Universidade de São Paulo
Faculdade de Saúde Pública

Nexos de sustentabilidade e intersetorialidade: políticas públicas em periferias urbanas

Alberto Matenhauer Urbinatti

Tese apresentada ao Programa de Pós-Graduação em Saúde Pública para obtenção do título de Doutor em Ciências:

Área de Concentração: Saúde Pública
Orientador: Prof. Dr. Leandro Luiz Giatti

São Paulo
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Aprovado em:

Banca Examinadora

Prof. Dr._____
Instituição: _____
Julgamento: _____

Prof. Dr._____
Instituição: _____
Julgamento: _____

Prof. Dr._____
Instituição: _____
Julgamento: _____

DEDICATÓRIA

Aos meus pais, meu irmão e minha companheira por todo o suporte emocional. Também a todas as pessoas envolvidas no Programa Saúde da Família no Brasil e, especialmente, nos locais aqui estudados.

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SOBRE O AUTOR

Nasci em Jundiaí, no interior de São Paulo, onde vivi toda a minha infância, adolescência e início da vida adulta. Uma cidade em que pude vivenciar intensamente o cenário político e cultural ao entrar como voluntário, aos 16 anos, no Movimento Voto Consciente Jundiaí e no Cineclube Consciência. Fiz muitos amigos e aprendi sobre pensar e atuar de forma coletiva.

Sou filho de biólogos, ambos funcionários públicos, o que com certeza foi a minha grande inspiração e incentivo para seguir carreira dentro da universidade pública. Aos 17 anos entrei no curso de Ciências Sociais na Universidade Estadual de Campinas (Unicamp), onde pude iniciar minha carreira de pesquisador como bolsista de iniciação científica durante dois anos, sob orientação da Prof. Leila da Costa Ferreira (Instituto de Filosofia e Ciências Humanas/Núcleo de Estudos e Pesquisas Ambientais). Terminei a graduação em junho de 2013, recebendo o título de bacharel em Sociologia.

Ingressei no mestrado em Sociologia em 2014, também orientado pela Prof. Leila da Costa Ferreira no Instituto de Filosofia e Ciências Humanas da Unicamp. Integrei o projeto Fapesp que a professora coordenou sobre mudanças climáticas no Brasil e na China. Mais especificamente, estudei políticas climáticas no município de São Paulo em referência ao caso de Pequim, na China.

Em 2015, fui selecionado pelo Instituto Confúcio da Unicamp para passar aproximadamente um mês na China, como forma de aprofundamento no estudo do idioma mandarim e na cultura chinesa de forma geral. Olhar com distanciamento para situações do passado nos fazem criar, muitas vezes, narrativas lineares das nossas escolhas. Apesar de ter essa consciência, acredito que essa viagem mudou bastante a maneira como entendia a relação do homem com o ambiente. Foi nesse sentido, depois de quase um mês vivenciando a poluição atmosférica de Pequim em seus altíssimos níveis, que decidi seguir a minha carreira na área dos estudos ambientais dando enfoque à saúde pública.

Finalmente, ingressei no doutorado no ano de 2016, sob orientação do Prof. Leandro Giatti, do Departamento de Saúde Ambiental (FSP/USP). Desde então, pudemos fazer pesquisas em contextos urbanos periféricos e vulneráveis, buscando compreender e aprender sobre o que pode ser a “sustentabilidade” nesses locais.

EPÍGRAFE

"O morro não tem vez
Mas se derem vez ao morro
Toda a cidade vai cantar"
(JOBIM; MORAES, 1963)

"Um bom lugar
Se constrói com humildade,
É bom lembrar [...]"
(SABOTAGE, 2000)

RESUMO

URBINATTI, Alberto Matenhauer. "Nexos de sustentabilidade e intersetorialidade: políticas públicas em periferias urbanas". **[tese de doutorado]. São Paulo, Faculdade de Saúde Pública, Universidade de São Paulo**, 2020.

A abordagem do nexo água-energia-alimentos tem ganhado bastante destaque nos últimos anos como sendo uma categoria teórica para pensar temas relacionados à sustentabilidade em processos de governança. Este estudo busca compreender a abordagem do nexo de forma crítica, como um caminho teórico para pensar a sustentabilidade e auxiliar na identificação de práticas intersetoriais na governança da saúde, frente aos desafios ambientais em contextos urbanos periféricos da Região Metropolitana de São Paulo. Para esta finalidade, primeiro foram revisados conceitos de "governança do nexo"; depois, elaborou-se um enquadramento conceitual de "nexos de humildade", que a partir dos pilares de enquadramento, vulnerabilidade, distribuição e aprendizagem, busca reconhecer a natureza híbrida e plural da intersetorialidade na governança; e, por fim, sob esta lente, foram analisados dois programas municipais de saúde alinhados com o Programa Saúde da Família, e com diretrizes socioambientais. São eles: o Programa Ambientes Verdes e Saudáveis, em São Paulo, e o Programa Ambienta Saúde, em Guarulhos. As conclusões do estudo sugerem que inúmeras narrativas convergentes com o nexo vêm sendo desenvolvidas em contextos periféricos por meio desses programas de saúde, em agendas intersetoriais que englobam os temas da água, energia, alimentos e meio ambiente. As interações entre diferentes atores dentro desses programas, mas especialmente os agentes comunitários de saúde e agentes de promoção ambiental, vêm buscando estimular práticas cotidianas sustentáveis do ponto de vista dos recursos nessas populações locais. As narrativas plurais convergentes com o nexo possibilitam contestar a normatividade da abordagem como uma categoria teórica universalmente aplicável. Assim, apontam para formas de repensá-la a partir do chamado "Sul" global, com base no envolvimento de diferentes saberes no fazer científico e no desenvolvimento de políticas públicas, buscando transformações sustentáveis no horizonte.

Palavras-chave: governança sustentável; políticas públicas; saúde ambiental, nexo água-energia-alimento; Região Metropolitana de São Paulo.

ABSTRACT

URBINATTI, Alberto Matenhauer. "Nexus of sustainability and intersectoriality: public policies in urban peripheries". **[doctoral thesis]. São Paulo, Faculty of Public Health, University of São Paulo**, 2020.

The water-energy-food nexus approach has gained considerable prominence in recent years as a theoretical category for addressing sustainability issues in governance processes. This study seeks to understand the nexus approach critically as a theoretical way to think about sustainability. Likewise, as a way to assist in the identification of intersectorial practices in health governance in peripheral urban contexts of the São Paulo Metropolitan Region. For this purpose, first, concepts of "nexus governance" were reviewed; then, a conceptual framework of "nexus of humility" was elaborated, which from the pillars of framing, vulnerability, distribution and learning seeks to acknowledge the hybrid and plural nature of intersectoriality in governance; and, finally, under this framework, two municipal programmes with social and environmental guidelines, and aligned with the Family Health Programme, were analysed. They are: the Green and Healthy Environments Programme, in São Paulo, and the Environment Health Programme, in Guarulhos. The conclusions suggest that several narratives converging with the nexus have been developed in peripheral contexts through these health programmes in intersectorial agendas that encompass water, energy, food and environment issues. The interactions between different actors within these programmes, especially community health workers and environmental promotion workers, have sought to stimulate resource-sustainable day-to-day practices in local populations. The plural narratives converging with the nexus provide an opportunity to contest the normativeness of the approach as a universally applicable theoretical category. Thus, they indicate ways to rethink it also from the so-called Global "South", based on the involvement of different knowledges in the scientific making and development of public policies in the search for sustainable transformations on the horizon.

Keywords: sustainability governance; public policies; environmental health, water-energy-food nexus; São Paulo Metropolitan Region.

