sites. The interfaces should be dealt with jointly as coupling agents in social-ecological processes. They should thus be fully investigated in any LTSER program portfolio (Barnaud et al. 2018).

NETWORKING LONG-TERM SOCIAL-ECOLOGICAL RESEARCH SITES AND PLATFORMS TO DELIVER SUSTAINABLE DEVELOPMENT POLICIES

Overall, almost 5 years was necessary to structure the French LTSER network around the SES interface, formalize the framework, and assemble the various items and concepts. The framework is currently being applied successfully in all French LTSERs (see Fig. 3 for a detailed working example, and Bretagnolle et al. [2018] for another example). The framework allows us to explore various questions within the SES (Fig. 2) and to describe the boundaries of the SES being studied (Kansky et al. 2016). Our experience in structuring the network highlights three key features: First, adopting a common operational transdisciplinary conceptual framework is a powerful tool to address a portfolio of actions toward sustainability. Second, the RI offers a diversity of contrasting and complementary ecological and social situations over a wide range of SESs (Table 1, Fig. 2); the RI is thus organized as a network distributed along ecological (e.g., climate and ecosystem types) and socio-economic (e.g., livelihoods and urbanization) gradients (Table 1) that promote the emergence of comparisons and experimental approaches at every level of the SES, addressing research questions related to the key elements of the adaptive management interface (Fig. 2). Third, the use of the SES approach in the LTSER network implies the recognition of researchers among the stakeholders of the SES they study, thus contributing to, and sometimes initiating, socialecological experiments. The level of involvement of scientists as stakeholders also follows a gradient: In some cases, scientists may be a simple observer group, whereas in others they are active actors in action-oriented research sites, e.g., activists or simply participating in management committees. In a few cases, they may even become landscape managers, e.g., within the NATURA $2000\,$ network or in LTSER Plaine & Val de Sèvre (Berthet et al. 2012).

LTSER sites are therefore dynamic tools that can be adapted to new challenges and in which scientists, as stakeholders involved in collective action, must bear a clear definition of their exact roles, accepting that research is not neutral (Falck and Spangenberg 2014). For instance, we recently developed the concept of SES experiments (Gaba and Bretagnolle, unpublished manuscript) as a new tool for place-based research in which scientists perform experimental manipulation of some of the components of the SES. Such experiments were performed with farmers in LTSER Plaine & Val de Sèvre (Gaba et al. 2018). Experimental approaches in policy interventions are strongly needed to design for performance evaluation and improvement of the SES over time (Daily et al. 2009). Recognizing scientists as stakeholders may ensure long-term persistence of SES research within LTSER sites. This, as in any long-term RI, is only guaranteed as long as researchers are committed and funding is sufficient.

Therefore, to move from concept to sustainable development policies of SESs, the example of the French LTSER network stresses that scientists and stakeholders need (1) to better define the key drivers, i.e., the processes underlying the interaction dynamics, at the interface between ecosystem and society, especially those acting at the landscape scale; and (2) to identify the adaptive management processes and pathways, in terms of practices and collective actions, to provide operational knowledge for policy makers.

Responses to this article can be read online at: http://www.ecologyandsociety.org/issues/responses. php/10989

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1. The French LT(S)ER network

Long Term Ecological Research (LTER) is a global network that has been active since the 1980s (Mirtl *et al.*, 2018). It promotes the long-term observation of ecological phenomena in different sites. The network also has a branch in France. One of the specificities of the French network is the emphasis not only on the ecological dimension of LTER sites, but also on social aspects. For this reason, all French LTER sites are now also LTSER sites, which stands for Long Term Social-Ecological Research (Mirtl *et al.*, 2013; Bretagnolle *et al.*, 2019). This perhaps reflects the high level of anthropization in Europe. However, this phenomenon is limited to France. Anthropogenic pressure on ecosystems is increasing at the time of the Anthropocene (Crutzen, 2006). The "S" in LTSER is also a reference to the concept of Socio-Ecological System (SES), which is gaining currency to refer to different kinds of systems where human society and environmental systems are closely coupled at various levels (Liu *et al.*, 2007).

The French LT(S)ER network is an inter-disciplinary and inter-university network of platforms, also known in French as *Zones Ateliers* (ZA), and the sites

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within them, that is coordinated by the Institute of Ecology and Environment (INEE) of the National Centre for Scientific Research (CNRS). The network promotes long-term observation and research to answer fundamental questions of ecology, but also to respond to societal challenges in relation with environmental dynamics at local, regional and global levels. According to data of the French LT(S)ER network, there are currently 15 LTSER platforms that are labeled by the CNRS, 13 of which are located in the mainland and 2 overseas. More than 1,500 people from more than 118 partner institutions are directly or indirectly involved in the production of the research produced by these platforms. More than 230 of the scholars involved are doctoral candidates.

1.1. The importance of societal actors in a transdisciplinary research process

The research performed in the French LT(S)ER network is place-based and action-oriented. It aims at contributing to solve problems of resilience and sustainability. As such, the network promotes "research, training and invention that can inform action for sustainable development", i.e. so-called sustainability science (Clark, 2007). For this reason, the network's objective is to construct its research questions as much as possible together with a wide range of stakeholders to ensure that research results are not only transferred to managers, but also appropriated by all relevant social actors (Van Kerkhoff, Lebel, 2006). Moreover, the inclusion of various types of stakeholders allows to build not only on scientific knowledge, but also on practical knowledge. In this paper, we mobilize the concept of transdisciplinary research process to illustrate how knowledge is co-produced in a LTSER (Church, 2018). Transdisciplinarity should not be confused with interdisciplinarity. While interdisciplinarity consist in the combination of different scientific disciplines to investigate a common object within a research process, transdisciplinarity means including both scientific and social actors in the co-production of solution-oriented transferable knowledge.

As illustrated in Figure 1 (Lang *et al.*, 2012), societal problems and scientific problems are the starting point of a transdisciplinary research process. They are not necessarily identical. The framing of a problem and the constitution of the team that will work to identify solutions is therefore very important, because the sharing of the problem and the legitimacy of both the scientific and the societal team are fundamental to the process of co-production of transposable and problem-oriented knowledge. This is a non-linear process that aims at the ownership and implementation of co-produced knowledge. Secondly, these results can be, on the one hand, used in societal practices and, on the other, contribute to scientific practices. They fuel both societal and scientific discourses that will then contribute to the definition of new societal and scientific problems. This iterative process brings us back to the starting point with new challenges.



Figure 1: Conceptual model of a transdisciplinary research process (source: redesigned based on Lang, 2012: 28)

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Transdisciplinary research processes contribute to what some authors describe as adaptive governance (Webster, 2009).

1.2. Public participation in environmental governance

The issue of transdisciplinary research processes within LTSER sites must however be understood in the framework of science-policy relations. The relationship between scientists and decision-makers is complex, as they are sometimes involved either directly or indirectly in decision-making (Jasanoff, 1990). However, scholars are only one kind of societal actors alongside non-governmental organizations, which include businesses, associations, religions and the media, as well as individuals. These actors can participate in environmental governance processes alongside government organizations. They contribute to so-called public participation in environmental governance. Compared to other sectors of government such as health, finance and defense, the environment distinguishes itself for a greater degree of openness to public participation at different levels, including scholars (Church, Ramcilovic, 2009). As per the 1997 Aarhus Convention, access to information, participation in decision-making and access to justice is particularly important. If the public is not aware of an environmental issue, such as pollution in a certain place or the services provided to the community by a particular ecosystem, it is as if the problem did not exist. Scientists play a key role as legitimate informants, contributing to the awareness raising that is necessary to empower citizens and civil society.

Public participation in decision-making does not only allow to demand governments to solve environmental problems but can also contribute to improve decision-making by widening the knowledge base to include knowledge that is otherwise not necessarily available to decision-makers that are sometimes distant from the ground. Public participation in decision-making also increases the legitimacy of decision-making processes and the ownership of the decisions. This increases in turn the likelihood of implementation and compliance. Access to justice is also important to ensure the rule of law, including in case of violation of the right of access to information and of participation in decision-making. For these reasons, public participation of civil society has become a cornerstone of environmental governance processes at all levels, including planning (Raymond, 2009). Countries around the world, encourage participation and adopted legislation, also within the European Union, to ensure its effectiveness. However, there are many ways to participate and levels of citizen participation (Arnstein, 1969). The lower level of participation is manipulation, as illustrated in Figure 2. Information and consultation is also a form of public participation. In fact, government organization can sometimes act without informing the public or hearing its point of view. According to Arnstein (1969), the highest levels of citizen power are partorganizations such as in the case of public-private partnership for water provision, followed by delegated power, when civil society acts on behalf of government organizations, such as in the case of a convention between a local government and a non-governmental organization for the management of a park. Of course, the highest level is citizen control, where civil society manages to self-organize, find locally appropriate solutions and avoids one-size-fits-all panaceas (Ostrom, Janssen, Anderies, 2007).



Figure 2: Eight levels of citizen participation (source: redesigned based on Arnstein, 1969).

1.3. Citizen science

The LT(S)ER network is increasingly aware of the role of civil society and citizens in the production of scientific knowledge (Abbott *et al.*, 2018; Muelbert *et al.*, under review). We have already seen that the participation of civil society in transdisciplinary research processes contributes to produce solution-oriented transferable knowledge. At the same time, we live in a period of increasing skepticism towards science and scientists (De Pryck, Gemenne, 2017). Public participation in science-making also contributes to science education, in the sense that it helps disseminate and transfer scientific knowledge. Moreover, public participation in the production of scientific knowledge contributes to increase public awareness about how science is produced, its potential, as well as its limits, with a view to increase the legitimacy of science and improve scientist-citizen relations. Last but not least, so-called citizen science allows scholars to enlarge their knowledge base with the practical knowledge of other actors. This knowledge may not be produced in a science laboratory but is the result of *in situ* observations and experiences. In some cases, citizens and scholars can work togethe<u>a</u> 70

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track pollution levels (McKinley *et al.*, 2017). This collaboration between professional and non-professional scientists can sometimes be formalized as partnerships between academic institutions and non-governmental organizations. Of course, this can represent a form of cheap labor that is exploited by scientific institutions. If this is the case, this form of citizen science usually does not last over time. For scientist-citizen partnerships to last in the long-term, cooperation must be mutually beneficial, where the process is agreeable to both parties and results are both useful for civil society and relevant for scientific research.

2. The example of the Argonne LTSER project

The Argonne is a low-mountain forest located in the North-Eastern part of France between the midsize cities of Reims and Metz. It used to mark the border between the former regions of Champagne-Ardenne and Lorraine. Since the merger of the two regions in 2015, the Argonne is now part of the Grand Est region. The most frequent type of land cover is forest, which represents about half of the area, followed by farmland, as well as flood meadows and peatlands. The Argonne are a biodiversity hotspot at the crossroads of major ecological corridors. The area is renowned for its forest landscape. If tourism is not really developed, the Argonne's different species and ecosystem features have long been studied by scholars, particularly from nearby academic institutions in Reims, Nancy, Strasbourg, Amiens and Paris. The University of Reims can also count upon its Center for Research and Training in Ecoethology (CERFE), which is located since the 1990s within the Argonne in the municipality of Boult-aux-Bois.

With no major city less than 30 minutes away, no urban center with more than 5,000 inhabitants and a population of less than 16 inhabitants/km², the Argonne is among the least densely populated areas in France. It represents the beginning of the so-called "empty diagonal" of France, spanning from the Meuse to the Landes departments. Along the urban-rural continuum, the Argonne therefore positions itself at the rural extreme and is therefore representative of the challenges faced by rural areas in France. This is also due to the destruction that took place first during the Franco-Prussian Wars and then, most importantly, during the First World War and, to a lesser degree, Second World War. The Argonne is located not far from the martyr city of Verdun and represented the front of the First World War for most of the conflict. This left permanent traces in the collective memory of the population, as well as significant levels of soil and water pollution. Questions about everyday life can be asked. How to live in a low density area? The Argonne is currently undergoing several parallel labeling processes, particularly the creation of a Regional Natural Park and the establishment of a LTSER site (Figure 3).



Figure 3: Location of the Argonne LTSER project within the French LT(S)ER network (source: author generated based on a map by the French LT(S)ER network, 2017).

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2.1. The Argonne PNR project

In 2007, a group of local actors, particularly civil society organizations, started reflecting upon how to encourage younger generations not to abandon the area and at the same time protect its unique natural and cultural heritage. The discussions therefore shifted from how to promote social and economic development per se to how to support the sustainable development of the Argonne also for the generations to come. By 2009, the idea to create a Regional Natural Park (PNR) emerged clearly from the discussions, so the group created an association called "Argonne PNR" to promote the creation of the park. The promotion of the idea was not an easy task because the area was split up into two different administrative regions, three departments, a dozen of federations of municipalities (in French: intercommunalités) and more than one hundred municipalities. The association succeeded in federating civil society organizations to pursue the common goal of the park and in mobilizing the two regions, the three departments, as well as many municipalities and federations of municipalities, which are the most difficult to mobilize in such projects because of the little awareness about the specific objectives and practical functioning of Regional Natural Parks, lack of human and financial resources, which usually come from the regional level, as well as general resistance to change. It also succeeded at identifying a first perimeter of the park, which was defined at the municipal level based on the consideration of natural and cultural aspects, as well as the contribution of local experts. In 2013, the two regions and three departments tasked Argonne PNR for the preparation of a feasibility and opportunity study (Lévy, 2016) and provided funding. This is the first formal step towards the creation of the Regional Natural Park of the Argonne, as illustrated in Figure 4. Argonne PNR decided not to contract a consulting firm but decided to hire a young professional and produce the study not only in-house but also mobilizing a large number of partner organizations, local experts and inhabitants. They all contributed to the drafting process. This enlarged the knowledge base while at the same time increasing the local ownership of the final product and of the overall process.



Figure 4: Timeline for the construction of the Regional Natural Park of the Argonne.

Argonne PNR also mobilized scholars with various disciplinary backgrounds, including both social and natural sciences, and of different levels of seniority. They included ecologists, botanists, agronomists, geographers, planners, sociologists and political scientists from nearby universities and other research institutions, as well as some local experts. A Scientific Committee of the association was established and met at regular intervals to provide advice and scientific backstopping to the preparation of the study, including its atlas (Association Argonne PNR, 2016). A first draft of the feasibility and opportunity study was produced in 2016. The study was then finalized and delivered in 2017. The study was also submitted to the National Biodiversity Agency, whose experts were positively impressed by its technical quality.

In the meantime, the political and administrative situation changed drastically. In 2015, the Champagne-Ardenne and Lorraine regions had merged with Alsace to form the Grand Est region. The subsequent elections witnessed the departure of the center-left regional councils of both regions and the arrival of a center-right regional council. At the same time, the new laws in the framework of the ongoing territorial reform process resulted in the merger of some federations of municipalities, as shown in Figure 5 (next page), and transferred some competences of nature protection from the departments to the federations of municipalities. By 2016, the two regions that requested the feasibility and opportunity study did not exist anymore and the three departments that supported the process were not competent on the matter anymore. Consequently, the Regional Natural Park of the Argonne project is currently on hold. In the meantime, Argonne PNR not only delivered the study but also started implementing some pilot actions in line with what a park would do, such as producing communication materials, organizing every year a march across the Argonne, developing a brand for local products, as well as promoting local heritage and ecotourism. Supporting the development of research and innovation is also among the priorities of Argonne PNR. This is possible also because the new region, some federations of municipalities, individual donors and many volunteers keep supporting the work of Argonne PNR and the pursuit of the long-term objective of crating the Regional Natural Park of the Argonne. As between 2009 and 2013, it may take seral years for all the federations of municipalities to concur on the establishment of the park. In the meantime, civil society is moving forward with a de facto "citizen natural park" through the implementation of the pilot actions, thanks to the available support.

2.2. Participation of civil society in the Argonne LTSER transdisciplinary research process

One of the pilot actions supported by Argonne PNR is the creation of an Argonne LTSER platform, also known in French as *Zone Atelier Argonne* (ZARG) project. As shown in Figure 6 (see page 237), the process was initiated in 2017 in the framework of the Scientific Committee of Argonne PNR, whose members

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Figure 5: Perimeter of the feasibility and opportunity study and of the federations of municipalities (source: Association Argonne PNR, 2016).

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expressed the desire to build on the work done with the feasibility and opportunity study and strengthen collaboration among themselves and with Argonne PNR and its partners. Because of the availability of long-term data sets on both ecological and social aspects and because of the involvement in the activities of the French LT(S)ER network and other LTER sites of some members of the Scientific Committee, the development of an LTSER platform in the Argonne rapidly emerged as a suitable instrument to pursue the objectives of both the scholars involved and Argonne PNR. Subsequent exchanges with representatives of the French LT(S)ER network and of some of its platforms confirmed the idea that the main features of the Argonne LTSER project are also in line with the priorities of the network, particularly regarding the inclusion of other societal actors and of social sciences alongside natural sciences.



Figure 6: Timeline for the creation of the Argonne LTSER.

For this reason, the Argonne LTSER project was designed from the very beginning as a transdisciplinary research process with the participation of societal actors in all of its phases, starting from preparation. The small dimension of the Argonne compared to some other LTER platforms and the presence of an umbrella organization such as Argonne PNR, which brings together non-governmental organizations and individuals with the support of government organizations, facilitates the process. Table 1 (next page) shows the level of participation of civil society in the different phases of the project using Arnstein's scale (Figure 2 *supra*). The Argonne LTSER project is currently in phase ④. The levels of participation indicated for phase ⑤ and above are projected, not observed levels. They are based on current expectations. This analysis is performed regarding the development of the Argonne LTSER project as a transdisciplinary research program. Of course, the same analysis can be repeated for each transdisciplinary research projec**50** con-

Phase of the transdisciplinary research process	Level of participation of civil society
Societal problems	Delegated power
Ø Scientific problems	Informing
③ Problem framing Team building	Consultation
④ Co-creation of solution-oriented transferable knowledge	Partnership
③ (Re)integration and application of created knowledge	Delegated power
® Results useful for societal practice	Consultation
⑦ Results relevant for scientific research	Consultation
	Informing
Discipline-specific scientific discourse	Informing

Table 1: Level of participation of civil society in the Argonne LTSER project.

The level of participation in the definition of societal problems and in the (re) integration and application of created knowledge is high, because the region and the federations of municipalities partially delegated some of these competences to Argonne PNR, which for example facilitated the identification of the priorities of the 2017 Territory Project for the Argonne. This is a project "by", "for" but also "on" this territory, where the inhabitants and their way of life are a research object as much as their living space. The level is also high for the co-creation of solution-oriented transferable knowledge, because the Argonne LTSER project and other societal actors are expected to partner through Argonne PNR to identify solutions to scientific and societal problems. The level of participation in the definition of scientific problems and in the problem framing and team building phases is instead medium. For example, the Argonne LTSER project organized three public events in 2018: one in May and one in September to inform the public but also other scholars about the existence of the Argonne LTSER project and of ongoing and potential research and one in October to consult Argonne PNR and the public on the development of a Research Agenda for the Argonne (Table 2), which aims at combining the main themes of ongoing and potential research with the priorities of the 2017 Territory Project for the Argonne. These events will continue in 2019.

Forest and ecosystem issues, water resources and soil, environmental governance and military history have been identified so far as the main areas with potential for collaboration across disciplines and laboratories. The Research Agenda for the Argonne was developed to identify the demand of research for the area, identify gaps and co-produce innovative, place-based and use-inspired research projects and programs that can fill these gaps. This resulted in the identification of research gaps in terms of issues that are priority for societal actors but that are left behind by scholars, such as tourism development, as well as practice gaps in terms of questions that are raised in scientific research but that are not yet raised on the agenda of societal actors, including decision-makers. A medium level of participation is expected to be maintained in all phases of implementation, including consulting both scientific and societal actors on the results of scientific research and societal practice, as well as informing both parties about scientific publications and societal processes.

PRIORITIES OF THE TERRITORY PROJECT	AREAS OF ONGOING RESEARCH
AGRICULTURE Support agriculture and forestry in connection with the territory Have a chain of farm products under the Argonne brand - Building on local specificities - Targeting high-end markets - Promoting short food supply chains - Working with transformers - Experimenting (tests, lab) - Connecting with the preservation of soils, meadows - Cluster - Facilitating and supporting - Networking with enterprises - Connecting with health	AGRICULTURE – Agri-environmental indicators – Valorization of orchards
FOREST/WOOD Have a chain of local materials for building – Markets and tenders – Poplars – Sawmills – Pilot projects – Meetings of professionals – Study tours in the Northern Vosges – Have a wood energy sector – Forest maintenance – Cooperative companies of collective interest – Agroforestry – Haet networks – Insertion – Short supply chains – Operators	FOREST - Landscape connectivity for wildlife - Valorization of bark of local species - Geohistory of forests - Forest crisis under the Ancien Régime - Forest soil pedology
TOURISM Develop an Argonne tourism strategy – Argonne as a major tourist destination – Creating an event, national attraction – Creating tourism products – Selling innovative products – Improving communication (guides) – Creating an Argonne get-together	Develop more research on the topic of tourism

PRIORITIES OF THE TERRITORY PROJECT	AREAS OF ONGOING RESEARCH
HERITAGE Preserve and enhance natural and cultural heritage A living and shared heritage – Relying on associations – Launching an inter-associative challenge to achieve concrete projects and ambitions Develop more activities on military history and ecological challenges.	HISTORY - Local history - Front of the Great War - Archeology of the Great War - Military geography before the Great War in the Argonne WATER-SOIL-AIR / ENVIRONMENT - Watercourses in the Barrois - Hydrogeology - Pollutants - Aquatic ecotoxicology
BUSINESS Accompany and welcome companies in Argonne An incubator territory for sustainable development – Encouraging innovation – Cooperation – Facilitation – Social and environmental responsibility – Transmission	ECONOMY – Ecological economy – Bioresources and circular economy
VILLAGES Valorize village centers and housing, work for the deve- lopment and connection of services on the territory The "Cooperative Villages", villages that "give envy", "En-village", "Villages of the future" – Integrated sustainable development approach integrated – Launching through a call for expressions of interest and support for pilot projects – Mutual aid, cooperation	RURALITY – Geography of the rural world – Rural development – Traditional societies
COMMUNICATION Strengthen the dynamism and image of the Argonne and develop a local communication strategy "We Argonne", lead people to create narrative – Inter-Argonne information network – Storytelling, publishing, promotion – Communication towards inhabitants to make them ambassadors – Label / national level brand / PNR – Crossing of the Argonne – Gathering, coordinating – Inventing, writing, building a narrative	GOVERNANCE - Relationship to nature - Nature parks - Ecological transition - Ecosystem governance - Law of local authorities - Sociology - Management

Table 2: Comparison between the priorities of the 2017 Territory Project and the ongoing or potential research on the Argonne.

3. Conclusion: An initiative driven by civil society

This contribution presented first the importance of societal actors within the French LT(S)ER network and their role in transdisciplinary research processes that promote public participation in environmental governance, as well as citizen science. It then discussed the level of participation of civil society in the case of the Argonne LTSER project. It showed that the project is currently being designed to ensure a high or medium levels of participation in each phase. It is expected that this will contribute to solve both scientific and societal problems, improve science-policy relations and foster cooperation among disciplines in both the natural sciences and the social sciences, among the academic institutions, particularly within the new region, as well as other societal actors.

The Argonne LTSER platform is transforming this area into a living lab of sustainability. It will provide the opportunity for long-term transdisciplinary research processes to tackle the problems of rural areas and social-ecological systems such as the Argonne and contribute to their transformation towards sustainability. The research infrastructure of the French LT(S)ER network will also facilitate collaboration and allow developing joint actions and socio-ecological experimentations together with other LTSER platforms in France, for instance with regard to data infrastructure, the development of shared protocols to study for example problems of public health in forest areas such as the diffusion of the Lyme disease, as well as the participation in international collaborations in the framework of the global and European LTER network.

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How are cities planning to respond to climate change? Assessment of local climate plans from 885 cities in the EU-28



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ABSTRACT

Article history: Received 23 July 2017 Received in revised form 20 March 2018 The Paris Agreement aims to limit global mean temperature rise this century to well below 2 °C above pre-industrial levels. This target has wide-ranging implications for Europe and its cities, which are the source of substantial greenhouse gas emissions. This paper reports the state of local planning for climate change by collecting and analysing information about local climate mitigation and adaptation plans

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across 885 urban areas of the EU-28. A typology and framework for analysis was developed that classifies local climate plans in terms of their alignment with spatial (local, national and international) and other climate related policies. Out of eight types of local climate plans identified in total we document three types of stand-alone local climate plans classified as type A1 (autonomously produced plans), A2 (plans produced to comply with national regulations) or A3 (plans developed for international climate networks). There is wide variation among countries in the prevalence of local climate plans, with generally more plans developed by central and northern European cities. Approximately 66% of EU cities have a type A1, A2, or A3 mitigation plan, 26% an adaptation plan, and 17% a joint adaptation and mitigation plan, while about 33% lack any form of stand-alone local climate plan (i.e. what we classify as A1, A2, A3 plans). Mitigation plans are more numerous than adaptation plans, but planning for mitigation does not always precede planning for adaptation. Our analysis reveals that city size, national legislation, and international networks can influence the development of local climate plans. We found that size does matter as about 80% of the cities with above 500,000 inhabitants have a comprehensive and stand-alone mitigation and/or an adaptation plan (A1). Cities in four countries with national climate legislation (A2), i.e. Denmark, France, Slovakia and the United Kingdom, are nearly twice as likely to produce local mitigation plans, and five times more likely to produce local adaptation plans, compared to cities in countries without such legislation. A1 and A2 mitigation plans are particularly numerous in Denmark, Poland, Germany, and Finland; while A1 and A2 adaptation plans are prevalent in Denmark, Finland, UK and France. The integration of adaptation and mitigation is country-specific and can mainly be observed in two countries where local climate plans are compulsory, i.e. France and the UK. Finally, local climate plans produced for international climate networks (A3) are mostly found in the many countries where autonomous (type A1) plans are less common. This is the most comprehensive analysis of local climate planning to date. The findings are of international importance as they will inform and support decisionmaking towards climate planning and policy development at national, EU and global level being based on the most comprehensive and up-to-date knowledge of local climate planning available to date. © 2018 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND

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Abbreviations

CO ₂	Carbon Dioxide
EC	European Commission
EU	European Union
GDP	Gross Domestic Product
GHG	Greenhouse gases
LCP	Local Climate Plan
SECAP	Sustainable Energy and Climate Action Plan
UA	Urban Audit
UK	United Kingdom
UN	United Nations

1. Introduction

Tackling climate change is a priority for the European Union (EU), which has set ambitious short and long-term emissions reduction targets, i.e. to reduce greenhouse gases (GHG) emissions by 20% by 2020, 40% by 2030 and 80% by 2080 compared to 1990 levels (European Commission, 2011). Meeting these targets will increase the likelihood that the aims of the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC, 2015) can be met. The central aim of the Paris Agreement is to keep global temperature rise this century well below 2 °C above pre-industrial levels, and to pursue efforts to limit the temperature increase even further, to 1.5 °C. Furthermore, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change.

Cities¹ are crucial actors in climate change mitigation and

adaptation efforts (Kousky and Schneider, 2003; Rosenzweig et al., 2010). This is particularly the case in Europe, where approximately 74%² of the population lives in urban areas. However, how and why cities engage in climate policy is a matter of current debate (Castán Broto, 2017; De Gregorio Hurtado et al., 2014, 2015; Heidrich et al., 2016; Olazabal et al., 2014; Reckien et al., 2015) and the effect of (binding and non-binding) national or international policies on the local level is not well understood (Kelemen, 2010). Engagement of European cities in climate mitigation and adaptation efforts has been partially assessed (Flacke and Reckien, 2014; Reckien et al., 2014a). However, the risk of climate-related impacts combined with vulnerability and exposure of human and natural systems requires a response to climate change, in terms of both mitigation (to address the causes of climate change) and adaptation (to deal with the consequences of a changed climate), across all European cities.

Cities can play a key role in developing and implementing climate change programs because they are located at the interface of local action and national and international level climate change adaptation and mitigation commitments (Heidrich et al., 2016). Moreover the synergies and trade-offs that exist between mitigation and adaptation (Landauer et al., 2015) are especially felt by cities (IPCC, 2015). Castán Broto (2017) argues that cities play a pivotal role in transnational climate change governance in three ways: firstly, cities support processes of learning and exchange between local governments and other sub-national organizations. Secondly, they gather local resources and knowledge in order to implement specific schemes. Thirdly, by raising the profile of cities in international agendas they evoke the interest of political and business actors. In order to excel in this pivotal role, cities need to design and implement local climate plans (LCPs). In this study, LCPs are considered as planning documents prepared at the city level

¹ referring to all local authorities with urban characteristics, i.e. urban areas, towns, and cities.

² http://www.statista.com/statistics/270860/urbanization-by-continent/(last accessed 19 December 2017).

that contain policies that are relevant to climate change adaptation and/or mitigation (see also the methods section below and Supplementary Information).

The climate governance at the national level in each Member State influences the development and implementation of climate plans at the lower administrative levels, including LCPs (Heidrich et al., 2016; De Gregorio Hurtado et al., 2015). However, in countries where national climate policies are lacking or weak cities align themselves to international climate networks (Heidrich et al., 2016; Reckien et al., 2014b; Villarroel Walker et al., 2017). The largest climate networks in Europe are the EU Covenant of Mayors and the UN Compact of Mayors, although other international, national or sub-national/regional networks have also been formed to support the diffusion of international best practices and to help cities share climate change planning related knowledge. Bauer and Steurer (2014) argue that regional climate change networks help prepare policy systems for innovation by spreading information on the magnitude and timing of climate impacts and identifying potential response options. However, the influence of networks, relative to that of local and national governance, is only beginning to be explored (De Gregorio Hurtado et al., 2015; Reckien et al., 2015). Another influential factor is proximity to a country that is actively addressing climate change. Neighbouring such a country seems to spur on to tighten one's own mitigation policies (Biesenbender and Tosun, 2014; Tompkins and Amundsen, 2008).

