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Liquid Encounters
Hydrosocial Territories, Socionatures, and Subjectivities of Interbasin Water Transfers

Robert Nicholas Bourguignon

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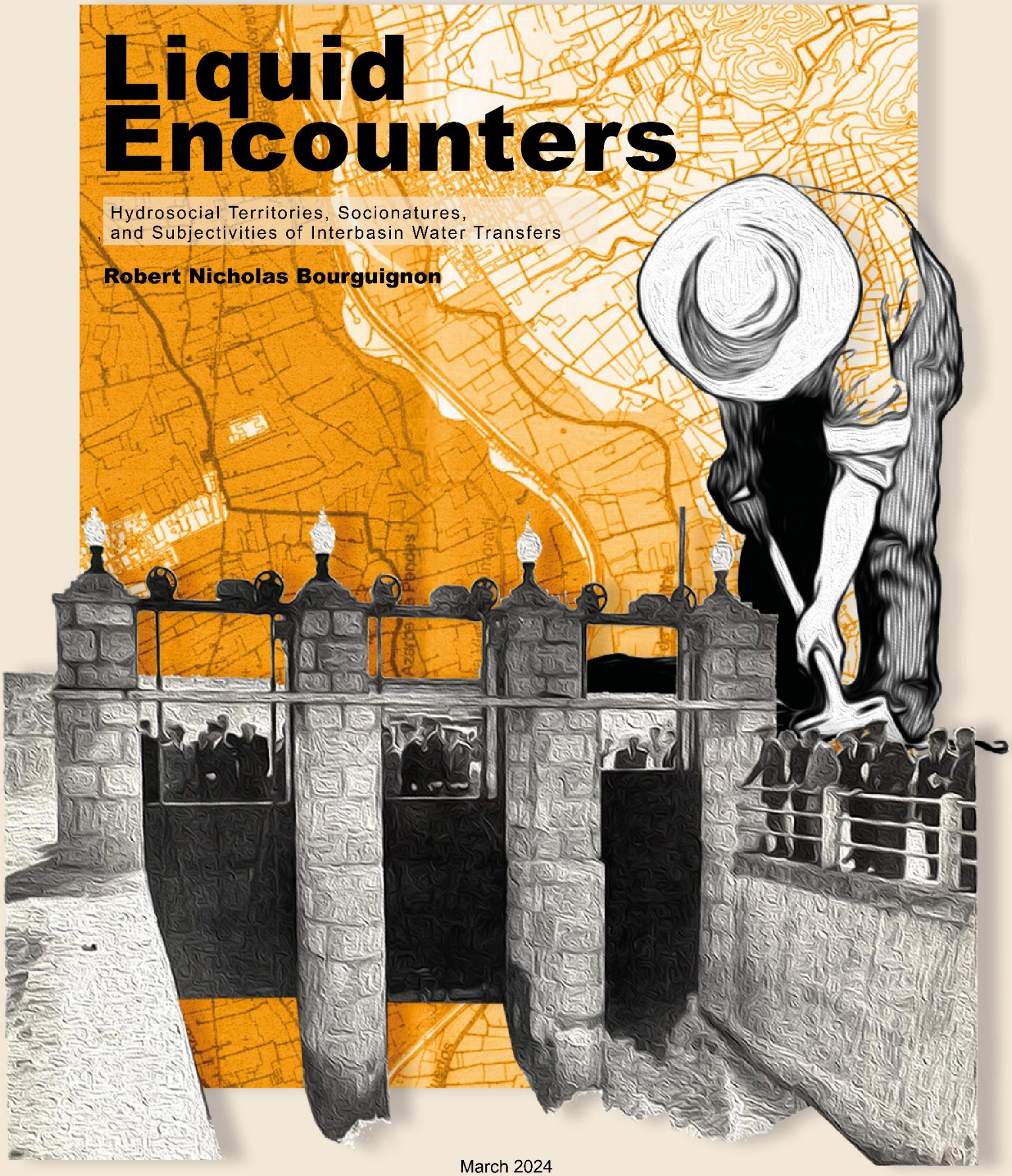
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Robert Nicholas Bourguignon



March 2024

Ph.D. Dissertation submitted for the Ph.D. programme in Environmental and Science Technology.
Institut de Ciència i Tecnologia Ambientals (ICTA).
Universitat Autònoma de Barcelona (UAB)

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UAB Universitat Autònoma de Barcelona

ICTA Institute of Environmental Science and Technology-UAB

WEGO ITN

RIVERHOOD

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Suggested citation: Bourguignon, N. 2024. Liquid Encounters: Hydrosocial Territories, Socionatures, and Subjectivities of Interbasin Water Transfers. Ph.D. dissertation. Universitat Autònoma de Barcelona.



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This dissertation was developed within the WEGO-ITN (Wellbeing, Ecology, Gender and cOmmunity-Innovative Training Network) project funded by the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 764908. This dissertation was also developed as part of the Riverhood project. Riverhood has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No 101002921)

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Cover design: Biagio Fontana

Note: UK English spelling is used in this work

To the women in my life

My mother Cheryl
and my grandmother Beverly

Who follow this journey from afar,
and for so much more

"We are all bodies *of* water, in the constitutional, the genealogical, and the geographical sense."

Astrida Neimanis, (2012) Hydrofeminism: Or, On Becoming a Body of Water

Table of contents

Acknowledgements v

Summary viii

Resumen ix

Resum xi

List of tables, figures, maps and images xiii

List of abbreviations and acronyms xv

1. Introduction 1

1.1. The motivations informing my personal and scientific journey 1

1.2. The TSA and techno-political transformations 3

1.3. Problem description, research objectives and research questions 7

1.4. Conceptual review and theoretical background 8

1.1.1 Political ecologies, hydrosocial territories and interbasin water transfers 9

1.1.2 Governmentalities, hegemonies, and counterhegemonies in territorial construction 13

1.1.3 Hydrosocial territories and subjectivities 15

1.1.4 More-than-human waters and relationalities 19

1.5. Methodologies 20

1.5.1. Literature review 21

1.5.2. Multi-case studies 22

1.5.3. More-than-human storytelling 24

1.6. Outline of the dissertation 24

2. Connected and disrupted hydrosocial territories: the making of modern socionatures through inter-basin water transfers 27

2.1. Introduction 27

2.2. Theory and conceptual framework 29

2.2.1. Interbasin Water Transfers 29

2.2.2. The emerging Political Ecology of water transfers 31

2.2.3. IBWTs and hydrosocial territories: territories, regimes, time and power 33

2.3. Methodology 34

2.4. Results 36
2.4.1. IBWT impacts 36
2.4.2. Webs of interconnected IBWT impacts 37
2.4.3. The longevity of IBWT territories 39
2.4.4. Divergent hydrological imaginaries and their contestations 40
2.5. Discussion 42
2.5.1. IBWTs and changes in dimensions 42
2.5.2. Modern regimes within IBWT territories 43
2.5.3. Connected basins, contested territories 44
2.6. Conclusion 45
3. Tracing (un)common senses in irrigation communities: hegemonies and counter-hegemonies across Spain's Tagus-Segura Interbasin Transfer complex 47
3.1. Introduction 47
3.2. Hegemony, common senses and hydrosocial territories 48
3.2.1. Hegemony and counterhegemony 48
3.2.2. Hydrosocial territories and productive tensions with hegemony 51
3.3. Methodology and case studies 53
3.4. The (un)common senses of interbasin transfers and Irrigation modernization 55
3.4.1. Interbasin common senses: the TSA, water policy and territorial development 55
3.4.2. On-plot common senses: irrigation modernization in Spain and the Tagus and Segura basins 58
3.4.3. Socionatural histories of infrastructures and technologies in irrigation communities 62
3.5. Common senses of hegemonic and counterhegemonic territories 64
3.6. Conclusion 69
4. Fabricating Irrigators: Contested Hydrosocial Territories and Subject-Making in Spain's Tagus–Segura Interbasin Transfer Arena 70
4.1. Introduction 70
4.2. Materials and Methods 72
4.2.1. Theoretical Framework 72
4.2.2. Methods 75

4.3. Results 76
4.3.1. Shaping the Ideal Regante Subject—Hydraulic and Agrarian Legislation and Policy 76
4.3.2. The Actual Regante Subject 79
4.3.2.1. Hegemonic Territory Subjectivities 79
4.3.2.2. Hegemonic Frontier Territory Subjectivities 80
4.3.2.3. Counterhegemonic Territory Subjectivities 82
4.4. Discussion 83
4.4.1. The Contradictions of Realizing Ideal and Real Regantes 83
4.4.2. Alternatives to an Ideal Regante 87
4.5. Conclusions 88
5. More-than-human co-becomings: the interdependencies of water, embodied subjectivities and ethics 91
5.1. Introduction 91
5.2. Gender-water intra-action in a wastewaterscape in Maharashtra, India 93
5.2.1. The multiple waters of Pravah 95
5.3. Water across time, space, basins and subjects - the Tagus River 98
5.3.1. The divergent flow(s) of the Tagus 98
5.3.2. Conflicting meanings and contradictions of interdependent waters 100
5.4. Ethics of more-than-human interdependencies 101
5.5. Conclusions 104
6. Conclusion 106
6.1. Synthesis and key findings 106
6.2. Research contributions 111
6.2.1. Theoretical contributions 111
6.2.2. Empirical contributions 115
6.2.3. Methodological contributions 117
6.3. Limitations and caveats 117
6.4. Future research 118
6.5. Conclusion 119
Bibliography 121

Appendices 151
Appendix 1 – Fieldwork questions 151
Appendix 2 – Irrigation community data 154
Appendix 3 – Articles reviewed 155
Appendix 4 – IBWT case basic information 158
Appendix 5 – Socionature variables and case descriptions 165
Appendix 6 – Irrigation surface and modernized irrigation data 170
Appendix 7 – Irrigated surface data 173
Appendix 8 – Ideal regante policies and legislation 1866-2023 176

Acknowledgements

The work of this Ph.D. took place across multiple geographies, covering multiple international and personal events, celebrations and tragedies, and it is here that I pause to reflect on the personal and professional networks and relationships (and whatever falls in between and beyond this binary) that have sustained me throughout these five (and counting) years and give thanks to these. This journey has taken me from Rome, through Berlin, Barcelona, Madrid, villages and towns in the provinces of Toledo, Albacete, Alicante and Murcia, and back to Rome again, and with many in-betweens; indoors because of a devastating virus, outdoors breathing in the sierra winds with their promise of almond and pistachio blossoms; in offices and classrooms with a handful of individuals, or online with hundreds. Across these spaces and places, I have met some fantastic people along the way, and deepened friendships too.

To my supervisors Sergio and Rutgerd thank you both for your time and patience, and for engaging with my thinking on this journey! Despite a pandemic, shifts and changes in ideas and papers, it has been a fruitful and inspiring process that has allowed me to grow and become more confident in my thinking. Through your collaboration, I have been enriched not only with your theoretical, methodological and empirical insights, and you have also opened the door to new acquaintances and friendships, including fellow mentors and Ph.D. students from Riverhood/River Commons who will continue their inspiring work!

Doy las gracias ante todo a las personas que facilitaron su tiempo, sus vidas, y sus territorios y hogares a ayudarme a realizar esta investigación. A Encarna, Alejandro en Toledo, Primitivo y Miguel en Palencia, Fernando en Murcia, Rafael en Yeste, Luis en Letur, Pedro en Orihuela, Fernando y Maria en Totana, Tomás en Talavera, Rafael en Alcolea de Tajo, y a tantas otras personas que no puedo mencionar, cada uno de vosotros y vuestros compañeras y compañeros abristeis una ventana a vuestra realidad que os agradezco de corazón. Me mostrasteis vuestra historia y manejo del agua y todo ligado a ello, los temores, las incertidumbres, el amor y el arraigo en vuestros territorios que difícilmente olvidare y que sirve como inspiración no solo para el contenido de esta tesis, si no tambien de formas de entender y amar (en lo bueno y lo malo) las tierras y aguas en el que uno está arraigado. Esta tesis no existiría sin vuestra colaboración, y va dedicada a vosotros y a vuestras aguas.

The "Well-being, Ecology, Gender and Community" (WEGO-ITN) network was the start of this journey, and has been my home away from home, my moral support, and inspiration, through thick and thin. Sharmini, thanks for your check ins and support to navigate not only the EU's legalese and very serious deliverables, but above all the transfer to Barcelona, helping me to thrive. To the mentors, thank you for engaging with my ideas and for being sources of inspiration yourselves! Margreet, thank you for your continued encouragement and for pulling me into the brainstorming in Montpellier, and so much more. Ana, muchísimas gracias por acogerme en la

Defensoría de Montevideo, y a compartir tu tiempo y tu familia conmigo y con Constance. ¡La estancia contigo fue una inspiración en lanzar mi pensamiento a las problemáticas del agua en el contexto uruguayo! Panagiota, for helping navigate with me and Ilenia what a Feminist Political Ecology ITN means in ICTA-UAB. To my fellow scholars - Anna, Dian, Ankita, Eunice, Mai, Nanako, Marlene, Milja, Eoin, Alice - thank you for your patience with my watery metaphors, and for being there in times of need! To Constance, for our savouring alfajores in Montevideo and mutual support. To Enid and Irene, for the common inspiration and patience in co-writing together and thinking more-than-humanely. I want to give special thanks to two women who have been steadfast, unconditional, and irreplaceable to me in these years. Wendy, thank you for your support, humour, and your disarming honesty and empathy from before WEGO, throughout, and already after WEGO. You demonstrated how research could be done in both care-full and carefree ways, which is no easy accomplishment. You have always been my reference on how to do academia otherwise and look forward to future Roman aperitivos. And Ilenia, my comrade, my sister in arms and laughs and tears, thank you. You have been a rock of intellectual, moral, physical, and emotional support and inspiration. With so many 'genaus' and 'no puc més' behind us, we started together and finished together, navigating uncertainties and frustrations, moments of joy and oh so many memes. I know I have a sister even if we will no longer be colleagues (for now!). I ringraziamenti non saranno mai sufficenti.

I would like to highlight the role of the Fundación Nueva Cultura del Agua as a crucial network in pushing forward new ways of conceptualising, politicising, and networking water in the Spanish context. Laura, Julia, Nuria, Carles, y tantos otros, gracias por acogerme y por desarrollar una red inspiradora y arraigada en sus ríos, cuencas y gentes. Javi and Paula from NEWAVE, thank you for your help and inspiring work, I hope to continue engaging with it in the future!

A las colegas en el ICTA, tantas gracias a Laura y a Cristina por acogernos a mí y a Ilenia y a navegar las estructuras burocráticas de la universidad. Hubieron muchos altibajos administrativos, pero siempre pensasteis a nosotros y explorar como superar alguna barrera con muchas risas! To Santiago, Nick, Austin, thank you for your friendship, your curiosity, and for your help in Barcelona and in the UAB and ICTA!

This Ph.D. journey has been a (perhaps?) rewarding opportunity not just for myself but for my family, who have supported me in indescribable ways. Dad, without you and your love for the rivers that you introduced me to, this would never have happened. You introduced me to the Tajo through camping and fishing trips, or where you fished and I roamed the riverbanks, hill sides and forests. Taking you with me on exploratory interviews, asking you of your memories of what has been and what could be was a way of flipping the coin. Sharing with you my insights and ideas, and you contrasting then with your own experiences, memories and thoughts cannot be valued enough. Mike, you have been my sounding board for the Spanish context and accompanied me in both the personal and academic. Your curiosity and love for the road have taken us back to the alto Tajo and beyond for very important reasons beyond the Ph.D., but you have always helped me ground my

research and put up with my worries, doubts, and jokes. Thanks for all the screenshots of water levels in Entrepeñas! Pat, gracias por tu apoyo, interés y curiosidad, siempre contrastando lo que decía y pensaba con tus propias ideas y profundo conocimiento literario y antropológico. ¡Ha sido un placer pensar y seguir pensando contigo!

To my US family, aunts, uncles, cousins, I thank you all from the bottom of my heart for your support and interest, no matter the miles. You have all been there for me in our common moments of loss and helped me persevere even in the weird times of COVID and outside of it. I know that the women of our lives who left us in this period would be proud of all of us.

E a Biagio, grazie dal più profondo di me stesso. Nonostante i saltimbanchi continui da un paese a l'altro, da una città a l'altra, tu sei stato sempre la mia ancora, la mia tana. L'appoggio emozionale, spirituale e materiale che hai fornito in questo percorso non può essere misurato. Grazie per il tuo incoraggiamento, la tua fiducia, e la tua pazienza. C'é l'abbiamo fatta!

To all of you, thank you, and I have been honoured to have you as companions in this journey of exploring different waters and the different territories they bathe. To continued flows and conversations!

Summary

This dissertation addresses the multi-scalar and multi-dimensional politics and contradictions of territorial transformations induced by Inter-Basin Water Transfers (IBWT), particularly the Tagus-Segura Aqueduct (TSA) in Spain. As a type of large-scale hydraulic infrastructure, there has been scant scholarship on IBWTs in comparison to other infrastructure. Nonetheless there has been increasing attention towards their social, environmental, and economic impacts. Hydrological stress experienced in both the Tagus and Segura basins is the result not only of climate-change induced meteorological change, but of a century-long political vision of socioecological and territorial transformation of the country. This dissertation is a theoretical and empirical examination of multi-scalar and multi-territorial hydrological and social relations of water and its conveyance through IBWTs and is informed by and in turn informs concepts and debates in political ecology and the political ecology of water, hegemonies and counterhegemonies, and feminist political ecologies of subjectivities and ethics of the more-than-human. It seeks to answer how the TSA recreated dominant narratives on water's use and value, and through it, uneven territorial configurations, and irrigator subjects, what are the situated politics of compliance and resistance to these processes of hydrosocial territorialization and subject-making, and what are the results of said politics. First, I review and analyse IBWTs as collected in the scientific literature, using a political ecology of water framework to analyse their impacts and degradations, and the outcome of conflicts and contestations emerging from IBWT construction and operation. Next, I mobilize a hydrosocial territorial framework to examine and characterize tools and common senses of hegemony and counterhegemony in the construction of different hydrosocial territories of the TSA, through the operation not only of the Aqueduct but also of on-plot modernization actions and policies. The same case combines the hydrosocial territorial framework with a feminist political ecology of subjectivities analysis to see how the Aqueduct and on-plot modernization has contributed to the construction of ideal forms of irrigator subjects, and how actual subjects align with or greatly depart from the ideal within the hydrosocial territories they inhabit. I then descend to the personal, where I draw on my personal histories and relations with place in the Tagus and Segura basins alongside WEGO colleagues' own research experiences in India to think about the ethical implications of water-based more-than-human relationships and co-becoming. Across this multi-scalar journey, this research contributes to a critical reflection on the impacts of IBWTs and the territories and subjects they fashion, while pointing to existing and possible alternatives grounded in more just and equitable hydrosocial relations.

Key words: Inter-basin water transfers; political ecology; water; hydrosocial territories; hegemony; subjectivities.

Resumen

Esta tesis doctoral aborda la política y las contradicciones multiescalares y multidimensionales de las transformaciones territoriales causadas por los trasvases de agua entre cuencas, concretamente el Acueducto Tajo-Segura (España). Como tipología de infraestructura hidráulica a gran escala, los trasvases entre cuencas han sido poco investigados en comparación con otros tipos de infraestructuras similares. Aun así, hay una creciente atención a los impactos sociales, ambientales y económicos de los trasvases. El estrés hídrico experimentado en las cuencas del Tajo y el Segura es resultado no solo del cambio climático, sino también de un siglo con una visión política de cambio socio-ecológico y territorial del país. Esta tesis examina empírica y teóricamente las relaciones hidrológicas y sociales del agua, en sus múltiples escalas y dimensiones, y el transporte de esta a través de los trasvases entre cuencas, que informa y a su vez es informado por conceptos y debates de la ecología política y la ecología política del agua, hegemonías y contrahegemonías, y de ecologías políticas feministas de las subjetividades y la ética del más-que-humano. Busca responder cómo el acueducto Tajo-Segura ha recreado las narrativas dominantes sobre el uso y valor dado al agua, y mediante esto, crea configuraciones territoriales desiguales y sujetos regantes. La tesis también explora la política situada de la conformidad y resistencia a estos procesos de territorialización hidrosocial y la creación de sujetos, así como los resultados de esta política. En primer lugar, hago una revisión y análisis de los trasvases entre cuenca a partir de la literatura científica y utilizo un marco analítico de la ecología política del agua para analizar los impactos y degradaciones causadas por las mismos, al igual que el resultado de los conflictos y contestaciones políticas que surgen de la construcción y operación de los trasvases. A continuación, utilizo un marco de territorios hidrosociales para examinar y caracterizar las herramientas y sentidos comunes de hegemonía y contrahegemonía en la construcción de varios territorios hidrosociales del acueducto Tajo-Segura, mediante la operación del trasvase y asimismo de las acciones y políticas de modernización del regadío. Seguidamente, utilizo el mismo caso de estudio para combinar el marco de territorios hidrosociales con el análisis de la ecología política feminista de las subjetividades para analizar como el acueducto Tajo-Segura y las políticas de modernización del regadío han contribuido a la construcción de sujetos regantes ideales, y como en la práctica los sujetos regantes se alinean o no con este ideal en los territorios hidrosociales en los que viven. Continúo bajando a la escala de lo personal, donde me inspiro en mi propia historia y en las relaciones personales con diversos lugares en las cuencas del Tajo y el Segura, acompañado con las experiencias investigativas basadas en la India de mis colegas de WEGO para pensar de forma conjunta sobre las consecuencias éticas de las relaciones más-que-humanas ligadas al agua. A través de este viaje en múltiples escalas, esta investigación contribuye a una reflexión crítica de los impactos de los trasvases entre cuencas y de los territorios y sujetos que crean, y al mismo tiempo indica las alternativas existentes y posibles que están arraigadas en relaciones hidrosociales más justas e igualitarias.

Palabras clave: Trasvases de agua entre cuencas; Ecología política; Agua; Territorios hidrosociales; Hegemonía; Subjetividades

Resum

Aquesta tesi doctoral aborda la política i les contradiccions multiescalars i multidimensionals de les transformacions territorials causades pels transvasaments d'aigua entre conques, concretament l'Aqüeducte Tajo-Segura (Espanya). Com a tipologia d'infraestructura hidràulica a gran escala, els transvasaments entre conques han estat poc investigats en comparació amb altres tipus d'infraestructures similars. Tot i així, hi ha una creixent atenció als impactes socials, ambientals i econòmics dels transvasaments. L'estrès hídric que es viu a les conques del Tajo i el Segura no és només resultat del canvi climàtic, sinó també d'un segle amb una visió política de canvi socioecològic i territorial del país. Aquesta tesi examina empíricament i teòrica les relacions hidrològiques i socials de l'aigua, en escales i dimensions múltiples, i el transport d'aquesta a través dels transvasaments entre conques, informant i alhora essent informada per conceptes i debats de l'ecologia política i l'ecologia política de l'aigua, les hegemonies i contrahegemonies, i les ecologies polítiques feministes de les subjectivitats i l'ètica del més que humà. Cerca respondre com l'aqüeducte Tajo-Segura ha recreat les narratives dominants sobre l'ús i el valor donat a l'aigua, i d'aquesta manera, crea configuracions territorials desiguals i subjectes regants. La tesi també explora la política situada de la conformitat i la resistència a aquests processos de territorialització hidrosocial i la creació de subjectes, així com quins van ser els resultats d'aquesta política. En primer lloc, faig una revisió i anàlisi dels transvasaments entre conca a partir de la literatura científica i utilitzo un marc analític de l'ecologia política de l'aigua per analitzar els impactes i les degradacions causades pels mateixos, així com el resultat dels conflictes i contestacions polítiques que sorgeixen de la construcció i operació dels transvasaments. Tot seguit, utilitzo un marc de territoris hidrosocials per examinar i caracteritzar les eines i sentits comuns d'hegemonia i contrahegemonia en la construcció de diversos territoris hidrosocials de l'aqüeducte Tajo-Segura, mitjançant l'operació del transvasament i de les accions i polítiques de modernització del regadiu. A continuació, faig servir el mateix cas d'estudi per combinar el marc de territoris hidrosocials amb l'anàlisi de l'ecologia política feminista de les subjectivitats per analitzar com l'aqüeducte Tajo-Segura i les polítiques de modernització del regadiu han contribuït a la construcció de subjectes regants ideals, i com a la pràctica els subjectes regants s'alineen o no amb aquest ideal als territoris hidrosocials on viuen. Continuo baixant a l'escala personal, on m'inspiro en la meva pròpia història i en les relacions personals amb diversos llocs de les conques del Tajo i el Segura, acompanyat amb les experiències investigatives basades a l'Índia dels meus col·legues de WEGO per pensar de forma conjunta sobre les conseqüències ètiques de les relacions més-que-humanes lligades a l'aigua. Mitjançant aquest viatge en múltiples escales, aquesta investigació contribueix a una reflexió crítica dels impactes dels transvasaments entre conques i dels territoris i subjectes que creen, i alhora indica les alternatives existents i possibles que estan arrelades en relacions hidrosocials més justes i igualitàries.

Paraules clau: Transvasaments d'aigua entre conques; Ecologia política; Aigua; Territoris hidrosocials; Hegemonia; Subjectivitats

List of tables, figures, maps and images

Tables

Table 1: Research question, questions and sub-questions along scale 8
Table 2: Hydrosocial dimensions and their variables. 35
Table 3: Webs of socionatural relations: comparison of interconnection and causal linkages of biophysical, socioeconomic and governance dimensions within 4 IBWTs in 6 cases 38
Table 4: Cases reporting differences in planned and actual IBWT water use 39
Table 5: incidence of contestation, means pursued, changes in terms of outcome, and impact on IBWT planning and operation 40
Table 6: Irrigation communities in the Tagus and Segura River basins 54
Table 7: Irrigated surface and modernization in irrigation communities in the Tagus and Segura River basins 61
Table 8: Ideal *regantes* by historical period—1866–2023 77

Figures

Figure 1: Illustration of donor and recipient basins within Inter- and Intra-Basin Water Transfers. 30
Figure 2: Proportion of irrigated land against total cultivated land and proportion of modernized irrigated land against total irrigated land in regions containing the Tagus and Segura basins between 2002-2021 61
Figure 3: Timeline of agricultural (green) and hydraulic (blue) legislation and policies at the European, State, and TSA-connected regional (Castille–La Mancha and Murcia) levels between 1999 and 2023 78

Maps

Map 1: Peninsular Spain and the Balearic Islands with principal rivers, autonomous communities, and the location of the TSA 5
Map 2: Irrigation communities in the Tagus and Segura River basins 55
Map 3: Irrigated surfaces in Peninsular Spain and the Balearic Islands in 2008 with outlines of autonomous communities (regions) and RBAs 60
Map 4: Hydrosocial territories and irrigation communities in the Tagus and Segura River basins and the location of the TSA 65

Images

Image 1: (L) Segura River Basin Authority on the left with a pro-TSA banner (April 2022), and (R) Sacedón town hall in the upper Tagus river basin with an anti-TSA banner (May 2022). ... 5

Image 2: (L) The Tagus as it crosses a medieval bridge in La Puebla de Montalbán downstream from an industrial slaughterhouse (April 2022), and (R) the Tagus with foam as it passes past Toledo (April 2022) 6
Image 3: My grandparents, uncles and father on the Entrepeñas reservoir, circa 1959 115

List of abbreviations and acronyms

CAP	Common Agricultural Policy
COVID-19	COronaVIrus Disease of 2019
EU	European Union
FENACORE	National Federation of Irrigation Associations
FERTAJO	Federation of Irrigators of the Tagus Basin
FPE	Feminist Political Ecology
IBWT	Inter-Basin Water Transfer
IWRM	Integrated Water Resource Management
RBA	River Basin Authority
RBMP	River Basin Management Plan
SCRATS	Central Union of Irrigators of the Tagus-Segura Water Transfer
STS	Science and Technology Studies
TSA	Tagus-Segura Aqueduct
WFD	Water Framework Directive

1. Introduction

Si un día somos dueños de las aguas españolas, que caen en cantidad suficiente, aunque desigualmente repartidas, y las podemos distribuir según esa conveniencia, habremos realizado el acto más firme de soberanía. La fina y melancólica espiritualidad del Norte, templada en las austeridades castellanas, podrá llegar a fructificar aquí en Levante por la conjunción de aquellas aguas y este sol, y entonces sí que serían los vuestros unos productos nacionales capaces de llevar al último rincón del mundo, desde América hasta el Extremo Oriente, una encarnación del alma española.

Manuel Lorenzo Pardo, 1933

El problema del trasvase es en sí todo lo que ha significado, y lo que ha significado ha sido la promesa de una llegada de agua que no fue real, pero que se ha convertido una demanda real de agua. Entonces falta agua en la cuenca del Segura, y gran parte, o parte de ese problema vino por el trasvase, por la promesa... El problema es que ahora hay un monstruo gigante consumiendo agua en la cuenca del Segura, por culpa del trasvase en gran parte, y ese monstruo quiere agua, y quiere agua, y tiene un poder económico y político enorme, y claro, nosotros no somos nada comparado con ellos. Y el día que se fijen en nosotros…

Luis López Juárez, Comunidad de Regantes las Fuentes de Letur, personal communication (6 May 2022)

1.1. The motivations informing my personal and scientific journey

This research project does not begin with this page, or when I started my Ph.D. journey in 2018. It starts much further back, in the mid-1990s. As a child living in Madrid, I would spend weekends roaming the countryside, or playing in brooks and streams. At the time, I did not think much of why I would fall ill after being immersed in the water, or why the nearby river Jarama which flowed past a factory smelt so bad. I only thought that the stench would flow into the Tagus River and then on for hundreds of kilometres to dissipate past Lisbon, in the Atlantic Ocean. In contrast to the stench, I would think of camping trips in the upper Tagus basin, where my father would jokingly say the water was so clear the trout could see you leaving Madrid. I would also remember the size of the Entrepeñas dam holding what seemed like vast amounts of water, and of the huge pipes that transfer water to the Segura River basin in southeast Spain, who around that time were suffering from drought. That much I remember as a child.

25 years on and the stench is still there, as are the dam and pipes. However, with new thoughts, tools, and aims, I learnt more about water users on both sides of the transfer, of their worries, struggles and aims. This Ph.D. journey has taken me across the Tagus and Segura basins to encounter diverse hydrological, rural and agrarian realities that, despite the distances, local histories

and situations on the ground, still exhibit the same qualities I rediscovered in my childhood memories – the fixation with the transfer (for good or ill), the search for a crystalline water, different (and yet not so different) stenches, and a preoccupation with whether there would be enough water for their needs. This struck me considering how entrenched and confrontational discourses surrounding the Tagus-Segura Aqueduct (TSA) are. Whether presented as a life-saving and life-generating infrastructure whose opponents are unsupportive of a national hydraulic solidarity (Bukowski, 2007; López-Gunn, 2009; Swyngedouw, 2015), or as an engineering project of an age gone past detrimental to the socioeconomic and environmental needs of the Tagus basin (Hernández-Mora *et al.*, 2014; San-Martín González *et al.*, 2015; San-Martín González, Larraz-Iribas and Hernández-Mora, 2018), these confrontations that have become inter-regional conflicts fought at the local, regional and national stage are evoked as '*guerras del agua*' – water wars – that started in the mid-1990s and have become recurrent in the 21st century (Gil, 1995; Swyngedouw, 2015; Mateo, 2023).

The water wars made headlines in regional and national media, against backdrops of alarming predictions of scarcity, and calls for more water resource development and water saving technology. And yet, there were realities on the ground that did not square with the water resource development discourse. Whether it was the frenzied expansion of the tourist sector and of golf courses along the mediterranean coast (Rodríguez-Labajos and Martínez-Alier, 2015) or within the Tagus river itself (Sánchez, 2023), the expansion and regional domination of an irrigated agricultural system that exports virtual water to northern Europe (Vos and Boelens, 2018), or the bickering and judicialization of political conflicts over how much water could be considered a minimum environmental flow (Hernández-Mora *et al.*, 2014), the impacts and contradictions of the physical and discursive deployments of hydraulic infrastructure and technology and the transformation wrought across multiple territories and scales are the driving forces inspiring this dissertation.

Large-scale hydraulic works are conceived and deployed at national and regional scales, yet they are experienced and embodied at local and individual levels. It is at these scales that I posit territorial and socionatural transformations occur, reinforcing and at the same time problematizing the deployment, operation, and continued logic of hydraulic works (Harris and Alatout, 2010).

The choice of hydraulic works also lends itself to this scalar journey. While the scholarship on large scale hydraulic works has been primarily dedicated to dams, that of infrastructure such as the TSA, an Inter-Basin Water Transfer (IBWT), has received far less attention. This is because in comparison to dams or other large scale hydraulic works, IBWTs are costlier, are made up of multiple individual projects (dams, canals, tunnels), and there are fewer of these operating (Tockner *et al.*, 2016; Shumilova *et al.*, 2018). Nonetheless their impacts contradictorily reinforce and pierce across the unitary divide of river basins as a hydrological management unit (Molle, 2007, 2008), multiplying the problematics of river basin governance (Gupta and van der Zaag, 2008; Shumilova *et al.*, 2018). This dissertation therefore traces water's journey through hydraulic works within and

across scales, across river basin and administrative boundaries, and amongst the perceptions of users of where it *should* be, where it *should not* be, and why this ought to be so.

These questions are political in nature, and inform not only questions of equity and justice in water provision and distribution, but also the linkages these questions have to how water is experienced by local users in territories bathed (or not) by IBWT water. The scalar jump downwards to the local and the individual makes the choice of positioning this research project alongside the principal water user in Spain, irrigators, all the more relevant. With 80.5% of Spain's water being dedicated to agriculture (Ministerio para la Transición Ecológica y el Reto Demográfico, 2022), spread across a scant 20% of Spain's cultivated land area (Ministerio de Agricultura Pesca y Alimentación, 2021) irrigated agriculture and its practitioners have an inordinate say and practice in how waters are mobilized and used. The expansion of irrigated agriculture and the transformation of irrigation practices co-produce irrigator women and men subjects and the territories they live in and irrigate, and these subjects aid, abet or resist the processes feeding said expansion and transformation in different and unpredictable ways (Boelens *et al.*, 2016; Nightingale, 2018).). The role of IBWTs in feeding these processes are likewise informed by how irrigator subjects reinforce or question the same IBWT role. The scalar jump is therefore not only downwards, but springs back to the national scale from the positioning of interrelated individuals.

Given the above, this dissertation is a theoretical and empirical examination of multi-scalar and multi-territorial hydrological and social relations of water and its conveyance through IBWTs, and is informed by and in turn informs concepts and debates in political ecology and the political ecology of water, hegemonies and counterhegemonies, and feminist political ecologies (FPEs) of subjectivities and ethics of the more-than-human. It explores and informs how the IBWT, irrigator subjects and the territories irrigated are co-produced in unequal and different ways along hegemonic common senses and imaginaries (Ekers and Loftus, 2008; García López, Velicu and D'Alisa, 2017; Hommes and Boelens, 2017), and next, it aims to point to existing counterhegemonies and alternatives to *how things are* (Zwarteveen and Boelens, 2014; Harris, 2015) within the same interrelated IBWT spaces and scales. By doing so, it responds to the dual need interrogating how and why IBWTs stand apart from other hydraulic infrastructure in creating and being created by specific political and economic pressures and interests, but also how the peoples, natures and territories they touch materially and discursively respond to these.

The following sections present the conceptual review and theoretical background mobilized in the dissertation, followed by the dissertation outline and research questions, and finishing with the methodologies used.

1.2. The TSA and techno-political transformations

The Spanish hydrological panorama is one of significant variation. The northern Atlantic coast receives the most rainfall, spread across the meteorological year and producing a temperate

climate. The interior has less rainfall, with dry summers and cold winters, while the south and mediterranean coasts has hot dry summers and mild winters, with this area presenting the least rainfall (Ministerio de Medio Ambiente, 2000). As will be outlined in chapters 3 and 4, the physical transformation of this panorama has been the objective of the Spanish State and the political, economic and agricultural elite since the late 19th century, invoking a hydraulic paradigm whose aim was to correct a naturally occurring hydraulic 'imbalance' (Saurí and del Moral Ituarte, 2001; López-Gunn, 2009) across this national space. The organization of water governance based on the territory of the river basin departed from the correction of this imbalance, where water's governance at the basin scale responded to governing water at a national unitary scale, which envisioned transferring water across all river basins and therefore extracting the most value out of each drop of water (Bukowski, 2007; Varela Ortega and Hernández-Mora, 2009; Swyngedouw, 2015). While envisioned in Spain, this hydrological dream is not unique to Spain, with grand cross-basin water transfer plans at the national scale being envisioned and constructed in India and China, to name two examples (see chapter 2). Within Spain however, the TSA is the physical manifestation of this paradigm, and the keystone of what *could* have been a nationwide system of IBWTs.

In its inauguration in 1979, the TSA was designed to transfer up to 650 hm3/year of water from the headwaters of the Tagus river in Castilla-La Mancha (in the Entrepeñas-Buendia reservoir complex) along 286 km of canals and pipes and the Jucar river, to the Mundo river within the Segura river basin, within the Region of Murcia (as outlined in Map 1). From there it is distributed along two branches. The right-hand bank branch takes a south-west direction across Murcia and into the province of Almeria (in Andalusia). The left-hand bank branch instead branches twice, once eastward into the province of Alicante (Valencian Community), and southwards across the region of Murcia towards the city of Cartagena. The transferred water is dedicated to human consumption and to irrigate a large swathe of territory covered by the aforementioned branches that were formerly rain-fed agricultural areas. In 1980, the law established that 400 hm3/year of the TSA would be distributed across 147,255 ha (considered an area of national interest), of which 76,876 ha would be newly irrigated surface and the remaining amount corresponding to improvements on existing irrigated surfaces (Confederación Hidrográfica del Segura, 2015).[1]

[1] It is unclear but in the 1970s and by the 1980 law, seemingly 50,000 ha of existing irrigated surfaces in the basin would not be served by TSA water resources. This would suggest that at the outset of TSA operation, authorities envisaged nearly 75% of total irrigated surface in the basin to be using TSA water resources.

Map 1: Peninsular Spain and the Balearic Islands with principal rivers, autonomous communities, and the location of the TSA



Source: own elaboration with data from Gobierno de Castilla-La Mancha, n.d.

Between 1979 and 2017, the mean amount of water transferred has been 330 hm3/year, with current transfer regulations allowing water transfers to occur when reservoirs at the donor basin are filled with at least 400 hm3 (quantities above this amount are considered 'surplus' water resources to the Tagus basin's needs). The latest proposal for the 2022-2027 Hydrographic Plan for the Segura basin states that the irrigated zone using TSA water resources covers 145,000 ha with a gross water demand of nearly 600 hm3/year (Confederación Hidrográfica del Segura, 2021). Nonetheless there are strong indications that a rebound effect has occurred (López-Gunn, Mayor and Dumont, 2012), where water saved through the introduction of drip irrigation as encouraged by plot modernization policies has encouraged the expansion of irregular irrigation in the basin, benefitting agro-export companies, large landholders as well as regional and local governments. Other (direct and indirect) impacts the TSA has had in the Segura basin include an increasing polarization and conflict between Tagus irrigators and non-Tagus irrigators (taking on a strong class conflict dimension) as well as the general population in the basins (see Image 1), ecological damage to the Mar Menor saltwater lagoon, loss of springs in the upper Segura due to expansion of wells and drip irrigation in the highlands.

Image 1: (L) Segura River Basin Authority on the left with a pro-TSA banner (April 2022), and (R) Sacedón town hall in the upper Tagus River basin with an anti-TSA banner (May 2022).



Source: Nicholas Bourguignon (copyright)

In the Tagus basin, on the other hand, water demand is stretched by a multiplicity of actors, essentially making the Tagus a closed basin (see Molle, Wester, and Hirsch 2010). The principal uses of water are for urban supply (considering that two European capitals – Madrid and Lisbon – sit in the basin), hydroelectric power generation, and agriculture. The Albufeira convention also places a guarantee on minimum water availability there has to be on the Spanish side of the border. Irrigated agriculture does not have as long a pedigree as that of the Spanish levant. Nonetheless Tagus waters served multiple agricultural uses in the last 70 years, including the establishment of productive irrigated agriculture as well as being used as a vehicle for internal colonization during the Francoist dictatorship, power generation (hydroelectric and nuclear), and urban supply. With all these demands, both the Tagus and its' tributary sub-systems face hydrological stress. Tributary sub-systems suffer from lower flows due to intra intra-basin water transfers serving the Madrid metropolitan area. The Tagus itself in its middle stretch suffers from high levels of contamination due to both untreated waste from the urban area of Madrid as well as other municipal areas and agricultural run-off reaching the river, and these do not dilute at the Tagus-Jarama confluence since the Tagus's own headwaters are transferred to the Levant via the TSA (see Image 2).

Image 2: (L) The Tagus as it crosses a medieval bridge in La Puebla de Montalbán downstream from an industrial slaughterhouse (April 2022), and (R) the Tagus with foam as it passes past Toledo (April 2022)



Source: Nick Bourguignon (copyright)

In addition to the aforementioned stresses experienced in both connected basins, climate change is impacting the Tagus and Segura basins, as well as across Spain. Recent studies (Senent-Aparicio *et al.*, 2023) have shown that there has been an overall decrease of precipitation throughout Spain. Nonetheless there has been an increase in high-intensity storms and extreme precipitation events in the mediterranean coast and Andalucia, significantly changing statistically informed historical understandings of flow calculations and flood risk in the mediterranean basins, and affecting infrastructure planning (Serrano-Notivoli *et al.*, 2017; Senent-Aparicio *et al.*, 2023). Combined with decreasing TSA transfers based on water availability in the Entrepeñas-Buendia reservoirs, the looming decision over whether the TSA can continue functioning has increased the political stakes in the water wars to halt or continue transferring the Tagus's waters to southeast Spain.

1.3. Problem description, research objectives and research questions

The hydrological stress experienced in both the Tagus and Segura basins is the result not only of climate-change induced meteorological change, but of a century-long political vision of socioecological and territorial transformation of the country through a 'hydraulic surgery' (Gupta and van der Zaag, 2008) and hydraulic reorganization of Spain's river basins. The consequences of the materialization of this vision have led to the current impasse of the water wars. This combines not only a pitting of conflicting visions and entrenched interests of who and what *should* get water once it has been made transferable through the construction of the TSA. It is increasingly a contestation over the meaning of water's uses – social, environmental, human and non-human – and the logics over securing water for specific models and uses, with different agricultural models being paramount in this. These consequences are not only multi-dimensional, but multi-scalar. Similar issues are found wherever IBWTs are proposed or are constructed worldwide, in parliaments and ministries, municipal halls, irrigation associations, and households that suffer from or depend on the transfer of water across basins.

Following this framing of the problematics of the TSA in particular and of IBWTs more generally, the research objectives follow a scalar outline informed by political ecology in general and hydrosocial theory in particular. The first objective is to develop an understanding of the socio-environmental and political impacts of IBWTs as a hydraulic infrastructure across the globe. The second objective, at the national and regional scales, is to examine the visions informing the policies that drove the development of the TSA, and how irrigated territories and irrigators themselves changed with its operation through the transfer of the Tagus's water. The final objective, located at the individual scale, is to explore my own positioning and positionality vis-à-vis the TSA and my consideration for the human and more-than-human, and how it informs a situated and relational political stance within research.

Considering these objectives, the following Table 1 outlines the overall research question, as well as the questions and sub-questions located at each scalar level outlined in the objectives:

Table 1: Research question, questions and sub-questions along scale

Overall research question: As an IBWT, how has the TSA recreated dominant narratives on water's use and value, and through it, uneven territorial configurations and irrigator subjects? What are the situated politics of compliance and resistance to these processes of hydrosocial territorialization and subject-making, and what are the results of said politics?	
Scale	**Questions and sub-questions**
Global	How have IBWTs brought about social and ecological changes to hydrosocial territories? • Do IBWTs always serve modern socionatural regimes? • What consequences are there for understanding contestations linked to IBWTs?
National and regional	What territories are produced through the confluence of the hegemonic projects of IBWTs and on-plot irrigation modernization? • How are these produced? • What territories resist or deter this confluence of hegemonic projects?
Community	How are irrigator subjectivities constructed in relation to the (contested) configuration of the particular hydrosocial territories in which they are assumed to take part?
Individual	How can the politics of more-than-human interdependency enable the narration of the situated complexities of the more-than-human as a process of co-becoming?

1.4. Conceptual review and theoretical background

This dissertation is grounded in, departs from and informs the corpus of diverse concepts and approaches under the theoretical umbrella of Political Ecology, and within said umbrella, the political ecologies of water. More particularly, because of the focus on the multiplicity of territories, scales and subjects encountered, I investigate and utilize the expanding concept of hydrosocial territories (Boelens *et al.*, 2016) in conjunction with contributions from FPEs on power, performativity and subjectivity (Butler, 1999; Harris, 2006, 2009; Nightingale, 2006, 2013, 2018; Sultana, 2011; Neimanis, 2012), probing the concept in various ways throughout the following chapters. The dissertation also engages with questions of hegemony, governmentality, and the more-than-human. In the subsequent subsections, I discuss how I have deployed key features of the political ecologies of water, hydrosocial territories and feminist subjectivities throughout this dissertation.

1.4.1. Political ecologies, hydrosocial territories and interbasin water transfers

The origins of political ecology are firmly rooted in an ambition to link the social and physical sciences to address conflicts and problems related to environmental changes. This ambition led to the use of political economy's concerns over social relations of production and access and control over resources to be applied to environmental disturbance and degradation, analyses and models over rehabilitation and conservation, and sustainable alternatives, coupled with a concern over marginalized social groups and issues of social justice (Paulson, Gezon and Watts, 2005). Expressly critical and against apolitical ecologies, the discipline has bred multiple variations and points of entry, though a unifying point can be said to be the need to politicise, and thereby render visible and contest, socionatural inequalities and challenge views that the world is unchangeable (Robbins, 2004; Loftus, 2009). Political ecologies therefore make normative claims about how the world *should be*, working with frameworks that identify, question and criticize socionatural inequities and environmental injustices, and the role of power embedded in the production of said inequities and injustices (Robbins, 2004; Rodríguez-Labajos and Martínez-Alier, 2015).

An important contribution in political ecology, and more particularly the political ecology of water, is the framework of the coproduction of socionatures. Socionature does not bracket but embrace the complex interaction of nature and society, and grounds it in its historical (re)production. Socionatural thinking understands "the world as always already networked, already embedded" (Rocheleau and Roth, 2007, p. 433), and society and nature are seen as inseparable and coproduced (Haraway, 2003a; Truelove, 2011, p. 144; Bear, 2017). Through this coproduction attention is given to process, with Swyngedouw arguing that material practices, representational visions, and symbolic expressions are related and irreducible, and where he insists "on the ontological priority of process and flux that become interiorized in each of the moments (lived, perceived, conceived) of the production process, but always in a fleeting, dynamic, and transgressive manner" (Swyngedouw, 2015, p. 21). The political dimensions that emerge from this also allows for a questioning of boundaries between nature, society and technology, giving a basis to understand how efforts to 'naturalize' phenomena such as droughts or watersheds depoliticizes them (Zwarteveen and Boelens, 2014, p. 149), hiding how choices on how to deal with natural water scarcity or manage water along natural boundaries of watersheds is still a choice, and therefore a political act.

Socionatures have been particularly helpful in conceptualizing and working with political ecologies of water. As argued by Loftus (2009), political ecologies of water have been at the forefront of developing new and different approaches to human-environment relations, embracing socionatural approaches. Moreso than other elements and material, he argues that water embodies and expresses social relations and is therefore crucial in the production and reproduction of power

(not only with and over water but over other dimensions and arenas where water plays a role). The political ecology of water therefore opens new understandings to the political ecologies of power, and the constant predicament of the political economy of development. Swyngedouw mobilises this interest in power to demonstrate how water and power are mutually constitutive in the Spanish context to justify and transform the nation's hydraulic reality through the expansion of dams and a desire to connect all basins through IBWTs (Swyngedouw, 1999, 2015), as will be illustrated in chapters 3 and 4.

Power and knowledge are therefore intermeshed to construct particular and situated knowledges and truth claims that reinforce or contest particular ideals. For example, the hydraulic paradigm presented in section 1.2 (and subsequently in chapter 3) is the intermeshing of a particular vision and knowledge of Spain's hydraulic reality along the unit of the river basin with the backing of the apparatus of the State and specific elite classes to realize the vision. In her feminist critique of an objective and universal science and its link to authority and violence, Donna Haraway (1988) argued for situated, embodied and partial knowledges to counter unaccountable universalizing knowledge claims and truths generated by it. Situated knowledges are linked to bodies and practitioners from below, and generated in and learnt across community, rather than depending on the god trick claim of seeing everything, everywhere, all at once, and from nowhere. Situated knowledges have their histories and emanate from particular times and places; that is, they have lineages, and very different articulations where local, rural, and different forms of social categorization generate vastly different understandings of seeing the world differently from universalistic conceptions of Capital S Science (Escobar, 1999). For example, situated socionatural knowledges in Mexico and Bolivia (see chapter 2) informed successful contestations against IBWTs. Seeing knowledge as situated also links it to (physical and epistemic) communities and power relations between these. When enrolled into the political ecology of water, Boelens, Vos and Perrault (2018, p. 14) argue that

"it is therefore important to consider that knowledge about water, including scientific knowledge, does not spring from natural reality but instead helps to construct these realities. Water knowledge and truth claims are internal to the socio-natural networks that constitute reality (e.g. Foucault, 1980; Whatmore, 2009). The choice and classification of concepts and their interrelationships do not represent the nature of water control, but the human intentions to tame and order water affairs. As Haraway (1991) argued, they sprout from situated knowledge. Water knowledge, power and truth all depend on and reproduce each other."

Examples of situated knowledge in action abound. Loftus (2009) grounds his research on the situated knowledges of women and gender roles in municipal water provision in Durban, South Africa to bring power analyses into a political ecology of water, and explore these as emancipatory project which must start from situated understandings of everyday life. Harris (2015) explores political ecologies of water, FPE and thinking 'otherwise' to challenge and offer alternatives to

neoliberal environmental governance, where everyday, embodied, emotional dimensions can be points of departure to research empirical dimensions as varied as water justice movements, indigenous politics and counter-movements as alternatives to a marketized and commodified water world predicating efficiency. Specifically, FPEs challenge efficiency and productive assumptions and highlight women's and others' experiences, livelihoods, and needs to build sensibilities towards other views of what matters, and away from capitalist and market logics.