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ABREVIATURAS

ACS: Agentes Comunitárias (os) de Saúde

APA: Agentes de Promoção Ambiental

ARS: Análise de Redes Sociais

BHU: *Basic Health Unit*

CHW: *Community Health Workers*

CLD: *Causal Loop Diagrams*

CPS: Caminhos Para a Sustentabilidade

CPTM: Companhia Paulista de Trens Metropolitanos

DA: *Discourse Analysis*

DAIS: Departamento de Assistência Integral à Saúde de Guarulhos

DSS: Determinantes Sociais de Saúde

EMPLASA: Empresa Paulista de Planejamento Metropolitano S/A

ENA: *Egonetwork Analysis*

EPW: *Environmental Promotion Workers*

ESCT: Estudos Sociais da Ciência e Tecnologia

EHP: *Environment and Health Programme*

GHEP: *Green and Healthy Environments Programme*

MMP: Macrometrópole Paulista

NGO: *Non-Governmental Organisations*

ODS: Objetivos do Desenvolvimento Sustentável

PAS: Programa Ambienta Saúde

PAVS: Programa Ambientes Verdes e Saudáveis

PNUMA: Programa das Nações Unidas para o Meio Ambiente

PSF: Programa Saúde da Família

PTS: *Pathways to Sustainability*

ResNexus: *Resilience and Vulnerability at the Urban Nexus of Food, Water, Energy and the Environment*

RSL: Revisão Sistemática de Literatura

Sabesp: Companhia de Saneamento Básico do Estado de São Paulo

SDG: *Sustainable Development Goals*

SLR: Systematic Literature Review

SMADS - Secretaria Municipal de Assistência e Desenvolvimento Social de São Paulo

SMSG: Secretaria Municipal de Saúde de Guarulhos

SMSSP: Secretaria Municipal de Saúde de São Paulo

SNA: *Social Network Analysis*

SocNetV: *Social Network Visualizer*

SVMA: Secretaria Municipal do Verde e Meio Ambiente de São Paulo

STS: *Science and Technology Studies*

SUS: Sistema Único de Saúde

UBS: Unidade Básica de Saúde

WEF: *Water, Energy and Food*

APRESENTAÇÃO

Esta tese foi organizada segundo as normas e diretrizes do Programa de Pós-Graduação em Saúde Pública, da Faculdade de Saúde Pública da Universidade de São Paulo para a apresentação de teses em formato de artigos, que exigem no mínimo três manuscritos (artigo, livro ou capítulo de livro) resultantes da pesquisa de doutorado, sendo que um deles deve estar pronto para futura submissão após o término da tese. Os demais podem ter sido submetidos ou publicados em periódico ou livro arbitrado por pares.

No tópico 1, o documento apresenta uma introdução que correlaciona os temas pesquisados. Primeiramente, foram caracterizados os desafios da governança ambiental em contextos urbanos. Em seguida, apresentamos o conceito de nexo água-energia-alimento, bem como a chamada "governança do nexo". Depois apresentamos a abordagem de caminhos para a Sustentabilidade como uma espécie de conceito guarda-chuva que reúne elementos para englobar a governança ambiental e a governança do nexo, considerando a importância de uma governança democrática da própria ciência em conjunto com as políticas públicas e a sociedade. Finalmente, apresentamos brevemente características da governança da saúde no Brasil, a partir dos princípios e valores do Sistema Único de Saúde (SUS), do Programa Saúde da Família (PSF), como parte da Atenção Primária à Saúde, e as dois programas municipais de que englobam diretrizes socioambientais. Ao longo da tese vamos mostrar como estes programas são amigáveis ao conceito de nexo água-energia-alimentos. São eles: o Programa Ambientes Verdes e Saudáveis (PAVS) em São Paulo e o Programa Ambienta Saúde (PAS) em Guarulhos. O tópico 1 termina com a apresentação das regiões de estudo.

No tópico 2 são apresentados o objetivo geral e os objetivos específicos desta pesquisa. Em seguida, o tópico 3 mostra a metodologia utilizada em cada um dos artigos apresentados. É importante destacar que o desafio ao traduzir discussões do chamado "Norte" global para o caso brasileiro foram conscientes ao longo da pesquisa. Para o caso do segundo artigo, buscou-se não centralizar o debate no Brasil, mas propor ideias mais abertas que pudessem ser transformadas e adaptadas, primeiramente, para o próprio debate do nexo e, além disso, mediante o contexto de análise. Para o caso do terceiro artigo, as abordagens consideradas foram também, de alguma forma, transformadas e adaptadas quando relacionadas com os estudos de caso.

No tópico 4 estão colocados os resultados da pesquisa a partir dos três artigos científicos produzidos durante o período. O primeiro deles, intitulado “The conceptual basis of water-energy-food nexus governance: systematic literature review using network and discourse analysis”, foi publicado em open access pelo periódico internacional Journal of Integrative Environmental Sciences. O segundo, intitulado “‘Opening up’ the governance of water-energy-food nexus: Towards a science-policy-society interface based on hybridity and humility”, foi publicado no periódico Science of The Total Environment. O terceiro é o artigo “’Nexus’ narratives in urban vulnerable contexts: Pathways to Sustainability via municipal health programmes”, que atende às normas da Pós-Graduação, não sendo submetido a nenhum periódico e apresentado para avaliação da banca de defesa.

No tópico 5, estão as conclusões. Foi buscado ali correlacionar os resultados obtidos, criando um percurso coerente e conectado entre os três artigos. Por fim, seguem as referências, anexos e apêndices que julgamos relevantes.

1. INTRODUÇÃO

1.1. GOVERNANÇA AMBIENTAL EM CONTEXTO URBANO

Esta tese se inicia com o tema da governança ambiental em contextos urbanos, devido ao enorme desafio que é pensar caminhos em direção à sustentabilidade ambiental, econômica e social em uma região metropolitana como a de São Paulo. As buscas por definições contundentes de governança contribuíram para que o termo se tornasse polissêmico. Muitas vezes ele tem sido usado por modismo, significando um enquadramento, conceito descritivo, conceito fetiche, campo, abordagem, teoria, perspectiva, entre tantos outros (LEVI-FAUR, 2011).

Principalmente por considerar aspectos políticos e econômicos, o termo governança foi se descolando daquilo que poderia ser considerado como "governo" para os cientistas políticos mais clássicos, que se centrou no papel do Estado e suas burocracias. Governança, desta forma, passou a ser relacionada com aquilo que seria o envolvimento de outros entes não-estatais (JACOBI; SINISGALLI, 2012). De todo modo, é preciso que seja considerada a não linearidade tanto de "governo" como de "governança", pois, se analisados como sendo processos, sempre estarão incompletos pelo fato de as sociedades urbanas serem governadas de formas diferentes e em períodos diferentes (LE GALÈS, 2011). Em última instância, Le Galès (Ibidem) nos informa que entender esse processo é se perguntar: quem governa o quê e como governa? É por isso que não é tarefa simples definir claramente os limites entre os dois termos.

O debate sobre a governança na América Latina e no Brasil assumiu características próprias. Como mostrou Marques (2013), nos anos de 1990 as definições do termo estiveram associadas com a administração pública, a redução do Estado e a integração de atores privados. O Estado, nesse caso, foi considerado sob perspectivas negativas, na medida em que suas ineficiências foram colocadas em comparação com a "eficácia" da concorrência imposta pelos setores privados e a própria inclusão desses setores em agências dos governos. Ainda segundo Marques (Ibidem), uma segunda onda de definições buscou associar governança com democracia e participação social, devido aos recém-criados conselhos, iniciativas de orçamento participativo e conferências nacionais, ampliando os espaços de participação social no período de redemocratização do país. Pode-se dizer que o termo assumiu uma certa ideia de "poder local". Em suma, pode-se dividir estes dois movimentos da governança urbana no Brasil entre um modelo mais gerencial da administração pública, inspirado em práticas das empresas

privadas, e um modelo mais democrático-participativo, que se baseia no controle social e na democratização das relações entre Estado e sociedade a partir de mecanismos de participação social (FREY, 2012).

Nesse contexto, Marques (2013) chama a atenção para aquilo que deveria ser evitado na definição de governança, o que o autor atribui como sendo "ficções" sobre o tema. Primeiro, a governança como alternativa para o governo; segundo, a governança como sendo necessariamente positiva; terceiro, a governança fazendo desaparecer hierarquias; quarto, a governança significando necessariamente mais democracia; quinto, a governança como eficiência ou capacidade; sexto, a governança envolvendo dimensões prescritivas ou normativas; e sétimo, a governança envolvendo a ideia de "melhores práticas". Tendo colocado de maneira transparente essas associações a serem evitadas, a definição mais geral que o autor sugere é a de "um conjunto de atores estatais e não estatais interconectados por laços formais e informais que operam no processo de decisão política e envoltos em contextos institucionais específicos" (p. 16-17). Este processo evidencia certos padrões de governança, que são definidos pelas próprias burocracias e agências estatais do governo, pelos políticos e seus partidos, pelas companhias privadas de um determinado local e pelos movimentos sociais.