Moreover, European LCPs have been positively associated with the size of a city, gross domestic product (GDP) per capita and with adaptive capacity, i.e. with institutional capability and economic strength (Reckien et al., 2015). By contrast, cities with high unemployment rates, but also warmer summers, close proximity to the coast, and hence increased projected exposure to future climate impacts have significantly fewer LCPs (Reckien et al., 2015). Lack of resources, inadequate capacity in terms of preparedness, and low levels of competence and political salience rank as the principal barriers to local climate planning across EU countries, especially in lower income EU countries (Massey et al., 2014). Lack of political commitment, associated with inertia towards the integration of climate action in local policies, is a further barrier in many cities that needs to be addressed by specific research. Climate change planning in European cities is therefore often determined by local institutional capacity rather than by a proactive response to anticipated future needs (Reckien et al., 2015).

European national and local government climate change policies have prioritised mitigation over adaptation (Reckien et al., 2014a). This preference might be motivated by other benefits of mitigation (Puppim de Oliveira et al., 2013), such as economic savings and improved energy security, in addition to reduced emissions (Bulkeley and Kern, 2006; Heidrich and Tiwary, 2013; Hunt and Watkiss, 2011; Kousky and Schneider, 2003; Villarroel Walker et al., 2017; Wende et al., 2012). Similarly, adaptation in cities is seldom carried out systematically with measures across several sectors (Wamsler et al., 2013). Adaptation implementation often depends on alignment with other programmes (e.g. health) that are designed to address non-climate related problems as well.

In this study we use the term 'city' to refer broadly to all local authorities with urban characteristics, i.e. urban areas, towns, and cities. Specifically, the study analyses the LCPs of 885 Urban Audit (UA) cities across the EU-28 countries. Data on UA cities is available in the Eurostat repository, based on information collected and provided by the National Statistical Institutes, the Directorate-General for Regional and Urban Policy and Eurostat. We first develop a typology of LCPs in Europe. We then identify and review existing LCPs, focusing on stand-alone, comprehensive LCPs that were developed with climate change mitigation and/or adaptation as the main motivation. The study addresses two principal research questions:

- What are the emerging patterns of LCPs' distribution across the EU-28?
- How can the overall pattern be explained, i.e. what is the relative influence of local, national or international policies and networks on the development of LCPs?

The focus of the work is on the distribution of stand-alone LCPs and the factors driving their development. In contrast to standalone LCPs, the mainstreaming of climate issues in other policies or climate related plans is not considered here. This, together with the quality of LCPs and their content are subject to future research.

A previous study, conducted on a smaller sample of 200 cities across 11 EU Member States revealed a large variation in climate change response, which was most noticeable on a north—south axis (Reckien et al., 2014a). A follow-up investigation (Heidrich et al., 2016) already discussed the respective roles of national legislation and international networks in motivating the development and implementation of local climate strategies on that smaller sample. A related study also examined the potential of specific institutional, environmental and socio-economic urban characteristics to act as drivers of, or barriers to climate action (Reckien et al., 2015). The analysis presented here represents a significant advance on these studies, in the number of cities analysed and the breadth of information considered, paving the way for more detailed consideration of the engagement and preparedness of European cities in response to climate change.

2. Methodology and methods

2.1. The sample of cities

The analysis is based on the entire sample of 885 UA core cities in the EU-28, and uses some of the data provided in the UA database,³ which is now called "Statistics on European cities". The UA city sample currently contains 885 core cities and 22 greater cities or larger urban zones across the EU-28, plus a number of cities in Iceland, Norway, Switzerland and Turkey. The more than 900 cities in the EU-28 together represent 25% of the EU's population. The UA defines a city as a local administration unit (LAU) where the majority of the population lives in an urban centre of at least approximately 50,000 inhabitants. However, as explained below, to ensure representativeness within countries and across the EU-28, the UA also includes some smaller urban centres with less the 50,000 inhabitants. The UA adopted the following criteria in order to ensure a balanced and regionally representative sample (see Fig. 1): cities in each country should represent about 20% of the population in the country, have a good geographical distribution (at least one city from each NUT3 Region), and vary in size to include large and small cities (including some urban centres with less than 50,000 inhabitants).

The UA is run by the European Commission and Eurostat (2017) and has been developed in cooperation with the national statistical offices to compare data across European urban areas. Datasets include statistical information on individual cities and on their commuting zones (called 'Functional Urban Areas'). The topics and datasets that are reported by the database are wide ranging and include, for example, demography, housing, health, environment, and education. The database is a very useful resource for climate

³ http://ec.europa.eu/eurostat/statistics-explained/index.php/Statistics_on_

European_cities (last accessed: 26 May 2017); http://ec.europa.eu/eurostat/web/ cities/data/database (last accessed 19th December 2017).



Fig. 1. Map of the location of Eurostat Urban Audit cities, showing resident populations as of 1st January 2012. Source: Eurostat (2015).

change policy makers and urban planners alike (Seto et al., 2014). For more details on the methodology, definition and classifications used in the analysis see Supplementary Information and Eurostat (2004).

2.2. Typology of local climate plans

The LCPs of European cities are drafted and published in a variety of forms, and vary in terms of detail, structure and scope. Some of the plans are comprehensive stand-alone documents, such as comprehensive adaptation or mitigation plans. Other LCPs are integrated into another document such as a sustainability plan, resilience plan, or Local Agenda 21, and these sometimes integrate adaptation and mitigation. Increasingly, aspects of climate change are also covered by spatial development plans; sectoral plans, e.g. air quality plans or emergency response plans (for heat waves, flooding, or energy shortages); and plans prepared for other purposes but which are nevertheless relevant to climate change.

Due to the multitude of planning constellations and types of LCPs available we developed a typology of LCPs that also serves as a framework for analysis. It is based on two dimensions: the alignment with spatial (local, national and international) policies and level of integration with other local policy documents (Table 1). This study only considers plans with a clear focus on climate change and those developed for an entire urban area as stand-alone documents, i.e. those defined as type A1, A2, and A3 plans according to

Table 1

Typology of Local Climate Plans (LCPs). This study only comprises LCPs with a clear focus on climate change and those developed for the entire urban r	egion, i.e. plans of type
A1, A2, and A3.	

Spatial dimension	Integration with or placement within the existing local policy documents									
Туре	Comprehensive and stand- alone (A)	Mainstreamed and inclusive (B)	Partial GHG sources and impacts, stand-alone (C)	Operational (D)	Related (E)	Areal (F)				
Autonomous (1)	A1 - Local Climate Plan of the urban authority/ administration that comprehensively (multiple sectors) addresses climate change. The plan does not rely on support from international networks or funding agencies, and are described in a stand-alone document. 'Adaptation' or 'mitigation' should be mentioned in the title (e.g. Local Climate Mitigation Plan, Local Climate Adaptation Plan) or identified in the preface/ introduction as the main motivation for developing the plan.	B - Climate change aspects included in another municipal plan, e.g. sustainability plan, resilience plan, development/master plan, core strategy.	C – Local Climate Plan, addressing partial aspects of climate change in stand- alone documents, relating to particular sectors, such as energy, or particular impacts (such as heat waves, flooding, etc.).	D - Local Climate Plan for parts of the municipal operations, such as universities, schools, housing associations, hospitals, e.g. site- and operation-specific carbon management plans in the UK.	E – Plan with relevance to the climate issue but without a clear focus and no single section dedicated to climate change, e.g. urban development plan, municipal emergency response plan, disaster risk reduction plan, civil protection plan.	F – Local Climate Action Plan for part of a city/ urban area.				
regulation (2)	A2 - Local climate Plan produced in response to requirements of national legislation, and published as a stand-alone document.									
Internationally induced (3)	A3 - Local Climate Plan developed under the auspices of international urban climate networks, such as the EU Covenant of Mayors and UN Compact of Mayors, e.g. Sustainable Energy and Climate Action Plan (SECAP), Sustainable Energy Action Plans (SEAP), etc.									

the typology set out in Table 1.

Types A1 and A2: In this category we included LCPs relevant for the entire urban area that mention 'climate' or 'climate change' in the title or, in the introduction, and identify responding to climate change as main motivation for producing the plan. These plans were detected using common search engines, entering search terms such as 'climate change mitigation planning' and 'climate change adaptation planning' (see Supplementary Information). In addition, we reviewed websites of municipal authorities, focusing on those departments that might cover climate action (e.g., planning, energy, sustainable development).

Type A3: In absence of type A1/A2 LCPs we checked for plans that have been developed under the auspices of international climate networks (in particular the EU Covenant of Mayors and the UN Compact of Mayors). We extracted and noted the presence of a Sustainable Energy Action Plan (SEAP) (for mitigation), or a Sustainable Energy and Climate Action Plan (SECAP) (combining mitigation and adaptation), developed for the Covenant of Mayors.

2.3. Selection of local climate plans for the Urban Audit cities sample

For each country, a team of authors (with native or full professional language proficiency) compiled a database of local climate (mitigation and adaptation) plans through a combination of desk/ web review and occasionally direct contact with local authorities. We took advantage opportunities to obtain the information we needed online and only contacted the respective city representative(s) in cases where further information and/or clarification were needed. In all cases the respective plan or policy had to be, or to be made available to us. A more comprehensive version of the analysis guidelines can be found in the Supplementary Information.

The information extracted was entered into a database, where the name of the mitigation and adaptation strategy, the web link, and the date of search was recorded, along with comments on particularities of each city. The relevant documents where downloaded and saved.

The LCP may either be officially adopted by the municipal government, or simply acknowledged and noted; it may be binding or non-binding. The database includes draft and finalized plans as well as current and past strategies, i.e. including those with a timeframe that had already expired (e.g. 2010–2016). We included draft documents because we assume that the planning process is just as important as the plan itself (Heidrich et al., 2013; Millard-Ball, 2013) and that a draft plan can already produce effects such as awareness raising and capacity building.

The size of a municipality or local area differs across Europe and this has implications for what counts as local climate plan. For example, in France, municipalities are small compared to other countries. This motivated the transfer of the competence for LCPs from municipalities to city-regions (larger urban areas) as part of the territorial reform enacted in 2015. We recorded both municipal

Table 2

Number of autonomous mitigation, adaptation and joint plans in Urban Audit Cities in 24 EU countries where the development of LCPs is not compulsory (A1). Key: Dark grey is > 66.7%, light grey is > 33.3% and <= 66.7%.

A1	UA Cities	Mitigation plans		Adaptati	on plans	Joint p	lans	No plar	18
	N	N	%	N	%	N	%	N	%
Austria	6	2	33.3					4	66.7
Belgium	11	5	45.5	1	9.1	1	9.1	6	54.5
Bulgaria	18							18	100.0
Croatia	5			1	20.0			4	80.0
Cyprus	2							2	100.0
Czech Republic	18	1	5.6	1	5.6			17	94.4
Estonia	3							3	100.0
Finland	9	7	77.8	7	77.8	7	77.8	2	22.2
Germany	125	101	80.8	31	24.8	4	3.2	21	16.8
Greece	9							9	100.0
Hungary	10							10	100.0
Ireland	5	4	80.0	1	20.0	1	20.0	1	20.0
Italy	76			2	2.6			74	97.4
Latvia	4							4	100.0
Lithuania	6							6	100.0
Luxemburg	1							1	100.0
Malta	1							1	100.0
Netherlands	51	15	29.4	1	2.0			35	68.6
Poland	68	66	97.1	2	2.9	1	1.5	2	2.9
Portugal	25	1	4.0	6	24.0			18	72.0
Romania	35	1	2.9	4	11.4	1	2.9	31	88.6
Slovenia	2							2	100.0
Spain	109	11	10.1	8	7.3	4	3.7	98	89.9
Sweden	13	10	76.9	4	30.8			2	15.4
EU-24	612	224	36.6	69	11.3	19	3.1	372	60.8

plans and plans of city-regions as LCPs in the French case, as many cities are still in the process of transferring the competence from one level to the other. A similar issue relates to cities in Ireland and the UK, where one city can make up multiple local authorities (Heidrich et al., 2013). In these cases, we reported plans for local authorities within a city (e.g. London).

Type A1 and A2 LCPs were searched for between November 2016 and January 2017. Subsequently, in May 2017, information on type A3 climate plans developed under the auspices of international urban networks (e.g. Covenant of Mayors for Climate and Energy, Compact of Mayors) was retrieved from the organizations' websites.

3. Results

This section summarizes our findings and provides a comprehensive overview of the current state of development of LCPs across the EU-28. As mentioned above, we report only on LCPs of types A1, A2, and A3, as defined in Table 1, in order to focus on cities with stand-alone plans that comprehensively address climate change.

3.1. Type A1: autonomous and comprehensive LCPs

National governments in 24 of the EU-28 countries do not require the preparation of LCPs. In these countries, LCP development is the result of local level engagement and action. Table 2 shows the large disparities in the prevalence of LCPs across these 24 European countries.

Overall, approximately 37% of the cities in this sample have an A1 mitigation plan. They are particularly numerous in Poland, Germany, Ireland, Finland and Sweden, where more than two-thirds of cities have a mitigation plan.

Across the EU-24 sample, about 11% of cities have an A1 adaptation plan; thus overall there are far fewer adaptation plans than mitigation plans. Finland is a forerunner in this respect, with most cities having an adaptation plan. Less than one-third of cities have adaptation plans in 12 other countries, while adaptation plans are non-existent in the remaining 11 countries. The fact that mitigation plans are far more numerous than adaptation plans might suggest that mitigation planning precedes adaptation planning. However, there are some cities with an adaptation plan but no mitigation plan. These include, for example, Zagreb (Croatia) and Bologna and Ancona (Italy).

Some of the plans address mitigation and adaptation issues in the same document. This is the case in most Finnish cities, but also in some Irish cities. However, overall only 3% of type A1 LCPs in Europe are joint plans.

Overall, 10 of the 24 countries that do not require LCPs do not have any cities with local A1 mitigation or adaptation plans. The countries concerned, apart from two small countries with a single UA city (Luxembourg and Malta), are located in the south, southeast and north-east of Europe.



Fig. 2. Distribution of LCPs across city size in the 24 countries without a national obligation to develop plans. (A1) Data on number of inhabitants relate to the total population on the 1st of January for the latest year available (2008–2016).

Fig. 2 shows how the LCPs in countries without national legislation requiring the development of LCPs are distributed across city size. The proportion of cities with an A1 mitigation plan and/or an A1 adaptation plan increases in line with their size. Around 80% of cities with more than 500,000 inhabitants have a mitigation and/or adaptation plan. Fig. 2 shows that some of the smallest urban centres, with less than 50,000 inhabitants, are also addressing the challenges of climate change; however the data in that category is far from representative, because of the small sample size. Joint plans are more likely to be developed in large cities but not exclusive to them, suggesting a relation to economic or institutional capacity.

3.2. Type A2: Nationally required and regulated LCPs

While many national governments provide some policy guidance to local authorities on the production and design of LCPs, their content and legal status is usually left to the discretion of local authorities. Only 4 countries, Denmark (DK), France (FR), Slovakia (SK) and the United Kingdom (UK), have made the adoption of LCPs compulsory, determining their legal status and providing guidance on the development and content of plans.

Since 2008, local planning authorities in the UK have a statutory duty to include "policies designed to secure that the development and use of land in the local planning authority's area contribute to the mitigation of, and adaptation to, climate change" in their local planning documents.⁴ The legislation demands the inclusion of climate change issues in general local planning documents addressing both mitigation and adaptation. The regulation applies to local planning authorities of all sizes.

In 2010, France made it compulsory for municipalities to adopt LCPs. The French local authorities are required to produce a Local Climate-Air-Energy Plan (*Plan Climat Air Energie Territorial*), which is a stand-alone document. It must include sections on mitigation and adaptation, but most often the focus is mitigation and particularly the link between energy policy, air quality and GHG emissions. However, these regulations only apply to areas with a certain number of inhabitants. Initially, LCPs were compulsory for municipalities of more than 50,000 inhabitants, but the scope of the regulations was expanded to cover smaller-sized urban areas in

2016. Since then LCPs have been obligatory for municipalities with more than 20,000 inhabitants.

In Slovakia, local authorities are obliged to develop an Action Plan for Sustainable Energy (e.g. *Akčný plán trvalo udržateľnej energie mesta Nitra do roku 2020*), which are strategic framework documents related to climate change mitigation. The requirement to develop these plans is set out in the National Energy Policy and the National Framework and Energy Strategy of the Slovak Republic, which relate in turn to obligations stemming from EU directives 2006/32/EC (relating to energy end-use efficiency and energy services), 2012/27/EU (relating to energy efficiency), and 2003/87/EC (relating to emissions trading). Cities are required to take measures to improve the efficiency of public services and to influence energy consumption by key stakeholders and end users.

In Denmark, only local climate change adaptation plans are legally required, whereas mitigation plans are voluntary. However, mitigation LCPs are indirectly demanded as a component of mandatory municipal heat supply plans, which are required by law and aim to reduce the energy sector's dependence on fossil fuels (§1 in the Danish Heat Supply Law [LBK no. 523]).⁵ Mitigation is dealt with by the Danish Climate Law [LOV no. 716], which came into force in 2014 and whose goal is for Denmark to become a 'low emission society' in 2050.⁶ Regarding adaptation, in 2013, the then Environment Minister Ida Auken made it mandatory for Danish municipalities to include climate change adaptation into municipal spatial plans—a requirement integrated into the Danish planning law since February 2018. Accordingly, municipalities are required to identify local areas that may be exposed to flooding and erosion as a result of climate change and designate these areas as such in the municipal spatial plans. If urban developments are planned in these designated areas, the municipalities have to ensure the implementation of preventive measures. Moreover, Denmark is among the few countries with a Ministry of Climate, which was created in the wake of the UNFCCC Conference in Copenhagen in 2009.

Table 3 shows the number of mitigation, adaptation and joint LCPs produced in the UA cities of Denmark, France, Slovakia and the

⁵ https://www.retsinformation.dk/forms/R0710.aspx?id=190081; (last accessed 19 December 2017).

⁶ https://www.retsinformation.dk/forms/R0710.aspx?id=163875; (last accessed 19 December 2017).

Table 3

Number of mitigation, adaptation and joint plans in four countries where LCPs are compulsory (A2) compared with other countries. The table shows all plans, i.e. including those that were developed before there was a legal requirement for the development of Local Climate Plans. Key: Dark grey is > 66.7%, light grey is > 33.3% and <=66.7%.

A2	UA Cities	Mitigation plans		Adaptatio	Joint	t plans	No plans		
	N	N	%	N	%	N	%	N	%
Denmark (A2)	4	4	100.0	4	100.0				
France (A2)	98	74	75.5	54	55.1	53	54.1	24	24.5
Slovakia (A2)	8	6	75.0	1	12.5			1	12.5
United Kingdom (A2)	163	90	55.2	95	58.3	72	44.2	63	38.7
4 countries (A2)	273	174	63.7	154	56.4	125	45.8	88	32.2
24 countries (A1)	612	224	36.6	69	11.3	19	3.1	372	60.8
28 countries (A1 + A2)	885	398	45.0	223	25.2	144	16.3	460	52.0



Fig. 3. Distribution of LCPs across city size in countries with a national obligation to develop plans. (A2) Data on number of inhabitants relate to the total population on the 1st of January for the latest year available (2008–2016).

UK, and the total number of plans for these four countries compared with the prevalence of LCPs in other countries. Some basic analyses show that cities with a national obligation to develop LCPs are approximately 1.8 times more likely to have a mitigation plan and about 5.0 times more likely to have an adaptation plan—although this is also influenced by the length of time the regulation has been in force. Moreover, our sample indicates that the large majority of all joint mitigation and adaptation plans (86.8%) in the EU were produced in cities of two countries (France and the UK) with national climate legislation that require and provide guidance for the development of LCPs. However, compliance with the legislation is not universal: one in four cities in France and one in three in the UK do not possess a LCP of type A2 and thus may not be complying with national legislation.

Fig. 3 shows the distribution of type A2 LCPs across city size in the four countries where they are compulsory. The data reveals the same pattern as for autonomously produced (type A1) LCPs in other countries. Larger cities are more likely to have an LCP than smaller cities and compliance rates are 100% in cities with more than 500,000 inhabitants.

3.3. Type A3: plans of international climate networks

International climate networks are initiatives that play an

important role in boosting development of urban local climate plans (Heidrich et al., 2016; Reckien et al., 2014b). While there are also regional and national climate networks in many countries, the EU Covenant of Mayors for Climate and Energy and the UN Compact of Mayors are the most important initiatives at the international level.

The Covenant of Mayors brings together some 7000 local and regional authorities voluntarily committed to implementing EU climate and energy objectives on their territory. It was launched by the European Commission (EC) after the adoption of the 2020 EU Climate and Energy Package in 2008, with the aim of endorsing and supporting the efforts of local authorities to reduce GHG emissions and implement sustainable energy policies. The Covenant of Mayors asks signatories to prepare so-called Sustainable Energy Action Plans (SEAPs). These are envisaged as roadmaps, charting the paths of EU cities towards the goal of reducing carbon dioxide (CO₂) emissions by 20% by 2020. For adaptation, a similar network initiative-Mayors Adapt-was launched in 2014, inviting cities to make political commitments and take action to prepare for the impacts of climate change. At the end of 2015, both initiatives merged under the new integrated Covenant of Mayors for Climate & Energy. The new Covenant of Mayors asks signatories to prepare Sustainable Energy and Climate Action Plans (SECAPs), containing a commitment to the EU 2030 objectives to reduce CO₂ emissions by

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Fig. 4. Status of local climate policies and plans of Type A1 and A2 across 885 cities in the European Union. Countries in beige do not require their local governments to develop Local Climate Plans; countries in dark orange make it compulsory for cities and larger local governments to develop either Local Climate Mitigation Plans (Slovakia) or Local Climate Adaptation Plans (Denmark) or both (France, UK). Overseas territories are not shown for the sake of clarity of the cities and countries on the mainland. Fort-de-France on Martinique (France), Santa Cruz de Tenerife (Spain) and San Cristóbal de la Laguna (Spain) on Tenerife have "a mitigation LCP only". Funchal on Madeira (Portugal) is a "city with separate mitigation and adaptation LCPs". (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

at least 40% and adopting an integrated approach towards climate change mitigation and adaptation. $^7\,$

The Compact of Mayors is an international initiative launched in 2014 at the United Nations (UN) Climate Summit by the UN Secretary General and UN Habitat in collaboration with the C40 Cities Climate Leadership Group (C40), the Local Governments for Sustainability (ICLEI), and the United Cities and Local Governments (UCLG) (C40 ICLEI, 2012). As part of their commitment, cities agree to perform a series of key activities on mitigation and adaptation, including carrying out an inventory, creating targets and metrics, and establishing a local climate action and adaptation plan.⁸

Both initiatives have been successful in encouraging cities to address the challenge of climate change. The EU Covenant of

⁷ http://www.covenantofmayors.eu/about/covenant-of-mayors_en.html; (last accessed 19 December 2017).

⁸ https://www.compactofmayors.org/resources/; (last accessed 19 December 2017).

Table 4

Number of UA cities in the EU-28 signatory to the Covenant of Mayors (CoM, 2020 goal), Covenant of Mayors for Climate and Energy (CoM, 2030 goal), and the Compact of Mayors (A3), with average stage in each process. Last update CoM: 22.05.2017, Compact: 20.02.2017. Key: Dark grey is >66.7%, light grey is >33.3% and \leq 66.7%; Mit. = Mitigation; Ada. = Adaptation; w/o = without.

	UA Cities	CoM Signatories		CoM Sig with SEAF	natories 9 (All A3)	CoM Sig with SEA type A1/A2	gnatories P (A3) w/o 2 Mit. LCP	CoM Sig with SEC A3	natories CAP (All 3)	CoM Sign with SE (A3) w/o t A2 Ada	natories ECAP type A1/ . LCP	Adapt Con (A:	nmitment 3)	Average Covenant stage	Co	mpact	Average Compact Stage (Badge)
	Ν	Ν	%	N	%	N	%	N	%	N	%	Ν	%		N	%	
Austria	6	2	33.3	2	33.3	1	16.7	0	0.0	0	0.0	1	16.7	2.0	0	0.0	0
Belgium	11	9	81.8	8	72.7	3	27.3	1	9.1	0	0.0	4	36.4	2.3	1	9.1	1
Bulgaria	18	5	27.8	5	27.8	5	27.8	0	0.0	1	5.5	1	5.6	2.2	3	16.7	1
Croatia	5	3	60.0	3	60.0	3	60.0	0	0.0	0	0.0	1	20.0	3.0	1	20.0	1
Cyprus	2	2	100.0	2	100.0	2	100.0	0	0.0	0	0.0	0	0.0	2.5	1	50.0	1
Czech Republic	18	3	16.7	1	5.6	1	5.6	0	0.0	0	0.0	2	11.1	1.7	0	0.0	0
Denmark	4	4	100.0	4	100.0	0	0.0	0	0.0	0	0.0	1	25.0	2.0	1	25.0	4
Estonia	3	2	66.7	2	66.7	2	66.7	0	0.0	0	0.0	1	33.3	2.5	0	0.0	0
Finland	9	8	88.9	7	77.8	0	0.0	0	0.0	0	0.0	2	22.2	2.5	3	33.3	1
France	98	32	32.6	30	30.6	0	0.0	3	3.1	0	0.0	4	4.1	2.1	5	5.1	1
Germany	125	37	29.6	35	28.0	2	1.6	3	2.4	0	0.0	14	11.2	2.4	6	4.8	1.5
Greece	9	5	55.6	4	44.4	5	55.6	0	0.0	0	0.0	1	11.1	2.6	1	11.1	2
Hungary	10	5	50.0	4	40.0	4	40.0	0	0.0	0	0.0	1	10.0	1.8	2	20.0	1
Ireland	5	4	80.0	3	60.0	1	20.0	1	20.0	0	0.0	3	60.0	2.3	0	0.0	0
Italy	76	58	76.3	56	73.7	56	73.7	0	0.0	0	0.0	15	19.7	2.4	5	6.6	1
Latvia	4	4	100.0	3	75.0	4	100.0	0	0.0	0	0.0	1	25.0	2.5	1	25.0	1
Lithuania	6	2	33.3	2	33.3	2	33.3	0	0.0	0	0.0	0	0.0	3.0	0	0.0	0
Luxemburg	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0.0	0	0.0	0
Malta	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0.0	0	0.0	0
Netherlands	51	15	29.4	15	29.4	6	11.8	0	0.0	0	0.0	2	3.9	2.1	2	3.9	4
Poland	68	9	13.2	7	10.3	1	1.5	0	0.0	0	0.0	2	2.9	2.2	5	7.4	1.2
Portugal	25	17	68.0	17	68.0	15	60.0	1	4.0	0	0.0	5	20.0	2.8	5	20.0	2.2
Romania	35	22	62.9	18	51.4	16	45.7	0	0.0	0	0.0	3	8.6	2.0	1	2.9	1
Slovakia	8	4	50.0	2	25.0	2	25.0	0	0.0	0	0.0	3	37.5	1.5	0	0.0	0
Slovenia	2	2	100.0	2	100.0	2	100.0	0	0.0	0	0.0	0	0.0	2.0	2	100.0	1
Spain	109	66	60.6	64	58.7	49	45.0	1	0.9	1	1.0	20	18.3	2.4	10	9.2	2.2
Sweden	13	10	76.9	10	76.9	3	23.1	0	0.0	1	7.7	2	15.4	2.6	5	38.5	1.6
UK	163	26	16.0	26	16.0	3	1.8	0	0.0	0	0.0	4	2.5	2.3	8	4.9	2.4
EU-28	885	356	40.2	333	37.6	188	21.2	10	1.1	3	0.3	93	10.5	2.1	68	7.7	1.6

Mayors has been very successful in Europe and the UN Compact of Mayors successfully engaged many cities throughout the world. A Global Covenant of Mayors for Climate and Energy was launched in June 2016⁹ aimed at linking the two initiatives to generate synergies and avoid duplication, especially among EU local authorities.

In this section we present findings on participation in the Covenant of Mayors and Compact of Mayors, by UA cities in EU-28 countries. Table 4 shows that 356 or 40% out of 885 UA cities are signatories of the Covenant of Mayors. Among them, 333 cities (38%) have a SEAP, 10 cities (1%) have a SECAP and 93 cities (10.5%) have an adaptation commitment (some of them as SECAP). The status of all cities in the Covenant process is on average 2.1 (stage 1 - signature, stage 2 - action plan submitted, stage 3 - results monitored), showing that most cities have submitted an action plan and some already monitor their results. Countries where, on average, cities have reached the highest stage in the Covenant of Mayors process include Croatia, Lithuania and Portugal.

Table 4 also shows that 8% of the UA cities in our sample are members in the Compact of Mayors. They are on average at stage 1.6 in the process (stage 1- register commitment, stage 2 - take inventory, stage 3 - set reduction targets, stage 4 - create plan(s) to address climate mitigation and/or adaptation), signifying that many cities of the Compact network are still at stage 1 and have not yet carried out an inventory.

Comparing this with Table 2 we conclude that cities in countries

where autonomous (type A2) plans are less common are more likely to produce internationally accredited plans, whereas cities in countries where autonomous plans are more common tend to engage less in international networks.

Table 5 summarizes the statistics and shows that A1 and A2 LCPs are slightly more numerous (total 398 for mitigation and 223 for adaptation) than A3 LCPs (total 333 for mitigation and 103 for adaptation). It further shows that 66.2% of EU UA cities have either an A1, A2, or A3 mitigation LCP, 25.5% have an adaptation LCP, 16.4% have joint LCPs; and 32.5% have no type A1, A2 or A3 LCP.