Considering socionatures and situated knowledges, the political ecology of water has developed various tools and conceptual frameworks. The waterscape was the first to emerge, as an expression of socionature (Karpouzoglou and Vij, 2017). This was proposed by Swyngedouw (1999, 2015) as the social, economic, and ecological landscape where water's changing position has to be understood and referenced, and takes on a hybrid character – part natural, part social – embodying a multiplicity of historical geographical relations and processes. Socionatural waterscapes developed both in of itself and inspired further complementary conceptual thinking. Waterscapes were used to examine more nuanced relations, for example by putting gender and constitutive power relations in relation to contaminated drinking water in Bangladesh (Sultana, 2011), the materialization and renegotiation of gender relations in new waterscapes through the construction of new irrigation schemes and increasing involvement of women in them in Turkey (Harris, 2006), or analysing everyday dimensions of resource inequality through processes of social and spatial differentiation in Delhi, India (Truelove, 2011). Waterscapes have been a fruitful avenue in examining discrete configurations of relations in specific geographies and scales, though analysis across multiple geographies and scales have been developed with new concepts. The more recent complementary concepts that have emerged from this tradition are the hydrosocial cycle (Linton and Budds, 2014), hydrosocial territories (Boelens *et al.*, 2016), and most recently riverhoods (Boelens *et al.*, 2022).

Linton and Budds follow this common conceptualization of water's and society's co-constitution in space and time with the hydrosocial cycle (2014, p. 175). Key ideas include that the need to manage water affects how society is organized and reverberates cyclically on water's organization, that by virtue of this water and society are related internally and therefore particular social relations produce particular waters, and finally, despite this, water's material properties in the hydrosocial process structure and disrupt social relations. The application of the hydrosocial cycle to analyse empirical cases focuses on social processes occurring with flows of water itself, such as in financial flows, labour processes, or political contestations revolving around dam construction in Canada (Linton and Budds, 2014). While the focus on the co-constitution of water and society and its reverberations across hydrosocial processes allow an analysis of social processes, it still remains vague in terms of the political projects and imaginaries driving the same processes. In particular, while it touches on material aspects and spaces, it does not do so in a manner that grounds territories and inhabitants that shape subjective grounded experiences to hydrosocial processes.

Hydrosocial territories on the other hand are defined by Boelens et al. (2016, p. 2) as

"*the contested imaginary and socio-environmental materialization of a spatially bound multi-scalar network in which humans, water flows, ecological relations, hydraulic infra-structure, financial means, legal-administrative arrangements and cultural institutions and practices are interactively defined, aligned and mobilized through epistemological belief systems, political hierarchies and naturalizing discourses*."

The socionatural precept of rejecting society-nature dichotomies continues within hydrosocial territorial thinking, with humanized natures and waters being crafted on territories along human visions of the world as is, and how it should be. As with waterscapes and the hydrosocial cycle, socionatural production in hydrosocial territories create socionatural hybrids (Latour, 1993), or cyborgs (Haraway, 1991), whose production and reproduction internally relate nature and society. One cannot exist without the other. Hydrosocial territorial thinking enrols an understanding of hydrosocial networks, where networks of water, technologies, society and nature are intrinsically interrelated and mutually determining (cf. French, 2019; Rocheleau & Roth, 2007). Where hydrosocial territorial thinking stands out is on refining an understanding of these networks by highlighting networks' span and durability, reinforcing dimensions of both time and space. Hydrosocial territories and processes of territorialization are therefore argued to be spatially bound, subject-built, socionatural networks produced by actors collaborating and competing over the definition, composition and ordering of this networked space (Boelens *et al.*, 2016). This leads to what two important considerations for this dissertation, namely the role of dominance in territorialization through conducting the conduct of subject populations as well as resistance to it (Foucault, 1991; Scott, 1998), and enrolment of territories-within-territory, or territorial pluralism, whereby the question of scale becomes salient (Boelens *et al.*, 2016; Hoogesteger, Boelens and Baud, 2016).

In this dissertation I engage explicitly with the concept of hydrosocial territories due to its fit with the empirical realities of IBWTs. While waterscapes and hydrosocial cycles can be used to analyse the empirics of IBWTs, my interest is to better understand a hydrosocial networks' scope (in terms of its' span and durability) that is literally encased in concrete and steel as a 'hardened morality' in an IBWT (Boelens, 2015; Hommes *et al.*, 2020). Taking the example of the TSA (see section 1.2), the connection of the Tagus and Segura basins has encased not only the physical transfer of water, but also the hydrological paradigm that prescribes how water should be used, the institutional norms and expectations of the scale at which water should be governed (which in turn facilitates the operation and governance of the transfer). That the transfer *must* occur is a political decision, with its supporters and detractors. In this way the TSA is not only acting on but also acted upon by subjects, placed in specific territories, scales and spaces. In this way, the resulting TSA hydrosocial network produces and reproduces new configurations of domination and resistance across multiple interconnected territories, between and across scales.

1.4.2. Governmentalities, hegemonies, and counterhegemonies in territorial construction

Political ecology literature conceptually developing hydrosocial territories has expanded significantly since the term was coined in 2015. A driving impetus in this literature has been to unpack and analyse social relations of domination and resistance to domination, with the resulting transformation of socionatural territories and subjects therein. Examples include the exploration of how projects to expand IBWTs to increase water flows for expanded irrigation in Boliva generated countermovements that upended existing networks and processes of domination and subordination, and produced new constellations of hydrosocial power relations in existing irrigation and natural park territories (López *et al.*, 2019). In Peru, the dominant paradigm embodied in the engineering corps resulted in the domination of nature and rural highlanders through hydroelectric development (Hommes and Boelens, 2018), while in the USA, white anglo-defined and controlled water governance systems exposed the its domination alongside the confluence of race and indigeneity with water resource conflicts (Jaramillo, 2019)..

The approach most used to frame domination within hydrosocial territorial literature is governmentality. Governmentality, or the 'arts of government', was developed by Michel Foucault to analyse the arts of government that conduct the conduct of subjects, whereby what is appropriate and normal is internalized by subjects and these rendered governable (Foucault, 1991, 2008), and is "a field of action between heterogeneous relations of power and states of outright domination" (Ekers and Loftus, 2008, p. 703). Foucault identified different forms of governmentalities, categorized as truth, sovereign, disciplinary and neoliberal, applied top down or bottom up (termed as capillary action), that coexist and overlap (Foucault, 1991, 2008; Hommes *et al.*, 2020; Hommes, Hoogesteger and Boelens, 2022). Governmentality is expressed through imaginaries, and these materialize in the form of the deployment of technology and infrastructure. These can be conceived as the materialized and embedded norms shaping geographies, politics, morals and behaviour (Swyngedouw and Boelens, 2018; Hommes, Hoogesteger and Boelens, 2022). The result is the creation of subjects who behave and perform along what dominant norms, knowledges and governmentalities consider acceptable, good and irreprehensible (Hommes *et al.*, 2018), such as in the different irrigator subjects that emerged before and after the construction of the TSA (see chapter 4).

Governmentality's analytical strength is reflected in its proliferation in recent decades across a wide range of disciplines, methodologies and empirical fields. Examples include analysing the interconnection of environments, territories and their socio-political relations (Escobar, 2008; Hommes *et al.*, 2020), as methodology in inquiring the reality and scope of intended governmental actions (Li, 2007), the process of power in coproducing both territory and population within environmental narratives (Alatout, 2006), or in identifying processes of control and discipline over processes of territorialization (Peluso and Lund, 2011).

Within the hydrosocial territorial literature, this has been deployed to examine how the norms, knowledge and government mentalities behind hydraulic projects are an attempt to materialize these dominant ideas into reality through the use of imaginaries (Boelens *et al.*, 2016; Hommes *et al.*, 2018; Hommes, Hoogesteger and Boelens, 2022). For example, Hommes *et al.* (2020) examine how specific governmentalities, particularly modernist governmentality, shape urban-rural relations and water transfers in Latin America and create specific and differentiated rural and urban subjectivities that are (dis)connected from new water flows. Martel, Sutherland and Hannan (2022) explore river rehabilitation projects in South Africa pursued using different governmentalities to establish the creation of related modes of governing water and environmental subjects. Hommes *et al.* (2018) use governmentalities to examine how these advance neoliberal projects, and are themselves contested by water justice movements that struggle not only for access to and use of water but for their participation, political co-decision making, and their struggle for socionatural integrity in connection with water.

The subjectivities that emerge from imaginaries, and the subsequent application of governmentalities are not foregone conclusions. Infrastructure and technologies (whether hydraulic or otherwise) may be envisioned to be used by designers and implementers that nonetheless take unpredictable paths when implemented and constructed – subjectivities emerging from these are dynamic, contested, and contradictory (Hommes, Hoogesteger and Boelens, 2022). For example, the strong link between specific rural and urban imaginaries, discourses and subjectivities and the relations they ought to have also casts the territories in which said subjects inhabit to hold specific and normative qualities. These are to be rendered through different governmental policies that make rural areas and their inhabitants comprehensible, controllable and exploitable for a specific hydrological aim – the provision of water to urban areas (Hommes *et al.*, 2020).

Another, complementary approach I mobilise for this dissertation to analyse domination and resistance to it is Gramscian hegemony. Hegemony is understood as the practices and ideologies associated to the power relations between a dominant group subordinating other groups in a society. These practices and ideologies are deployed to influence thoughts and decisions, thereby cultivating the consent of subordinate groups to be governed rather than through mechanisms of outright coercion (Ekers and Loftus, 2008; Sneddon, 2013; Harris, 2015; García López, Velicu and D'Alisa, 2017), creating realities that seem normal (Warner, Hoogesteger and Hidalgo-Bastidas, 2017). Examples of hegemonic practices and ideologies I engage with in the Spanish context are, for instance, the hydraulic paradigm that was mobilised not only to distinguish a 'wet' Spain and a 'dry' Spain, but also to transfer water from one to another to correct a hydraulic 'imbalance' (see sub-section 3.4.1), the policies that build these (see sub-section 4.3.1), and the efficiency paradigm justifying the replacement of traditional irrigation practices with drip irrigation (see sub-section 3.4.2).

The role of the State is crucial to understanding hegemony, which highlights the State's simultaneously centralised and diffuse nature. Rule is consolidated through coercion and

acquiescence, and in the latter power is consolidated in institutions outside the state (Ekers and Loftus, 2008; Nightingale, 2018). At the same time, hegemony focuses on the everyday practices and performances of power (Butler, 1997a; Sneddon, 2013) bounded in sedimented, contradictory common senses grounded in socionatures (Ekers and Loftus, 2008).

Within the hydrosocial territory literature, Gramscian hegemony has not been developed as strongly as it has been done with Foucault. Swyngedouw and Boelens (2018) state that hydrosocial literature exploring concepts such as waterscapes focus on hegemonic structures and discourses that drive and emerge from socionatural reconfigurations. They add that the concept of hydrosocial territories maintains the focus on these "arts of statecraft" (2018, p. 130) and the shaping of multi-scalar political geography, while stressing that the conceptual innovation brought by hydrosocial territories is the diversity of overlapping and simultaneously existing hydrosocial regimes and imaginaries. Governmentality brings attention to the normalizing subtleties of the web of domination-resistance (see Hommes *et al.*, 2018; Duarte Abadía, Boelens and du Pré, 2019). Hydrosocial territories likewise "highlights the existence of other, alternative worldviews and vernacular knowledge and how these may co-exist and overlap with, and/or contest, hegemonic forces, structures, and discourses that affect socio-natural reconfiguration" (Duarte Abadía, Boelens and du Pré, 2019, p. 3). As such, hegemony is mobilised in a structural fashion. Nonetheless, internalised forces of hegemonic consent through common senses (García López, Velicu and D'Alisa, 2017) – and the fragility these suffer in their contradictions and rearticulations that lead to counterhegemonies – can enrich hydrosocial territories' exploration of conducting the conduct of subject populations (Boelens *et al.*, 2016).

I acknowledge the theoretical tensions between Gramsci and Foucault. At the same time, I also take heed from Ekers and Loftus that these tensions can be productive (2008). They present two productive tensions that I take forward. Firstly, Foucauldian techniques of subjection can be linked to hegemonic projects. Secondly, Foucauldian conceptions of the social fabric see it as fragmented and discontinuous, while Gramsci sees politics as struggle that is socially constitutive. Gramscian internal relationships of the socionatural world encourages forging links across spatialities and positionalities. Both governmentality and hegemony can be used to analyse processes and projects of hegemonic domination and Foucauldian techniques of subjection through governmentality to create unexpected hydrosocial subjects.

1.4.3. Hydrosocial territories and subjectivities

Descending towards the scale of social groups and individuals, the subject of subjects and their (re)creation emerges. Here I mobilise Judith Butler's analysis of subject performance. This concept was used famously by Butler to argue that gender is performed; "gender is in no way a stable identity or locus of agency from which various acts proceed; rather, it is an identity tenuously constituted in time – an identity instituted through a *stylized repetition of acts*" (1988, p. 529 emphasis

in orignal). Butler argued that gender does not prefigure the subject, and that it comes to being through its repeated performance by gendered subjects, with these informed by power relations and the environment subjects are located in (Butler, 1999; Harris, 2006; Nightingale, 2006). This argument has been mobilised by feminist political ecologists, within political ecologies of water as well as other political ecologies, to intersect not only gender but also other categories of social difference such as class, caste, race, age within individual subjects (Crenshaw, 1991; Nightingale, 2011; Lau and Scales, 2016). Inspired by this intersectional analysis, subjectivity is analysed as a process through which people are "disciplined by and identified with certain discourses and practices" (Nightingale and Ojha, 2013, p. 33), where "the 'subject' is constituted by power, both power over and the power to act, and often refers to the discursive processes through which people become subjects of states or other types of authority" (Nightingale, 2013, p. 2366). A performative approach to understanding the socioenvironmental State is deployed by Nightingale (2018) and used in Chapter 2 to understand how the exercise of power by subjects produces State processes, and delineating what environmental subjects, and the territories they inhabit, belong within the state (such as recipient basins) and which need to be corralled (donor basins).

Butler's performativity is not only informed by Foucauldian theory (Butler, 1997b) and speaks back to arts of government and the internalization of what is 'normal' by subjects, but she has also explored how hegemony acts through power to generate the consent to be governed through common senses and the daily rearticulations of social relations (Butler, 2000). She states "the theory of performativity is not far from the theory of hegemony in this respect: both emphasize the way in which the social world is made - and new social possibilities emerge - at various levels of social action through a collaborative relation with power." (2000, p. 14). This understanding is deployed to think about the emergence not only of counterhegemonic subjects, but also of counterhegemonic territories crafted through the performance of irrigator's traditional practices within an overall setting of hegemony within the TSA's connected basins (see chapter 3).

Mobilising Butler's theory of performativity vis-à-vis natural resource politics and governance has had important implications within FPE. Andrea Nightingale's (2006) exploration of gender relations and forest resource politics in Nepal has two points to consider. Firstly, environmental change is in part constituted by material practices and the production of symbolic meanings of resources, and restrictions on resource use are as much symbolic of environmental conservation as they are of actual environmental change. She deploys the example of marginalized groups breaking user-group rules made by local elites in gathering forest resources, since the rules overall benefit local elites, and re-signify the subject positions of marginalized groups. Secondly, symbols and material practices need to be considered multi-scalarly, where top-down development programmes' assumptions of gender (or other categories of social difference) roles (re)enforce axes of difference that make it difficult for marginalized people to contest subjectivities, which has ecological implications. Taking the same example employed above, existing user-group rules replaced older rules through new governance mechanisms instigated by donor organizations

pushing for local participatory processes. Thus, the performance of being a 'good' irrigator can be based on single or multiple parameters, whether it is water efficiency, environmental stewardship, or contributing to vibrant rural communities. This becomes problematic and contradictory insofar as understanding what 'good' irrigation is changes from subject to another, from one territory to another, and from one level of authority (regional governments, national governments, the EU) to another, as will be shown in chapter 4.

Nightingale further developed her scholarship on subjects and performative theory when examining fishermen subjects in Scotland (2013). She makes two distinctions about subjectivities. Firstly, subjectivities shift when individuals move between different spaces and places, implying that subjectivities are embodied and emerge relationally in space. Secondly, subjects are ambivalent, struggling between the desire to be subjected and resting it. Based on this, and following Longhurst (2003), she makes three arguments when theorising subjectivities in natural resource management. Firstly, subjects are always placed, that is, performed in specific places and spaces. Second, subjectivities are embodied and therefore material, that is, they are constituted by physical acts. Finally, resistance to subjection entail moments of re-subjection, where dominant discourses are reproduced as subjects resist them.

There have been ample examples of performativity being applied to FPEs of water and subjectivities. Leila Harris (2006), in her exploration of changing waterscapes and the emergence of women irrigators in southeastern Turkey, explores how local socionatural changes due to irrigation development shift traditional notions of desirable masculinities and femininities, since signifiers of attaining and therefore performing roles of desirable masculinities and femininities shift and change in relation to changing material circumstances and conditions. Shrestha, Joshi and Clement (2019) analyse how hydraulic engineers in Nepal reinforce notions of masculinities associated with power, status, prestige and ability precisely through performing their engineering within the context of control and subordination of water through hydraulic works. A similar theme is explored by Vera Delgado and Zwarteveen (2017) who historically situate masculinities and engineering science and knowledge against indigenous gendered knowledges and practices in Peru, integrating multiple and intersecting categories of social difference within a contemporary neoliberal waterscape of irrigation water provision with real symbolic and material effects on water inequity.

Hydrosocial territory scholars have engaged with subjectivities and processes of subjectification, drinking from the same Foucauldian cup as Butler and feminist political ecologists. Where they differ is that feminist political ecologists place more emphasis on intersectional, emergent, shifting, and contested subjectivities, while hydrosocial territorial scholars have sought to interlink subjectivities to territories (or place), knowledge production, and power dynamics of visions and imaginaries. For example, Mills-Novoa et al. (2020) argue that Foucauldian governmentalities and knowledge production practices produce objects (hydrosocial territories) and subjects to be governed within climate change adaptation projects in Ecuador, where participatory practices manufacture and cajole subjects towards determined ways of thinking and identifying in

line with manufactured hydrosocial territories. Jaramillo (2019) explored how acequias (irrigation canals) as commons in New Mexico, USA, produce new social relationships and subjectivities, particularly how acequia irrigation represents a non-centralized and communal form of irrigation practice that produces local subjects based on communal social spaces and with communal moral values.

The clearest exposition of subjectivity in hydrosocial territories comes from Hommes et al. (2020), in their exploration of water governmentalities. They utilize an understanding of subjectification proposed by Rose (1996). According to him, subjects are seen as assemblages metamorphosing and changing properties as connections expand (1996, p. 172), with subjectification referring to processes and practices where humans relate to themselves and others as subjects (1996, p. 38). This is informed by Foucauldian internalization of norms and self-disciplining, and his understanding is deployed alongside developments in the literature on the creation of environmental subjects. This is mobilised to highlight the role of water infrastructure and subjectification to create hydrosocial territories allowing the transfer of water from rural to urban areas. These territories emerge as highly unequal in terms of power relations and material water. Rural and urban subjects are consciously interrelated, whether in solidarity or in protest, with specific subjectivities created and cast through governmentalities that enable the creation of the rural-urban transfer territory (even if this is resisted).

Building on governmentalities towards the impact of infrastructure, Hommes, Hoogesteger and Boelens (2022) explore the relationship between infrastructure and their shaping of territories and subjectivities. Governmentality and its understanding of power as productive allows for the (re)production and transformation of territories, imaginaries, subjects and subjectivities. Imaginaries are normative and moral frameworks, and are the basis for transformational projects; "imaginaries provide the background within which subjectivities are formed, understood and enacted." (Hommes, Hoogesteger and Boelens, 2022, p. 3). Struggles over territories are therefore struggles over vision and subjectivities. The implication of creating specific hydrosocial configurations is that specific subjects are needed, and powerful actors engage in creating specific imaginaries through infrastructure to integrate and constitute existing and new subjects, through subjectification processes based on systems of truth claims and knowledges. The materialization of the imaginary pushing for hydraulic projects results in hardened moralities (Boelens, 2015).

This exposition of subjectivities between the scholarly practices of FPE and hydrosocial territories shows they are not exclusionary, though attention has to be given to how they are utilized. Just as governmentalities and hegemonies each carry their own baggage, so does the departure of subjectivities between these two scholarships.

1.4.4. More-than-human waters and relationalities

The final theoretical consideration I engage with is the more-than-human and water so as to consider the possibilities and contradictions of the water worlds built through and despite of the TSA, and of the ethical relations that have to be considered within these worlds. Sarah Whatmore coined the term more-than-human when considering all the matter, living and non-living, human and non-human, involved in food provision, consumption and elimination; "The rhythms and motions of these inter-corporeal practices configure spaces of connectivity between more-than-human life worlds; topologies of intimacy and affectivity that confound conventional cartographies of distance and proximity, and local and global scales." (2002, p. 162). The shift therefore displaces the human from the centre of study to take into account that "humans are always in composition with nonhumanity, never outside of a sticky web of connections or an *ecology*"(Bennett, 2004, p. 365; cf. Rocheleau, 2016).

The more-than-human is inspired by and has inspired a wide variety of scholarship across multiple disciplines, from cultural geography, post-humanism, Science and Technology Studies (STS), feminist philosophy, political ecologies, and de/postcolonial studies. It emerged at the turn of the millennium by taking aim at environmental studies that removed humans from their research as well as with Marxist and post-structural scholars that considered the non-human simply as raw material for capitalism (Isaacs, 2020). Sarah Whatmore aimed to illustrate how the environment was more than a human achievement and to explore the 'livingness' or vitality of matter (see also Singh, 2013), with more-than-human inquires investigating empirical cases as varied as genetically modified organisms and hormonal treatments in food production to captive breeding of African elephants (Isaacs, 2020).

Recognizing the wide variability to which the approach can be applied, I take onboard Sarah Whatmore's exploration of more-than-human modes of enquiry, which "neither presume that socio-material change is an exclusively human achievement nor exclude the 'human' from the stuff of fabrication" (Whatmore, 2006, p. 604). This engages with the TSA and how water flows in both the Tagus and Segura basins are intrinsically shaped by human hands, Such as through the TSA or through new technologies that have desalinated seawater and treated wastewater irrigating the fields of high technology, drip-irrigated territories in Murcia (see sub-sections 3.4.3 and 4.3.2.1), or by water's material properties in carrying contamination to the irrigated fields in the Tagus basin (see sub-section 4.3.2.2.) Yet, simultaneously, current hydrosocial configurations could not exist without the mobilization of these waters. This therefore establishes a foothold to inquire into the possibilities and contradictions of 'livingness' as applied to the hydrosocial territories of the TSA. Using the TSA as an example, it is clear that local and geohistorical contexts are important, but likewise, and of interest to me, is that these are situated within wide, multi-scalar contexts. This assumes that knowledges are geographically and ontologically situated (Haraway, 1988), within political ecologies (Robbins, 2004) and saturated with meanings and historical legacies, whether it

be drip-irrigated fields embedded in histories of water extortion or in centuries-old traditional irrigation systems with their own vibrant ecologies (see sub-sections 3.4.3 and 4.4.12.2.3).

Relationality is likewise a theme in the more-than-human approach I engage with. In her Companion Species Manifesto, Haraway (2003a) develops the principle of significant otherness to explore how it could allow more-than-human vitality to flourish. She develops significant otherness by exploring how people rooted in different ontologies can live together (Verran, 2001 in Haraway, 2003b), questioning the ontological separability of human and non-human bodies (Thompson, 2005 in Haraway, 2003b), and eschewing binary categorizations to think instead with relational categories and partial connections (Strathern, 1991 in Haraway, 2003b). Applied to the TSA case, the multiple ways that hydrosocial territories are fashioned through different types of irrigation methods, whether facilitated by or in spite of the TSA, also represent different ways of knowing and conceptualizing water with their particular histories, as will be illustrated in chapters 3 and 4. Nonetheless these ontologies inform different power relations, placing them in the aforementioned multi-scalar contexts of processes such as global capitalism (such as Murcia's agrarian economy based on food exports) or climate change (a concern looming not only over the individual territories but across the globe).

My preoccupation with significant otherness and 'livingness' within the more-than-human water worlds of the TSA hydrosocial territory complex I explore in chapter 5 is in its contradictions. This is most stark when the positive, 'vibrant' search for promoting ways of being and life in all its forms is embedded in life-denying configurations and political projects. Power flows through more-than-human 'sticky webs' (Bennett, 2004, p. 365) of the Tagus and Segura rivers can be life giving but very often they are life denying, to both humans and non-humans (see Image 2). The invocation of principles of care and vibrant relationality vis-à-vis the more-than-human by social groups, who follow through with imaginaries and actions that are presumed to be life-affirming (Singh, 2013) is very subjective. What is life-affirming to a commercial farmer in the Segura basin can be very different to life affirming actions and conditions to farmers in the same basin, or the Tagus basin. In this way, socionatural differences and inequalities impact different human beings, subjectivities and non-humans in very different ways (Harris, 2006). I therefore explore these more-than-human issues, and through it, also grapple with my own position as researcher, as well as a human being within these river basins with my own history and relationship with the waters in question.

1.5. Methodologies

The methodologies involved throughout the dissertation can be grouped into 3 types, according to the chapters outlined below – critical literature reviews, multi-case studies, and self-ethnography. I point out at this stage that while initial fieldwork planning in 2019 foresaw a more ethnographic approach instead of a multi-case study, the outbreak of the Coronavirus Disease of

2019 (COVID-19) in early 2020 forced me to reconsider, from an ethical and security perspective, how to reach out to the irrigation communities (see section 1.4.2. below). Site visits were limited to a few weeks in spring of 2022 between surges of the COVID-19 pandemic.

1.5.1. Literature review

Chapter 2 is approached through a critical literature review methodology. Historically, the aim of reviews of this nature is to synthesize knowledge for the generation of "best" evidence and filtering out "bad" evidence to be used by decision-makers (Grant and Booth, 2009), and arrive "at working research conclusions and workable practice solutions" (Sandelowski, 2008, p. 104).

Reviews as methodology have been critiqued particularly when positioned as an objective approach to summarize research. Systematic reviews tend to favour quantitative research over other ways of knowing (Pope, 2003), knowledge systematization and procedural objectivity claims may suppress quality (Maclure, 2005), and highly contextual fields present suitability challenges to knowledge synthesis (Chambers *et al.*, 2018). Taking these critiques into consideration, review methodologies can still be "a critically useful interpretation and unpacking of a problematic that situates the work historically and methodologically" (Lather, 1999, p. 3).

Reviews of IBWTs present challenges. In the most recent review of IBWTs, Purvis and Dinar (2020, p. 4) note that literature on IBWTs is too inconsistent to develop their own empirical methodology. Similarly, the multiplicity of approaches and disciplines that examined IBWTs makes attempts at a systematic, quantifiable review inappropriate. I choose to follow a more qualitative account of IBWT cases, illustrating different hydrosocial dimensions, changes in these, and interlinkages as described in the cases themselves.

The mapping and narrative process is inspired by network thinking. Rocheleau and Roth (2007, p. 433) encourage researchers "to apply network metaphors, models and theories to questions of power … integration of culture and nature, and relations of rootedness and mobility within and across territories". Networks help conceptualize the interlinkages of different dimensions and scale, focusing attention on interlinkages and reciprocal effects cascading across the network. To see how power is deployed, acted on and through whom, this network approaches also asks to keep in mind communities' positions within networks, vis a vis other dimensions, processes and scales, not only their geographical position.

Following a network approach, I mapped these narratives and interpreted them along an iterative process, resulting in a narrative account of biophysical and socioeconomic conditions and changes caused by IBWTs, a deeper comparison of interlinked hydrosocial territories in 4 typologies, and an account of conflicts and contestations emerging from IBWTs.

1.5.2. Multi-case studies

For chapters 3 and 4, I proposed a comparative case study of various irrigation associations that incorporates intersectional approaches that can pick up on participants' accounts of technological changes as well as their desired socionatural state. Due to time and health constraints (fieldwork planning was conducted in 2021-2022 with the COVID-19 pandemic still being a concern), I aimed to reach a middle ground between richness of data and wide-ranging representativeness. Therefore, pure ethnographic methods were ruled out, and purely quantitative methods were also inappropriate. To reach this middle ground, I proposed a multi-case study (Yin, 2009a)and semi-structured interview approach combining participant observation and material documenting part of participants' local hydrosocial territory (technologies used, biophysical environment).

Based on the historical and contextual background of the TSA, I focused on irrigation associations (comunidades de regantes) by virtue of being the largest water users in Spain, with irrigation accounting for 69% and 86% of total water use in the Tagus and Segura basins respectively for 2015. While the total number of irrigation associations is not known, many are federated both in the National Federation of Irrigation Associations (FENACORE), and in basin-specific federations. The largest of these basin-specific federations are the Federation of Irrigators of the Tagus Basin (FERTAJO) and the Central Union of Irrigators of the Tagus-Segura Water Transfer (SCRATS).

For ease of access and time considerations, I selected irrigation associations through contact with the basin-level federations or through contacts made so far through activists. Preliminary interviews with heads of federations (FERTAJO), presidents of irrigation associations (comunidad de regantes del canal bajo del Alberche), water regulators (Confederación hidrográfica del Segura), and activists in both basins (Plataforma en Defensa del Tajo, Asociación de Mujeres Rurales del Raiguero) have provided important considerations and dynamics between and within irrigation associations in both basins.

Amongst the various factors to consider, I found that one of the most important, both at the association level and at the member level, is the question of modernization. It represents a change in technology and knowledge, changing dynamics amongst members (see Sanchis-Ibor, Boelens, and García-Mollá 2017; García-Mollá et al. 2020), while at the same time introducing new actors (with particular interests and political and economic leverage) in water use and management within irrigation. This potentially encourages a negative feedback loop of water savings being deployed to expand irrigated surfaces (a rebound effect), rather than contributing to ecological flows or other uses. It can also introduce new patterns of economic and political control of irrigation associations, both at the organizational scale and at the member scale, by these new actors and amongst powerful members within associations. Modernization was investigated through individual interviews and ensuring that chosen associations have a mixed level of modernization, with interviewees being able

to recall pre- and post-modernization experiences. This applied in both the Tagus and Segura basins.

As for other factors, these are quite basin, even-sub-basin specific. Even if the TSA water transfer may not impinge directly on water availability in the Tagus, its operation can impact some factors more directly than others. Associations that directly source their water from the Tagus downstream from the confluence of the Jarama with the Tajo are more subject to variations in water availability caused by the TSA than those on the subsystems and will also have to deal with contamination from Madrid. These types of associations, directly sourcing water on a stressed Tagus, can represent a "worst case" scenario, compared to associations that may be found in sub-systems that do not suffer directly from the TSA. These, however, are often found on sub-systems that transfer water to Madrid and are invariably called stressed subsystems. Associations in these areas offer a picture of different issues that irrigators face that are still linked one way or another to the TSA. Other factors include the location of associations above or below the point of the TSA transfer, and whether associations are "social" or not. Regarding the former, there are very few associations upstream from the TSA transfer, partly because of a harsh climate, and none are included in the Tagus federations. As for the latter, these are found in subsystems in the Extremadura region and pre-date TSA operation.

Factors in the Segura basin are different. There are associations that directly source their water from the TSA, and are invariably larger, and highly modernized. Being direct beneficiaries of the TSA, an association here would be selected for interviews. At the same time, there are other associations who practice traditional irrigation practices. Comparisons of other associations not benefiting from the TSA prove more complex though. Older associations in Murcia's and Alicante's *vegas*[2] still water by gravity and resist pressures for modernization, while associations at the headwaters of the Segura (Albacete province) face issues linked to modernization and groundwater extraction. In this respect, the choice for other associations is to be a traditional association in the *vega* and in the headwaters, though searching for one that may be embarking on modernization.

Based on the sampling mentioned above, I conducted semi-structured recorded interviews (see appendix 1 for guiding question list) with 27 individuals between May and June 2022. I conducted interviews with members and associated individuals of 6 irrigation associations (see appendix 2) in both the Tagus and Segura basins, and where possible following intersectional categories – age, male/female, class (hectares owned and degree of modernization). This aims to ensure a degree of representativeness within associations. The small number of associations chosen cannot in any way aim to be representative of the whole basins, but it aimed to paint a picture of 6 hydrosocial territories that are linked together within their own basins and across basins by the TSA water transfer.

[2] Floodplain in Spanish

1.5.3. More-than-human storytelling

In part due to the hiatus imposed by the COVID-19 pandemic, I decided to employ more-than-human storytelling to think with my colleagues about the more-than-human relationalities of water (see section 1.3 and chapter 5). Individual human attachment to place, territory or country infuses the political into debates within and across more-than-human entities that pulse through multi-scalar spaces (Bawaka Country *et al.*, 2013). This echoes what Fenske and Norkunas (2017) argue in methods on storytelling of the more-than-human, "remembered meanings of nature, for example, as represented by a person's narrative of her or his life, will change as the social meanings of human–nonhuman relationships change. In this sense, storytellers not only reflect their specific realities but also create them" (2017, p. 106). It provides an opportunity of thinking through the troubles of one's positionality in relation to spaces that are always co-constituted with others, whether human, or more-than-human (Barad, 2007). Storytelling of the more-than-human (Tsing, 2015; The Multispecies Editing Collective, 2017) has the potential to narrate complex stories about the entanglements of life (Fenske and Norkunas, 2017).

1.6. Outline of the dissertation

This dissertation is built on 6 chapters, starting with this one, and finishes with a concluding chapter that draws on the arguments and synthesizes the results of the preceding chapters, and pointing towards future lines of research. As anticipated in section 1.1., chapters 2 to 5 follow an empirical scalar descent downwards, from the scale of IBWTs (chapter 2), irrigation communities in hydrosocial territories connected by the TSA (chapter 3), irrigator subjects in said communities (chapter 4), and my own understanding, relation and co-becoming with the Tagus and Segura rivers and the TSA (chapter 5). Chapters 2 and 4 have been published as articles in scientific journals, and chapter 5 has been published as a book chapter. Chapter 3 has been submitted for peer review as an article to a scientific journal.

Chapter 2 (based on an article published in the Journal of Political Ecology as Bourguignon, 2023[3]) provides a theoretical and empirical review and analysis of IBWT cases worldwide. It uses and develops an emerging framework of a political ecology of water transfers alongside socionatural regimes to explore how IBWTs set in motion a standardization not only of space but also of time in water governance and allocation. It poses the questions of how have IBWTs brought about social and ecological changes to hydrosocial territories, whether IBWTs always serve modern socionatural regimes, and what consequences are there for understanding contestations linked to IBWTs. Based on a review of 29 IBWTs analysed in 26 scientific articles and book chapters, I analyse IBWT impacts in donor and recipient basins, interconnections across these different impact types, the longevity and changing uses of IBWTs, and finalize with an analysis of

[3] Bourguignon N (2023) Connected and disrupted hydrosocial territories: the making of modern socionatures through inter-basin water transfers. Journal of Political Ecology 30: 241–273.

the contestations that arise from planning and operation of IBWTs. I argue how IBWTs impact donor basins more and that there are few changes in water governance mechanisms through their operation, that perceptions of guaranteed flow to recipient basins become naturalized, and despite the number of contestations, those based on defence of territory and ways of life are strongest and have greater chances of success.

Chapter 3 (based on an article submitted on the 29th of December 2023 to the journal Environment and Planning E: Nature and Space as Bourguignon[4]) descends to the scale of irrigation communities interlinked by the TSA and the deployment in these of drip irrigation as an on-plot technology. It mobilises hydrosocial territorial frameworks and explores how the hegemonic common senses of the TSA and drip irrigation intertwine differentially in these irrigation communities to produce distinct types of interconnected hydrosocial 'territories within territory' of the TSA. The article poses the questions of what territories are produced through the confluence of the hegemonic projects of IBWTs and on-plot irrigation modernization, how are these produced, and what territories resist or deter this confluence of hegemonic projects. Based on fieldwork and irrigation expansion and modernization data provided by the irrigation communities and from the Spanish Ministry of Agriculture, I identify the common senses of the TSA (hydraulic paradigm, hydrological imbalance at the national scale, valuation of water as an economic resource), of drip irrigation (efficiency and water savings), and how these have been experienced in the different irrigation communities discussed. Through this, I characterize the irrigation communities as hegemonic core, hegemonic frontier, and counterhegemonic based on the acceptance or rejection of these common senses, leading to the material constitution of said territories.

Chapter 4 (based on an article published in the journal Water as Bourguignon, Villamayor-Tomás and Boelens, 2024[5]) descends to the scale of individuals and subject formation at the level of irrigation communities, identified through their placement as hegemonic core, hegemonic frontier, and counterhegemonic discussed earlier in chapter 3. In this chapter, we identify the ideal irrigator subject constructed over different periods of Spanish history and how this ideal differs in reality throughout the different hydrosocial territories of the TSA complex. Utilizing a hydrosocial territorial, hegemonic, and FPE of subjectivities framework, we ask how irrigator subjectivities are constructed in relation to the (contested) configuration of the particular hydrosocial territories in which they are assumed to take part. We explore the complexities and contradictions of authorities establishing ideal regante subjects across time and space and to what extent these ideals are realized by irrigators themselves. We argue that recent policy shifts in the 21st century have created ideal subjects with multiple and contradictory roles and responsibilities, linked to plot modernization, agricultural professionalization, and farmer rejuvenation. This creates contested spaces between

[4] Bourguignon N (n.d.) Tracing (un)common senses in irrigation communities: hegemonies and counter-hegemonies across Spain's Tagus-Segura Interbasin Transfer complex. Environment and Planning E: Nature and Space.
[5] Bourguignon N, Villamayor-Tomás S and Boelens R (2024) Fabricating Irrigators : Contested Hydrosocial Territories and Subject-Making in Spain's Tagus-Segura Interbasin Transfer Arena. Water 16(192): 1–21.

smallholders and large capitalist farmers in core and frontier hegemonic territories, while counterhegemonic territories resist these pressures by embodying alternative values and imaginaries.

Chapter 5 (based on a book chapter published in Contours of Feminist Political Ecology as Bourguignon, Leonardelli, Still, Nightingale and Nelson, 2023[6]) descends to the scale of the personal, written alongside fellows from the WEGO-ITN network. We think together on the development of the concept of more-than-human interdependency to trouble essentialising narratives that may be read into such complex and situated relationships, and how thinking with the politics of interdependency can enable us to narrate the situated complexities of their emergence as a process of co-becoming. My own contribution to this chapter focuses on my personal relationship with the Tagus River and this research project, exploring my positionality as a method of storytelling of the more-than-human, recounting the Tagus River as a journey in history (including my own). I consider the contradictions of interdependent subjects across the various territories of the Tagus River and how it spills outwards across many types of waters and domains, while at the same time considering the importance of partial perspectives in never fully knowing the river, and the politics of valuation systems that consider what is of interest and what is not in such a vast territory. My own writing is contrasted with accounts of wastewaterscapes in Maharashtra, and both come together in reflecting on the ethics of co-becoming in more-than-human interdependencies, of justice, and of life and death, and of research that co-becomes through our own ways of making sense.

Chapter 6 concludes the dissertation by bringing together the arguments from the previous chapters. It answers the overall dissertation research question of how the TSA's recreation of dominant narratives of water's use, territorial configurations and subjects, and the situated politics of compliance and resistance to these. By doing so, it discusses how it contributes to scholarship in political ecologies of water, hydrosocial territories, and FPEs. It discusses the limitations and caveats, as well as future research emerging from the findings.

[6] Bourguignon N, Leonardelli I, Still E, et al. (2023) More-Than-Human Co-becomings: The Interdependencies of Water, Embodied subjectivities and Ethics. In: Harcourt W, Agostino A, Elmhirst R, et al. (eds) Contours of Feminist Political Ecology. Cham: Palgrave Macmillan, pp. 129–153. Available at: http://dx.doi.org/10.1007/978-3-031-20928-4_6.

2. Connected and disrupted hydrosocial territories: the making of modern socionatures through inter-basin water transfers[7]

Abstract

Actual and projected water scarcity has accelerated the development in number and scale of hydrological infrastructure in the form of IBWTs. These are unique since they transfer freshwater from one geographically distinct river catchment or basin to another. IBWTs represent a continuation of supply-side policies that pose distinct water governance challenges. This matters: if all projected IBWTs are completed by 2050, the volume of water transferred would represent 48% of global water withdrawals. This paper examines IBWTs from a socionatural perspective. Building on the political ecology scholarship of hydrosocial territories, I probe how IWBTs co-constitute and reconfigure socionatural relations, and supplement discursive elements of the hydrosocial territory concept with that of socionatural regimes to understand how changes caused by IBWTs are experienced by communities and ecologies in unequal ways. This requires seeing how IBWTs bring about social and ecological changes to hydrosocial territories, what features of hydrosocial territories are influenced by IBWTs, how do these changes conceptually inform hydrosocial territories, and what consequences are there for understanding contestations. Through a critical literature review of 26 scientific articles and chapters, I define multiple socionatural dimensions – biophysical, socioeconomic and governance – and their interrelations in each of the 29 IBWTs described in this literature. From this review, I found that IBWT territories generally degrade biophysical dimensions and socioeconomic conditions for communities in water-sending "donor" basins, and that IBWTs have potentially long shelf lives, conditioning future territorial reconfigurations. The number of contestations also suggests that water governance institutions are ill-equipped to take on the challenge that IBWTs bring in governing across multiple basins, and that IBWTs generate contestations that speak not only to simple allocation disputes, but to defence of territory and ways of life. Contestations seen through a socionatural perspective highlights the political stakes for those who see the worlds they know shift irrevocably when IBWTs become fixtures of their hydrosocial territory.

2.1. Introduction

Actual and projected water scarcity has accelerated the development, in number and in scale, of hydrological infrastructure, particularly of mega-projects in the form of IBWTs. IBWTs are unique, transferring freshwater from one "geographically distinct river catchment or basin to another" (Davies, Thoms and Meador, 1992, p. 327). In the most ambitious cases, planned IBWTs make up multi-IBWT hydro-networks, such as India's river linking program or China's South to

[7] This chapter is published as: Bourguignon, N. (2023). Connected and disrupted hydrosocial territories: the making of modern socionatures through inter-basin water transfers. *Journal of Political Ecology*, 30, 241–273. https://doi.org/10.2458/jpe.2848

North Water Transfer. Despite increased implementation of demand-side policies with the water governance paradigm shift towards Integrated Water Resource Management (IWRM) in the 1990s – supporting equity, ecological integrity and economic efficiency – supply-side options such as IBWTs are not decreasing, but increasing (Gupta and van der Zaag, 2008). If all projected IBWTs are completed by 2050, the volume of water transferred would represent 48% of the global water withdrawal (Shumilova *et al.*, 2018). This matters since transformations wrought by IBWTs are multi-scalar, multi-dimensional and multi-basin, affecting ecologies, societies, and water governance politics and institutions in highly unequal, inter-related and contentious ways.

Complex, multi-scalar, and multi-territorial, IBWTs provide opportunities to develop interdisciplinary political ecology scholarship on socionatural perspectives. Political ecologies of water developed multiple concepts exploring socionatures as assemblages, notably through waterscapes (Swyngedouw, 1999, 2015) and more recently through the hydrosocial cycle (Linton and Budds, 2014) and hydrosocial territories (Boelens *et al.*, 2016). These have recently contributed to an emerging political ecology of water transfers, positing IBWTs as archetypally socionatural and embodying the materialization of the contested imaginaries of hydrosocial territories (Bourblanc and Blanchon, 2014; Islar and Boda, 2014; Hommes and Boelens, 2017). Attention in this field is paid to higher scale processes and authority, when socionatural transformations occur locally. Similarly what features of socionatures change is only briefly described or mapped. Finally, the question of a hydrological intervention's temporality and how its influence on contested imaginaries of territories is yet to be explored.

I argue that this emerging field can be developed by incorporating the concept of socionatural regimes (Kolinjivadi, Vela Almeida and Martineau, 2020) into a critical review of IBWT cases in the scientific literature. While building on insights from previous reviews of IBWTs (Gupta and van der Zaag, 2008; Rinaudo and Barraqué, 2015; Shumilova *et al.*, 2018; Purvis and Dinar, 2020), I analyse the socionatural dimensions of the hydrosocial territories that IBWTs co-constitute, focusing on biophysical and socioeconomic relationships that give rise to changing political directions and contested imaginaries. I also examine the ways modern socionatural regimes shape perceptions of water through IBWTs, and how they fit in an understanding of hydrosocial territories. How have IBWTs brought about social and ecological changes to hydrosocial territories, do they always serve modern socionatural regimes, and what consequences are there for understanding contestations linked to IBWTs are three questions that will guide this article. Reviewing IBWT cases in the scientific literature from the past 12 years, I aim to showcase IBWTs' socionatural transformations and the responses and resistances to these as examples of the emergent tensions of locally situated struggles to create more just, equitable, and ecologically robust hydrosocial territories.

This article begins in section two by introducing IBWTs as multidisciplinary problems best understood socionaturally. It presents the socionatural concepts developed in the political ecology of water, establishing hydrosocial territories as particularly useful to examine IBWTs through its use

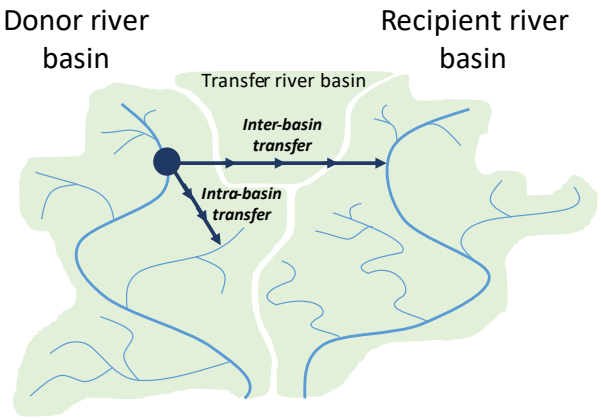
of contested imaginaries. Identifying gaps in this literature, I present socionatural regimes (Escobar, 1999; Kolinjivadi, Vela Almeida and Martineau, 2020) as a complementary socionatural concept that can support the understanding of IBWT changes from a hydrosocial territorial lens. The following section (three) presents the critical literature review, taking heed to make it explicitly qualitative and narrative to best understand the linkages across socionatural dimensions and how contestations emerge. Section four collects four pertinent issues emerging from the literature and critical literature review, exploring 1) how IBWTs degrade socionatural dimensions, 2) how these dimensions are inseparable, 3) a presentation of the long duration and changing water uses of IBWTs, and 4) on contested IBWT territories. Before concluding, I discuss how IBWTs are the realization of specific imaginaries that bring about socionatural disintegrity, and that as infrastructure they fashion new territories. In these ways they continue the standardizing and rationalizing tenets of modern socionatural regimes. Contestations may resist this when they defend socionatural territories and visions of water that reject state and capital-led visions of water use, but the absence of contestations also reflects state-subject making as well as differing understandings of where authority, and visions supporting it, emanate from.

2.2. Theory and conceptual framework

2.2.1. Interbasin Water Transfers

IBWTs transfer water from river basins where it is considered in excess to basins where it is considered scarce. Yet IBWTs are difficult to typologize: they can transfer water amongst sub-basins within a single river basin as intra-basin water transfers, or cross 'transfer' basins found between a donor and recipient basin (see Figure 1 below). Within water management literature, IBWTs are a supply-side water management option. These supply-side options aim to increase water supply, though it is not always as a response to increased water demand. Increasing water supply in specific places, whether through IBWTs, dams, desalination plants, navigation schemes or groundwater pumping, sets conditions to trigger economic and social development but is also an expression of national and political power (Sternberg, 2015; Shumilova *et al.*, 2018).

Figure 1: Illustration of donor and recipient basins within Inter- and Intra-Basin Water Transfers



Source: Author's own illustration

IBWTs share common features with other types of hydrological infrastructure, yet also stand apart. They can be multi-purpose and large-scale, and require substantial investments in infrastructure and storage, and exist to support economic activities (Gupta and van der Zaag, 2008; Purvis and Dinar, 2020). Yet IBWTs are unique in that they are assemblages of hydrological infrastructure that connect previously unconnected river basins. This implies issues concerning single elements of the hydrological infrastructure that makes up an IBWT, such as dams, but also an increase in the spatial scale at which water is managed. Such issues are best tackled in a transdisciplinary manner (Gupta and van der Zaag, 2008). By working with and justifying concepts of water surplus and scarcity, or the river basin as the preferred management unit, these concepts become naturalized and unquestioned within scientific and public discourse.

As they increase in number, scope and scale, IBWTs raise a gamut of issues: flow disruptions, contamination, introduction of non-native species, and political conflict between communities across donor, transmitting and recipient river basins, as well as between rural and urban inhabitants. Water governance literature has examined a number of topics concerning IBWTs: their alignment with tenets of IWRM (Gupta and van der Zaag, 2008); their historical and current evolution and popularity as an engineering intervention (Rinaudo and Barraqué, 2015); their importance within the water-food-energy nexus (Shumilova *et al.*, 2018); and their sustainability as a policy intervention (Purvis and Dinar, 2020). Two features of IBWTs emerge from these discussions. The first is scale. IBWTs increase complexity by increasing the territory and number of connected users (Gupta and van der Zaag, 2008), and IBWT-induced environmental impacts occur at larger scales, including salinization and the loss of habitats (Shumilova *et al.*, 2018). Second, all agree on the mixed bag of advantages and disadvantages IBWTs bring about. Purvis and Dinar (2020) found that environmental management and environmental rehabilitation outcomes had

positive results, but that environmental effects, irrigation outcomes, and environmental justice outcomes were likely to have negative results.

It is clear that IBWTs are increasing both in number and scope, with potentially long-lasting consequences. Analyses of IBWTs reveal questions focusing on scale, dimensions, complexities and contradictions. Their complex, multi-dimensional impacts have been explored from governance perspectives, but an important issue not covered in this literature has been how IBWTs have been supported, resisted, and contested. To deal with this I employ a socionatural political ecology perspective.