Retomando os termos "laços formais e informais", a definição nos parece bastante acertada para pensar a dinâmica no contexto brasileiro, visto que muitos processos de negociação não acontecem de forma transparente na burocracia estatal do país. Estas negociações ficam evidentes, por exemplo, na governança das questões ambientais no país e, particularmente, em grandes contextos urbanos. A definição de governança ambiental sugerida por Castro et al. (2011, p. 02) compreende "práticas formais e informais do uso e manejo de recursos naturais renováveis e não-renováveis e suas implicações transfronteiriças". Isto quer dizer que existem dimensões multi-escalares para o uso e o manejo de recursos, tanto em relação aos aspectos ambientais, sociais, econômicos e políticos, quanto em relação às esferas locais, regionais e globais. O que vem sendo chamado de governança do nexo água-energia-alimentos tem exatamente essas características, como abordaremos no próximo tópico.

Outro termo associado ao debate da governança ambiental é o de governança "sustentável" ou governança para o desenvolvimento sustentável. De acordo com Moura e Bezerra (2016), esta governança promotora do desenvolvimento sustentável pode ser entendida como "a capacidade de inserção da ideia de sustentabilidade no conjunto das políticas públicas e em suas inter-relações" (p. 91). Contudo, as autoras evidenciam que a visão setorial dominou historicamente o ambientalismo no Brasil e culminou em um distanciamento da implementação

dos instrumentos da política ambiental em relação às demais políticas públicas. A intersetorialidade aparece como um tema central para a governança ambiental, ao pressupor que práticas cooperativas são capazes de alterar comportamentos e responsabilidades socioambientais (SANTOS et al., 2017).

A definição de intersetorialidade sugerida por Akerman et al. (2014, p. 4294), ou intersetorialidades, busca responder às seguintes perguntas: "o que", "como", "com quem" e "para que":

> Este caminho poderia redundar num possível conceito operacional em que intersetorialidade seria definida como um modo de gestão (o que) desenvolvido por meio de processo sistemático de (como) articulação, planejamento e cooperação entre os distintos (com quem) setores da sociedade e entre as diversas políticas públicas para atuar sobre (para que) os determinantes sociais.

No entanto, como mostram os autores, faltam aportes teóricos mais claros para firmarem o termo como categoria de pesquisa e avaliação. Não obstante, os autores sugerem que na própria governança a intersorialidade é vista mais como experiência do que práxis. A intersetorialidade é uma questão central para a abordagem do nexo água-energia-alimentos e para as políticas públicas de saúde, temas que serão desenvolvidos nesta tese; contudo, como mostraremos mais a frente, a atribuição de certa normatividade, ou positividade, a processos cooperativos de integração de diferentes setores precisa ser vista com cautela.

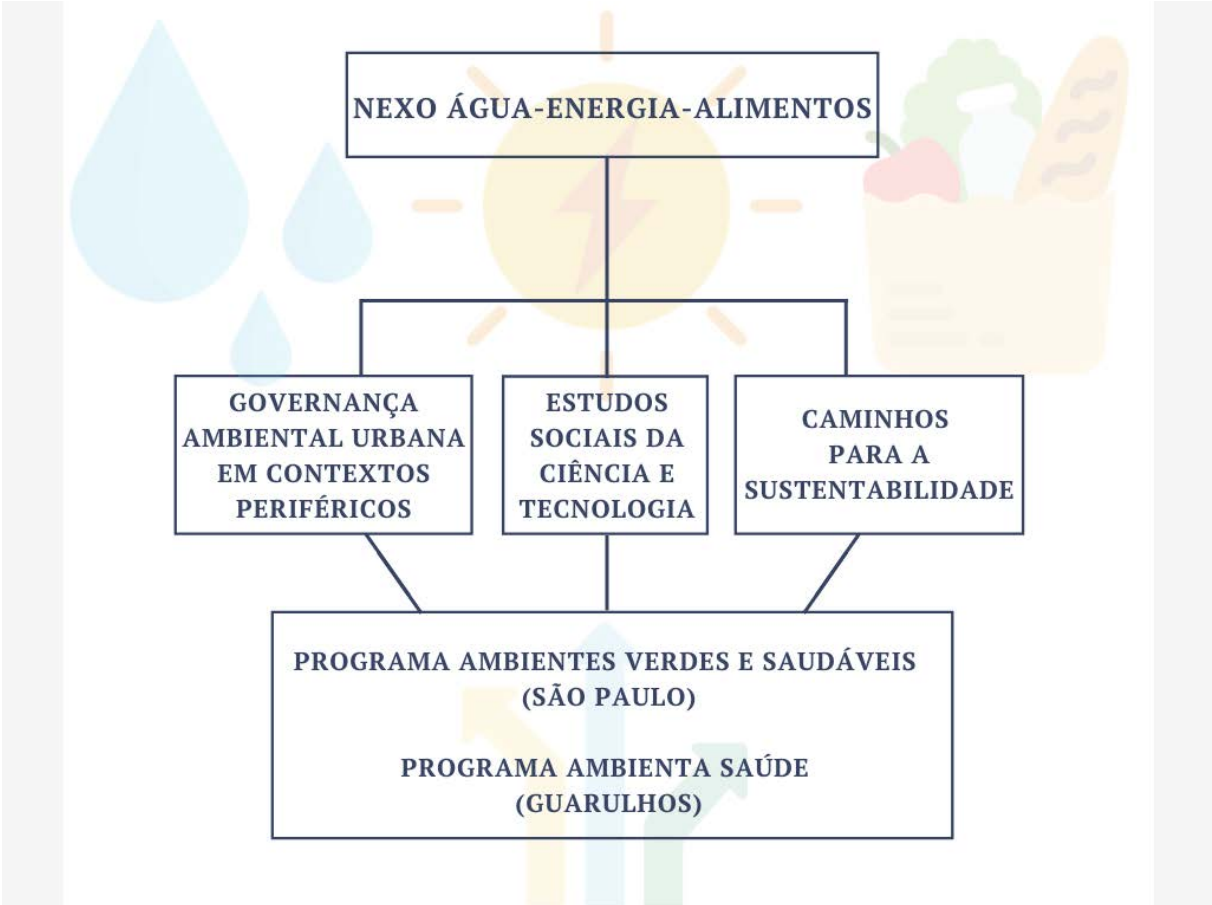
Prosseguindo na contextualização da governança ambiental, é importante compreendê-la não somente como uma construção ideológica, mas como um conjunto de práticas que estão inter-relacionadas com o Estado, a sociedade civil, os mercados e o ambiente (BARROS, 2019). Pode-se dizer que a dimensão ideológica está associada com a busca por modos não hierárquicos de governo, no qual diversos segmentos da sociedade participam da formulação e implementação de políticas públicas (RHODES, 1997; JACOBI; SINISGALLI, 2012). Isto tem relação com o termo "capacidade governativa", proposto por Santos (1997), a fim de considerar não só a capacidade de um determinado sistema político para identificar problemas da sociedade e formular soluções através das políticas públicas, mas também para identificar processos de decisão que se mantém em ambientes mais ou menos democráticos no Brasil.

Quando pensada em contextos urbanos, particularmente em regiões metropolitanas, a governança ambiental é caracterizada por problemas ambientais decorrentes da concentração urbana, intensa desigualdade social e seus impactos para população, o que nos permitiria chamá-las de "métropoles insustentáveis" (JACOBI, 2013). A grave fragmentação e inércia nos

processos políticos brasileiros ressoam com os interesses arraigados em torno de infraestruturas já estabelecidas, atrasando ainda mais a implementação de transformações sociais e tecnológicas que prometem ambientes mais sustentáveis do ponto de vista econômico, ambiental e social (URBINATTI; FERREIRA, 2019). Essas transformações envolvem assimetrias de poder entre grupos com interesses diversos, o que tornaria o processo de governança urbana permeado por questões de injustiça e de conflitos ambientais (TORRES et al., 2019).

As questões aqui abordadas são importantes panoramas sobre como a abordagem do nexo água-energia-alimentos chega ao contexto brasileiro e se correlaciona com debates anteriores e já mais consolidados. Isto vale também para a perspectiva de governança a partir da abordagem de caminhos para a Sustentabilidade que será discutida nos tópicos seguintes. Para tornar mais transparentes as escolhas teóricas e conceituais que os três artigos vão abordar ao longo da tese, a **Figura 1** esboça um mapa conceitual desta pesquisa.