The findings regarding the distribution of type A1, A2 and A3 LCPs across countries and European regions are summarised in Fig. 4. Cities in eastern and southern Europe have fewer mitigation and adaptation LCPs, whereas most central and northern European cities have a LCP. The prevalence of types of LCPs is often clustered in countries.

4. Discussion and conclusion

Our dataset includes 885 cities in all 28 EU countries, and is the first to provide a detailed database of local climate action. It is thus much more comprehensive and representative than previous similar studies. It contributes towards establishing patterns of local climate action and assessing the effectiveness of action by cities in support of EU policy targets geared towards combating climate change and meeting the objectives of the Paris Agreement. Data collected for this study was last updated in January 2017 (with some exceptions, e.g. climate networks). This allowed plans developed in the wake and immediately after the 2015 UNFCCC

⁹ http://europa.eu/rapid/press-release_IP-16-2247_en.htm; (last accessed 19 December 2017).

Table 5

Number of mitigation, adaptation and joint plans of Type A1, A2, and A3. Please note that we count the existence of a SECAP and Adapt Commitment as A3 adaptation LCP, because no more detailed information was available. Key: w/o = without.

A1/ A2/ A3	UA Cities	Miti _s pl	gation ans	Adap pla	tation ans	Joint	plans	No plans	
	N	N	%	N	%	N	%	N	%
A1 plans (24 countries)	612	224	36.6	69	11.3	19	3.1	372	60.8
A2 plans (4 countries)	273	174	63.7	154	56.4	125	45.8	88	32.2
A3 plans in cities w/o A1/ A2 plans (28 countries)	460	188	40.9	3	0.0	1	0.0	288	62.6
All A3 plans, i.e. in cities with or without A1/ A2 plans (28 countries)	885	333	37.6	103	11.6	10	1.1	552	62.4
All cities with A1, A2 or A3 plans (sum of lines 1-3)	885	586	66.2	226	25.5	145	16.4	288	32.5

Conference in Paris, which saw a significant increase of climate action at all levels, to be included.

This paper has presented the data and provided an initial analysis. We intend to update this work at regular intervals to map, observe and compare the evolution of local climate planning over time. This will continuously inform decision making and thinking by stakeholders at all levels and across sectors.

4.1. Methodological challenges and insights

- 1) The accessibility of LCPs can be challenging, especially for medium and small-sized cities. In a few cases, there was some evidence of the existence of LCPs, but no copy of the plan available. While we are sure to have found the vast majority of LCPs for our sample, some LCPs might exist that are not publicly available on the webpages of the municipalities concerned.
- 2) The use of the typology across countries proved challenging. Despite the co-development of the typology and analytical framework by members of the research team, a framework that clearly distinguished comprehensive, mainstreamed, partial and related plans, the application of the framework to the different national situations proved difficult at times. For example, it was difficult to know which plan came first when cities had both an A1/A2 and A3 plan. We recorded most of them as A1/A2, unless it was absolutely clear that the plan was developed initially for the Covenant of Mayors. Similarly, it was sometimes difficult to distinguish between types of plans considered in this paper (A1, A2 and A3) and plans assigned to the other categories (i.e. B, C, D, E, and F) that were excluded from our analysis. For example, the distinction between A3 plans and Local Energy Plans (type 3) is not always straightforward. It should also be noted that, while the typology might suggest a hierarchy (of commitment or effectiveness) from A down to F, this was not intended and the typology should not be interpreted in this way. The typology distinguishes among different approaches adopted by cities in addressing the challenge of climate change but does not imply that one approach is 'better' than others. For example, type B plans can be more successful than type A plans in addressing and implementing climate change issues in the real world, by mainstreaming climate change-related issues in other local policy processes. The classification of plans was also made more difficult by the fact that mitigation and adaptation are not always dealt with at the same level of detail, depth, or length. Moreover, while in some countries there is a recent trend towards including LCPs into broader sustainability plans (as in the

Netherlands), in other countries an opposite trend can be observed (as in France, where local Agenda 21s are being transformed into more technical and narrow LCPs). In this paper, we did not include sustainability plans or local Agenda 21s. As a result we may have underestimated the level of climate engagement in European cities.

Evolving local governance structures complicated the analysis. Local government reforms can have a significant impact on local climate planning, when competences are moved from one level to the other. For instance, when France merged a large number of smaller municipal authorities into larger 'intermunicipal' ones, competence for development of LCPs moved 'up' to the higher level. By contrast, Italy has transformed its provinces, which were previously responsible for most urban planning, into large inter-municipal authorities. In some cases, this made existing plans obsolete, thus creating a legal 'inbetweenness' that we found difficult to characterise. In this assessment, we included the lowest-level plans (e.g. municipal over inter-municipal), unless more recent higher-level plans existed in a context of territorial reform. Furthermore, lowerlevel plans interact with higher-level plans in the respective spatial planning systems. This is particularly salient in the case of water and climate plans and adaptation plans in general, which usually cover larger areas, such as in the Netherlands, Finland, and Italy. To maintain consistency we therefore also included plans for metropolitan regions (larger urban areas including a number of municipalities that are part of the UA). For example, the metropolitan region of Helsinki has a plan that also covers the adjacent UA cities of Esbo, Vanda and Lahtis. It should also be mentioned that the restriction to UA cities introduces a distortion of representability. In some countries (e.g. Portugal where UA cities cover only 8% of municipalities), urban centres outside the UA may have LCPs that were not recorded in this study.

4.2. Interpretation of the findings

 The drivers of LCPs in countries without national legislation to develop LCPs need further exploration—in many of those countries more than 2/3 of cities have LCPs. Some countries stood out as having a large proportion (two-thirds or more) of UA cities with autonomously developed (type A1) mitigation plans. These included Poland (97.8% coverage), Germany (80.8%), Ireland (80.0), Finland (77.8%) and Sweden (76.9%). This prevalence of LCPs could be due to several factors, such as the level of climate awareness, the presence of local expertise, the level of administrative decentralization, the presence of institutional capacity or political commitment, the impact of political parties and the amount of funding available. Further research is needed to elucidate which factors contribute the most and how they interact with each other and other factors.

- 2) The existence of national regulation has a significant impact on local climate planning. Cities in Denmark, France, Slovakia and the UK, where LCPs are compulsory, are about 1.8 times more likely to have a mitigation plan, and 5.0 times more likely to have an adaptation plan than cities in other countries-although this is also influenced by the length of time the regulation has been in place. The case of Denmark, where all four UA cities have both mitigation plans and adaptation plans, is particularly interesting. Moreover, our sample indicates that almost all joint mitigation and adaptation plans (86.2% of the total joint plans) were produced in France and the UK. It seems that, without national regulation, local authorities are reluctant or do not have the capacity to produce joint plans. It is worth highlighting that French and British cities represent about 30% of all UA cities and are therefore particularly well-represented in the sample.
- 3) There are countries where a significant number of LCPs were developed under the auspices of Covenant of Mayors. These included, most notably, Cyprus, Denmark, Slovenia, Latvia (100.0% of UA cities), Finland (88.9%), Belgium (81.8%), Ireland (80.0%), Sweden (76.9%), Italy (76.3%), Estonia (66.7%), Portugal (64.0%), Romania (62.9%) and Spain (60.6%). Within our sample, the EU Covenant of Mayors has five times as many signatories as the UN Compact of Mayors. No country has a significant number of members of Mayors Adapt. In the light of these results, we conclude that, in countries where autonomous (type A1) LCPs are rare and cities are not required by national legislation to develop plans, international networks such as the Covenant of Mayors help raise awareness, build capacity and, often through EU-funded projects, provide the expertise and the funding necessary to develop LCPs. The cases of Spain and Italy are particularly interesting, as the number of Spanish and Italian signatories is particularly high. They represent more than onethird (35.0%) of the signatories of the Covenant of Mayors in our sample (and more than three-quarters (76.7%) of the total signatories to the Covenant of Mayors at the time of writing). However, UA cities are probably not a representative sample of local authorities that are signatory to the Covenant of Mayors, considering that the UA contains only few urban areas with less than 50,000 inhabitants, while local authorities of all sizes can sign the Covenant. This is the case for Malta, where several smaller cities that make up part of the Valletta UA city have submitted action plans to the Covenant of Mayors for Climate and Energy but these do not cover the entire UA city. Actions promoted by the Covenant of Mayors also differ from the plans considered in this study in other ways: the Covenant of Mayors is mostly focused on what the local authority owns, rather than the city as a whole; the timeframe is often different; and plans can cover administrative areas with populations ranging from a few hundred people to several million. This means that, while our sample can be considered as representative of European cities, defined as urban centres with (in most cases) more than 50,000 inhabitants, it is not fully representative of the signatories of the Covenant. Future research should assess how promotion of climate plans by the Covenant of Mayors interacts with other factors driving the development of LCPs in European cities.

This is the most comprehensive analysis of local climate planning to date. However, we acknowledge the limitations of a study on the existence of LCPs for climate mitigation and adaptation achievements. Although our sample includes LCPs that have been adopted years ago and could therefore potentially prove successful implementation the analysis of planning and policy documents cannot. It is yet to determine whether and to what extent cities in Europe are acting on and moving towards adaptation and mitigation goals. Our sample allows for larger objectivity than previous studies, although, as mentioned above, it may still underestimate climate engagement in smaller cities and of other types than standalone, comprehensive LCPs.

4.3. Final conclusions

Our analysis of 885 cities across the 28 European countries has shown that approximately 66% of the EU UA cities have either an A1, A2, or A3 mitigation LCP; that 26% have an adaptation LCP; 16% are joint LCPs; and about 33% of cities have neither an A1, nor an A2 or an A3 LCP.

Although far more numerous, mitigation plans do not always precede adaptation plans, which is different from the conclusions of earlier assessments (Reckien et al., 2014a; b). There is large diversity in the proportions of cities with different types of plans across the EU, with generally more plans in central and northern EU countries, which agrees with the results of previous studies. City size, international climate networks and national regulation are influential parameters in driving the development of LCPs. About 80% of the cities with more than 500,000 inhabitants have an A1 or A2 mitigation and/or an adaptation plan. We also found that the EU Covenant of Mayors has an important role to play in encouraging smaller cities, notably in Italy and Spain, but also in many other countries, to engage in climate action. Overall, though, LCPs developed independently (type A1) as well as in response to national legislation (type A2) are more numerous in European countries than LCPs developed as part of international climate networks (type A3). The prevalence of LCPs is greater in countries that require local authorities to develop LCPs than in those that do not, by a factor of 1.8 for mitigation and a factor of 5.0 for adaptation.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jclepro.2018.03.220.

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composed of representatives from the University of Navarra and the Catastrophes Chair of Fundación Aon España, The Jury of the "José María Sarriegi" Scientific Disclosure Award,

has the honour of distinguishing:

Jon Marco Church

for being co-author of the award-winning article in the 2019 call, entitled *"How are cities planning to respond to climate change? Assessment of local climate plans from 885 cities in the EU-28"* and published in the *Journal of Cleaner Production* in 2018.

In Madrid, on 7th November 2019

President of Fundación Aon España Mr. Eduardo Dávila

Managing Director of Fundación Aon España President of its Catastrophe Observatory Mr. Pedro Tomey

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Urban climate change mitigation and adaptation planning: Are Italian cities ready?



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ABSTRACT

Climate Action Planning is one of the top priorities of cities in order to reduce greenhouse gas emissions and strengthening climate-resilience, as pointed out by the New Urban Agenda and the Paris Agreement.

This study aims at assessing the development of climate change mitigation and adaptation planning in Italian cities. To this end, we analysed the availability of Local Climate Plans (LCPs) in 76 cities, which are included in the Eurostat Urban Audit (UA-2015) database. In a further step, we analysed the content of the urban climate change mitigation and adaptation plans available in a smaller sample of 32 Italian cities of 2007 Eurostat Urban Audit database (UA-3), looking at the single actions undertaken for addressing mitigation and adaptation to climate change. Results show the almost total absence of comprehensive and stand-alone urban climate change adaptation plans in Italy (except for two cities, Ancona and Bologna), whereas we found that in 61 out of 76 cities municipal civil protection plans are the instruments that deal with local emergencies associated to extreme weather events. On the other hand, 56 out of 76 urban climate change mitigation plans (i.e. Sustainable Energy Action Plans) are being developed in the framework of the Covenant of Mayors, which is a transnational network of local governments created by the European Union (EU) in 2012. The results obtained on the mitigation side point out that, in absence of a national law that imposes Italian cities to develop LCPs, transnational networks are an effective boost to voluntary commitment to reach EU climate and energy objectives.

1. Introduction

Cities are places of high overall primary energy consumption and high GHG emissions (Sims et al., 2007). Moreover, the growing urbanization and the complex patterns of urban economic assets, infrastructure and services make cities also particularly vulnerable to climate change (Geneletti & Zardo, 2016; IPCC, 2012). Hence, improving climate mitigation and adaptation strategies in urban areas is crucial for sustainable development, a role that cities increasingly take on (Rosenzweig, Solecki, Hammer, & Mehrotra, 2010; Van Staden & Musco, 2010) and that is acknowledged by international organizations supporting their efforts (ICLEI, 2010).

Among multiple possible pathways, climate planning at the local level is a key avenue to mainstream mitigation and adaptation actions (Measham et al., 2011). Cities are the ideal framework for implementing low-carbon policies (Gouldson et al., 2015) and adaptation strategies through a strategic planning process shared with citizens and local stakeholders (Geels, 2011). In the words of Picketts, Déry, and Curry (2013), climate adaptation planning "is well suited to local levels of governments, as citizens can participate in creating targeted adaptation strategies that address the important regional impacts, and these strategies will provide tangible benefits to local residents". As shown by reviews of planning documents undertaken for European cities (Reckien et al., 2014; Reckien et al., 2014; Reckien, Flacke, Olazabal, & Heidrich, 2015), the UK (Heidrich, Dawson, & Reckien, 2013), Italy and Spain (De Gregorio Hurtado et al., 2015), Australia (Baker, Peterson, Brown, & McAlpine, 2012) and North America (Zimmerman & Faris, 2011), urban planning has increasingly been addressing climate mitigation and adaptation issues (Kumar & Geneletti, 2015).

Regarding the content of Local Climate Plans (LCPs), for example,

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the study by Reckien, Flacke, Dawson, et al. (2014) identified that: (i) adaptation plans are far fewer than mitigation plans in European cities, i.e. about 30% as compared to 65%, respectively; (ii) a profound North-South gradient with fewer plans in the South, except for smaller cities; and (iii) a cumulative CO2/GHG-reduction target of about 37%. Moreover, the study pointed out that mitigation measures concentrated mostly on energy saving, energy efficiency and renewables, thus focusing only on the energy sector. On the other hand, adaptation plans were found to be broader in their scope and rather vague dealing, for instance, with urban planning and management, water management, awareness raising, etc. Concrete measures were seldom mentioned. Also, Baker et al. (2012, p. 127) summarize for Australia that "local governments were not effectively planning for climate impacts. While they were aware of expected climate change impacts, their capacity to use this information to develop geographically specific action plans was limited." The lack of LCPs is often connected to a lack of resources and capacity of local governments to tend to climate planning (Reckien et al., 2015). It is also related to multi-level governance systems in which the upper levels of government do not set policy frameworks that encourage and guide local climate action (De Gregorio Hurtado et al., 2014), which is particularly important in the case of medium and small cities. To overcome the lack of policy references and resources, many European cities use the services of climate-related national or transnational networks of local authorities, particularly when national and regional guidelines and support are absent. This is the situation in many Southern and Eastern European countries and cities (Pietrapertosa, Khokhlov, Salvia, & Cosmi, 2018; Reckien, Flacke, De Gregorio Hurtado, et al., 2014). Climate networks are highly important also, for example, for cities in the United States (Zimmerman & Faris, 2011).

The cited literature notes that, despite the diffusion of local climate planning, it is still necessary to pay increased attention to adaptation at the local level (Baker et al., 2012), particularly to cities in vulnerable locations (along rivers, coasts) and without resources (adaptive capacity, high unemployment) (Reckien et al., 2015).

As pointed out by the Intergovernmental Panel on Climate Change (IPCC) the Mediterranean basin is one of the main climate change hotspot, that is, one of the most responsive areas to climate change. In this region, Italian cities are particularly vulnerable to climate change and are already experiencing a rise in temperatures and increases in water scarcity, frequency of floods, forest fires, windstorms and storm surges. A dossier of Legambiente, the largest environmental association in Italy (Legambiente, 2018) shows that 198 Italian municipalities have been affected by negative impacts of climate change, from 2010 to 2018, recording 340 extreme weather events, 109 cases of infrastructure damaged from heavy rainfall, and 157 people victims of bad weather.

This study aims at contributing to the mentioned studies by analysing urban climate actions in Italy, focusing at how these vulnerabilities are dealt with in Italian cities through the content analysis of LCPs of a well-distributed and balanced sample of cities from the Urban Audit database of Eurostat (Eurostat, 2007; Eurostat, 2015). We refer to LCPs as a general term that includes all forms of planning undertaken at city level that contain policies that are relevant for climate change mitigation and adaptation. This general term is used because: (i) some aspects of spatial planning in Italy are regulated at the regional level, hence different regions may adopt different terminology and require different content for their planning instruments; (ii) climate adaptation/mitigation-relevant content can be found in the country also in urban planning instruments or in documents that focus on issues different from, or broader than climate change (e.g., civil defence and emergency plans).

To our knowledge, this is the second study of this kind in Italy, only preceded by one that can be considered as the research background of this study, conducted on a smaller sample of plans (UA-3 from Eurostat, 2007) and with a simplified review framework than the one proposed here (De Gregorio Hurtado et al., 2015). This first study revealed some

dynamism in LCPs, such as identification of ambitious emission reduction targets; holistic approaches to mitigation strategies; it also found shortcomings in the information baseline and implementation measures of proposed strategies. There is also a report to share the experience of Italy at the international level, which uses an even smaller subset of cities, looks for good practices and focuses more on the competences of local authorities (Church, 2013). This study points out the high level of decentralization of climate planning despite responsibility that is still with the central government, as well as the great variety of measures, where research, innovation and competitiveness often play an important role.

The purpose of this paper is to make steps forward in the assessment of the development of local climate planning in Italy, to identify and discuss the main shortcomings of the plans related to the implementation of plans and measures, Italy's climate goals, and international agreements, and propose recommendations for the improvement of the plans and the policy framework in which the plans are developed. Particularly, our analysis addresses the following main research questions:

- How Italian cities are aware of impacts of climate change and how they are acting?
- How ambitious are the mitigation policies of cities?
- What cities are doing to cope with their climate vulnerabilities?
- What mitigation and adaptation topics and instruments (with associated actors and funding mechanisms) are contained in LCP?

Section 2 provides an overview of the Italian context related to mitigation and adaptation planning. Section 3 describes our methods for selecting the sample of cities and identifying the relevant LCPs. It also presents the review protocol that was used to analyse the content of the plans. Our results are illustrated and discussed in Section 4. Finally, some conclusions and recommendations are presented in Section 5.

2. The Italian National Framework on mitigation and adaptation

In compliance with the 1997 Kyoto Protocol, the Italian Ministry for the Environment, Land and Sea (IMELS) supported the development and implementation of the 2002 National Action Plan to reduce GHGs and is currently preparing a new National Plan for Energy and Climate, consistently with the Paris Agreement. At the same time, the Ministry of Economic Development released the Italian National Energy Strategy (SEN) (MISE, 2017), which aims at achieving and exceeding the environmental and decarbonisation targets established by the 2008 Climate and Energy Package ("20-20-20" package) of the European Union and take on a leading role in defining and implementing the Roadmap 2050. In particular, according to the SEN, Italy intends to reduce GHG emissions of 39% by 2030 and 63% by 2050 respect to 1990 levels.

Concerning adaptation, the National Strategy for Adaptation to Climate Change (IMELS, 2014) was approved in October 2014, although several sectoral strategic documents have already included climate change adaptation aspects (e.g., National Biodiversity Strategy, White Paper on Challenges and Opportunities for Rural Development to Mitigate and Adapt to Climate Change). The National Strategy for Adaptation to Climate Change (IMELS, 2014) provides an overview of the impacts of climate change in several socio-economic sectors and natural systems, identifying a set of actions and adaptation measures to address these impacts. The portfolio of actions and measures selected have to be carefully evaluated and selected through appropriate criteria in the National Adaptation Plan to Climate Change which is, in accordance with the EEA definition, "a more detailed document providing a roadmap for the implementation of specific adaptation actions that are being planned" (EEA, 2013, p. 68).

The Italian National Adaptation Plan to Climate Change is currently administered by the IMELS that, in October 2017, closed a public

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consultation aiming at collecting comments and integrations from institutional stakeholders, but it hasn't be approved so far. In particular, a comprehensive questionnaire was set to investigate the perceptions of impacts and vulnerabilities and to collect actions to cope with climate change and a wide public consultation on the first draft was carried out involving citizens, associations and stakeholders.

The processes to define the Strategy and the Plan have been quite different. In the case of the Strategy, a wide process of collaborative involvement of scientific communities of different disciplines has been organised both in the definition and in the process of reviewing. In the case of the Plan the process of consultation followed a more oriented 'top down' approach, involving sectoral scientific communities only after the publication of a first plan proposal. Looking in particular at the sections dedicated to urban environments, the range of actions proposed in the Plan reveal a disconnection with local and regional planning systems - in all cases - as they do not include potential implications with the legal framework of regional planning, that in Italy represents the main asset for local and urban governance. The Plan risks being impossible to implement, because of lack of technical tools to integrate actions in ordinary planning processes. It is therefore necessary to focus on the urban level to understand the role of Italian cities in the framework of the national climate policies, as outlined by Heidrich et al. (2016).

2.1. Focus on the urban level

The current Italian legislation lacks National laws binding municipalities to develop any kind of plan or strategy aimed at reducing greenhouse gases or adapting cities to climate change. An exception is provided by the Municipal Energy Plan (Piano Energetico Comunale -PEC), introduced by the 1991 national Law (Italian Law 10/1991, art. 5) for cities with more than 50,000 citizens, and the Urban Plan for Sustainable Mobility (Piano Urbano della Mobilità Sostenibile - PUMS), more recently introduced by a national Decree from the Ministry of Infrastructure and Transport (Decree n. 257, art. 3, 2016) for municipalities and associations thereof with more than 100,000 inhabitants. Thus, on the one hand, larger cities have developed, and sometimes upgraded, their Municipal Energy Plan, aimed at identifying the current energy balance and programming energy saving and renewable energy interventions, with positive repercussions on the reduction of GHG emission. On the other hand, the newly introduced Urban Plan for Sustainable Mobility will allow cities to take action on sustainable mobility with a medium to long-term (10-year) horizon, but with predefined time-based verifications and monitoring, promoting participation and coordinating with sectoral and urban planning on a supra-scale and communal scale.

This confirms that cities have assumed an increasingly important role, moved originally by their interest to plan their future in line with sustainability criteria (De Gregorio Hurtado et al., 2014).

In 2008, a new urban initiative launched by the European Union caught the interest of many Italian cities: the Covenant of Mayors (CoM). This network was established after the adoption of the 2020 European Union Climate and Energy Package to endorse and support the efforts deployed by local authorities in the implementation of sustainable energy policies. The CoM has had a big echo among Italian mayors, reaching the highest number of signatory cities in Europe. As a result, many Sustainable Energy Action Plans (SEAPs) have been developed in Italy, formalizing the political commitment of Mayors to curb GHG emissions on their territory by at least 20% by 2020.

As concerns adaptation, the Covenant of Mayors Initiative on Climate Change Adaptation (Mayors Adapt), launched in 2013 in the framework of the EU Adaptation Strategy, was merged with the Covenant of Mayors and from 2017 onwards was entirely integrated into the new Covenant of Mayors for Climate and Energy which "pledge to reduce CO_2 emissions by at least 40% by 2030 and to adopt an integrated approach to tackling mitigation and adaptation to climate change" (Covenant of Mayors for Climate and Energy, 2017). Signatories of the new Covenant of Mayors for Climate and Energy now commit to prepare and implement Sustainable Energy and Climate Action Plans (SECAP). Recently, Covenant of Mayors for Climate and Energy, 2018 and the Compact of Mayors (2017), another city network addressing climate change launched at the 2014 United Nations Climate Summit in New York, have come together to form the Global Covenant of Mayors for Climate & Energy, aiming at combining efforts and leadership to accelerate climate action at the local level worldwide (EC, 2016).

3. Methodology

Following the methodological approach utilized in the EU-28 analysis (Reckien et al., 2018), two main issues were widely debated at the beginning of the study in order to setup the methodological approach and to fully address our research questions concerning the assessment of local climate planning in Italy. First, which Local Climate Plans (LCPs) needed to be investigated in our case study and, second, which cities could be included in the Italian sample.

An exhaustive description of how these two issues were addressed in our study is reported in the following sections.

3.1. The LCPs under focus

In Italy, there is no national legal requirement to adopt Local Climate Plans, as stand-alone documents. In this study, we investigated the availability of planning documents or strategies focusing on mitigation (M), adaptation (A) or addressing mitigation and adaptation together (M/A).

To prioritize all these planning documents in order of strategic importance we introduced a three-level analysis framework based on (Reckien et al., 2018). As depicted in Fig. 1, we started our analysis searching comprehensive and stand-alone plans (Level 1). Then, we assessed whether they had been developed autonomously (Level 1-A) or had been induced by international urban climate networks (Level 1-B). For those cities without comprehensive plans, we also investigated the availability of sectoral plans addressing single aspects of climate change in stand-alone documents (Level 2) and, in their absence, on climate related local-level plans (Level 3).

In particular, this approach was based on the following definitions. *Comprehensive and stand-alone (Level 1*): In this category, we included stand-alone documents relevant for the entire urban area and that at least mention 'climate' or 'climate change' in the title or as a main motivation of the plan development in the introduction. We introduced a further distinction with regard to the framework in which they were developed:

- Autonomously developed (Level 1-A): Adaptation/mitigation plans developed by a local government, independently from international networks or international funding;
- Internationally induced (Level 1-B): Plans that were developed within international urban climate networks, such as the Covenant of Mayors and the Compact of Mayors (e.g. SEAPs).

Sectoral (Level 2): In absence of mitigation and adaptation plans/ strategies developed for the entire city, we checked for sectoral plans with a climate dimension, addressing single aspects of climate change in stand-alone documents, relating to particular sectors (energy, heat wave, flooding, etc.). Only sectoral plans with at least a major section on 'climate' or 'climate change' were included in this category.

Related to Climate Change (Level 3): For cities lacking Level 1 and Level 2 M/A plans, we looked at local plans that are relevant from a climate perspective (e.g. emergency plans, disaster risk reduction plans, civil protection plans) but that do not explicitly focus or include a section on climate change.



Fig. 1. Flowchart of LCPs review.

Level 1-3 plans were collected between October 2016 and May 2017 referring to international databases (e.g. made available by the Covenant of Mayors and Compact of Mayors) and through common search engines using keywords for mitigation and adaptation, such as: [city name] Strategia Cambiamenti Climatici (Climate Change Strategy); Piano di Azione Cambiamenti Climatici (Climate Change Action Plan); Cambiamenti Climatici ed Energia (Climate Change and Energy); Cambiamenti Climatici e Protezione Ambientale (Climate Change and Environmental Protection), Piano/Strategia di Adattamento Cambiamenti Climatici (Climate Change Adaptation Plan/Strategy), Piano/Strategia di Mitigazione Cambiamenti Climatici (Climate Change Mitigation Plan/ Strategy), Piano energetico comunale con riduzione di emissioni di CO2/ GHG (Municipal Energy Plans with CO2/GHG emission reductions); Piano anticaldo/Piano ondate di calore (Heatwave Plan); Piano di gestione rischio alluvione (Flood risk Plan), Piano di Protezione Civile (Civil Protection Plan), Piano di Emergenza (Emergency Plan), etc.

In addition to that, websites of local governments, municipalities and/or other authorities were checked with a special focus on those departments (e.g. planning, energy, sustainable development) that might cover climate action. In some cases, the municipality or planning department were contacted with regard to the municipality's climate actions and to request the related documents, if not available online.

The information gathered with this approach was organised in a shared database, taking into account for this study only the LCPs finalized and adopted by the city council or authority.

3.2. The city sample

For the Italian city sample, we referred to the urban areas included

in the Urban Audit (UA-2015) database (Eurostat, 2015), which aims to provide statistics on a range of socioeconomic aspects relating to urban life in 885 cities spread across the EU Member States, Norway, Switzerland and Turkey. The Urban Audit delineates the "core city" according to political and administrative boundaries while the "larger urban zone" includes the core city and its commuter belt. The Urban Audit cities were selected in cooperation with the national Statistical Offices and are geographically dispersed to ensure a balanced and regionally representative sample which fit with the aims of our research.

In the specific case of Italy, the UA-2015 database (Eurostat, 2015) includes 76 large, as well as medium-sized cities for which we explored the state of local climate change response in terms of availability of Local Climate Plans (LCPs), as defined in Section 1. The main output of this activity is a database of LCPs on mitigation and adaptation already published. In case of more plans covering mitigation and/or adaptation we referred to the most recent plan adopted.