2.2.2. The emerging Political Ecology of water transfers

Socionatural thinking emerges from political ecology scholarship on human-environment relations. It questions both the society-nature binary and established narratives and knowledge of the world, through critical analysis of the distribution of power, its application on the natural environment, and the unevenly distributed costs and benefits of environmental change (Rocheleau and Roth, 2007; Loftus, 2009). Political ecologies of water have been at the forefront of socionatural thinking. Political ecologists argue that water is part-natural, part-social, and socionatural water is seen as a process in which social relations are embedded (Bourblanc and Blanchon, 2014); that is, where power relations shape human knowledge of and intervention in water, leading to particular forms of governing nature and people (Boelens, 2015).

Political ecologies of water developed innovative concepts based on socionatural thinking. These engage with socioenvironmental injustices stemming from the complex interaction of nature, society, technology and culture (Truelove, 2011; Bourblanc and Blanchon, 2014; Zwarteveen and Boelens, 2014). Political ecologies of water are hybrid styles that combine material and discursive analyses (Rodríguez-Labajos and Martínez-Alier, 2015) exploring the coproduction of socionatural assemblages. The concept of "waterscapes"(see Swyngedouw, 1999, 2015), was an initial effort in this direction, and inspired further complementary conceptual thinking. Waterscapes became more nuanced, for example by putting gender and constitutive power relations in relation to contaminated water (Sultana, 2011) or analysing everyday dimensions of resource inequality through processes of social and spatial differentiation (Truelove, 2011).

IBWTs have recently been deployed to explore hydro-socionatural concepts, such as the hydrosocial cycle (Linton and Budds, 2014) and hydrosocial territories (Boelens *et al.*, 2016), contributing to an emerging political ecology of water transfers. The hydrosocial cycle is explored by Bourblanc and Blanchon (2014) and Islar and Boda (2014), providing some important considerations: natural and artificial flows become part of the same hydrosocial cycle and exemplify socionature; water governance challenges are better understood through the cycle rather than through the basin; and the cycle also represents flows of social relations influencing investment strategies and structuring social relations themselves.

The concept of hydrosocial territories provides a strong conceptual grounding for understanding the socionature of IBWTs. It focuses on territories as contested imaginaries and their materializations, and "as a battle of divergent (dominant and non-dominant) discourses or narratives, [hydrosocial territoriality] has consolidating a particular order of things as its central stake" (Boelens *et al.*, 2016, p. 7). Boelens et al. (2016) build their understanding of imaginaries on three characteristics. First, using Foucauldian governmentality as a concept to understand dominance. Second, they identify processes of subjectification and how they change. Finally, they recognize a plurality of scales, the idea of overlapping and contested 'territories within territory.'

While relatively new, hydrosocial territory literature has expanded quickly and is exploring the role of infrastructure in territorialization both conceptually and empirically. Hommes and Boelens's (2017) work on rural-urban relations in Peru builds on Boelens et al.'s initial definition of the concept of territory as contested imaginary, and of territories within territory (see Boelens et al. 2016, 2). Hommes and Boelens argue that contested imaginaries describe divergent interest groups' interpretation of current arrangements and how the future should be. Recognizing territorial diversity and struggles therein are struggles over meanings in socionatural world views, their definitions of problems, and the material realization of imaginaries. Infrastructure is not just physical but is accompanied by ascribed social norms, practices, networks and ideas with political interests and discourses behind them. IBWTs represent being modern, resulting in tense conflictual relationships between modernity's imaginary and its social, economic, and ecological costs. An empirical example of mapping hydrosocial territorial changes instigated by IBWTs was conducted by Lopez et al. (2019) in Bolivia. The authors showcase shifting alliances across user groups who hold divergent imaginaries of what hydrosocial arrangements should be, engaging various stakeholders at different scales of administration and (global) finance.

This emerging political ecology of water transfers builds on a strong tradition of socionatural thinking. Bourblanc & Blanchon's (2014) use of the hydrosocial cycle concept to critique the assumption that the river basin is the natural unit for water governance is part of a tradition of calling out naturalizing discourses in water governance that underpin socioenvironmental injustices (Molle, 2009b; Zwarteveen and Boelens, 2014; Swyngedouw, 2015). This tradition also critiques a lack of political analysis in scholarship on human-environment relations and socio-ecological systems (Cote and Nightingale, 2012), and questions the naturalization of institutional immobility. Islar and Boda's (2014) analysis of problem framing speaks to the relationship of expert knowledge and power, where scarcity is naturalized to justify IBWT interventions, and on the predatory nature of urban areas to appropriate resources from rural areas, instigating socionatural changes leading to increased inequality. Hommes and Boelens (2017) argue that the collision of unequal imaginaries in the constitution of new hydrosocial territories involves the materialization of their discourses and vision, realized through the mobilization of power.

Several gaps appear in the literature on both water governance and the political ecology of water. They suggest the flow of power across scales is generally in one direction. Yet hydraulic vision and decision-making can spill upwards to higher scales of authority, and of political and financial power. More particularly, we see that IBWTs create new hydrosocial territories, but little attention has been paid to what social or environmental features of hydrosocial territories and socionatural systems change, how they do so, along what imaginaries and by what means. Additionally, while the spatiality and multiple scales of IBWTs has been studied, their temporality – their longevity and what impact this duration has on imaginaries, other hydrological interventions, or policies – has not been sufficiently explored. A socionatural regime approach (Escobar, 1999; Büscher *et al.*, 2012; Kolinjivadi, Vela Almeida and Martineau, 2020) can provide a supplemental analysis of IBWT longevity that strengthens a hydrosocial territorial analytical framework.

2.2.3. IBWTs and hydrosocial territories: territories, regimes, time and power

IBWTs can represent the insertion in time and space of assemblages that condition a particular type of material and discursive behaviour, creating and engulfing territories along rearticulations of socionatural relations. This conditioning, however, is political. Following Escobar (1999), Kolinjivadi, Vela Almeida and Martineau define socionatural regimes as a set constellation of relational networks between humans and nature, representing "multi-scalar relational networks that both influence and are equally affected by a *tendency* towards ontological uniformity of socionature relations" (2020, p. 5, emphasis in original). They argue that *modern* socionatural regimes fix rigid, totalizing perceptions of time – informed by modern science in its standardization of reality and (non) human subjects – that are inherent to capital's socionatural relations. IBWTs as assemblages are manifestations of modern regimes, seen through increasing control over water (Hommes and Boelens, 2018), its rhythms, and a naturalization of its availability to where it is transferred.

IBWTs forming part of hydrosocial territories co-constitute State-Society relations and modern socionatural regimes through the process of subjectification of humans and non-humans, particularly through the suppression of the divergent imaginaries that socionatural relations *could* have. Here, a feminist performative understanding of power provides a way to think with this issue. States do not just have power; rather, the exercise of power produces "stateness" and subjects, and the State as process shows "how the state emerges as a multi-sited, contradictory, and inconsistent set of effects" (Nightingale, 2018, p. 693). State subjectification effects are partial, renegotiating state-society boundaries of who or what belongs. As part of hydrosocial territorial imaginaries, planning and operation of IBWTs erases divergent histories, temporalities and futures of alternative water arrangements, thus serving the narrative and materialization of modern socionatural regimes. Feminist performative understandings of the State also give explanatory power over the appeal of IBWTs as development projects espoused by state and powerful actors, the contestation of IBWTs

by other actors, or to what extent contestations shift the terms and legitimacy of state-building processes.

The idea of socionatural regimes helps us think about some of the gaps identified in hydrosocial territory literature, but when used to explore IBWTs and other hydrological infrastructure, it also informs associated debates in environmental justice. Within the political ecology of water, Zwarteveen and Boelens (2014) include socio-natural justice (or socio-natural integrity) as an additional dimension to Schlosberg's three dimensions of environmental justice – distribution, recognition and participation (Schlosberg, 2004). Socio-ecological integrity stands apart from the previous dimensions because it recognizes three specific aspects: water's dual life-securing and life-threatening nature, its embeddedness in delicate and dynamically shaped socio-natural environments, and its role in inter-generational justice (Zwarteveen and Boelens, 2014, p. 147). The shift to thinking of justice in generational time opens ontological possibilities that include the plurality of generations of multiple species, and moves away from its uniformization. In a nutshell, thinking with IBWTs about how and why changes occur in hydrosocial territories, what regimes are constituted, and by which actors, leads us back to questions of the imperfect and constant co-constitution of hydrosocial territories, the resistance to these, and the durability and integrity of divergent territories.

I trace IBWTs and the changes they induce across different dimensions, and how they are experienced by communities and territories in unequal ways. Seeing how IBWTs impact different communities and processes requires understanding their multiple but deeply interlinked social and ecological dimensions (Rocheleau and Nirmal, 2015). To contribute to the emerging literature on hydrosocial territories and IBWTs, this article's principal aim is to examine how the scientific literature has documented how IBWTs change hydrosocial territories. Emerging from this, it poses the following sub-questions: How have IBWTs brought about social and ecological changes to hydrosocial territories? What features of hydrosocial territories are influenced by IBWTs? How do these changes conceptually inform hydrosocial territories and socionatural regimes? And what consequences are there for understanding contestations linked to IBWTs?

2.3. Methodology

This article reviews how the scientific literature has documented biophysical, socioeconomic and water governance changes in IBWT cases. Historically, the aim of reviews of this nature is to synthesize knowledge for the generation of "best" evidence and filtering out "bad" evidence to be used by decision-makers (Grant and Booth, 2009), and arrive "at working research conclusions and workable practice solutions" (Sandelowski, 2008, p. 104). Reviews as methodology have been critiqued particularly when positioned as an objective approach to summarize research. Systematic reviews tend to favour quantitative research over other ways of knowing (Pope, 2003); knowledge systematization and procedural objectivity claims may suppress quality (Maclure, 2005); and highly

contextual fields present suitability challenges to knowledge synthesis (Chambers *et al.*, 2018). Taking these critiques into consideration, review methodologies can still be "a critically useful interpretation and unpacking of a problematic that situates the work historically and methodologically" (Lather, 1999, p. 3).

Reviews of IBWTs present challenges. In the most recent review of IBWTs, Purvis and Dinar (2020, p. 4) note that literature on IBWTs is too inconsistent to develop their own empirical methodology. Similarly, the multiplicity of approaches and disciplines that examined IBWTs makes attempts at a systematic, quantifiable review inappropriate. For these reasons I present a more qualitative account of IBWT cases, illustrating different hydrosocial dimensions, changes in these, and interlinkages as described in the cases themselves.

The mapping and narrative process is inspired by network thinking. Rocheleau and Roth (2007, p. 433) encourage researchers "to apply network metaphors, models and theories to questions of power … integration of culture and nature, and relations of rootedness and mobility within and across territories". Networks help conceptualize the interlinkages of different dimensions and scale, focusing attention on interlinkages and reciprocal effects cascading across the network. To see how power is deployed, acted on and through whom, network approaches also ask to keep in mind communities' positions within networks, in terms of multiple dimensions, processes and scales, not only their geographical position.

Following a network approach, I used an iterative process to map and interpret these narratives, resulting in a narrative account of biophysical and socioeconomic conditions and changes caused by IBWTs, a deeper comparison of interlinked hydrosocial territories in 4 typologies, and an account of conflicts and contestations emerging from IBWTs. I identified dimensions and variables in the literature review on both IBWTs and the political ecology of water that provide interlinkages between and within dimensions across basins connected through IBWTs (see table 1 below). The review framework established 3 dimensions: biophysical, socioeconomic and water governance. Within each dimension, I established variables and classified them as descriptive and outcome. The former describes conditions prior to IBWT construction and operation. The latter describe changes or issues that are relevant once IBWTs are operating.

Table 2: Hydrosocial dimensions and their variables.

	Hydrosocial dimensions		
Variables	**Biophysical variables**	**Socioeconomic variables**	**Water governance variables**
	• Basins • Flow • Habitat • Species distribution • Contaminants	• Demography and habitation • Economic activities and agriculture and forestry • Other extractive industries • Water consumption	• Allocation • Monitoring • Institutions • Contestation

Source: Author's own compilation

The sample was established by using the Scopus search engine. Search criteria were: "Interbasin transfer" or "inter-basin transfer" or "interbasin transfers" or "inter-basin transfers", for

articles published since 1989. The result was 274 articles. This sample was explored with further exclusion and inclusion criteria. To capture social dimensions as well as some narrative description of all dimensions of IBWTs, the review excluded sources other than journal articles and book chapters, articles whose exclusive topics were in disciplines outside of the social sciences, and those where more than 4 IBWT cases are discussed. After further examination of articles published prior to 2011, these, aside from 2 articles, were found to not have enough information for the review exercise. The final sample was 26 articles and book chapters (see appendix 3). 29 IBWTs were identified in the sample. Out of these, 11 were sub-project IBWTs of 5 large-scale IBWT projects. This generated a total of 52 cases of IBWTs reviewed (see appendix 4). At the time of publication of the articles, 26 IBWT cases had been built, another 21 planned, 2 were halted and 3 were cancelled.

2.4. Results

This section presents the four most pertinent themes emerging from the review that inform what features of hydrosocial territories change through IBWTs. These are: 1) the impacts caused by IBWTs as measured by variables (full descriptions of all variables covered in the review can be found in appendix 5); 2) the interconnections across groups of impacts; 3) the longevity of IBWTs; and 4) the nature of contestations arising from IBWT planning and operation. The section will close with a description of contestations emerging from IBWTs.

2.4.1. IBWT impacts

Whether looking within or across biophysical or socioeconomic dimensions, IBWTs seem to degrade variables. Socioeconomic variables negatively affect biophysical variables, and governance variables react slowly. IBWTs trigger declines in biophysical variables when these interplay in unequal ways with socioeconomic systems, particularly where economic and extractive activities are concerned. Flow affects certain economic activities as do water quality and migration, but in specific places and territories, and certainly not where the benefits of an IBWT accrue.

Contamination emerged as the most common impact linked to IBWTs. Most contamination was found in water, with half of cases reporting these in recipient basins compared to slightly less than half in donor basins. Three IBWTs stand out: the Ankara Kizilirmak plan in Turkey (Islar and Boda, 2014, p. 4), the Lesotho Highland Water Project (Blanchon, 2015, p. 168), and China's South to North Water Transfer (Rogers *et al.*, 2020). These cases highlight the urgency with which IBWTs are planned in periods of drought, the extractive contexts for newer justifications of water transfers, the increasing government concern about contamination, and the unknown consequences of changing water flows for which they cannot plan.

Economic activities in donor basins. also suffered due to IBWT operation. In four cases in China and Turkey, industries were forced to cease operation and communities were relocated to reduce polluting activities and maintain water quality for water transfer. Two other cases mention

livestock damage through IBWT operation in recipient basins. In Nogales, Mexico, wastewater infiltration in the water table harmed livestock (Prichard and Scott, 2014). In South Africa's Orange River Development Project, the spread of pests in the recipient basin harmed livestock (Gupta and van der Zaag, 2008).

Finally, IBWTs bring about population movements caused by uncertainty for rural livelihoods, relocations, or opportunities in urban areas. Operational IBWTs aided urban areas surpass the biophysical limitations that local water supplies set for expansion and attract migrants. Population flows attributed to IBWTs occurred in Turkey, China, the USA and Mexico, nearly all occurring in donor basins. In Turkey, prolonged planning of the Istanbul Greater Melen project caused uncertainty for rural inhabitants, pushing them to migrate to urban areas (Islar and Boda, 2014). In China, construction of the whole South to North Water Transfer is expected to relocate 300,000 people (Gupta and van der Zaag, 2008).

2.4.2. Webs of interconnected IBWT impacts

IBWTs are multi-dimensional and multi-scalar, and when analysing these with a socionatural perspective, this multiplicity can be mapped. In this section, I selected six cases and four IBWTs with different operating status (see Table 3 below). Following a short description of each case, I mapped and analysed causal links between each variable, noting where interconnections are described by authors as having a positive, negative, or undetermined effect.

The planned Integration Project of the Sao Francisco River in Brazil aims to transfer water from the Sao Francisco River basin to the semi-arid north east of Brazil for irrigation, urban residential, and industry needs. While plans have been proposed since the 19th century, there are concerns this IBWT will cause significant environmental issues by reducing water availability in the Sao Francisco basin, and that benefits will accrue to large landowners (de Andrade *et al.*, 2011).

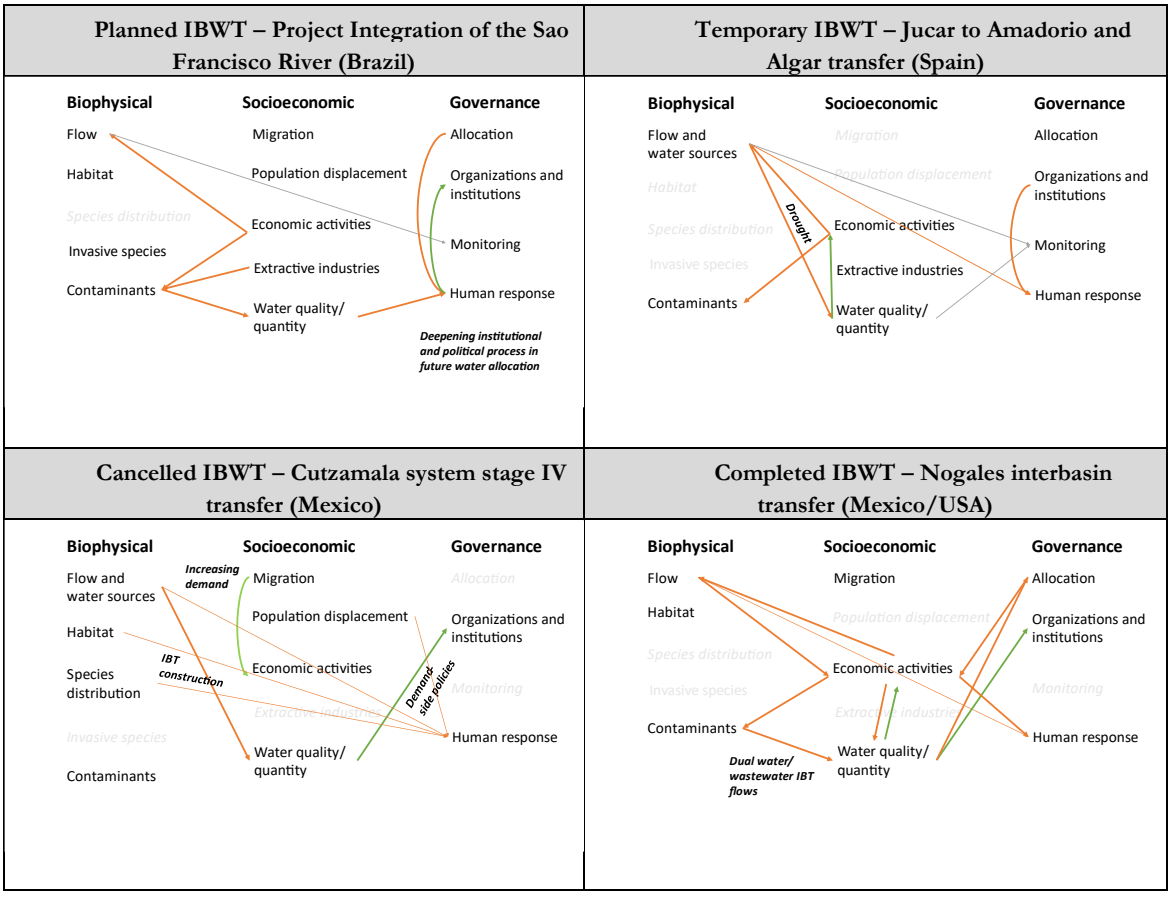
The temporary Jucar to Amadorio and Algar transfers in Spain occurred between 1999 and 2001, during extreme water scarcity in the Amadorio and Algar rivers. The donor Jucar River recovered from a drought period and its water was transferred to meet urban residential needs, since traditional aquifer sources were compromised. Envisaged to last 5 months, the transfer continued for two years (Sanchis-Ibor *et al.*, 2019).

The cancelled Cutzamala system stage IV transfer in Mexico aimed to transfer water from the Temascaltepec river to the Valley of Mexico to supply Mexico City, as an expansion of an existing network of IBWTs. Despite initial construction, the project was cancelled following resistance from social movements comprised of inhabitants in the Temascaltepec river basin (Cabral and Ávila-García, 2013).

The completed Nogales interbasin transfer between Mexico and the USA is a two-way transfer between Mexico's Los Alisos River basin and the USA's Upper Santa Cruz river basin, with fresh water transferred from Los Alisos to Nogales in the Upper Santa Cruz basin, and wastewater transferred back to the Los Alisos basin for treatment, thereby avoiding expensive treatment in the

USA. Wastewater return flow increased surface flow in Los Alisos, but caused groundwater contamination. Dry wells in rural areas persist, and wastewater continues to increase in urban areas (Prichard and Scott, 2014).

Table 3: Webs of socionatural relations: comparison of interconnection and causal linkages of biophysical, socioeconomic and governance dimensions within 4 IBWTs in 6 cases[8]



Source: compiled by author with information gathered from: de Andrade et al. 2011; Lee et al. 2014; Sanchis-Ibor et al. 2019; Prichard and Scott 2014; Cabral and Ávila-García 2013

From the cases examined, IBWTs link biophysical and socioeconomic dimensions in negative causal linkages. The principal biophysical variable connecting across socioeconomic and governance dimensions is water flow. In Brazil, the donor river's flow is interrupted due to hydropower. In Spain reduced flow is attributed to seasonal drought and intensive groundwater extraction for irrigation and municipal use. In Mexico, initial construction affected springs in the donor basin, while in the Nogales case diminished flow affected agriculture and ranching activities in the Los Alisos basin.

[8] The presence of variables discussed in the cases is indicated by their presence (not greyed out). Causal linkages are indicated by arrows, with colors indicating whether relationships have a negative effect (orange), an undetermined effect (grey), or a positive effect (green) on that variable's dimension. Key triggers of relationships are indicated in bold italics.

Contamination is a causal link in the socioeconomic dimension. Economic and extractive activities cause contamination, affecting water quality. In Brazil, extractive industries are found in the Sao Francisco basin, as is waste from agriculture and municipalities. In Spain, intensive agriculture in the Jucar basin caused filtering of nitrates and pesticides in groundwater for urban use. In the Nogales case, wastewater leaked into the water table in the Los Alisos basin, though treated wastewater has helped economic activity in Nogales. Disturbances to habitats and species distribution only fall into a causal link with contestations in Mexico, where rural inhabitants in the donor basin contested the IBWT's construction, fearing these disturbances would affect their livelihoods and way of life.

Complexity increases when socioeconomic variables link with other variables within and across dimensions. The principal conduit for relationships remains economic activity. In the case of migration, this was fuelled by rural to urban migration to Mexico City. In the case of water quality and allocation politics, limited water availability reduced livelihood opportunities for ranchers in Mexico but fuelled the growth of urban and industrial activity in Nogales. In the case of Spain, IBWT water kept irrigated agriculture afloat during a time of drought.

2.4.3. The longevity of IBWT territories

An emerging aspect of research on IBWTs concerns their actual and potential longevity. This longevity is linked to the reason for which water is transported, and these reasons can change. As seen in the following Table 4, a striking difference found in the cases is that between planned and actual water use. Of eleven cases describing planned and actual IBWT water use, four show differences between planned and actual water use. In addition, uses change over time. Three cases in the USA, Brazil and South Africa/Lesotho saw the number of use categories expand while one case in Australia saw categories shrink. Three of these four cases became operational between 1913 and 1949 and are the oldest IBWT cases within the sample.

Table 4: Cases reporting differences in planned and actual IBWT water use

IBWT name	Country	Year of operation	Planned water use	Actual water use
Paraiba do Sul	Brazil	1913	Hydropower	hydropower; urban supply
Colorado-Big Thompson Project (C-BT)	USA	1947	Irrigation	urban supply; industry; hydropower; recreation
Snowy Mountains Hydroelectric Scheme (SMHS)	Australia	1949	hydropower; irrigation; Drinking water	hydropower
Telugu Ganga Project	India	1996	Drinking water	Drinking water, irrigation

Source: de Andrade et al. 2011; Chokkakula 2018.

Shifts in longevity of transfers and differences between planned and actual use are invariably driven by why and where water is transferred to. Within socioeconomic variables, water consumption drives IBWT planning and operation, with urban supply the primary planned and actual use. This use is a blanket term, since urban areas represent a variety of uses, having

industries, agricultural areas, and a need for drinking water. 13 of the 29 cases were built or were operational prior to the year 2000, and all are still operational as documented in the cases.

2.4.4. Divergent hydrological imaginaries and their contestations

Reaction, resistance and contestation can become emblematic features of IBWTs. In this review, 37 contestations are reported in 28 cases. 15 cases explicitly identify actors in agriculture within disputes. 12 mention government bodies at various scales. 19 contestations are attributed to water scarcity and/or allocation disputes. 7 are linked to economic issues. 6 are linked to environmental concerns including habitat destruction or lack of minimum environmental flows. 4 are linked to issues of identity and rights, including fear of loss of rights to water (Domènech, March and Saurí, 2013), historical prioritization of water to white farmers over other groups (Blanchon, 2017), and losses of identity and ways of life (Cabral and Ávila-García, 2013).

22 cases identify 26 contestations being pursued by legal, technical, and/or political means[9]. The following Table 5 shows whether contestation outcomes changed political, socioeconomic or governance structures, and whether these contestations impacted IBWT planning and/or operation:

Table 5: incidence of contestation, means pursued, changes in terms of outcome, and impact on IBWT planning and operation

Contestation means	Number of cases	Contestation outcome		Impact on IBWT planning/operation	
		No change	Change	No impact	Impact
Political	10	4	6	7	1
Legal	2	1	1	1	1
Technical	3	1	2	1	
Political and legal	5	2	3	2	3
Political and technical	5	4	1	3	1
Legal and technical					
Political, legal and technical	1		1		1
Total	26	12	14	14	7

Source: compiled by author

How contestations affect political, socioeconomic or governmental variables differs substantially across cases. Political means include, for example, debates concerning the planning of Brazil's Project Integration of the Sao Francisco River that spread to a national discussion regarding the desirability of megaprojects to solve water management issues (de Andrade *et al.*, 2011). In Turkey's Istanbul Greater Melen project, protests against the project's social and environmental costs were ignored by authorities, but protests against land expropriation for dam construction were heeded in parliament (Islar and Boda, 2014). In Iran's Yazd and Kashan IBWTs, protests against water scarcity in donor basins led to the destruction of infrastructure (Bozorg-Haddad *et al.*, 2020).

[9] The terms political, legal and technical refer to tactics used in contestations. Political means are those that resort to popular mobilisation. Legal means refer to contestations using judicial processes. Technical means are those that resort to governance or engineering solutions

Technical means include the establishment of a river basin organization in Brazil's Paraiba do Sul IBWT (de Andrade *et al.*, 2011).

The combination of political and legal means often sees political contestations linked with judicial or legislative changes. In Spain, the Ebro Transfer Scheme was subjected to protests against supply-side water policies, and subsequently cancelled by the Spanish High Court (Gupta and van der Zaag, 2008) leading to donor and recipient basins legislating water claims (De Stefano and Hernández-Mora, 2018). In Nepal's Melamchi Water Supply project, various issues ranging from rich-poor and urban-rural disparities, international loan conditions financing the project, and livelihood destruction led to protests from rural inhabitants, urban activists and the urban poor. These protests resulted in increased compensation to affected rural inhabitants, an expansion in the number of village development committees affected by the project, and the partial halting of water privatization processes (Domènech, March and Saurí, 2013).

The combination of all three means occurred in Bolivia's Yungas de Vandiola Interbasin Irrigation Water Transfer Project (López *et al.*, 2019). Proposed expansion of an existing scheme created conflict, benefitting more communities at the expense of irrigation associations. Technical papers presented were contested by non-beneficiaries, legal vetoes by the National Service of Protected Areas were rescinded when the redesigned project no longer affected a national park, and non-beneficiaries mobilized to get the regional government and international financiers to withdraw support and ultimately cancel the expansion.

These examples describe changes caused by contestations to the political, socioeconomic or governmental environment. There are fewer examples of how contestations impacted IBWT planning or operation, suggesting a 'durability' of IBWTs as infrastructural and water management assemblages. Contestations against the Ebro Transfer Scheme and the Yungas de Vandiola Interbasin Irrigation Water Transfer Project led to their cancellation. In the Melamchi Water Supply project, the contestation process forced the IBWT operator to shift from international to local control, and resulted in increased compensation for rural inhabitants. Yet for the most part IBWT planning and operations weather contestations.

Following the multi-dimensional analysis exemplified in figure 2, contestations act as a conduit between biophysical, socioeconomic and governance variables. In two cases contestation led to positive and negative changes in organizations or institutions. In Brazil, it led to changes in the institutional decision-making process for water allocation, while in Spain, irrigation associations lost a legal case to be compensated for water restrictions during the emergency drought period. Contestations can also be seen as reactions to expected or actual changes in biophysical and socioeconomic variables. The Cutzamala phase 4 IBWT was cancelled because of anticipated changes and ranchers searching for compensation.

2.5. Discussion

This section explores how IBWTs brought about social and ecological changes to hydrosocial territories, what features of these territories change, how these changes conceptually inform hydrosocial territories, and what consequences are there for understanding contestations.

2.5.1. IBWTs and changes in dimensions

Both water governance and political ecology of water literatures have documented IBWT impacts, and this review supplements these by identifying IBWT territorialities as those with highly unequal yet interlinked costs and benefits across biophysical and socioeconomic dimensions. Prior IBWT reviews documented flow disruptions, contamination, introduction of non-native species, salinization and the loss of habitats (Shumilova *et al.*, 2018), as well as negative impacts on environmental effects and irrigation outcomes (Purvis and Dinar, 2020). This review identifies contamination, economic activities and migration as additional features of hydrosocial territorial change when IBWTs are planned or constructed. This adds further nuance to the mixed bag of advantages and disadvantages of IBWTs that scholars have identified (Gupta and van der Zaag, 2008; Rinaudo and Barraqué, 2015; Shumilova *et al.*, 2018; Purvis and Dinar, 2020). Changes to governance emerge either from contestations or from changes in water quality and quantity. In Brazil's Sao Francisco River project, this governance challenge is pre-empted by deepening political and institutional processes for water governance. Nevertheless, IBWTs de-link ecological dimensions from some socioeconomic variables in donor and some recipient basins, supporting specific imaginaries and benefits of actors acting on interconnected territories (Hommes and Boelens, 2017) within an IBWT-wide hydrosocial territorial web.

Changes in biophysical and socioeconomic variables prior to and post-IBWT operation show a range of degradations. Biophysical features are by and large degraded: flows are disturbed, some cases see or expect loss of species and introduction of invasive species, and contaminants increase (with decreases feared to reverse due to IBWT operation). Socioeconomic features degrade in unequal fashion however: donor basin economic activities diminish while those in recipient basins increase, and outmigration and community displacement occur in donor basins compared to recipient basins.

This review offers a partial snapshot of the multitude of mutable relationships IBWTs change and generate. The cases reviewed here focused on actual or potentially negative impacts, but some areas of IBWTs that were not the focus of research – such as the cities of Mexico City, Nogales, urban and intensely irrigated areas of south east Spain, and, in the future, the north east region of Brazil – greatly benefitted from water supplied by IBWTs. Prioritizing water supply to specific places and through processes involving displacement, livelihood loss and ecological destruction is a political choice that questions the viability of water-based inter-generational justice and socio-natural integrity (Zwarteveen and Boelens, 2014). Its materialization is nonetheless fashioned through discursive means too.

2.5.2. Modern regimes within IBWT territories

IBWTs have become permanent fixtures of a hydrosocial territory, with the earliest example of an ongoing functional IBWT dating back to 1913, engendering changes in how water is obtained, allocated, used and disposed of. Yet their flexibility also allows shifts in the purposes for which water is transferred (see table 2). Rinaudo and Barraqué (2015) and Shumilova *et al.´* (2018) show that IBWTs adapt to changing water use needs. Contestations occur between different groups and across different scales, as a result of physically connecting different basins, and bringing into collision different imaginaries of what territory should look like, as well as different ideas about who and what should be included and excluded in those territories (Hommes and Boelens, 2017; Nightingale, 2018). The long time span of IBWTs and the shifts in water uses suggest that contestations are likely to continue cropping up as new generations of IBWTs get constructed and age (Shumilova *et al.*, 2018). Since 2000 the number of IWBTs constructed has increased, and various water uses emerge (such as minimum environmental flows) and dwindle (such as agriculture) in step with broader socioeconomic changes.

Yet while uses change, the perception of guaranteed availability may not change, because IBWT water tends to be viewed as a *natural* part of a recipient basin's water supply. As discussed by Kolinjivadi, Vela Almeida and Martineau (2020), modern socionatural regimes standardize socionatural relations, and the long duration of most IBWTs is evidence of strong control over water supply by privileged areas, independent of water's own rhythms. While there are few IBWTs that are over 50 years old, those few that do continue operating and adapting are a testament to IBWTs' permanence in hydrosocial territories as well as the priority assigned to urban areas, irrigated agriculture, or hydropower generation.

For this reason, IBWTs are costly in time and finance. Their construction requires a revenue stream coming from transformed rural and urban environments; whether urban expansion and economic growth, or through irrigation providing export-friendly agricultural products and accelerated growing cycles. Gupta and Van der Zaag (2008, p. 31) argue that IBWTs can lock in special interests of financiers, politicians and engineers who benefit from and service the infrastructural complex for decades, and this review suggests that this is product of modern socionatural regimes of discipline and control. Water accounting practices set in, developmental visions of territorial transformation are realized (as in the Nogales case) or idealized (as in the case of Brazil's Sao Francisco River), and alternatives to IBWTs become less feasible. This is visible in cases where IBWTs have transformed migratory patterns, but also in cases where authorities ignored protests, such as in Turkey's Istanbul Greater Melen project. Socionatural regimes realize imaginaries of how water and power should flow, but that does not mean that an IBWTs' permanence is pre-figured.

2.5.3. Connected basins, contested territories

By physically moving water from one basin to another, IBWTs not only disrupt established biophysical parameters, but also human modes of producing and their fit within territories. In some cases, water transfers pit different human communities against each other by creating highly interconnected but unequal hydrosocial territories.

The review of literature found that a majority of cases reported contestations, and while a majority of these are linked to allocation disputes, various are linked to concerns over losses of (mainly traditional agricultural) livelihoods, identities and rights, as well as environmental destruction. Three examples from the review exemplify this dynamic. In the case of the cancellation of Mexico's Cutzamala system stage IV, donor basin inhabitants aimed to defend not only their water sources but also linked habitats, biodiversity and ways of life against a historically and increasingly thirsty metropolis of Mexico City (Cabral and Ávila-García, 2013). In Spain, the cancellation of the Ebro transfer involved the mobilization of social movements that urged to consider environmental and spiritual dimensions of water (Gupta and van der Zaag, 2008). In Bolivia, the halting of the Yungas de Vandiola Interbasin Irrigation Water Transfer Project occurred through the mobilization of diverse arrays of irrigation associations, farmers groups, and political parties well beyond the river basins in question, as well as funding groups in Europe, who together mobilized issues of equity to deny expansion of water allocation to established users of an already existing IBWT (López *et al.*, 2019).

While Gupta and Van der Zaag (2008) note that IBWTs serve economic heartlands, the resistance to changes wrought by IBWTs by those contesting IBWTs can be read as a defence of territory, ways of life, and even shifting public attitudes to discourses on water. Hommes and Boelens's (2017) idea of "contested imaginaries of territorial crafting within hydrosocial territories" provides powerful conceptual backing to this review, and supports the analysis of material and discursive changes behind shifts in hydrosocial territories. At the same time, the standardization (Kolinjivadi, Vela Almeida and Martineau, 2020) and disciplining of water supply wrought by modern socionatural regimes strengthens discursive power through IBWT planning and operation. IBWTs may be seen as an illegitimate water grab by inhabitants who practice specific territorially-based and territorially-dependent livelihoods, but also a discursive well-being that emerges from livelihoods, shared communities and shared land and waterscapes. This is coherent with the cases of cancelled IBWTs seen in Mexico and Bolivia, and partly in Spain. Both material and discursive wellbeing come under threat when communities and practices disappear.

The question of whose imaginary of a socionatural regime becomes realized, at the expense of more socionaturally just territories, shifts attention to power, and to contestations with few results or an absence of contestations altogether. Surprising absences include the scale of displacements and economic disruption caused by China's South to North Water Transfer's Middle route. Another example is Turkey's Istanbul Greater Melen project, where authorities ignored

protests. In these cases, the question of how state processes create subjects comes into play (Nightingale, 2018). I argue that in these cases the political dynamics respond to how communities understand where absolute authority emanates from – locally, or from the state – and the ways in which imaginaries (Hommes and Boelens, 2017) are backed by popular and material power that shuts down dissent and proposals for alternatives to IBWTs.

Examples of contestations, or their absence, provide evidence of three factors underpinning hydrosocial territorial changes and resistance to IBWTs. First is the inhabitants' attachment to specific hydrosocial territories, and association with livelihoods and habitats. Second is their integration in scalar processes of state-making and capital. And third, in some cases such as Mexico and Bolivia, inhabitants make a counterclaim of control over narratives and, subsequently, over actual water. Many contestations pursued by technical means have little to no impact on IBWT planning and operation, which highlights the role of social movements in resisting IBWT territories when biophysical and socioeconomic dimensions are on the line. Yet the absence of contestations also shows how "silent" injustices pass by with little notice (Zwarteveen and Boelens, 2014, p. 152). Transformations of socionatural relations affect different groups in different ways, and social stratification is important for determining who is experiencing what (Cote and Nightingale, 2012; Fabinyi, Evans and Foale, 2014). Underpinning these transformations are imaginaries (Hommes and Boelens, 2017), an array of actors who wield them, and the power they mobilize to realize them.

2.6. Conclusion

Via this critical literature review of IBWTs I have demonstrated how IBWTs shift hydrosocial territories into new albeit difficult arrangements. I documented where IBWTs change features of hydrosocial territories unequally – through contamination, prioritization and reconfiguration of economic activities in specific basins, and population movements. These topics have been lacking in the emerging literature on the political ecology of water transfers as well as in water governance. IBWTs can cause the disintegration of existing ecosystems, and of the socioeconomic systems of communities residing in donor basins. They fashion new hydrosocial territories and subject them to broader and deeper processes of capital accumulation following modern socionatural regime logics (Kolinjivadi, Vela Almeida and Martineau, 2020). Nonetheless, IBWTs are ongoing and never predetermined, and they create messy outcomes of conflicting imaginaries (Hommes and Boelens, 2017) where the state aims to exercise power in terms of who and, more particularly, what hydrosocial territories "belong" (Nightingale, 2018).

Examining IBWTs from a socionatural perspective also points to new ways of focusing on the political implications of socionatural degradations of multiple, interconnected territories and dimensions. IBWTs reviewed here show that there is little sense to adapt to changing circumstances if specific communities are displaced, the habitats and species they know disappear, or if protests

and demands for change are neutralized or ignored. At the same time, the analysis of socionatural regimes and their discursive elements (Escobar, 1999; Kolinjivadi, Vela Almeida and Martineau, 2020) can show how societies re-articulate water and hydrological infrastructure in such a manner that an IBWT is considered indispensable, and water delivery is recast within modernist conditions. These two contributions provide ways to rethink, conceptualize and answer questions of socio-natural justice (Zwarteveen and Boelens, 2014), and contribute to imagining what a just, equitable hydrosocial territory contains, for humans as well as non-humans.

This is important, considering that this review has shown that IBWT water governance is often challenged by the actors involved. That so many conflicts and contested processes remain unresolved is a failure of water governance, and merits questioning to what extent IWRM is able to heed this challenge. Contestations have focused on the loss of livelihoods, material wellbeing, identities and patrimony linked to biodiversity and habitat (Douguet and O'Connor, 2003). They also focus on reimagining and revaluing water in ways that sit awkwardly, if not in direct opposition, to processes of state-making (Nightingale, 2018) and remaking territories along specific imaginaries (Hommes and Boelens, 2017). Seen socionaturally, these very political imaginaries come into relief and can be mapped in their complexity.

What has this review not been able to do? While they work with the idea of hydrosocial territories, most of the articles reviewed did not go deeply into issues of custom or culture that point at local understandings of how people and territories are co-constituted alongside water through IBWTs. This is an important nuance to better understand how individuals within communities grounded in specific hydrosocial territories are positioned vis a vis each other and their relation with water. It highlights the limits of a critical literature review, which is limited in presenting contextual information. It also provides future research paths. Namely, further ethnographic research could focus more on the realization of competing imaginaries within particular interconnected territories. Similarly, moments and conditions that precipitate shifts in hydrosocial territories could be examined through the integral webs of relations that co-constitute territories. Here, IBWTs play an ongoing role through their historical insertion in those territories, and their role in subjectification of humans and non-humans into modern socionatural regimes can be examined materially and discursively. In this respect, feminist intersectional methodologies can question the scale of "community", and better understand the influence of individuals' embodied experiences and actions on the enactment of visions and interests from their positions within and in relation to hydrosocial territory.

3. Tracing (un)common senses in irrigation communities: hegemonies and counter-hegemonies across Spain's Tagus-Segura Interbasin Transfer complex[10]

Abstract

Political ecologies of water have explored impacts of hydraulic infrastructure and technology at multiple scales. Hydraulic infrastructure in the form of Interbasin Water Transfers and irrigation technology in the form of the expansion of drip irrigation are recent examples of this. In this paper, I situate these within a hydrosocial territory lens to understand interbasin water transfers and drip irrigation as hegemonic projects developing particular common senses that function to govern and dominate irrigators and their territories. I argue that hegemony is materialized through the performance of common senses, though these shift, adapt, and fall out of favour either to new and emergent hegemonies or to counterhegemonies. I mobilise this argument to characterize three territories that are interconnected by the Tagus-Segura Interbasin Water Transfer in Spain, and which are differentially experiencing the spread of drip irrigation as hegemonic core, hegemonic frontier and counterhegemonic hydrosocial territories. Through their histories, experiences and practices, these territories transform and are transformed by webs of domination and resistance within hegemonies' search for unquestioned, consented governance.

3.1. Introduction

Political ecologies of water have long focused on conflicts and contestations surrounding the transformations of hydrological socionatures (Zwarteveen and Boelens, 2014; Rodríguez-Labajos and Martínez-Alier, 2015; del Bene, 2018). Scholarship on the emerging political ecology of transfers via IBWTs identifies their multi-territorial and multi-scalar impacts across basins as a defining feature compared to other hydraulic infrastructure (Gupta and van der Zaag, 2008; Molle, 2009a; Bourblanc and Blanchon, 2014; Bourguignon, 2023). At the other end of the scale, changes in irrigation technology have likewise brought about important changes in how water is delivered to plots, not only in the physical ways it is done but how it is socially organized (van der Kooij, Zwarteveen and Kuper, 2015; Sanchis-Ibor, Boelens and García Mollá, 2017; Duarte Abadía, Boelens and du Pré, 2019; García Mollá *et al.*, 2020; Poblador, Sanchis-Ibor and Kuper, 2021; Sanchis-Ibor *et al.*, 2021). The changes wrought between these two scales and spaces in irrigation are processes of domination, consent, resistance and governance, where changes in the socionatural organization of water are also changes in how rural life ought to be organized.

[10] This chapter is based on a manuscript submitted on the 29th December 2023 to the journal *Environment and Planning E: Nature and Space* as Bourguignon N (n.d.) Tracing (un)common senses in irrigation communities: hegemonies and counter-hegemonies across Spain's Tagus-Segura Interbasin Transfer complex. Environment and Planning E: Nature and Space.

Socionatural transformations, domination and consent also lead to resistances and alternatives to the dominant and unequal way of how things are. For this reason I propose to explore Gramscian understandings of hegemony and counterhegemony (Gramsci, 1971; Ekers and Loftus, 2008; Sneddon, 2013), and the common senses that support the hegemonic hydrological projects that naturalize their conception and operation. At the same time, the invocation of IBWTs and on-plot transformations requires a hydrosocial and scalar analytical framework (Boelens *et al.*, 2016; Hoogesteger, Boelens and Baud, 2016). To this end, I expand hydrosocial territorial understandings of hegemony and counterhegemony when applying these to the case of the TSA IBWT complex. Doing so highlights where hegemonies and their projects emerge, how they are deployed, and how they are replaced with new ones. At the same time, resistance and counterhegemonies can also be traced in their historical specificity, and how they shift and adapt to hegemonic projects. This I argue can enrich hydrosocial territorial scholarship providing further analytical tools alongside that of Foucauldian governmentality (Hommes *et al.*, 2018; Duarte Abadía, Boelens and du Pré, 2019).

In the following sections I unpack the concept of hegemony, and the role of hegemonic 'common senses' that drive the intellectual projects behind large-scale hydraulic infrastructure and on-plot irrigation modernization. I then link this to hydrosocial territorial interplay in the territorial production of the hydrosocial territories making up the TSA complex. I follow by providing a methodological description, where I deploy a literature review of the hegemonic projects of IBWTs and on-plot modernization in Spain and a description of the case studies of 6 irrigation communities I visited across the Tagus and Segura basins in 2022 and interviewed 26 irrigators. Following the presentation of the results of this methodology, I discuss and characterize how the different territories and irrigation communities are hegemonic core, hegemonic frontier and counterhegemonic territories based on the deployment and resistance of established and emerging common senses of hydraulic hegemonic projects. I conclude by reflecting on the implications for theory and future research in bringing in hegemonies within the hydrosocial territory framework.

3.2. Hegemony, common senses and hydrosocial territories

3.2.1. Hegemony and counterhegemony

Hegemony has a rich scholarly trajectory within political ecology, mobilised to understand the dynamics of dominance and resistance to it (Ekers and Loftus, 2008; Harris, 2015; García López, Velicu and D'Alisa, 2017). Hegemony is understood as the practices and ideologies associated to the power relations between a dominant group subordinating other groups in a society. These practices and ideologies are deployed to influence thoughts and decisions, thereby cultivating the consent of subordinate groups to be governed rather than through mechanisms of outright coercion (Ekers and Loftus, 2008; Sneddon, 2013; García López, Velicu and D'Alisa, 2017), creating realities that seem normal (Warner, Hoogesteger and Hidalgo-Bastidas, 2017). The

role of the State is crucial to understanding hegemony, which highlights the State's simultaneously centralised and diffuse nature. Rule is consolidated through coercion and acquiescence, and in the latter power is consolidated in institutions outside the State (Ekers and Loftus, 2008; Nightingale, 2018). At the same time, hegemony focuses on the everyday practices and performances of power (Butler, 1997a; Sneddon, 2013) bounded in sedimented, contradictory common senses grounded in socionatures (Ekers and Loftus, 2008).

The concept of common sense is critical to hegemony's reproduction of consent. Common senses are defined as "uncritical and largely unconscious way(s) of perceiving and understanding the world that has become 'common' in any given epoch" (Gramsci, 1971, p. 322). Common senses are produced through everyday spatial practices normalizing ruling ideas that are continuously rearticulated (Birkenholtz, 2009; García López, Velicu and D'Alisa, 2017), with their enforcement appearing to happen spontaneously (Birkenholtz, 2009). Common senses limit terms of debate, close off other conflicting ideas, and become the frame of reference for solving social problems (Sneddon, 2013). However, the constant crises and contradictions of capitalism as the hegemonic ideal implies that the rearticulations of hegemonic common senses are constant and incomplete (Birkenholtz, 2009; García López, Velicu and D'Alisa, 2017). The different commons senses we enact are often in contradiction with one another. "An effective hegemony makes sense of incongruities among various discourses, prioritizing some [common senses] to the detriment of others." (García López, Velicu and D'Alisa, 2017, p. 3). The corollary is that hegemony itself is fragile, unstable, and constantly rearticulated (Birkenholtz, 2009; Peluso and Lund, 2011).

Within political ecologies and economies of water, hegemony has been deployed in various ways. Most notably, hydro-hegemony has examined the dynamics and geo-politics of relations between nation-states sharing common river basins (Zeitoun and Warner, 2006; Hirsch, 2016; Menga, 2016). More nuanced approaches examining hegemony within states and societies relevant to this paper have been deployed to examine how hegemonic concepts jump across scales, borders and states, influencing water policy discourses. Hegemonic concepts are ideas that become dominant within a society, moulding and structuring how individuals and groups perceive and interpret phenomena, and becoming themselves common senses (Sneddon, 2013). Examples of these concepts abound. Goldin, Sneddon and Harris present water crises and scarcity, water service privatization and participation in water governance as three concepts that converge and reinforce each other – increasingly at high levels of governments, professions and academia – as "complex bundles of acceptance/imposition or good/bad associated with particular governance regimes and practices" (2013, p. 4). Goldman (2007) examines how transnational policy networks led by the World Bank drove the argument and built a global consensus for the privatization of water services as the singular most effective approach for water governance in the 1990s and 2000s. Molle (2009a) traces the construction and legitimization of the river-basin as the natural territorial water governance unit, linked to national and regional development, and modernity. Warner et al. (2017) argue that the Nirvana concept (Molle, 2008) of the 'hydraulic mission' of dam building and water

taming was able to be recast as a hegemonic concept to serve a nation's autonomy, development, modernity, and economic growth in the midst of contrasting concepts such as IWRM or green growth.

The mobilization of multiple concepts that serve hegemonic interests in water governance points to an array of actors that are found at different scales, each with their own motivations. These can converge and reinforce several coinciding hegemonic concepts (for example scarcity, privatization, or river basin governance) within particular spaces which crowd in and reinforce several common senses, and crowd out and delegitimize others (Harris, 2015). As argued by Sneddon**,** these multiple hegemonies, or hegemonic projects, privilege specific ideas on water and disseminate these in specific ways, representing a more nuanced version of hegemony in action since the consent to be governed is attained through a manner that sustains the hegemonic positions of groups that is constantly rearticulated (Birkenholtz, 2009, p. 211; Sneddon, 2013).