Figura 1: Mapa conceitual da tese



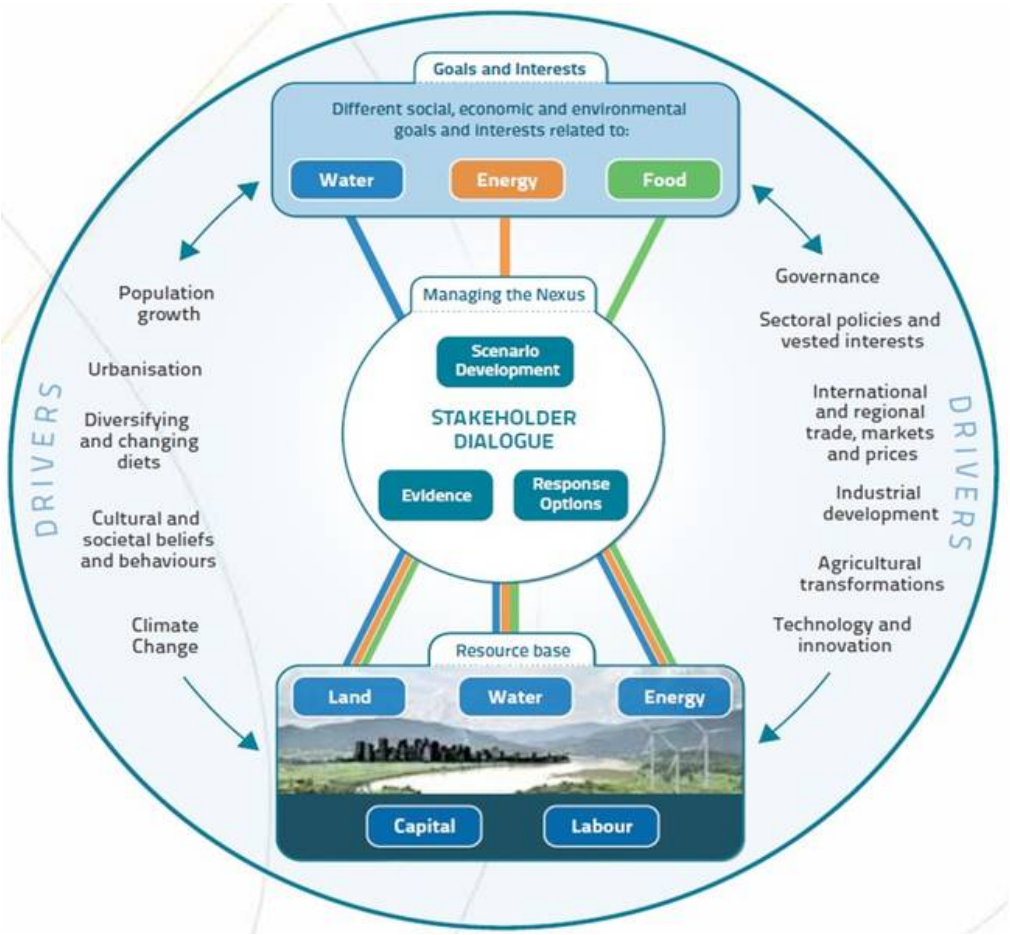
Fonte: elaboração própria.

1.2. A ABORDAGEM DO NEXO ÁGUA-ENERGIA-ALIMENTO

Em um cenário de acentuação das mudanças ambientais globais, e entre elas as mudanças no clima, o debate sobre a crise planetária por conta da escassez e má distribuição de recursos tem papel central. É nesse contexto que múltiplas respostas têm entrado em debate nos últimos anos. Uma delas é a chamada racionalidade do nexo (*nexus thinking*), que é a base constitutiva da abordagem do nexo água-energia-alimentos – ou simplesmente "nexo" (HOFF, 2011; GIATTI et al., 2016). O termo ganhou relevância a partir da Conferência de Bonn, em 2011, com o objetivo de reforçar a integração e o acesso universal aos recursos básicos como pilares essenciais para a prosperidade, a segurança e a equidade do planeta (BAZILIAN et al., 2011).

O nexo pode ser definido como uma perspectiva baseada em sistemas que engloba de maneira interligada e interdependente os sistemas hídricos, energéticos e alimentares (ALBRECHT; CROOTOF; SCOTT, 2018). Stringer et al. (2014) mostram de maneira bastante clara essas cadeias de interação ao dizer que a água é necessária para a geração de energia, enquanto a energia é necessária tanto para o fornecimento de água como para a produção de alimentos. Os alimentos podem ser usados para produzir energia e a água é necessária para cultivar alimentos, estes que carregam água (virtual) geralmente através do uso de energia. Nota-se, assim, que um problema em uma dessas interações é capaz de gerar outros problemas em escala (HUSSEY; PITTOCK, 2012). A **Figura 2** ilustra essas interações dinâmicas em torno dos recursos.

Figura 2: O nexo água-energia-alimentos e suas inter-relações



Fonte: FAO, 2014.

Podem ser traçadas associações com abordagens anteriores mais amplamente debatidas, tais como economia verde (JACOBI; SINISGALLI, 2012) e modernização ecológica (BRIANEZI; SORRENTINO, 2012). Dentre essas associações estão o investimento na conservação dos serviços ecossistêmicos, a criação de "mais com menos" e a aceleração da inclusão de grupos mais pobres e excluídos que, em muitos casos, ainda não têm acesso a serviços qualificados (BAZILIAN et al., 2011; HOFF, 2011; ALLOUCHE et al., 2015). Como mostra Kjellstrom et al. (2007), água potável e saneamento adequado são fundamentais para equidade sanitária em áreas urbanas carentes, assim como o acesso à energia nos domicílios é uma questão de saúde ambiental por conta de efeitos nocivos, por exemplo, para as muitas famílias que ainda utilizam carvão para cozinhar.

Nesse sentido, há uma evidente relação entre "o nexo" e a saúde pública. Esta relação engloba pretensões mais amplas de buscar respostas para as questões globais associadas à fome, à universalização do acesso à energia e água potável, se aproximando com os Objetivos do

Desenvolvimento Sustentável (ODS) (BIGGS et al., 2015; BIEBER et al., 2018). Principalmente o ODS 1 (erradicação da pobreza), ODS 2 (fome zero e agricultura sustentável), ODS 6 (água potável e saneamento), ODS 7 (energia limpa e acessível) e ODS 12 (consumo e produção responsáveis) (RASUL, 2016). Estes objetivos são cruciais para os países em desenvolvimento e recebem atenção especial em ambientes urbanos.

É neste escopo, portanto, que o nexo assume uma atenção para a "saúde urbana" (CAIAFFA et al., 2008), podendo ser tratado como nexo água-energia-alimentos-saúde (MILLER-ROBBIE et al., 2017) ou nexo água-alimentos-nutrição-saúde (MABHAUDHI et al., 2016). A vasta literatura sobre os determinantes sociais de saúde (DSS) traz de diferentes maneiras correlações como estas, considerando as condições de vida e a relação com os recursos no meio ambiente. Por exemplo, os modelos conhecidos como de *Dahlgren e Whitehead*, que propõe diferentes camadas de determinantes como acesso à educação, alimentos saudáveis, água e esgoto, ou de *Diderichsen e Hallqvist*, que considera a posição social do indivíduo como mais ou menos expostos a riscos que causam danos à saúde (BUSS; PELLEGRINI FILHO, 2007). Destarte, esforços sustentáveis que visam a promoção da saúde, com atenção especial às iniquidades e desigualdades na exposição aos riscos ambientais, requerem planejamento de recursos necessários para dar suporte a essas iniciativas (SCHULZ; NORTHRIDGE, 2004). Colocadas sob as lentes do nexo, a gestão dessas alternativas depende de escolhas tecnológicas, disponibilidade de recursos e fatores de mercado (SHANNAK et al., 2018).

Dois aspectos contrastantes aparecem em processos de governança em direção a um possível "nexo". O primeiro deles são os *trade-offs*, que podem ser entendidos como soluções de um setor que geram consequências para outros setores. O segundo diz respeito às sinergias, isto é, situações que geram trocas positivas para diferentes setores. Segundo Kurian et al. (2018), se por um lado a análise dos *trade-offs* tem o potencial de revelar quais as prioridades em um processo de governança e informar as normas de equidade definidas localmente nas intervenções, por outro, compreender as sinergias pode determinar o progresso na garantia de um equilíbrio e mitigação de possíveis efeitos reversos em planejamento e gestão ambiental. Em última análise, os dois aspectos envolvem negociações (KURIAN, 2017).