A sub-sample of cities was further selected to enter in the core phase of the research which dealt with an in-depth content analysis of the available LCPs. "Italian cities have been included in Urban Audit since the Pilot Phase (Roma, Milano, Napoli, Torino, Palermo, Genova, Firenze, Bari) then in UA-2 (Bologna, Catania, Venice, Verona, Cremona, Trento, Trieste, Perugia, Ancona, L'Aquila, Pescara, Campobasso, Caserta, Taranto, Potenza, Catanzaro, Reggio di Calabria, Sassari, Cagliari), and in UA-3 (Padova, Brescia, Modena, Foggia, Salerno)" (Bretagnolle et al., 2013). In this case we referred to the smaller sample of 32 cities included in the 2007 Urban Audit database (UA-3) of Eurostat (Eurostat, 2007). An analysis protocol and a set of indicators were defined as a common and transparent basis for the content analysis of plans in each one of the analysed cities. In Table 1,
Table 1

Μ

The UA-2015 IT city sample (76 cities)	The UA-3 IT city sample (32 cities)
Steps of analysis1. Extraction of statistics2. Availability of Local Climate Plans (LCPs)	 Extraction of statistics Availability of Local Climate Plans (LCPs) Development of an analysis protocol and a set of indicators Content analysis of plans
 Cities included Roma, Milano, Napoli, Torino, Palermo, Genova, Firenze, Bari, Bologna, Catania, Venezia, Verona, Cremona, Trento, Trieste, Perugia, Ancona, Pescara, Campobasso, Caserta, Taranto, Potenza, Catanzaro, Reggio di Calabria, Sassari, Cagliari, Padova, Brescia, Modena, Foggia, Salerno, Piacenza, Bolzano, Udine, La Spezia, Lecce, Barletta, Pesaro, Como, Pisa, Treviso, Varese, Busto Arsizio, Asti, Pavia, Massa, Cosenza, Carrara, Benevento, Sanremo, Savona, Vigevano, Matera, Viareggio, Acireale, Avellino, Pordenone, Biella, Lecco, Messina, Prato, Parma, Livorno, Reggio nell'Emilia, Ravenna, Ferrara, Rimini, Siracusa, Monza, Bergamo, Forlì, Latina, Vicenza, Terni, Novara, Giugliano in Campania 	Roma, Milano, Napoli, Torino, Palermo, Genova, Firenze, Bari, Bologna, Catania, Venezia, Verona, Cremona, Trento, Trieste, Perugia, Ancona, L'Aquila, Pescara, Campobasso, Caserta, Taranto, Potenza, Catanzaro, Reggio di Calabria, Sassari, Cagliari, Padova, Brescia, Modena, Foggia, Salerno
Geographical distribution Northern: 53% Central: 14%, Southern: 33%	Northern: 38% Central: 12%, Southern: 50%
Time framework of the analysis October 2016–April 2017	May 2017

the main features of this 2-step city analysis are represented.

3.3. The analysis protocol for the 32 city sample

An in-depth content analysis of the available LCPs was conducted on the subsample of 32 cities. It was based on an analysis protocol consisting of a set of specific indicators populated by means of an interactive procedure based on online forms and shared files.

In particular, the collecting-form of indicators was organised in two sections, one for mitigation and one for adaptation, each of them with a common introductory section collecting general information on the available plans, as reported in Table 2.

The next two sections of the collecting-form were aimed at gathering comprehensive information on the latest adopted plans on mitigation and adaptation. As concerns mitigation, the content analysis focused mainly on the existence of a baseline emission inventory and future projections, CO₂/GHG emission reduction targets, mitigation topics included in plan and means and instruments to achieve them, actors involved, funding, communication aspects, monitoring and evaluation strategy and information on the local development framework. Similarly, for adaptation we looked at the impact/vulnerability inventory distinguishing among the different adaptation topics considered and the related means/instruments foreseen for the plan's implementation, actors involved, funding sources identified, communication strategies, monitoring strategies and additional information on the local framework in which the plan was developed. The whole list of topics, subtopics and research questions the analysis of LCPs was

Table 2

General information collected on the mitigation/adaptation plan/strategy.

Plan/strategy name Level of plan (1-A, 1-B, 2 and 3) Is this a CC Mitigation (CCM) plan? (Does the plan talk about CCM?) Is this a CC Adaptation (CCA) plan? (Does the plan talk about CCA?) Status of plan (state of development) Department in charge of developing the plan Year of plan development Language Link to webpage (if available online) Weblink to pdf (if available online) Remarks Community involvement: participation mode

focused on is reported in Tables A.1 and A.2 of the Appendix A.

4. Results and discussion

In the following paragraphs a general assessment of climate planning in the 76 (UA-2015) Italian cities of the full sample will be presented, followed by a detailed content analysis of the smaller sample of 32 (UA-3) Italian cities.

4.1. Availability of LCPs in 76 (UA-2015) Italian cities

A comprehensive search of Local Climate Plans (LCPs) officially adopted and published in 76 (UA-2015) Italian cities was carried out between October 2016 and April 2017 in order to have a full picture of how Italian cities are committed to reduce carbon emissions and prepared for a changing climate. The results are presented according to the analysis framework introduced in the methodological section.

4.1.1. Comprehensive and stand-alone plans (level 1)

The analysis of comprehensive and stand-alone LCPs started with the search of stand-alone documents that are mitigation and/or adaptation plans developed autonomously by the urban authority/administration.

In Italy (Table 3), no city has an autonomous mitigation plan or a joint mitigation and adaptation plan whereas only 2 cities have a reference document on adaptation: Ancona (Local Adaptation Plan of the Municipality of Ancona, 2013) and Bologna (Adaptation Plan of the Municipality of Bologna, 2014). It is worth underlining that both documents were developed in the framework of EU LIFE projects: LIFE "act" for Ancona and LIFE "BLUEAP" for Bologna.

The picture varies significantly when we look at the planning documents developed on the basis of the commitment assumed by cities within the Covenant of Mayors: the Sustainable Energy Action Plans (SEAPs) define key actions that contribute to achieving the overall objective of reducing CO₂ emissions by a minimum of 20% by the year 2020, mainly through the promotion of energy efficiency and the use of renewable energy sources in a local authority's territory. Table 4 shows that 58 cities, that represent more than 76% of the UA sample, are members of the Covenant of Mayors (i.e. they are at Step 1 – Signature), 96.6% of them have developed a SEAP (having reached Step 2 - Action Plan submitted), and 26.3% of them have entered in the monitoring

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Table 3

Level 1-A plans in the 76 UA-2015 city sample for Italy.

Italy (76 UA Cities)		Mitigation plans		Adaptation plans		Joint plans		No plans	
		%	n.	%	n.	%	n.	%	
Comprehensive and stand-alone documents - Autonomously developed (Level 1-A)	0	0.0	2	2.6	0	0.0	74	97.4	

phase of the CoM (Step 3 - Results monitored).

On the other hand, none of these Italian cities have developed a Sustainable Energy and Climate Action Plan (SECAP) more recently introduced by the new Covenant of Mayors for Climate and Energy. The SECAP is expected within two years following the date of the local council decision and aims at addressing both climate mitigation and adaptation targets by the year 2030 based on a Climate Risks and Vulnerability Assessment and a Baseline Emission Inventory. In particular, "the adaptation strategy can either be part of the SECAP or developed and mainstreamed in a separate planning document" (Covenant of Mayors for Climate and Energy, 2018).

In addition, we analysed cities committed to the Compact of Mayors. In our sample (Table 4), only 5 cities committed to the Compact of Mayors (Roma, Milano, Bologna, Firenze, and Padova) but none of them have already developed a mitigation and/or adaptation plan in this framework. In other terms, all of these 5 cities are still at the first step of the adhesion path set up by the Compact of Mayors: 1 - Register commitment, 2 - Take inventory, 3 - Set reduction targets, 4 - Create either a joint or individual action plan to address climate mitigation and adaptation.

Fig. 2 shows how these comprehensive and stand-alone climate plans (Level 1) are distributed across Italy. Taking into account the geographical distribution of our 76 city sample (Northern - 53%, Central - 14%, Southern - 33%) it is not surprising that 57% of the available SEAPs are concentrated in Northern Italy, followed by Southern Italy (30%) and Central Italy (13%).

On the other hand, cities without any climate plans are equally distributed between Northern (40%) and Southern Italy (40%), whereas the remaining 20% of cities are located in the central regions (Lazio, Marche, Toscana and Umbria).

With regard to the distribution of Local Climate Plans included in our 76 city sample in relation to the city size, Fig. 3 points out that the only 2 cities above 1,000,000 inhabitants (Roma and Milano), the 4 cities between 500,000 and 1,000,000 inhabitants (Napoli, Torino, Palermo and Genova) and 1 city below 50,000 inhabitants (Campobasso) have a Level 1-B plan (SEAP). On the other hand, looking at medium cities it can be observed that:

- 100,000–500,000 inhabitants: 82% of these cities have a SEAP; moreover, the only 2 cities with an adaptation plan (Bologna and Ancona) have also a SEAP.
- 50,000-100,000 inhabitants: 57% of these cities have a SEAP.

4.1.2. Municipal energy plans and emergency plans (level 2 and level 3) As concerns mitigation, only for those cities without a comprehen-

sive plan (Level 1) we analysed the availability of sectoral mitigation

plans and, in particular, of Municipal Energy Plans with a clear identification of a reduction target for CO_2/GHG emissions. Among the 20 analysed cities without a SEAP only three (Perugia, Brescia and Avellino) have an energy plan. These energy plans provide some baseline CO_2 emission or emission reduction scenarios but do not set CO_2 or GHG emission reductions targets; thus, they were not considered as a sectoral mitigation plan for our analysis. As a result, the study identifies that in the 76 analysed cities Municipal Energy Plans do not replace the lack of comprehensive mitigation plans. Whereas, municipalities with more than 100,000 inhabitants have 24 months of the entry into force of Decree n. 257/2016 (14/01/2017) for preparing their Urban Plan for Sustainable Mobility which will allow to reduce atmospheric and acoustic pollution, greenhouse gas emissions, and energy consumption.

In the case of adaptation, there are not sectoral plans for the 74 cities without a comprehensive plan. Thus, most aspects related to adaptation are covered by Municipal Emergency Plans, which are compulsory by the Civil Protection national law (L. 100/2012) and are available in most of the analysed cities. On this, the research shows that Municipal Emergency Plans are substituting the lack of sectoral adaptation plans. However, they cannot substitute the adaptation plans because their rationale is different and somehow opposite: instead of focusing on prevent the unavoidable effects of climate change (proactive approach), their target is how to deal with emergency situations (post-event action).

4.2. Content analysis of LCPs in 32 (UA-3) Italian cities

Using the collecting form reported in the Appendix (Tables A.1 and A.2), an in-depth analysis of the content of mitigation and adaptation plans of the sample of 32 (UA-3) Italian cities was carried out in May 2017. Mitigation and adaptation actions and strategies included in the LCPs available were analysed, as described in the following.

4.2.1. Mitigation

As already said for the larger sample of 76 (UA-2015) Italian cities, no comprehensive mitigation plan autonomously developed (Level 1-A) is currently available but we found a predominance of LCPs of Level 1-B that are plans developed within international urban climate networks, such as Covenant of Mayors. The great success achieved in Italy by the Covenant of Mayors is demonstrated by the fact that 78% of cities in our smaller sample of 32 cities have already developed their Sustainable Energy Action Plan (SEAP) in the framework of this European network. None of the analysed cities have sectoral plans of Level 2 such as municipal energy plans including CO_2/GHG emission reduction targets, whereas the remaining 22% of cities have no kind of mitigation plan.

Table 4

Level 1-B plans in the 76 UA-2015 city sample for Italy

Italy (76 UA Cities)		CoM members (UA cities)		CoM members (UA cities) with a SEAP		CoM members (UA cities) with a SECAP		Compact members (UA cities)		Compact members (UA cities) with a plan developed	
	n.	%	n.	%	n.	%	n.	%	n.	%	
Comprehensive and stand-alone documents - Internationally induced (Level 1-B)	58	76.3	56 (^a 20)	73.7 (^a 26.3)	0	0.0	5	0.1	0	0.0	

^a Cities with a monitored SEAP.



Fig. 2. Comprehensive and stand-alone plans (Level 1) in the 76 UA-2015 city sample for Italy.

Table 5 summarises the status of mitigation planning in the cities of the sample.

Focusing on SEAPs and, in particular on the mitigation targets, Fig. 4 represents for each analysed city: 1) the CO_2/GHG emission targets; 2) the baseline years related to emission reduction targets; 3) the target years (2020 for all cities, in compliance with the Covenant of Mayors rules). It shows that only 2 cities (Roma and Cremona) have set reduction targets on GHG emissions whereas most of the SEAPs refer to CO_2 emissions, 70% of them setting reduction targets for 2020 higher than 20%.

Looking at the actions proposed by plans in order to reach the mitigation targets, it can be noted that all the plans rely on energy efficiency measures, energy savings, and sustainable transportation. In particular, all the analysed plans promote actions aimed at increasing energy performances in old municipal buildings, upgrading the municipal fleet and promoting local public transport, smart mobility system, cycling, walking, car sharing/pooling, and electric cars. Moreover, an increase of energy production from renewable sources, mainly through the implementation of PV, solar thermal and biomass, is promoted by 96% of the analysed plans.

In order to boost the proposed measures, 96% of the plans aim at increasing citizens' awareness on energy and environmental issues closely related to the reduction of GHG/CO_2 emissions through the activation of soft measures such as information campaigns, thematic meetings with the involvement of schools and communities. Moreover, it can be pointed out that most of the analysed SEAPs were developed between 2009 and 2015 with a peak in 2012 (36%) by the administration itself, sometimes in collaboration with universities or research centers or with the support of consultancy firms. Only a 12% of plans were implemented in the framework of EU projects.

4.2.2. Adaptation

As concerns adaptation, as already said, only Bologna and Ancona developed a comprehensive stand-alone adaptation plan (Level 1-A). In particular, the Ancona's adaptation plan was drafted within the Life project "ACT - Adapting to Climate change in Time" in 2013, whose



Fig. 3. Distribution of the Level 1 plans per city size.

main focus was to develop a process for an effective municipal strategy for local climate change adaptation measures. The main vulnerabilities addressed by this plan are: landslides, coastal erosion, infrastructures, cultural heritage and heatwaves, paying particular attention on soft measures to raise citizens' awareness, like for example the establishment of a naturalistic laboratory. Likewise, Bologna developed its adaptation strategy in the framework of the Life project "BLUE AP -Bologna Local Urban Environment Adaptation Plan for a Resilient City" in 2014. This strategy focuses on several vulnerabilities of the city (extreme rain events and hydrogeologic risk, heat waves, freshwater scarcity and droughts) introducing different proposals that will be realized within a structured action plan.

On the other hand, as shown in Fig. 5, most of the analysed cities have developed a Level 3 plan namely "Related to Climate Change plan". In particular, 81% of the city sample (26 municipalities) has a Municipal Emergency Plan developed in compliance with the Civil Protection national law (L. 100/2012) that obliges all municipalities to implement a plan dealing with emergencies due to natural disasters. In particular, these plans aim at assuring the safety of population, focusing on topics that are relevant also to climate change (even if it is not explicit mentioned) as for example flood risk and heatwaves. As a matter

of fact, 85% of the analysed plans handles flood risk and 15% of them address heatwaves.

The remaining four cities (Bari, Palermo, Campobasso, and Caserta) of our sample register a strong delay on the adaptation front since they have no plan at all.

In this general framework it is important to underline that other cities are on track towards the implementation of an adaptation plan, as for example Venice that in 2014 approved the document "Venice Future Climate" (Venezia Clima Futuro) that lays the foundation for the development of a Climate Change Adaptation Plan for the city. Another example is represented by Padova that, already in 2011 integrated a chapter on climate change adaptation in its SEAP (SEAP, 2011) developed in the framework of the EU LIFE-LAKS project (LIFE-LAKS EU project). Moreover, in 2016, in cooperation with the University of Venice, Padova drafted the "Guidelines for the implementation of a Climate Change Adaptation Plan" which represent a good starting point for the development of a structured adaptation plan.

5. Conclusions

Today, the scientific community and many international

Table 5

Territorial distribution of mitigation plans in the 32 UA-3 city sample for Italy.

Type of plan	Number of cities	Geographic distribution
Level 1-A Comprehensive and stand-alone plans: Autonomously developed	0	-
Level 1-B Comprehensive and stand-alone plans: Internationally induced (e.g.: SEAPs)	25	Northern: 44% (Milano, Torino, Genova, Bologna, Venezia, Verona, Cremona, Trento, Trieste, Padova, Modena) Central: 12%, (Roma, Firenze, Ancona) Southern: 44% (Napoli, Palermo, Bari, Catania, Pescara, Campobasso, Potenza, Sassari, Cagliari, Salerno, L'Aquila)
Level 2 Energy plans with CO ₂ /GHG emission targets	0	_
No plan	7	Northern: 14% (Brescia) Central: 14% (Perugia) Southern: 72% (Caserta, Taranto, Catanzaro, Reggio Calabria, Foggia)
Total	32	

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Fig. 4. Carbon tree: CO₂/GHG emission targets in the 32 (UA-3) city sample.

organizations and networks recommend to tackle the challenge of climate change at local level. First, because cities welcome most of the European population and secondly because several cities directly suffer negative effects of climate change such as landslides, floods, drought and heatwaves.

In order to be ready to build climate-proof cities, municipalities have to engage themselves in reducing greenhouse gases, that are the main responsible of global warming, and creating climate resilient cities. This study assessed how Italian cities are engaged in such a climate planning activity through the analysis of the status of local climate planning in a representative sample of Italian cities. This analysis can be useful to derive some general recommendations useful to improve both the plans and the policy framework in which urban climate plans are developed.

Planning for mitigation and adaptation in Italy is being characterized as a dynamic process, where the policy framework is quickly evolving and more and more cities are engaging in climate actions. In particular, there is no national legislation that obliges cities to act in terms of mitigation or adaptation. Thus the development and implementation of climate plans is entrusted to local initiatives.

In this paper we found that most Italian cities pay great attention to climate change, even if much more to mitigation than to adaptation, due to historical reasons and the long experience gained in energy planning. The engagement in mitigation is demonstrated by the large number of cities that have voluntarily joined the Covenant of Mayors initiative and that have developed mitigation plans carrying out decarbonization strategies: more than 73% of cities in our sample of 76 cities, and 78% of the smaller sample of 32 cities are equipped with a SEAP in which a CO₂/GHG target was set. Regarding their commitment within the Covenant of Mayors, the content analysis of 32 Italian cities, showed that over the 50% of cities have set a CO₂/GHG targets for 2020 higher than 20% (the mandatory target). On the other hand it pointed out that about one-third of the available SEAPs were elaborated by the administration itself, in some cases benefitting from external technical support.

On the adaptation side, only Bologna and Ancona in our sample approved their adaptation plan/strategy, respectively in 2014 and 2013. Few other cities have started the planning process to identify climate vulnerabilities. This may be attributable to the lack of a national adaptation framework until 2014, when the National Adaptation Strategy was approved whereas the National Action Plan is still missing. Another relevant reason is the fact that often planning systems already exist for climate change-related risks such as hydraulic and hydrogeologic, mainly at provincial and regional level. This aspect could discourage cities on taking further action, considering also the general lack of economic resources.

Despite this, the study reveals that Italian cities are trying to catch up. A strong boost was given by international networks, such as Mayors Adapt and the Compact of Mayors, and by European funding programmes as LIFE that represent good opportunities for the most dynamic cities for gathering resources and implement adaptation plans. In fact, the study identifies how cities are making the most of the practical support, guidance and tools provided by the instruments mentioned. The exploitation of EU funding opportunities can support willing cities in developing plans and implementing actions.

The overall analysis of the policies and plans evaluated confirms a trend towards an increasing awareness on climate mitigation whereas the scarcity of local adaptation plans confirms that urban resilience is a very complex issue that Italian cities are addressing mainly with a sectoral reactive approach on civil security. Thus, while they address a relevant number of interrelated fields, the study suggests that Italian cities should apply a more cross-sectoral and holistic approach in the development of their strategies in order to avoid maladaptation and exploit trade-offs (synergies and opportunities) among mitigation and adaptation actions.

As a matter of fact, for the Italian context integration of mitigation and adaptation actions in local planning systems can represent a possible operative solution to maintain, in the long term, the expected results of local actions as well as to counteract carbon emission and reducing potential impacts of climate extreme events on cities. The scenario revealed by this study suggests also that cities needs the support and coordination of upper levels of government, to undertake climate action in a more systematic way. In this regard the new policy framework on adaptation that is being setting by the national government and some first examples of regional climate change plans (e.g. Abruzzo Region) could represent a step forward provided that local action will receive the necessary attention in terms of policy construction and provision of the necessary technical and financial resources.

Because citizens have a potentially important role in achieving the



Fig. 5. Adaptation plans (Level 1-A and Level 3) in the 32 UA-3 city sample.

targets set by the local climate plans, municipalities need to involve citizens, sectoral practitioners, stakeholders in all the implementation phases of the plans. Thus, a continuous communication and information flow has to be assured in order to achieve better informed population and good cooperation in reaching goals and cope with threats of climate change, designing and promoting an ad-hoc education and outreach campaign focused on behaviour change also through online and social media campaigns. Several experiences carried out so far have demonstrated how important is to target schools to reach households.

Furthermore, the Italian case study shows that climate networks have represented a crucial role in initiating and supporting cities on mitigation and adaptation planning, and they continue to represent a relevant framework to consolidate this trend in the medium term. This is particularly true for the Covenant of Mayors which has boosted, in the latest years, Italian cities to start developing mitigation plans (SEAPs). It is hoped that this process will be strengthened through the new integrated Covenant of Mayors for Climate & Energy stimulating municipalities at joining it and boosting the implementation of integrated mitigation and adaptation plans (i.e. the Sustainable Energy and Climate Action Plans - SECAPs). This challenge will interest also cities with an existing SEAP that will be able to upgrading the existing SEAP to also include reporting for 2030 commitments and adaptation. This will help keep the momentum of climate action in Italian cities

and support the integration of adaptation concepts in urban planning.

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Appendix A

Table A.1 Mitigation section in the second part of the collecting-form.

Topics	Subtopics and research questions
Emission inventory	Does the plan include a baseline emission inventory (i.e. of current emissions)?
·	Does the plan include future emission projections?
	Does the future emission projection use multiple scenarios?
	Which scenario has been chosen for mitigation efforts?
	Type of diagnosis
	Remarks
Emission reduction targets	Are there any quantitative mitigation targets?
	Emission target [city CO2, in %]
	Baseline year
	Target year
	Comments
	Emission target [city GHG, in %]
	Baseline year
	Target year
	Comments
	Other quantitative targets
	Other targets
With the star to the first of the star	Comments
Mitigation topics included in plan	Energy saving
	Energy emciency
	Energy provision
	Kind of renouvely and reserve addressed
	White of relevable energy addressed
	wasie management
	Transportation
	Kind of transport
	Municipal buildings and operations
	other buildings and building management
Mitigation means/instruments	Hard measures
	Soft measures
	Financial measures
	Information campaigns
	Institutional, organisation aspects
Actors:	Who is implementing the actions?
	Who is mostly benefiting from the mitigation actions?
Mitigation funding	Who paid for the development of the mitigation plan?
Communication	Is there a communication strategy accompanied to the implementation of mitigation?
	How will the actions be made known to the community?
Mitigation monitoring	Is there a monitoring & evaluation strategy/plan (controlling mechanism) attached to the mitigation process?
Information on the local development framework:	Done as part of EU-project?
	Done in combination with university/research center?
	Done by a consultancy firm?
	Done by the administration itself?
	Has international knowledge been used?
	Has national framework information been used?
	Has regional (sub-national) framework information been used?

Table A.2

Mitigation section in the second part of the collecting-form.

Topics	Subtopics and research questions
Impact/vulnerability inventory	Does the plan include a CURRENT risk or vulnerability assessment? Which type of CURRENT risk or vulnerability assessment? Does the plan include a FUTURE risk or vulnerability assessment? Which type of FUTURE risk or vulnerability assessment? Are the impacts on vulnerable groups addressed? Which groups are addressed? Does the plan include CC scenarios? Type of scenarios
Adaptation topics	Are community views concerted when developing the vumerability assessment or adaptation plan? Electricity/energy management Health aspects Urban greenery/agriculture/forestry & parks Transport Kind of transport Municipal buildings and operations

(continued on next page)

Table A.2 (continued)

Topics	Subtopics and research questions
	Other huilding management
	Uner building management
Adaptation means/instruments	Hard measures
	Soft measures
	Financial measures
	Information campaigns
	Institutional, organisation aspects
Actors	Who is implementing the actions?
	Who is mostly benefiting from the adaptation actions?
Adaptation funding	Who paid for the development of the adaptation plan?
Communication	Is there a communication strategy accompanied to the implementation of adaptation?
	How will the actions be made known to the community?
Adaptation monitoring	Is there a monitoring & evaluation strategy/plan (controlling mechanism) attached to the adaptation process?
Information on the local development framework	Was it done as part of EU-project?
	Was it done in combination with university/research center?
	Was it done by a consultancy firm?
	Was it done by the administration itself?
	Has international knowledge been used?
	Has national framework information been used (i.e. out of national guidelines, national adaptation plans, etc.)?
	Has regional (sub-national) framework information been used (i.e. out of regional guidelines, regional adaptation plans, etc.)?

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International Cooperation of Turkmenistan in the Water Sector

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Abstract The aim of this chapter is to provide an overview of cooperation of Turkmenistan with neighboring countries, donor countries, as well as international organizations, including financial institutions. Its core is an analysis of the major drivers of cooperation and an overview about the different types of interactions and relations between Turkmenistan and its international partners. This is not an attempt to evaluate the quality or quantity of Turkmen initiatives or actions and no recommendation was produced. This is an effort to systematize information that is available to the public and to reflect on the experience of the author working in the country and region on water issues.

Keywords Bilateral, International, Multilateral, Turkmenistan, Water

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1 Introduction

"Putting forward new proposals and initiatives on environmental issues, Turkmenistan stands ready for intensifying and promoting positive cooperation on global scale." These were the words that closed President Berdimuhamedov's message to the participants in the conference "Environmental Cooperation of Turkmenistan with Major International Organizations: Achievements and Success," held in Ashgabat on November 21–22, 2011. One of the objectives of that conference was to discuss the proposal to establish a Caspian Environment Council and to create a Regional Center for Climate Change in Ashgabat. I do not know how far these initiatives went, but what I know for sure is that the meeting promoted positive cooperation for this book, particularly for this chapter. My presentation at the conference focused more on cooperation between the United Nations Economic Commission for Europe (UNECE) and Turkmenistan in the water sector. This contribution will however go beyond this, starting from a short description of the situation in the four major transboundary water bodies, followed by a brief historical perusal of the last twenty years.

The aim of this chapter is to provide an overview of cooperation of Turkmenistan with neighboring countries, donor countries, as well as international organizations, including financial institutions. Its core will therefore be an analysis of the major drivers of cooperation, what Peter Haas called "influencing factors" [1], together with an overview about the different types of interactions and relations between Turkmenistan and its international partners. It goes without saying that this is not an attempt to evaluate the quality or quantity of Turkmen initiatives or actions and that no recommendation will be produced. This is an effort to systematize information that is available to the public. Moreover, this has nothing to do with the chapter dedicated to international cooperation in the Environmental Performance Review of Turkmenistan and its final recommendations that have recently been adopted by the UNECE Committee on Environmental Policy [2].

Few scientific papers have been published specifically on this topic in English [3–6], which is one of the reasons that persuaded me to accept the invitation of the editors of this book. So far, most scholarly research and development cooperation has focused on the regional scale, especially on the Aral Sea [7–10]. This is due to the relative difficulty in obtaining firsthand information about the situation in the country, particularly about strategic issues such as this. The general feeling is however that the situation is improving and this text is a demonstration thereof. The sources used for this analysis are, first of all, official documents and publications by the Turkmen government [11–14] and by international organizations [15–21], some of which are available online. Their interpretation relies heavily on the author's familiarity with the issue and the country, having specialized in regional environmental cooperation and having served the UN in Turkmenistan.

2 Transboundary Waters

As it can be observed from the map below, there are four transboundary water bodies in Turkmenistan, shared with a total of eight countries, based on hydrological boundaries:

- 1. Amu Darya–Sarygamysh Lake–Aral Sea basin (Afghanistan–Tajikistan– Uzbekistan–Kyrgyzstan–Kazakhstan)
- 2. Murgab river basin (Afghanistan)
- 3. Tejen river basin (Afghanistan-Iran)
- 4. Atrek-Caspian Sea basin (Azerbaijan-Iran-Kazakhstan-Russia)



Map produced by ZOÏ Environment Network, July 2011

Source: UNECE (2011) Second assessment of transboundary rivers, lakes and groundwaters

The Aral Sea basin is the largest catchment area in Central Asia and one of the largest closed water systems in the world [7–9]. Its main effluents are on one hand the Amu Darya, which is the most important river in Central Asia and flows from Afghanistan and Tajikistan to Turkmenistan and Uzbekistan, and on the other hand the Syr Darya, which flows from Kyrgyzstan to Uzbekistan, Tajikistan, and

Kazakhstan. With regard to the Amu Darya, a small but significant amount of water originates from Afghan territory, but its exploitation is currently very low because of the war and of the socioeconomic situation in the country. Most of the water is generated instead on Tajik territory, but the country uses only a small proportion of it. Hoping to achieve energy and food security, Tajikistan, which is the poorest among former Soviet republics and has recently experienced a civil war, is investing heavily in the development of hydropower production and of irrigated land. This worries Uzbekistan, which apparently fears at the same time water scarcity and flooding due to dam failure. This could have negative effects on its cotton fields and industry, which is particularly demanding of water. In Turkmenistan, the Karakum canal brings water from the Amu Darya all the way to Ashgabat and beyond; the Altyn Asyr lake is being filled by drainage waters through the main drainage canal of the Golden Age that runs across the country from Turkmenabat and through the Karakum desert; water is also brought to the depression in the northwestern part of the country, significantly extending the river basin.