Within the hydrological sphere, the enrolment of State and dominant elites'-sanctioned practices and interventions are not just material interventions. They bolster hegemonic concepts and projects such as water scarcity (Sneddon, 2013). I deploy two types of scalar interventions – large-scale hydraulic infrastructure and on-plot drip irrigation transformation – that I argue serve as vehicles for hegemonic concepts. The former have been widely researched, invoked as a crucial component of State-making (Bakker, 2002; Giglioli and Swyngedouw, 2008; Swyngedouw, 2008, 2015; Harris and Alatout, 2010) and rendering water modern in the sense that it becomes a resource - ahistorical, abstract, and amenable (Kaika, 2005; Linton, 2014). Out of the various types of large-scale hydraulic infrastructure, IBWTs are particular in that they reinforce a hegemonic concept – the river basin as a natural unit for water governance, and the reinforcement of water scarcity wherein supply and demand across basins can be managed (Gupta and van der Zaag, 2008; Molle, 2009a; Bourblanc and Blanchon, 2014; Bourguignon, 2023). Regarding the latter, drip irrigation is often presented under the guise of modernization, with the aim of replacing traditional irrigation (blanket watering, surface, furrow) with automated water delivery systems by pipe or tube directly to the plant. While this is the technical premise, the reasons behind implementing it also constitute hegemonic projects - reduce water consumption to manage scarce water resources more efficiently (van der Kooij, Zwarteveen and Kuper, 2015; Sanchis-Ibor, Boelens and García Mollá, 2017; Duarte Abadía, Boelens and du Pré, 2019; García Mollá *et al.*, 2020; Poblador, Sanchis-Ibor and Kuper, 2021; Sanchis-Ibor *et al.*, 2021).

The success of hegemonies – their common senses and projects – requires their constant construction and rearticulation for consent to be governed. The fragility of hegemony lies precisely in moments of rearticulation, where counterhegemonic ideas and counter-common senses can take root. By making hegemonic concepts a frame of reference, Sneddon argues that possibilities for counterhegemonies emerge (2013). How this occurs is manifold and has been a point of interest for political ecologists (Escobar, 2008; Harris, Goldin and Sneddon, 2015; Lave, 2015). Here I reinforce arguments made on the everyday nature of the construction of common senses – just as

they serve to reinforce hegemonies, common senses can also be counterhegemonic. Butler (1997a) argues that transformation occurs through the ways in which every day social relations are rearticulated and open new conceptual horizons by anomalous or subversive practices. Similarly, García López, Velicu and d'Alisa argue that counterhegemony requires practices that repoliticise dominant ideas, thereby making these practices collective: "Transforming common senses requires performing new socio-ecological (power) relations in the everyday life of routinized sociality." (2017, p. 3). Following their words, everyday practices hint at potential subversive or anomalous practices driven by their own common senses. As illustrated by Harris (2015), allocating water along the hegemonic concept of water efficiency hides non-market values of water, whether these are intended for health reasons, poverty alleviation or cultural and spiritual needs, even if these needs are materialised in everyday practices. Thus, alternative, subversive common senses can emerge that dissonate strongly with hegemonic ones, particularly at the intersection where water-related inequities and injustices (Zwarteveen and Boelens, 2014) are inextricably tied to hegemonic concepts.

3.2.2. Hydrosocial territories and productive tensions with hegemony

The link between hegemony and hydrosocial territory lies in both literatures' concern with domination. In their seminal paper, Boelens et al. understand hydrosocial territories as the materialization of contested imaginaries, and "as a battle of divergent (dominant and non-dominant) discourses or narratives, has consolidating a particular order of things as its central stake" (Boelens *et al.*, 2016, p. 7). This consolidation of particular orders occurs materially and discursively in territories. My mobilisation of hydrosocial territories stems from examining changes in hydrological infrastructure and technologies from above (hydraulic infrastructure) and from below (on-plot drip irrigation). These combine to form new hydrosocial 'territories-in-territory' – or territorial pluralism – (Boelens *et al.*, 2016; Hoogesteger, Boelens and Baud, 2016; Hommes, Hoogesteger and Boelens, 2022) where multiple territories are imagined and acted upon in the same geographical and temporal space. Following Hoogesteger, Boelens and Baud (2016), territories are understood as created by actors for specific purposes, who claim and defend authority over spaces and related social groups, resources, technologies and ecologies. Furthermore, they are "spatially organized at different interrelated and often overlapping levels, such as the national, regional and local" (2016, p. 92). Territories are nonetheless disputed by subjects with differing interests and competing projects. Disputes between subjects aim to consolidate boundaries, socionatural organizing and control for purposes at specific scales (Hoogesteger and Verzijl, 2015; Hoogesteger, Boelens and Baud, 2016). As such, territories-in-territory implies that diverse territories overlap, interact and conflict with each other in the singular geographical and political spaces (Hoogesteger, Boelens and Baud, 2016).

An important consideration at this point is to clarify how hydrosocial territory literature has conceptualized and mobilized its own understanding of domination and resistance within and

between territories. From its outset, the literature conceptualizes dominance in hydrosocial territories through Foucauldian governmentality. In the same seminal paper on hydrosocial territories, Boelens et al. state that dominant, powerful hydrosocial territories aim to align humans, nature and thought within networks to transform various socionatural water worlds into a dominant governance system (2016, p. 6). Inspired by Foucault (1991, in Boelens et al., 2016), these "hydro-territorial projects and imaginaries aim to "conduct the conduct" of specific subject populations" (2016, p. 6). Since then, governmentality within hydrosocial literature has expanded considerably (see Hommes, Boelens and Maat, 2016; Hommes *et al.*, 2018, 2020; Boelens *et al.*, 2022; Hommes, Hoogesteger and Boelens, 2022; Martel, Sutherland and Hannan, 2022). In this literature, scholars demonstrate how various modern forms of (potentially overlapping) governmentalities (Foucault, 1991) employ subtle techniques whereby subjects internalize norms, thereby reconfiguring hydrosocial territories and relations in a way that shifts local users' sense of belonging and behaviour (Boelens *et al.*, 2016). Governmentality is expressed through imaginaries, and these materialize in the form of the deployment of technology and infrastructure. These can be conceived as the materialized and embedded norms shaping geographies, politics, morals and behaviour (Swyngedouw and Boelens, 2018; Hommes, Hoogesteger and Boelens, 2022). Processes of governmentalities are not always explicit, more often subtle, with territorialization recognizing, incorporating and disciplining local, alternative territories (Boelens *et al.*, 2016). As such, processes of resistance and contestation are present, but the focus is the everyday politics and processes of subjectification and territorialization, and where power emerges not as a ´thing´ but as a process (Boelens *et al.*, 2016; Hommes, Boelens and Maat, 2016; Hommes, Hoogesteger and Boelens, 2022; cf. Butler, 1988).

In this paper, I argue that hegemonic approaches to understand causes, forces and pathways of domination and resistance in hydrosocial territories can complement Foucauldian governmentality approaches. Within the hydrosocial territory literature, Gramscian hegemony has not been developed as strongly as it has done with Foucault. Swyngedouw and Boelens (2018) state that hydrosocial literature exploring concepts such as waterscapes focus on hegemonic structures and discourses that drive and emerge from socionatural reconfigurations. They add that the concept of hydrosocial territories maintains the focus on these "arts of statecraft" (2018, p. 130) and the shaping of multi-scalar political geography, while stressing that the conceptual innovation brought by hydrosocial territories is the diversity of overlapping and simultaneously existing hydrosocial regimes and imaginaries. Governmentality brings attention to the normalizing subtleties of the web of domination-resistance (Hommes *et al.*, 2018; Duarte Abadía, Boelens and du Pré, 2019). Hydrosocial territories likewise "highlights the existence of other, alternative worldviews and vernacular knowledge and how these may co-exist and overlap with, and/or contest, hegemonic forces, structures, and discourses that affect socio-natural reconfiguration (Duarte Abadía, Boelens and du Pré, 2019, p. 3). As such, hegemony is mobilised in a structural fashion. Nonetheless, internalised forces of hegemonic consent through common senses (García López, Velicu and

D'Alisa, 2017) – and the fragility these suffer in their contradictions and rearticulations that lead to counterhegemonies – can enrich hydrosocial territories' exploration of conducting the conduct of subject populations (Boelens *et al.*, 2016).

I acknowledge the theoretical tensions between Gramsci and Foucault. At the same time, I also take heed from Ekers and Loftus that these tensions can be productive (2008). They present two productive tensions that I take forward. Firstly, Foucauldian techniques of subjection can be linked to hegemonic projects. Secondly, Foucauldian conceptions of the social fabric see it as fragmented and discontinuous, while Gramsci sees politics as struggle that is socially constitutive. Gramscian internal relationships of the socionatural world encourages forging links across spatialities and positionalities.

Taking heed of forging these links across spatialities and positionalities, I apply hegemonic approaches within a hydrosocial territorial framework to analyse the case of the TSA complex. Not only does this engage with territorial plurality within one geographical space (Boelens *et al.*, 2016; Hoogesteger, Boelens and Baud, 2016; Hommes, Hoogesteger and Boelens, 2022), but across many hydrologically interlinked spaces. It also links how common senses generated through the application of hegemonic projects play out in these spaces, in patterns that reinforce or fail to reproduce consent, or generate spaces for counterhegemonic common senses. If hegemony is constantly rearticulated in everyday practices that reproduces it, and allowing in its rearticulation moments for anomalous or subversive practices that generate counterhegemonies (Butler, 2000; García López, Velicu and D'Alisa, 2017), by the same token new and emerging practices and common senses that reproduce hegemony in different arrangements can also be identified. The confluence of the hegemonic projects of large-scale hydraulic infrastructure and drip-irrigation deployment provide material and discursive space for new common senses to emerge, and the actors performing these transform specific territories where the confluence is strongest and least resisted. As such, this paper aims to answer the following questions: What territories are produced through the confluence of the hegemonic projects of IBWTs and on-plot irrigation modernization? How are these produced? And what territories resist or deter this confluence of hegemonic projects?

3.3. Methodology and case studies

In this section I establish the context of the TSA complex and the spread of on-plot drip irrigation throughout this large territory. I then present and analyse how the common senses emerging through the implementation of the TSA complex and drip irrigation produce distinct territories within the geography of the TSA complex. I use three sources of empirical data. Firstly, I drew on scientific literature on the TSA and drip irrigation to establish hegemonic common senses. Secondly, to establish the expansion of irrigated surfaces and their modernization, I reviewed empirical data on cultivated and irrigated surfaces and their modernization across Spain

and the regions (autonomous communities) in which the Tagus and Segura basins are located as collected in the Ministry of Agriculture's yearly Survey on Crop Areas and Yields and its sectoral analysis of irrigated surfaces (Ministerio de Agricultura Pesca y Alimentación, 2021, no date a; see appendices 6 and 7). Finally, I explored the impact of the TSA, its operation, and of drip irrigation at the irrigation community level through a comparative case study (Yin, 2009b) of 6 irrigation communities in the Tagus and Segura basins (see Map 2 and Table 6) conducted in May-June of 2022. As listed in Table 6, I henceforth name these communities by their geographic name (Alberche and Alcolea communities in the Tagus basin and the Cartagena, Totana and Letur communities in the Segura basin), while the Orihuela community is a historical consuetudinary tribunal, which as such will be named the Orihuela tribunal.

I selected irrigation communities through contact with the basin-level federations or through contacts made through activists, and snowballing led to contact with other irrigation communities. I interviewed 27 individuals in 6 irrigation communities – 2 in the Tagus basin, 4 in the Segura basin – considering whenever possible gender, age, and farm size (based on number of hectares of irrigated land owned) as selection criteria. I conducted semi-structured interviews for them to share their experiences, histories, and accounts of technological changes in their communities, and perceptions of water use and sustainability in other communities within and across the TSA-connected basins. For ethical purposes interviewees were anonymised.

Table 6: Irrigation communities in the Tagus and Segura River basins

Basin	Autonomous community	Province	Irrigation community	Established	Water sources	Irrigated surface (ha)	Members	Water concession (Hm3/ year)
Tagus	Castilla-La Mancha	Toledo	Canal Bajo del Alberche	1957	Surface	8,879	3,000	78.00
	Castilla-La Mancha	Toledo	Alcolea de Tajo	2000	Surface	3,632	373	25.42
Segura	Región de Murcia	Murcia	Campo de Cartagena	1952	Transfer; groundwater; Residual	42,255	9,699	144.29
	Región de Murcia	Murcia	Trasvase Tajo-Segura de Totana	1979	Transfer; Groundwater; Treated residual; desalinated	10,780	4,500	13.35
	Comunidad Valenciana	Alicante	Juzgado Privativo de Aguas de Orihuela	1275	Surface; Treated residual	6,793	11,270	45.00
	Castilla-La Mancha	Albacete	Las Fuentes de Letur	1986	Surface	351	400	0.98

Source: Appendix 2

Map 2: Irrigation communities in the Tagus and Segura River basins



Source: own compilation using data from Ministerio para la Transición Ecológica y el Reto Demográfico (no date) and Gobierno de Castilla-La Mancha (no date)

3.4. The (un)common senses of interbasin transfers and Irrigation modernization

3.4.1. Interbasin common senses: the TSA, water policy and territorial development

The ideological basis that drove water resource development in Spain can be traced to the late 19th century, and hegemonic common senses developed then persist to this day through the development of a hydraulic paradigm. The *regeneracionistas* of the late 19th and early 20th centuries, and particularly the figure of Joaquin Costa, established the discursive elements that characterized Spain overall bountiful in water, but spread unevenly in time and space and needing of correction (Swyngedouw, 2015). Spain was presented as having a natural hydrological imbalance at the national scale between a wet north and a dry south, and necessitated the intervention to produce a new

geography for national wealth creation by harnessing water principally for irrigation and hydroelectric power (López-Gunn, 2009; Hernández-Mora *et al.*, 2014; Swyngedouw, 2015; Martínez-Fernández *et al.*, 2020). The hydraulic paradigm to solve this imbalance involves solving inter-regional water cycle differences where unreliability and unevenness can be corrected through supply-side technological modifications (Saurí and del Moral Ituarte, 2001), particularly through dam construction and IBWTs. Irrigation expansion was a compromise solution to solve agrarian questions of unequal land distribution. Water would be mobilised to expand irrigation and provide land to a new class of smallholder farmers without jeopardising the interests or position of landed elites and avoiding land reform (Barciela, 1996; Saurí and del Moral Ituarte, 2001; Swyngedouw, 2015).

The hydraulic paradigm foresaw two important elements. Firstly, the State would ideally hold a central role in guiding this policy and mobilizing resources to accomplish it. Where private sector initiative failed before and during the II Spanish republic to accomplish the paradigm, the authoritarian Francoist dictatorship spearheaded the policies supporting the paradigm (Saurí and del Moral Ituarte, 2001; Bakker, 2002; López-Gunn, 2009; Swyngedouw, 2015). As argued by Bakker (2002), water management and investment by the State was a form of social legitimation and a means of capital accumulation to embark on urbanisation, industrialization, and agricultural modernization. Similarly, hydraulic policy was deeply intertwined with territorial transformation. Early laws regulating the TSA prescribed territorial development and water regulation policy, but territorial development policy for irrigation was legislated prior to the establishment of the TSA. After the conclusion of the Spanish civil war, laws were passed that designated specific territories to be irrigated or improved as irrigated zones of high national interest, as identified by the National Institute for Colonization (Barciela, 1996) and formalised in the 1973 law for agrarian reform and development, whose designation provided material and legal support from the State for their development (Ministerio de Medio Ambiente, 2000), guided by general transformation plans. Territories designated as high national interest for irrigation in which irrigation communities are located include the Alberche (1946), Cartagena (1972), Totana (1973), and Alcolea (1982) communities.

Secondly, the correction of the hydrological imbalance required managing water at both the basin level and at a unitary national level (Swyngedouw, 2015). Spain was at the forefront of instituting and managing water at the basin level through River Basin Authorities[11] (RBAs) as early as 1929 (Bukowski, 2007; Varela Ortega and Hernández-Mora, 2009; Swyngedouw, 2015). These however would be guided at the national scale, particularly to coordinate and manage the wholesale transfer of 'surplus' water from the humid north to the dry south and east of Spain. These transfers operated along two social principles – solidarity and cohesion – where those with a resource share it in solidarity with those needing it, but those ceding it should be compensated for

[11] Confederaciones hidrográficas in Spanish.

the economic, social and environmental damages caused (Saurí and del Moral Ituarte, 2001; López-Gunn, 2009). The aim of the transfers was to have a nationally integrated system of IBWTs that would allow water management that followed a basin surplus-deficit logic at a national scale (Swyngedouw, 2015).

This system began to be realized with the completion of the TSA in 1979, a year into the return of democracy in Spain. the TSA was designed to transfer up to 600 hm3/year of water from the head of the Tagus River along 286 km of canals and pipes and the Jucar River, to the Mundo River within the Segura River basin (see Map 2). From there it is distributed for human consumption and to a large swathe of irrigated territory across the region of Murcia and the provinces of Alicante (Valencian Community) and Almeria (Andalusia). By the 1990s, the draft National Hydrological Plan of 1993 proposed the National Water Balance Integrated System,[12] which would have built 150 reservoirs, redistributed 3,768 million m3 through IBWTs (from the northern basins towards the south), and expand the irrigated surface by 600,000 ha (López-Gunn, 2009). The plan was never realized after new pressures and political actors came onto the hydrological stage.

The paradigm until this point is considered the traditional paradigm, whose principal beneficiaries were above all irrigators in southeast Spain, hydroelectric companies, and constructors. As illustrated by Saurí and del Moral Ituarte (2001), the paradigm encapsulates three features that unconsciously and uncritically became the vision of Spain's hydrological reality (Gramsci, 1971; Sneddon, 2013). Firstly, irrigation of Spain's interior drylands would put these spaces on an equal footing with eastern Spain's highly productive irrigation systems, thereby increasing crop productivity, increase land values, and modify land tenure, social organization, and cultural behaviours. Secondly, the State would assume all costs of (capital intensive) hydraulic infrastructure and would guide rural development through the creation of new settlements, provision of agricultural inputs and technological knowhow. Lastly, water is valued exclusively as an economic resource, with its ecological, cultural, aesthetic, and emotional dimensions being secondary if not denied altogether.

New actors, conditions, and common senses emerged in the 1990s that created spaces for questioning the assumptions of the traditional hydraulic paradigm. Firstly, there were growing citizen movements made up of environmentalists, academics, social activists, and water managers that coalesced into the New Water Culture platform. These movements reinforced ways of seeing water, habitats, territories, and landscapes as having intrinsic values and worth protecting. The New Water Culture platform successfully demonstrated and lobbied against the planned 2001 National Hydrological Plan, whose principal investment was a planned IBWT from the Ebro river in the north to southeast Spain (Martínez-Fernández *et al.*, 2020; Vos *et al.*, 2020). Secondly, the emergence of regional governments exercising devolved power recast the paradigm at a lower scale, breaking

[12] Sistema Integrado de Equilibrio Hidraulico Nacional in Spanish

down the prospects of a unitary national paradigm. Regional governments' claims are increasingly mediated through water, territory and identity, alongside an increased global acceptance of subsidiarity as an important policy principle (López-Gunn, 2009; del Moral Ituarte and Hernández-Mora, 2016). Finally, but not least, Spain's accession to the European Union (EU) and the adoption of the EU's Water Framework Directive (WFD) in 2001 gave administrative, legal, and representative space to acknowledge and push for alternate dimensions of valuing water, and responsibility to the State and regions to uphold it in the face of popular discontent and legal action. It was likewise a vehicle for new concepts and logics based on the Washington consensus that frowned upon the singling out of preferred sectors (irrigation and hydropower), State roles in infrastructure development, and subsidizing resource and service provision (López-Gunn, 2009). The WFD opened up decision-making spaces to "other actors through organising active public participation processes that complement existing participatory committees within RBAs in the different phases of development of River Basin Management Plans (RBMPs)" (Martínez-Fernández *et al.*, 2020, p. 570).

The emergence of these new common senses, whose variety and points of ideological departure are very different, contest the ingrained common senses of the traditional hydraulic paradigm. Calls for the completion of a network of IBWTs or for the continuation of the TSA are remade and contested. Nonetheless they sit alongside the policy drive for on-plot drip irrigation modernization.

3.4.2. On-plot common senses: irrigation modernization in Spain and the Tagus and Segura basins

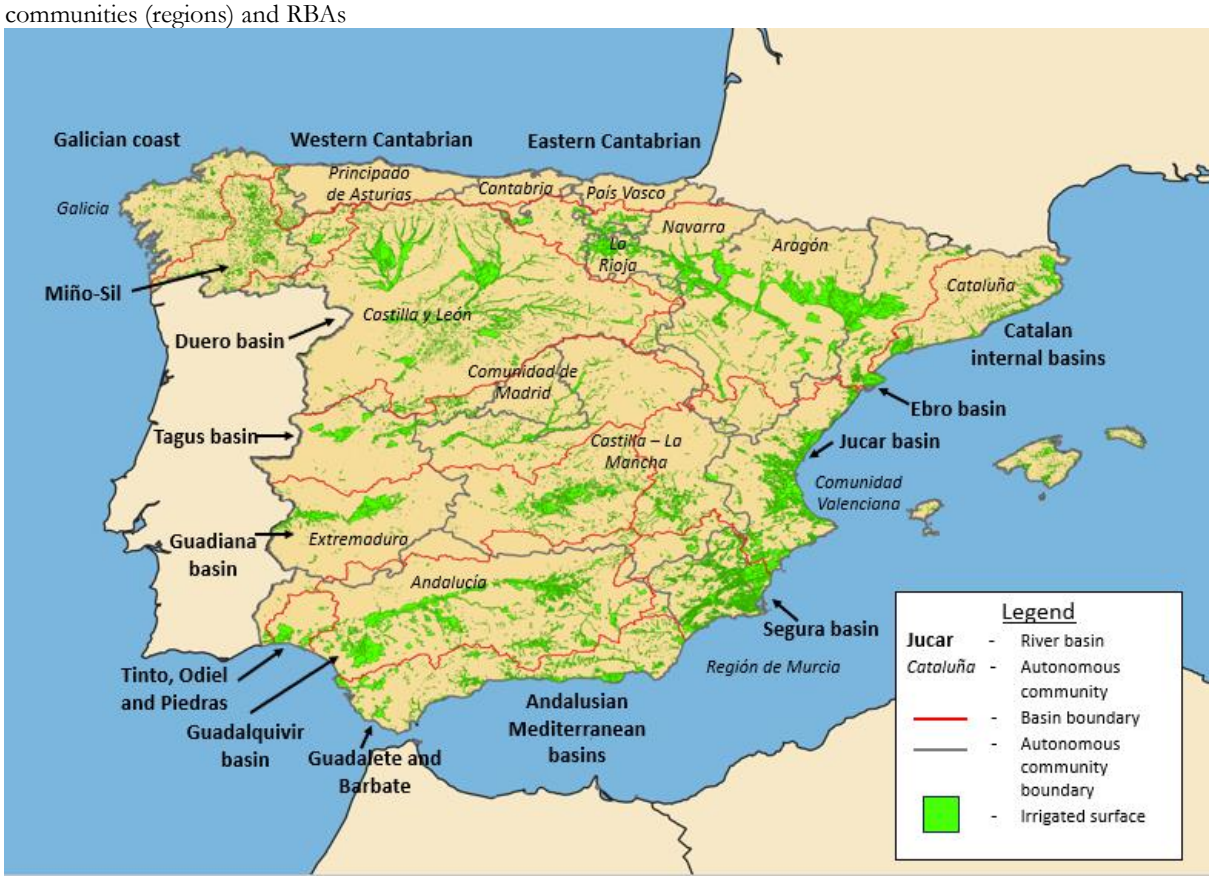
The development and introduction of drip irrigation is premised on two common senses that have proven to be persistent. The mantra of both efficiency and water savings has been the hallmark of drip irrigation, whereby irrigating by drip is sold as a modernizing technology. First postulated as a tool to reduce agricultural water demand, its spread has been pitched by stakeholders such as the water device industry, official agencies and global policy institutions, rounded in discourses and concepts of water saving and efficiency (Sanchis-Ibor, Boelens and García Mollá, 2017). While studies in the 1970s have supported that drip irrigation has a proven record of water-saving capacity in various agricultural settings (Poblador, Sanchis-Ibor and Kuper, 2021), its dissemination has followed a top-down approach through massive subsidisation, shaping a second hydraulic mission (Sanchis-Ibor, Molle and Kuper, 2020) of national programmes allocating large subsidies to farmers and water user associations (Poblador, Sanchis-Ibor and Kuper, 2021).

The push for drip irrigation is presented in neutral, technical, win-win formulas but their impacts are multi-dimensional and not always positive. This push by authorities can be understood as part of a hegemonic moralizing mission to make irrigators efficient by curbing their local and traditional systems that are depicted as unruly, disobedient and intangible (Sanchis-Ibor, Boelens

and García Mollá, 2017). This action would purportedly make water and society modern and fulfil the obligations of technicians, engineers, and farmers to serve modern society. The introduction of drip irrigation changes water user associations' internal management structures and cohesion, allowing the entry of private enterprises (Sanchis-Ibor, Boelens and García Mollá, 2017) and leading to an increased dependence on external service providers through private enterprises providing functions that had been performed by water user associations (García Mollá *et al.*, 2020). There has also been the increased stigmatization of irrigators who are reluctant to changes (Poblador, Sanchis-Ibor and Kuper, 2021), and the increased competition for water coupled with the extension of entrepreneurial and capitalist farming (López-Gunn, Mayor and Dumont, 2012). In Spain, several studies have also pointed to certain problems associated with the policy push for drip irrigation (Martínez-Fernández *et al.*, 2020). While water withdrawals may decrease at plot level, water consumption does not since irrigation water does not return to rivers or aquifers (Lecina *et al.*, 2010). Secondly, modernization often leads to production intensification processes which neutralize unitary water savings and lead to increased consumption (Martínez-Fernández *et al.*, 2020). Thirdly, water permits are not usually revised post-modernization which leads to an expansion of the irrigated area rather than having the saved water reallocated back to the water budget or to environmental flows (Corominas Masip and Cuevas Navas, 2017).

The materialization of the common senses behind large scale hydraulic infrastructure, IBWTs and on-plot modernization can be visualized by the spread of irrigated surfaces in Spain. I present the spread of irrigation in Spain, its RBAs and regions of Spain (see Map 3). Since 2002, Irrigated and greenhouse surfaces have increased in all Tagus and Segura basin regions, as has the proportion of irrigated land against total cultivated land as has the proportion of irrigated cultivated land to hectares of total cultivated land (see appendix 7 Table 7.1 and Figure 2).

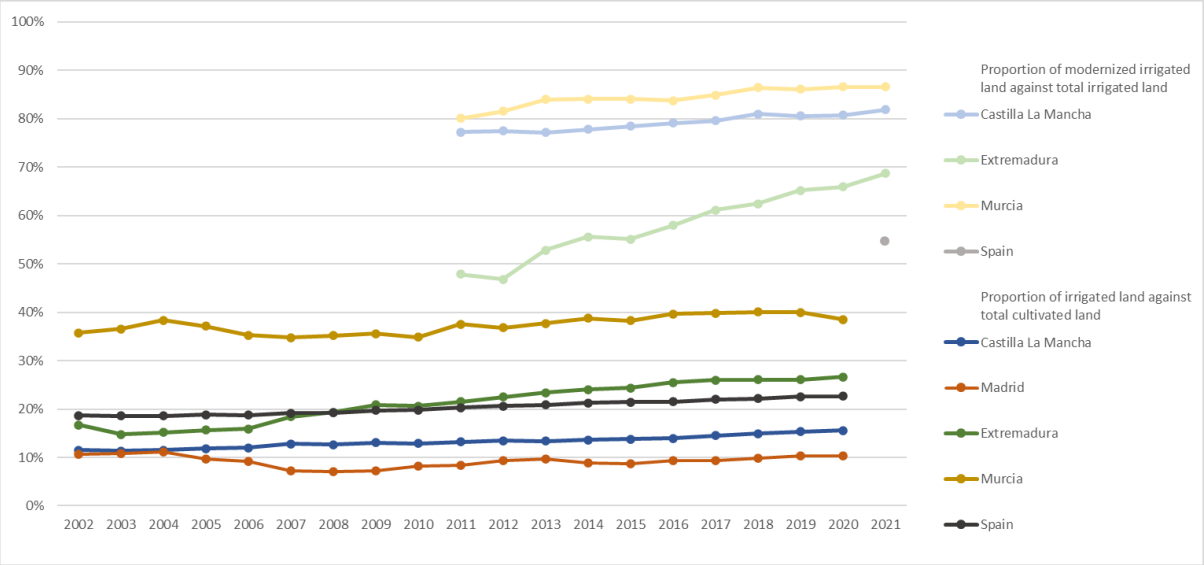
Map 3: Irrigated surfaces in Peninsular Spain and the Balearic Islands in 2008 with outlines of autonomous communities (regions) and RBAs



Source: own compilation using data from Gobierno de España (2008) and Ministerio para la Transición Ecológica y el Reto Demográfico (no date)

When analysing trends for the on-farm modernization of irrigated cultivated land (which includes drip, spray, and greenhouse cultivation), the overall trend in all regions is of modernized irrigation supplanting traditional irrigation. In the Segura basin, the proportion of modernized irrigated land against total irrigated land has grown from 80 to 87% in 2021, leaving traditional irrigation as almost anecdotal. Castilla La Mancha also has a significantly high level of modernized irrigation, growing from 77% to 82%. By 2021, all these regions were above the national proportion of 55%. This data points to irrigated surfaces and modernized irrigation systems reaching saturation in the Segura basin, and the implicit proportional growth of both irrigated surfaces and modernization of irrigation systems in the Tagus basin.

Figure 2: Proportion of irrigated land against total cultivated land and proportion of modernized irrigated land against total irrigated land in regions containing the Tagus and Segura basins between 2002-2021



Source: compiled from data in appendices 6 and 7

When comparing these trends to the data on irrigated surfaces and modernized irrigated surfaces provided by the irrigation communities studied (See Table 7), several correlations and incongruencies from the autonomous community trends appear. Firstly, the Segura communities in Murcia – the Cartagena and Totana communities – are not only the largest but are also amongst the most modernized communities, with modernized surfaces above and below the regional average of 87% in 2021. They are also the communities with a lower amount of water concessions to hectares of irrigated surface. Conversely, the Orihuela tribunal and Letur community are not only amongst the least modernized, but also have the smallest average plot size per member. The Tagus communities in Castilla-La Mancha – specifically the Alberche and Alcolea communities – are hugely disparate in terms of the proportion of modernized surface against the regional average of 81% in 2021. Alcolea's total modernization contrasts to Alberche's 16%.

Table 7: Irrigated surface and modernization in irrigation communities in the Tagus and Segura River basins

Basin	Irrigation community	Irrigated surface (ha)	Modernized irrigated surface (ha)	Average hectare of total irrigated surface per member (ha)	Proportion of modernized irrigated surface against total irrigated surface (ha)
Tagus	Canal Bajo del Alberche	8,879	1,411	3.0	16%
	Alcolea de Tajo	3,632	3,632	9.7	100%
Segura	Campo de Cartagena	42,255	41,410	4.4	98%
	Trasvase Tajo-Segura de Totana	10,780	6,072	2.4	56%
	Juzgado Privativo de Aguas de Orihuela	6,793	356	0.6	5%
	Las Fuentes de Letur	351	21	0.9	6%

Source: Appendix 2

3.4.3. Socionatural histories of infrastructures and technologies in irrigation communities

Within the Tagus basin, the Alcolea and Alberche communities are both located in the province of Toledo in central Spain, downstream from the TSA and the cities of Madrid and Toledo. The former has irrigated lands surrounding the city of Talavera de la Reina, while the latter is in a rural area. The Alberche community was established in 1952 as a productive irrigation community, part of the Franco dictatorship's policy of internal colonization to boost agricultural production (Swyngedouw, 2015). Irrigation is traditionally done by hoses and ditches, though there has been an introduction of sprinkler and drip irrigation. Despite being designated a zone of high national interest in 1982, the Alcolea community was established in 2000 through a regional and national policy on the condition that farmers only irrigate through drip irrigation. While both sit next to the Tagus River, the Alberche community draws water by gravity from the Alberche river, a tributary of the Tagus, and the Alcolea community pumps water directly from the Tagus. In the former, farmers complain about the quantity of water in the Alberche tributary since most is transferred for urban consumption in Madrid. In the latter, farmers complain about the Tagus's water quality, referring to Madrid's residual waters not being treated, coupled with low flows in the Tagus attributed to the TSA.

In the Tagus basin, the agrarian economy evolved from vegetables, cotton and tobacco to the current domination of crops for livestock, and the emergence of almond and pistachio trees. The latter accelerate the installation of drip irrigation dominated by agribusinesses, emerging drip irrigation managers and providers, and new landowners and leasers (from individuals to investment funds) located in Madrid or abroad. Farmers reported investment funds and large enterprises purchasing or leasing irrigated land for pistachio cultivation. Farmers fear that small and medium-sized farmers will disappear over the next decades through the generational handover crisis, with individual farmers struggling to pass it on to their children. There is a small increase of women irrigation farmers who inherit irrigated land in the communities from their fathers, but it remains very male-dominated. The dynamics of small-holder precarity and generational handover is further exacerbated by the push for on-plot modernization and increasing energy costs on which modernization depends, and the flat growth of the prices paid to farmers for their produce from supermarkets.

The Segura basin communities where modernization advanced the most are the Cartagena and Totana communities. The Cartagena community was established in 1952, and up until the TSA went operational, irrigated with brackish groundwater and untreated wastewater. It continues to use brackish groundwater, treated wastewater, and until recently desalinated water. The Totana community was established in 1979 but has a long history of irrigation. The Guadalentín river

flows to the south, and inhabitants from Totana and nearby parishes irrigated with muddy waters[13] since at least the mid-16th century (Crespo Romera, 2003). The first artesian wells were dug in the 1930s-40s and well water was owned and tightly controlled by local elites, who auctioned it amid accusations of collusion and extortion. After completion of the TSA the Totana community sourced more water from treated wastewater, private wells, and desalination plants on the coast.

Flood irrigation traditionally used in the Totana and Cartagena communities is being replaced by drip irrigation. A characteristic of the Cartagena and Totana communities is that farmers all state that their agriculture depends on mixing TSA water with locally derived water (surface water, groundwater, desalinated, treated wastewater) to improve water quality for irrigation. Drip irrigation requires the construction of on-plot reservoirs, which serve the purpose of this mixing. The practice of flood irrigation is increasingly frowned upon as being wasteful. New business providing irrigation technology in the area emerged, including networks of cooperatives and homegrown medium and large agribusiness. Generational handover is also seen as a significant problem. Nonetheless this increased the availability of irrigated land for lease and purchase, accelerating local agribusinesses' growth. The advantages large agribusinesses have is significant and point to tensions within these communities. While all farmers complain about the increasing requirements by national regulations and supermarket suppliers and administrative procedures to receive subsidies, agribusiness hire technicians and specialists, and production volumes give them an edge when negotiating prices. Cooperatives provide similar services to their members, yet some farmers feel that these are overwhelmed. Contract farming is also practiced by small and medium farmers to guarantee a purchase of food produced.

In this context of precariousness, internal conflicts within communities emerge between small farmers and large agribusinesses. Small farmers claim there are cases of preferential treatment within the communities' administration towards agribusinesses, pressure on small farmers to sell land, and opaqueness in water accounting practices. Oftentimes it is women farmers who mobilize awareness raising and resistance to what they deem are social and environmental injustices that small farmers suffer. In the Totana community, small farmers in a nearby parish are also attempting to have historical irrigation rights (Crespo Romera, 2003) recognized which would give them priority in water allocation.

The other two communities in the Segura basin present a different set of socionatural histories and territorial configurations. The Orihuela tribunal is a centuries-old institution near the mouth of the Segura River in the province of Alicante. The Letur community is found in the upper stretch of the basin, in the province of Albacete. The Orihuela tribunal traces its establishment to 1275, through a royal privilege declaring that the beneficiaries continue irrigating "as in times of the moors"[14] through a system of alternating 'live and dead'[15] water (Diz Ardid and Sánchez Mateos,

[13] 'Aguas turbias', own translation. This is water that is channelled down ravines during the infrequent rainy spells characteristic of the region.
[14] Own translation. This is a historical recognition by the Castilian king Alfonso X of the irrigation improvements brought to and developed by Muslim Arabs in Islamic Spain.

2011) that depends on traditional flood irrigation (Martí and García Mayor, 2020). Drip irrigation has been introduced to cultivate citrus trees, though there are reversals in this trend due to high energy and maintenance costs. The biggest issue facing the Orihuela tribunal is water quality, since its formal concessions are surface water from the Segura (containing wastewater emerging from urban areas of the Murcia region) and treated wastewater. The Letur community is located upstream of where the TSA joins the Segura River. It has 3 main canals sourced from natural springs. The community traces its origins back 1000 years (Navarro, 1995), and its farmers are proud of the hydrological heritage and its biodiverse territory. The community mandated that its main canals cannot be covered, though individual farmers are free to choose on-plot irrigation practices. There is a deep-seated belief that traditional irrigation and the spatial extent to which people can farm is dictated by the biophysical limits of the aquifer, which provides enough water to be used not only by the community but leaves enough for the environment and for water users downstream. The Letur community's principal concern is that nearby agro-industrial activities using artesian wells can impact their natural springs. The dynamics of generational handover are not felt as acutely in the Orihuela tribunal and Letur community.

3.5. Common senses of hegemonic and counterhegemonic territories

Having presented the common senses driving the hegemonic projects of the TSA and on-plot modernization and their acceptance at presenting and solving problems (Sneddon, 2013), and how irrigation communities have experienced these projects, whether accepting or resisting them, I present how the confluence of hegemonies and counterhegemonies have produced specific, interrelated territories (see Map 4 below).

[15] 'Aguas vivas y muertas', own translation

Map 4: Hydrosocial territories and irrigation communities in the Tagus and Segura River basins and the location of the TSA



Source: own compilation using data from Ministerio para la Transición Ecológica y el Reto Demográfico (no date).; and Gobierno de Castilla-La Mancha (no date)

The hegemonic common senses (Gramsci, 1971; Birkenholtz, 2009; García López, Velicu and D'Alisa, 2017) behind the hydraulic paradigm in Spain (Saurí and del Moral Ituarte, 2001; López-Gunn, 2009; Hernández-Mora *et al.*, 2014; Swyngedouw, 2015; Martínez-Fernández *et al.*, 2020) drove the naturalization of the idea of a hydrological imbalance throughout Spain (Saurí and del Moral Ituarte, 2001), and the construction of the TSA was a materialization of the solution to rectify this imbalance between the Tagus and Segura basins. Alongside hydraulic policy, rural development policies enacted since the end of the civil war identified specific territories as 'high national interest' for irrigation development, and the physical movement of water through the construction and operation of the TSA is a clear example of State-making (Bakker, 2002; Kaika, 2005; Giglioli and Swyngedouw, 2008; Swyngedouw, 2008, 2015; Harris and Alatout, 2010; Linton, 2014). This reinforced the hegemonic common sense that State-led and State-financed identification of where water should go, on either side of the TSA, was the State's prerogative (Saurí and del Moral Ituarte, 2001; Bakker, 2002; López-Gunn, 2009; Swyngedouw, 2015). The hegemonic common senses deployed through the construction of the TSA led to the creation of what I argue are hegemonic core, hegemonic frontier, and counterhegemonic territories, an illustration not only of territorial pluralism within one geographic space (Boelens *et al.*, 2016; Hoogesteger, Boelens and Baud, 2016; Hommes, Hoogesteger and Boelens, 2022) but of multiple, interconnected geographical spaces. Hegemonic core and frontier territories are products of the

traditional hydraulic paradigm, nonetheless they diverge regarding how each territory has experienced the irruption of new hegemonic common senses, particularly with regards to the performance of common senses of on-plot modernization.

The hegemonic core territories encompass the TSA beneficiary Segura basin's territories. These include the Cartagena and Totana communities. Singled out by the State as zones of high national interest, the hydraulic history behind these territories before and after the arrival of the TSA conditioned in many ways the acceptance and support for a common sense that would bring water from afar, as recipients of national solidarity (Saurí and del Moral Ituarte, 2001; López-Gunn, 2009) to correct a national hydraulic imbalance. Their socionatural histories of uneven muddy surface water and brackish groundwater sources, coupled with a privatized and highly unequal groundwater provision, grounds the arrival of the TSA as a materialization and rearticulation of everyday practice of expected and actual water provision that *ought to be* (Birkenholtz, 2009; García López, Velicu and D'Alisa, 2017). The transformation of dryland agriculture into irrigated agriculture also reinforces the concept and common sense of scarcity and of water valuation in an unidimensional manner – that of a scarce economic resource (Mehta, 2001; Saurí and del Moral Ituarte, 2001; Sanchis-Ibor, Boelens and García Mollá, 2017). The common sense of scarcity in this territory drives those of efficiency and water savings (Harris, 2015; Sanchis-Ibor, Boelens and García Mollá, 2017) to materialize in the spread of drip irrigation's success in the communities in these territories, and for irrigators to continue lobbying for the continuation of the TSA. It also leads to the mobilization of further hydrological supply-side materializations that provide further sources of water that remain firmly entrenched in the unidimensional valuation of water as solely a scarce economic resource, namely desalinated and treated wastewater. While the smallholder model envisioned in the hydraulic paradigm was realized (Barciela, 1996; Saurí and del Moral Ituarte, 2001; Swyngedouw, 2015), the consequent growth and specialization of the intensive agricultural model has led to the development of locally grown large agribusinesses. Smallholders are pitched in conflict with large businesses over water and land, and the generational handover crisis has also created space for new common senses amongst remaining smallholders to claim local histories of water (Crespo Romera, 2003). With everyday subaltern performances creating moments of crisis for hegemonic common senses (Butler, 1997a), new understandings and valuations of water linked to tradition and environment create opportunities for local counterhegemonies (García López, Velicu and D'Alisa, 2017).

The hegemonic frontier territories cover the communities of the TSA donor Tagus basin, where Alcolea and Alberche are located. As with the hegemonic core territories, these have also been singled out by the State as zones of high national interest. Where these differ with hegemonic core territories is that these are not the recipients of the common sense of solidarity but expect compensation in the form of cohesion (Saurí and del Moral Ituarte, 2001; López-Gunn, 2009). Emerging common senses that mark the end of the traditional hydraulic paradigm (López-Gunn, 2009; del Moral Ituarte and Hernández-Mora, 2016; Martínez-Fernández *et al.*, 2020; Vos *et al.*,

2020) also make these territories frontiers of new hegemonies and inter-scalar power relations when previous common senses break down in their rearticulation, providing space for new hegemonic common senses to emerge (Birkenholtz, 2009; Sneddon, 2013; Harris, 2015). Three intersecting common senses emerge. Firstly, the regional government of Castilla-La Mancha has fought to limit or cancel the TSA, where compensation is mobilised politically as being insufficient in the face of degraded water quality of the Tagus River and is attributed the TSA and limiting prospects of local rural development. This reflects the push of regional governments exercising power and recasting the paradigm at a lower scale (López-Gunn, 2009; del Moral Ituarte and Hernández-Mora, 2016). Secondly, the entry of new actors – investment funds and service providers – coupled with the generational transfer crisis create a paradigm where competitive, market-oriented forms of agricultural production in line with a Washington Consensus (López-Gunn, 2009) style of privatization and service provision (Sanchis-Ibor, Boelens and García Mollá, 2017; Sanchis-Ibor, Molle and Kuper, 2020; Poblador, Sanchis-Ibor and Kuper, 2021) replaces the traditional hydraulic paradigm's focus on settling and populating Spain's dryland interior (Barciela, 1996; Swyngedouw, 2015). This is reflected in rural inhabitants' fear for the future of their rural social fabric when landowners and workers no longer reside in the communities. Thirdly, on-plot modernization becomes the new vehicle of hegemonic common sense materialization, with Alcolea's requirement for on-plot water provision to be done exclusively by drip irrigation (see in table 2) being an example, and reflecting a generalized trend regionally and nationally (see figure 1). Nonetheless the flipside is increased dependence on service provision and vulnerability to fluctuating energy prices that hit smallholders and family farms harder, contributing to the generational handover crisis.

Standing in contrast to hegemonic core and frontier territories are the counterhegemonic territories in the Segura basin, which include the Letur community and Orihuela tribunal. The low level of drip irrigation (see table 2) and reported perceptions by irrigators points to both the ambivalence towards drip irrigation in both Orihuela and Letur and the outright regulation of limiting the conveyance of water by pipes in Letur. This represents a deep-seated questioning of hegemonic common senses in counterhegemonic territories. The continuation of flood irrigation is criticized not only by policy but also by irrigators in hegemonic core and frontier territories, who depict flood irrigation and its practitioners as wasteful. Nonetheless flood irrigation has survived regime and policy shifts, and in relation to the efficiency common-sense of on-plot modernization, represents an everyday subversive practice repoliticizing and collectivizing a counter-common sense (Butler, 1997a; García López, Velicu and D'Alisa, 2017). Echoing Harris (2015), the values tied to water are embodied in the very territory, whether through Orihuela's alternation of live and dead water (Diz Ardid and Sánchez Mateos, 2011; Martí and García Mayor, 2020) reforging community, ecological and territorial linkages, or Letur's focus on 'enough' water for their needs, the environment's, and that of neighbours downstream. While these have been historical practices, political changes have provided spaces and moments, such as through the WFD, that have

questioned the traditional hydraulic paradigm (Martínez-Fernández et al., 2020; Vos et al., 2020) that buoys alternative dimensions of water to be valued, such as through the New Water Culture movement. These provide moments where the rearticulation of hegemonic common senses become questioned and where counterhegemonies emerge with more force (Butler, 2000; García López, Velicu and D'Alisa, 2017).

The production of multiple and interconnected territories-in-territory (Boelens *et al.*, 2016; Hoogesteger, Boelens and Baud, 2016; Hommes, Hoogesteger and Boelens, 2022) across the TSA complex and the tracing of hegemonies and counterhegemonies across these has allowed an entry point to think about the intersection of hegemony, hydrosocial territories and the roles of IBWTs and on-plot modernization in rearticulating domination and the consent to be governed (Ekers and Loftus, 2008; Sneddon, 2013; García López, Velicu and D'Alisa, 2017). I have characterized specific territories along the historically situated construction and performance of hegemonic concepts and their common senses to understand the nuanced role of power in enacting domination through acquiescence and consent (Butler, 1997a; Sneddon, 2013). I also chose the hegemonic projects of large-scale infrastructure and on-plot modernization to illustrate that hegemonic projects require a role for the State, but that the State is not always absolute but diffuse (Ekers and Loftus, 2008; Nightingale, 2018). While the role of the Franco dictatorship was essential to materialize the hydraulic paradigm (Saurí and del Moral Ituarte, 2001; Bakker, 2002; López-Gunn, 2009; Swyngedouw, 2015), this paradigm and its associated common senses predated and outlived the dictatorship as seen in hegemonic core and frontier territories. Nonetheless drip irrigation modernization, as a new hegemonic project and correlated common sense of efficiency, depended not only on the State for its diffusion but on a network of service providers and new actors and regions with devolved power stepping into material circumstances for their benefit in hegemonic frontier territories.

Highlighting the State's diffuse role and the performance of power at different levels, and casting state actions, processes and policies as hegemonic projects imbued with rearticulating common senses, provides hydrosocial territories not only with an additional analytical framework. The literatures' use of Foucauldian governmentality explores the subtle internalization of norms to conduct the conduct of subject populations (Boelens *et al.*, 2016; Hommes *et al.*, 2018; Duarte Abadía, Boelens and du Pré, 2019). Hegemony, on the other hand, has provided a framework where I demonstrate internalized and unquestioned common senses becoming questioned in and outside of the State (in regions and the EU), leading to new hegemonies and counterhegemonies that bring about new webs of domination and resistance, and these being continuously interlinked across scales (Ekers and Loftus, 2008). From an emancipatory perspective, hegemonic projects and their resistance create moments and spaces that counterhegemonies emerge with and from, whether its smallholder resistance to agribusinesses in hegemonic core territories or everyday ontological pluralities of water practiced in counterhegemonic territories. These provide potential alternatives and examples of equative and just water futures (Zwarteveen and Boelens, 2014; Hommes *et al.*,

2018; Duarte Abadía, Boelens and du Pré, 2019), though always grounded in their particular histories and relations within the web of domination and resistance.

3.6. Conclusion

In this paper, I have brought forward an analytical framework based on hegemony, counterhegemony and the common senses of hegemonic projects to cast a wide net across the TSA complex. I have argued that the hegemonic projects developed since the 19th century in Spain, represented by the hydraulic paradigm, have shifted and materialized in the form of large-scale hydraulic infrastructure as well as on-plot modernization. These produce not only forms of centralized State domination, but diffuse forms of acquiescence and consent through common senses to produce a web of hydrosocial territories-in-territory. Tracing these common senses (Birkenholtz, 2009; García López, Velicu and D'Alisa, 2017) requires grounding territories and inhabitants in space and time, and to analyse how hegemony plays out in different ways, from the historical to the novel. In this way, characterizing territories as hegemonic core and hegemonic frontier is not a typology but an identification of how hegemony's rearticulation and materialization creates distinct relations that always shift, and with very different experiences within these. It also provides a way of identifying the subaltern and resistant practices and performances that make alternatives and counterhegemonies grounded in local histories possible (Butler, 1997a; Sneddon, 2013), even within the core of hegemony. The implications this framework brings is to widen hydrosocial territorial scalar analysis to other cases that explore IBWTs (Bourguignon, 2023), river basins or across basins, and that hydraulic, geographic, and other socionatural spatial analysis can be enriched by engaging with agrarian and rural development analysis. Potential avenues of further research can explore the impacts of these hegemonic projects in the production of particular subjects and processes of subjectification.