Esses aspectos que dizem respeito à intersetorialidade vêm sendo discutidos a partir da dissolução dos "silos"[1] (ARTIOLI et al., 2017). A dissolução pode ser entendida como uma forma de buscar abrir as caixas da especialização. Em outras palavras, trata-se do argumento

[1] No original, em inglês, leia-se "break down the silos".

de que é preciso considerar processos decisórios multi-níveis, intersetoriais e transdisciplinares. No entanto, ao abrir essas caixas, o conceito não deixa claro de que forma o conhecimento deve ser integrado (CAIRNS; KRZYWOSZYNSKA, 2016; URBINATTI et al., 2020a). Da mesma forma, os perigos que estão presentes em novos silos transversais não ficam evidentes (STIRLING, 2015). De todo modo, a governança do nexo pode ser associada com a governança policêntrica e multí-nível. Sistemas de governança policêntricos equilibram e deveriam integrar vias *bottom-up* e *top-down* de influência e laterais (intersetoriais) em relação à sua capacidade adaptativa (OSTROM, 2010; PAHL-WOSTL; KNIEPER, 2014; PAHL-WOSTL, 2017). Dessa forma, inclui mercados, mecanismos regulatórios, hierarquias burocráticas e redes de aprendizagem (PAHL-WOSTL, 2015).

A sobreposição das capacidades de decisão é um dos principais cerceamentos à governança do nexo, pois ela tem o desafio de promover interações entre as estruturas de governança pré-existentes (BENSON et al., 2015). É importante reconhecer nessas estruturas os nexos existentes e possíveis na ponta dos processos políticos, ou seja, nos contextos mais vulneráveis do ponto de vista social, ambiental e econômico. Por conta de a abordagem do nexo trabalhar com argumentos econômicos mais explícitos em comparação com debates paralelos sobre a sustentabilidade, é preciso ponderar os estudos mais pautados em termos de relações de custo-benefício e eficiência de recursos, principalmente sobre perspectivas técnico-administrativas e técnico-científicas, com outros mais críticos (WEITZ et al., 2017; WIEGLEB; BRUNS, 2018). Certamente os aspectos técnico-científicos são insuficientes e precisam ser traduzidos em alternativas palpáveis à realidade dessas populações. Contudo, não basta que elas sejam apenas instrumentais; faz-se necessário um processo de aprendizagem social nas negociações sobre os recursos (GIATTI, 2019). Especificamente quanto a essa questão, quando propomos os "nexos de humildade"[2], no segundo artigo dessa tese, isto ficará mais evidente.

Neste contexto, a definição de governança do nexo que se assume aqui considera três aspectos iniciais importantes, apresentados no primeiro artigo que constitui a tese. Em primeiro lugar, o conceito de governança do nexo não deve ser encarado como universalmente aplicável. Com isso buscamos dizer que cada contexto de análise terá seus próprios arranjos de governança para água, energia e alimentos. Em segundo lugar, torna-se necessário reconhecer as diversas bases conceituais sobre as quais o conceito vem sendo abordado. O artigo mostra que pelo menos 24 outros conceitos de governança foram associados ao debate. Também por

[2] Tradução livre de "nexus of humility", perspectiva que foi sugerida a partir do conceito de tecnologias de humildade proposto por Sheila Jasanoff (2003b; 2007).

isso a amplitude de definições fica visível. Em terceiro lugar, o nexo precisa ser encarado como uma ferramenta importante para debater alternativas para a mitigação das desigualdades sociais, tais como o próprio acesso aos recursos básicos de sobrevivência. Assim, a governança do nexo deve assumir características inclusivas para fomentar a participação de vários segmentos, mas principalmente aqueles mais desfavorecidos (URBINATTI et al., 2020b).

Dito isto, no próximo tópico abordaremos o nexo como um "caminho para a Sustentabilidade", assumindo algumas sugestões dadas por essa abordagem como forma de dar mais robustez à ideia de governança do nexo.

1.3.O NEXO COMO UM CAMINHO PARA A SUSTENTABILIDADE

Não há dúvidas de que a ideia de "governar" a água, energia e alimentos de maneira setorial é bastante desafiadora; se torna ainda mais quando a governança é pensada de maneira intersetorial. Exatamente por isso, assim como foi mostrado no tópico anterior, o próprio olhar para a governança carece de alguma amplitude que tenha por garantia mais flexibilidade nas definições. É neste sentido que a ideia de caminhos para a Sustentabilidade (CPS)[3] pode agregar ao debate sobre o nexo. Esta é uma abordagem que vem sendo encorajada pelo STEPS Centre (Social, Technological and Environmental Pathways to Sustainability), da Universidade de Sussex, Reino Unido. A abordagem parte do pressuposto de que pensar a "governança sustentável" passa por reconhecer a dinâmica do mundo em que vivemos, a partir das complexas relações entre ecologia, tecnologia, pobreza e justiça (LEACH et al., 2007a).

Isto engloba um olhar sistêmico para os sistemas biológicos, sociais, econômicos ou políticos, particularmente nas suas interações. Estes sistemas dinâmicos seriam caracterizados pela complexidade, incerteza, não-equilíbrio e muitas vezes pelas condições caóticas. É neste contexto que se torna importante o reconhecimento de um "estado permanente de incertezas"[4] (STIRLING, 2010). Este reconhecimento é importante para que as complexidades não sejam reduzidas a meros cálculos, ou em outras palavras, exista alguma resistência às pressões por justificação (COLLINGRIDGE, 1980). Estas "pressões" políticas, econômicas e disciplinares

[3] "Pathways to Sustainability", no original. Caminhos para a Sustentabilidade é uma tradução livre do autor. Esta abordagem foi conhecida durante o período de estágio no exterior realizado entre os meses de fevereiro e maio de 2019 na Universidade de Sussex, no Reino Unido. O uso da letra maiúscula no "S" de Sustentabilidade é uma escolha para diferenciá-la da generalização e polissemia do termo "sustentabilidade", significando, portanto, a maneira própria como o termo é compreendido no estudo.

[4] Tradução livre do autor. No original o termo é "Incertitude status".

para justificação forçam sistematicamente cientistas e formuladores de políticas a enfatizar as condições aparentemente mais traiçoeiras do "risco". Contudo, as definições mais convencionais de "risco", como magnitudes ponderadas pela probabilidade, implicam intrinsecamente três outras condições distintas: incerteza (falta de confiança nas probabilidades), ambiguidade (falta de concordância com as magnitudes) e ignorância - onde não sabemos o que não sabemos (WYNNE, 1992).

É para lidar com este estado de incertezas que a primeira dimensão sugerida pela abordagem CPS é justamente o enquadramento de um determinado sistema e seu ambiente, como ele é delimitado e quais estruturas e funções podem ser consideradas como essenciais. Neste enquadramento, múltiplas narrativas coexistem, realizadas por diferentes atores e coproduzidas com instituições baseadas em relações de poder e de conhecimento. Em segundo lugar, a abordagem sugere que é a governança que moldará os enquadramentos predominantes e a forma como eles são negociados, colocando as propriedades de um sistema em escalas temporais.

É daí que surge no horizonte a "Sustentabilidade", entendida como a capacidade de manter um certo ritmo através da estabilidade, durabilidade, resiliência e robustez (LEACH et al., 2007a). Seguimos a sugestão de Leach et al. (2007a) para diferenciar "sustentabilidade" ("a capacidade geral de manter qualquer característica não especificada da estrutura ou função de um sistema por períodos indefinidos de tempo", p. 18) de "Sustentabilidade" ("a capacidade de manter valores especificados de bem-estar humano, equidade social e qualidade ambiental por períodos indefinidos de tempo", p. 18)[5].

Nesta perspectiva, é necessário entender o que a "Sustentabilidade" significa em um determinado contexto, uma tarefa que a própria governança deve realizar (LEACH et al., 2007b). Esta tarefa é um processo político para a abordagem e, para tal, deve incluir uma diversidade de conhecimentos e reconhecimento das relações de poder que integram essas interações. Em geral, a consciência das camadas de poder na formulação do conhecimento e no processo decisório tende a estimular o que os autores chamam de "modéstia" ou "humildade" na governança (LEACH et al., 2010). Neste contexto, sugerimos aqui que a governança do nexo, que engloba olhares para estruturas pré-existentes e propostas futuras de governança intersetorial, pode se tornar menos normativa e mais "modesta" caso seja pautada nas cinco dimensões da governança ressaltadas pela abordagem CPS. Como mostrado na **Figura 3**, são

[5] Tradução livre do autor.

elas: entidades políticas e espaços; estruturação e prática; poder e conhecimento; incertezas; história, política e contexto. Essa questão que chamamos aqui como "modéstia" ou "humildade" será abordada com mais profundidade no tópico seguinte.