In general, all downstream countries are greatly concerned by the overexploitation of water resources, which is causing the disappearance of the Aral Sea and which is having serious consequences for the livelihoods of millions of Kazakhs and Uzbeks. As the UN Secretary General put it after visiting the area in 2010: "During my flight over the Aral Sea, from Uzbekistan, I was particularly shocked by what I saw. A sea that was once the fourth largest inland bodies of water in the world has shrunk by nearly 90 percent [...]. Clearly, this is a collective problem requiring collective effort - not just from regional leaders, but the entire international community."¹ All countries understand that international cooperation is needed to support efforts at the global, regional, national, and local scale to mitigate the causes and to adapt to the consequences of the so-called "tragedy" of the Aral Sea. It must be noted, however, that the Aral Sea is not the only transboundary lake in the area. There is also the large and shallow Sarygamysh Lake, which finds itself in a depression between Turkmenistan and Uzbekistan and which consists mainly of agriculture drainage waters originating from the Amu Darya. For this reason, its level and the quality of its water is also an issue of concern for the two countries.

Given that drainage water for the Altyn Asyr lake originates from the Amu Darya, this contribution focuses mainly on this catchment area. In order to fully understand the geopolitical situation, it is however fundamental to have a clear picture of all transboundary waters of Turkmenistan, starting from the Murgab river basin. From the mountains of Afghanistan, the river extends itself to the Turkmen city of Mary, where it mixes with the Karakum canal and north of which it ends up in the desert. The Tejen represents another significant transboundary river for Turkmenistan. It also originates from the reliefs of Afghanistan, flows westward to Herat and northward along the border with Iran, defining it, before disappearing in the Karakum desert. In 2004, Iran and Turkmenistan inaugurated the Doosti dam,

¹Quoted from his briefing to the Security Council of April 15, 2010, on the Secretary General's visit to Central Asia.

also known as the Iran–Turkmenistan Friendship Dam, which finds itself on the Tejen river. Located on the border between the two countries and very close to the border with Afghanistan, its reservoir plays an important role in stabilizing water supply to avoid social, economic, and environmental catastrophes such as the ten month drought of 2000. Through a pumped scheme, the reservoir also provides drinking water to the distant city of Mashhad, which is the second largest city in Iran. This greatly extends the scope and import of the Tejen river basin.

Finally, the Atrek river flows from the Iranian to the Turkmen side west of the Kopet Dag mountains. With a changing riverbed, its waters are used mainly for irrigation and reach the Caspian Sea only in flood season. The latter is a transboundary water body itself, shared with Azerbaijan, Iran, Kazakhstan, and Russia. It is of great importance for Turkmenistan because of its coastal and underwater oil and natural gas reserves, because of its influence on regional climate and environmental change, and because it is the natural habitat of a Turkmen staple produce such as sturgeon, from which caviar is derived. The government is also investing a lot in tourist infrastructure through the Avaza development project. As in-depth analysis of this water body goes well beyond the economy of this chapter, the reader is invited to refer to other titles of this series by the same editors, for further information [22, 23].

3 Historical Perspective

In order to fully understand the context, it is important to at least provide an overview of the kinds of interactions experienced in the lifetime of individuals that are now at senior positions of government structures. We all know that the Soviet period was characterized by massive investment in water infrastructure and ambitious projects that greatly impacted nature, society, and the economy. Cooperation among Soviet republics was mediated and sometimes enforced by Moscow and it resulted in a system where – by greatly simplifying it – the downstream Kazakh, Turkmen, and Uzbek SSRs were providing oil and natural gas, in which they are rich, to the upstream Kyrgyz and Tajik SSRs in exchange for water. Research, surveying, and design were carried on mainly by the branch of the "Hydroproject" Institute in Tashkent, including the planning of dams and canals. This is perhaps the reason for the popular claim reported by Erika Weinthal that the Uzbeks are the "water people" or *vodniki* of Central Asia [24, 25]. A series of agreements was in place with Iran and Afghanistan to manage transboundary rivers.

By the early 1980s, the situation of the Aral Sea was catastrophic. On top of that, the Soviet invasion of Afghanistan and the Iranian revolution of 1979 greatly contributed to the destabilization of the whole region. The Soviet response to the situation was the launching of a large-scale planning effort to save the Aral Sea. In 1982, a Water Resources Master Plan for the Amu Darya and Syr Darya river basins adopted the principles of limiting water extraction per hectare of irrigated land and of sharing available water among the riparian SSRs. By the mid-1980s, detailed regulations were

issued for the operationalization of these plans and two river basin organizations were created for the management of the Amu Darya and the Syr Darya, respectively. According to most witnesses, in this period, the role of Central Asian SSRs, including the Turkmen SSR, was rather passive, as major decisions were taken in Moscow.

In the early 1990s, the fall and dissolution of the Soviet Union created a vacuum. This meant the need to establish a new mechanism at least capable of mediating disputes among the newly independent states. This did not come from the Community of Independent States (CIS), but in the form of the Interstate Commission for Water Coordination (ICWC), which was created as a regional intergovernmental arrangement, where all states of the region are equally represented. The two river basin organizations were restructured as joint companies and an ICWC Scientific Information Centre (ICWC SIC) was established in Tashkent to exploit synergies with the "Hydroproject" Institute. Over time, the ICWC SIC has become a key resource for water information in Central Asia. The fall of the Soviet Union also brought along a shift from planning to programming. An International Fund for Saving the Aral Sea (IFAS) was established to finance projects to mitigate the causes and to adapt to the consequences of the situation in the Aral Sea basin. Riparian and donor countries have pledged and invested hundreds of millions of dollars through this mechanism. Without the mediating role of Moscow, some consistency was lost in transition, despite the best efforts at coordination by many partners. Moreover, the sudden absence of an authority capable of arbitrating problems and enforcing solutions meant the emergence of disputes in the long term.

For Turkmenistan as for most newly independent states, these were eventful years of hope and enthusiasm under the leadership of Saparmurat Niyazov, also known as Turkmenbashi. Few individuals knew how to run a fully independent country. Few knew exactly what they were doing: on one hand, there was the tendency of welcoming all initiatives coming from abroad; on the other hand, path dependency from Soviet structures can be observed alongside the desire to renew everything, such as in the case of the Aral Sea. As it can be noticed comparing the list of participants to international meetings and the number of treaties signed and ratified since independence, Turkmenistan was participating actively in international processes until the mid-1990s. The number of projects implemented with the assistance of donor countries, international organizations, and financial institutions was also quite high.

It was not until the decision taken in 1995 to strictly adhere to permanent neutrality in its foreign policy that Turkmenistan started to progressively withdraw from the international scene, refusing to participate in international meetings and projects and, of course, to become member of new organizations or party to new conventions, with few exceptions [26]. There are many hypotheses about this empty chair policy: some believe, for instance, that it was a reaction to overexposure and negative experiences in the early period, while others argue that it was an explicit foreign policy choice. The fact is that, for the following decade, Turkmenistan effectively closed itself to international cooperation, even refusing development aid. The only exception was a general support to the United Nations because of its universality and neutrality. A significant gesture was calling a national holiday after the Turkmen proverb "a drop of water is a grain of gold," which is still celebrated on the first Sunday of April and is an opportunity to take stock of what the country does in the water sector. Another example is the Framework Convention for the Protection of the Environment and Sustainable Development in Central Asia, which was proposed in 2006 and which includes provisions for the management of transboundary waters.²

Since late 2006, the arrival to power of Berdimuhamedov and his policy of reform and increasing openness brought along a new wave of hope for international cooperation. With regard to foreign policy, the reform process started from improved relations with neighboring countries, from Afghanistan, which receives humanitarian and development aid from Turkmenistan, and Iran to Kazakhstan and Uzbekistan. This represents a welcome development for improved management of transboundary waters and has already been reflected in a more active stance in IFAS, which is the only true regional arrangement that is truly functioning at present time, as ICWC and other processes are captive of either the rivalry for leadership in the region between Uzbekistan and Kazakhstan or the conflicting interests of upstream and downstream countries.

Ashgabat slightly distanced itself from Russia, considering that dependence on gas exports to Moscow was excessive, and carefully balanced its relations with all major powers, from the USA to the EU and from India to China, particularly through economic policy. The pursuit of positive neutrality is possible also because of the relative wealth of a country, which is considered medium income by global levels and which allows it to act as a donor more than a recipient country. In 2010, development aid to Turkmenistan accounted for only about 16 million USD, according to UNDP. At the multilateral level, Ashgabat increased its participation in United Nations projects and processes and relaunched relations with development banks. Under Berdimuhamedov's leadership, it now pursues the adoption of international standards. To do so, it has partnered with international institutions such as the European Bank for Reconstruction and Development (EBRD) and the UNECE, which is a standard setting organization in fields ranging from water to the environment and from housing to transport, especially under the leadership of its former head Ján Kubiš.

In this framework, Turkmenistan often volunteers to act as chair of multilateral processes and to host international conferences in the magnificent buildings completed over the last few years in Ashgabat. Moreover, because of its economic resources, it often proposes to host international centers, such as the new Regional Center for Climate Change mentioned above or the United Nations Regional Center for Preventive Diplomacy for Central Asia, which was launched in 2007 and whose presence in Ashgabat is a reflection of the opening and neutrality of the country. Water and the environment is also one of the three priority areas of the center³ [18, 19]. While the country is still young and developing, it is too early to make a balance of foreign policy under Berdimuhamedov.

² See article 9. On November 26, 2006, the framework convention was signed only by Kyrgyzstan, Tajikistan, and Turkmenistan.

³ See its program of actions for 2009–2011 and, most recently, for 2012–2014.

4 Main Issues

After having looked briefly at transboundary water bodies and having provided a short historical overview, we will now analyze the three major drivers of cooperation in the water sector. These are regular supply of water from upstream countries, sharing water with neighboring countries, and sufficient supply of water to the Aral Sea. These are also the main issues for the Altyn Asyr lake and, more generally, the Amu Darya basin. Other issues such as climate change or risk management, which may be of great import at the global or regional scale, but that, for the geographical configuration of the country or for other contingencies are not currently at the very top of the agenda, will also be mentioned. It can be noted that main drivers are relatively short term, while the latter issues are more long term. This tension is frequent in all kinds of decision making – not only in Turkmenistan – and is a major concern for the sustainability of any given policy. Because of the sensitive nature of the first set of issues, most international partners have no choice but to work on questions that are currently not at the top of the government agenda, while they aspire to contribute to more critical issues such as solving the problem of the Aral Sea.

The regular supply of water from upstream countries is of great import for downstream countries such as Turkmenistan and Uzbekistan. Of course, it also important that water is sufficient to meet the needs of downstream countries, but this responsibility is shared by both upstream and downstream countries and will be considered from the perspective of the whole basin. The emphasis here is on regularity because, besides natural variability, such as seasons, there is also human generated variability. This depends mostly on interventions upstream, such as the construction of a new dam or the operations of existing ones or the launching of large irrigation schemes. Of course, upstream countries can and have the right to do so and downstream countries can and have the right to be concerned about undesirable effects such as the extremes of draught and flooding. With international agreements and judicial decisions, international law provides principles, instruments, and examples of how to solve these issues and international partners are working closely with the governments of the region to achieve peaceful solutions [15, 27]. Particularly in the latter period, Turkmenistan has consistently highlighted the need to avoid confrontation, military and otherwise, which would be detrimental to all. It has insisted on the importance of reaching a "mutually beneficial" agreement for the "rational use" of water resources.

Another key issue for Ashgabat is the sharing of water with neighbors. Turkmenistan is downstream with regard to Iran and Afghanistan and is both upstream (middle part of the Amu Darya) and downstream (lower and upper part of the same river) for Uzbekistan. Here, we mean active sharing alone, i.e., the water flow that is left for downstream countries, given that passive sharing or the water that is received from upstream, has been and, at the same time, will be dealt with in the previous and following paragraph. For the Amu Darya basin, this is still regulated by the 1992 Almaty Agreement, which allocated 43% of the water drainage of the Amu Darya to Turkmenistan and which, by the way, also created

the ICWC. Other issues, such as infrastructure maintenance, are regulated by a more specific agreement. Governments hold bilateral and sometimes multilateral meetings on these topics and there is regular collaboration between operators on both sides, such as in the case of the Qarshi pumping stations shared by the two countries [21]. As the country is currently under the agreed share and given that exchange with Uzbekistan is generally positive, this would be no great issue, if it was not that the country seems to be aware of the fact that, if current trends are confirmed, according to frequently quoted government sources,⁴ Turkmenistan risks running out of water by 2020. This is one of the reasons why, in recent years, the government has been putting so much emphasis on saving water and, more generally, on the rational use of water. As it can be seen from the data below, this is especially pressing in the Amu Darya basin, also considering that the amount of water used by Uzbekistan is comparable.

	How much of the share agreed in 1992	How much water of the Amu Darya
	of the Amu Darya is actually	is used by Turkmenistan for
	used by Turkmenistan? ⁵	nonirrigation purposes? ⁶
1990	76%	1%
1997	70%	2%
2010	79%	9%

There is no need, however, to wait until 2020 to be concerned about water consumption in the whole Amu Darya basin. In Soviet times, ambitious projects and irrigation practices resulted in the excessive use of the river's water, which caused in turn water supply to the Aral Sea to become insufficient. Moreover, while the 1992 Almaty Agreement provides grounds for distributional justice among the five Central Asian republics, it theoretically allows them to withdraw 100% of the water of the Amu Darya, if you sum the share of each state. This leaves nothing for the Aral Sea or, to put it differently, puts the responsibility solely in the hands of riparian states and their capacity and good will to ensure that sufficient amounts of water end up in the Aral Sea, which is clearly not the case. In this regard, Turkmenistan is often criticized in international contexts for its large and liberal consumption of water. Its majestic fountains are often cited as example, even if consumption for nonirrigation purposes is relatively small compared to the agricultural sector, including cotton, as it can be seen in the figures above. In order to solve the issue of excessive water use, IFAS has been implementing large programs funded by the countries of the region and by donors, frequently with the assistance

⁴ This must be at the national scale. I am not aware of exactly how the projection was calculated.

⁵ According to simple calculations of the author based on data produced by the Joint Company "Amu Darya" and published on the web portal CAWATERinfo. The total mean annual flow of all rivers in the Amu Darya basin is assumed to be constant and estimated at around 74.22 km³ (without the Zeravshan).

⁶Based on the same data as above. UNECE reports that the 1997 figures are actual water uses, while the 2010 figures are prospective water requirements [20].

of international organizations. However, there is no binding agreement and no way for the international community to force riparian countries to keep water use to sustainable levels and to manage the Amu Darya so to ensure that it receives sufficient amounts of water. The environmental pressure caused by the social and economic damage along the shores of the Aral Sea is serious, but seems, at this stage, to be considered less important than the losses that would derive from reducing water consumption in certain areas and for specific activities. This is a conscious and explicit political choice. There is, moreover, the fear that if a given country went ahead with large water saving plans, other countries would not do the same, which would result in a comparative disadvantage for the virtuous country. This is a typical cooperation dilemma. This does not mean, however, that the perception and understanding of the situation or the actual situation might not change in the future and that countries could not find the right incentives and political will to limit water use to sustainable levels.

Another important issue but one that has not reached the very top of the government's agenda yet is that of climate change. As one of the editors of this volume has pointed out in several occasions [28], Central Asia and Turkmenistan are among the parts of the world that have already experienced the highest increases of temperature and that are expected to suffer the highest increases in the coming future, which is cause of particular concern given the relative scarcity of water, that most of the country is desert and that many settlements are located in mountain areas. Most international organizations and development partners are somehow involved in trying to bring the attention of the government on this issue. The leadership of the country proved to be sensitive to the issue, launching high visibility initiatives such as the already mentioned regional center. It is likely that changing climate will result in more extreme events such as draughts and floods, which are already cause of concern. Risk management needs not only sustainable land and water management but also early warning and alert systems that sometimes need an international reach, such as in the case of most transboundary rivers. The governments of the region, which is prone to natural disasters such as earthquakes, are in regular contact on the matter and many international partners are also involved strengthening the capacity of the governments to respond.

Other issues of concern with an international dimension are environmental impact assessment of transboundary projects, such as dams and new irrigation schemes, prevention of and fighting against transboundary pollution, and transboundary effects of industrial accidents that can contaminate water. Access to environmental information, such as water quality in specific areas by the public, is another issue often raised by international partners. Nontraditional issues such as payments for ecosystem services, such as water sanitation performed by certain ecosystems, or more generally the so-called "green economy" discussed at recent international conferences, including ecotourism in wetlands, are relatively new. Another nontraditional approach to water management is including trade in agricultural products also in the water balance of countries. It is often said that exporting one tomato is like exporting four gallons of water. As far as I know, this approach is new to the region. Finally, technology exchange must also be mentioned. Turkmenistan actively uses international conferences and scholarly exchanges to invite experts from the USA, Israel, as well as other countries, to introduce new technologies and innovative techniques in the country.

5 Formal and Informal Interactions

International cooperation is not limited to formal interactions. An issue that is often overlooked in the various analyses is the co-presence of different types of interactions. There is in fact a wide range of informal activities going from general monitoring to the daily running of irrigation schemes and the cleaning up of riverbanks. These practical activities are usually performed at the level of operators and local governments. While there can be local rivalries and misunderstandings, in most cases cooperation with the other side of the river seems to be regular and positive, especially on environmental issues, cemented as it is by the sharing of common resources and by many years of living side by side. Many individuals working on two sides of the same border have studied together in Soviet institutes and have developed links of friendship. This seems to hold true with all neighboring countries, from Uzbekistan to Afghanistan. These activities are usually performed below the radar of officialdom as there is no need to have formal meetings and exchanges. Of course, the official level regularly monitors the situation and provides inputs, ultimately exercising control, if needed. On the Amu Darya, government authorities are more vigilant toward the Afghan than the Uzbek border for obvious security reasons.

Turkmenistan, however, distinguishes itself for its high level of formality both internally and externally. This is a reflection of its Soviet past and of the huge role that the public sector and government structures play in the national economy, as well as perhaps a cultural trait. Level of formality is an important trait in Turkmen domestic and foreign policy and is often used as a way to prioritize, also in the water sector. Huge importance is given, for example, to high level foreign guests. Their participation in official celebrations, such as the national holiday "a drop of water is a grain of gold," tends to have positive effects on relations between Turkmenistan and international partners, from donor countries to international organizations. Respect for elders and generous hospitality are traditional values in Turkmenistan, as well as in the greater region. There are many kinds of formal interactions and they range for the most formal, such as agreements and commissions, to the less formal, such as meetings and programs. The general trend is toward less formality, but there is still – and I have recently argued that there should be [29] – room for formal frameworks, including legal agreements and institutional structures. This is particularly true in the case of Turkmenistan also in the water sector.

6 Bilateral and Multilateral Relations

Two main types of relations can be identified in international cooperation. On one hand, there are bilateral relations between Turkmenistan and other countries individually. In the water sector, these countries can be classified in neighbors, donors, and others. On the other hand, there are multilateral relations at different scales: subregional, regional, and global. Multilateral relations often take place in the framework of international agreements or organizations. The following paragraphs are going to present the main bilateral and multilateral relations of Turkmenistan relevant for the water sector. This will allow to complete an overview of the status of international cooperation of the country in this issue area.

6.1 Bilateral Relations

The most important partner of Turkmenistan in the water sector is Uzbekistan, as the two countries share a significant part of the Amu Darya. From the trinational border shared also with Afghanistan, the river moves northwest well into Turkmen territory. It then defines the border with Uzbekistan north of Turkmenabat before fully entering Uzbek territory south of Urgench. As with all its neighbors, Ashgabat cultivates friendly relations with Tashkent. Meetings are frequent both at formal and informal levels. The countries jointly operate irrigation schemes such as the Qarshi pumping stations. These are regulated by the Agreement between Turkmenistan and the Republic of Uzbekistan on Cooperation on Water Management Issues, signed in Turkmenabat on January 16, 1996. This agreement includes some provisions for dispute resolution and is still in force. Also, the joint management of the large and shallow Sarygamysh Lake should not be forgotten. Its level and the quality of its water are of vital importance for the inhabitants of the surrounding area. While it is true that the two countries have some basic interests in common due to their geographical position and share many positions, it is unfair to equate the foreign policy of the two countries as far as water is concerned. Turkmenistan is very careful at maintaining its neutral stance and good neighborly relations, while Uzbekistan generally favors a bilateral approach. For this reason, it is an exaggeration to characterize them as a downstream block against upstream countries.

The second most important partner for water management is Afghanistan. Three important rivers originate from there: the Amu Darya, the Murgab, and the Tejen. For decades, relations have been complicated by the Soviet invasion, civil war, the Taliban regime, and the current war. In recent years, Turkmenistan has tried to foster good neighborly relations, also extending humanitarian assistance and development aid. In Soviet times, attempts were made to establish a shared water monitoring system, but war got in the way. In case of floods upstream, alert mechanisms for downstream countries are weak. The situation makes it difficult to know exactly what happens on the Afghan side and Turkmen experts are eager to learn more about it, especially considering the importance of transboundary rivers. Moreover, for security reasons, it is difficult for foreigners, including official representatives of international organizations, to obtain permission to visit and assess the situation on the border. Peace and prosperity in Afghanistan will definitely have consequences for water use and for downstream countries. The potential for collaboration between experts and administrations of the two countries is great and neutral frameworks such as the UN Special Programme for the Economies of Central Asia (SPECA), where both countries are full members and whose chairmanship is currently held by Turkmenistan, are ideally positioned to facilitate these contacts.

The third most important partner is Iran. The two countries share two rivers: the Tejen and the Atrek. Only the latter originates in Iran. We have seen that the Tejen flows from Afghanistan, defines first part of the Afghan–Iranian border and part of the Turkmen-Iranian border, where it feeds the Doosti dam, also known as the Iran–Turkmenistan Friendship Dam. The management of the dam is regulated by an agreement signed in 2004, which is similar to the bilateral agreement with Uzbekistan. With the exception of the Doosti dam, where a joint coordination commission was created, it must be noted that Turkmenistan has not established bilateral commission for the management of transboundary rivers, despite the fact that they are an instrument chosen by many countries and enshrined by several agreements and conventions [30]. The dam is of vital importance for the Iranian city of Mashhad, so trinational cooperation among Iran, Turkmenistan, and Afghanistan is essential, considering that the Tejen river also flows through the Afghan city of Herat. The joint management of the Atrek river and the Caspian Sea are also important but are more distantly related to the focus of this book. Relations between the two countries are friendly and meetings are regular.

Another important country in the region is Tajikistan. With 80% of the Amu Darva's run-off originating from there, the country is a "water superpower."⁷ Of course, any change in water use in Tajikistan has consequences for Uzbekistan and Turkmenistan and the Aral Sea. The first and most immediate issue of concern is the presence of adequate mechanisms to alert downstream countries in case of flood upstream. A second issue is the potential consequences of the failure of existing or planned hydropower plants for downstream countries. A third issue is the integrated management of the river system, particularly with regard to finding a balance - and mechanisms to regulate it - between hydropower production, land irrigation, and clean water, on one hand, and guaranteeing that a sufficient amount of water ends up in the Aral Sea, on the other hand. For these reasons, relations between the two countries have known moments of tension in the past, but these have been much lower than the levels experienced with Uzbekistan on these issues. Turkmenistan tends to deal with the situation through regional platforms such as IFAS, SPECA, and UNRCCA. Diplomatic relations between the two countries are normal. These instances will be discussed in more detail below together with other multilateral processes.

⁷Calculation of the author based on data published by the IFAS Executive Committee.

Finally, relations with donor countries in the water sector, such as the USA and the European Union, are cordial, but conditioned by the double reluctance of donors to fund activities in a middle-income country and of Turkmenistan to receive financial assistance it has not requested. There is a general agreement that the country needs technical assistance and capacity building, as many experts left the country after the collapse of the Soviet Union. This is a kind of assistance that donors are normally happy to provide, as it allows them to give a competitive edge to their own experts, particularly in the case of Germany, France, and other European countries. Turkmenistan generally welcomes such assistance and does not come with a hidden agenda. Spontaneously or as a result of technical assistance, Turkmenistan also collaborates with research institutes or individual experts from Russia, Israel, the USA, as well as other parts of the world, particularly for the implementation of its water projects. International conferences organized in Turkmenistan are usually the occasion to foster these collaborations.

6.2 Multilateral Relations

Moving to multilateral relations, there are at least three distinctions to be made: first, between formal and informal groupings of countries; second, based on sector or functions; and third, according to scale. With regard to the first distinction, we will focus on formal processes. As we have already discussed above, Turkmenistan keeps a neutral stance and tends to favor formal interactions. Concerning the distinction among the various sectors, the most important difference is between development banks and other international organizations Turkmenistan is member of. In fact, while countries usually find themselves in a position where they request the assistance of development banks, such as the World Bank, the Asian Development Bank (ADB), and the EBRD, to finance various initiatives, the relationship with other international organizations is normally the opposite. Organizations such as the United Nations often make proposals, but they rarely have resources themselves. They need to partner with donor countries to obtain these resources and they need to obtain the agreement of recipient countries to implement projects. This puts countries such as Turkmenistan decidedly in the driver's seat. Now, the relative wealth of the country puts it in a position where its need for funding from development banks in the water sector is limited, so this distinction is also not fully relevant to our case. Therefore, we chose scale as the main organizing principle for the concluding paragraphs, distinguishing between the subregional (Central Asia) and regional (Europe or Asia) scale, on the hand, and the global scale, on the other hand. We will see that the position and relative weight of Turkmenistan with regard to other countries at the different scales makes a significant difference for its attitude toward various platforms.

At the subregional scale, the three main platforms are ICWC–ICSD–IFAS and UNRCCA. As it has already been mentioned above, ICWC was created in 1992 to

act as secretariat for the Almaty Agreement. Turkmenistan played an important role for its creation in the early 1990s. Under the ICWC, there is also an Interstate Commission for Sustainable Development (ICSD), which takes care of more specifically environmental issues, with a good degree of success. The environment is the most advanced sector in terms of subregional cooperation and Turkmenistan played an important role for the creation of this body as well. A SIC was established under the ICWC in Tashkent and acts as the main source of information for the water sector in Central Asia. There is a branch of the SIC in each member state, including Turkmenistan, and Turkmen authorities regularly share relevant information with the SIC. Turkmenistan strives to maintain positive working relations with all members of the ICWC, the ICSD, and the SIC. The greatest efforts are made, however, with regard to IFAS, which is arguably the only fully functioning autonomous subregional arrangement in Central Asia.

Like the five other member states, Turkmenistan also has a permanent representative in the IFAS Executive Committee, whose headquarters change on a rotating basis. This makes sure that the interests of all countries are taken into consideration. This is one of the advantages of IFAS, which resulted in the approval of the Aral Sea Basin Program (ASBP), which has already reached its third cycle. Supported by donors, the ASBP is basically a project container that is the result of a careful balance between the position of both upstream and downstream countries as requested by the presidential summit of 2009. There are in fact projects to support adaptation to the consequences of environmental change along the shores of the Aral Sea, as well as projects to promote mitigation of its causes in all riparian countries. To be fully adopted, the ASBP needs however to be approved at the national level by all member states. At the time of writing, Turkmenistan is about to join Kazakhstan and Uzbekistan, who have already approved it. It is hoped that the fact that no upstream country has approved it yet is not a sign of politicization of the program, which is mutually beneficial and quite neutral, which is in turn one of the prerequisites of Turkmenistan to support it. It is worth noticing that a significant part of the funding for the ASBP will come from Central Asian republics themselves, particularly for projects at the national level. Donor support was requested for regional initiatives, particularly from Germany and ADB.

Another relevant platform is represented by the UNRCCA, considering that water and the environment is one of its three priority areas. Mission created in 2007 through the UN Secretary Council, the UNRCCA constantly engages in political dialogue with all Central Asian republics to prevent conflict, also in the water sector.⁸ This comes in the form of good offices of the UN Secretary General, who visited the region in 2009, and of his special representative, Miroslav Jenča, whose office is hosted in Ashgabat. This comes also in the form of regular consultations at the highest political level, of meetings, seminars, and trainings on the general situation, but more frequently on specific issues such as the joint

⁸ See the letter dated May 7, 2007, from the Secretary General to the President of the Security Council (S/2007/279).

management of transboundary waters. The UNRCCA currently manages a project sponsored by the government of the USA to promote dialogue and a mutually beneficial agreement on water resources management. In this manner, it supports the work of IFAS and it builds capacity about international law, mediation of potential disputes on transboundary waters, and for the creation of an early warning mechanism for transboundary water issues, with the support also of France. The idea of such a center in Central Asia has been in the air for several years, but the offer of Turkmenistan to host it in Ashgabat once again proved fundamental for the actual opening of the center.

At the regional level, important frameworks of reference for water issues are the two UN Regional Commissions, the UNECE, which is based in Geneva, and the Economic and Social Commission for Asia and the Pacific (ESCAP), which is based in Bangkok. Together they manage and service SPECA. All Central Asian republics are at the same time members of both regional commissions, which are essentially standard setting organizations also in the water and environment sectors. The general neutrality of the United Nations and the technical nature but political leadership of the regional commissions – the Executive Secretary is traditionally a former minister of foreign affairs and an Under-Secretary General (USG) – makes them ideal platforms to advance cooperation in the water sector in the region. The last UNECE "Environment for Europe" Ministerial Conference, held in Astana in 2011, focused on water and the green economy and provided an opportunity for the countries of the region to discuss issues of common interest and to prepare for Rio + 20.