4. Fabricating irrigators: contested hydrosocial territories and subject-making in Spain's Tagus–Segura interbasin transfer arena[16]

Abstract

This article explores how irrigation farmer (regante) subjectivities are constructed in direct conjunction with the production of modernist–capitalist hydrosocial territories across the Tagus and Segura River basins in central and south-east Spain. We explore the complexities and contradictions of how, at various scales of governance, authorities establish and seek to realize ideal regante subjects across time and space. We mobilize a hydrosocial territory approach, combined with FPE and hegemony literature, to explore how such ideal subjects are built through Spanish and regional legislation and policies from 1866 to 2023. Through interviews with *regantes* in six irrigation communities, we identify different ideal and actual regante subjects in territories interconnected by the Tagus–Segura Aqueduct. We analyse how policy shifts lead to multiple and contradictory roles and responsibilities for regante subjects, which are linked to plot modernization, agricultural professionalization, and farmer rejuvenation. These sharpen divisions between smallholders and emerging large capitalist actors. Counterhegemonic territorial proposals resist these pressures by embodying alternative values and imaginaries. We conclude that through such counterhegemonic struggles, subject construction is enriched, identifying real-life existing and future alternatives for more just hydrosocial territories.

4.1. Introduction

Irrigation farmers in Spain, known as *regantes*, and the irrigation communities they are part of, face pressures from above and below. From above, there are increasing regulatory requirements from multiple scales of authorities, such as the EU's Common Agricultural Policy (CAP) and those emerging from the State and decentralized regions. Next, they face pressures from supermarket certification processes; competition from non-EU markets; water variability in both quantity and quality; and the climate crisis (Borras *et al.*, 2022). From below, the crisis related to the transfer of land from one generation to the next limits the entry of young and new *regantes* into irrigated agriculture (Zagata and Sutherland, 2015). Young people are unwilling or unable to enter the sector, and there is an increasing demand for diverse knowledge (mechanical, chemical, administrative). Within this situation, the drive for on-plot modernization as a policy choice upends traditional arrangements and creates new requirements and challenges.

Regantes and their relation to water have undergone profound challenges and changes throughout Spain's recent history. The material and discursive link with water(s) is deeply embedded

[16] This chapter is adapted from an article published as: Bourguignon, N., Villamayor-Tomás, S. and Boelens, R. (2024) 'Fabricating Irrigators : Contested Hydrosocial Territories and Subject-Making in Spain's Tagus-Segura Interbasin Transfer Arena', Water (Switzerland), 16(192), pp. 1–21. Available at: https://doi.org/https://doi.org/10.3390/w16020192.

in the Spanish national imaginary (Swyngedouw, 2015) and in Spanish irrigation farmer subjectivities (Ortí, 1984; Fernández Clemente, 2000; Boelens and Post Uiterweer, 2013). Irrigation plays an important role, historically and currently, in a country with uneven rainfall such as Spain. As of 2021, irrigated agriculture accounts for 22.6% of the cultivated surface, from 18.7% in 2002 (Ministerio de Agricultura Pesca y Alimentación, n.d. a). The crops grown under irrigation have fuelled the export and livestock sectors compared to rainfed crops. The history and role of *regantes* in rural development has likewise shifted and changed, with current trends in Spanish rural depopulation (Gómez Valenzuela and Holl, 2023) making their position even more important. Technological and infrastructural advancements have also multiplied water sources (from surface and groundwater to deeper groundwater, wastewater, and sea water), their geographical reach through intra and inter-basin transfers (Bourguignon, 2023), the capital and technical knowledge needed to realize these, and with them, growing complexity and inter-scalar socionatural relations between *regantes*, water, and territory (Remmers, 1993; Swyngedouw and Boelens, 2018; Duarte Abadía, 2022).

The challenges and shifting structures, conditions, and realities that *regantes* face imply that the profile of the *regantes* is also shifting. They shift from traditional irrigation practices in historical riverside minifundia to large family enterprises and agribusinesses, the emergence of contract farming, and the rental and ownership of irrigated land by new urban owners and investment funds, managed by service industries (Santos Pérez and Remmers, 1993; Sanchis-Ibor, Boelens and García Mollá, 2017). These changes and profiles happen at different paces and in different ways across different territories, however, and alternatives exist where *regantes* continue traditional minifundium-based irrigated agriculture—in hinterlands; in historic, centenary institutions; or when resisting takeovers and expansion by agribusinesses or implementing new models(Remmers, 1999; Mirhanoğlu *et al.*, 2023).

'Farmer', 'irrigator', '*regante*'—these are people who grow our food, many of whom live in rural areas and interact with land and water to coproduce landscapes and territories. However, the public imaginary of the farmer, and in Spain of the regante, is oftentimes unidimensional and idealized (van der Ploeg, 2003), and authorities at multiple scales—regions, the State, the EU—encourage a circumscribed model regante subject to be governed (van der Ploeg, 2008; Duarte Abadía, 2023). Ignoring the multifaceted and complex lives of *regantes* and how *regantes* as subjects are crafted risks ignoring the diversity of territories and histories of the principal water users of the country. This poses misguided policy prescriptions and guidance for land and water resource governance and the conflicts and contestations surrounding them. Assuming one regante subject ignores the multiplicity of values and rationales—tied to local histories and territories (Hommes, Hoogesteger and Boelens, 2022)—behind irrigation farming. Likewise, unpacking the regante subjects allows for an examination of the role of power and politics in shaping generations of *regantes*. Hegemonic power is enacted in different times and with different outcomes across the scales of regional governments, the State, and up to the EU, through policy actions. These shape

and are shaped by values and imaginaries, their insertion in irrigation system governance, and the subsequent shaping of subjects and territories. From a policy perspective, it institutes limited expectations about how *regantes* actually behave when confronted with changing circumstances (such as drought, technological innovation, or regulatory demands) (Villamayor-Tomás, 2014).

In this article, we explore how regante subjects are produced and mobilized through European, national, and regional hydrological and agricultural policies within the context of the TSA interbasin transfer in Spain. We also explore how regante subjectivities are produced by *regantes* themselves, in relation to each other, in relation to *regantes* across basins and infrastructural/technological options and choices, and in relation to historical, present, and imagined water sources.

These subjectivities are framed and embedded in specific territories and represent sets of both hegemonic and counterhegemonic imaginaries (Bourguignon, n.d.). This article, therefore, poses the question of how regante subjectivities are constructed in relation to the (contested) configuration of the particular hydrosocial territories in which they are assumed to take part. We explore the complexities and contradictions of authorities establishing ideal regante subjects across time and space and to what extent these ideals are realized by *regantes* themselves. We cast light on existing hegemonic, non-hegemonic, and counterhegemonic territorial imaginaries, the latter veering from the ideal regante subject. This can inform the search for more equitable and just water futures.

4.2. Materials and methods

4.2.1. Theoretical framework

The conceptual aim of this paper is to problematize and question the construction of the regante as a modernist water user in irrigated agriculture with the politics behind the production of the techno-capitalist irrigation farmer as subject. It explores the construction of the ideal regante subject as envisioned and deployed materially and discursively by various levels of authority—from the regional level, to the State, to the EU—and how regante subjectivities are in practice realized, whether these conform to or subvert the ideal, and the relationship these subjects have with the territories they manipulate and inhabit.

FPE contributions to the subjectivity literature provide ways of thinking about human–environment relations and the co-creation of socionatures embedded in material realities. This literature focuses on subjectivities and natural resource use intersecting social categories of difference (Nightingale, 2013; Morales and Harris, 2014; Lau and Scales, 2016). Acknowledging that subject creation has long been a concern of the social sciences (Galt, 2013), feminist contributions are inspired by, for instance, Butler's (1999) performativity of gender, which sees gendered subjectivities as constructed and informed by power relations and their environment (Nightingale, 2006). Subject performance is not limited only to gender but equally involves other social categories of difference such as class, race, or age, which combine intersectionally (Crenshaw, 1991;

Nightingale, 2011; Lau and Scales, 2016). Through this, subjectivity is studied, amongst others, as a process through which people are "disciplined by and identified with certain discourses and practices" (Nightingale and Ojha, 2013, p. 33). The subjects are produced through multi-dimensional aspects of power, which are exercised and internalized, commonly with unexpected consequences (Nightingale, 2006). Through power, subjectivities oftentimes develop processes of social differentiation and hierarchies. Mainstream narratives and processes of subjection tend to shape individualized modes of identification; subjectivities that relate to neoliberalized natures break away from forms of communal resource management (Harris, 2009). In this way we can visualize the link between subject formation, power, and Foucauldian governmentality as a form of dispersed everyday rule through strongly individualized practices and contained perspectives that legitimize particular knowledges (Foucault, 1980; Ekers and Loftus, 2008).

Theoretical insights by Nightingale (2013) provide a particularly relevant understanding of subject creation and subjection and the power relations linked to resource users and the environments they are embedded in. She explores the creation of fishermen subjects in Scotland and argues that the construction of specific subjects, as outsiders, as 'good' or 'bad' fishermen is linked to the method and technology at fishermen's disposal, to their connection to community, to perceptions of 'sustainable' fishing, and to the construction of fishermen subjects by policymakers when the governed subjects comply or resist. She invokes three developments made by feminist geographer Longhurst (2003) when theorizing the subject. First, subjects are always placed; that is, they perform in specific places and spaces. Second, subjectivities are embodied and, therefore, material; that is, they are constituted by physical acts. Finally, and mirroring the arguments made by Hommes, Hoogesteger and Boelens (2022), resistance to subjection entails moments of reframing and breaking away from modes of established meaning making and self-identification as territorial subjects.

The hydrosocial territory literature emerges with a strong focus on the construction of subjects through governmentality and contested modes of territorialization (Boelens *et al.*, 2016). We consider multi-scalar hydrosocial transformations and their impact on subject-making, ranging from on-plot and the irrigation community scale to basin and interbasin exchanges and scales. We also enrol the concept of hegemony grounded in Gramscian thought, where dominant ideas and discourses espoused by the State and other institutions vested with power (Ekers and Loftus, 2008; Sneddon, 2013) are constantly rearticulated to stabilize the hegemony. They become accepted as dominant and unquestioned facts and relationships with implications for how social groups perceive problems and possible solutions (Bourguignon, n.d.; Nightingale, 2006; Sneddon, 2013; Harris, 2015).

On-plot technological transformations were documented by Sanchis-Ibor, Boelens and García-Mollá (2017), who explored the role of privatization as a subtle technology transfer and modernization issue, shaping new subjectivities and identities involving the moralization of technology and counter-moralization strategies (see also Flaminio, Rouillé-Kielo and Le Visage,

2022). We take on the transformation of regante subjects through these strategies, where different authorities not only encourage the adoption of on-plot technologies to create model *regantes* but they also create regante others, that is, those water users who continue traditional forms of irrigation. Not only are authorities complicit in creating these subjects but irrigation farmers themselves are quick to name 'good' and 'bad' examples of *regantes*, and these are intimately tied to place and water use based on the type of irrigation practiced.

This brings in arguments brought forth by Hommes, Hoogesteger and Boelens (2022), who explored the hydrological infrastructures' role in (re)constructing territory, imaginaries, and subjectivities through governmentality endeavours. Imaginaries informed by science and technology are never apolitical, and their realization through (hydrological and hydraulic) infrastructure contains their own prescriptions and norms. Whether specific subjects subscribe to this dominant imaginary or not, the subjects stand in relation to its truth claims. New subjectivities emerge when circumstances and relations shift, such as when infrastructure is constructed, and technologies are implemented that change the subjects' ways of living and operating in socio-technical systems. The ideals of the imaginary also contrast between expected (normative) and actual (lived) experiences of subjects and their self-perception regarding expected and actual access and control over the material environment. The materialization of infrastructure as "hardened morality or materialized power"(Hommes, Hoogesteger and Boelens, 2022, p. 5; cf. Pfaffenberger, 1988) nonetheless does not guarantee a fixed path over how infrastructure is actually used, governed, or abused. The clash between normative and lived subjectivities can give life to new imaginaries and identities, where "fugitive energies" (Hommes, Hoogesteger and Boelens, 2022, p. 6) can propel new subjectivities, generating new imaginaries that challenge and change existing hydrosocial territorial configurations anew.

The notion of territories within a territory (territorial pluralism) (Boelens *et al.*, 2016; van Teijlingen, 2019) positions multiple entangled and hybridizing territories where territorialization contributes to "conducting subject populations' conduct" (Foucault, 1980, 1991). This also finds expression in, for instance, the construction of "river-as-subject" (Boelens *et al.*, 2022) by authorities, *regantes*, and the imaginaries deployed to do so.

IBWTs such as the TSA problematize water resource governance by piercing across water basins, these being discrete water governance units as encapsulated in IWRM paradigm (del Moral Ituarte and Hernández-Mora, 2016; Swyngedouw and Williams, 2016; Bourguignon, 2023). Of continuing interest here is how the TSA as a conduit and infrastructural artifact mediates and constructs regante and river subjects on either side of the TSA. As argued by Boelens et al., "A socio-ecological river expresses being/becoming subject through the meaning ascribed to it, which in turn shapes the river and those ascribing the meaning at the same time" (2022, p. 15). Here, it is not only humans or presumably dehumanized river ecologies that are subjectified, but in an integrated manner, this also includes the IBWT infrastructure itself, being bestowed with new and often contested meaning. *Regantes* in the Tagus and Segura basins cannot materially or discursively

understand their own place, self, or waters without recourse to the TSA, to *regantes* within their own communities and basins, or in the other basins that now become connected (Ženko and Menga, 2019; Hommes *et al.*, 2020; Duarte Abadía, 2023).

4.2.2. Methods

In terms of methodology, the results explore two dimensions. The first section outlines the evolution of the construction of ideal regante subjects as envisioned by authorities across five distinct periods from 1866 to 2023 through an analysis of the hydrological, agricultural, and rural development legislation and policies at the levels of the State, the EU, and from two regions—Murcia and Castille–La Mancha. The source material includes a literature review of the scholarship examining Spanish hydraulic and agricultural policy, as well as legislative and policy documents (see (see appendix 8).

The second section explores the lived regante subjectivities and is based on interviews and group meetings (interviews were anonymized and pseudonymized) with 27 individuals in six irrigation communities: two in the Tagus basin and four in the Segura basin—with the TSA as a backdrop. The interview selection considered, whenever possible, gender, age, and farm size (based on number of hectares of irrigated land owned) as selection criteria. Semi-structured interviews with *regantes* were conducted to share their experiences, histories, and accounts of technological changes in their communities, as well as perceptions of water use and sustainability in other communities within and across the aqueduct-connected basins (see Table 6).

Based on the fieldwork conducted in 2022, the establishment of hegemonic and counterhegemonic irrigated territories in river basins connected by the TSA is based on the history and relationship with dominant, hegemonic visions of irrigation practice and territorial transformation. Combining hegemony with the hydrosocial territories approach revealed particular relationships from *regantes* with their immediate territories and irrigation communities to hegemonic discourses and practices.

Following this framework, the hegemonic core territories are those where their transformation is most aligned with the hegemonic imaginaries on the State's ideal irrigation territory (Bourguignon, n.d.). Next, the so-called frontier hegemonic territories also feature transformations moving towards the hegemonic ideals of irrigation, though these are only partially realized. Finally, so-called counterhegemonic territories are those that do not subscribe to or even reject the hegemonic ideal and present configurations of alternatives to hegemony (Harris, 2015) and potential pathways for water justice (Owens *et al.*, 2022). Map 4 places the irrigation communities visited in Table 6 within the hegemonic territories within the territory framework discussed above.

4.3. Results

4.3.1. Shaping the ideal regante subject—hydraulic and agrarian legislation and policy

The historical construction of the regante subject by hegemonic authorities has changed markedly since the Spanish State declared water as part of the public trust in 1866, thereby putting *regantes*, as the principal water users in Spain, under the jurisdiction of State power. The time from 1866 to 2023 is broken down into five historical periods where the ideal *regante*'s portrayal shifts, and these fall under the general sociopolitical epochs of Spanish history from the late 19th into the 21st centuries. The first period, *regeneracionismo*, began in 1866 with the declaration of water as part of the public trust and ended in 1938 towards the end of the Spanish civil war when the Francoist regime began undoing the II Republic's agrarian reform and began centralizing power. The early dictatorship period, starting at the closure of the civil war, ended in 1952 when the regime ended its period of international isolation, and agrarian reforms began encouraging the training of farmers and *regantes*. The late dictatorship ended its period with Franco's death, leading to the democratic restoration period, from the passing of the 1978 Spanish constitution to 1998. This period is marked by the redistribution of power to the Spanish regions, the development of regional autonomy, and the insertion of EU legislation. The current democratic regionalization period is named as such due to the establishment and push of regional agricultural and rural development plans, with regional governments flexing their power and visions accorded through their autonomy from the central government. It started in 1999 with the modification of the 1985 water law, and the development of regional CAP-funded development plans gave more power to the regional governments and stakeholders in directing their vision of *regantes*. The following Table 8 summarizes the *regante* ideal from each period, as laid out in the analysis in appendix 8.

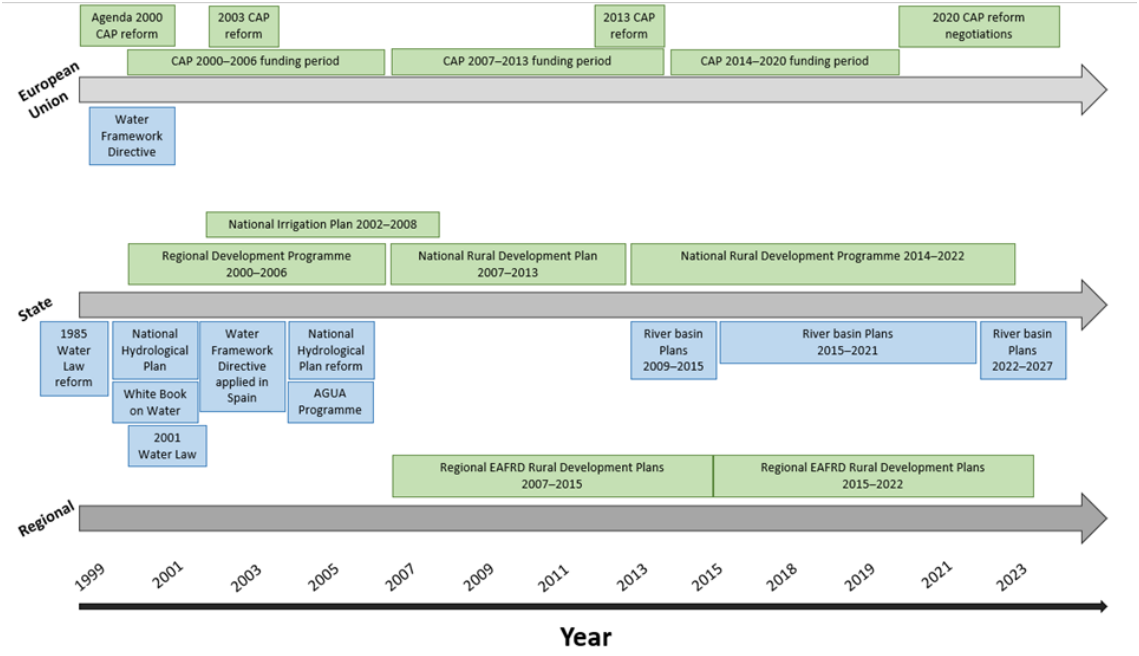
Table 8: Ideal *regantes* by historical period—1866–2023

Historical Period	***Regante* Ideal**
Regeneracionismo (1866–1938) Hegemon*:* State	*Regantes* as petty-bourgeois, small scale, independent, democratic, modern, and competitive (Maurice and Serrano, 1977; Ortí, 1984; Swyngedouw, 2015, p. 74). Combination of expansive supply-side hydraulic policy to make water available for irrigation expansion and internal colonization creating communities of smallholders with agricultural experience to create agricultural surplus (See also Ministerio de Fomento, 1907, 1911; Ministerio de Obras Públicas, 1932; Ortega Cantero, 1984; Gómez Benito, 1994; Mateu González, 2002).
Early dictatorship (1939–1951) Hegemon*:* State	Colonist *regantes* in new irrigation schemes deemed peasants (campesino), though aimed to be modern food producers and serving as an example to large landowners to attract land sales and private investment in the new colonies and irrigation schemes (Barciela, 1996). They would settle new territories declared in the national interest through the sale of the land of large landowners. The figure of campesino denotes the smallholder peasant farmer. As a social class in and of itself, the campesinado, or peasantry, was the subject of the Second Republic's agrarian reforms to have them and landless peasants own land and, by Francoist agricultural policies, to provide them the land without jeopardizing the status and political will of the large landowners who were the regime's supporters (Roiz Célix, 1983; Oliva and Camarero, 2001; Congost, 2007). (See also Jefatura del Estado, 1939, 1940, 1949; Swyngedouw, 2015)
Late dictatorship (1952–1977) Hegemon*:* State	Continuation of the early dictatorship's ideal, with more expectations of knowledge transfer and professionalization vested through the agricultural extension services (Duarte Abadía, 2022). Expansion of the number of colonists serving the ideal. (See also Jefatura del Estado, 1953, 1971)
Democratic Restoration (1978–1998) Hegemon*:* State, EU	No explicit mention of a *regante* ideal, though farmer ideals are characterized. Emerging contradiction between EU and State policy envisioning farmers and their roles. EU begins with the professionalization of the figure of the farmer, who would receive CAP finance, including technical assistance and support, support to small firms, and rural tourism, as ways of reducing out-migration (European Commission, 1991a, 1991b). The Spanish legislation on water reinforces the rationality and scarcity view of the water resource (Jefatura del Estado, 1985). Agricultural policy views traditional irrigation as irrational and wasteful: it identifies the contradiction of traditional agriculture as strong in populating rural areas but changing it on competitivity principles requires modernization (Remmers, 1993). By identifying the limits on competitivity, the ideal farmer (and *regante*) would have larger plots, be young, have access to land and the means of production, and access markets (Ministerio de Agricultura Pesca y Alimentación, 1993; Jefatura del Estado, 1995; Ministerio de Medio Ambiente, 2000).
Democratic Regionalization (1999–2023) Hegemon*:* State, Regions, EU	The ideal *regante* runs an economically efficient agri-enterprise with a modernized, water-efficient irrigation system. The *regante* is most likely male, preferably young, professional, and has the technical and general knowledge to work with increasingly complex and innovative irrigation distribution and on-plot application systems and technologies, as well as increasing protocols and requirements to be environmental stewards and produce exporters (Sanchis-Ibor, Boelens and García Mollá, 2017). *Regantes* would also be the facilitators of economic change, job creators, and reinvigorating rural communities (Jefatura del Estado, 1999; Ministerio de Medio Ambiente, 2000; Ministerio de Agricultura Pesca y Alimentación, 2002, 2012, no date b; Martínez-Fernández *et al.*, 2020). The regional variants of the *regante* also emerge. The Murcian *regante* ideal is young, knowledgeable of various issues, incorporating multiple water sources for irrigation, and exporting produce outside of Spain. The Manchegan *regante* is modernized, saving water and aiding in the establishment of new irrigation schemes and gaining new technical knowledge (Hommes, Hoogesteger and Boelens, 2022).

Source: own elaboration based on data in appendix 8

Compared to the previous historical periods, the current democratic regionalization period has multiple sources of authority establishing legislation and policy, which makes the reading of time and authority complex. The following Figure 3 provides an outline of the timeline and scales of the policies in this period.

Figure 3: Timeline of agricultural (green) and hydraulic (blue) legislation and policies at the European, State, and TSA-connected regional (Castille–La Mancha and Murcia) levels between 1999 and 2023



Source: own elaboration (see appendix 8).

In the current democratic regionalization period, the WFD was incorporated into Spanish legislation, and one if its key policies—shifting river management to the basin level—already found Spain managing water at the river basin level through its RBAs (Martínez-Fernández *et al.*, 2020). Its focus on environmental criteria, attention to the quality of bodies of water, and increasing the participation of stakeholders was a novelty in the Spanish context (del Moral Ituarte and Hernández-Mora, 2016), which had RBAs until then being governed alongside technocratic, supply-side criteria, and with a near-monopoly of the hydroelectric and irrigation sectors in the governance boards. The competent authorities designated in Spain under the WFD are the RBAs and the ministry for ecological transition and demographic challenge (De Stefano and Hernández-Mora, 2018). The regional governments play a role in RBA governance, with representation in their governing boards assigned according to the proportion of the territory and population that the regions have in the river basin, alongside the user associations (del Moral Ituarte and Hernández-Mora, 2016). Among many other hydrologically related functions, the RBA user-participatory boards decide annual allocation quotas (De Stefano and Hernández-Mora, 2018).

Within the agricultural sector, the introduction of RBMPs as required by the WFD, which, in turn, would inform the National Hydrological Plan, saw these focusing on increasing water-use

efficiency through the modernization of the irrigation systems. Nonetheless, these pose problems, since water consumption has not decreased but surface water and aquifer recharge has (Lecina *et al.*, 2010); furthermore, crop production has intensified and water concessions were not revised post-modernization and impact the social cohesion of the traditional irrigation communities (Congost, 2007). It should be noted that the last National Hydrological Plan of 2001 aimed to transfer water from the Ebro basin to the Segura basins, representing the last attempt of large-scale transfers within Spain's hydrological paradigm. Following significant opposition, this was cancelled, even if the WFD was contested by the supporters of defending Spain's "singularity", which backed transfers to southeast Spain for urban and irrigation development (Martínez-Fernández *et al.*, 2020).

4.3.2. The actual regante subject

Following the presentation of ideal *regantes* across historical periods, this section presents the results of interviews with *regantes* and how they act and are in the different territories. We follow Longhurst's three categories of analysis for understanding subjects—that subjects are always in place, they are embodied and material, and subjection and re-subjection reproduce dominant discourses (Longhurst, 2003). We apply these across the territorial categorizations of hegemony, frontier hegemony, and counterhegemony, thereby linking subjectivity with water and territory.

4.3.2.1. Hegemonic territory subjectivities

The hegemonic territories in Totana and Cartagena have their own histories of irrigation and power relations over water, conditioning the current perceptions of water and land. Totana's link to a nearby river that is historically irrigated with muddy waters was not included in the perimeter designed for the TSA water until 2019. This and the local elites' historical ownership of wells that auctioned irrigation water at exorbitant prices condition hydrological relationships to this day. The semi-arid nature of the region also invokes descriptions of place as desert turned green due to the TSA. There are high levels of on-plot modernization and professionalization of *regantes* setting up agribusinesses, growth of large, locally based agribusinesses, and smallholder and medium-sized *regantes* purchasing and leasing plots from an emergent crisis of generational handover.

In this way, hegemonic territories display a close alignment with policy discourses describing ideal *regantes* (see Table 8). The development of distribution systems and on- plot modernization infrastructure and technologies are perceived to be among the most technologically advanced and innovative in the world, with the principle of absolute control over resource inputs to grow crops shared by irrigation community leadership, as well as smallholders. Traditional flood irrigation is questioned at best: "they [water] are scarce resources. We don't understand how there are still areas where flood irrigation is practiced".[17] Even those critical of the TSA, who question water scarcity discourses justifying the continuation of the TSA, point to technology to secure alternative water sources. At the same time, *regantes* face significant uncertainty due to water availability, increasing demands from regulatory authorities, requirements to receive subsidies, and increasing certification

[17] Costa Cifuentes, M. (Comunidad de Regantes Trasvase Tajo-Segura de Totana, Totana, Murcia, Spain). Personal communication, 2022

requirements from supermarkets. Smallholders also criticize contradictions in policy support, which they argue goes to richer *regantes*.

In hegemonic territories, there is a distinction between *regantes*, those that do things "the old way", and those that are technologically developed. The latter are dependent on engineers, technicians, and service providers. This is accentuated by the distinction between who is considered a regante, those that own plots of land, and the professional *agricultor* farmer, likewise a regante by virtue of owning irrigated land. Professional farmers are those engaged in production for international markets. "Here most of us . . . there are small areas where there are still *regantes* with small plots for self-consumption, but very little . . . Most farmers and *regantes* have an average of, well it depends, there are farmers with more than 100 ha, farmers with between 100 and 50 ha, and then there are many that have 10, 15, 20, 5 ha. Around there. But most farmers sell their products with cooperatives, enterprises . . . and it's true that it could be 5% of farmers that do it for leisure, that have a job and have a small plot to grow on, and they may take it to a cooperative, but at a small scale".[18] Following national and European protocols and requirements, as well as certifications to sell to supermarkets, can be onerous and requires the regante to pay service providers to ensure that these are met. A second distinction is based on plot size: medium and large landholders, and smallholders. Smallholders argue that they, not multinationals, would be the ideal *regantes* in a sustainable future since they are the ones connected to territory, to land and water, and who have a connection to their local environment and can safeguard it. Traditional irrigation practices in the basin that have historical concessions are seen as destined to disappear.

4.3.2.2. Hegemonic frontier territory subjectivities

Frontier hegemonic territories were established during the early dictatorship and as late as the democratic restoration period. Historically, and under directives of the then ministry of agriculture and National Institute of Colonization, both the Alberche and Alcolea communities were directed towards specific crop choices by national and regional authorities. The irrigation community surrounds the city of Talavera de la Reina, with urban expansion eating into the irrigable perimeter and the Tagus RBA not permitting expansion of the perimeter. The plots of land were originally small, around 4 ha, and when the cattle sector became dominant, all farmers had under 10 heads of cattle, considering themselves self-sufficient. Nowadays, there are farms with over 100 heads of cattle that can be considered viable. Investment funds are entering the irrigation community and buy land to cultivate high-value tree crops. This increases land prices but complicates the individual *regantes*' ability to expand. This also reduces alfalfa production, worrying *regantes* with livestock. The Alcolea community's relationship with the river has been lost due to contamination and eutrophication. Residents could bathe in the river and canals, but now, *regantes* deal with contamination, eutrophication, and stench. Nonetheless, water is seen as giving life, and

[18] Costa Hernández, F. (Comunidad de Regantes Trasvase Tajo-Segura de Totana, Totana, Murcia, Spain). Personal communication, 2022

the transformation from rain-fed to irrigated agriculture is symbolized by the shift in colours, from brown and yellow to green.

In hegemonic frontier territories, the entrance of investment funds as actors in the Alberche and Alcolea communities drives land purchase and concentration. The purchase of land by the funds and the planting of tree crops lasting potentially up to 30 years is making it increasingly difficult for local *regantes* to rent land. In the Alberche community, there has been no investment in the maintenance of the community's distribution network. In the Alcolea community, water quality is a concern. *Regantes* check visually and by smell the state of the water in the water source. When there is strong eutrophication in summer, *regantes* must be careful that algae do not foul their distribution systems.

The frontier hegemonic territories consist of *regantes* attempting to keep in line with hegemonic discourses, yet they face challenges from the entry of new actors and an acute crisis of the generational handover of land. The establishment of the Alberche community responded to the dictatorship's policy of 'internal colonization' to expand irrigation, in- crease food production, and encourage the establishment of smallholder communities. This is reflected in the establishment of a local agrarian training centre and low interest credit provided for the purchase of machinery that covered full costs. Such policies encouraged young farmers in the 1950s and 1960s to settle. Nowadays, similar subsidies cover a fraction of the required machinery costs, effectively barring young farmers from accessing land unless they inherit it. *Regantes* do not see their children continuing in agriculture, since they consider the uncertainty of economic viability to be an impediment, and individuals trained in agriculture cannot purchase their own land. The entry of investment funds has local *regantes* worried that it will accelerate the end of the locally based, smallholder professional regante. Local *regantes* expect the future to be based in agribusinesses and service providers, including irrigated land management services. The Alcolea community, on the other hand, reflects policy decisions of the current democratic regionalization period. The local National Institute of Colonization spurred the transition to livestock in the area, while the requirement to practice drip irrigation is reflected in regional policy.

The hegemonic frontier *regantes* see themselves as educated, trained through local demonstration plots and by agrarian training centres. The technical knowledge needed to be able to grow crops in conditions allowing sales to supermarkets means they must master multiple disciplines and navigate administrative processes. Lately, there has been more interest from people new to the sector, from Madrid, in training as farmers. However, as mentioned earlier, it is very difficult to obtain land, and new farmers can only work for other *regantes*, service providers, or agribusinesses. The current policies and administrations are seen to only favour large agribusinesses, exacerbating the generational handover crisis and creating a distinction between two regante subjects, those locally based *regantes* who still own land and live in the community and absent *regantes* owning land but using service providers.

4.3.2.3. Counterhegemonic territory subjectivities

Regantes in counterhegemonic territories are intimately linked with centuries-old irrigation systems. In Letur, they seek to maintain their territories as they are, resisting changes and keeping open-air canals fed by springs. The irrigation system is perceived as the result of a centuries-old process of trial and error and an example of sustainable water use, resisting social, political, and economic changes, as well as shifting food system models. In Orihuela, the irrigation system is dependent on the cycle of "live and dead water", recycling irrigation water—which relies on flood irrigation (Martí and García Mayor, 2020). It dates to 1275 through a royal privilege declaring that the beneficiaries "irrigate and irrigate as much as they did in times of the moors and more if they can" (Torres Fontes, 2008, p. 290). This is a historical recognition by the Castilian king Alfonso X of the irrigation improvements brought to and developed by Muslim Arabs in Islamic Spain. Traditional agriculture up to the 1970s involved women and men watering their fields with buckets, wooden mills, and mules. According to the data provided in 2023 by the secretary of the Orihuela tribunal[19], approximately 95% of the system still practices flood irrigation. The land in the system is highly distributed, described as "a brutal minifundium"[20], with average holdings not reaching a hectare.

The material acts in counterhegemonic territories focus on maintenance and intervention in systems and resistance to actions from authorities that impact their systems. In Letur, the network is constantly worked on and repaired. The leadership of the irrigation community passed bylaws ensuring the canals remain uncovered, "that the water can be seen, and that it can continue being enjoyed as it has been for centuries, and that Letur remains the same".[21] The community has mobilized to stop the drilling of artesian wells close to the springs and to reject the installation of water counters. In Orihuela, smallholdings meant that before mechanization was introduced, *regantes* would water by hand. The arrival of the TSA saw the transformation of rain-fed lands uphill of the valley floor dedicated to fruit trees. In the 1980s, the canals feeding the traditional system were impermeabilized with concrete, which affected the collection of dead water after irrigation.

Regantes in counterhegemonic territories present resistance, as well as ambivalence, towards hegemonic discourses. The Letur community perceive themselves as outsiders of agricultural development policies. The policies require covering canals, installing water counters, or shifting to drip or spray, which are resisted. The community perceived that they are constantly under the threat that the Segura RBA could tap and exhaust their aquifer. The Letur leadership claim policy should "support those who truly take care of water, not only of those who destroy it".[22] While Letur is not immediately impacted by the TSA, they argue the transfer created supply expectations that became a real, unsatisfiable demand: "Now there is a giant monster consuming water in the Segura basin, in large part thanks to the transfer, and that monster wants water, wants water, and it has an enormous

[19] Mazón Balaguer, M.P. (Juzgado Privativo de Aguas de Orihuela, Orihuela, Alicante, Spain). Personal communication, 2022
[20] Mazón Balaguer, M.P. (Juzgado Privativo de Aguas de Orihuela, Orihuela, Alicante, Spain). Personal communication, 2022
[21] López Juárez, L. (Comunidad de Regantes Las Fuentes de Letur, Letur, Albacete, Spain). Personal communication, 2022
[22] López Juárez, L. (Comunidad de Regantes Las Fuentes de Letur, Letur, Albacete, Spain). Personal communication, 2022

political and economic power, and we are nothing compared to [that monster]".[23] In the Orihuela tribunal, there is a perception of total abandonment by authorities towards traditional agriculture and the Segura River. The agricultural development policies are perceived as benefiting large farms and irrigation communities. This is seen as hypocritical when there is similarly a policy push for ecological agriculture, zero-kilometre food production, protection of the environment, and reduced contamination. The arguments for modernization are refuted by traditional *regantes*. The reuse of water and its cycling through the system cannot be carried out with drip irrigation, and policies mark the end of the small-scale farmer. The TSA is described as "a monster, a seven-headed hydra".[24]

Counterhegemonic territory *regantes* see themselves as defenders of the environment, of territory, and of water. Cooperation in both Letur and Orihuela is crucial for the functioning of their systems. In Letur, irrigation systems respect biophysical and territorial limits, with no expectations of expanding the irrigable perimeter. The constant flow of water provides for the local ecosystem, the landscape, and communities downstream. Few individuals live off agriculture exclusively; most *regantes* are retired or part-time farmers for self-consumption or for additional income. Farming is valued not only economically but there is also joy and satisfaction in tilling soil or sharing produce with family members. In Orihuela, specific on-plot technologies are not seen as superior or inferior to one another but depend on crop choice. Sustainable water use is that which uses the right amount to optimize crop growth. The traditional model is compared to intensive irrigation models that create landscapes of plastic greenhouses. As stated by the tribunal's secretary, "In terms of traditional irrigation's water sustainability, examining the numbers well, it beats the [TSA] transfer ['s irrigation model] totally. If you are speaking about economic performance, they [the TSA transfer's irrigation model] wipe us [the Orihuela tribunal's traditional irrigation model] clean. Without a doubt".[25] Future outlooks of the smallholder regante are perceived to be bleak because there is no policy support, and there is a suspicion that is what is desired by the regional and national authorities.

4.4. Discussion

4.4.1. The contradictions of realizing ideal and real regantes

Early policies and legislation, from *regeneracionismo* through the dictatorship, set the legislative, policy, and infrastructural agenda for hydraulic development that aimed to not only transform territories through supply-side infrastructure but also begin crafting a social category of farmer, regante, to do so. A specific imaginary (Hommes, Hoogesteger and Boelens, 2022) of water control is developed and institutionalized, with the State putting surface water under the public trust in 1866, RBAs being established in 1926, and planned infrastructural works, including the TSA, being proposed in 1936. The State's vision of total hydraulic transformation (Ekers and Loftus, 2008;

[23] López Juárez, L. (Comunidad de Regantes Las Fuentes de Letur, Letur, Albacete, Spain). Personal communication, 2022
[24] Mazón Balaguer, M.P. (Juzgado Privativo de Aguas de Orihuela, Orihuela, Alicante, Spain). Personal communication, 2022
[25] Mazón Balaguer, M.P. (Juzgado Privativo de Aguas de Orihuela, Orihuela, Alicante, Spain). Personal communication, 2022

Sneddon, 2013; Swyngedouw, 2015) responded not only to make Spain self-sufficient in food production but also responded to political pressure to resolve the agrarian question of providing peasants with land by populating the interior of the country and expanding irrigation schemes, as seen in hegemonic frontier territories. The end of international isolation sped the construction of hydraulic infrastructure, with the TSA being approved in 1955, construction commencing in 1968, and transfers being legally approved in 1971. It is with the arrival of the TSA that hegemonic territories transformed, and counterhegemonic territories entered a discursive and material relation with the TSA and hegemonic discourses and policies through the reintegration of the Segura RBA, such as by impermeabilizing the live water–dead water network of Orihuela.

The transformation of *regantes* occurs in parallel to hydraulic developments. The 1932 irrigation works law constituted the colonization boards, later continued under the dictatorship's National Institute of Colonization in 1939, which intervened in the hegemonic frontier territories of the Tagus basin as late as the 1980s. As in the 1950s, with policy reform and the institution of agricultural extension services, there is the beginning of a modernizing discourse (Barciela, 1996) and an explicit conducting of subject populations (Boelens *et al.*, 2016; Hommes *et al.*, 2020; cf. Mills-Novoa *et al.*, 2020). This aimed to professionalize *regantes* and their knowledge base, not just a policy of the populating territory, reflected in the ideal regante subjectivity of the late dictatorship (Table 8). As seen in credit policies that hegemonic frontier territories experienced positively, *regantes* look back at this period as one where the minifundia model allowed them to make a living for their families. The minifundia model is also present in hegemonic and counterhegemonic territories, but this period is remembered in the hegemonic territory of Totana for the unjust distribution of water through private wells. The arrival of the TSA coincides with the beginning of scalar policies, including the EU, which, alongside hydraulic policy, prescribed ideal visions of *regantes*, which included the modernization of their plots (the 1985 water law) to rationalize water use and their professionalization and importance in fixing populations and leading a rural regeneration (the 1995 law on modernization of agrarian units).

It is in the democratic regionalization period that the policy focus on modernization, professionalization, and rejuvenation of *regantes* deepens, establishing multiple roles and heightening contradictions between the ideal and actual *regantes*. Revisiting Figure 2 highlights the multiple scales of authorities and their policy actions that prescribe the ideal regante when confronting the challenges of modernization, professionalization, and rejuvenation in all territories. The push for hegemonic principles (Bourguignon, n.d.) as normative moral frameworks (Sanchis-Ibor, Boelens and García Mollá, 2017) collides in different ways in hegemonic, hegemonic frontier, and counterhegemonic territories. The multiple scales of authorities also imply that the frames of reference to which *regantes* are subject and respond to (Nightingale, 2013) multiply. While EU policy does not discursively build a clear regante subject, national and regional policies build various ideals.

At the EU scale, the CAP provides the financial means for territorial transformations through the European Agricultural Fund for Rural Development since 1999, dedicated to

modernization, agri-environmental, and rural development measures (Lillemets, Fertő and Viira, 2022). At the State level, the 2000–2006 Regional Development Program, the 2002–2008 National Irrigation Plan, the 2007–2013 National Strategic Plan for Rural Development, and the 2014–2022 National Rural Development Program lay out broad visions for *regante* ideals. As seen in Table 8, it is at the regional level that policies articulate somewhat different roles for the ideal regante. While the ideal Murcian *regante* focuses on mastering various knowledges, mobilizing various waters, and exporting internationally, the ideal Manchegan *regante* is to modernize their fields, aid in saving water, and mobilize further land to put under irrigation where possible.

The realization of ideal *regantes* in hegemonic and frontier hegemonic territories lays bare several contradictions and struggles in attaining this realization. First, when *regantes* perform the ideal regante subject (Butler, 1997b; Nightingale, 2013), they experience precariousness and a loss of autonomy (Sanchis-Ibor, Boelens and García Mollá, 2017) that contributes to perceptions from *regantes* that their children do not want to follow in their parents' footsteps. Dependence on service providers, pressure to adopt technology and knowledge upgrading, competition and search for markets, increasingly demanding certification processes, and the uncertainty of water provision in sufficient quantity (through the TSA in hegemonic territories) or quality (from the Tagus in part of the hegemonic frontier territories) are all factors causing stress and contributing to the generational handover crisis, since older *regantes* cannot or choose not to keep up.

Second, policy drives have led to a principal contradiction over regante subjects. Local large agribusinesses in hegemonic territories and investment funds in hegemonic frontier territories have caused land prices to rise, and new, young farmers cannot enter the sector. Ironically, the realization of ideal subjects in the contemporary period occurs in contexts where it is feared that agrarian communities will die out, and in their place, ideal subjects strive for an individualized but dependent existence where other human relationships are increasingly mediated through the paid services mentioned above (and increasingly, paid natures for new water sources such as desalinated and treated wastewater), echoing, in part, Harris's argument on subject individualization in neoliberalized natures (2009).

Finally, inter- and intra-community land size differences and tensions emerge in hegemonic and hegemonic frontier territories, linked to access to subsidies, water, land, and to the roles of reproducing rural life. Contentious relations between smallholders and large businesses in hegemonic territories reflect the dissonance between lived histories and struggles over securing water resources. In Totana, histories of the local irrigation with muddy waters and the extractive control of groundwater by local elites in the pre-TSA period that are remembered to this day are contrasted with the current attempts to recognize extinguished historical water rights that smallholders push to have recognized vis-à-vis large landholders and businesses that have water access. In the hegemonic frontier territories of Alberche and Alcolea, the irruption of investment funds purchasing land, and water concessions with it, change the social and administrative structure of who works the land and of the rural communities embedded in the territory. These differences

and tensions in both hegemonic and hegemonic frontier territories point to various issues that an ideal regante would resolve. However, this hegemonic ideal masks multiple issues that actually exist. Nonetheless, land size differences are also a reflection of power relations within the community, which limits the array of potential solutions and experiences (Bourguignon, n.d.; Harris, 2009; Sneddon, 2013) that are presented.

This collapse of rural areas, combined with the issue of land and rural rejuvenation in hegemonic and hegemonic frontier territories in the current democratic regionalization period, reveals one of the principal contradictions in the development policies regarding the role of the ideal regante in constructing ideal territories. Namely, they are expected to be the motor of attracting and fixing populations in rural areas, which contrasts with what is really happening. These territories were singled out by policy and interventions from *regeneracionismo* through to the democratic restoration period, creating a minifundia model of smallholder and medium-sized farms in irrigation schemes that were able to support *regantes* and their families. While policies point to irrigation as being far more successful than rain-fed agriculture in attracting and fixing population in rural areas, irrigation community dynamics are leading to smallholders dying out and selling or leasing their land—land that is singled out for subsidies and that has potential water concessions when within the irrigable perimeter of the irrigation community. The demand for irrigable land and prices for its lease or sale often puts it out of the range of smallholders and encourages agrarian social differentiation. This is why *regantes* in hegemonic and hegemonic frontier territories foresee an end to smallholder agriculture and the rise of agribusiness and investment-fund-led land ownership in these areas.

The policy ideals lay out the mechanisms by which hegemony spreads materially through the State, regional and regante action and through which regantes and spaces are co-constituted (Hommes, Hoogesteger and Boelens, 2022) in hegemonic and hegemonic frontier territories. As stated earlier, while there are variations at the regional level, the Murcian regante would ideally mobilize multiple waters, while the Manchegan regante would ideally modernize their plots and aid in spreading irrigated surfaces. The fact that the Murcian *regantes* in Totana and Cartagena are using multiple water sources—TSA, surface water, desalinated water, and treated wastewater—links the physical acts and embodies *regante* subjects with the various water sources, and through this, they subject themselves to policy directives describing the ideal *regante* (Longhurst, 2003; Nightingale, 2013). Manchegan *regantes* similarly embody the territories they live in through irrigation practices. Nonetheless, they present two conundrums. On the one hand, an emerging *regante* subject is the legally present and physically absent landholder *regante* who enters the community through investment fund purchase. Second, *regantes* are expected to modernize their on-plot systems to enable water savings that allow for the expansion of irrigated surfaces in the Tagus basin, which abstracts their relations with water and territories well beyond the boundaries of their own lived communities. This abstraction likewise plays out the conflicts at the regional, national, and European levels of water management over the hegemonic hydraulic paradigm where drip

irrigation is unquestioned, even if it brings its own problems and contradictions over water savings (Lecina *et al.*, 2010). Frontier hegemonic ideal and existing *regante* subjects face contradictory movements where new *regante* subjects shake the foundations of existing ones and where moralizing strategies (Sanchis-Ibor, Boelens and García Mollá, 2017) lay bare policy contradictions between economic efficiency on the one hand—efficient irrigation farms maximizing resource use for cash crops—and rural community life on the other.

4.4.2. Alternatives to an ideal regante

These policies also outline which regante deviates from this ideal. These are traditional *regantes* and the schemes they work with are considered obsolete, working with old infrastructure or traditional earth channels and practicing flood irrigation. These *regantes* and their schemes are to be subjected to modernization drives, resulting in water savings, and trained in innovative practices for this purpose. The irony, compared to the performance of the ideal, is that *regantes* have not expressed precariousness and loss of autonomy. The TSA and supply expectations are imagined and experienced differently than intended in different territories (Hommes, Hoogesteger and Boelens, 2022), and subjects experience the inter-connected socio-ecological rivers through it differently as well (Boelens *et al.*, 2022; Dupuits, Puertas and Balsiger, 2023). There are concerns and worries linked to water availability or encroachment due to the "monster/hydra" that the TSA has produced in increasing water demand. In response to hegemonic moralizing claims (Bourguignon, n.d.; Sanchis-Ibor, Boelens and García Mollá, 2017), the choice for on-plot modernization is pursued ambivalently, compared to *regantes* in hegemonic territories declaring that flood irrigation should be abandoned. Drip irrigation is seen as another tool that can help the *regante*, just as flood irrigation does. However, the values ascribed to traditional irrigation systems that drip or flood go beyond a single (economic) premise (Santos Pérez and Remmers, 1993; Duarte Abadía, 2022; Mirhanoğlu *et al.*, 2023). The values of water that focus on maintaining an ecological balance, using enough to ensure downstream users can have water, or keeping it visible for aesthetic reasons, do in part coincide with some of the policies' aims, particularly the ecological ones. Likewise, the values of water coincide with different visions that require a community effort in cooperation and coexistence to maintain these (Harris, 2009; Duarte Abadía, 2023). However, the method of achieving ecological balance is anathema to the scarcity-related values of water prescribed as the driving focus of policies.

Having mapped the space between ideal and actual *regantes*, we turn to the future and what the contradictions realizing these ideal *regantes* reveals. Hegemonic and hegemonic frontier smallholder *regantes* fear that smallholders will be replaced by an arrangement of agri-businesses and investment-fund-propelled arrangements by fund owners and service providers. This foretells a situation where *regante* subjects are legally present and physically absent and where *regante* labour is conducted by trained professionals to care and work irrigation systems and plots with no proprietary link to the land itself. What this means for the social fabric of rural areas is still

unknown but evokes a familiar figure in Spanish agrarian history—the itinerant labourer. Alternative models such as cooperatives exist in hegemonic and frontier hegemonic territories; however, at least in hegemonic territories, they do not fully meet the multiple demands from their *regante* members and the demands from wholesalers and supermarkets.

Alternative territories and socionatural arrangements exist in counterhegemonic territories that point at more equitable and just arrangements for working with, conceptualizing, and visualizing water (Owens *et al.*, 2022). Whether it is open canals or a system of live and dead water, both require coordination and a divergence of ideal visions of institutions vested with power (Ekers and Loftus, 2008; Sneddon, 2013). Similarly, the position of smallholders in hegemonic territories to strive for a more just water future has involved constant activism and the research into historical rights that are fought to be recognized as a way of maintaining a hydraulic and agricultural heritage that looks not only at economic viability but also at a community viability in rural areas that considers other dimensions such as social and environmental health care, reciprocity, co-created and entwining vernacular and modern knowledges, and multi-scalar alliances (Götz and Middleton, 2020; Villamayor-Tomás and García López, 2021; Duarte Abadía, 2022, 2023).