Figura 3: Aspectos da governança para a abordagem de caminhos para a Sustentabilidade

ENTIDADES POLÍTICAS E ESPAÇOS	Reconhecimento do significado de múltiplos atores, redes, entidades e espaços, formais e informais, mais fixos ou mais transigentes, em diferentes escalas.
ESTRUTURAÇÃO E PRÁTICAS	Reconhecimento da importância de estruturas institucionais duradouras, mas também da agência dos cidadãos, técnicos e atores políticos particulares, avaliando as formas como as relações são construídas e renegociadas através da prática.
PODER E CONHECIMENTO	Reconhecimento do significado tanto da economia política como de formas dispersas e capilares de poder, relações de poder a partir do conhecimento e do discurso, formas de enquadramento e reflexividade.
LIDAR COM AS INCERTEZAS	Reconhecimento das incertezas nos processos sócio-técnico-ecológicos e nos próprios processos de governança, exigindo abordagens adaptativas e deliberativas.
HISTÓRIA POLÍTICA, CULTURA E CONTEXTO	Avaliação da importância de determinadas histórias e culturas políticas para o surgimento e funcionamento da governança.

Fonte: Adpatado de Leach et al. (2007b).

1.4. A CONTRIBUIÇÃO DOS ESTUDOS SOCIAIS DA CIÊNCIA E TECNOLOGIA

Como mostrado nas seções anteriores, a "racionalidade" do nexo busca, pelo menos em parte, abrir as caixas da especialização. Usando termos de Latour (LATOUR, 2004), e de acordo com Cairns e Krzywoszynska (2016), os desafios relacionados ao nexo são "questões de preocupação" e não "questões de fato"[6], uma vez que são frequentemente processos controversos e não apenas objetos a serem investigados. Isto torna a própria categoria conceitual "nexo" uma questão de preocupação.

[6] Tradução livre do autor para "matters of concern" e "matters of fact".

O reconhecimento dessas controvérsias passa primeiro pela constatação do estado permanente de incertezas, discutido anteriormente, na governança da água, energia, alimentos e o meio ambiente. Em segundo lugar, passa por evitar reduzir o nexo a uma única forma de interação entre os recursos. Este olhar para um nexo singular entre os recursos pode ser conveniente para interesses particulares de cientistas, políticos e corporações privadas; no entanto, pode falhar ao abordar o mundo real da dinâmica complexa de interação entre os recursos. Em outras palavras, é importante superar a ideia de que o nexo água-energia-alimento, enquanto categoria teórica ou prática, será sempre apolítico e positivo (VAN GEVELT, 2020). Isto quer dizer que ele não deve se encerrar em argumentos técnicos e positivistas de integração de setores e políticas públicas. A este respeito, estudos sobre o nexo que discutam as complexidades a partir de processos de geração de conhecimento associados às pesquisas científicas, mudanças tecnológicas, decisões políticas e inovações sociais mais amplas ainda são pouco encontrados na literatura.

É por esse motivo que durante o período de estágio no Science Policy Research Unit (SPRU), da Universidade de Sussex, entre os meses de fevereiro de 2019 a maio de 2019, surgiu a possibilidade de compreensão do debate sobre o nexo, não só pela abordagem CPS, mas também a partir de uma perspectiva que pudesse contribuir para uma compreensão mais robusta da interface ciência-política-sociedade (CHILVERS; EVANS, 2009). Assim sendo, dentro dos chamados Estudos Sociais da Ciência e Tecnologia (ESCT)[7], tendo a autora Sheila Jasanoff como uma das expoentes, foi possível encontrar apreciações atrativas para discutir o nexo.

Os ESCT surgiram por volta da década de 1970 e 1980 como um campo interdisciplinar distinto que trata a ciência e a tecnologia como indissociáveis estruturas sociais e práticas (ROHRACHER, 2015). Esses estudos têm influência dos trabalhos precursores sobre a ciência como objeto direto da pesquisa científica, como, por exemplo, na sociologia do conhecimento de Karl Mannheim (1991) e na investigação da ciência como um sistema social na obra de Robert K. Merton (1973). Em contraste com os precursores, para os ESCT a ciência e a tecnologia estão abertas à análise social, não sendo tratadas como o resultado de uma forma privilegiada de conhecimento sobre a natureza (ROHRACHER, 2015). Eles fazem parte de uma chamada "virada participativa" nos estudos da ciência, isto é, o envolvimento de "não cientistas" no desenvolvimento científico e tecnológico (LENGWILER, 2008).

Disciplinas distintas dos ESCT estendem a avaliação de como o poder se relaciona com o conhecimento (FOUCAULT, 1980), discutindo como o conhecimento pode ser

[7] Science and Technology Studies (STS) no original, em inglês.

representado pelo poder, e ainda como o poder pode moldar o conhecimento (MACMYNOWSKI, 2007). Este ponto ajuda a esclarecer, por exemplo, que existem formas de poder implícitas nas definições singulares do nexo que funcionam como meios poderosos para justificar intervenções associadas que favoreçam grupos específicos. Para evitar esses favorecimentos desiguais, os ESCT mais clássicos, apesar de não serem homogêneos e não tratarem sobre o debate do nexo, demonstram maior atenção aos valores da democracia e da participação pública não apenas na implementação de políticas, mas também na própria geração do conhecimento (JASANOFF, 1996).

De acordo com Collins et al. (2010), os ESCT tiveram três fases, ou "ondas", diferentes. A primeira delas mais focada na questão da autoridade que a ciência passou a exercer, principalmente das ciências exatas, no contexto e após a Segunda Guerra Mundial. A segunda fase buscou desconstruir essa autoridade, discutindo as novas incertezas sobre a ciência. Por fim, a terceira fase estaria voltada ao combate do "populismo tecnológico", ou seja, questionar até qual ponto a participação pública e, portanto, não especialista, poderia definir questões tecnológicas complexas; por isso, acreditam que deve haver uma separação clara entre momentos técnicos dedicados aos especialistas e momentos de participação. O primeiro texto a aludir a essa terceira fase foi o de Collins e Evans (2002), que acabou por receber críticas contundentes de Wynne (2003) e Jasanoff (2003a). As principais delas foram em relação à desnecessidade da divisão dos ESCT em diferentes "ondas" distintas; por compreenderem que Collins e Evans reforçam a hegemonia cultural científica da "sociedade científica ocidental"; e, dentre outras questões, pelo fato de Wynne e Jasanoff não concordarem com o público acessar conteúdos de decisão apenas após os especialistas já terem feitos suas escolhas.

Assim fica mais proeminente a ideia de "coprodução de conhecimento" (JASANOFF, 2004) como um recurso analítico. Este termo assumiu inúmeros significados que, de alguma forma, reconhecem a abertura persistente e diversidade de saberes necessária nos processos de geração de conhecimento. Pode-se dizer que, por um lado, a concepção de coprodução recebeu um olhar mais "positivista", no qual o conhecimento é gerado por diversos atores em cenários específicos, isto é, a partir do entendimento de que as pessoas têm algo a oferecer para a construção de resultados de maneira colaborativa (LWEMBE et al., 2016). Por outro lado, o olhar essencialmente "construtivista" reconhece que todo conhecimento é coproduzido na medida em que é moldado pelos contextos de cultura e poder (STIRLING et al., 2018). Isto não quer dizer que projetos específicos orientados pela busca colaborativa de resultados são desnecessários; muito pelo contrário, é simplesmente um chamado para a importância de

reconhecer que o conhecimento sempre é condicionado pelo poder por meio das relações sociais e em processos duradouros (STIRLING, 2006, 2011; STIRLING et al., 2018).

Nesse contexto, os ESCT podem ajudar a trilhar perspectivas para a democratização não apenas do processo de avaliação de políticas públicas com base no conhecimento, mas também o próprio desenvolvimento da ciência. A democratização da ciência pode ser vista como a capacidade de envolvimento do público enquanto sujeitos ativos em diálogos científicos, e não como meros objetos da investigação (DRYZEK et al., 2019). Para isso, é importante considerar que a própria pesquisa científica está sujeita a pressões políticas (DE VRIES, 2007; MARRES, 2007). Aqui, como na literatura dos ESCT, o que está em jogo é o grau e a qualidade da participação tanto na elaboração da ciência quanto na construção de políticas públicas.