It must be noted, that the UNECE, in particular, has developed and services the 1992 Water Convention, which enshrines most generally accepted principles for the management of transboundary waters. In the framework of the EU Water Initiative's (EUWI) National Policy Dialogue (NPD) on Integrated Water Resources Management (IWRM), the UNECE is supporting the government of Turkmenistan in the accession process, which is expected to take place shortly. In particular, the UNECE is supporting a working group of national experts that are assisting the government in the preparation of the technical documents and draft legislation needed for accession. The EU has partnered with the UNECE to support the NPDs in Central Asia. The 2002 EU Water Framework Directive and the 1992 UNECE Water Convention are the two main frameworks of reference. With several non-UNECE member states that expressed interest in joining the convention, including Iran and Afghanistan, it must be noted that the 1992 Water Convention, on the hand, is evolving from a regional to a global convention, on the other hand, was caught in the dispute between upstream and downstream countries and politicized, even if the letter of the convention merely reflects general principles that are commonly accepted in many other subregions.⁹ Some countries proposed to develop a water convention specific to Central Asia. Turkmenistan itself had

⁹ The 1997 New York Convention, which was developed by the International Law Commission of the UN General Assembly and was supposed to be the global convention, has not managed to enter into force yet because of some controversial provisions.

presented the Framework Convention for the Protection of the Environment and Sustainable Development in Central Asia in 2006, but these approaches have not gathered consensus from all interested countries yet.

Other frameworks active in the water sector at the regional level are a development bank such as the Islamic Development Bank (ISDB) and an international organization such as the Organization for Security and Cooperation in Europe (OSCE). While the former is providing loans for rural water supply infrastructure, the latter is implementing small projects focusing on capacity building for the sustainable management of land and water to fight against soil degradation. On the side of development banks, the absence of the EBRD and the ADB from the water sector is significant if compared to other countries in the region. Again, the availability of financial resources for water projects gives Turkmenistan a high degree of autonomy in this regard. A specific feature of these regional arrangements is that they are sometimes dominated or have a strong imprinting from a large country or group of states in the broader region. While this is not necessarily a problem, this may clash with the strict neutrality of Turkmenistan. The OSCE, for instance, is perceived to be dominated by Western European countries and their values, the ADB by China, the EBRD by the United Kingdom, the ISDB by Saudi Arabia, etc.

Finally, we move to the global level, where somehow Turkmenistan, because of its foreign policy, feels more comfortable, particularly in the framework of the United Nations. Because of their neutral platform, the United Nations are in a position to collaborate with Turkmenistan much more closely than other international partners. However, water being a territorial resource, global initiatives in the water sector are struggling. We already saw how a regional agreement, such as the 1992 Water Convention, is de facto becoming a global standard. It is interesting to see how Target C to "halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation" of Millennium Development Goal (MDG) 7 to "ensure environmental sustainability" is generally being pursued at the national scale. There are traces of this in the United Nations Development Assistance Framework (UNDAF) negotiated between the United Nations and the government, but there are no projects currently being implemented specifically about water supply and sanitation, as far as I know. The United Nations Development Programme (UNDP), which is the only international organization present in Turkmenistan capable of implementing large projects, has instead obtained funding from the new Adaptation Fund to implement a two million dollar project to address climate change risks to farming systems at national and community level, with particular attention to the water sector. Concretely, this means that some analysis, support to the revision of the Water Code (in collaboration with the UNECE), and plenty of activities at the farmer, communal, and water users association level will be implemented. Again, while the government focuses on core functions such as water supply and sanitation, international partners try to promote forward looking issues such as climate adaptation. This resonates well with the government, which we saw promoting high visibility initiatives, such as that of launching a Regional Center for Climate Change in Ashgabat. Often, these international initiatives in the environment sector are also supported by UNDP, which is

implementing projects to prepare the countries of Central Asia, including Turkmenistan, for their participation in large international conferences such as Rio + 20.

A peculiar case is that of the World Bank. In the late 1990s, it had approved a thirty million dollar project to improve water supply and sanitation in the northern region of Dashoguz in the framework of the ASBP. In the early 2000s, it had also performed a study on integrated water resource management at the subbasin level, where the need is particularly acute because of the presence of the Sarygamysh Lake and the proximity of the Aral Sea. Besides national and local authorities, some of these activities were implemented in collaboration with the United Nations Children's Fund (UNICEF). For reasons that are described in the final report of the project, which is published online on the bank's website [31], the project was not completed and its implementation was considered unsatisfactory, I assume by both the bank and the government. This was followed by a long period when the bank did not grant any loan to the country, which coincided with the closing up of the country until the mid-2000s. In recent years, relations with Turkmenistan have normalized and the World Bank is once again making investments. As far as I know, no loan has been granted in the water sector yet, but this may come in the future. In the framework of the NPD, the Ministry of Water Economy has recently expressed some interest in launching a pilot project of integrated water resource management at the subbasin level in the Dashoguz region, which may be an opportunity to build upon the work of the World Bank in the early 2000s.

Finally, we must not forget more traditionally environmental initiatives in the water sector such as the sites designated under the 1971 Wetlands Convention and the UNESCO Biosphere Reserves. These are purely scientific initiatives, where cooperation is relatively easier and which receive strong support from the government. In the case of the former, Turkmenistan rejoined the convention, which focuses on the protection of wetlands and of the migratory birds that inhabit them, in 2009 (its territory had been under the convention until the fall of the Soviet Union). The only Ramsar site in Turkmenistan is the Hazar State Nature Reserve on the Caspian Sea coast south of Turkmenbashi. The site is being supported by the UNDP with generous funding from the Global Environment Facility (GEF). Together with four other natural sites, including the Amu Darya State Nature Reserve, the site is now also on the national tentative list of Turkmenistan to enter the UNESCO World Heritage List. No natural property is currently located in Turkmenistan. The inscription of a site on the list would be not only a great recognition for Turkmen heritage but would also be an excellent manner to ensure continuous monitoring of the protection and sustainability of these sites, also in terms of tourism development. Another site on the national tentative list, the Repetek Biosphere State Reserve, is also a UNESCO Biosphere Reserve, the only one in the country. This is another tool to ensure continuous monitoring of sights, as well as a way to transform them in living labs to improve our understanding of coupled human-environment systems [32, 33].

To conclude our overview of bilateral and multilateral relations of Turkmenistan, it is important to mention a peculiar platform, the Environment and Security Initiative (ENVSEC), which brings together six global and regional partners – the United Nations Environment Programme (UNEP), UNDP, UNECE, OSCE, the Regional Environmental Center (REC), and the North Atlantic Treaty Organization (NATO) – to fight against environmental threats to reduce the risk of conflict. Interagency coordination is well known to be an arduous exercise, but this one has been more successful than others. Moreover, because of its many water and environmental issues, Central Asia is certainly one of the key areas for this initiative, which has recently produced an analysis of the situation in the Amu Darya River Basin [21].

Of course, this quick perusal does not include all aspects and certainly some international partners and cooperation activities of Turkmenistan in the water sector have not found their place here. The objective of this chapter was to describe, to provide a conceptual framework to analyze the situation, and to highlight major elements, so the reader can understand the overall picture and possess the elements to deepen specific issues. Even if there is no intention to evaluate the foreign policy of Turkmenistan in the water sector, the picture emerging from this analysis is that of a country principled in its relations, selective about its partners, in good terms with its neighbors, with a solid, balanced, and expanding network of international connections. In this manner, Turkmenistan is contributing to developing institutions capable of managing transboundary waters in times of increasing environmental pressure.

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Soft Power of Tajikistan on the Water Agenda: Cross-Scale Dynamics

Jon Marco Church

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Abstract Freshwater is among the major resources of Tajikistan. With the majority of the surface water originating from its territory, the country represents a water tower for the Amu Darya and consequently for the Aral Sea. Per inhabitant, Tajikistan uses much less of the water resources used in other riparian countries and has a significant hydropower potential. To fully develop it, Tajikistan follows a sophisticated strategy that includes the construction of the Rogun dam and that is articulated on several levels: from the citizen level to the national level with a national water sector reform and to the international level with many bilateral, regional, and global initiatives. Tajikistan has become one of the leading countries on water cooperation at the global level and places the United Nations at the center of global water governance. The soft power of Tajikistan on the water agenda can be broken down in several attributes: the international context with a fragmented global water governance; the leadership provided at the highest levels of the state and the stability of power structures; the expertise and capacity built in the country; the support of many countries, international organizations, and international financial institutions; as well as the traditional hospitality of the Tajik people. This all contributes to the so-called Dushanbe Spirit. With its water initiatives and by hosting conferences in Dushanbe, Tajikistan provides a public good to the international community. The latest initiative to date led to the declaration by the UN General Assembly of the International Decade for Action "Water for Sustainable Development" (2018–2028).

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1 Tajikistan and Its Water Resources

Tajikistan is among the poorest former Soviet republics in terms of GDP, together with Kyrgyzstan.¹ Contrary to other Central Asian republics, such as Kazakhstan, Turkmenistan, and Uzbekistan, Tajikistan (Fig. 1) does not possess significant reserves of oil or natural gas. The greatest resource of Tajikistan is its people. Consequently, many Tajiks work abroad, particularly in the Russian Federation. According to World Bank data, Tajikistan is the country in the world that depends the most from remittances. They represented 47% of GDP in 2011.² The long crisis of the Russian economy is having a considerable impact on Tajikistan.

Another resource of the country is freshwater. According to official data, with 64 km³, Tajikistan ranks first among the five former Soviet republics of Central Asia for its water resources, well ahead of Kyrgyzstan. This corresponds to about 7,649 m³ per inhabitant, which is well above the 1,700 m³ that is normally considered as sufficient [1]. At least since Soviet times, Tajikistan is represented as a land rich in water, also in official speeches and in school textbooks. It is a mountain country, and its water is naturally clean. Sarez, a lake located at 3,255 m above sea level (Fig. 2), symbolizes this feature with its crystal clear water. Dushanbe, the capital of Tajikistan, was known in the Soviet period for the quality of its drinking water. The Tajik people are proud of their water.

At the national level, the main user of water is the agricultural sector, including aquaculture, with 94% of the resources available, followed by industry and the hydropower sector, with 3.5%, and by drinking water supply and sanitation with 2.5%.³ Even if only 7% of the surface is cultivated, agriculture is important for the country, as it represents 25% of the GDP and employs 46% of the workforce, with 73% of the population living in rural areas.⁴ Irrigation and drainage of agricultural land are therefore key issues for Tajikistan.

Nevertheless, since Soviet times, the country is mainly known for its potential for the production of hydropower, which is estimated at 527 TWh/year. For the sake of comparison, this is of the order of magnitude of the electric consumption of a country the size of Germany.⁵ To this day, the installed capacity is of 5,190 MW and generates 94% of the electricity produced in the country.⁶ With its 3,000 MW,

¹See the data of the World Bank and of the IMF for 2013.

²World Bank, Development Prospects Group, Migration and Remittances Unit (2013), "Migration and Development Brief," n. 20.

³Data for land and water resources of Tajikistan for 2010.

⁴See the data of the CIA World Factbook, consulted on 17 September 2016.

⁵Compare the data of the International Hydropower Association and those of the International Energy Agency for 2016.

⁶Data of the Ministry of Foreign Affairs of Tajikistan.



Fig. 1 Map of the average flow of rivers and withdrawal of the main canals of the Aral Sea Basin (*Source*: Zoi Environment Network (2011))



Fig. 2 Photo of Sarez Lake (Source: Church (2015))

the hydropower plant of Nurek, whose dam is the second tallest in the world, concentrates more than half of the installed capacity in the country [2]. However, every year, the reservoir of Nurek loses capacity especially because of siltation and, in this regard, would need major maintenance work to be undertaken.

For this reason and to match an increasing demand for electricity, the government of Tajikistan chose to continue its ambitious policy and exploit its hydropower potential, because it is a clean and renewable energy, which is also very competitive from the perspective of costs. During the last decade, this resulted in the construction of a large number of small hydropower plants and in the reactivation of some large projects that remained frozen since the end of the Soviet period, particularly the Rogun dam, which would become the highest dam in the world [3, 4]. With an installed capacity of 3,600 MW, this dam and its hydropower plant would allow not only to exceed by far the demand but also to reduce the dependency of the country from Nurek.

At the same time, the production and consumption of electricity are characterized by high seasonality. In winter, the electricity produced by hydropower plants is limited because of the need to fill the reservoirs, while the demand for electricity is highest because of the cold weather; on the other hand, the reservoirs of the hydropower plants empty during the summer, which results in a production surplus. The exploitation of this electricity is among the priorities of the government. For this reason, Tajikistan and Kyrgyzstan developed the CASA project to export more than 1,000 MW of electricity to Pakistan and Afghanistan during the summer period [5].⁷ The development of the hydropower sector of Tajikistan and Kyrgyzstan and the export of electricity are two components of the same long-term strategy that is a priority for both countries.

2 The Hydro-Energy Complex at the Regional Level

Tajikistan is located at the same time upstream and downstream of two large transboundary river basins, i.e., the Amu Darya and the Syr Darya [6, 7]. With 80% of the volume originating from its territory, Tajikistan represents a water tower for the Amu Darya.⁸ The Amu Darya basin is shared with Afghanistan, whose Pyanj tributary marks almost the whole border with Tajikistan; with Kyrgyzstan, for a small part of the Vakhsh tributary; with Turkmenistan; as well as with Uzbekistan [8]. On the other hand, the Syr Darya basin is shared with Kyrgyzstan, where 73% of the volume comes from; with Uzbekistan, which finds itself at the same time upstream and downstream from the Tajik province of Sughd; as well as with Kazakhstan.

⁷See also the final declarations of the last two editions of the Regional Economic Cooperation Conference for Afghanistan (RECCA), held in Dushanbe in 2012 and Kabul in 2015.

⁸Data of the Ministry of Energy and Water Resources of Tajikistan for 2016.

As shown in the map above (Fig. 1), all the water feeding into the Aral Sea or what is left of it originates from these two rivers. The Aral Sea represents one of the most serious environmental disasters of all times: 90% of the surface of what once was the fourth largest continental water body in the world disappeared with grave consequences for millions of Kazakhs and Uzbeks surrounding it [9–12]. The Amu Darya contributes 68% of the water of the Aral Sea. Therefore, Tajikistan bears a special responsibility for water supply in the basin, given that 55% of the water of the Aral Sea originates from its territory.

Tajikistan uses about 12% of the resources of the Amu Darya, which corresponds to about 1,880 m³ per inhabitant.⁹ This is about half of the approximately 3,487 m³ of resource per inhabitant theoretically available in the Amu Darya basin. This figure is well above the 1,700 m³ per inhabitant that would be sufficient, which explains why the Amu Darya basin, contrary to the Syr Darya basin, is usually not considered as not experiencing water stress, at least theoretically [13]. How to explain the tragedy of the Aral Sea? The initial fault comes from the Soviet period. The relative abundance of water in the region led to excessive water transfers, marked in red on the map above, to the persistence of obsolete irrigation techniques, and to the development of crops that need great amounts of water, such as cotton. This is a typical example of exceeding a threshold and of resource collapse.

In Soviet times, the five republics were part of the same hydro-energy complex. During summer, upstream countries provided water for the irrigation of fields below; in exchange, downstream countries provided fuel during winter. For this reason, several reservoirs were built in the region. They were used both for crop irrigation and to produce hydropower, which was also used to pump water from aquifers and for mountain agriculture. Moreover, the five republics were part of the same electric grid, which allowed them to use the surplus electricity produced during the summer [2]. It must be highlighted that Afghanistan, where about 14% of the water of the Amu Darya comes from, never was part of this system. On top of that, cooperation is complicated because of four decades of almost uninterrupted conflict that started with the invasion of Afghanistan by the Soviet Union.

After the fall of the Soviet Union, the five republics of Central Asia initially tried to maintain the system in place [14–16]. In 1982, Moscow had in fact developed a master plan for water resources in the Amu Daria and Syr Daria basins to regulate the hydro-energy complex of the region and to solve the problem of the Aral Sea. In particular, the master plan limited water extraction per hectare of irrigated land and shared the resource in the form of a percentage of the available volume for each one of the five republics. These values were set for the last time in 1987.

In 1992, the Almaty Agreement among the five countries gave continuity to the existing rules and created the Interstate Commission for Water Cooperation (ICWC) to manage the shared resource and particularly to decide the water allocation. Several regional institutions were therefore created, such as the Scientific

⁹Calculations of the author based on data for 2010 of the Basin Water Organization "Amu Darya," published on CA Water Info.

Information Center of ICWC (SIC ICWC) and the International Fund for saving the Aral Sea (IFAS). However, the situation of the Aral Sea remains desperate and the regional context has evolved significantly [17, 18].

A civil war stroke Tajikistan between 1992 and 1997, which weakened the country and had repercussions in the relations with Uzbekistan, which remained tense for many years, but are now improving. The management of the hydro-energy complex and, particularly, the water-fuel exchange between these two countries has greatly suffered from this situation. Tajikistan experienced in several occasions the closing of borders with Uzbekistan and the blocking of fuel deliveries, as well as other goods, provoking energy shortages especially in winter, while Uzbekistan is afraid that Tajikistan does not release sufficient amounts of water to irrigate during the vegetation period or, conversely, that it provokes floods downstream [2, 19].

For these reasons, Uzbekistan has been opposing for many years the Rogun dam project [20]. This large infrastructure was conceived in Soviet times by the HydroProject Institute in Tashkent both to produce more hydropower and to better manage irrigation. Nowadays, Uzbekistan fears that the Rogun reservoir is filled too rapidly, provoking water shortage downstream. According to Kai Wegerich, Uzbekistan behaves therefore as a hydro-hegemon in the region and does everything it can to impose its national interests and hinder Tajikistan from fully developing its hydropower potential [21, 22].

On the other hand, Tajikistan must take into consideration the position of Uzbekistan to reestablish the conditions of trust necessary to continue investing in the development of the hydropower sector. The strategy that it follows is sophisticated and articulated on several levels. At the citizen level, the government tirelessly emphasizes the importance of water for the development of the country and particularly of Rogun [3]. In 2010, the government went as far as encouraging citizens to invest part of their savings in the construction of the dam as a manifestation of patriotism.

Additionally, more than 15 years ago, Tajikistan launched a water sector reform process at the national level, following the principles of Integrated Water Resource Management (IWRM) [23], which is still ongoing. This ambitious process is supported by many partners, starting from the European Union, whose Water Framework Directive inspires the reform, but also Germany, Switzerland, the United States, the World Bank, and the Asian Development Bank, among others [24]. This reform contributes to signal the commitment of Tajikistan toward an approach to water management that, far from limiting itself to energy policy and to the national level, also includes other sectors, starting from agriculture and drinking water supply and sanitation, as well as a transboundary dimension, with an intense cooperation with neighboring countries, including Afghanistan [25].

Concerning bilateral relations with Uzbekistan, the government of Tajikistan keeps inviting Uzbekistan to develop a management system that is mutually beneficial. For instance, it proposed to reestablish the water-fuel exchange on the model of the system that was in place in the Soviet period. Uzbekistan is even regularly invited to participate in the construction of Rogun, in its financing, and in benefit sharing, like Tajikistan already does with the Russian Federation and with
the Islamic Republic of Iran for the Sangtuda 1 and 2 dams, respectively. Tajikistan has even accepted to submit the Rogun project to a social, economic, and environmental impact evaluation by an independent body, as requested by Uzbekistan. The evaluation was carried on by the World Bank and was favorable to the project, considering that it is overall better than its alternatives.

Then, at the regional level, Tajikistan actively participates in the activities of many institutions created after it gained independence, starting from the ICWC and especially IFAS. Of course, there are disagreements among countries, for example, on data and information sharing and use, but Tajikistan remains firmly committed to these processes. The only major exception is the 1992 UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki Convention), which was politicized and transformed into a contentious issue between downstream countries, which ratified it, and upstream countries, which refuse to ratify it [26–28]. This is surprising, because the Helsinki Convention was ratified by almost all countries in Europe and former Soviet republics, regardless of their upstream or downstream position.

Finally, at the global level, Tajikistan has become one of the leading countries on water cooperation. Since 2000, it launched several initiatives and hosted in Dushanbe a great number of events (Table 1). Some authors focus their attention only on the use of these initiatives to establish a favorable context for the development of the hydropower sector [29]. If this is clearly a manifestation of soft power, i.e., the capacity to coopt partners more than to force them, the remainder of this chapter will be dedicated to breaking down the attributes of the soft power of Tajikistan on the water agenda and explaining the different factors that made it possible for this small country to become leader on water. This will allow to appreciate the many elements that, well beyond the hydropower ambitions of the country, allow Tajikistan to lead on this issue. The following paragraph, as well as the rest of the chapter, is mainly based on direct observation by the author, who acted as consultant of the Government of Tajikistan on the water sector reform process at the national level for UNECE between 2011 and 2013 and on the last three global water conferences held in Dushanbe for UNDP in 2013, 2015, and 2016 (Table 2).

Period	Title	Context
2003	International Year of Freshwater	UN
2005-2015	International Decade for Action "Water for Life"	UN
2010	Group of Friends of Water at the UN General Assembly	UN
2013	International Year of Water Cooperation	UN
2018-2028	International Decade for Action "Water for Sustainable Development"	UN

 Table 1
 Global water initiatives of Tajikistan since 2003

Year	Title	Co-organizer
2003	International Fresh Water Forum	UN
2005	International Conference on Regional Cooperation in Transboundary River Basins	International Network of Basin Organizations
2008	International Conference on Water Related Disaster Reduction	UN
2010	High Level International Conference on the Midterm Comprehensive Review of the Implementation of the International Decade for Action "Water for Life"	UN
2011	Towards the UN Conference on Sustainable Development (Rio+20): Water Cooperation Issues	UN
2013	High Level International Conference on Water Cooperation	UN
2015	High Level International Conference on the implementa- tion of the International Decade for Action "Water for Life"	UN
2016	High Level Symposium on SDG 6 and Targets: Ensuring that No One Is Left Behind in Access to Water and Sanitation	UNDESA

 Table 2
 Global water conferences in Dushanbe since 2003

3 The Attributes of the Soft Power of Tajikistan on the Water Agenda

The first element that explains the success of the water initiatives of Tajikistan is the international context. If it was not favorable, these initiatives would not have the level of interest that they have been raising for more than 15 years. As it can be observed from the table below, the architecture of global water governance is extremely fragmented (Table 3).¹⁰ Countries such as Sweden, France, Germany, the Netherlands, or Hungary support different processes. These initiatives sometimes compete against each other. For this reason, many of these countries have recently called for a new global water architecture. A High Level Panel on 2030 Global Water Architecture was convened by Switzerland, France, Hungary, and the Netherlands during the 2016 World Water Week in Stockholm and introduced by a high-level government representative from Germany.

The action of Tajikistan puts the UN at the center of global water governance. Most member states support this approach. Thirty-nine countries, including Uzbekistan, have even joined the Group of Friends of Water at the UN General Assembly, created by the Permanent Mission of Tajikistan in New York. The UN is an organizational platform that is inclusive and representative of the diversity of the countries of the world, including least developed countries (LDCs), small island developing states (SIDS), and landlocked developing countries (LLDCs), such as

¹⁰See the final report of the UN Secretary General's Advisory Council on Water and Sanitation (UNSGAB).

Process	Launch	Secretariat	Actors	Aim	Notes
International Hydrological Programme (IHP)	1976	Paris	Governments	To promote research on water issues	Supported by UNESCO
World Water Week (WWW)	1991	Stockholm	Experts and decision- makers	To provide a plat- form to share expe- rience and perspectives	Organized by the Stockholm International Water Institute (SIWI)
Helsinki Convention	1992	Geneva	Governments	To provide a regional framework for the management of transboundary watercourses	Supported by UNECE but open to coun- tries in the whole world
Global Water Partnership (GWP)	1996	Stockholm	Governments, international organizations, NGOs	To promote Inte- grated Water Resource Manage- ment (IWRM)	Created with support from the World Bank, UNDP, and Sweden
World Water Council (WWC)	1996	Marseille	Governments, international organizations, NGOs	To raise awareness about public and private water management	It organizes a World Water Forum every 3 years
New York Convention	1997	New York	Governments	To provide a global framework for the management of transboundary watercourses	Ratified by only 36 countries
UN Water	2003	New York	UN agencies	To coordinate the action of the UN	

 Table 3
 Main processes of global water governance

Tajikistan. For these countries, water is extremely important. Recent analyses by UNDP demonstrate that access to water and sanitation influence 78% of the statistical variance in the Human Development Index (HDI) across the world's countries. No other development driver examined explain anywhere near this much of the HDI. This demonstrates the very close linkage between development and access to basic water and sanitation services.¹¹ Finally, institutions such as the General Assembly and the Economic and Social Council (ECOSOC) have the capacity to produce legal documents, contrary to other processes, which limit themselves to political declarations.

The second element that explains the success of the initiatives of Tajikistan is the constant involvement of the highest levels of the state. The stability in power of the

¹¹See the remarks of the UN Secretary General at the Opening Ceremony of the High Level International Conference on the Implementation of the International Decade for Action "Water for Life" held on 9 June 2015 in Dushanbe.

President of the Republic of Tajikistan, Emomali Rahmon, and his regular participation in many international events, from the UN General Assembly in New York to Rio+20 (2012), from the World Water Forum in Daegu-Gyeongbuk (2015) to the World Water Week in Stockholm, made him a champion of the water cause at the global level. Recognizing his commitment, he was invited by the UN Secretary General and the President of the World Bank to join the High Level Panel on Water (HLPW). This group is composed of ten heads of state and government and aims at facilitating the implementation of Sustainable Development Goal 6 on water. As element of comparison, at the beginning of the 2000s, Kyrgyzstan was promoting the issue of mountains on the global agenda similarly to the role of Tajikistan for the water agenda [30, 31]. The departure from power of the former president of Kyrgyzstan, Askar Akayev, in 2005 represented a significant blow for the mountain agenda, which has not recovered yet.

A third element is the expertise present in the country. Tajikistan can in fact count on a minister of foreign affairs who was trained as a hydrometeorologist, who wrote a doctoral thesis about Sarez Lake, and who worked for many years on water management at the national and regional level before becoming Permanent Representative of Tajikistan at the UN in New York between 2005 and 2013. Thanks to his expertise of water issues and his knowledge of the UN system, he plays a key role in the development and implementation of the initiatives of Tajikistan. Moreover, the presence for many years of a young and energetic deputy minister in charge of water resources, who is very dynamic and respected also at the international level, is another asset of the country. To this, one must add an interministerial team whose experience increased with each initiative. The conferences hosted in Dushanbe also contribute to the capacity building of the staff involved in the process and to keep in the country talents that would otherwise leave the public sector for private companies, international organizations, or abroad.

All these elements constitute the "Dushanbe Spirit" that is much appreciated during water conferences in Tajikistan. Moreover, participants are always impressed by the traditional hospitality of the Tajik people. Tajikistan provides the international community with a platform, whose philosophy is close to that of the World Water Week in Stockholm, integrating it within a UN framework. By doing this, Tajikistan provides a public good that is appreciated by the most part of the international community and by the UN, which openly supports these initiatives, mainly through the Country Office of the United Nations Development Programme (UNDP) in Dushanbe and the Department of Economic and Social Affairs (UNDESA) of the UN Secretariat in New York. The participation of the UN Secretary General at the High Level International Conference on the implementation of the International Decade for Action "Water for Life" in 2015 was a sign of strong appreciation (Fig. 3).



Fig. 3 The UN Secretary General, the President of Tajikistan, and the Prime Minister of Pakistan during the Water for Life Conference in Dushanbe (*Source*: Press Service of the President of Tajikistan (2015))

4 An Assessment of 15 Years of Initiatives and the New Water Decade

The assessment of the water initiatives of Tajikistan is positive. It is however important to highlight a certain number of issues. First, despite substantial efforts, there is still room for improvement in water management in Tajikistan. The UN Special Rapporteur on the Human Rights to Safe Drinking Water and Sanitation has recently urged the Tajik government "to reach out to the millions of people currently without access to safe drinking water and sanitation in the country."¹² Moreover, the situation of the Aral Sea remains desperate [32]. Finally, at the global level, some countries resist to the initiatives of Tajikistan, expressing doubts about the capacity of the UN to support the global governance of this precious resource and about the capacity of the country to provide leadership on this issue. For instance, with about 1,000 hotel rooms and an airport with a capacity of less than 5,000 passengers per day, it would have been impossible for Dushanbe to host the 46,000 participants in the World Water Forum in 2015.

¹²Press release of 12 August 2015.

However, the positive elements greatly exceed the limits. Other than the recognition of the country and its leaders as water champions at the global level, it is important to mention the financial support provided to Tajikistan from many partners for the development of its water resources, starting from the implementation of the water sector reform at the level of the seven basins of the country and for the improvement of drinking water supply and sanitation in both urban and rural areas. Nevertheless, the greatest success is the signature in 2016 of the framework agreement for the erection of the Rogun dam. The beginning of the construction of CASA must also be highlighted. This is a clear sign of the fact that the conditions required to make the investments necessary for the realization of these infrastructures start to be met. The role of the water initiatives of Tajikistan should not be underestimated. They contribute to build confidence in the country, as well as its capacity.

At the global level, the initiatives of Tajikistan, such as the International Decade for Action "Water for Life," contributed to achieve 5 years in advance the target set for access to drinking water in the framework of the Millennium Development Goals.¹³ The global conferences in Dushanbe on water have also contributed to raise awareness of the international community on vulnerable groups such as women and children, as well as on the specific issues of least developed countries. Strong of this positive experience and encouraged by many actors, the president of Tajikistan now wants to gain a new momentum to existing initiatives. In 2015, he proposed therefore to launch a new International Decade for Action "Water for Sustainable Development," aimed at contributing to the achievement of Sustainable Development Goal 6 and its targets, i.e., to "ensure availability and sustainable management of water and sanitation for all."

A new resolution was presented to the UN General Assembly in 2016. If many countries oppose the creation of new international days, years, and decades, the majority of member states supported this initiative of Tajikistan to extend the existing process. As a result, the UN General Assembly declared the International Decade for Action "Water for Sustainable Development" (2018–2028). The resolution was sponsored by 177 UN member states and adopted by consensus.¹⁴ This new decade aims at improving knowledge generation and dissemination and emphasizes the need to step up of international cooperation and collaboration in science, research, and innovation for the sustainable development of water resources.