4.5. Conclusions

This article has laid out the historical construction of the ideal regante subjects and how they have been attempted to be realized, resisted, or ignored in various territories interconnected by the TSA. The territories and individuals are subjected and crafted together through power relations (Ekers and Loftus, 2008; Sneddon, 2013), emulating the ideal demanded by powerful interests or despite said ideal (Harris, 2015; Duarte Abadía, 2023). This hegemonic ideal has shifted over the long duration of Spain's hydraulic and agricultural policies and political structures. Today, multiple levels of authority lay out differing visions, whether as hard infrastructure or soft governance (Hommes, Hoogesteger and Boelens, 2022), and this multiplicity also leads to multiple and often contradictory demands on *regantes*. As demonstrated throughout this article, hegemonic power is challenged through these contradictions, particularly when an overriding aim—water savings and modernization—is painted with a broad brush stroke to also coincide with the contrasting policy aims of maintaining social cohesion and rural vitality. In this revelation, the existing and new counterhegemonies offer alternatives against technocratic approaches.

The intersection of constructed and interlinked hydrosocial territories (Boelens *et al.*, 2016) through IBWTs, the spread of new on-plot technologies, and the particular histories and relations with hegemonic practices that different territories are subjected to create different *regante* subjects. This article demonstrates the value of broadly examining multiple territories and interrogating multiple experiences of power to break down unquestioned subjectivities. By utilizing Longhurst's (2003) approach to understanding subjects, place, subject material acts, and the relationship between subjection and resubjection in relation to hegemonic discourse and policies, we have demonstrated that multiple subjectivities emerge that are embedded in territory and in relation to

the *regantes* inhabiting them, as well as to *regantes* inhabiting other interconnected territories. Hegemony, as experienced through the implementation of hydraulic and agricultural policy, also embeds a moralizing discourse (Sanchis-Ibor, Boelens and García Mollá, 2017) to identify regante and practices that need to change. Nonetheless, the current hegemonic visions require ideal *regantes* to fulfil multiple and contradictory roles—job creators, private entrepreneurs, fixers of rural populations, quality assurers, and food producers. Intersecting issues of class and land—holding, generational handover crises, and youth in agriculture are all present in the interconnected territories but experienced very differently depending on how the hegemonic discourses are accepted. In that respect, the precariousness and individualization (Harris, 2009) of the regante in hegemonic and hegemonic frontier territories are not as salient in counterhegemonic territories, pointing to water just alternatives (Boelens *et al.*, 2022) and models that embody different and multiple values (Hoogendam, 2018; Paerregaard, 2018; Dupuits, 2019; Ross and Chang, 2020; Vos *et al.*, 2020; Villamayor-Tomás and García López, 2021; Basel, Hoogesteger and Hellegers, 2022; Ricart and Rico-Amorós, 2022; Whaley, 2022; Hidalgo-Bastidas, 2023).

What does this mean for broader questions of water management in Spain and beyond? Above all, large-scale hydraulic infrastructure such as the TSA has impacts beyond water redistribution. It creates conditions, new subjects, and new relationships that governing institutions at multiple scales may not be able to react to quickly enough or have existing powers entrenched in (Seemann, 2016; Aubriot, 2022; Basel, Hoogesteger and Hellegers, 2022; Mirhanoğlu, Loopmans and Özerol, 2022; Baumann, 2023; Birkenholtz, 2023; Bourguignon, 2023; Flaminio and Reynard, 2023). Likewise, the spread of on-plot irrigation modernization has become a silver bullet in policy, but different subjects react to it in very different ways, producing not only varied imaginaries but, with them, different territories. Most importantly, water governance and water policies have to be seen in conjunction with other policies and sectors, particularly agriculture, since water subjectivities are entwined, embodied, and placed in lived and loved territories (Hulshof and Vos, 2016; Goodwin, 2019; Yates, 2022).

This argument opens various possibilities for future research. From a theoretical standpoint, the combination of feminist understandings of subjectivity with that of hydrosocial territories points to fruitful engagements in other empirical material. Second, this article engaged with multi-scalar empirical material that hydrosocial territorial literature can expand on. While sacrificing richness of detail, interconnections open new avenues of interrogation that stand-alone case studies cannot engage with. Furthermore, deeper questions on the implications of looking at multiple interconnected territories hegemonically and the subjects created because of or in spite of hegemony opens inquiries into scalar impacts on water governance and institutional forms of irrigation that the policies may try to flatten or simplify. Finally, there is a focus on the *regantes* obviated attention to these same subjects' other and equally important, multiple identities, including particular gender, class, and ethnic relations and modes of belonging. Next, they interact with other subjects of agrarian life—e.g., (migrant) labourers or small-scale entrepreneurs. Investigating their

roles as both subjects and inhabitants of hydrosocial territories would provide important dimensions to understand the changing and interconnected irrigation systems.

5. More-than-human co-becomings: the interdependencies of water, embodied subjectivities and ethics[26,27]

Abstract

Framing more-than-human interdependencies within feminist political ecology means starting from an understanding of relationality. In this chapter we explore the politics of interdependencies through situated entanglements with water. Drawing on research with waters and communities in Maharashtra, India and the Tagus River in Spain, we focus on the co-constitution of embodied subjectivities with the more-than-human, addressing issues of wellbeing, illness and ecological change in contemporary waterscapes. In doing so we explore the contradictions, tensions and ethical implications of situated more-than-human co-becomings.

5.1. Introduction

In a small drought-prone rural village in Maharashtra, Pravah[i][28], India, farmers irrigate their farms using the wastewater of the city of Pune. Water becomes multiple and troubled as it is used, embodied, and experienced in different ways. Water(s) and women farmers co-become through their varied relationships to one another. Similarly, the journey of the Tagus River through Spain and Portugal tells a story of multiple, troubling waters interwoven with landscapes, people, histories and more-than-human co-becomings. The Tagus as an entity is shaped by multiple human interests - irrigation, human consumption, international relations - but also shapes human communities within and beyond its basin. These stories raise contradictions and ethical concerns that highlight the importance of thinking through more-than-human interdependencies to understand how water- and hydro-scapes emerge.

Whether a village served by a wastewater scheme in Maharashtra, India, or an IBWT infrastructure in Spain, hydraulic schemes and infrastructures create webs of relations within and across multiple scales. This inspires us to grapple with more-than-human concerns. The term 'more-than-human' situates humans within the sticky webs of relations, making humans interdependent with other beings and materials (Haraway, 2003b; Barad, 2007; Isaacs and Otruba, 2019). We focus on the relationality of the more-than-human to consider the ethical contradictions that flows of power within these webs engender. These relations can be life-giving or denying (Bawaka Country *et al.*, 2013; Singh, 2013; Zwarteveen and Boelens, 2014), create socionatural difference and inequalities (Harris, 2006; Nightingale, 2006; Sultana, 2009; Ahmed and Zwarteveen,

[26] This chapter is published as: Bourguignon, N., Leonardelli, I., Still, E., Nightingale, A., & Nelson, I. (2023). More-Than-Human Co-becomings: The Interdependencies of Water, Embodied subjectivities and Ethics. In W. Harcourt, A. Agostino, R. Elmhirst, M. Gómez, & P. Kotsila (Eds.), *Contours of Feminist Political Ecology* (pp. 129–153). Palgrave Macmillan. https://doi.org/10.1007/978-3-031-20928-4

[27] The first three authors contributed equally in writing the chapter and are listed in alphabetical order; the fourth and fifth authors contributed to the overall conceptualisation and finalisation of the manuscript and are listed in alphabetical order.

[28] All names of people and dwelling places are pseudonymised, names of rivers and infrastructure are not changed.

2012), and permeate the co-constitution of embodied subjectivities (Nightingale, 2006; Singh, 2013). Particularly, we focus on water and the ways it co-constitutes uneven relations between and within different human beings, other beings, and materials across multiple times and scales (Neimanis, 2012). In doing so, we recognize that our attempt to grapple with the more-than-human is always situated, partial and shaped by our positionalities.

In this chapter, Irene Leonardelli presents the section dedicated to Pravah in the second person, recognising herself as a researcher generating data together with a translator as well as with local researchers-activists and informants in the village. Nick Bourguignon presents the section dedicated to the Tagus River in the first person, recounting his experiences and knowledge of the river. Enid Still engages with these narratives philosophically by thinking through the ethical implications of more-than-human interdependencies. Ingrid Nelson and Andrea Nightingale have been co-thinkers through the entire process, helping to find a narrative thread, navigate the wide literatures on socionatures and reflecting on FPE praxis. Together, we aim to think of waters through different lenses and in different geographies, with specific histories and socialities, while remaining aware that our human histories and privileges shape these representations of waters. This movement between different positions of the self in relation to water and the more-than-human is intentional, as we feel it reflects the way water is unbound, percolating through bodies and soils; shaping both alliances and conflicts between different actors, such as the state, community organisations and farmers.

Framing more-than-human interdependencies within FPE means *starting* from an understanding of relationality (rather than the experience of distinct individuals) (Rowe, 2005; Nightingale, 2011). Exploring this relationality as entangled, multiple and situated has enabled feminist political ecologists to contribute to debates on how subjectivities are co-constituted with the more-than-human (Nightingale, 2006). Andrea Nightingale (2013) demonstrates that the Scottish fishermen's emotional and political subjectivities are co-constituted by the sea; it can give or take life, it can create a sense of purpose and bend political will, and it can create or destroy possibilities for fishermen. Secondly, intersectional inquiry into how power operates within these entanglements has enabled nuanced accounts of how gender, caste, class, age, seniority, marital positions and ethnicity are differently implicated in the community management of ecological resources (Elmhirst *et al.*, 2017; Nyantakyi-Frimpong, 2019). Furthermore, FPE questions how socionaturally constituted power dynamics refract upon hierarchical social relations and boundaries, as well as wider systems of power such as colonialism (Nightingale, 2011; Nelson, 2017).

For this chapter, we draw on this work in FPE and related disciplines, focusing on the development of the concept of more-than-human interdependency in an attempt to trouble essentialising narratives that may be read into such complex and situated relationships (Haraway, 2003b; Barad, 2007; Rose, 2012; Bawaka Country *et al.*, 2013; Nightingale, 2013; Nelson, 2017). In doing so, we remain aware that writing about the more-than-human is a socially mediated process,

despite the multiple forms of more-than-human agency that go beyond the immediate human experience.

The next section begins with the case of Pravah, where a wastewater reuse scheme allows farmers to farm throughout the year, cultivating different crops both for household consumption and to sell at the market. However, the wastewater that is used for irrigation percolates into the village's shallow aquifer contaminating the existing, scarce, water. Women, who primarily bear responsibility for water, have to navigate different levels of contamination at water sources and adjust their practices accordingly. The concept of 'waterscape' flags an ontological definition of water where power is enrolled in co-constitutive representations and materialities of water (Baviskar, 2007). Next, we journey with Nick's account, where the river's ebbs and flows constitute fuel and food that sustains the lives of many beings, as well as embodied memories of co-becoming with the multiple existences of "the Tagus". Bubbling forth in Eastern Spain, the Tagus cuts through canyons and pine forests, meanders past Toledo and across plains and *dehesas*, joining the Atlantic Ocean in Lisbon. Yet the waters also join with the Mediterranean through the Tagus-Segura IBWT. Wastewater from Madrid's 6.6 million inhabitants joins the Tagus with wafts of ammonia, to bubble through Toledo. The concept of 'hydrosocial territory' helps explore the multiple scales of contested socionatural materializations of spatially bound networks of the river (Boelens *et al.*, 2016). Finally, we discuss the situated knowledges and ethical implications that emerge from these ethnographic explorations and the way they illuminate interdependencies in particular ways that can inform processes of co-becoming with water. Each of the following sections discuss how such interdependencies are lived and yet often obscured, and how thinking with the politics of interdependency can enable us to narrate the situated complexities of their emergence as a process of co-becoming.

5.2. Gender-water intra-action in a wastewaterscape in Maharashtra, India

> *The main public well in the village is called Sakarbai [sugar lady] because its water used to be pure, fresh and sweet. (…) Water was very scarce outside the monsoon season, but it was so good that it used to taste like coconut water. She [Sakarbai] used to give us the best water even in summer, when we used to climb down the well to get whatever water we could find. But after we started using wastewater for irrigation, she [Sakarbai] was really badly affected. It's not her fault, but her water became disgusting, so we stopped drinking it.*
>
> *Interview with Sonali, 28 February 2020*

Sonali, a seventy-year-old woman belonging to the Maratha caste -the upper caste in the village of Pravah- and who worked her entire life as a farmer, is talking while sitting on the floor of her house. Sakarbai is the name of the well where she used to fetch water for drinking and other domestic purposes since she moved to Pravah as a just-married child, at the age of six. Around

2009, Sakarbai started changing. It happened as more farmers in Pravah started buying wastewater to irrigate, taking advantage of a wastewater reuse system called Purandar Lift Irrigation Scheme. This was designed by the Government of Maharashtra in the early 2000s to address water scarcity in 60 rural villages located in the Purandar sub-district, south-east of Pune. Wastewater is pumped up from the Mula-Mutha river, which flows through Pune collecting untreated water from the urban sewer system and industrial effluents, manufacturing industries, construction sites, automotive garages and hospitals (Jagtap and Manivanan, 2019). Farmers can buy wastewater outside the monsoon season, usually from January until June when their wells are empty. Along with traditional rainfed crops such as *bajra* (pearl millet) and *jowar* (sorghum), they use wastewater to irrigate different non-traditional crops, particularly flowers, to sell at the market in nearby towns and Pune. Wastewater reaches Pravah through a system of pump houses and pipelines; farmers store it in private water ponds (see also Leonardelli et al., 2022). From these ponds, wastewater percolates into the shallow aquifer of the village, contaminating the existing, albeit scarce, groundwater. This way, all wells (those used for irrigation as well as Pravah's former drinking water well Sakarbai) get recharged with (at least partly) contaminated water.

As the Purandar Lift Irrigation Scheme changes water flows, a wastewaterscape (Karpouzoglou and Zimmer, 2016) emerges. This entails new material-discursive relations between different humans and waters. Wastewater opens up possibilities (e.g., for irrigating and thus farming differently) and closes down others (e.g., drinking pure and sweet groundwater), re-articulating more-than-human relations in troubling ways that raise ethical questions and concerns. Here we unfold some of these re-articulations focusing on the interdependencies between women farmers[29] and water, thereby troubling boundaries that signify what is considered an ethical encounter. We make this choice because in Pravah, like throughout Maharashtra and other parts of rural India, fetching water, cooking, cleaning, washing and bathing children are tasks performed mostly by women. Women also perform much of the everyday work in the farm, work which is profoundly mediated by water (Krishna and Kulkarni, 2018). The focus on women farmers also stems from our ethico-political commitment to complicate dominant representations, challenging the processes through which women farmers' experiences, knowledges and practices are marginalised and/or silenced, especially those of women farmers of Scheduled Castes[30], landless women, single women and widows (Bhat, 2016). Indeed, the conceptualization of 'farmers' in India most often reproduces the imaginary of farmers as male landowners (Agarwal, 2003; Padhi, 2012; Still, 2022).

Feminist scholars studying water in rural, agrarian contexts have shown how gender and water are intimately interwoven (Harris, 2006; Sultana, 2009; Ahmed and Zwarteveen, 2012; Mehta, 2014; Bossenbroek and Zwarteveen, 2018). Their interdependence is simultaneously material,

[29] We use the category of "women farmers" to refer to people who, during our fieldwork, identified themselves as such, though sticking to a definition of gender as a fluid "performative accomplishment" (Butler, 1990)shaping a myriad of different subjectivities.
[30] "Scheduled Caste" is a politically imposed category that encompasses all castes considered to be outside the caste or varna system, and who are therefore systemically oppressed and socio-economically disadvantaged. It is a recognized term in the Constitution of India and is used to enable reservation status for those from scheduled castes, to enable their representation in social and political life (see Gnana, 2018).

symbolic and discursive, with "gender" and "water" (and all that emerges in their relation, for instance farming) continuously co-constituting and re-defining one another (Bossenbroek and Zwarteveen, 2018). Re-allocations of water, for instance those fostered by neoliberal processes of development, imply changes in gender labour relations, roles and responsibilities, thus also re-defining gender embodied subjectivities (Harris, 2006). At the same time, experiences such as headaches and backaches from hauling heavy loads of water, as well as the health implications arising from consuming unsafe water, illustrate how embodied gendered subjectivities are spatially produced through everyday dealings with water (Sultana, 2009).

These studies have pointed out how everyday dealings with water significantly shape gendered embodied subjectivities. Yet what we aim to emphasize here is that how water behaves in and through specific landscapes (seeping, percolating, overflowing, evaporating) and what it transports (algae, sediments, organic matters, contaminants) also play a role in co-constituting specific gendered embodied subjectivities.

In order to reflect these fluid sensibilities, we draw inspiration from post-human and STS feminist scholars, as they cultivate sensitivity for what more-than-humans, and water particularly, trigger and afford in socionatural relations (Barad, 2007; Pickering, 2009; Neimanis, 2017). Particularly, Barad (2007)'s concept of intra-action helps focus the analysis on how human bodies and nature bodies co-constitute one another -simultaneously discursively and materially-, meaning they do not exist as separate, discrete entities. This conceptualization helps us decentre the idea that humans dominate matter to instead pay more attention to the specific behaviours that different humans and more-than-humans, including water, afford as they relate. This becomes useful to unpack how gendered subjectivities embodied by women farmers of different castes and classes and water co-become in the wastewaterscape of Pravah.

5.2.1. The multiple waters of Pravah

Around 2011, soon after the wastewater reuse scheme started functioning, Sonali and all other women farmers across caste and class noticed that the colour of Sakarbai water had become more and more turbid; its taste was more bitter, and unpleasant. At the same time, people fell sick with stomach diseases, which they related to the water they were drinking. These sensorial and embodied experiences laid a foundation for women farmers across caste to re-signify what water is: how and for which purposes it could be used. Though they appreciated the abundance of water in Sakarbai, as they no longer had to depend on government-sponsored water trucks or walk long distances to fetch water during the driest months of the year, they deemed Sakarbai water as unclean, smelly, "full of chemicals" and "dangerous". "*It's not her fault*" said Sonali: recognizing how this exogenous water flow damaged the local "sweet" and "pure" water of their aquifer. For a few years, the Gram Panchayat [village council], in consultation with the local doctor, added a "medicine" to Sakarbai water to disinfect it, to heal it, before using it for drinking and cooking.

Then around 2016, the Gram Panchayat decided to install a water vending machine (commonly known as water ATM) behind the main square of the village. This technology purifies Sakarbai's water through a reverse osmosis system to make it safe to drink. Most women farmers now buy this filtered water for drinking; those who can afford it also use it for cooking- mostly women farmers from the Maratha (upper) caste. Other women (mostly those belonging to Scheduled Castes) and the least well-off farmers of the Maratha caste- still go to Sakarabi to fetch water for cooking. Only women farmers belonging to a less well-off caste (a Non-Scheduled herding caste) and residing about 2 km away from the main village do not buy filtered water for drinking but disinfect the one they find in their irrigation well. For them, filtered water is too expensive and too long a walk.

For washing clothes, cleaning and bathing, women of all castes use the water they get from the taps installed outside of almost every house of the main village. Tap water is pumped from two public wells located close to several wastewater ponds, transported through a closed pipeline to a water tank, where it is disinfected, and then distributed to the taps. Women farmers told us that this water remains highly contaminated: they would never use it for drinking or cooking, not even after disinfecting it or boiling it themselves. Sometimes it smells badly, especially during the driest months when they buy the greatest quantities of wastewater. Moreover, women farmers of all castes often complain about irritations and rashes on their arms and legs, as well as about hair loss as they use tap water for bathing. Women farmers of the herding caste residing far away from the main village do not have access to tap water as the pipelines connected to the water tank do not reach as far. Since their shelters are located next to the wells they use for irrigating, they pump water directly and use it for domestic uses. They say that well water is pure enough as it percolates from the irrigation ponds where wastewater is initially stored, in the process purified by the soil.

In fact, in the narratives of women farmers across caste, the materiality of wastewater changes as it percolates through the soil of Pravah, mixing with groundwater: the longer it percolates, the more it purifies and becomes somehow less exogenous, and thus also less "bad" and "dangerous" (see Tozzi & Leonardelli, n.d.). The wastewater stored in the irrigation ponds is deemed as the most contaminated. Women farmers know this as they use it across the farm: it smells badly, it contains algae and looks foamy and turbid, especially when it is just delivered. They told us that animals (cows and goats) often get sick if they directly drink from those ponds.

As women farmers navigate and make sense of water quality through the landscape of Pravah, water becomes multiple waters. At different sources, they get water for different purposes; they store them separately and treat them differently. Significantly, while everyone in the village at least partly adjust their water practices, more well-off farmers (mostly belonging to the upper Maratha caste) have better means to deal with the consequences of this contamination: for instance, buying filtered water for multiple purposes and not just for drinking, accessing medicines and health services if necessary (see also Mehta & Karpouzoglou, 2015).

At the same time, because wastewater percolates in the shallow aquifer, it brings new irrigation and farming opportunities to all farmers of Pravah, not only to those who can afford to buy wastewater for irrigation. The benefits of the Purandar Lift Irrigation Scheme are easily accessed by well-off farmers belonging to upper castes; they can afford the cost of wastewater as well as the agricultural inputs required to engage in irrigated farming, cultivating diverse crops throughout the year (Leonardelli, Kemerink-Seyoum and Zwarteveen, 2022). Yet less well-off farmers (who are usually of Scheduled Castes and the herding caste) also find more water in their wells: some of them are able to farm on larger plots of land, including commercial crops like flowers. This way, as wastewater percolates through the landscape of Pravah, it benefits farmers across caste, even those that do not have the means to access the irrigation scheme directly.

These new farming opportunities mean both new responsibilities as well as work burdens for women across castes (Leonardelli, Kemerink-Seyoum and Zwarteveen, 2022). While they play an increasingly important role in deciding what to cultivate and how to organize the work, commercial cash crops such as flowers require a lot of care and effort. Women farmers across caste are increasingly involved in irrigation and in spreading pesticides- tasks that have historically been part of the male domain. Yet, wastewater fosters the growth of unwanted weeds, and thus long hours of strenuous weeding work. Women farmers need to carefully supervise the irrigation process to clear the drips when they are plugged by sediments and algae and wash them with an acid lotion after every cropping cycle (see also Tozzi & Leonardelli, n.d.). This sheds light on how what wastewater transports and what it is made of also matters in re-articulating everyday work in the farm, and thus also in shaping embodied subjectivities.

Through their intra-action, (waste)water and women farmers co-become in Pravah, in ways that sometimes reinforce and sometimes go beyond caste differences (Nightingale, 2011; see also Leonardelli, Kemerink-Seyoum and Zwarteveen, 2022). In this regard, the relations that enact the wastewaterscape of Pravah are troubling and ambiguous: as wastewater flows from the city to rural areas, it carries particles that co-constitute human and more-than-human bodies. It allows farmers across castes to cultivate and sell more crops throughout the year, but it also pollutes the aquifer, badly affecting the health and well-being of more-than-human bodies, including people's bodies, water, soil, animals (Tozzi and Leonardelli, n.d.). While farmers, including women farmers across castes, are generally satisfied with being able to sell crops throughout the year and to diversify their livelihood, they -and we, with them- remain entangled in the different 'goods' and 'bads' at play from using untreated wastewater for irrigation (see also Abrahamsson et al., 2015). The ethical slipperiness of these more-than-human entanglements enables reflection on the nature of ethics when conceptualised within processes of more-than-human co-becoming- a conceptualisation we grapple with in the final section.

5.3. Water across time, space, basins and subjects - the Tagus River

Recognizing individual human attachment to place, territory, or country infuses the political in debates within and across more-than-human entities that pulse through multi-scalar spaces (Bawaka Country *et al.*, 2013). It is also a way of thinking through the troubles of one's positionality in relation to spaces that are always co-constituted by the intra-action between oneself, other humans, and more-than-humans (Barad, 2007). Storytelling of the more-than-human (Tsing, 2015; The Multispecies Editing Collective, 2017) has the potential to narrate complex stories about the entanglements of life (Fenske and Norkunas, 2017). I therefore tell my own story of interdependence with a river that has been present in my life and is the subject of my own research – the Tagus River.

Visiting stretches of the river reveals different realities that a dominant discourse may hide. Where a political ecology of water (Swyngedouw, 1999; Baviskar, 2007; Boelens *et al.*, 2016) helps think of large and complex hydrosocial territories, feminist contributions (Harris, 2006; Sultana, 2011; Neimanis, 2012) emphasize the situatedness, subjectivities and relations of human bodies vis-a-vis more-than-humans, often articulated through the concept of waterscapes. By articulating this story from my situated feminist perspective, I see the Tagus River as a hydrosocial territory and explore ethical dilemmas within it. Hydrosocial territoriality helps me think of the divergent discourses that (re)produce material relations and subjects within a (dominant) political order, which incorporates multiple territorialities across scales, different actors – particularly irrigation communities[31] – and where dominant modes reconfigure material relations and subjects through particular water truths and knowledge claims (Harris, 2006; Boelens *et al.*, 2016). The frictions that emerge when non-dominant territories are pulled into a political order are captured in how inhabitants of the Tagus basin - myself included - narrate, live and experience the river.

5.3.1. The divergent flow(s) of the Tagus

The Tagus emerges in a pine grove at 1,600 metres above sea level in Eastern Spain. It leaps westward, gaining speed, until it flows through deep canyons lined with willows and poplars and eagles fly above. This early stretch has human visitors camping and hiking alongside the clear green water, as my family has done, connecting to the riverine landscape produced over geological time. Historically, loggers navigated pine logs along the canyon walls down to the city of Toledo, where they became embedded in buildings and cities.

The river encounters its first human obstacles in the reservoirs of Entrepeñas, Buendía, and Bolarque. Since 1979, some Tagus waters flow artificially southeast, across the plains of Castille la Mancha through 286 kilometres of canals and pipes, into the Mundo River and then into the Segura River, watering the historical and expanding irrigation fields of the Spanish Levant (Morote *et al.*, 2020).

[31] Irrigation communities are historic as well as contemporary water user associations that use historic and existing irrigation schemes. They are regulated by law (2001 Spanish national hydrological plan and receive public water concessions from RBAs (Hernández-Mora *et al.*, 2014)).

Exiting its original canyons, the river meanders down the plains of Guadalajara, with less flow and energy due to the syphoning off to Spain´s levant. It reaches Aranjuez, where irrigation communities have cultivated strawberries for centuries (Moreno, 1980), and a few kilometres further downstream the Jarama River joins it. The Jarama is artificially swollen, receiving water transfers from other tributaries to slake the thirst of Madrid's 6 million inhabitants and industries, bringing with it waste. Urban residents of Madrid are physically embodied in the waste that flows down the Jarama into the Tagus, even if awareness of this finishes at the flush of a toilet. As a child, I played in and fell ill from this water that had strong tangs of ammonia.

The polluted river reaches the Castrejón reservoir, before being channelled along the Castrejón canal. While the canal waters fields, the river itself pulses agonisingly along, reaching the mediaeval bridge of Montalbán. Standing on this bridge, the stillness in the air is pierced by shrieks from a nearby slaughterhouse, and the polluted river turns from brown to red. Amid the stench, storks retrieve unidentifiable things from the water. Witnessing this stretch, through what is seen and smelt, the river is embodied within myself. I react, rejecting these senses. They inform an ambivalent subjectivity, where I directly experience and feel attachment to the river while simultaneously feeling disconnected to its rural stretches by virtue of my identification as both urban and foreign. This then informs a personal politics that is inspired by how the river *is* in other stretches – clear, flowing, rich. Following Barad's (2007) intra-action, this subjectivity is an example of material and discursive co-constitution with the river, and also a reflection of the entanglement of senses, location and material informing this politics (Neimanis, 2012, 2013; Singh, 2013).

The river regains its waters from the canal and flows on to Talavera de la Reina. Irrigation communities here sprung up after the Spanish Civil War using water from the Alberche River. Yet even this tributary of the Tagus suffers from low flow due to a transfer of its headwaters to Madrid. The river ran dry here in 2006.

The main Tagus river runs its course from the region of Castille la Mancha and into Extremadura, where hydroelectric power reigns supreme. The river becomes a series of reservoirs, inundating villages while ancient Roman temples sit atop the view. It receives most of its flow from tributaries. Irrigation associations were created during the Francoist dictatorship, despite low yields since the soil is poor. This was described as a policy of internal colonization. Even here, the river has its more-than-human witnesses in areas where it flows unimpeded, with hundreds of vultures flying above it in Monfragüe. Yet, the human persists. The river is held in reservoirs throughout this region to ensure that treaty-bound 2,700hm^3 per year of water are given over the border into Portugal (Escudero Gómez & Martín Trigo 2020).

But what of the Tagus' waters that flow in the other direction, towards the Levant and the Mediterranean? After the transfer, it mixes with that of the Jucar and Segura Rivers and is spread out along irrigation channels from the Murcia region to the provinces of Alicante and Almeria. When reaching intensely irrigated fields, it is further mixed with groundwater, desalinated water, and treated wastewater, flooded across fields or dripped through plastic pipes, becoming the subject

of conflicts over water and farmland (Greenpeace, 2017), and discourse over regional rights to the Tagus. Some of it seeps across the region and into the Mar Menor saltwater lagoon, increasingly afflicted by processes of eutrophication, before entering the Mediterranean. Some also reaches the last stretch of the Segura River where it supplies the centenary irrigation institutions, which trace their origins to medieval Muslim Spain. For them, their canals hold live and dead water[32] depending on its location within the irrigation network. Irrigation farmers on both ends of the transfer embody divergent narratives over how the waters of the Tagus are best used - whether for intensive and modern forms of irrigated agriculture, or to see its waters as live or dead depending on the canal it flows within. The Tagus then becomes entangled with the European polity as it becomes embodied in the fruits and vegetables that are exported throughout Europe.

5.3.2. Conflicting meanings and contradictions of interdependent waters

The Tagus exemplifies the meeting of multiple discourses, social and material relationships and embodied subjectivities across many hydrosocial territories formed by water transfers. The river and its tributaries are a living, historical, and contemporary relationship between humans and more-than-humans, the living and the deceased, the material and the discursive. As Puig de la Bellacasa (2017) argues, material practices and ethical dispositions are inseparable, but at the same time they are non-innocent. Multiple conflicting meanings of water, as –resource or ecosystem, and the aesthetics and emotions ascribed to it, ranging from pride to sadness, to anger, envelop and co-constitute what is a deceivingly simple word, *river*. The politics of interdependency with water, illuminated in these often-contradictory meanings and relations with the river, enables us to reconsider the more-than-human as active beings in what is considered ethical practice, rather than as simply subjects of ethics (Plumwood, 2012).

By highlighting my own relationship and partial understanding of the river, I recognize my own affects and emotions in my personal history, giving due respect to other subjects inhabiting and living with the same river. This requires looking at how capturing emotional communication between human and more-than-humans takes place (González Hidalgo and Zografos, 2019), and similarly, understanding the politics of subjects' own understanding of how they care for the same shared river and believe that their actions are "life affirming" (Singh, 2013, p. 190).

In this respect, the Tagus can be conceived as a tortured example of a conflict between different understandings of Singh's life affirmative actions that spills out and creates multiple waters - urban wastewater, ecosystem water, potential energy water - within a river, and in turn spills onto other more-than-humans - soils, cities, energy systems, that cross multiple scales. Activists denounce the water transfer to Spain's levant as ecologically crippling, while irrigation farmers in the levant as well as in the Tagus basin are upset by being cast as abusers of the river, while they provide food to millions. Water connects the human scale to all other scales of life (Neimanis,

[32] "Live" water is water that is brought into fields to irrigate them via canals from a source (river, spring, well) while "dead" water is collected from fields after irrigation into canals (Morales Gil, Rico-Amorós and Hernández-Hernández, 2005). Dead water can be reutilized further downstream (becoming live again) or is brought back into a river

2012). Recounting the complexity of the Tagus's multi-scalar nodes helps record what polluting activities and those in positions of power have done to territories, humans, non-humans and more-than-humans as well as the unequal impacts of these actions. Recording and narrating illuminates these stories and histories into contemporary politics, thereby giving possibilities for different directions of political action in the constant co-becoming with the river.

With my partial understanding of the Tagus, I draw out the struggles for dominance and memories of different versions of the Tagus. My telling casts a new light on how activists, irrigation farmers, politicians, and civil servants fight over articulating different meanings of life-giving and taking on the river, who is the true steward of water and therefore of land and territory, and who is safe-guarding (human and more-than-human) life (Singh, 2013). This problematizes the hydrosocial territory perspective (Boelens *et al.*, 2016); from a partial and situated understanding, I trace part of the webs of relations amongst identified subjects - myself, my family, farmers, activists - as co-constituting material flows. Yet the webs of relations are never fully knowable.

Similarly, the fight amongst actors articulating different meanings is also an exclusionary fight over subjective human values that often affords little compromise. Recognizing other value systems allows me to judge what and how other human and more-than-human subjects are valued, and requires me to choose with who/what and how I want to belong with (Rowe, 2005). It also forces me to identify the consequences of other value systems, their material and discursive articulations, that lead to outcomes that go against my own ethics of more-than-human life. Belonging is invariably nested in divergent and conflicting understandings of territories, the subjects within, and the forces that subjectify. A more-than-human co-becoming sees me/us as interdependent, even if this interdependence is anything but innocent, and the river carries the consequences of this relational web (Neimanis, 2012) as nitrites and ammonia.

I as researcher co-become (Bawaka Country *et al.*, 2013) with the Tagus as I write the interdependent histories and relationships of the multiple human subjects constantly relating *with* the Tagus as more-than-human. That this co-becoming is fraught also shows how "Country" is not innocent; rather, it can support and harm life, reflecting flows of power that are multifaceted and consequential for subjects and ecologies (Swyngedouw, 1999; Nightingale, 2011). My own experience and memory inform my situated politics. Interdependency and co-becoming with the Tagus is relational; it is a political and ethical positioning of the self vis-à-vis the more-than-human river, and against socionatural articulations that subject it and us to exclusionary and oppressive ways of living. The smell of ammonia is a testament to and result of the uneven politics that co-constitutes the Tagus, and a call for rethinking the ethical implications of interdependent embodied subjectivities of/with the Tagus.

5.4. Ethics of more-than-human interdependencies

These situated narratives of co-becoming with water illustrate the politics of interdependencies and their ethical implications. The ebbs and flows of the Tagus River are

implicated in the lives and deaths, the thriving and suffering of people and more-than-humans, all of whom shape the fluid waterscapes of the river both materially and discursively. In Pravah, Sakarbai's water has turned 'bad' and the tap water has health implications for human and more-than-human beings who use it. Despite this, there are benefits from the use of wastewater. Flowing with the increased, more reliable water supply are economic and social benefits for many in the farming communities. The multiplicity of different waters in both cases are therefore infused with ethics through their situated more-than-human interdependency. Rather than being considered moral or immoral, these relationships with multiple waters are understood and experienced as part of wider webs of ethical significance in everyday life (Puig de la Bellacasa, 2017). The co-mingling of pasts, presents, and potential futures in such waterscapes is therefore also knotted with ethical relations that inform ways of living with the multiplicity of water as it moves, laden with power, through lands, bodies and infrastructures (Rose, 2012). These illustrations of more-than-human interdependencies demonstrate that rather than occurring in an 'encounter', interdependencies are always ethical because they emerge through relational assemblages; entangled lives carry responsibility to others, giving both life and death.

When ethics are understood in this way, as enmeshed in multi-species everyday practices, embodied engagement within the world and more-than-human relational knowledge formation (Richardson-Ngwenya and Nightingale, 2018), this legitimises and makes necessary an acknowledgement of more-than-human interdependencies as crucial to the maintenance of life (Puig de la Bellacasa, 2017). Drawing on the work of Levinas and his student Hatley, feminist philosopher Deborah Bird Rose (2012), exemplifies the workings of more-than-human ethical relations, by extending the idea of ecological relationality beyond spatially configured power dynamics and locating ethics in time, a move which helps deepen the ethical and justice dimensions of the two water narratives here. Mobilising the work of ecologists on 'flying foxes and their co-evolved myrtaceous mutualists,' Rose (2012, p. 135) argues that the webs of mutualism that occur between the myrtaceous trees and flowers which attract flying foxes, who in turn assist in the pollination of various woodland and rainforest species, can be understood as ethical in that they maintain each other, themselves and their future 'selves' or generations (See also Zwarteveen & Boelens, 2014 and their conceptualisation of 'socio-ecological justice'). Ethics becomes the ontological condition of the ebb and flow of life and death, it is a responsibility, or maintenance of life, between different beings.

These insights bring us to questions of care and responsibilities once we have narrated co-becomings such as those above. What Rose (2012, p. 136) terms 'multispecies knots of ethical time' are the intertwined histories, presents and futures that are embodied in the practices of species as they move through the world. This ethical intertwining of bodies and ecologies over time and space relates to the feminist stance on the ethics of care as "a vital interweaving web of life" (Puig de la Bellacasa, 2017, p. 4). Following Tronto (2015), Puig de la Bellacasa (2017, p. 6) maintains a distinction between ethical dispositions and material practices while calling for them to be

considered inseparable. In doing so she articulates more-than-human interdependency as an ethics of care:

> *[…]'ethics' in an ethics of care cannot be about a realm of normative moral obligations but rather about thick, impure, involvement in a world where the question of how to care needs to be posed. That is, it makes ethics a hands-on, ongoing process of recreation of 'as well as possible' relations and therefore one that requires speculative opening about what a possible involves [...] unthinkable as something abstracted from its situatedness.*

Thinking of ethics as embodied and situated, helps to de-centre the human, and therefore moral discourse, in more-than-human interdependencies. As a speculative politics, this ethics of care is 'non-innocent', meaning it is both troubled by its situatedness and co-constituted through complex more-than-human intra-action (Barad, 2007). In Pravah this manifests in the way the wastewaterscape and its social, economic and embodied consequences cause harm as well as material benefits, a contradiction that plays out as women farmers navigate the different scales of the wastewaterscape in everyday life. These ambiguities are further exemplified in the paper by Bawaka Country and colleagues (2013), where they reconceptualise natural resource management through the Aboriginal indigenous ontology of co-becoming. *Wetj*, a practice of reciprocal sharing, care and 'intra-action' (Barad, 2007) between all beings, '...springs from and supports a Yolŋu ontology of co-becoming which sees all beings, including human beings, as coming into existence through relationships' (Bawaka Country *et al.*, 2013, p. 187). Or in other words, beings 'only exist, be-come vibrant, powerful and important, through relationships' (ibid., 2013, p. 189). They demonstrate how the perspective and meaning of natural resource management changes when agency and communicative status is given to Country. Rather than assuming humans as the primary care-givers and care-takers of Country, the maintainers of morality, Country is seen as a sentient, multifaceted assemblage of beings, that sometimes cares for humans and non-humans, sometimes harms, but is always interdependent, in a mutual, relational co-becoming. As narrated above, the entangled waterscapes of the Tagus demonstrate the ways that water as an ambiguous care-giver and care-taker of multiple more-than-human assemblages, also engender a non-innocent process of co-becoming. These often-contradictory relations of mutuality also emerged clearly in the first section, as we unfolded how waters and gendered subjectivities co-constitute one another -or intra-act- in the wastewaterscape of Pravah in ambiguous, non-innocent ways.

If ethics are embedded in the everyday life of all beings, which unfolds over and through diverse temporalities (Rose, 2012) and socionatural flows of power (Nightingale, 2011), the multiplicity and mobilities of water as it percolates through rocks, soils and bodies, is itself ethically infused. The complexity of ethics within this wider frame of 'multispecies knots' cannot therefore be reduced to analysis of a particular encounter between 'human' faces, nor as Barbara Davy (2007) argues, the requirement of human recognition or legitimisation of the other that this moment

implies. The waters of Pravah and the Tagus, in their multiple forms, both continuously enable and disable life; they both take and give life (Bawaka Country *et al.*, 2013). Therefore, to build on Rose's (2012) and Davy's (2007) arguments, ethics, we suggest, are provoked, but not through a particular encounter between knowing ethical selves. Rather ethical relations emerge through dwelling *within* more-than-human interdependencies.[33] Thinking with the waters of Pravah and the Tagus demonstrates the uneven politics of dwelling within more-than-human interdependencies. Teasing out the ways in which water entangles humans enables us to think beyond human-centric ethical practices and implications, and to conceive of ethics as embedded within the co-constitution of embodied subjectivities, within processes of more-than-human co-becoming, creating for us new questions about interdependencies, caring and the kinds of narratives we tell about those co-becomings.

5.5. Conclusions

In this chapter we have explored different ways of grappling with the more-than-human, focusing on the politics of interdependencies through situated entanglements with water. We have done so by juxtaposing two cases that are geographically distant and working on different scales of operation. Human-water relations in the village of Pravah, in Maharashtra, and the flow of the Tagus River, in Spain, shape differentiated and ever-changing embodied subjectivities (including those of the researchers): a process of co-becoming that has specific implications for how we understand and engage with more-than-human interdependencies and therefore ethics.

Drawing on FPE and other allied disciplines, we started our journey of grappling with the more-than-human by acknowledging the importance of unpacking nature/society binaries, the symbolic and material boundaries that maintain them and the power dynamics in which they are enrolled. We thus framed more-than-human interdependencies from an understanding of relationality as entangled, multiple and situated (Rowe, 2005; Nightingale, 2011). Understood as interdependent and entangled, the more-than-human forces us to look beyond distinct individuals, supposedly separate from ecologies and other beings. Therefore, it becomes important to attend to the specific and situated characteristics of such relations as the basis for theorizing. To unpack these characteristics of more-than-human interdependency, we found it useful to interweave FPE with STS and post-human scholarship: it helped us attend to the specific affordances of water (water percolates, contaminates, transports sediments and algae, etc.), which play a role in shaping differentiated gendered embodied subjectivities and, conversely, how water is signified.

Two main points emerged as we walked through Pravah with women farmers and along the flows of the Tagus River. Firstly, more-than-human relations, and especially human-water relations, are ambiguous, troubling and never innocent. They create differentiated possibilities of well-being and illness, both for human and more-than-human actors. Secondly, as the authors, we actively co-

[33] For further discussion on the more-than-human politics of dwelling see Tim Ingold (2005)

enact the more-than-human relations we describe and theorize about. And this has ethical and political implications, not least because what we can say about the more-than-human is always partial, mediated by the social, by our (human) ways of making sense of the world. For instance, the focus on the interdependency of women farmers and (waste)water in Pravah is a specific political choice to challenge the processes through which experiences of women farmers from multiple castes, their knowledges and practices in relation to (waste)water, are marginalised and/or silenced; and to interweave feminist struggles with environmental concerns in Maharashtra. The story of the Tagus takes on a different positionality, embodied within the hydrosocial territory it narrates. The process of knowing and becoming with the Tagus invariably collides with other divergent forms of co-becoming that create an emotional and sensorial rejection of processes that make specific territories. Nonetheless this same process also informs a situated politics, one which demands an acknowledgement of how everyone and everything that is part of the more-than-human co-become in ways that defy anthropocentric modes of (dis)ordering the world (Halberstam, 2020).

This chapter therefore illuminates the ways water relations are ethically infused processes of co-becoming. In illustrating the emergent ambiguity of more-than-human interdependency, the chapter contributes to troubling the neat moral boundaries that constrain the multiplicity of more-than-human ethical relations within spheres of privileged human moral reasoning (Tronto, 1993; Richardson-Ngwenya and Nightingale, 2018). Through highlighting the politics of interdependencies that animate the multiple waters along the Tagus and in Pravah, and exploring our own role as researchers in the narration of such, we have also sought to question the nature of ethics as something bounded by human reason. These particular narrations of co-becoming with water highlight the importance of empirically unpacking the complexity of embodied waters and how they shape not only economic and agricultural possibilities, but also everyday, embodied senses of well-being, illness and change in contemporary waterscapes. Exploring more-than-human relations therefore involves thinking with the situatedness and embodiment of such relations, thus revealing the ways in which power flows and plays across what often appear as distinct bodies, spheres or scales. In doing so, these intersecting relations and an understanding of our own entanglement in them as researchers, contributes to FPE, STS and philosophies that seek to disorder or blur the boundaries that constrain life and deeper understandings of its more-than-human interdependencies.

6. Conclusion

6.1. Synthesis and key findings

This dissertation contributes to a multi-scalar, critical understanding of IBWTs and their socionatural impact on territorial construction, creation of subjects, and contestations arising out of these. Throughout the dissertation, I mobilised a political ecology of water framework – particularly that of hydrosocial territories – and feminist political ecologies of subjectivities, to illustrate how IBWTs in general, but the TSA in particular, co-produced irrigator subjects and the territories irrigated in unequal ways along hegemonic common senses and imaginaries (Ekers and Loftus, 2008; García López, Velicu and D'Alisa, 2017; Hommes and Boelens, 2017). I also illustrated existing counterhegemonies and alternatives to *how things are* (Zwarteveen and Boelens, 2014; Harris, 2015) within the TSA's connected spaces and scales. I did this with four significant contributions. Firstly, I integrated temporal scales of modern socionatural regimes within hydrosocial territories of IBWTs to examine their impacts and contestations, finding that IBWT durability contributes to the standardization and normalization of modern socionatural relations. Secondly, by developing a framework to expand the notion of territorial pluralism alongside a categorization of hydrosocial territories by hegemonies and counterhegemonies. Thirdly, by analysing the creation of ideal irrigator subjects and how actual subjects deviate from the ideal within hegemonic and counterhegemonic hydrosocial territories. Finally, I reflected on my own privileged, partial position within the web of relations that co-produce and co-become within the TSA arena. The principal novel contribution of the dissertation is to expose the hegemonic and counterhegemonic mechanisms of co-production of hydraulic infrastructure and technology, human and more-than-human subjects, and territory across multiple scales, and revealing interconnected possibilities of more just hydrosocial presents and futures.

As presented in the introduction, this dissertation is a socionatural, multi-scalar journey where each scale presented a distinct set of complementary and conceptual objectives as laid out in chapters 2 to 5. Firstly, there was the development of a political ecology of IBWTs that synthesized findings from a range of IBWTs worldwide to frame their impacts, how these are interlinked, and arising contestations; secondly, at the scale of a singular IBWT (the TSA), the framing of how hydrosocial territories in basins linked by the TSA are produced; thirdly, the inquiry of how subjectivities are produced in relation to a particular configuration of how hydrosocial territories assume them to take part; and fourthly, pose how more-than-human interdependency can narrate the complex situatedness of processes of co-becoming. These objectives come together to answer how IBWTs inform and are themselves informed by the processes that (re)create hydrosocial territories.

To reach these objectives, a variety of methodologies were used, ranging from critical literature reviews of IBWTs worldwide, fieldwork examining multi-case studies of selected

irrigation communities and the subjectivities of irrigators within these on either side of the TSA, and more-than-human storytelling of my own experience, positionality, and history of interdependence and co-becoming with the Tagus River. These were applied in the preceding 4 chapters. What follows is a short summary of each chapter's key findings.

Chapter 2 presented a systematic, critical literature review of 29 IBWTs which were the subject of research in 26 articles and book chapters published since 2011, based on an initial review of 274 articles published since 1989. The chapter departs from previous IBWT review exercises (Gupta and van der Zaag, 2008; Rinaudo and Barraqué, 2015; Shumilova *et al.*, 2018; Purvis and Dinar, 2020) to consider multiple and networked dimensions (Rocheleau and Roth, 2007) that IBWTs impact. In turn, I built on previous research using hydrosocial approaches within political ecologies of water (Bourblanc and Blanchon, 2014; Islar and Boda, 2014), including a hydrosocial territorial approach (López *et al.*, 2019). Three gaps identified included the assumption that power flowed downwards across the scales of hydrosocial territories, that the reconfiguration of hydrosocial territories through IBWTs did not pay attention to what and how socio-environmental dimensions were altered and along which imaginaries, and finally the dimension of time in terms of the durability of operation of IBWTs to inform imaginaries was not taken sufficiently into account. This led to me adopting the concept of modern socionatural regimes (Escobar, 1999; Kolinjivadi, Vela Almeida and Martineau, 2020) to embed the analysis within understandings of socionatural justice that employ generational timeframes aside from the concerns of distribution, recognition and participation within environmental justice (Schlosberg, 2004; Zwarteveen and Boelens, 2014).

Based on this, the review found that IBWTs trigger declines in the quality of biophysical variables when interplaying with economic and extractive socioeconomic variables, with governance mechanisms reacting slowly to these. Causal links across variables identify changes in flows and contamination from economic activities and fuelled rural-urban migration. Furthermore, IBWTs remain enduring features of hydrosocial territories, with transferred waters' uses shifting and adapting to changing needs over time, though this remains primarily to supply urban areas. Contestations arising from IBWT planning and operation also use a variety of measures, though these were primarily politically pursued. Of 26 contestations, only 7 led to some form of impact on an IBWT's planning or operation, and of all planned and operational IBWTs, only 2 planned cases were cancelled, pointing to a durability of IBWT planning and operation.

By utilizing a hydrosocial territorial approach, this review supplemented further IBWT impacts and established that biophysical impacts occurred in both donor and recipient basins, while economies and populations of donor basins suffered in many cases. Impacts painted as positive in recipient basins at the expense of other territories (both in donor and recipient basins) are nonetheless a political choice with long lasting consequences (Zwarteveen and Boelens, 2014), and the materialization of IBWTs depend on discursive elements to garner support. IBWTs, because of their large, fixed investment and costs, also greatly support modern socionatural regimes by naturalizing a very modern understanding of how and where water ought to flow. Continuous and

uninterrupted flow to recipient basins becomes unquestioned, an example of a standardization (or the elimination of the erratic) of socionatural relations (Kolinjivadi, Vela Almeida and Martineau, 2020) and which reinforces the longevity of IBWTs by locking in special interests and imaginaries of territorial transformations supported by these (Gupta and van der Zaag, 2008). Finally, the operation of IBWTs sets in motion processes of territorial inequalities that pit different interests and communities against each other, as evidenced in the number of contestations. The factors that mediate the success of this outcome include attachment and dependence on particular hydrosocial configurations, the integration of communities in processes of State-making and capital, and the strength to elaborate counter-narratives against modern socionatural regimes of IBWTs.