Estas aspirações, digamos, mais ambiciosas de colaboração têm em seu âmago uma melhor compreensão da própria elaboração do "conhecimento" (STIRLING, 2011). Por exemplo, quando os cientistas se envolvem em políticas, eles são especialmente propensos a enfatizar (seja de forma direta ou indireta) a autoridade particular de suas próprias reivindicações. Por outro lado, quando os políticos se envolvem em debates da ciência, eles se tornam propensos a reivindicar políticas que sejam pautadas por evidências científicas, como se "o melhor conhecimento disponível" de alguma forma justificasse de maneira única decisões particulares. Isto ainda em um cenário de interações razoáveis, pois, nos últimos anos no Brasil, movimentos de opinião pública, endossados por políticos eleitos, têm trazido posições anticientíficas e antidemocráticas (MONTEIRO, 2020). Aqui, pode-se levantar questões mais gerais e controvérsias sobre como a autoridade é construída e a aceitabilidade é projetada nas sociedades contemporâneas (JASANOFF, 1994).

É a partir desse contexto que as chamadas "tecnologias de humildade"[8], proposta por Jasanoff (2003b; 2007), podem ser encaradas como uma forma de ampliar a abordagem do nexo. Basicamente, a autora se refere ao progresso da ciência e tecnologia, sugerindo que qualquer intervenção deve considerar as seguintes perguntas: "*Qual é o propósito? Quem será prejudicado? Quem será beneficiado? E como podemos saber?*" (JASANOFF, 2003b, p. 240) Quatro pilares são fundamentais para a proposição da autora:

- *Enquadramento*: as soluções dependem da forma como o problema é enquadrado; se muito amplo ou muito estreito, as decisões podem sofrer consequências;

[8] Tradução livre do autor, no original "technologies of humility".

- *Vulnerabilidade*: compreender as vulnerabilidades de uma determinada população; no entanto, não a partir de cálculos gerais, mas buscando compreender narrativas individuais de sujeitos ativos dentro de um contexto histórico-cultural;
- *Distribuição*: tornar transparente a distribuição dos malefícios e benefícios de uma determinada intervenção, entendendo qual o alcance das interações entre cientistas, formuladores de política e cidadãos;
- *Aprendizagem*: reconhecer que a experiência está sujeita a diferentes interpretações, tanto dos cientistas quanto dos formuladores de política e da população; as interações entre essas pessoas vêm acompanhadas de processos de aprendizagem que não são necessariamente consensuais, mas abertos às diferenças e ao conflito.

Com base nisto, foi proposto no segundo artigo que compõe a tese o enquadramento conceitual que intitulamos como "nexos de humildade". Seguindo as sugestões de Jasanoff (2003b), os "nexos de humildade" são uma forma de tornar o conhecimento na interface entre ciência e política mais transparente, responsável, e reflexivo em relação aos interesses sociais de parcelas mais vulneráveis da população. Tornando, portanto, possíveis intervenções direcionadas à concepção de nexo não como apenas formas resolutivas, mas também formas reflexivas. Dessa maneira, entendendo o nexo como um debate proximal ao conceito de CPS, podemos dizer que estes também são "nexos de Sustentabilidade". A seguir estão colocados os desafios da análise de duas políticas públicas na Região Metropolitana de São Paulo, mais especificamente dois programas municipais do setor da saúde, não só à luz dessa literatura, mas também pelas próprias características das regiões de estudo.

1.5. NEXOS DE SUSTENTABILIDADE A PARTIR DE PROGRAMAS MUNICIPAIS DE SAÚDE

Neste tópico serão apresentados os aspectos contextuais do estudo aqui proposto. Partindo do pressuposto de que o nexo é um ponto de vista sobre as sinergias e os *trade-offs* entre recursos, como seria pensá-lo a partir de políticas pré-existentes em um contexto urbano como a Região Metropolitana de São Paulo? Esta pergunta motivou a busca por políticas públicas que vêm ocorrendo na região que poderiam contribuir para o debate aqui proposto. Ela surgiu durante o período de realização do projeto ResNexus, ao qual esta pesquisa se vinculou, que integrou equipes do Brasil, Reino Unido e Holanda para o estudo de três cidades médias

em regiões bastante diferentes: Guarulhos, no Brasil, Sofia, na Bulgária, e Kampala, em Uganda. No caso brasileiro, ficou definido que a pesquisa se daria no bairro do Novo Recreio, situado na periferia de Guarulhos, onde buscou-se compreender práticas sociais da população residente em relação à água, energia e alimentos.

Durante as idas ao campo (entre os anos de 2016 e 2018), foi possível concluir o estado de vulnerabilidade social, econômica, política e ambiental em que os moradores do bairro se encontram. Isto afeta diretamente a relação deles com os recursos: a água chega dia sim, dia não e o abastecimento não chega a todas as regiões do bairro; a energia é bastante informal, o que a torna bastante instável; o transporte, também associado à energia, é restrito e sofre complicações em períodos de chuva; o acesso à alimentação saudável é bastante complicado, na medida em que o bairro produz poucos alimentos frescos e há poucas alternativas em mercados (GIATTI et al., 2019). A má distribuição de serviços básicos como estes para as populações que vivem em grandes áreas urbanas aumenta em maior grau a vulnerabilidade de regiões menos centralizadas (GIATTI, 2019). Nesse sentido, pensar questões como a vulnerabilidade social e a injustiça ambiental, relacionando-os com o uso e a ocupação do solo, renda e a qualidade do saneamento ambiental é uma forma de compreender aspectos capitalistas modernos que perpetuam desigualdades no acesso a recursos naturais (FRACALANZA et al., 2013). Estas vulnerabilidades estão relacionadas principalmente à informalidade do Novo Recreio, que teve sua ocupação acentuada nos anos de 1990 e, ainda hoje, a maioria das casas não possui documentação oficial. Além disso, o bairro se situa na borda da Serra da Cantareira, o que torna a ocupação urbana problemática, na medida em que avança os limites do parque estadual. Estes elementos todos criam um dilema para o poder público e empresas de abastecimento entre remover parte da população do local para outras áreas da cidade e fornecer serviços de qualidade.

Neste contexto, notou-se que a infraestrutura provida pelo estado, como a escola municipal e a Unidade Básica de Saúde (UBS), ainda que insuficientes para atender ao bairro como um todo, são de extrema importância para a garantia de educação básica e promoção da saúde entre os moradores. A pesquisa se aprofundou na única UBS situada no bairro (UBS Novo Recreio), tendo a oportunidade de conviver com os funcionários e contar com ajuda deles para visitar domicílios e realizar etnografias e conversas com os moradores durante o trabalho de campo do projeto ResNexus. Da mesma forma, foram entrevistados secretários, técnicos e outros funcionários da Prefeitura de Guarulhos. Este panorama de imersão nas questões do município foi essencial para acompanhar o processo de implantação do Programa Ambienta

Saúde (PAS), lançado em agosto de 2017[9]. Um dos funcionários do Departamento de Assistência Integral à Saúde (DAIS), que faz parte da Secretaria Municipal de Saúde de Guarulhos (SMSG) convidou o grupo de pesquisadores do ResNexus não só para acompanhar o lançamento, que ocorreu no Centro Educacional Adamastor, mas também para construir ideias a serem integradas na política. O programa é fortemente influenciado pelos ODS. Tanto a gestora da UBS Novo Recreio à época, quanto algumas agentes comunitárias de saúde (ACS) do bairro foram convidadas para participar das reuniões de construção do programa.

Figura 4: Princípios e valores do PAS

Fonte: Dados fornecidos pela Prefeitura de Guarulhos (informação pessoal)[10].