Water is an essential resource for life. Its management cannot be improvised. The timeframe is necessarily long. The international years and especially the decades proposed by Tajikistan encourage long-term action and vision. It is therefore important to add the temporal scale to the various spatial levels to fully understand the action of Tajikistan on water issues [33]. These two dimensions represent not only central elements for the hydropower development of the country

¹³Document A/71/260 of 28 July 2016.

¹⁴Document A/RES/71/222 of 21 December 2016.

but also two key dimensions to ensure the sustainable development of water resources in the world.

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Abstract

The major challenge for water management in Central Asia is to ensure that there is sufficient water to feed a growing population, to produce enough goods and services for growing economies and sustain vital life support systems in the context of a changing and uncertain future climate, geopolitical trends and urbanization. We claim that water governance plays a key role in addressing these issues in the region. However, we argue that looking at multilevel governance is not sufficient to address the major challenges for water governance in Central Asia. We suggest looking beyond the spatial, administrative and normative scales and include also on other scales, such as time, planning and knowledge. Based on a review of the mainstream literature, which focuses on the spatial, normative and administrative dimension, as well as of research on other scales, we highlight the importance of other scales, as well as of their interaction. Due to the high level of interdependence of these elements, we observe that cooperation and integration prevail over conflict and disintegration. While

there are regular tensions, the trend is positive and is accelerating with all five Central Asian republics engaged in one way or the other in promoting water cooperation. We therefore suggest that this progress should be measured in all dimensions of water governance: not only the spatial, administrative and normative scales, but also the temporal, planning, relational and knowledge ones.

Graphical/Visual Abstract and Caption



Introduction: water resources in Central Asia

Central Asia is a region located south of the Russian Federation, west of China, north of the Islamic Republics of Iran and Afghanistan and east of the Caspian Sea (Dukhovny & Schutter, 2011). Azerbaijan, the northern provinces of Afghanistan and the Xinjiang Uyghur Autonomous Region of China are sometimes considered to be also part of the Central Asian region. In this article, we will focus on the Aral Sea Basin, which corresponds to the most populated part of the region, covers the

southern part of Central Asia and constitutes the third largest endorheic basin in the world (Figure 1). The Aral Sea Basin is composed of two major sub-basins, i.e. the Amudarya Basin to the south and Syrdarya Basin to the north, as well as two minor endorheic but interconnected sub-basins, i.e. the Murgab and the Harirud, which flow from Afghanistan into Turkmenistan (Kostianoy & Kosarev, 2010; Zonn, Glantz, Kostianoy, & Kosarev, 2009). The major challenge for the management of water resources in Central Asia is to ensure that there is sufficient water to feed a growing population, to produce enough goods and services for growing economies and sustain vital life support systems in the context of a changing and uncertain future climate, geopolitical trends and urbanization. All this complicates but also makes imperative to take more proactive measures towards achieving Sustainable Development Goal Six (SDG 6), particularly ensuring safe drinking water and sanitation for all, implementing integrated water resources management (IWRM) at all levels, including through transboundary cooperation. It is also important to address the disappearance of the Aral Sea, which shrank to more than one tenth of its original size over the last sixty years. The UN Secretary General described visiting the area in June 2018 as a "tremendous shock". Other major challenges include increasing water efficiency and productivity, as well as the management of transboundary waters, given that all major basins are transboundary.

In this article, we claim that water governance plays a key role in addressing these issues (Taylor & Sonnenfeld, 2017), particularly in the context of the Sustainable Development Goals (Kanie & Biermann, 2017; Monkelbaan, 2019). Issues such as the disappearance of the Aral Sea and water scarcity are in fact rarely the result of physical lack of water resources. For instance, between the Amudarya and the Syrdarya, while it is the Syrdarya that, at least theoretically suffers the highest levels of water stress, it is the Amudarya that displays higher levels of water scarcity, especially in the longer run (Dukhovny et al., 2018; Revenga, Brunner, Henninger, Kassem, & Payne, 2000). This is mainly due to poor management, insufficient water accounting and lack of effective coordination mechanisms across sectors and countries.

Water governance is the political, institutional, regulatory and judicial context where water management takes place and that can influence its outcomes in terms both of social performance, environmental performance and externalities to other socio-ecological systems (McGinnis & Ostrom, 2014; Ostrom, 2009). We mobilize the concept of governance instead of simply government not to limit ourselves to the role of government organizations, but to include all other types of actors that contribute to addressing these issues, such as international organizations, non-governmental organizations, the private sector, as well as academia, and the actions they take. Also, the concept of governance allows to put forward the need of governmental organizations to reach out to other actors and engage in multi-stakeholder processes (Andersson, 2016; van Zeijl-Rozema, Cörvers, Kemp, & Martens, 2008). Moreover, governance takes place at multiple levels: global, regional, national and local. The concept of multilevel governance (Finger, Tamiotti, & Allouche, 2006; Hooghe & Marks, 2003; OECD, 2011) has gained currency to highlight how governmental organizations act within nested systems where they interact with international organizations, local authorities, as well as nongovernmental organizations (Howlett & Rayner, 2006). In this respect, we argue that looking at multilevel governance is not sufficient to address the major challenges for water governance in Central Asia. As follow-up to Wegerich (2004), we suggest that, to better understand water governance in the region, it is important to also consider different scales, including institutions, but also space, time and other dimensions, as well as the different levels therein.

This article therefore aims at providing a review of the scientific literature on the different scales of water governance in Central Asia. In the paragraphs below, we illustrate each scale with at least one relevant example, hence explaining why each scale should be taken into consideration to better understand water governance in Central Asia. Of course, these scales and the levels therein interact in a complex manner. Their interaction is a gap in the current literature on water governance in Central Asia, which shall be further explored.

UNDERSTANDING WATER GOVERNANCE ACROSS SCALES

Research on water governance in Central Asia often focuses on the spatial and institutional dimension, focusing on the relations between upstream and downstream countries and on the international legal framework that emerged after the collapse of the Soviet Union (Boisson de Chazournes, 2006; Janusz-Pawletta & Gubaidullina, 2015; Ziganshina, 2016; Zinzani & Bichsel, 2018). However, there are several other scales that are relevant to understand water governance in Central Asia, such as time, planning and knowledge. For example, the high seasonality of water resources in Central Asia may result in conflicts of use between the release of water for irrigated agriculture in summer and the retention of water in reservoirs for hydropower production in winter, when the inflow of water from mountain glaciers is lower. To understand the nexus between water, food, energy and the environment, it is therefore essential to take into consideration at least the time and knowledge scales, together with the spatial and institutional scale (Granit et al., 2012). The lack of consideration for other scales in the multiplication of the scales considered and by the difficult access to information about other scales due to logistical and language barriers.

In this article, we propose to address this challenge by building on the theoretical framework to analyse scale and cross-scale dynamics put forward by Cash et al. (2006). Moreover, we base our analysis on our long-term first-hand experience of water governance in Central Asia. Following Gibson, Ostrom, and Ahn (2000), Cash and colleagues define "scale" as the "spatial, temporal, quantitative, or analytical dimensions used to measure and study any phenomenon" and "levels" as the "units of analysis that are located at different positions on a scale" (p. 7). They identify seven types of scale: spatial, temporal, jurisdictional (administrations), institutional (normative), management (planning), networks (relations) and knowledge. In Figure 2, we propose a slight adaptation of the key scales and levels identified by Cash and colleagues to better suit the Central Asian context.

Cash and colleagues then identify five types of interaction among different levels and scales: multilevel single-scale, cross-level single-scale, multilevel multi-scale, multilevel cross-scale, as well as cross-level cross-scale. Single-scale means that actions remain confined to different levels within a single scale, such as the hierarchical relations between legal documents such as a constitution that may give the right to all citizens to accessible and safe drinking water and sanitation and the laws and regulations that are subordinate to the provisions contained in the constitution; multilevel and multi-scale mean that actions occur at different levels within different scales without necessarily observing interactions across levels and scales, such as research on water resources that may take place at the national and international level on spatial issues at the local and regional level but may not refer to each other; cross-level and cross-scale mean instead that actions at one level and scale are interrelated with actions at other levels and scales, thus constituting interactions. This is the typical situation for the integrated management of complex issues and wicked problems such as water resources (Levin,

Cashore, Bernstein, & Auld, 2012; Rittel & Webber, 1973). For instance, disaster risk reduction of issues such as flooding imply flows that go from upstream to downstream that interact with short-term meteorological phenomena and long-term climate dynamics and that are dealt with through a nested system of national and local plans that sometimes overlap with basin plans, just to give an idea of the complexity of many water-related issues. However, in the economy of this review article, it will not be possible to address each type of interaction among different scales and each respective level. This is a gap in the scientific literature on water governance in Central Asia that, in our opinion, needs to be filled. We are convinced that addressing these interactions allows to better understand water governance in Central Asia.

WATER GOVERNANCE ACROSS SCALES AND LEVELS

In the paragraphs below, we therefore review interactions within the seven different scales identified by Cash et al. (2006) regarding water resources in Central Asia. We provide brief case studies to exemplify what we see as the main challenges of each scale. These cases are not representative of all configurations. While they focus on important issues, we do not claim that they are an exhaustive survey of the most important issues of water governance in Central Asia. They are mere illustrations of the need to look across scales. We then discuss how taking into consideration each scale contributes to better understand water governance in the region. Finally, we discuss the implications of crossscale water governance in Central Asia.

Spatial scale: upstream and downstream

The first scale that needs to be taken into consideration when analysing water governance in Central Asia is space. Within both major sub-basins of the Aral Sea, there are upstream and downstream countries. Regarding the Amudarya, the river and its tributaries flow from Tajikistan, Afghanistan and to a much lesser degree Kyrgyzstan, then forms the border between Afghanistan and Uzbekistan, crosses the territory of Turkmenistan and returns and ends up in Uzbekistan; the Syrdarya originates in Kyrgyzstan and flows to Tajikistan, Uzbekistan and once again Tajikistan before reaching once more Uzbekistan and Kazakhstan. Considering the Aral Sea Basin, Kyrgyzstan and Afghanistan can therefore be considered as upstream countries. Tajikistan, Turkmenistan and Uzbekistan are both upstream and downstream, while Kazakhstan is purely downstream (Lipponen, 2011). An upstream position physically gives countries and communities within countries the possibility to withdraw water that flows downstream. Those in a downstream position may suffer from water scarcity because of excessive withdrawals upstream. Water governance plays a key role in making sure that the needs of the countries upstream and downstream are both taken into consideration. In Central Asia, this usually takes place within national and regional institutions, basin organizations, as well as bilateral and multilateral discussions (Wegerich 2015). The importance of the spatial configuration is highlighted in the case below, which is representative of many similar situations throughout the region.

The Karshi cascade consists in the 87-kilometre long Karshi canal and pumping scheme that takes water from the southern part of Turkmenistan to the Kashkadarya steppe (also known as Karshinskaya) where the Karshi city is located in the southern part of Uzbekistan (Glantz, 1999, pp. 31, 166; Kostianoy & Kosarev, 2010, p. 80). It was built between 1961 and 1973. It was meant to implement an "integrated approach to the development of virgin lands" (Dukhovny & Schutter, 2011,

p. 216), which can be seen as an early version of integrated water resources management (Dukhovny & Horst, 2008). The deviation starts near the Kyzyl-Ayak village in Turkmenistan. Six large pump stations located on the Turkmen side lift water 132 meters above the Amudarya (Dukhovny & Schutter, 2011, pp. 164-167). With an intake of up to 5 km³ of water per year, it is among the major diversions of the Amudarya. It transfers water to the Kashkadarya, which is an endorheic basin in Uzbekistan and doubles the irrigated area from 500 to 1,000 thousand hectares. The Talimardjan reservoir was built in on the Uzbek side to regulate water supply and its level is a key indicator for water management in the area. Drainage water is collected through a system of collector canals to the Sultandak reservoir. The Shordarya canal was built in 1987 to return at least some of the water back to the Amudarya to try counter the disappearance of the Aral Sea despite the high salinity and low quality of drainage water (UNECE, 2006, p. 80). More than 800 thousand people live in the area and the livelihoods of a significant proportion of them depend on irrigated agriculture, usually large farms growing cotton. The pumping stations were rehabilitated in the 2000s with the support of the World Bank. Moreover, the economic viability of the irrigation scheme depends on the provision of cheap energy to operate the pumping stations. Coordination between upstream Turkmenistan and midstream Uzbekistan is therefore essential to ensure the functionality of the Karshi cascade and sustain the local community.

Temporal scale: path dependency

Given that water quality and quantity change over time (both within a year and in the long run), temporal scale with its emphasis on rates, durations or frequencies is more than relevant to water management. This subsection will look at the importance of seasonality and climate change in the region, as well as the impact of the Soviet heritage on contemporary water governance in Central Asia.

Central Asia has a rather unique model of transboundary water governance deriving from its history and characterized by multiple dimensions of path dependency. Massive water storage infrastructure and distribution networks that were built in Soviet time and continue connecting upstream, middle stream and downstream areas across the region in a complicated way is among the most telling examples of technical path dependency in the world. In institutional terms, the transboundary water management system is also heavily grounded on pre-independence norms, organizations and practices. With the 1992 Almaty Agreement,¹ Central Asian countries validated the Soviet-time Schemes for Integrated Water Resources Use and Protection for the Amudarya and Syrdarya, which were evidence-based analytical and strategic planning documents, equivalent to huge river basin plans.²

The two basin water organisations (BWOs) for the Amudarya and Syrdarya, created in 1987 to deal with inter-republic and inter-sectoral distribution of water and to operate inter-republic irrigation canals and collectors, were put under the Interstate Commission for Water Coordination (ICWC) in Central Asia, also established in 1992. Similarly, the Commission decided to establish a Scientific Information Centre (SIC), based on the Central Asian Irrigation Research Institute (SANIIRI) established in 1925, making use of the scientific potential of one of the oldest research institutions in Central Asia. Finally, informal practices and connections among water professionals – especially irrigation engineers – established in the pre-independence time have been forming and influencing decision-making over the last 25 years, even though many specialists had to leave their jobs due to low salaries and other reasons. Moss and Dobner (2016) observe, for example, that whilst striving to improve the efficiency

of irrigation systems modern water bureaucracies are reinforcing the path dependency of not only the physical infrastructure but also its own raison d'être, recalling the heyday of the Soviet irrigation engineering. Indeed, water profession in the Soviet time was highly respected and well paid and the Ministry of Land Reclamation and Water Recourses of the USSR was one of the most influential ministries at that time.

Despite being path dependent in many ways, transboundary water governance system in Central Asia cannot be regarded as static. Rather, the system and its main actors (regional and national stakeholders) have been adapting – with different degrees of success – to shifting conditions, as well as political, economic and organisational settings. Those changes included technical measures, such as the construction of new facilities to address seasonal imbalances, shifting of crops and harnessing untapped hydropower potential, as well as institutional arrangements, such as regular meetings of the ICWC, bilateral interactions, technical group meetings and many others. Given the complexity of the issues and underlying interests, this process has been non-linear and contested in many ways. It is worth mentioning that constant restructuring and reshaping governmental institutions also lead to diminishing the influence and power of water ministries that were often merged with either agriculture or energy.

It is safe to conclude that the radical transformation of political and economic relations in the region has been accompanied by strong path dependency in the area of water management. The need for change, also because of the observed and expected impact of climate change, has been also pushed by many forces, requiring more forward-looking and adaptive management practices. It is well known that the main issues in water management and allocation in the Amudarya and Syrdarya basins have to do with accommodating different seasonal requirements of two dominant water uses: hydropower production and irrigated agriculture. Existing controversies may increase in the future due to the impacts of climate change on water availability, especially during the growing season. For instance, according to Dukhovny et al. (2018), trends of climate change in the Amudarya basin suggest that, according to average warming scenario, by 2050 water availability will be decreasing in the growing season on the main rivers of the basin such as Vaksh (by 5%), Surkhandarya (by 6%), Kafirnigan (by 8%), Zeravshan (by 11%), with decrease in the summer months ranging from 15 up to 35%. Also, the frequency of extreme water events is expected to increase dramatically making it even harder for water managers to ensure the working conditions of water systems.

On the good side of things, existing and planned multipurpose reservoirs may play an important role in regulating the inter-seasonal flow and reducing the risk of disaster. There are also opportunities to harvest positive effects of climate change on plant growth and potential shortening plant development phases. As Stulina and Solodkiy (2015) research in the Fergana Valley demonstrates, the growth of the area's thermal potential due to climate change leads to reaching the sum of effective temperatures in shorter time that allows sowing crops earlier, as well as reducing crop development phase and the growing season as a whole. These findings suggest that water demand may be reduced; time for second crops may also be secured. That kind of research must be better fed into the renewed and more adaptive water management framework in the region.

Transboundary water management is adaptive but must be enhanced

Transboundary water management system in the Amudarya basin set up in Soviet times has been adapting to new conditions and challenges by enabling operational water management and adjusting water allocation to actual water conditions of the year. But it was less successful in dealing with extreme conditions, such as droughts and floods, as well as long-term planning and management, both instrumental for proper water management under climate changes and other types of change (Ziganshina, 2016). Therefore, further enhancement of the system's adaptability is a must.

Administrative scale: intergovernmental framework

The countries of Central Asia created joint organisations for shared waters immediately after gaining independence, signalling their sovereignty claims but also adopting a pragmatic approach to water management issues.

The Interstate Commission for Water Coordination (ICWC) in Central Asia made up of the heads of national water authorities of the five Central Asian countries was established in 1992 with the important mission of ensuring that water is allocated and used by riparian countries in a coordinated way. To this end, the Commission shall meet quarterly to "elaborate and approve annually water use limits for each republic and the region as a whole, schedule for reservoir operation regimes, correct the former according to updated forecasts, depending on actual water availability and current water-related conditions" (Article 8, para. 1). It is also entitled to "determine water policy in the region, elaborate its key directions taking into account all economic branch needs, integrated and rational use of water resources, and long-term regional water supply program and measures for its implementation" (Article 8, para. 2).

In 1993, the ICWC was placed under the newly established Interstate Council on the Aral Sea (ICAS). In 1997, the ICAS was merged with the International Fund for Saving the Aral Sea (IFAS) and the ICWC became one out of two commissions operating under its umbrella. As of today, the Commission has five executive bodies, including two Basin Water Organizations (BWO): BWO Amudarya, with its central office in Urgench (Uzbekistan) and four territorial divisions located in Tajikistan (Kurgan-Tyube), Turkmenistan (Turkmenabad) and Uzbekistan (Urgench, Takhiatash); BWO Syrdarya, has its central office located in Tashkent and its territorial divisions spread in the provinces of Kazakhstan, Tajikistan and Uzbekistan; the Secretariat is located in Tajikistan; the Scientific Information Centre, with its central office in Tashkent and branches in Kazakhstan, Kyrgyzstan and Tajikistan; the Coordination Metrological Centre is located in Kyrgyzstan.

Despite the challenging geopolitical and socio-economic context, the ICWC and its executive bodies are playing a prominent role in setting up and implementing water allocation quotas, as well as providing a forum for information exchange, building capacity, conducting and coordinating research and joint projects, and in facilitating mutual learning between the riparian countries. Through its decisions, the ICWC gave the green light to introducing advanced approaches to water management, such as integrated water resources management, strengthening informational cooperation, introducing decision support systems and automation of head water facilities (Ziganshina, 2014).

The Commission's record also reveals the challenges that need to be addressed to enhance its legitimacy and effectiveness. The need for institutional reform was raised by all riparian countries over the last 25 years but most prominently by Kyrgyzstan, which has suspended its participation in the IFAS and its bodies from 2016 because "the reforms of the IFAS repeatedly proposed by Kyrgyzstan were not carried out" and the IFAS "does not take into account hydropower aspects of water use and the requirements of individual countries of Central Asia".³ At the Summit of Heads of States that was held on 24 August 2018, the President of the Kyrgyz Republic said that his country was ready to restore its participation in the IFAS, if its comprehensive reform was carried out taking into account the needs and interests of all states.

To address these challenges, a special task force on legal and institutional reform comprised of national and regional representatives was created under IFAS. The task force started its work by taking another close look at recommendations prepared in 2010 within the IFAS Kazakhstan-led project on improving institutional framework.⁴ At that time, recommendations containing two options for institutional reform could not satisfy countries, with Uzbekistan supporting the softer option of strengthening existing institutions and Kyrgyzstan insisting on radical reform and transformation. There is a hope that this new endeavour taken in a more cooperative era could come up with more satisfactory results, thanks to the ongoing improvement of overall relations among Central Asian republics. The question remains, however, whether Kyrgyzstan will be willing to join this IFAS-led group.

It is important to note that the success of institutional reform at the regional level is closely aligned with proactive steps taken at the national level. Given the importance of hydropower development for Tajikistan, this country established the Ministry of Energy and Water Resources in 2013 and its first deputy minister currently represents both water and energy sector at the meetings of ICWC. In Uzbekistan, the Ministry of Water Management was recently formed, among other things, with the intention to separate the regulation of water issues from agriculture, as the largest water user in the country (Yalcin & Mollinga 2007). This example illustrates functional mismatches where the mandate of regional institutions is too narrow to address the existing transboundary water governance problems.

Normative scale: ongoing transition process

The normative dimension also needs to be considered to understand water governance in Central Asia. It is not enough, however, to look at the constitutional level, where significant differences can already be found; it is also necessary to look at the treaties ratified by each country, the key laws and legal principles that were adopted, as well as the bylaws and other normative acts all the way down to the actual operational rules followed by water service providers and users. Also, the effectiveness of these norms must also be taken into account. In this regard, even if the World Bank ranked Central Asian countries among the bottom third where the rule of law applies the least in the world⁵, the normative scale is not irrelevant for water governance in Central Asia, because there are many instances where norms are followed and because norm production is also an opportunity to assess, discuss and possibly improve water management.

At the constitutional level, all Central Asian republics gave continuity to the 1977 Constitution of the Soviet Union (Article 11), which mentioned that water and other natural resources are state property. However, if many mention the responsibility of the state to ensure rational use, none goes as far as

explicitly mentioning the need to preserve water quality, as mentioned in the Soviet Constitution (Article 18). No constitution explicitly mentions the human right to water and sanitation, even if each country recognizes it, as it was declared by the United Nations General Assembly, and is engaged in achieving SDG 6. Concerning water-related treaties, there is a divide between upstream and downstream countries. The 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki Convention) and the 1997 Convention on the Law of the Non-Navigational Uses of International Watercourses (New York Convention) are extremely politicized. Kyrgyzstan and Tajikistan have so far strongly opposed the ratification of the Helsinki Convention, apparently because of fear that it can be interpreted in ways that give too much power to downstream countries over water uses in upstream countries and perhaps also because supporting these conventions would be perceived as unpatriotic in a context of tensions with some neighbouring countries that are not always related to water. So far, only Uzbekistan has ratified the New York Convention.

Each country in Central Asia, except Uzbekistan, possesses a so-called Water Code, which functions de facto as a framework law. They were for the most part developed in the early 2000s as part of the transition process from a planned economy. The codes contain the key principles about the organization of water management and coexist with several laws and by-laws on specific aspects. The statutes of the various institutions that oversee water sector are also important. Some of these legal documents provide grounds for the development of private water service providers and some market mechanisms. These normative developments have so far focused on improving the accountability and financial sustainability of water service providers and on creating incentives for water saving through tariffs for household, industrial and irrigation uses. In each Central Asian country, private sector development is limited. Water management is almost entirely controlled by the public sector, with few functioning market mechanisms in place and almost no private water service provider active in the region. This can be explained by the Soviet heritage, a slow privatization process and low levels of domestic and foreign direct investment that are also related to the geopolitical position of the countries in a volatile region. The legal principles enshrined in the post-Soviet constitutions of the early 1990s also contribute to explain the predominance of the public sector.

A singular feature of water law in Central Asia is the presence of a specific law on Water User Associations (WUAs) in both Kyrgyzstan and Tajikistan, which are among the few countries in the world having such a law. Both laws were developed under the leadership and with the support of the donor community, particularly USAID and the World Bank. These laws aim at creating the legal conditions to reestablish the communal services in charge of on-farm water distribution, such as allocation, canal maintenance, equipment modernization and accounting, that had been disbanded with the dissolution of collective farms (Dukhovny, Mirzaev & Sokolov, 2008; Abdullaev, Kazbekov, Manthritilake, & Jumaboev, 2010; Lerman & Sedik, 2017). The implementation and revision of these laws is a complicated and sometimes controversial process. Even if some WUAs are performing well, they are often perceived as bureaucratic structures with little capacity. Their effectiveness is hard to evaluate (Balasubramanya, Price, & Horbulyk, 2018; Dörre & Goibnazarov, 2018).

Planning scale: implementing IWRM and the basin approach

IWRM has been practiced in water management and agriculture development of Central Asia long before independence, which can be illustrated by an integrated approach to desert lands development

WIREs Water

in the Golodnaya Steppe and other steppes. Dukhovny and colleagues observe that water management in the Soviet republics of Central Asia has been taking into account the hydrographic principle (several basin organisations were established), the need to coordinate between water users across multiple levels, water conservation and consolidated records for all types of waters and their uses, but two key principles of the contemporary IWRM – public participation and economic and financial viability – were not present (Dukhovny, Sokolov, & Ziganshina, 2014) before independence. The absence of these two principles made it challenging for newly independent countries of Central Asia to cope with water management problems in the light of transition to market economy, commercialisation and geopolitical settings. In addition to integration of these two principles, new social, economic, political and industrial conditions also called for reassessment of old approaches and practices to water resources management in the region, which became ineffective. Hence, with help from development partners countries have been re-introducing IWRM principles in the region.

The five Central Asian republics are still in transition from a planned economy and particularly the system of water management in place before independence, which was highly focused on engineering solutions, employed a huge workforce and was highly centralized. However, the system in place did not respect the borders of the newly independent states, suffered from low productivity and contributed to disasters such as the disappearance of the Aral Sea. Since the late 1990s, the water sector of each country underwent a profound and ongoing reform process from a state-centric and technology-centred system to what Abdullaev and Rakhmatullaev (2015) call "socio-political control", which is more centred around social structures and political processes. In this context, policy documents and their production processes are key supports to bring together different institutions and structures and co-produce solutions that are meant to address existing problems. These documents go from overall concepts of state policy with regard to water resources to long term national strategies with concrete targets, such as the one that Tajikistan is currently developing to ensure the achievement of SDG 6 by 2030 (Church, 2018). These documents also include more specific programs, usually accompanied by implementation and investment plans, under which many projects can be developed.

While the proliferation of policy and planning documents that can be observed in Central Asia is certainly rooted in the planned economy of the Soviet Union, this also corresponds to the needs of so-called development partners or donor countries and organizations, such as the European Union (EU), its member states, particularly Germany, plus Switzerland, which are by far the largest donors in the water sector in Central Asia, but also the United States, Japan, Canada, the Republic of Korea and other developed countries. Among donor organizations, it is possible to mention the World Bank, the Asian Development Bank, the European Bank of Reconstruction and Development, the United Nations Development Programme, the Aga Khan Foundation, together with many others. These policy and planning documents are useful to ensure donor coordination and to identify areas where to focus development aid.

This may partially explain the relative success of the National Policy Dialogues on Integrated Water Resources Management that were launched in the 2000s under the EU Water Initiative and implemented in all Central Asian republics except Uzbekistan by the United Nations Economic Commission for Europe (UNECE) together with the Organisation for Economic Co-operation and Development (OECD). While they serve as a de facto National Water Council, i.e. ministerial-level platform to encourage intersectoral and multistakeholder dialogue within the countries, they also helped introduce in Central Asia the principles of the 2000 EU Water Framework Directive (Dukhovny, Mirzaev, & Sokolov, 2008; Wouters, Dukhovny, & Allan, 2007). While many administrative structures remain, each country is progressively currently moving from the administrative management of water resources towards a basin approach (Wegerich 2015). Following the French and European model, ministries in charge of water are in the process of deconcentrating their functions with the establishment of River Basin Organizations, alongside River Basin Councils that are meant to ensure intersectoral and multistakeholder dialogue at the basin level. Sub-basin organizations and councils are also being created, if necessary. At the same time, as Dukhovny et al (2014) observe institutional water reforms in the region illustrate the greater focus on augmenting water supply rather than managing water demand. Currently water management organisations and their various divisions are responsible for both water delivery and water use, so they pay less attention to managing demand, which is regulated within administrative units rather than hydrographic boundaries.

It is unsure whether the reforms that are currently being developed and piloted in all Central Asian republics with the support of development partners will manage to address major issues, such as drastically improving water productivity and efficiency to restore the Aral Sea, not leaving anyone behind in the achievement of SDG 6, continue developing the hydropower and irrigation potential in both the Amudarya and Syrdarya basins, ensuring the good ecological status of surface and underground waters, as well as significantly increasing public and private investment in the water sector, particularly with regard to disaster risk reduction. The current institutional reforms provide however an opportunity and incentives to renew and streamline management practices, improve the knowledge base, train and increase the capacity of human resources at all levels, as well as improve working conditions, thanks to investment in new equipment and buildings. Last but not least, basin-level institutions are supposed to better fit the dynamics of river basins, something that the mere coordination of administrative-level institutions struggles to do. In this regard, it is important to note that these are long term transformation processes, whose benefits will be fully understood only in a few decades.

Relational scale: top-down and peer-to-peer

 As we have seen above, hierarchies, i.e. vertical, top-down, formal actor relations, dominate transboundary water governance in Central Asia. This does not mean, however, that networks or informal relations are not embedded into these hierarchies; rather they are co-evolving and interdependent. Informal relations have played a significant role in promoting compliance with existing water agreements and new interests and needs of the riparian countries as well as in building vertical and horizontal connections across the spectrum of old and new actors.