In **chapter 3**, I took the TSA complex as an IBWT agricultural hydrosocial territory to study how hegemonic common senses (Gramsci, 1971; Birkenholtz, 2009; García López, Velicu and D'Alisa, 2017) deployed through both the TSA and on-plot modernization shaped multiple 'territories-in-territory' (Boelens *et al.*, 2016; Hoogesteger, Boelens and Baud, 2016; Hommes, Hoogesteger and Boelens, 2022). I took onboard existing scholarship within political ecologies utilizing the concept of hegemony to frame questions of dominance and resistance, contrasting and complementing it with existing hydrosocial territory literature that uses Foucauldian governmentality as the principal (though not exclusive) framework to understand domination. Inspired by Ekers and Loftus (2008) to engage with both frameworks, I linked techniques of government with hegemonic common senses to encourage links across spatialities and positionalities, and as a way of framing how hegemonic common senses emerge from and reinforce particular governmental logics, as well as logics of power that can frame the emergence of counterhegemonies (Butler, 2000; García López, Velicu and D'Alisa, 2017) within dispersed yet interconnected hydrosocial territories-in-territory. .

Based on a review of scientific literature on the TSA and drip irrigation, empirical data on cultivated and irrigated surfaces and their modernization across Spain and within TSA regions, and through a comparative case study (Yin, 2009b) of 6 irrigation communities in the Tagus and Segura basins, I established common senses of IBWTs in the case of the TSA, of drip irrigation, and their deployment in the irrigation communities visited. Common senses of the TSA are based on the Spanish hydraulic paradigm, foreseeing State-led and financed development of hydraulic resources, the need to correct a naturally occurring hydraulic imbalance that necessitated the use of IBWTs based on concepts of national solidarity and reciprocity, and water being considered exclusively as an economic resource (Saurí and del Moral Ituarte, 2001). Over time this shifted to have regions adopt elements of the paradigm, while new movements questioned the paradigms' values. Drip irrigation's common senses are based on the principles of water efficiency and water savings, deployed to subject irrigators to these principles and as a by-product link this with economic, capitalist efficiency. The adoption of drip irrigation is demonstrated through wholesale increases nationally and in the TSA regions, which I contrasted with the deployment in the irrigation communities.

The use of hegemonic common senses of IBWTs and drip irrigation, and counterhegemonies of these, allowed me to categorize particular territories as the core of hegemonic projects, others as on the frontiers of hegemonic projects, and those resisting these as counterhegemonic. Doing so reinforced the role of the State as diffuse (Ekers and Loftus, 2008; Nightingale, 2018), with hegemonic common senses predating and outliving an example of a coercive State (the Franco dictatorship), and power flowing to other levels (the regions) to rearticulate hegemonic common senses. Counterhegemonies rely on these and the contradictions of hegemonies, where smallholder resistances or ontological pluralities to value water and territory come to the fore. While enmeshed within and in dialectic relation with hegemonic projects and common senses, these point to alternatives and serve as examples of just water futures.

Chapter 4 explored irrigator subjectivities, how they are envisioned by various levels of authority and how they are realized in practice, within the framework of hegemonic core, hegemonic frontier and counterhegemonic territories of the TSA developed in chapter 3. Using the same fieldwork data used in chapter 3, and through a review of hydraulic and rural development policies at the national, regional and EU levels, my co-authors and I built a framework of the ideal irrigator through distinct time periods from 1866 to 2023, and contrasted these shifting ideals with how irrigator subjects responded to the ideal in the various territories. We engaged with FPE approaches to subjectivity including intersectional understandings of multiple and overlaying categories of difference (Nightingale, 2006), and with recent scholarship in the political ecology of water – namely riverhoods – to examine the TSA as being bestowed with meaning and which irrigators on either side cannot ignore (Boelens *et al.*, 2022).

We identified 5 different irrigator ideals over the course of more than 150 years of policy, which became more contradictory and demanding in terms of expectations and responsibilities by multiple authorities at the turn of the 21st century, particularly at the regional level. This was expressed in the shift from a simple 'getting bodies on the ground' to settle newly irrigated areas to the triple policy objectives of irrigation modernization, subject professionalization, and as agents of rural social rejuvenation. We contrasted these with interviews with irrigators in hegemonic core, hegemonic frontier, and counterhegemonic territories to establish different types of irrigator subjects that co-produce these territories alongside the operation of the TSA from above, and of the degree of adoption of drip irrigation from below.

Hegemonic core and frontier territory irrigators had two types of subjects, those closely aligned with the ideal subject, toeing the line with becoming entrepreneurial, export-oriented capitalist farmers, and smallholder subjects struggling with access to water and suffering most from the generational handover crisis. This precariousness has led to intra-community conflicts in hegemonic core territories, and to the entry of new actors and 'legally present but physically absent' irrigator subjects in hegemonic frontier territories. Counterhegemonic territory subjectivities on the other hand are closely linked to traditional irrigation systems and see drip irrigation as another tool rather than a value-laden system. Values are placed more on the lived traditional system and seeing

water with different ontologies that require community cooperation to continue functioning (Harris, 2009). These different subjectivities co-producing territories within the framework of the TSA point to different outcomes for the rural social fabric, and where multiple policy objectives lead to impossible contradictions for those who follow them.

Chapter 5 finishes the scalar journey with my narration of a more-than-human story telling of my positioned and partial history with the Tagus and Segura rivers. Alongside my colleagues, I reflected on the ethics and implications of my research journey vis-à-vis considerations of other humans entangled in the politics of co-being and co-becoming with their respective hydrosocial territories.

Within my own reflections, I focused on the non-innocence of material practices and ethical dispositions behind these (Puig de la Bellacasa, 2017), particularly when multiple ontological visions collide within the vast geography of the TSA complex. Interdependence takes on multiple and contradictory meanings when I identify my own history and emotions linked to the territory I traverse and relate it to the politics of other subjects inhabiting these spaces embodying their own conception of what care means. This takes on special meaning when conceptualising how river and territory embodies 'life-affirming' practices (Singh, 2013), whether its caring for soils and waters for their intrinsic value, or using them to care for ones' family, or feed the many. Yet these choices and ways of seeing hydrosocial territories requires actively choosing who and what I want to belong with and to (Rowe, 2005) by recognising the consequences of different ways of justifying life-affirming practices. Finally, co-becoming is not innocent, since the material reality of the more-than-human river alongside the manifestation of the social relations it carries can support and hinder life, with the river carrying the consequences of human actions (Neimanis, 2012).

My story-telling, alongside the accounts of waste water from Pravah, came together to argue for an understanding of interdependent more-than-human webs infused with ethical significance in everyday life (Puig de la Bellacasa, 2017). More-than-human interdependencies are not so much encounters, but relational assemblages that are always ethical, thereby informing ways of living. Ethical more-than-human relations are embedded in time as a responsibility for life amongst beings, with mutualism and adaptation serving as examples of inter-generational justice (Rose, 2012; Zwarteveen and Boelens, 2014). Embodied, situated and relational ethics therefore decentres the human and with it moral discourses in more-than-human interdependencies, but acknowledges the contradictions of these, an example of co-becoming amongst multi-scalar more-than-human relationships (Bawaka Country *et al.*, 2013). Arguing that ethics is embedded in the everyday life of all beings and utilizing the examples of Pravah's and the Tagus' uneven politics, we find that the fluid entanglements of water and humans enables us to think beyond human-centric ethical practices and to conceive of ethics as part of the co-constitution of embodied subjectivities within processes of more-than-human co-becoming.

6.2. Research contributions

6.2.1. Theoretical contributions

The ´long durée´ within hydrosocial territories

Within hydrosocial territory research, discussions of temporalities and time are important insofar as political ecologies are always situated in space and time (see also the recent work by Götz and Middleton, 2020; Flaminio, Rouillé-Kielo and Le Visage, 2022; Drapier, Germaine and Lespez, 2023). Political ecologies of water such as the hydrosocial cycle takes into account temporalities of water (Linton and Budds, 2014), and hydrosocial territories incorporate network thinking to encompass their span and durability (Boelens *et al.*, 2016). From a FPE perspective, embodied and partial knowledge is situated in both place and time (Haraway, 1988; Escobar, 1999). My contribution to this domain has been to demonstrate how IBWTs shift understandings of water's own temporality – its seasonal, climactic availability – and the immobilisation of this temporality, but also of the importance of both 'diving deep' into the empirical situatedness of communities' and individuals' histories of their hydrosocial relations, and of 'diving forward' into their imagined futures.

As discussed in chapter 2, modern socionatural regimes (Kolinjivadi, Vela Almeida and Martineau, 2020) have a disciplining, standardizing effect on socionatural relations, where control of water, in quantity and quality is the imperative. Assured transfer for specific uses – urban consumption, agriculture and hydropower – requires a discipline over the material transferred for modern, capital-oriented sectors and spaces. This represents not only an ontological uniformity (Escobar, 1999; Kolinjivadi, Vela Almeida and Martineau, 2020) that leads to unquestioned and naturalized expectations of water's availability in time, but also of water's behaviour in time and *across* basins. Time becomes enmeshed in space at larger scales and fixed in the "hardened morality" of the IBWT infrastructure (Hommes, Hoogesteger and Boelens, 2022, p. 5). With it, the interests and imaginaries (Boelens *et al.*, 2016) of the industrial, agricultural and political elites become locked in time too, since the durability of IBWTs shows that these interests adapt and change while utilizing a dependable and regulated source of water.

Looking back and looking forward in time was another contribution seen in chapters 3 and 4. The hydrological memories of irrigation communities in these chapters mediated local perceptions and socionatural relations, and with it the articulation of hegemonic common senses or their refutation to generate counterhegemonic senses (Gramsci, 1971; García López, Velicu and D'Alisa, 2017). Whether it was the invocation of a king's royal privilege in 1275, or the living memory of an abusive groundwater distribution system before the arrival of the TSA, these are invoked in relation to existing water practices, and to give normative judgement on the practices of others. The other side of the coin is looking towards the future. Mobilizing the concept the socionatural integrity and inter-generational multi-species justice (Zwarteveen and Boelens, 2014;

Houart, 2023) places IBWTs as hardened morality (Hommes, Hoogesteger and Boelens, 2022) into the future, and politicizes what has been considered a given.

Hegemonies, scales and territoriality

This dissertation is infused with a hydrosocial territorial approach from beginning to end. Compared to other frameworks in political ecologies of water – waterscapes, the hydrosocial cycle – hydrosocial territories are a best fit when examining the empirics of IBWTs. In particular, the embedded notion of territorial pluralism (Hoogesteger, Boelens and Baud, 2016) allows a multi-scalar vision of different dimensions and processes inhabiting and co-producing the same spatial extension (see also Flaminio, Rouillé-Kielo and Le Visage, 2022).

Chapter 2 mobilised territorial pluralism to envision IBWTs as breaking across basin boundaries to connect these within a whole hydrosocial territory. While distant and far apart, IBWTs put disparate territories into relation with one another (Hommes *et al.*, 2019), and as indicated by Gupta and van der Zaag (2008) and supported by the findings of chapter 2, these usually serve economic heartlands at the expense of donor basins (Hommes *et al.*, 2019). Chapter 2 also exemplified the dynamism of changes of 'territories-in-territory' (Boelens *et al.*, 2016; Hoogesteger, Boelens and Baud, 2016; Hommes, Hoogesteger and Boelens, 2022) over long expanses of time (see above), with IBWTs reinforcing spatial socioecological inequalities of erstwhile hydrologically unconnected territories. This grounded the analysis of contestations across territories, and particularly of who and what 'belongs', and what does not and needs to be disciplined through territorialising processes (Nightingale, 2018).

Territorial pluralism in IBWTs was further developed in chapter 3 by mobilising Gramscian hegemony and developing a characterization of hegemonic core, hegemonic frontier and counterhegemonic 'territories-in-territory'. While identified as territorialisation processes occurring within one geographic space (Boelens *et al.*, 2016; Hoogesteger, Boelens and Baud, 2016; Hommes, Hoogesteger and Boelens, 2022), the characterization of different hegemonic projects and their different, unequal impacts and developments within smaller, discrete territories of the TSA arena necessitated a characterization of multiple geographies within one overarching, higher scale geographic area. Doing so allowed a tracing of the impacts of different hegemonic common senses (Gramsci, 1971; Birkenholtz, 2009; García López, Velicu and D'Alisa, 2017) and the rejection of these in counterhegemonies (Butler, 2000; García López, Velicu and D'Alisa, 2017) by actors along co-produced subjectivities and territories. Chapter 4 continued this framework to further explore the co-constitution of subjectivities within these characterized territories. The principal contribution was the multi-scalar construction of differentiated subjects within this understanding of territorial pluralism, where IBWTs from above and irrigation modernization from below convened to produce particular subjectivities (Nightingale and Ojha, 2013). The interaction of these two scales, and the policy processes and power relations producing them, mediated the inter-

and intra-community relations and perceptions of not only where water *ought* to come from, but also how it is used in different territories.

The final contribution to territoriality comes from a FPE-infused understanding of my own positioned, partial, and situated perspective vis-à-vis the territories I visited, and the more-than-human relations with water I co-became with, as narrated in chapter 5. Here the difficult political choices based on subjective (and always partial) awareness of subjects encountered whose value systems are in conflict with my own requires a recognition that these may be conversely understood as 'life-affirming' (Singh, 2013) along different normative judgements. Nonetheless these value systems are representative of unequal power relations, and the materialization of hegemonic value systems become evident and material in the contamination that the rivers carry (Neimanis, 2012).

Feminist performativity and subjectivities

While I utilized a hydrosocial territorial approach throughout the dissertation, this has been supplemented with theoretical insights and approaches from FPEs, particularly through feminist framings of power within socio-ecological relations literature and the construction of subjectivities, based on Butler's theories of performativity (Butler, 1988, 1999; Harris, 2006; Nightingale, 2006; Bossenbroek and Zwarteveen, 2018). The hydrosocial territorial approach mobilizes Foucauldian domination through its arts of government (Foucault, 1991, 2008), which also emphasizes everyday social interactions and unseen contestations beyond the eye of formal power and officialdom that create counternarratives and non-determinant outcomes, and socio-political change (Scott, 1998).

In chapter 2, I mobilised Nightingale's (2018) framing of the socioenvironmental State as not so much having power but exercising power, thereby producing stateness and subjects in an incomplete and contradictory fashion. This framing reinforced the hydrosocial territorial IBWT analysis by giving explanatory power to the appeal of IBWTs by dominant groups within the State, their contestations by groups and territories considered outside of the State and subjects of State domination, and how contestations (or lack thereof) shift the legitimacy of State-building mechanisms and the emanation of where authority lies – locally or in the State (Cote and Nightingale, 2012; Zwarteveen and Boelens, 2014).

Butler's performativity also emerges within conceptualizations of hegemony presented in chapter 3. In particular, the persistence of traditional irrigation practices become counterhegemonic when contrasted with the hegemonic projects of hydraulic paradigms from above, but most particularly with drip-irrigation technologies from below. The continued practice and maintenance of traditional irrigation alongside the ontological diversity of water, whether as dead and live water in Orihuela, or as life-giving in Letur, become subversive and anomalous when everyday social relations are rearticulated (Butler, 1997a; Ekers and Loftus, 2008; Sneddon, 2013; Nightingale, 2018). This laid the groundwork for conceptualising relations of domination and acquiescence across territories mediated by the TSA and the spread of drip irrigation within the framework of territorial pluralism (Boelens *et al.*, 2016; Hoogesteger, Boelens and Baud, 2016).

Feminist conceptualizations of subjectivities are the foundation for the exploration of irrigator subjectivities in chapter 4. The establishing of categories of social difference become tied to territory and processes in these producing said difference. Whether it is land holding in hegemonic core territories where smallholders contest the access to water that large landholders have in the Segura basin, the emergence of absent landholder subjects in hegemonic frontier territories in the Tagus basin, social differences within and across irrigation communities emerge where class and landholding signify irrigators' positioning vis-à-vis others. In particular, and linked to the point made above and in chapter 3 regarding hegemony and performance (Butler, 1999), irrigation method becomes a powerful category of social difference whereby traditional irrigators are identified by others with discourses of water waste and inefficiency (Nightingale and Ojha, 2013), reproducing unequal power relations, dominant governmentalities, and the legitimation of hegemonic water discourses, knowledges and related practices (Harris, 2009) linked to a specific territory. Subjectivities reinforce their link with place and territory when conceptualized as embodied, situated, and in constant processes of re-subjection, whether as irrigators in hegemonic core territories wholeheartedly supporting the defence of the TSA and continued expansion of new water sources and irrigation, or whether as traditional irrigators resisting these discourses to defend their communities and their historic irrigation practices against pressures to modernize (Longhurst, 2003; Nightingale, 2013). This feminist understanding of subjectivity was deployed within the hydrosocial territory of the TSA by building the ideal to which processes of re-subjection occur, to demonstrate how the sources of dominant discourses multiply and contradict each other and is utilized by certain irrigator subjects in hegemonic core territories to push for, identify and embody increasing sources of water for irrigation.

The final contribution mobilising feminist conceptions of power and subjectivity is in the co-becoming and interdependency of subjects with the Tagus River. The development of a feminist ethics of interdependency and of my own situated and embodied positionality vis-à-vis the TSA and the rivers it connects required a reckoning of my own politics and values with those human inhabitants that subscribe to other value systems, and which despite the perceived goods and ills they commit, form part of the more-than-human Tagus River (Puig de la Bellacasa, 2017). Grappling with this relationality in the more-than-human remains problematic on one front and offers hope on another in this regard. It is problematic when it becomes personally difficult to engage with irrigators and inhabitants whose value systems are fully at odds with my own regarding a socioenvironmental politics that in my eyes (and that of other irrigators and inhabitants) reduce the vitality of the more-than-human assemblage they inhabit (and in which I am only a guest after all). Secondly, and on a hopeful note, recounting the stories and histories of other irrigators and territories to irrigators across basins opens up possibilities of encounter and commonalities that hitherto had not been considered, as well as of revealing different more-than-human water worlds that had not been imagined. Decentring the human and placing said human not just in place but in time within more-than-human relations (Rose, 2012) was an opportunity of recounting not just my

personal history and of the generations preceding me (see Image 3 below) that have been and are embedded within the story of the Tagus river and the TSA, but of other human and non-human generations coming before and after this moment in time. What emerged was an acknowledgement of my privileged position in travelling across these different worlds to narrate to others about different existences and possibilities, and of my own interlinked and grounded history with waters crossing basin boundaries that bathe other inhabitants' communities.

Image 3: My grandparents, uncles and father on the Entrepeñas reservoir, circa 1959



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6.2.2. Empirical contributions

By conceptualising this dissertation as a scalar journey, I have covered a wide array of hydrological infrastructure, policies, territories and communities, and my own history and memory. I started with a critical literature review of existing and planned IBWTs worldwide to understand their multi-dimensional impacts. I followed with a case study of the TSA as a single IBWT, complemented with Spanish irrigated surface and drip irrigation expansion data, hydrological and rural development policy analyses, and multi-case studies of irrigation communities in the Tagus and Segura basins. I finished the journey with a more-than-human storytelling of my connection with the Tagus River and the TSA.

The critical literature review of IBWTs in chapter 2 built on existing reviews of IBWTs (Gupta and van der Zaag, 2008; Rinaudo and Barraqué, 2015; Shumilova *et al.*, 2018; Purvis and Dinar, 2020). It went beyond these by employing a political ecology of water perspective to develop a database of IBWT impacts across biophysical, socioeconomic and governance dimensions. Where it was possible, it identified the causal connections between these to find that biophysical dimensions, particularly in donor basins, are impacted by IBWT operation and socioeconomic activities, while governance arrangements responded slowly. Finally, contestations linked to IBWT planning and operation were identified and analysed, finding that few contestations result in shifts

or cancelling of IBWT planning and operation. This offers the opportunity of expanding tools and databases that collect and record the socioenvironmental impacts of large hydraulic infrastructure such as the Environmental Justice Atlas.

Descending to the case of the TSA, I built an empirical link between the discursive elements behind the need and continued operation of the hydraulic infrastructure and irrigation expansion and changes within irrigation technologies to establish hegemonic common senses. I identified the hydraulic paradigm, as State-guided, aimed at balancing a national perception of hydraulic imbalance to serve purported needs of an arid Spain, and valuing water exclusively as an economic resource. This changed in the last decades, though elements such as the imbalance remained at the level of regional authorities. Drip irrigation's discursive elements were also identified, based on water efficiency and savings. These were contrasted with the histories of local irrigation communities on either side of the TSA, and this established how the discursive elements were keenly adopted in hegemonic core and frontier territories as zones of high national interest, while ignored or resisted in counterhegemonic territories that had their own embedded traditional irrigation systems.

The implications this has for authorities at multiple scales is to reconsider two things in particular. Firstly, the TSA has enabled the development of an irrigation model in Murcia that has developed an irrigated agriculture that while it presumes to be water efficient, has led to expanded irrigated surface on a very precarious water source – the TSA. The irony is that the same model of agriculture is being emulated in the donor basin. A reassessment of the extension of the model would reduce pressure not only at the basin level, but also for irrigation communities. Secondly, the blanket expansion of drip-irrigation has become a policy silver bullet but whose impacts within and across communities leads to a dismissal of the potential of traditional irrigation methods which, where practiced, offer lessons to maintain, recover, or develop environmentally rich communities.

The interlinkages between hydrological and rural development policies in Spain presented a significant contribution to understanding how both sets co-constructed visions of ideal irrigator subjects. Revising over 150 years of policies established 5 stages of irrigator ideals that have become more complex and contradictory since Spain returned to democracy, and formal power was divested to both the EU and the regional governments. This was again contrasted with the experiences of irrigators on either side of the TSA. What emerged were multiple subjectivities struggling to realize the prescriptions of ideal irrigator subjectivities, differentiated by land holdings, territorial histories of irrigation practice, and the irruption of new actors and conditions that ideal prescriptions have not considered. It is no surprise that at the time of concluding this dissertation in February 2024 multiple agrarian protests have erupted across the EU, but particularly in Spain over, among other things, the burden of bureaucratic processes and anger over the distribution of policy support that is argued to benefit large landholders. Here, authorities as multiple levels ought to reassess policy priorities more granularly, particularly in terms of land-holding of irrigation, the

presence of landowners in communities, and rethink support to traditional irrigation models, where practiced, as a way of supporting rural communities.

IBWTs, the TSA and irrigator subjectivities served as a way of conceptualizing and understanding not only IBWT impacts – these are the tip of the iceberg. They also required an understanding of the governmental policies and prescriptions, local histories and changes therein, and subject formation that IBWTs instigate and connect.

6.2.3. Methodological contributions

This dissertation mobilised a range of qualitative, quantitative, and mixed method analyses. It reinforces the need for a multi-pronged research method approach in the social sciences, and which can inform the fields of political ecologies and FPEs. The variety of sources of information and ways of analysing them not only triangulates and reinforces findings, but it also enriches the accounts and connections across scales that so much of this dissertation is based on. This is particularly the case of hearing the voices of irrigators who so often are spoken about when the TSA and the irrigation sector is discussed or is the subject of analysis, but who seldom make it themselves as interviewees in research.

Designing and conducting a critical literature review of IBWTs – their impacts, connections, and contestations – built a critical mass of data, both quantitative and qualitative, that allowed to categorize impacts and contestations, and to compare and contrast them. This also provided input for fieldwork design (see section 1.4.2.).

The multi-case study was a deeply qualitative engagement with individual irrigators. Even though these were relatively short engagements, utilising the same semi-structured interview format across multiple irrigation communities in 2 river basins provided a means to compare and contrast their histories, opinions, worries, and thoughts about the future of irrigation not only in their communities but in others. The variety of contexts based on a single (if significant) interconnection – the TSA – made similar remarks and experiences important, while heterogeneity was assured by differing geographies. It was also an opportunity for irrigators to have their voices heard and shared.

A significant contribution was conducting the quantitative and qualitative irrigation sector analyses in chapter 3 and the qualitative hydraulic and rural development policy analyses in chapter 4. These provided a triangulation of what irrigator interviewees mentioned and argued, it provided a historical understanding of how multi-scale decisions and developments were experienced at the local level.

6.3. Limitations and caveats

There are several limitations that this dissertation has to take into account. Firstly, while the systematic literature review conducted the sampling in English, Spanish and French, the number of

reviewed articles deemed fit for review greatly limits any extrapolation and generalization of findings. As stated, it was a qualitative review based on a relatively small number of articles, and for this reason no statistical analysis was conducted.

Secondly, the impact of the COVID-19 pandemic significantly altered planned fieldwork and visits to irrigation communities. While this had originally been envisioned as a longer-term ethnographic study, the timing of the pandemic and the availability of financial resources limited this to the multi-case study method described above. While this provided a breadth of irrigation communities visited, what was sacrificed was depth, and deeper engagements with communities that could highlight more intersectional approaches. Time availability and gatekeeping by communities limited the range of individuals that could be interviewed, and self-bias, while carefully considered, is always a possibility when timespans to conduct research is short. This does mean that, considering the vast geography the TSA occupies and the number of irrigators and people working in ancillary capacities, important voices and perspectives have no doubt not been included.

Finally, the applicability of the findings and lessons learnt in this research are circumscribed to a particular (privileged) place and time. In no way do I profess the findings from this research to be universal, and this would go against the spirit of research within FPE and political ecologies in general.

6.4. Future research

The relevance of situating IBWTs and their impacts within a research agenda is only going to increase with increasing climate disruption and dwindling water resource supplies. As outlined in chapter 2, IBWTs are forecast to continue being developed, at larger scales across many countries and continents. I present three principal avenues for further research.

With this in mind, the critical literature review in chapter 2 provides a base to which conduct further in-depth and qualitative research in other parts of the world, as well as to track impacts and contestations as time goes on. More importantly, qualitative and interdisciplinary research that builds on multi-dimensional socionatural impacts and changes in particular areas can provide a stronger link at the inequities generated within and across donor and recipient basins, their communities, and ecologies.

Digging deeper within irrigation communities, participatory research and ethnographic approaches can be pursued in the communities visited to better understand historicized, embodied subjectivities, and pursue a more intersectional approach with irrigators. Furthermore, an opportunity presents itself to better understand other subjects, particularly that of farm labourers and new categories of landowners (the legally present and physically absent in hegemonic frontier territories) who are deeply intertwined with irrigation communities and hydrosocial relations.

Hegemonic and counterhegemonic territoriality can be applied not only to other hydrosocial arenas, but to other common pool resources, such as fisheries and forests. This approach

encourages examining processes of socionatural State-building and subject-making with a territorial plurality vision that elucidates processes and spaces where hegemonic projects succeed (with all the consequences that brings) and where it is resisted, pointing to new areas of understanding interrelations of domination, acquiescence and resistance.

Finally, the integration of hydrosocial territoriality with critical agrarian studies can provide strong theoretical and empirical links between the land/water interface. As evidenced throughout this dissertation, researching irrigation practices is not limited to water, it touches on rural and agrarian practices, ontologies and dynamics. A research agenda integrating both hydrological infrastructure and technology, territory building, and agrarian dynamics would provide a strong understanding in an arena where water resources dedicated to agriculture are key.

6.5. Conclusion

The TSA was the product of a dominant hegemonic vision, encapsulated by the hydraulic paradigm, of viewing water exclusively as a resource, to be used only for human use. After its completion, it reproduced said vision by allowing the development of an intensive agricultural model using transferred water from the Tagus that allowed the enrichment and creation of new agrarian elites in a hitherto water poor region in the Segura basin. Despite changing water availability due to climate change, the model has been successful in being recreated, ironically, in the Tagus basin itself, instigating a recreation of similar processes of the creation of agrarian elites, though these divorced from the territories being irrigated. The dominant vision also takes hold in counterhegemonic territories of the Segura basin, where communities and their irrigation practices are cast as irresponsible with regards to water and held as examples of how not irrigate considering water scarcity in the basin. The result of the TSA is an uneven tapestry of different hegemonic and counterhegemonic territories where the hydraulic paradigm is adapted to changing times and conditions, but always in the service of increasing water resource development for irrigated agriculture in an ideal setting. This paradigm can be found in different guises worldwide (in China, USA or India are apt examples), whether for urban development, agriculture, or hydropower. The logic of transferring water remains the same – it will be put to a better use than where it is.

Descending to the community scale, how the TSA is experienced depends very much on the historical and personal relationship irrigators have to it. The historically and contemporarily experienced water injustices and inequities of irrigators on either side of the TSA are situated through very political decisions made more than a century ago, and whose vision of how water ought to behave lives on. As laid out in the introductory remarks, those decisions continue, and irrigators continue that spirit whether by defending the TSA, distilling fresh water from the sea, or fighting to continue a traditional method of irrigation and way of life. The situated politics of these positions do not remain at the community level – they bounce back up and across scales in relation to new policies, market demands, or new ways of thinking about water espoused by new social movements that reinforce or challenge their situated political positions.

What this means for the future of rural communities depends very much on the situated and embodied experience and position of different irrigators and the histories they live with. Nonetheless what I have succeeded in doing is to demonstrate that, despite physical distance, they are (and I am) interconnected by rivers, by concrete, and by the contrasting visions of what both river and concrete mean (both normatively and materially) for the various inhabitants and territories explored.

This journey has provided ample opportunities for further research, not just in water worlds, but potentially beyond. In particular, the co-constitution of interconnected territories through infrastructure and technologies, natures and societies, and the projects of domination connecting these does not have to remain within irrigation. Inequities in natural resource management arenas are increasingly interconnected and multi-scalar. Similarly, further examination of intersectional inequities within the same irrigation contexts would yield a better understanding of the community impacts of water being transferred across basins.

As a recommendation, this dissertation calls for a break in further development of IBWTs and a better understanding, and compensation, for the impacts IBWTs have on socionatures on both donor and recipient communities. It calls for a better understanding and appreciation of locally sourced and managed water, and a celebration not only of just territorial pluralism, but also of ontologically plural visions of water. A feminist-inspired political ecology of IBWTs points to the existing interconnections, and to possible, just, alternative water worlds where diverse ways of living in and with hydrosocial territory does not deny future, equitable more-than-human relations across communities, rivers and basins.

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Appendices

Appendix 1 – Fieldwork questions

1. **Tecnologia hidráulica, cambios en la misma, y efectos sociales y ambientales en el territorio**
   - **1.1.** *Tecnologia y conocimiento al que tienen acceso, y que nuevas tecnologías entran en el territorio*
     - **1.1.1.** ¿Qué tecnología de riego usas, y que otras tecnologías se usan en la comunidad de regantes? ¿Ha habido cambios en la tecnología de riego?
     - **1.1.2.** ¿Como entran nuevas tecnologías en la comunidad, y que personas, empresas u organizaciones las impulsan?
     - **1.1.3.** ¿Qué financiación requiere la instalación y operación de estas tecnologías?
     - **1.1.4.** ¿Qué beneficios y limitaciones tiene la tecnología de riego utilizada, a nivel socioeconómico, ambiental, y de gobernanza y cooperación entre miembros de la comunidad? ¿Si ha habido cambio de tecnología de riego, cuáles son las diferencias?
   - **1.2.** *Como las diferentes tecnologías cambian las percepciones del ambiente, bienestar socioeconómico, y convivencia con otros miembros y confederaciones hidrográficas*
     - **1.2.1.** ¿A qué punto satisface las necesidades económicas (familiares) y sociales (tiempo libre, posición social) la tecnología de riego empleada? ¿Si ha habido cambio en la tecnología de riego, de qué forma ha cambiado el nivel de satisfacción?
     - **1.2.2.** ¿En qué medida ha influido e influye la tecnología de riego y la actividad agrícola en el bienestar ambiental del territorio regado y más allá? ¿Si ha habido cambio en la tecnología de riego, de qué forma ha cambiado el bienestar ambiental?
     - **1.2.3.** ¿En qué medida influye la tecnología de riego en la cooperación entre miembros de la comunidad? ¿Si ha habido cambios de tecnología, como ha afectado la cooperación?
     - **1.2.4.** ¿Piensa que otros miembros de la comunidad, de otras CCRR de la cuenca, o bien de CCRR de la otra cuenca tienen satisfacen sus necesidades económicas de forma diversa? ¿Por qué?
     - **1.2.5.** ¿Qué es para usted un uso sostenible de agua para el riego? ¿De qué modo influye la tecnología de riego en un uso sostenible de agua? ¿Piensa que el uso de agua por parte de otros miembros de la comunidad, de otras CCRR de la cuenca, o bien de CCRR de la otra cuenca sea sostenible?
     - **1.2.6.** ¿Qué barreras y limitaciones vive en términos de aportar agua, fertilizante, pesticidas y tecnologías a su actividad? ¿Es lo mismo para otros miembros de la comunidad, de otras CCRR de la cuenca, o bien de CCRR de la otra cuenca?

1.3. *Como decisiones de suministro de agua, actividades económicas y cambios tecnológicos en otras partes de la cuenca y otras cuencas afectan la experiencia directa del medio ambiente, bienestar socioeconómico y convivencia de los regantes*

1.3.1. ¿De qué forma te afectan las decisiones de suministro de agua de parte de la Confederación Hidrográfica en tomar decisiones a nivel de tus necesidades socioeconómicas, en la adopción o no de tecnologías de riego, y en como la comunidad de regantes toma decisiones a suministrarte agua?

1.3.2. ¿Piensa que ha habido cambios en el medioambiente de su territorio (calidad de agua, flora y fauna)? ¿Piensa que estén ligados a i) decisiones del trasvase Tajo-Segura, ii) actividades industriales y/o agrícolas rio arriba, en la propia comunidad de regantes, o a actividades rio abajo, y iii) a cambios en la tecnología de riego rio arriba, en la propia comunidad de regantes, o a actividades rio abajo?

2. Territorios hidrosociales deseadas y justas, como se realizan, y si son complementarias a diferentes escalas

2.1. Teniendo en cuenta la disponibilidad de agua (calidad, cantidad, cambio climático), ¿qué tiene que cambiar para mejorar las prospectivas económicas y las condiciones ambientales locales?

2.1.1. ¿Cuál sería un futuro donde las condiciones socioeconómicas y medioambientales son mejores para ti que las actuales? ¿En qué se diferencia con las condiciones actuales?

2.2. ¿De qué forma afectaría este futuro deseado a otros usuarios de agua (otros miembros, otras CCRR, sectores, rio arriba y abajo, otras cuencas)?

2.2.1. ¿Qué rol habría para entes públicas y confederaciones hidrográficas en este futuro?

2.3. De qué forma positiva y/o negativa afectaría este futuro al medioambiente en otras CCRR y otras cuencas?

2.3.1. Que es para ti un cambio positivo y/o negativo en el medioambiente local y ajeno?

2.4. ¿Qué es para usted una distribución de agua justa y ecua dentro de la comunidad de regantes? ¿Se consigue en la actualidad?

2.4.1. ¿Como se distribuye agua en la comunidad de regantes? ¿Qué factores se tiene en cuenta? ¿Y en tiempos de sequía?

2.5. ¿La distribución de agua tiene en cuenta factores individuales como pueden ser la edad, el sexo, o la cantidad de superficie regada como propiedad individual? ¿Qué otros factores inciden en esta distribución? ¿La considera justa?

2.6. ¿Los factores como pueden ser la edad, el sexo, o la cantidad de superficie regada como propiedad individual afectan la participación de los miembros de la comunidad en la toma de decisiones de distribución de agua?

2.7. ¿Piensa que habrá suficiente agua, en cantidad y calidad, en el futuro deseado para las próximas generaciones dentro de la comunidad de regantes? ¿Piensa que los futuros regantes serán de su propia familia o de la comunidad?

2.8. ¿Como piensa que una distribución justa y ecua de agua se vería en otras CCRR, y en CCRR de la otra cuenca?

Appendix 2 – Irrigation community data

Basin	Irrigation community	Autonomous Community	Province	Year established	Water inputs	Water concession (Hm3/year) *	Total irrigated surface (ha)*	Modernized irrigated surface (ha)*	Members*	Average hectare of total irrigated surface per member (ha)	Proportion of modernized irrigated surface against total irrigated surface (ha)	Water concession against hectares of irrigated surface (m^3)
Tagus	Canal Bajo del Alberche	Castilla-La Mancha	Toledo	1957	Surface	78.00	8,879	1,411	3,000	3.0	16%	8,784.8
Tagus	Alcolea de Tajo	Castilla-La Mancha	Toledo	2000	Surface	25.42	3,632	3,632	373	9.7	100%	7,000.0
Segura	Campo de Cartagena	Murcia	Murcia	1952	Transfer; groundwater; Residual	144.29	42,255	41,410	9,699	4.4	98%	3,414.7
Segura	Trasvase Tajo-Segura de Totana	Murcia	Murcia	1979	Transfer; Groundwater; Treated residual; desalinated	13.35	10,780	6,072	4,500	2.4	56%	1,238.8
Segura	Juzgado Privativo de Aguas de Orihuela	Comunidad Valenciana	Alicante	1275	Surface; Transfer; Treated residual	45.00	6,793	356	11,270	0.6	5%	6,624.5
Segura	Las Fuentes de Letur	Castilla-La Mancha	Albacete	1986	Surface	0.98	351	21	400	0.9	6%	2,779.4

Source: interviews with heads and technicians of irrigation communities listed; water concession, irrigated surface, modernized irrigated surface and members data for the Campo de Cartagena irrigation community obtained from https://www.crcc.es/concesiones/ and https://www.crcc.es/estructura-agraria/ (accessed 01/07/2023)

* Data provided by irrigation communities, and dated to 2022 or latest available data

Appendix 3 – Articles reviewed

Paper ID	Case ID	Paper name (author year)	Paper bibliography
1	1; 2; 3; 4; 5	de Andrade *et al.* 2011	Andrade, José Geraldo Pena de, Paulo Sergio Franco Barbosa, Luiz Carlos Alves Souza, and Daniel Lucas Makino. 2011. "Interbasin Water Transfers: The Brazilian Experience and International Case Comparisons." Water Resources Management 25 (8): 1915–34. https://doi.org/10.1007/s11269-011-9781-6.
2	6; 7	Islar and Boda 2014	Islar, Mine, and Chad Boda. 2014. "Political Ecology of Inter-Basin Water Transfers in Turkish Water Governance." Ecology and Society 19 (4). https://doi.org/10.5751/ES-06885-190415.
3	8; 9.1; 9.2; 10.1; 10.2	Bourblanc and Blanchon 2014	Bourblanc, Magalie, and David Blanchon. 2014. "The Challenges of Rescaling South African Water Resources Management: Catchment Management Agencies and Interbasin Transfers." Journal of Hydrology 519 (PC): 2381–91. https://doi.org/10.1016/j.jhydrol.2013.08.001.
4	11.1; 11.2; 11.3	Shao and Wang 2003	Shao, Xuejun, and Zhaoyin Wang. 2003. "Interbasin Transfer Projects and Their Implications: A China Case Study." International Journal of River Basin Management 1 (1): 5–14. https://doi.org/10.1080/15715124.2003.9635187.
5	8; 9.1; 11; 12; 13; 13.1; 13.2	Gupta and van der Zaag 2008	Gupta, Joyeeta, and Pieter van der Zaag. 2008. "Interbasin Water Transfers and Integrated Water Resources Management: Where Engineering, Science and Politics Interlock." Physics and Chemistry of the Earth 33 (1–2): 28–40. https://doi.org/10.1016/j.pce.2007.04.003.
6	14-18	Bozorg-Haddad *et al.* 2020	Bozorg-Haddad, Omid, Mahyar Abutalebi, Xuefeng Chu, and Hugo A. Loáiciga. 2020. "Assessment of Potential of Intraregional Conflicts by Developing a Transferability Index for Inter-Basin Water Transfers, and Their Impacts on the Water Resources." Environmental Monitoring and Assessment 192 (1): 1–16. https://doi.org/10.1007/s10661-019-8011-1.
7	19; 35	Molle and Sanchis-Ibor 2019	Molle, François, and Carles Sanchis-Ibor. 2019. Irrigation Policies in the Mediterranean: Trends and Challenges. Global Issues in Water Policy. Vol. 22. https://doi.org/10.1007/978-3-030-03698-0_10.
8	11; 11.1; 11.2	Rogers *et al.* 2020	Rogers, Sarah, Dan Chen, Hong Jiang, Ian Rutherfurd, Mark Wang, Michael Webber, Britt Crow-Miller, *et al.* 2020. "An Integrated Assessment of China's South—North Water Transfer Project." Geographical Research 58 (1): 49–63. https://doi.org/10.1111/1745-5871.12361.
9	20	Ben Fraj *et al.* 2019	Fraj, Wafa Ben, Mohamed Elloumi, and François Molle. 2019. "The Politics of Interbasin Transfers: Socio-Environmental Impacts and Actor Strategies in Tunisia." Natural Resources Forum 43 (1): 17–30.

Paper ID	Case ID	Paper name (author year)	Paper bibliography
			https://doi.org/10.1111/1477-8947.12165.
10	21	Lopez *et al.* 2019	Lopez, Rígel Rocha, Rutgerd Boelens, Jeroen Vos, and Edwin Rap. 2019. "Hydrosocial Territories in Dispute: Flows of Water and Power in an Interbasin Transfer Project in Bolivia." Water Alternatives 12 (1): 267–2842031.
11	12	de Stefano and Hernández-Mora 2018	Stefano, Lucia De, and Nuria Hernández-Mora. 2018. "Multi-Level Interactions in a Context of Political Decentralization and Evolving Water-Policy Goals: The Case of Spain." Regional Environmental Change 18 (6): 1579–91. https://doi.org/10.1007/s10113-018-1318-6.
12	22	Chokkakula 2018	Chokkakula, Srinivas. 2018. "Transboundary Politics of Cooperation: Telugu Ganga Project, India." Regional Environmental Change 18 (6): 1645–54. https://doi.org/10.1007/s10113-018-1348-0.
13	8; 9.1	Blanchon 2017	Blanchon D. (2017) Who Runs the Orange River Oasis? A Case Study of the Midstream Orange River Oasis, Northern Cape Province, South Africa. In: Lavie E., Marshall A. (eds) Oases and Globalization. Springer Geography. Springer, Cham https://doi.org/10.1007/978-3-319-50749-1_6
14	23	Ruf 2017	Ruf, Thierry. 2015. "Transférer l'eau Du Rhône Dans Le Languedoc: Regard Critique Sur Les Incidences Du Projet Aqua Domitia et Les Contradictions Territoriales." Territoire En Mouvement Revue de Géographie et Aménagement 25–26: 1–24. https://doi.org/10.4000/tem.2778.
15	11	Rogers *et al.* 2016	Rogers, Sarah, Jon Barnett, Michael Webber, Brian Finlayson, and Mark Wang. 2016. "Governmentality and the Conduct of Water: China's South–North Water Transfer Project." Transactions of the Institute of British Geographers 41 (4): 429–41. https://doi.org/10.1111/tran.12141.
16	24	Sanchis-Ibor *et al.* 2019	Sanchis-Ibor, Carles, Marta García-Mollá, Teresa Torregrosa, Mar Ortega-Reig, and Martín Sevilla Jiménez. 2019. "Water Transfers between Agricultural and Urban Users in the Region of Valencia (Spain). A Case of Weak Governance?" Water Security 7 (November 2018): 100030. https://doi.org/10.1016/j.wasec.2019.100030.
17	19	Garrick *et al.* 2018	Garrick, Dustin E., Nuria Hernández-Mora, and Erin O'Donnell. 2018. "Water Markets in Federal Countries: Comparing Coordination Institutions in Australia, Spain and the Western USA." Regional Environmental Change 18 (6): 1593–1606. https://doi.org/10.1007/s10113-018-1320-z.
18	11.2	Pohlner 2016	Pohlner, Huw. 2016. "Institutional Change and the Political Economy of Water Megaprojects: China's South-North Water Transfer." Global

Paper ID	Case ID	Paper name (author year)	Paper bibliography
			Environmental Change 38: 205–16. https://doi.org/10.1016/j.gloenvcha.2016.03.015.
19	25	Magrin 2016	Magrin, Géraud. 2016. "The Disappearance of Lake Chad : History of a Myth." Journal of Political Ecology 23 (1): 204–22. https://doi.org/10.2458/v23i1.20191.
20	11.2	Deines *et al.* 2016	Deines, Jillian M., Xiao Liu, and Jianguo Liu. 2016. "Telecoupling in Urban Water Systems: An Examination of Beijing's Imported Water Supply." Water International 41 (2): 251–70. https://doi.org/10.1080/02508060.2015.1113485.
21	9.1; 9.2	Blanchon 2015	Blanchon, David. 2015. "Le Lesotho Highland Water Project, Ou Le Retour de La Grande Hydraulique En Afrique Australe. The Lesotho Highland Water Project: The Return of Large-Scale Hydraulics in Southern Africa." Bulletin de l'association de Géographes Français 92 (2): 167–83. https://doi.org/10.4000/bagf.594.
22	26	Cokorilo *et al.* 2015	Cokorilo, Marina, Zoran Stevanovic and Vesna Ristic Vakanjac. 2015. "Environmental Aspects of Proposed Engineering Solution for Inter-basin Transfer in East Herzegovina." In: Lollino G., Manconi A., Guzzetti F., Culshaw M., Bobrowsky P., Luino F. (eds) Engineering Geology for Society and Territory - Volume 5. Springer, Cham https://doi.org/10.1007/978-3-319-09048-1_99
23	27.1; 27.2	Prichard and Scott 2014	Prichard, Andrea Harrop, and Christopher A. Scott. 2014. "Interbasin Water Transfers at the US-Mexico Border City of Nogales, Sonora: Implications for Aquifers and Water Security." International Journal of Water Resources Development 30 (1): 135–51. https://doi.org/10.1080/07900627.2012.755597.
24	3	Lee *et al.* 2014	Lee, Hannah, Zamyla Chan, Kai Graylee, Arani Kajenthira, Daniela Martínez and Andrei Roman. 2014. "Challenge and response in the São Francisco River Basin" Water Policy 16 (1): 153-200
25	28	Domènech *et al.* 2013	Domènech, Laia, Hug March, and David Saurí. 2013. "Contesting Large-Scale Water Supply Projects at Both Ends of the Pipe in Kathmandu and Melamchi Valleys, Nepal." Geoforum 47: 22–31. https://doi.org/10.1016/j.geoforum.2013.02.002.
26	29	Cabral and Ávila-García 2013	Cabral, Valentina Campos, and Patricia Ávila-García. 2013. "Entre Ciudades y Presas. Oposición Campesina Al Trasvase de Agua y La Defensa Del Río Temascaltepec, México." Revista de Estudios Sociales 6 (46): 120–33. https://doi.org/10.7440/res46.2013.12.

Appendix 4 – IBWT case basic information

Case ID*	paper ID	Authors and year	Region	Country/ Countries	IBWT name	Donor basin	Transmitting basin	Recipient basin	Inter / Intra basin transfer	Construction status	Year of operation
1	1	de Andrade et al. 2011	South America	Brazil	Paraiba do Sul	Paraiba do Sul	-	Guandu River	Inter	built	1913
2	1	de Andrade et al. 2011	South America	Brazil	Sistema Cantareira project	Piracicaba River basin	-	Alto Tietê River basin	Inter	built	1973
3	1	de Andrade et al. 2011	South America	Brazil	Project Integration of the Sao Francisco River (PISF)	São Francisco	-	Small coastal basins (North route: Jaguaribe, Apodi, Piranhas and Brigida rivers; East route: Paraíba and Moxotó rivers and the Agreste Pernambucano region)	Inter	planned	Not applicable
3	24	Lee et al. 2014	South America	Brazil	Project Integration of the Sao Francisco River (PISF)	São Francisco	-	Small coastal basins (North route: Jaguaribe, Apodi, Piranhas and Brigida rivers; East route: Paraíba and Moxotó rivers and the Agreste Pernambucano region)	Inter	planned	Not applicable
4	1	de Andrade et al. 2011	North America	USA	Colorado-Big Thompson Project (C-BT)	Colorado River Basin	-	Front Range	Inter	built	1947

Case ID*	paper ID	Authors and year	Region	Country/ Countries	IBWT name	Donor basin	Transmitting basin	Recipient basin	Inter / Intra basin transfer	Construction status	Year of operation
5	1	de Andrade et al. 2011	Oceania	Australia	Snowy Mountains Hydroelectric Scheme (SMHS)	Snowy River	-	Murray and the Murrumbidgee rivers	Inter	built	1949
6	2	Islar and Boda 2014	Middle East and North Africa	Turkey	Istanbul Greater Melen project	Melen river	-	Istanbul city	Inter	planned	Not applicable
7	2	Islar and Boda 2014	Middle East and North Africa	Turkey	Ankara Kizilirmak plan	Kizilirmak river	-	Ankara city	Inter	planned	Not applicable
8	3	Bourblanc and Blanchon 2014	Sub-Saharan Africa	South Africa	Orange River Development Project (ORDP)	Orange river basin and Vaal River sub-basin	-	Great Fish and Sunday rivers sub-basins	Inter	built	1970?
8	5	Gupta and van der Zaag 2008	Sub-Saharan Africa	South Africa	Orange River Development Project (ORDP)	Orange river basin and Vaal River sub-basin	-	Great Fish and Sunday rivers sub-basins	Inter	built	1977
8	13	Blanchon 2017	Sub-Saharan Africa	South Africa	Orange River Development Project (ORDP)	Orange river basin and Vaal River sub-basin	-	Great Fish and Sunday rivers sub-basins	Inter	built	1977
9.1	3	Bourblanc and Blanchon 2014	Sub-Saharan Africa	South Africa, Lesotho	Lesotho Highlands Water Project (LHWP)	Senqu (Orange) river sub-basin	-	Vaal river sub-basin	Intra	built	before 1992
9.1	5	Gupta and van der Zaag 2008	Sub-Saharan Africa	South Africa, Lesotho	Lesotho Highlands Water Project (LHWP)	Senqu (Orange) river sub-basin	-	Vaal river sub-basin	Inter	built	-
9.1	13	Blanchon 2017	Sub-Saharan Africa	South Africa, Lesotho	Lesotho Highlands Water Project (LHWP)	Senqu (Orange) river sub-basin	-	Vaal river sub-basin	Intra	built	1998
9.1	21	Blanchon 2015	Sub-Saharan	South Africa,	Lesotho Highlands Water Project	Senqu (Orange) river	-	Vaal river sub-basin	Intra	built	-

Case ID*	paper ID	Authors and year	Region	Country/ Countries	IBWT name	Donor basin	Transmitting basin	Recipient basin	Inter / Intra basin transfer	Construction status	Year of operation
			Africa	Lesotho	(LHWP)	sub-basin					
9.2	3	Bourblanc and Blanchon 2014	Sub-Saharan Africa	South Africa, Lesotho	Lesotho Highlands Water Project (LHWP)	Senqu (Orange) river sub-basin	-	Vaal river sub-basin	Intra	planned	Not applicable
9.2	21	Blanchon 2015	Sub-Saharan Africa	South Africa, Lesotho	Lesotho Highlands Water Project (LHWP)	Senqu (Orange) river sub-basin	-	Vaal river sub-basin	Intra	planned	Not applicable
10.1	3	Bourblanc and Blanchon 2014	Sub-Saharan Africa	South Africa, Lesotho	Tugela-Vaal	Tugela river basin	-	Vaal river sub-basin	Inter	built	before 1992
10.2	3	Bourblanc and Blanchon 2014	Sub-Saharan Africa	South Africa, Lesotho	Tugela-Vaal	Tugela river basin	-	Vaal river sub-basin	Inter	planned	Not applicable
11	5	Gupta and van der Zaag 2008	Asia	China	South to North water transfer	Yangtze river basin	-	Hai, Yellow and Huai River basins	Inter	planned	Not applicable
11	8	Rogers et al. 2020	Asia	China	South to North water transfer	Yangtze river basin	-	Hai, Yellow and Huai River basins	Inter	planned	Not applicable
11	15	Rogers et al. 2016	Asia	China	South to North water transfer	Yangtze river basin	-	Yellow	Inter	built	2013 (eastern route case 14.1); 2014 (middle route case 14.2)
11.1	4	Shao and Wang 2003	Asia	China	South to North water transfer - East	Yangtze river basin	-	Yellow	Intra	planned	Not

Case ID*	paper ID	Authors and year	Region	Country/ Countries	IBWT name	Donor basin	Transmitting basin	Recipient basin	Inter / Intra basin transfer	Construction status	Year of operation
					route						applicable
11.1	8	Rogers et al. 2020	Asia	China	South to North water transfer - East route	Yangtze river basin	-	Yellow	Inter	built	2014
11.2	4	Shao and Wang 2003	Asia	China	South to North water transfer - Middle route	Yangtze river basin (from Hanjiang river sub basin)	-	Huaihe; Haihe	intra	planned	Not applicable
11.2	8	Rogers et al. 2020	Asia	China	South to North water transfer - Middle route	Yangtze river basin (from Hanjiang river sub basin)	-	Huaihe; Haihe	Inter	built	2013
11.2	18	Pohlner 2016	Asia	China	South to North water transfer - Middle route	Yangtze river basin (from Hanjiang river sub basin)	-	Huaihe; Haihe	Inter	built	2014
11.2	20	Deines et al. 2016	Asia	China	South to North water transfer - Middle route	Yangtze river basin (from Hanjiang river sub basin)	-	Huaihe; Haihe	Inter	built	2014
11.3	4	Shao and Wang 2003	Asia	China	South to North water transfer - West route	Yangtze river basin (from Tongtian, Yalong and Dadu Rivers sub-basins)	-	Yellow	Intra	planned	Not applicable
12	5	Gupta and van der Zaag 2008	Europe	Spain	Ebro Transfer Scheme	Ebro river basin	-	South-East basin	Inter	Cancelled	Not applicable
12	11	de Stefano	Europe	Spain	Ebro Transfer	Ebro river	-	South-East basin	Inter	Cancelled	Not

Case ID*	paper ID	Authors and year	Region	Country/ Countries	IBWT name	Donor basin	Transmitting basin	Recipient basin	Inter / Intra basin transfer	Construction status	Year of operation
		and Hernández-Mora 2018			Scheme	basin					applicable
13	5	Gupta and van der Zaag 2008	Asia	India	River Linking Programme	various	-	various	Inter	planned	Not applicable
13.1	5	Gupta and van der Zaag 2008	Asia	India	Peninsular River Development Programme	various	-	various	Inter	planned	Not applicable
13.2	5	Gupta and van der Zaag 2008	Asia	India	Himalayan Rivers Programme	various	-	various	Inter	planned	Not applicable
14	6	Bozorg-Haddad et al. 2020	Middle East and North Africa	Iran	Behesht abad	Chaharmahal and Bakhtiari	-	Isfahan, Yazd, Kerman	-	halted	Not applicable
15	6	Bozorg-Haddad et al. 2020	Middle East and North Africa	Iran	Tabriz	Miandoab	-	Tabriz	-	built	1999
16	6	Bozorg-Haddad et al. 2020	Middle East and North Africa	Iran	Chaloos	Gilan	-	Mazandaran	-	planned	Not applicable
17	6	Bozorg-Haddad et al. 2020	Middle East and North Africa	Iran	Kashan	Zayandeh-Rood	-	Kashan	-	planned	Not applicable
18	6	Bozorg-Haddad et al. 2020	Middle East and North	Iran	Yazd	Zayandeh-Rood	-	Yazd	-	built	1999

Case ID*	paper ID	Authors and year	Region	Country/ Countries	IBWT name	Donor basin	Transmitting basin	Recipient basin	Inter / Intra basin transfer	Construction status	Year of operation
			Africa								
19	7	Molle and Sanchis-Ibor 2019	Europe	Spain	Tajo-Segura Water Transfer Scheme	Tajo	Jucar	Segura	inter	built	-
19	17	Garrick et al. 2018	Europe	Spain	Tajo-Segura Water Transfer Scheme	Tajo	Jucar	Segura	Inter	built	-
20	9	Ben Fraj et al. 2019	Middle East and North Africa	Tunisia	Northern water master plan (?)	Far North coastal basins	Ichkeul Basin	Greater Tunis; Cap Bon; Sfax and Eastern Tunisia	Inter	built	1994 onwards
21	10	Lopez et al. 2019	South America	Bolivia	Yungas de Vandiola Interbasin Irrigation Water Transfer Project	Yungas de Vandiola basin	-	Pucara watershed	inter?	halted	Not applicable
22	12	Chokkakula 2018	Asia	India	Telugu Ganga Project	Krishna river	-	Pennar river	Inter	built	1996
23	14	Ruf 2017	Europe	France	Aqua Domitia	Rhone river basin	-	Previously Barcelona; currently Aude River (Narbonne)	Inter	planned	Not applicable
24	16	Sanchis-Ibor et al. 2019	Europe	Spain	Jucar to Amadorio and Algar transfer	Jucar	-	Amadorio and Algar rivers	Intra	built	1999-2001
25	19	Magrin 2016	Sub-Saharan Africa	Chad, Cameroon, Nigeria, Niger, Central African Republic	Congo basin to Chad lake basin water transfer	Congo river basin	-	Chad lake	Inter	planned	Not applicable
26	22	Cokorilo et al. 2015	Europe	Bosnia and Herzegovina	Upper Horizons	Neretva river basin	-	Trebisnjica river basin	Inter	planned	Not

Case ID*	paper ID	Authors and year	Region	Country/ Countries	IBWT name	Donor basin	Transmitting basin	Recipient basin	Inter / Intra basin transfer	Construction status	Year of operation
											applicable
27.1	23	Prichard and Scott 2014	North America	USA, Mexico	Nogales interbasin transfer	Los Alisos river basin	-	Santa Cruz river basins	Inter	built	-
27.2	23	Prichard and Scott 2014	North America	USA, Mexico	Nogales interbasin transfer	Santa Cruz river basins	-	Los Alisos river basin	Inter	built	2012
28	25	Domènech et al. 2013	Asia	Nepal	Melamchi Water Supply project	Melamchi valley	-	Kathmandu valley	Intra	planned	Not applicable
29	26	Cabral and Ávila-García 2013	North America	Mexico	Cutzamala system stage IV	Temascaltepec river	-	Mexico valley	Inter	Cancelled	Not applicable

* Cases with a decimal point are individual IBWTs making up part of a larger transfer scheme

Appendix 5 – Socionature variables and case descriptions

Dimension	Variable	Description
Biophysical	Basin(s)	Basic information on basins involved in IBWTs and if the IBWT is inter or intra basin water transfer is collected in appendix 2
	Flow	While flows vary due to seasonality, nearly half of the cases documenting flow modification discuss human-induced modifications to flow before IBWTs went operational, pinning the reasons on irrigation and overallocation of water resources in recipient basins. These cases reflect the justification for IBWTs in the first place, that is, a lack of water in recipient basins. These cases were found in China (Deines et al., 2016; Shao et al., 2003), Spain (Molle & Sanchis-Ibor, 2019), and Tunisia (Ben Fraj et al., 2019). In the north of China, water deficits are projected and expected to increase the use of groundwater, river desiccation, heavy water pollution, and the deterioration of riparian and estuarine ecosystems, and the construction of dams have interrupted water flows (Shao et al., 2003). In Beijing, though the city has depended on groundwater for well over 2,000 years, urban expansion has stressed supply to the point that the water table has dropped 21.7 meters leading to land subsidence, and the Hai River basin which Beijing is in has rivers running dry for more than 300 days of the year (Deines et al., 2016). In Spain, the Segura River basin barely has water reaching the sea, due to exploitation of all available water resources available, whether groundwater or surface water, for intense irrigated agriculture (Molle & Sanchis-Ibor, 2019). In Tunisia, a similar situation occurs, with dams allowing a distribution of water resources for irrigation and urban expansion (Ben Fraj et al., 2019).
	Habitat	One of the biophysical features that explores the biophysical dimension, habitat modification, is barely explored prior to IBWT planning, but is then quite well documented after IBWTs go into operation, collecting destructive consequences of IBWTs. During IBWT planning, six articles cite studies that note expected habitat disturbances, including coastal erosion and salinization in China and India. Actual recorded modifications include various phenomena. In Australia, coastal erosion occurred due to the Snowy Mountains Hydroelectric Scheme's transfer of water to the Murray and the Murrumbidgee river basins. This case was highlighted by the authors (de Andrade et al., 2011) for a noticeable absence of possible environmental impacts in the IBWT's planning phase. In China, phytoplankton blooms have emerged in the exposed canal of the Middle Route that makes up one of three transfers of the South to North Water Transfer. The main destination of the Middle Route is Beijing and does not have the infrastructure to treat phytoplankton (Rogers et al., 2020). Lake salinity disturbances in Tunisia were attributed to the reduction of natural inflows of river water to Ichkeul lake, a UNESCO biosphere reserve since 1977 (Ben Fraj et al., 2019). In Mexico, a decrease in riparian vegetation downstream of urban areas was noted after the Nogales Interbasin Transfer went into operation. Nonetheless this was attributed to a decade-long drought and not to the hypothesized reduction in the water table occurring due to expansion of groundwater extraction following reduced surface water availability since the IBWT started operation (Prichard & Scott, 2014). The only case to document measures to reduce habitat destruction is in Tunisia, which is no longer functioning following damage to infrastructure during the events of the Arab Spring (Ben Fraj et al., 2019).
	Species distribution	Changes in species number and distribution is even less documented, but as with habitat changes, reflects destructive changes wrought by IBWTs. Only two articles contain cases mentioning species distribution prior to IBWT planning, which includes threats to 11 endemic species reported in a WWF report for the planned Melen Project (Islar & Boda, 2014), expected impacts on aquatic salt-water species due to water abstractions from donor basins in India if the nation-wide River Linking Program goes into effect (Gupta & van der Zaag, 2008). After IBWTs went into operation, changes in species composition were documented in South Africa´s Great Fish River, one of the recipient basins of the Orange River Development Project IBWT, which included the domination of the pest blackfly species Simulium chutteri over other benign species and causing damage to livestock (Gupta & van der Zaag, 2008). In Tunisia, habitat modification of the Ichkeul lagoon led to the reduction in number and endangerment of rare migratory bird species (Ben Fraj et al., 2019). The construction

Dimension	Variable	Description
		of the now cancelled Cutzamala system stage IV in Mexico has led to the disappearance of animal and plant species, including those used by local human communities (Cabral & Ávila-García, 2013).
	Contaminants	Contaminants are relatively well documented among the cases, with 10 discussing the presence of contaminants prior to IBWT planning. Most of this contamination was found in water, with half of cases reporting these in recipient basins compared to slightly less than half in donor basins. Three IBWTs in particular stand out which highlight the urgency with which IBWTs are planned in periods of drought, extractive contexts for newer justifications of water transfers, and the increasing concern of contamination that governments have, but which cannot plan for unknown consequences of changing water flows. Within the planned Ankara Kizilirmak plan in Turkey, planned during a prolonged period of drought, the donor Kizilirmak River was found to have high levels of sulphate, chlorate, and heavy metals due to run-off from widespread agriculture and livestock breeding, contamination from solid waste dumping sites, and excessive salinity from local geological features (Islar and Boda 2014:4). The planned expansion of the Lesotho Highland Water Project which transfers water from Lesotho to South Africa's Gauteng region, is premised on the need by South Africa to have greater volumes of high-quality water to dilute effluents from gold mining, or acid mine drainage (Blanchon 2015:168-169). In three cases where there were changes to contamination following the construction and operation of IBWTs, all were based in China's South to North Water Transfer. In this transfer's Eastern route, measures to improve water quality across all IBWT basins started prior to IBWT operation and have continued since operation, though it is feared that changes in water flow direction in lakes connected to the IBWT along the Eastern route may disturb contaminated sediments (Rogers et al., 2020).
Socioeconomic	Demography and habitation	IBWT planning sets in motion population movements, whether from uncertainty to rural livelihoods, relocations, or promise of further opportunities in urban areas. Operational IBWTs then set in concrete the principal artery through which urban areas can surpass the biophysical limitations that local water supplies set, to expand and attract migrants. Flows attributed to planning occurred in Turkey, China, the USA and Mexico, and nearly all flows occurred in donor basins. In Turkey, prolonged planning of the Istanbul Greater Melen project caused uncertainty for rural inhabitants, which pushed them to migrate to urban areas. In the case of the Ankara Kizilirmak plan, there is mention of some resettlement and minor impacts on rural inhabitants that live in the vicinity of Ankara and the IBWT (Islar & Boda, 2014). In China, the construction of the South to North Water Transfer's middle route, and to a lesser extent the eastern route, is expected to lead to population relocations (Shao et al., 2003). More broadly, construction of the whole South to North Water Transfer is expected to cause the relocation of 300,000 people (Gupta & van der Zaag, 2008). This is also not taking into account what impact on "pull factors" extra water availability in the recipient basins of China's North will have. In the USA and Mexico, the Nogales interbasin transfer has surface water transferred from the Los Alisos River basin in Mexico to the Santa Cruz River basin in the USA, and wastewater transferred back, with treatment plants on either side of the border. Continuous expansion and planning of this IBWT serves to maintain growth of the city of Nogales, which witnesses increased population growth via rural to urban migration (Prichard & Scott, 2014). Flows attributed to IBWT operation were found in Brazil, USA and Mexico, and were occurring in donor basins. The cases in Brazil, the Paraiba do Sul IBWT and the Sistema Cantareira project which serve the cities of Rio de Janeiro and Sao Paulo respectively, had the IBWTs become the principal water source that facilitated urban expansion over decades (de Andrade et al., 2011). Another dimension of migratory flows can be represented as community displacements caused by IBWT planning and operation. These are noted in 15 cases, found in Brazil, Turkey, China, India, the Chad lake basin, South Africa, Lesotho, Nepal and Mexico. In China (Deines et al., 2016; Rogers et al., 2016, 2020), the heightening of the donor basin's Danjiangkou reservoir and canal construction along transmitting basins in the South to North Water Transfer Project's Middle Route displaced 402,000 people. Another 880,000 people were resettled for poverty relief, disaster relief, and pollution control upstream of the Danjiangkou Reservoir in the donor basin. In the South to North Water Transfer Project's Eastern Route, 8,000 people were resettled along the transmitting basin. In

Dimension	Variable	Description
		Lesotho, the construction of the Lesotho Highlands Water Project which provides water to South Africa's economic heartland caused the forced displacement of villages in the donor basin's high valleys (Blanchon, 2015). One case in Mexico noted expected displacements linked to the loss of land due to construction of reservoirs for stage IV of the Cutzamala system, though social mobilization and political action by inhabitants in the donor basin were able to cancel this IBWT (Cabral & Ávila-García, 2013).
	Economic activities and agriculture and forestry	Economic activities are a reflection of water consumption. Nearly half of the cases describe economic activities in the basins prior to IBWT planning, independent of whether said activities were going to be benefitting or affected by an IBWT, with a majority of these activities being agricultural. A few cases reported on specific groups partaking in these activities, and were invariably farmers, peasants and irrigators. One case in Nepal, when describing the territories involved in the Melamchi Water Supply project, specified castes, ethnic groups and land-holding patterns in the donor basin, the Melamchi valley (Domènech, March, and Saurí 2013). After IBWT planning or operation, donor basin economic activities suffered reductions as a result of IBWT operation. In 4 cases in China and Turkey, industries were forced to cease operation and communities relocated in order to reduce polluting activities and maintain water quality to ensure water transfer. In Turkey, the Istanbul Greater Melen project requested dyeing activities in the Melen basin to cease (Islar and Boda 2014). In China, the construction of the South to North Water Transfer's Middle route has had economic activities curtailed in the region close to the Danjiangkou reservoir, the point where water is transferred from the donor basin. This has included factory closures, including turmeric processing facilities, as well as a curtailing on the use of chemical fertilizers (Rogers et al. 2020; Pohlner 2016). Recipient basins on the other hand saw an expansion of agricultural and industrial activities as well as of urban areas. Nonetheless two cases also pointed out livestock damage associated to IBWT operation in recipient basins. In Nogales, Mexico, livestock suffered damage due to wastewater infiltration in the water table, since this particular IBWT transfers wastewater for treatment at the recipient basin (Prichard and Scott 2014). In South Africa's Orange River Development Project, as seen earlier, the domination of particular pests in the recipient basin has also caused damage to livestock in the area (Gupta and van der Zaag 2008).
	Other extractive industries	Extractive industries are mentioned in 8 cases. These include coal and oil extraction, gold mining, sand extraction, and quarrying. These occur in three recipient basins, two transmitting basins, and one donor basin. Cases mentioned these activities in basins, but aside from a need for more, better quality water in South Africa to treat gold mining waste (Blanchon, 2015), extractive industries are not necessarily linked to IBT planning and operation.
	Water consumption	Water consumption is the driving force behind IBT planning and operation, and therefore 43 cases describe planned IBT water use. By comparison, actual IBT water use was reported by a far lesser amount, in 11 cases. Urban supply is the primary planned and actual use for water that justify IBTs. This category invariably serves as a blanket term, since urban areas represent a variety of uses, having industries, agricultural areas, and a need for drinking water too. In this respect, 17 of 23 cases describing planned water use for urban areas also included other uses, mainly water for industry. It reinforces the argument that IBTs mobilise water to serve economic heartlands which are invariably urban (Gupta & van der Zaag, 2008). Planned and actual water use reflect each other for industrial, irrigation and hydropower generation, though it falls significantly for purported drinking water use. A striking difference between planned and actual water use is that various categories. This is attributed to the fact that all these categories, aside from recreation, are cases of planned IBTs. Recreation emerged as a new water use in the Colorado-Big Thompson Project in the USA, after IBT operation. Similarly, of 11 cases that described planned and actual IBT water use, 4 show differences between planned and actual water use. 3 cases in the USA, Brazil and South Africa/Lesotho saw the number of use categories expand while one case in Australia saw number of categories shrink.
Governance	Allocation	There are myriad allocation processes that involve governmental organizations, RBOs or local irrigation associations, pointing to organizational as well as institutional diversity in how IBWT water is allocated. Allocation criteria in these processes also vary greatly. In Spain, the temporary Jucar to Amadorio and

Dimension	Variable	Description
		Algar transfer had allocation limited if drought conditions are present (Sanchis-Ibor et al., 2019), while in the Tajo-Segura Water Transfer Scheme authorization started by government decree, which then shifted to permit trading (Garrick et al., 2018). In China's South to North water transfer, the river basin commission in the donor basin proposes allocations, which are then used by recipient basin municipalities in their water use plans (Rogers et al., 2016). In Bolivia's Yungas de Vandiola Interbasin Irrigation Water Transfer Project, legal agreements are drawn between irrigation associations based on water availability (Lopez et al., 2019). In South Africa, both the Lesotho Highlands Water Project and the Orange River Development Project have authorizations determined by water availability and minimum environmental flows (Blanchon, 2017). In Tunisia, allocations are based on needs and the volumes available, with priority given to domestic needs in both local areas and in the south (Ben Fraj et al., 2019). Finally, in Brazil's Sistema Cantareira project, allocations are based on licenses (de Andrade et al., 2011). 4 cases describe changes in allocation processes since IBWTs went into operation, which included the emergence of river basin commissions, local organizations, and market mechanisms. In Brazil, river basin commissions emerged as the preferred route in both the Paraiba do Sul and the Sistema Cantareira project (de Andrade et al., 2011). In Bolivia's Yungas de Vandiola Interbasin Irrigation Water Transfer Project, it was through the emergence of irrigation associations from other catchment areas (Lopez et al., 2019). In Spain, it was market actors acting on the introduction of permit trading (Garrick et al., 2018).
	Monitoring	Monitoring measures inform technical guidelines and are supposed to support water governance in making decisions that have real world impacts. Who actually conducts monitoring is not always clear, but there is a mix between government agencies, RBOs and public/private partnerships. Within IBWT-related monitoring, the sources discussed monitoring in relation to water quality (particularly to detect contaminant levels), quantity, and in the case of Tunisia's Northern Water Master Plan, Ichkeul lagoon's salinity to determine its environmental state (Ben Fraj et al., 2019). Water quality issues were picked up by monitoring in donor basins, including high nitrogen levels in the Chaloos IBWT in Iran (Bozorg-Haddad et al., 2020), and pollutants from economic activities and settlements in both the East and Middle routes of China's South to North Water Transfer (Pohlner, 2016; Rogers et al., 2020). In recipient basins, water quality issues found included sewage concerns in the Paraiba do Sul IBWT in Brazil (de Andrade et al., 2011), phytoplankton in the Chaloos IBWT in Iran (Bozorg-Haddad et al., 2020), and pollution in the Beijing area where all routes of China's South to North Water Transfer ultimately reach (Rogers *et al.*, 2016). There are few examples of monitoring affecting IBWT operation, though examples given show that there can be institutional learning, or examples where problems are literally moved from one place to another. In Brazil, the Paraiba do Sul IBWT saw the emergence of mechanisms for conflict mediation for environmental impacts and shifts to deciding water availability during drought. These were seen as lessons learnt from previous experiences with IBWTs in Brazil (de Andrade et al., 2011). In the Miandoab to Tabriz IBWT in Iran, pollution was discharged into wetlands or the sea rather than into the donor basin (Bozorg-Haddad et al., 2020). In Tunisia, the Northern water master plan's IBWT passes through the Ichkeul Basin, which contains saline lagoons with high biodiversity. Here, concerns over the lagoon's salinity led to the construction of a sluice gate to regulate lagoon salinity. Nonetheless, this gate has only been used to regulate reservoir levels, never to respond to environmental issues (Ben Fraj et al., 2019). Monitoring has led to the introduction of policies and instruments to resolve negatively perceived alterations to ecosystems in 11 cases. These mechanisms range across a number of categories: guaranteed environmental flows, environmental impact assessments, market mechanisms, fiscal measures for municipalities, infrastructure, limitation of economic activities and relocation of settlements, and shifts of municipal water sources. Nonetheless, the only measure that reports to have had some level of success in limiting these alterations have been the limitation of economic activities and settlement relocations in China's South to North Water Transfer's Middle route (Pohlner, 2016). More often than not, alterations persist: sewage goes untreated in Brazil's Paraiba do Sul IBWT despite tariffs on users (de Andrade et al., 2011); The Ichkeul lagoon faces salinity crises due to infrastructure no longer functioning (Ben Fraj et al., 2019); groundwater is still

Dimension	Variable	Description
		contaminated despite no longer been abstracted in Spain's Jucar to Amadorio and Algar transfer (Sanchis-Ibor et al., 2019); despite industry closure in China's South to North Water Transfer's Middle route, there is saline intrusion and chlorination downstream in the donor Yangtze basin (Pohlner, 2016).
	Institutions	With the emergence of IWRM as the hegemonic set of principles to govern water in an equitable, efficient and environmental manner (Gupta & van der Zaag, 2008), RBOs are the type of organization to be expected to be present in IBWT governance in cases as of the 1990s to 2000s too, particularly to give voice to lower scale actors and territories. In this regard, only 11 cases explicitly identified RBOs present in cases where water is governed at the river basin level. 8 cases also informed whether RBOs appeared before or after an IBWT went into operation. Of these, 6 cases had RBOs appear before IBWTs went into effect, in Brazil (de Andrade et al., 2011), Spain (De Stefano & Hernández-Mora, 2018), France (Ruf, 2015), and the Congo Basin (Magrin, 2016). The RBOs in Brazil, Spain and France emerged out of a national requirement for these kinds of organizations to be present in water governance. In the case of the Congo Basin, the Lake Chad Basin Commission represents a basin management organization made up of national governments that share the basin (Magrin, 2016). The two cases that had RBOs appear after IBWTs went into effect were in Brazil's Sistema Cantareira project (de Andrade et al., 2011) and South Africa's Orange River Development Project (Bourblanc & Blanchon, 2014). Both of these cases are historical IBWTs that went into operation in the 1970s, and as such it is reasonable that RBOs appeared as water governance organizations when they became ubiquitous with IWRM.

Appendix 6 – Irrigation surface and modernized irrigation data

Table 6.1: Hectares (millions) of total cultivated surface (selected autonomous communities and national data) – 2002-2020

Geographic area	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Castilla-La Mancha	3.89	3.85	3.85	3.86	3.84	3.84	3.81	3.76	3.72	3.69	3.70	3.69	3.70	3.70	3.71	3.72	3.71	3.70	3.68
Madrid	0.20	0.20	0.20	0.20	0.19	0.21	0.20	0.21	0.21	0.21	0.20	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Extremadura	1.28	1.37	1.32	1.31	1.26	1.23	1.19	1.12	1.13	1.13	1.14	1.10	1.08	1.07	1.05	1.05	1.08	1.09	1.07
Murcia	0.48	0.48	0.48	0.48	0.47	0.48	0.48	0.47	0.47	0.47	0.47	0.48	0.48	0.48	0.47	0.48	0.47	0.47	0.47
Spain	17.97	17.88	17.61	17.64	17.47	17.58	17.57	17.32	17.20	17.10	17.08	16.98	16.98	16.98	16.99	17.00	17.01	16.99	16.93

Source: Encuesta sobre Superficies y Rendimientos de Cultivos – 2002-2020 (https://www.mapa.gob.es/es/estadistica/temas/estadisticas-agrarias/agricultura/esyrce/resultados-de-anos-anteriores/ accessed 18/08/2023)

Table 6.2: Hectares (millions) of irrigated cultivated surface (selected autonomous communities and national data) – 2002-2020

Geographic area	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Castilla-La Mancha	0.45	0.44	0.44	0.46	0.46	0.49	0.48	0.49	0.48	0.49	0.50	0.49	0.50	0.51	0.52	0.54	0.55	0.57	0.57
Madrid	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Extremadura	0.21	0.20	0.20	0.21	0.20	0.23	0.23	0.23	0.23	0.24	0.26	0.26	0.26	0.26	0.27	0.27	0.28	0.28	0.28
Murcia	0.17	0.18	0.18	0.18	0.17	0.17	0.17	0.17	0.16	0.18	0.17	0.18	0.18	0.18	0.19	0.19	0.19	0.19	0.18
Spain	3.35	3.32	3.28	3.33	3.28	3.36	3.37	3.42	3.41	3.47	3.52	3.54	3.61	3.64	3.66	3.73	3.77	3.83	3.83

Source: Encuesta sobre Superficies y Rendimientos de Cultivos – 2002-2020 (https://www.mapa.gob.es/es/estadistica/temas/estadisticas-agrarias/agricultura/esyrce/resultados-de-anos-anteriores/ accessed 18/08/2023)

Table 6.3: Proportion (%) of irrigated cultivated surface (ha) to total cultivated surface (ha) (selected autonomous communities and national data) – 2002-2020

Geographic area	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Castilla-La Mancha	11.5	11.4	11.5	11.8	12.0	12.8	12.7	13.0	12.9	13.2	13.4	13.4	13.6	13.8	14.0	14.5	14.9	15.4	15.5
Madrid	10.7	10.8	11.2	9.7	9.2	7.3	7.1	7.2	8.2	8.4	9.3	9.7	8.9	8.7	9.3	9.3	9.8	10.3	10.4
Extremadura	16.7	14.8	15.2	15.6	15.9	18.4	19.3	20.8	20.6	21.5	22.5	23.4	24.0	24.3	25.5	26.0	26.1	26.0	26.6
Murcia	35.7	36.5	38.3	37.1	35.2	34.8	35.2	35.6	34.8	37.5	36.8	37.7	38.7	38.3	39.6	39.8	40.0	40.0	35.7
Spain	18.7	18.6	18.6	18.8	18.8	19.1	19.2	19.8	19.8	20.3	20.6	20.8	21.2	21.4	21.5	22.0	22.2	22.5	18.7

Source: calculated from data in tables 6.1 and 6.2

Appendix 7 – Irrigated surface data

Table 7.1: Distribution of cultivated and irrigated surfaces (ha) by autonomous community (2021)

Autonomous community	Irrigated surface (ha)	Total cultivated surface (ha)	Geographic surface (ha)	Irrigated surface as proportion of total cultivated surface (%)	Irrigated surface as proportion of total geographic surface (%)
Galicia	16,985	358,247	2,957,751	4.74	0.57
Principado de Asturias	657	25,177	1,060,568	2.61	0.06
Cantabria	430	6,617	533,018	6.49	0.08
Pais Vasco	6,692	85,400	723,329	7.84	0.93
Navarra	101,565	324,815	1,039,077	31.27	9.77
La Rioja	47,465	158,759	504,559	29.90	9.41
Aragon	420,527	1,789,153	4,772,208	23.50	8.81
Cataluña	271,361	819,352	3,211,133	33.12	8.45
Baleares	21,522	160,659	499,170	13.40	4.31
Castilla y Leon	472,113	3,550,749	9,422,206	13.30	5.01
Madrid	22,079	208,750	802,749	10.58	2.75
Castilla-La Mancha	582,767	3,686,340	7,945,932	15.81	7.33
Comunidad Valenciana	290,711	635,126	2,326,341	45.77	12.50
Region de Murcia	183,477	468,151	1,131,615	39.19	16.21
Extremadura	290,586	1,052,867	4,163,543	27.60	6.98
Andalucia	1,123,547	3,528,451	8,759,857	31.84	12.83
Canarias	25,417	43,807	744,510	58.02	3.41
Spain	3,877,901	16902421	50,597,566	22.94	7.66

Source: Ministerio de Agricultura Pesca y Alimentación, 2021

Table 7.2: irrigated surface by type of irrigation system in Region de Murcia – 2011-2021

Irrigation system type	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Flood (ha)	35,422	32,313	28,907	29,503	29,166	30,513	28,716	25,784	26,086	24,141	24,602
Sprinkler (ha)	1,436	1,166	1,363	2,148	1,020	1,184	807	624	756	761	875
Centre pivot (ha)	87	-	-	4	4	15	15	17	17	17	17
Drip (ha)	140,762	140,921	149,772	152,919	152,546	155,973	159,899	163,603	159,929	154,735	157,983
Other systems (ha)	26		3								
Total (ha)	177,733	174,399	180,045	184,574	182,737	187,686	189,437	190,027	186,788	179,654	183,477
Flood as percentage of total hectares (%)	19.9%	18.5%	16.1%	16.0%	16.0%	16.3%	15.2%	13.6%	14.0%	13.4%	13.4%
Drip and sprinkler as percentage of total hectares (ha)	80.0%	81.5%	83.9%	84.0%	84.0%	83.7%	84.8%	86.4%	86.0%	86.6%	86.6%

Source: Ministerio de Agricultura Pesca y Alimentación, 2021

Table 7.3: irrigated surface by type of irrigation system in Castilla-La Mancha – 2011-2021

Irrigation system type	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Flood (ha)	21,239	24,587	23,478	28,170	29,902	23,536	25,308	23,313	27,195	27,775	27,092
Sprinkler (ha)	104,521	114,383	106,700	108,395	101,246	100,687	100,124	101,436	99,857	93,286	95,171
Centre pivot (ha)	89,086	87,304	89,461	83,835	80,285	84,837	85,051	82,400	83,588	82,693	78,868
Drip (ha)	271,195	270,806	273,662	284,041	298,458	309,234	329,770	346,820	357,225	368,526	381,636
Other systems (ha)	542	476									
Total (ha)	486,582	497,556	493,302	504,441	509,891	518,293	540,253	553,969	567,866	572,279	582,767
Flood as percentage of total hectares (%)	4.4%	4.9%	4.8%	5.6%	5.9%	4.5%	4.7%	4.2%	4.8%	4.9%	4.6%
Drip and sprinkler as percentage of total hectares (ha)	77.2%	77.4%	77.1%	77.8%	78.4%	79.1%	79.6%	80.9%	80.5%	80.7%	81.8%

Source: Ministerio de Agricultura Pesca y Alimentación, 2021

Table 7.4: irrigated surface by type of irrigation system in Extremadura – 2011-2021

Irrigation system type	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Flood (ha)	110,702	119,414	103,709	98,574	99,966	98,014	93,146	89,858	84,074	80,040	74,614
Sprinkler (ha)	26,305	28,364	30,555	31,099	26,492	28,312	26,746	25,011	25,987	25,315	23,366
Centre pivot (ha)	16,354	16,730	17,488	16,535	16,824	14,494	13,394	15,887	14,478	16,973	16,467
Drip (ha)	90,301	91,262	105,261	112,871	116,548	126,603	140,557	150,304	158,351	162,386	176,139
Other systems (ha)											
Total (ha)	243,662	255,769	257,013	259,080	259,831	267,423	273,843	281,059	282,890	284,715	290,586
Flood as percentage of total hectares (%)	45.4%	46.7%	40.4%	38.0%	38.5%	36.7%	34.0%	32.0%	29.7%	28.1%	25.7%
Drip and sprinkler as percentage of total hectares (ha)	47.9%	46.8%	52.8%	55.6%	55.1%	57.9%	61.1%	62.4%	65.2%	65.9%	68.7%

Source: Ministerio de Agricultura Pesca y Alimentación, 2021

Appendix 8 – Ideal regante policies and legislation 1866-2023

Historical period	Scale	*Regante* ideal
Regeneracionismo (1866-1938)	State	***Regante* ideal:** Regantes as petty-bourgeois, small scale, independent, democratic, modern, and competitive (Swyngedouw, 2015). Combination of expansive supply-side hydraulic policy to make water available for irrigation expansion, and internal colonization creating communities of smallholders with agricultural experience to create agricultural surplus. **Key legislation and policies** 1879 water law - Surface water under the public trust, provided through an administrative concessionary system. 1907 law for colonization and internal repopulation[34] - establishment and administration of colonies, possibility of break-up large agricultural properties. Beneficiaries would be "families of poor laborers and suitable for agricultural work"[35] 1911 large irrigation schemes law[36] - State-led large-scale hydraulic projects 1932 irrigation works law[37] - combined hydraulic and colonization policies, specified specific areas to be irrigated that could be served by large scale hydraulic works (Gómez Benito, 1994). Gave State authority to expropriate irrigable, obliging land to be irrigated by colonists (Ortega Cantero, 1984). 1936 National Plan for Hydraulic Works,[38] - reduce agricultural imports for internal consumption, and boost agricultural exports by further irrigation development. First proposal of IBWTs. National assessment of regional water availability and needs based on a unitary (national) hydraulic vision of integrated river basin management (Gómez Benito, 1994; Mateu González, 2002; Swyngedouw, 2015)
Early dictatorship (1939-1951)	State	***Regante* ideal:** Colonists were deemed peasants[39], though aimed to be modern food producers and serving as an example to large landowners to attract land sales and private investment in the new colonies and irrigation schemes (Barciela, 1996).

1. Ley de colonización y repoblación interior de 1907
2. Own translation: "Tienen derecho a los beneficios de esta ley las familias de labradores pobres y aptas para el trabajo agrícola." (Gaceta de Madrid 1907 Number 348 Tome IV pg.975)

36 Ley de Grandes Regadios de 1911

37 Ley de Obras de Puesta en Riego de 1932

38 Plan Nacional de Obras Hidráulicas de 1936

39 Own translation of campesino. The figure of campesino denotes the smallholder peasant farmer. As a social class in of itself the *campesinado*, or peasantry, was the subject of the Second Republic's agrarian reforms to have them and landless peasants own land, and by Francoist agricultural policies to provide them land without jeopardising the status and political will of large landowners who were the regime's supporters. See Roiz Célix, 1983, Congost, 2007 and Oliva & Camarero, 2001 for more information on the Spanish *campesinado*

Historical period	Scale	*Regante* ideal
		Key legislation and policies 1938 National Service of Economic and Social Land Reform[40]; 1940 land devolution law[41] - parcellation and concentration of the land of family holdings, rationalizing farming systems, instituting improvements, and irrigation expansion, though in practice undid expropriation of land occurring through the Second Republic's agrarian reforms. 1939 National Institute of Colonization[42] and 1939 Law of Principles for the Colonization of Large Areas[43] - Large-scale irrigation expansion, purchase land from private landowners for irrigation and colonization projects to increase food production and foster the settling of territories that were declared of the national interest. 1949 law on colonization and distribution of property in irrigable areas[44] - Encouraged landowners to pay for the installation of irrigation works through the sale of 'excess lands' to peasant colonists (Barciela, 1996).
Late dictatorship (1952-1977)	State	***Regante* ideal:** Continuation of the early dictatorship's ideal, with more expectations of knowledge transfer and professionalization vested through the agricultural extension services. Expansion of the number of colonists serving the ideal. **Key legislation and policies** 1953 law of manifestly improvable farms[45] - expanded irrigation in private holdings, catalogue of improvable agricultural exploitations that could lead to expropriation of private land. Creation of an agricultural extension service (Barciela, 1996). 1952 Badajoz plan; 1953 Jaen plan – construction of dams for water and hydroelectricity, networks of canals and irrigation ditches, and construction of colonies and small irrigation fields, using the excess land format of the 1949 law on colonization and distribution of property in irrigable areas. 1955 council of ministers approval of the construction of the TSA, construction did not start until 1968. 1959 establishment of water commissioners - under State control, administered the assignment and management of water concessions, their policing, and the allocation of irrigation water,

40 Servicio Nacional de Reforma Económica y Social de la Tierra de 1938

41 Ley de 23 de febrero de 1940 Sobre devolución a sus propietarios de las fincas ocupadas por el Instituto de Reforma Agraria con arreglo a las Leyes de 1932 y 1935

42 Instituto Nacional de Colonización

43 Ley de 1939 de Bases para la Colonización de Grandes Zonas

Ley de 21 de abril de 1949 sobre colonización y distribución de la propiedad en las zonas regables

45 Ley de 3 de diciembre de 1953 de fincas manifiestamente mejorables

Historical period	Scale	*Regante* ideal
		effectively directing RBAs (Swyngedouw, 2015). 1971 law on use of the TSA[46] - approved the transfer of water from one basin to another with water transfer limit fixed at 600hm^3 per year (Swyngedouw, 2015).
Democratic Restoration (1978-1998)		***Regante* ideal:** No explicit mention of a *regante* ideal, though farmer ideals are characterised. Emerging contradiction between EU and State policy envisioning farmers and their roles. EU begins with the professionalization of the figure of the farmer, which would receive CAP finance, including technical assistance and support, support to small firms, and rural tourism, as ways of reducing out-migration. Spanish legislation on water reinforces the rationality and scarcity view of water resource. Agricultural policy views traditional irrigation is irrational and wasteful, and identifies the contradiction of traditional agriculture as settling rural areas but changing it on competitivity principles requires modernization. By identifying the limits on competitivity, the ideal farmer (and *regante*) would have larger plots, be young, have access to land and the means of production, and access markets.
	EU	**Key legislation and policies** Council Regulation 2328 /91 of 15 July 1991 on improving the efficiency of agricultural structures - Professionalization of farmer emerges as a figure with definition of "farmer practising farming as his main occupation" [47] CAP financial instruments funding LEADER I (1991-1994) and LEADER II (1994-1999) programs. LEADER I funded technical support for existing activities, measures supporting small firms, and rural tourism as ways of diversifying farm activities to prevent out-migration and landscape management.[48]
	State	**Key legislation and policies** 1978 Spanish Constitution – competencies in hydraulic and agricultural policy between State and Autonomous Communities (regions) divided. River basin plans in interregional basins including actions on irrigation schemes and hydraulic works must include basic norms for irrigation improvements or transformations, and are limited to a proposal that is a better or more rational use of surface waters without invading competencies considered agricultural in nature (Ministerio de Medio Ambiente, 2000). 1985 Water law – Water considered "a scarce natural resource, indispensable for life, and for the exercise of the immense majority of economic activities."[49] Includes groundwater as part of public trust

Ley 21/1971, de 19 de junio, sobre el aprovechamiento conjunto Tajo-Segura.

[47] Council Regulation (EEC) No 2328 /91 of 15 July 1991 on improving the efficiency of agricultural structures pg. 8

[48] Official Journal C 73, 19.3.1991

[49] Own translation: "El agua es un recurso natural escaso, indispensable para la vida y para el ejercicio de la inmensa mayoría de las actividades económicas" (Boletín oficial del estado 189 ley 29/1985, de 2 de agosto, de Aguas, pg. 25123)

Historical period	Scale	*Regante* ideal
		(López-Gunn *et al.*, 2012). Governance of water between the State and regions through RBAs, distinguishing inter- and intraregional basins, and planning occurs through a recurring National Hydrological Plan, informed by River Basin Plans created by RBAs (Swyngedouw, 2015). Administrative concessions motivated and adopted in function of the public good, and are competitively decided with preference given "to those with the most rational use of water and a better protection of the environment."[50] The principle of rational use and water declared a scarce natural resource presupposes a preference for irrigation practices that prove to be more rational. 1993 Royal decree of public works to improve and modernize traditional irrigation schemes[51] – traditional water distribution infrastructure can be impermeabilized and rationalized to reduce water losses and would benefit society as a whole. Would lead to water price reduction for *regantes*, and involves *regantes*' own knowledge of territory. 1995 law on modernization of agrarian units[52] – Recognition that "the dominant agrarian model maintains the basic family farm model, which, even if it constitutes a guarantee for the colonization of territory and maintaining rural social fabric, it also implies the continuation of structural deficits that need correcting."[53], Solve issues linked to small farm size, ageing of agrarian populations, rigidity in land markets, limited flexibility in the means of production, and limited structuring of the sector and commercial organization by prioritizing specific farms to ensure their economic viability and justify the concession of policy support. Ageing farmers and small plot sizes identified as limiting agricultural modernization.
Democratic Regionalization (1999-2023)		**Regante ideal:** the ideal *regante* runs an economically efficient agri-enterprise with a modernized, water efficient irrigation system. The *regante* is most likely male, since it is only towards the end of the period that there are clauses pointing at directing support to disadvantaged groups, including women. He is preferably young, professional, and has the technical and general knowledge to work with increasingly complex and innovative irrigation distribution and on-plot application systems and technologies, and increasing protocols and requirements to be environmental stewards, and produce exporters. *Regantes* would also be the facilitators of economic change, job creators, and reinvigorating rural communities. The regional variants of the regante also emerge. The Murcian regante ideal is young, knowledgeable of various issues, incorporating multiple water sources for irrigation, and exporting produce outside of Spain. The

[50] Own translation: "aquellos que proyecten la más racional utilización del agua y una mejor protección de su entorno." (Boletín oficial del estado 189 ley 29/1985, de 2 de agosto, de Aguas, pg. 25130)

[51] Real Decreto 678/1993, de 7 de mayo, sobre obras para la mejora y modernización de los regadíos tradicionales.

Ley 19/1995, de 4 de Julio de Modernización de las Explotaciones Agrarias

[53] Own translation: "el modelo agrario dominante ha permanecido el carácter básicamente familiar de las explotaciones que, si bien constituye una garantía de colonización del territorio y de mantenimiento del tejido rural, también implica la pervivencia de deficiencias estructurales que es preciso corregir." (Ley 19/1995, de 4 de Julio de Modernización de las Explotaciones Agrarias pg. 4)

Historical period	Scale	*Regante* ideal
		Manchegan regante is modernized, saving water and aiding in the establishment of new irrigation schemes and gaining new technical knowledge.
	EU	2000 WFD CAP 2000-2006 funding period 2003 CAP reform CAP 2007-2013 funding period 2013 CAP reform CAP 2014-2020 funding period 2020 CAP reform negotiations
	State	1999 modification of the 1985 water law[54] - introduced government-supervised, market-based mechanisms to either temporarily or permanently reallocate water among users and sectors.[55] Allowed Tagus basin *regante*s to sell water to Segura basin *regantes* under drought conditions and with enabling legislation in place (Hernández-Mora *et al.*, 2014). The law also recognized the protection of the environment as an operational condition (López-Gunn *et al.*, 2012). 2000-2006 Regional Development Programme[56] - rationalize water resources, improving the viability of farms, and rejuvenating their ownership. Water management considered poor. Through the consolidation and expansion of irrigation schemes, introducing water saving technologies, and encouraging the entry of young entrepreneurs into irrigation, the policy expected water savings, a professionalization and technological innovation of farmers, and the encouragement of fixing populations and jobs in rural areas. 2001 White Book on Water – Ministry of Environment publication reinforced understandings of surplus and deficit river basins independent of socioeconomic, historical, geographical material realities that reinforce water demand and where scarcity is produced (Swyngedouw, 2015). 2001 National Hydrological Plan – announced Ebro river transfer to the Jucar and Segura basins and the Catalonia internal basins, which followed the logic encapsulated in the white book. 2002-2008 National Irrigation Plan – Irrigation in Spain required improvement, modernization and consolidation, particularly to achieve reductions in water use only in existing irrigation schemes. No expansion of irrigation proposed. Reconceptualizes irrigation farming as social and multifunctional – fixing rural populations, structuring territories, and maintaining rural spaces. The plan's objectives focus on increased labour productivity and farm revenue, territorial structuring to avoid population loss, water use reduction, rationalization and contamination reduction through modernization of distribution and on-plot irrigation systems, and the incorporation

Ley 46/1999, de 13 de diciembre, de modificación de la Ley 29/1985, de 2 de agosto, de Aguas

[55] Ley 46/1999, de 13 de diciembre, de modificación de la Ley 29/1985, de 2 de agosto, de Aguas, pg.43105

[56] Plan de Desarrollo Regional España

Historical period	Scale	*Regante* ideal
		of environmental criteria in irrigation water management systems. *Regantes* are expected to be co-responsible for policy implementation, to receive training alongside technicians on environmentally friendly and innovative irrigation systems and practices, increase labour productivity and engage with markets, become more competitive, and be environmental stewards. Through these actions water use would reduce while reinforcing *regantes*' competitiveness and become local job creators. Young farmers were expected to be able to take on these roles more than older generations. Described unwanted practices and territories, stating "it is unthinkable that the effort and sensibility of *regantes* in old irrigation communities or irrigable areas are sufficient to take on the modernization projects, without which the changes to the legal framework can be successfully applied"[57]. 2004 reform of the 2001 National Hydrological Plan – Cancelled the Ebro transfer, focused on the modernization of hydraulic infrastructure serving irrigation schemes in various recipient basins as urgent measure. 2005 AGUA programme – Develop desalination plants, particularly to guarantee water supply to TSA recipient basins. 2007-2013 National Strategic Plan for Rural Development – incorporated regional plans. Continuation on overall focus on irrigated farming. Sustainable irrigation was to be achieved through improvements to reduce water consumption and water distribution losses, with these improvements understood as optimizing water effectiveness and achieving technical and economic efficiency in on-plot water delivery and application. Identified traditional irrigation systems to be protected and supported as part of Plan's environmental objectives and in line with European directives.[58] Focus of training of farmers and on youth continued, and young farmers encouraged to become landowners through measure to encourage obtaining their first property. 2014-2022 National Rural Development Program – identifies two irrigation-related needs – irrigation system expansion and modernization. Expansion would only occur in areas declared of the general interest that have not yet gone through irrigation transformation. Modernization would occur through a variety of infrastructural improvements, while decisions made by individual regantes would include innovations in crop choices and cultivars, and technification of on-plot systems. The program also indicated that savings in water would lead to improved environmental conditions through increased ecological flows.
	Regions	**Castilla-La Mancha** 2007-2015 rural development program – Principal aim to reduce water consumption. focuses on irrigation modernization to reduce water consumption and the contamination of soil and aquifers, in line with the WFD, though measures to be financed are at the level of delivery systems, not on-plot modernization.

3. Own translation (Plan Nacional de Regadios Horizonte 2002-2008 pg.8)
4. Plan Estrategico Nacional de Desarrollo Rural 2007-2013 pg. 110

Historical period	Scale	*Regante* ideal
		2014-2022 rural development program – focuses on irrigation system modernization, water savings, and the achievement of good status of water bodies (both surface and underground waters). Proposes establishing new schemes by reorganizing water concessions in basins where water savings have been achieved or in areas where aquifers are considered lower than good quality. Investments include on-plot improvements in drip or sprinkler irrigation. Regantes expected to engage in hands-on training, irrigation communities are expected to have technicians who are to be trained, and in newly irrigated areas the role of the regante will be to raise incomes, attract population, and create jobs.
		Murcia 2007-2015 rural development program – include support for on-plot modernization, and aims at a total rationalization of hydrological systems, including from new sources such as desalination and treated wastewater. The program foresaw training of *regantes* to introduce new water-saving practices and technologies, to market their products to the EU, on mechanization and pest control, among others. The modernizing push would ideally be led by young farmers.
		2007-2015 rural development program – identifies various needs in the irrigation sector, including, innovation and links strengthening amongst stakeholders, training in areas outside of technical knowledge (such as administrative procedures, environmental knowledge), the modernization and restructuring of farms, encouraging generational transition of farms, improved efficiency in water use and reduce uncertainty in its provision, and creating employment in rural areas. prioritizes training, qualification and rejuvenation of the professional farmer, maximum efficiency in resource use, and increasing the economic efficiency of farms. Measures within these priorities continue to be irrigation modernization and investments that create water storage and distribution. Water savings measures would also include knowledge transfer focusing on drought resistant cultivars, environmentally friendly agricultural practices, and climate change mitigation and adaptation.