ICWC has mechanisms to ensure that top-down instructions from its members are informed by bottom-up communications of informal or semi-formal communities of water users. For example, the SDC funded IWRM-Fergana project implemented by national water authorities of Kyrgyzstan, Tajikistan and Uzbekistan together with SIC ICWC and IWMI has been using social mobilization and networking practices to facilitate mutual learning and acceptance in addition to more formal institutional arrangements. Similarly, activities of the ICWC Regional Training is built on the idea that networking with professional colleagues in less formal settings helps to address complex cooperation problems that span organizational boundaries.

In addition to its support of hierarchical decision making by providing scientific analysis and expert opinion, SIC ICWC works with different networks at global and pan-regional levels such as World Water Council, Global Water Partnership and International Network of Basin Organization. For example, the Network of Water Management Organisations from Eastern Europe Caucasus and Central Asia that was established in 2008 allows its members to exchange views, experiences and information on various aspects of water management activity in a collaborative learning and informal environment, which is difficult to cultivate in the context of hierarchical structures.

Institutions outside the IFAS system, such as Central Asian Regional Environmental Centre (CAREC), are also actively engaged into regional water interactions promoting intersectoral dialogue, building capacity and enhancing the role of the civil society in sustainable development activities in Central Asia.

Knowledge scale: information exchange

The most active actor in the Central Asian water related knowledge domain is SIC ICWC, as its activities focus on conducting locally relevant research, producing expert advice, as well as collecting, analysing and disseminating water-related data, information and knowledge in the region and beyond. With the help of the SDC, SIC ICWC established the Central Asian Regional Water Information Base (CAWater-Info) and Portal (www.cawater-info.net) that embraces large volumes of information, including knowledge base and regional information system. The CAWater-Info Knowledge Base is regularly enriched with best practices in water management, irrigated agriculture and associated sectors from the region's own past and present experience, as well as from other parts of the world. This knowledge system adds value through adapting global and regional knowledge to local conditions, facilitating regional knowledge exchange, enabling continuous learning and education, promoting knowledge transfer to end-users, as well as supporting decision makers and practitioners. Further steps to expand and strengthen knowledge exchange in the region are needed. For example, the CAWater-Info Knowledge Base can be transformed into a more innovative platform that brings together a network of researchers, practitioners and decision makers to share experiences and lessons learnt from managing water and related resources. To do this, it is necessary to enhance regional ownership through the involvement of a broader community of experts and practitioners across the region and focus on target groups' (knowledge consumers) needs and preferences in knowledge dissemination for them to use knowledge in a meaningful and effective way.

Despite all the efforts of SIC ICWC and partner organisations, the availability of water-related data, information and knowledge in Central Asia is still problematic. Meters are limited. The equipment is often obsolete. Measurements are difficult to compare and aggregate. This can result in unreliable data that does not correspond with the reality on the ground. Moreover, measurements are sometimes still collected and stored in non-digital format. Of course, this includes historical data, which was sometimes lost because of the collapse of the Soviet Union and events such as civil war in Tajikistan and the two revolutions in Kyrgyzstan. Computer-based water information systems are being developed, often with the support of development partners. Moreover, some data is classified. This complicates access and limits the possibility of identifying trends and therefore develop evidence-based scenarios.

Very little data is open access and freely available to the general public and for research purposes. Official data is often based on expert estimates, calculated based on figures that sometimes date back to the Soviet period, adjusted to current parameters such as population and economic growth. This data is regularly published by statistical offices and is used for planning and policy-making purposes. This data is sometimes contested by the general public, including through social media, by neighbouring countries, particularly with regard to water allocation, as well as by development partners. This limits the capacity of evidence-based decision-making, particularly vis-à-vis challenges such as climate change and natural disasters. The Central Asian governments are trying to address this issue through several projects to improve the situation at the national and basin level. Development partners, who contribute to these efforts, sometimes resort to their own household surveys and remote sensing to gather some information, develop their own water-related databases and publish their data online or through various supports. The quality of this data however is also variable. It is rarely based on representative samples and can be methodologically inconsistent when not performed regularly.

Central Asian governments love to cite data

Data show the progress achieved and to produce targets that catalyse action. This is in keeping with the practices of the Soviet Union. Even if data is often based on rough estimates and targets can be hard to verify, it is useful to show differences between periods and between countries and areas and they are used to justify prioritizing actions, also within the same country and at the interagency level. The five Central Asian republics look at where they stand with regard to several indicators, particularly compared to their neighbours, to other CIS countries and to OECD members.

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Figures and Tables

Figure 1: River system in Central Asia (author: Zoi Environment Network 2017)



Figure 2: Schematic illustrations of different scales (letters) and levels (numbers), redrawn from Cash et al. (2006, p. 8) and adapted to the Central Asian context



Conclusion:

In this review article, we decided not to focus only on the usual issues that are mentioned when discussing water management in Central Asia, such as the disappearance of the Aral Sea, the development of hydropower and cotton farming. Instead, we chose to show how multidimensional water governance in the region is by adopting a conceptual framework that highlights different scales and levels. In doing so, we reviewed and brought together the mainstream literature, which usually focuses on the spatial and normative dimension, as well as research dealing with other scales. This allows to highlight the importance of multi-level and cross-scale interactions and how interdependent these elements are on each other. We learned, for instance, that upstream-downstream dynamics among riparian countries cannot explain management practices by themselves. For example, significant levels of path dependency from the Soviet period can still be observed. Developments such as the EU Water Framework Directive, IWRM and the basin approach also have an impact on planning activities and that the diffusion of these norms are usually channelled through development partners such as the World Bank or the United Nations Development Programme (UNDP).

In such an interdependent context (Keohane & Nye, 1977), it is not surprising to see countries resort to soft more than hard power (Menga & Mirumachi, 2016; Nye, 1990) to advance their national agendas and to observe more cooperation and integration than conflict and disintegration (Church, 2014). While there are regular tensions on the release of sufficient amounts of water for irrigation, on the development of some hydropower plants and their reservoirs, on the functioning and financing of IFAS, on the sharing of data and information, on their interpretation with regard to the projected impacts of climate change, the norm is good neighbourly relations. Countries and communities work together every day at all levels to ensure the rational use and sustainable development of water resources. The trend is positive and is accelerating with the arrival of a new president in Uzbekistan and the subsequent improvement of regional and bilateral cooperation. The water initiatives of Tajikistan at the global level and particularly the Water Decades also contribute to establish an open platform for policy dialogue (Church, 2017). With all five Central Asian republics engaged in one way or the other in promoting water cooperation and with the new president of Uzbekistan and the minister of foreign affairs of Tajikistan who are both hydrologists by training, there is hope for high level political commitment on water and progress on water governance in the region at all levels. Based on the perspectives put forward in this review article, we suggest that this progress should be measured on all the dimensions of water governance: not only the spatial, administrative and normative scales, but also the temporal, planning, relational and knowledge ones.

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Notes

¹ Agreement between the Republic of Kazakhstan, the Kyrgyz Republic, the Republic of Tajikistan, Turkmenistan, and the Republic of Uzbekistan on Cooperation in the Field of Joint Management of the Use and Conservation of Water Resources of Interstate Sources, Almaty (signed on 18 February 1992). These provisions were reconfirmed by the Heads of Central Asian countries in the Nukus Declaration. Nukus Declaration of the Central Asian States and International Organisations on the Problems of Sustainable Development in the Aral Sea Basin, Nukus (5 September 1995).

² Protocol of the Scientific and Technical Council of the Ministry of Water Resources Management of the USSR on Approval of the Principles of Inter-Republic Water Allocation of the Syrdarya Basin No 413 (29 February 1984); Protocol of the Scientific and Technical Council of the Ministry of Water Resources Management of the USSR on Approval of the Principles of Inter-Republic Water Allocation of the Amudarya Basin No 556 (10 September 1987).

³ First Deputy Foreign Minister of Kyrgyzstan Dinara Kemelova took part at the third High Level Dialogue between the European Union and Central Asia and Afghanistan in Brussels, 19 May 2016, available at www.mfa.gov.kg/news/view/idnews/2291 (last accessed 14 August 2017).

⁴ Project "Regional Dialogue and Cooperation on Water Resources' Management in Central Asia" implemented by the IFAS Executive Committee and UNECE, financed by the Government of Germany through Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH in the framework of the Berlin Water Process. The commitments to improve the organisational structure and legal framework of the IFAS were expressed by the Presidents of five Central Asian republics at the IFAS summit held in Almaty on 28 April 2009.

⁵ Worldwide Governance Indicators (2017), available at http://databank.worldbank.org/data/source/worldwide-governance-indicators (last accessed 30 November 2018).







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Water Planning

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Definitions

Water plans are policy instruments with varying degrees of legal bindingness to guide future use, development and protection of water resources. They can also be considered boundary objects that are co-produced by relevant authorities, experts and water users and other stakeholders.

Water planning is the process by which the use, development and protection of water resources over time is anticipated to prevent conflict over water use, as well as water scarcity and depletion. It may or may not lead to a water plan.

Keywords

water planning, water plan, water strategy, river basin, integrated water resources management

If you don't know what to do, start planning. (Anonymous)

1. Water planning and Sustainable Development Goals

All countries engage in one way or the other in water planning. Forms of water planning have existed at least since the first irrigation and urban water supply schemes that appeared thousands of years ago (Parker and Penning-Rowsel 1981; Helweg 1985; Grafton and Hussey 2011; Loucks and Beek 2017). In the United States, water planning has been a responsibility of the United States Army Corps of Engineers since 1850 and the first water plans as standalone documents appeared during the second half of the 19th century. Kinds of water plans differ from one country to the other. Not all countries require the development of water plans or of certain kinds of water plans. For instance, countries that rarely suffer from droughts are unlikely to develop plans to deal with water scarcity. A certain variability within countries can also be observed, as not all regions face the same challenges. For example, coastal areas may face infiltration of salted water in groundwater aquifers, while other areas may not. Central governments sometimes leave the development of certain kinds of plans to the discretion of local authorities, assuming sufficient capacity is present on the ground. To assist local authorities in the development of water plans, central governments and national agencies may develop guidelines, which play an important role for the harmonization of plans; likewise, to assist developing countries, international organizations such as the United Nations and other development partners also develop guidelines for the development of different kinds of water plans. Experts and consulting firms also play an essential role in the circulation of planning practices at all levels.

At the international level, countries are not required to produce water plans. The only exception is the 2000 EU Water Framework Directive, which requires European Union Member States to develop River Basin Management Plans for each river basin and review them on a six-year basis (De Stefano and Hernández-Mora 2012). Under the 1992 United Nations Economic Commission for Europe (UNECE) Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki Convention) and other cooperation processes, parties are encouraged to create joint commissions and develop joint plans for transboundary waters (UNECE 2009). The principles of international law, including those contained in the Helsinki Convention, in the 1997 United Nations Convention on the Law of Non-Navigational Uses of International Watercourses (New York Convention) and the 2008 Articles on Law of Transboundary Aquifers, guide riparian countries, which can be located upstream or downstream, to agree on mutually beneficial solutions to shared water problems. Water planning in transboundary contexts is an important tool for preventive diplomacy to avoid future water use conflicts.

Over the last decades, global development agendas supported the emergence of water planning as a norm, encouraging the development of certain kinds of plans. For instance, the 1992 Agenda 21 suggested the preparation of plans for various kinds of water uses at different levels. Moreover, the Plan of Implementation of the 2002 World Summit on Sustainable Development stressed the need for integrated water resources management (IWRM) (Matondo 2002) and water efficiency plans and for strategies, plans and programmes at the river basin, watershed and groundwater level. These commitments were reaffirmed by the 2012 Rio+20 Outcome Document "The Future We Want". Even if the 2030 Agenda for Sustainable Development has no direct SDG target on water planning, water planning is a key component of target 6.5 on the implementation of IWRM at all levels. Water planning and plans are taken into consideration in the definition of both indicator 6.5.1 on integrated water resources management, whose custodian is the United Nations Environment Programme (UN Environment), and indicator 6.5.2 on transboundary basin area with water cooperation, whose custodians are UNECE and the United Nations Education, Scientific and Cultural Organization (UNESCO) (UN-Water 2018). In the latter case, water cooperation is measured in terms of the existence of "operational arrangements", which include water agreements, plans, commissions and other processes and excludes tools that are not in force or dormant.

Water planning is a useful instrument to ensure the achievement of SDG 6 and other water-related goals and targets at the national, basin and local level. By identifying necessary and sufficient measures meant to solve the main problems to achieve water-related SDGs, water planning contributes to the optimization of government action, such as the rationalization of human resource and expenditure allocation, both investment and operation and maintenance. When water-related targets are clear, such as target 6.1 to achieve universal and equitable access to safe and affordable drinking water for all or other nationally appropriate targets, this can sometimes be done through backcasting, where the long-term targets can be broken down into short-term and midterm intermediary targets and milestones. Water planning may also allow prioritizing areas and sectors that are in most need and that may accelerate the achievement of SDGs. This is important to make sure that no one is left behind, in accordance to the 2030 Agenda for Sustainable Development. Water planning may also allow for burden sharing at the basin and local level. For instance, in a given country, a certain basin or city may be farther from an SDG target than others; in this case, this basin or city may be requested to make more efforts than others, which may have already done particular efforts in the past. Water planning can help develop and implement burden sharing.

The SDG monitoring framework is also useful for water planning, particularly at the national level. To monitor the implementation of the SDGs and the achievement of water-related targets, the United Nations developed a set of indicators at the national level and many of its agencies and programs are involved in collecting them. The United Nations Development Programme (UNDP) is currently helping several developing countries with the production of integrated assessments of SDG readiness, which include dashboards of SDG indicators. Together with official statistics and other data, these dashboards can be useful to provide the information base that is necessary to ensure that water planning is evidence-based and to monitor the achievement of SDG 6 and other water-related goals and targets (Church 2018). They usually build on official statistics, data available to the United Nations and other policy documents, such as national level sectorial plans. These dashboards are also useful to identify gaps in the information base and policy documents and eventually decide on proceeding with further data collection and policy development. They are also
useful to perform an integrated analysis of water plans and other water-related sectorial plans, such as plans on poverty reduction, land reform, industrial development and environmental protection.

2. Typology of water planning and plans

Water planning can be more plan-oriented or process-oriented (Fig. 1). This means that water planning can revolve around the design, approval, monitoring, evaluation and revision of water plans, in which case it can be considered as plan-oriented. Water planning can also revolve around the participation, communication, advocacy and transaction practices that take place within national water councils, local water boards, river basin councils,



joint waters commissions and other institutional settings where water-related problems and solutions are discussed, adopted, implemented and reviewed. In this case, water planning can be considered as process-oriented. Water planning does not always produce water plans intended as standalone documents.

Water plans can be called in different manners. Plan is the generic term. The most typical alternative titles are vision, blueprint, strategy, master plan, roadmap and program, from the most concise and generic kind of document to the longest and most specific one. Visions or strategies usually contain a description and analysis of the existing situation, identify the major problems and set goals that, if achieved, are meant to solve these problems. They may provide some examples of significant measures to achieve these goals, but they do not normally identify all specific measures that are necessary. Strategies and particularly visions are usually more political, as they may include choices that reflect a specific preference for society (Fernandez et al 2014). Plans and programs tend to be more technical. A master plan or program is more operational and usually contains concrete measures that are supposed to be necessary and sufficient to achieve strategic goals. However, the term program is often reserved for a set of measures, usually in the form of projects, that are meant to solve one of the major problems identified within a plan. A roadmap normally presents measures, including programs, in a sequential manner. In this case, the assumption is that the timing of measures is particularly important to achieve the expected results. River contracts are a specific kind of plan, where main water users and other key stakeholders agree to take specific responsibilities and implement concrete measures, sometimes in exchange of financial compensation.

There are many specific plans dealing with different water-related issues (Fig. 2). At the national, regional and basin level, there are irrigation and drainage plans, hydropower plans, industrial waters plans, plans on water-related disasters, water quality plans, groundwater plans, estuary plans and coastal water plans, just to mention the most common ones. There are also generic plans on IWRM or water efficiency that try to deal with water resources in a holistic manner. In recent years, there is a push towards source-to-sea planning to prevent issues of land-based sources of marine pollution. At the national, regional, district and local level, there are plans on drinking water supply and sanitation, water safety plans, most plans on water-related disasters such as flooding and draught (Hartmann and Driessen 2017), as well as rainwater plans. These plans are rarely at the basin level, as they focus more on the communities that need drinking water supply and sanitation and that need to be protected from water-related disasters than on water flows.

Fig. 2: Types of issue-specific plans

National/regional or	National/regional or
basin/aquifer level	district/municipal level
 IWRM Water efficiency Irrigation and drainage plans Hydropower plans Industrial waters plans Water quality plans Some plans on water-related disasters Groundwater plans Estuary plans Coastal waters plans 	 Drinking water supply and sanitation Water safety plans Most plans on water-related disasters such as flooding and draught Rainwater plans

3. The cycle of water planning

There is no one-size-fits-all in water planning. However, if one was to identify an ideal-typical cycle of water planning (Fig. 3), it would start with the building a balanced team and with the framing of the problem-shed. This is usually done by the authority responsible for water management at the relevant level, typically the ministry in charge of water resources at the national level, the river basin authority at the basin level or the department responsible for water services at the local level. Team-building and problem framing are important, because they introduce a relational and political bias in the process and may compromise the acceptability and, ultimately, legitimacy of the planning exercise. The teams responsible for water planning are usually called drafting committees, working groups or task forces and they may include one or more lead authors, experts in different water-related issues, technical assistants, as well as support staff.





Plan development always starts with the establishment of an information base (Fig. 4). This includes the legal and policy framework, a stakeholder analysis, as well as the identification of the geographical scope, time horizon, including a definition of short, medium and long-term, and relevant sectors. The information base also implies data collection and visualization, particularly in the form of maps and atlases. This may include surveys of expert opinion, particularly of key issues, and public opinion, particularly of water users. If data is sufficiently reliable and complete, this may allow some modeling and simulations of water flow (Tidwell et al 2004; Yates et al 2005). The identification of a tendential scenario, as well as two to four alternative scenarios, may then help to deal with uncertainty (Snover et al 2003; Straton et al 2011; Fernandez et al 2014). These scenarios may be taken from national sources, such as national development strategies or adapted from international sources, such as five stylized scenarios for water resources (Gallopín 2012) or the five shared socioeconomic pathways frequently used in climate-related research (Van Vuuren et al 2014). Scenarios are important to identify measures that are commensurate with likely future development paths.

Diagnostic analysis is the typical next step in water planning. This implies the identification of major and minor problems that require action. These issues must then be analyzed based on the infor-

Fig. 4: Typical components of a water plan

A. Information base

- Legal and policy framework
- Stakeholder analysis
- Geographical scope, time horizon, relevant sectors
- Data collection, mapping
- Public opinion, expert opinion
- Modeling, simulations
- Scenarios, uncertainty

i.B. Diagnostic analysis (problems)

- 1. Problems
- 2. Causes
- i.C. Goals (problem solved)
- 1. Intermediary goals
- 2. Targets

i.D. Measures (solutions)

- Regulatory
- Economic
- Communication
- Direct implementation
- Mix

i.E. Annexes

- Data tables
- Indicators
- Timeframe, milestones
- Financing plan
- Sustainability assessment
- Gender assessment
- Glossary, bibliography

mation collected. Hypotheses about the direct and indirect causes of these problems can thus be formulated. Diagnostic analysis can benefit from the participation of water users, particularly for the identification of specific issues and potential causes.

Goal setting is normally considered the core element of water planning. It implies envisioning the problem solved and eventually intermediary goals. These goals may take the form of targets when they correspond to a specific figure or range. The credibility of these targets depends on the reliability of the information base, sound analysis, as well as trust in the governance system. Goals are strategic in the sense that they indicate an overall direction for water management without detailing how the goals will be achieved or how contingencies will be dealt with.

Water planning usually extends to the indication of the measures that are expected to achieve goals. These measures shall be sufficient and necessary. They include regulation, such as legal instruments and policy guidelines, economic instruments, such as taxes, subsidies, quotas and exchangeable permits, communication instruments, as well as direct implementation, including both manmade and nature-based solutions. However, solutions are usually a mix of different kinds of measures, which are meant to be complementary and reinforce each other. Water plans usually include many other important elements. Data tables collect the data contained in the plan and other relevant data. Indicators are measurable elements that can signal whether a goal or target was achieved or not. Indicators may coincide with some SDG indicators. Timeframes represent the goals and measures contained in the plan in a chronological manner and may help ensure that goals and measures follow a logical order. They may indicate milestones, which consist in significant goals that are expected to be achieved under the plan, on whose achievement other goals may depend. Because of the SDGs, 2030 is a common time horizon or milestone for many recent planning exercises. In some cases, water plans and especially programs also include financing plans, presenting estimates about the cost of the measures proposed to achieve the stated goals. Water plans may contain various kinds of impact assessments, particularly on cross-cutting issues such as sustainability and gender. Finally, plans may include a glossary of key terms and sometimes a bibliography of key sources.

Once draft plans are completed, they enter approval iteration. At the national level, plans are usually developed under the auspices of one or more government agencies. The first step normally involves consultation with other government agencies through written correspondence and coordination meetings. Parliamentary committees in charge of water and related issues may also be consulted. The same goes for representatives of local authorities, possibly through their representative assemblies, if they exist. Water plans typically undergo some form of public hearing or at least consultation with water users, possibly through water user associations or federations thereof. Consultations normally require several iterations between government, parliament, local authorities and sometimes water users. These iterations may take months if not years. As soon as the water plan is sufficiently consensual or at least the choices to be made are clear, the plan is adopted by the competent authority, which may be the ministry in charge of water through a directive or, more frequently, through a decision of the council of ministers, given the intersectoral nature of water. In this regard, the role of the prime minister and his office can be crucial to ensure interministerial coordination. The process is similar at the basin and at other subnational levels, as well as in transboundary contexts, all differences considered.

The implementation of strategic plans is not mechanic. They sometime require the development of specific programs and action plans that were identified by the plan as priority actions or areas of intervention. These are further planning documents. Contingencies may also emerge that require adaptation to or deviation from the water plan through tactical measures that were not foreseen by the plan, such in the case of a major budgetary crisis or water-related disaster. For this reason, plans or the decisions that adopt plans often establish an implementation unit that is responsible for the daily follow-up to the plan. National, regional or basin-level water councils may also contribute to the process of constant revision and adaptation of the plan by increasing the number of stakeholders involved, giving them a voice. Without such institutional arrangements, water plans often remain a paper in a drawer that may represent a learning experience for those who contributed to its preparation, but with limited impact beyond them and perhaps those around them. This can also happen willingly, for example if the government considers that measures contained in the water plan are not applicable.

Plans require regular monitoring and evaluation, as well as revisions. The plan can appoint a responsible entity for the monitoring and the evaluation of the implementation of the plan. It is advisable that this is not the implementation unit, because of obvious conflict of interest. It may be another government agency, an external observatory or a service provider. However, a well-functioning institutional setup with an active water council may be preferable, because more transparent and responsive. External monitoring and evaluation may in fact be bureaucratic and untimely. Water plans usually provide a clear time horizon after which a plan is expected to be revised. This may also be the case vis-à-vis some significant changes to the situation on the ground. Plans may contribute to the design of institutional setups that constantly update the information and knowledge base for water planning, that are capable to seize opportunities for water development, to take preventive measures against future threats through risk reduction and to react in case of significant changes and water-related disasters. As such, water planning can be a contribution to achieve so-called adaptive governance (Groves et al 2015).

4. The relationship between water plans and other documents

The relationship between water plans among themselves and among other legal and policy documents, such as spatial plans, can be complicated (Fig. 5 and 6). In case of inconsistency, which one prevails? Water plans usually have a low level of legal bindingness. As such, they are more policy documents than legal ones. Like for many policy documents, the exact relationship among plans may be undetermined, leaving it up to policymakers and in some cases courts to use them



Fig. 5: Typology of relationship between water-related plans tems, the relationship among planning documents may be such that lower level plans prevail over higher level ones, based on the principle of specificity. This bottom-up approach is more likely to be found in decentralized political systems. The opposite can also be found,

meaning that higher level plans may trump lower level ones. This top-down approach is more typical of centralized systems. A hy-

or not. In some planning sys-

brid option is that lower level plans need to wait for the approval of higher level plans and then must take them into consideration, but not necessarily conform. Another similar hybrid solution is that lower level plans need to be submitted to higher level authorities for consideration, usually within a specific timeframe, without being required to follow the advice received. Uncoordinated and hybrid approaches are guite common.



Fig. 6: Example of complex relationship among water-related plans and permits at different levels

Permits for special water use and building permits play a key role in ensuring the effectiveness of water plans and planning processes. In most countries and in most situations, special uses of water are subject to the request of permits, sometimes also in the context of building permits. In the legislation, the issuance of permits may be subject to conformity not only with the laws in force, but also with water plans and other planning documents. In many cases, plans are at least taken into consideration by public authorities for the issuance of permits. Permits can also be subject to appeal in court both from other public authorities, which may challenge the legal grounds of the decision to issue or not permits, and, provided sufficient publicity is given to issued permits and to the issuing process, also by other users, neighbors and interested parties. Moreover, permits pay a key role for the monitoring of the use of water resources and are a key component of water information systems and knowledge bases.

5. Public participation in water planning

Like in other planning and environmental domains, public participation in water-related planning and decision-making is important. It enlarges the knowledge base, includes the perspectives of those who are usually left behind, particularly minorities and the poor, and prevents conflicts of use. It is also a key component of IWRM, including in its gender dimension. However, public participation in planning, including water planning, has been object of scrutiny and some criticism for decades (Wengert 1971). The main issue is representation of interests and stakeholders. Areas covered by water systems are often large with a high number of inhabitants and stakeholders with sometimes divergent actual and perceived interests. How to make sure that they are and feel represented? Intermediary organizations, such as water user associations and non-governmental organizations play an important role in this regard, as elected officials are usually the expression of a majority of the population and do not always fully represent minority interests. Therefore, the national, regional, basin and district level participation is usually indirect. Direct participation is normally effective only in small communities. There is evidence showing that public participation may improve the quality of water planning (Graversgaard et al 2017). Most forms of public participation increase the duration of planning processes and lead to necessary tradeoffs among different interests (Mooney et al 2012).

Co-production of water planning usually takes place between policymakers and experts. Larger companies, such as water service providers, large NGOs and water user associations may also be involved in this process. It is normally recommended to consult and elicit the opinion of the general population, smaller companies and grassroots NGOs through interviews and household surveys. It is important to keep the population informed of existing problems and potential solutions through appropriate means of communication. Examples include local newspapers, brochures, posters, local radio stations and social media. It is also of strategic importance to ensure as much access as possible to water-related information.

6. Challenges to water planning

First of all, there is no global or regional repository, observatory or documentation center of basin plans and planning. Many plans, particularly those at the national level, are increasingly available online. The existence at least of a repository would help better understand the phenomenon and encourage comparative analysis. Second, it is difficult to assess the effectiveness of water planning. Planning has been oftentimes criticized as ineffective, in the sense that plans are rarely followed to the letter (Millard-Ball 2013). This phenomenon is typical of policy documents that, unlike legal ones, are meant to guide action in a certain direction more than to enact specific rules or other measures. Planning processes are also opportunities for key stakeholders to communicate about strategic priorities on water resources, which is already an outcome per se, regardless of whether they lead to a planning document or not and whether this document is respected or not. Another frequent issue is the definition of the scope of water planning: some basins or cities can

be too big for a single water plan, others can be too small. Moreover, basins, just like settlements, can always be assembled into larger units and broken down into smaller ones.

On the content side, the major challenge is currently integration. First, the integration of adaptation to climate change into water plans (White et al 2006; Gober et al 2010; Gober 2013; Grafton 2014; Hurlimann and Wilson 2018) and, in general, the issue of adaptive planning (Groves 2015), meaning the capacity of planning to anticipate change in a context of uncertainty. The role of science and other kinds of knowledge in water planning is of great importance to increase the resilience of water systems. Second, the integration of so-called blue, gray and green water in water planning. This includes the reduction, recycle and reuse of industrial sewage in a context of circular economy and the water absorbed by soil, trees and other kinds of vegetation for rainwater management (Falkenmark and Rockström 2006; Woltjer 2007). Third, the integration of water planning from source to sea, including groundwater. This is important in coastal areas for the prevention of marine pollution from land-based sources and to deal with issues such as the infiltration of seawater into freshwater water bodies both on the surface and under the ground.

Finally, the role of science, expertise and other kinds of knowledge, such as traditional and indigenous knowledge, but also everyday knowledge, needs to be further explored, particularly in its interaction with policymaking. Water management is often considered as a highly technical issue that is normally better dealt with by water engineers and other specialists. However, water planning is often political, as it implies prioritizing certain actions and their beneficiaries over others, sometimes leaving some parts of the population behind. To help reduce the knowledge gap between science and policymaking and also to depoliticize some choices, decision-support systems were developed based on more or less sophisticated modeling of water flows and human behavior (Loucks and Costa 1991; Andreu et al 1996). However, they are rarely used. More recently, the diffusion of networked metering systems and the emergence of automatic canals and other waterrelated systems, potentially supported by machine learning and other "smart" solutions, is automatizing many routine management decisions (Stewart et al 2010). This has a potential impact on water planning in both cities and basins, as it extends the knowledge base and reduces potentially conflictual water management decisions, removing the human agency behind. At the same time, it crystalizes existing settings and routines in non-human systems, perhaps blurring the embedded political choices behind.

Cross references

- Integrated water resource management (Augusto Giuriatto Ferraço)
- Water governance (Manungufala)
- Water management and management actions (Capocchi)
- Water security (Manungufala)
- Water cycle (Vörösmarty)
- Water balance (Westenbroek)
- Water and adaptation to climate change (Zakorchevna)
- Water monitoring (Chapman, Warner and Dickens)
- Implementing water, energy, and food Sustainable Development Goals (Daher)
- Urban water infrastructure (Rodríguez)

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