O lançamento do PAS em Guarulhos foi inspirado no Programa Ambientes Verdes e Saudáveis (PAVS), que já está incorporado na Secretaria Municipal de Saúde de São Paulo (SMSSP) desde 2008. Basicamente, os dois programas podem ser considerados como parte de políticas públicas de saúde com características socioambientais. A promoção de saúde tem sido desenvolvida no Brasil a partir de características como a flexibilidade, abrangência, permeabilidade e pluralidade (SOUSA; PARREIRA, 2010) Isto se deve, em primeiro lugar, à própria constituição do Sistema Único de Saúde (SUS), que tem em seus valores a atenção

[9] Ver: https://guarulhosweb.com.br/noticia/231575/. Acesso em: 27 de julho de 2020.
[10] Campos, R. M. Ambienta Saúde Guarulhos. Destinatário: Alberto Urbinatti. [Guarulhos], 13 de abr. 2020. 1 mensagem eletrônica.

integral à saúde como direito de todos os brasileiros, fomentando, por um lado, a descentralização e a pluralidade, enquanto, por outro, a integração das ações em rede regionalizada e interdependente em termos operacionais e orçamentários (SANTOS; CAMPOS, 2015). Em segundo lugar, se deve ao Programa Saúde da Família (PSF), que a partir de equipes multiprofissionais visa garantir a atenção básica à saúde em diferentes regiões das cidades brasileiras (MINISTÉRIO DA SAÚDE, 2020). É interessante notar que em áreas urbanas metropolitanas com realidades socioambientais tão diversas, é muito difícil que a Equipe de Saúde da Família mantenha seu trabalho especificamente no tema da saúde, isto é, outros temas, como as questões ambientais, aparecem constantemente na rotina de trabalho dessas equipes (IANNI; QUITÉRIO, 2006).

O PAVS é um exemplo de como esses valores e princípios do SUS podem se dar a partir de temas ambientais. O programa surgiu em 2005 no município de São Paulo, a partir da demanda por políticas públicas que pudessem relacionar questões ambientais, promoção da saúde e qualidade de vida, principalmente no que concerne às populações periféricas. O programa se iniciou a partir de uma parceria entre SMSSP, Secretaria Municipal do Verde e Meio Ambiente (SVMA) e Secretaria Municipal de Assistência e Desenvolvimento Social (SMADS), em articulação com o Programa das Nações Unidas para o Meio Ambiente (PNUMA). Entre os principais objetivos estão: capacitar ACS dando foco para as questões socioambientais junto à população; gerar espaços de "co-gestão" na comunidade para enfrentamento dos riscos ambientais à saúde; e desenvolver uma agenda de ações integradas entre saúde e meio ambiente (PREFEITURA DE SÃO PAULO, 2010). Em 2008, foi incorporado no PSF, a fim de contribuir para a construção de políticas públicas integradas e intersetoriais no município, buscando fomentar o empoderamento e participação da comunidade (PREFEITURA DE SÃO PAULO, 2011). Apesar de a intersetorialidade ser praticada ainda de forma bastante pontual e fragmentada no SUS e PSF em geral (AKERMAN et al., 2014), a contribuição do PAVS está principalmente no intenso trabalho dos ACS e dos Agentes de Promoção Ambiental (APA), que mapeiam necessidades e lacunas nos locais em que atuam pra fortalecer ações intersetoriais da saúde e do meio ambiente (SOUSA; PARREIRA, 2010).

Figura 5: Relações multi-níveis no PAVS

Fonte: Prefeitura de São Paulo (2012).

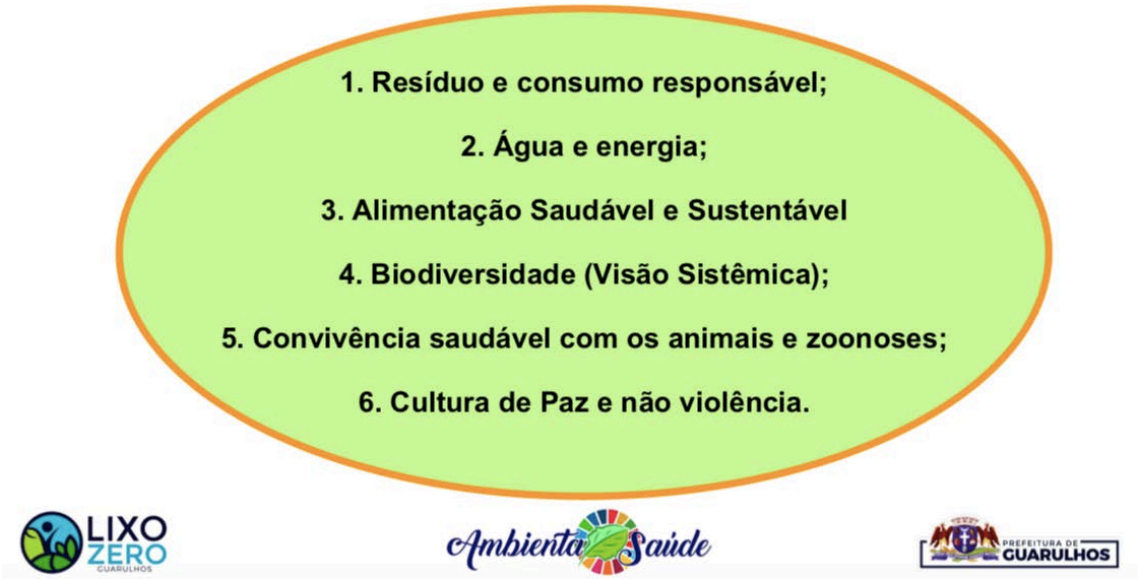
Durante os primeiros anos de formação da agenda do PAVS foram capacitados mais de 5000 ACS voltados para os seguintes eixos: Lixo; Água e Energia; Biodiversidade; Convivência Saudável com os Animais e Zoonoses; Consumo Responsável e Cultura da Paz e Não-violência (PREFEITURA DE SÃO PAULO, 2016). Nota-se que são temas bastante próximos – e até mais plurais – aos que a abordagem do nexo água-energia-alimentos costuma englobar. Além do processo de capacitação, o próprio programa conta com eixos temáticos plurais, que estão mostrados na **Figura 6**. Nesses mais de dez anos de história, o PAVS passou por diferentes gestões na Prefeitura de São Paulo. Todos os anos são publicados no portal eletrônico da prefeitura um balanço anual das atividades desenvolvidas. Apesar do programa continuar com ações nos territórios, o último balanço disponível é o do ano de 2018, no qual 205 projetos estavam em andamento, 505 práticas foram incorporadas em 23.247 ações coletivas com 473.368 pessoas envolvidas em todas as regiões do município (PREFEITURA DE SÃO PAULO, 2018).

Figura 6: Eixos temáticos do PAVS

Fonte: Prefeitura de São Paulo (2012).

A formulação do PAS em Guarulhos buscou formatos parecidos para capacitar funcionários das áreas da saúde. O município começou o processo de capacitação no ano de 2017 e objetiva chegar aos 7 mil funcionários da área da saúde. Ainda não existem dados oficiais para tais atividades, como mostraremos no terceiro artigo, o que justamente torna este estudo necessário na medida em que busca entender os atrasos e as barreiras encontradas ao longo do processo. De acordo com a **Figura 7**, os eixos temáticos do programa de educação ambiental do PAS são semelhantes aos utilizados pelo PAVS em São Paulo, incluindo os recursos água, energia, alimentos e meio ambiente como temas.

Figura 7: Eixos temáticos PAS



Fonte: Dados fornecidos pela Prefeitura de Guarulhos (informação pessoal)[11].

Estes eixos temáticos, de acordo com os dados fornecidos, se baseiam nos seguintes pressupostos: "a educação como processo contínuo e permanente de transformação e humanização de sujeitos e processos; a educação como um processo integral do indivíduo nas dimensões ambiental, cultural, social, econômica, política e de saúde; a realidade local e regional como ponto de partida para as intervenções; a construção coletiva e integrada dos conhecimentos, saberes e práticas dos diferentes atores envolvidos; e o planejamento das ações de forma democrática e participativa, com o controle social das intensões" (informação pessoal)[12]. Estes são pontos essenciais, quando de fato seguidos, para pensar em políticas públicas oportunas para desenvolver perspectivas democráticas, inclusivas para a saúde e o meio ambiente. Além disso, a promoção da saúde se torna mais robusta ao agregar perspectivas já existentes e outras novas, principalmente se voltadas ao desenvolvimento de projetos em grandes centros urbanos (SANTOS; CAMPOS, 2015).

Ao fim e ao cabo, o debate sobre a promoção de saúde no Brasil, incluindo aspectos ambientais, apresenta características iniciais amigáveis ao debate do nexo – que, por sua vez, é recente no Brasil. A pesquisa brasileira tem dado respostas do "Sul" global à abordagem do nexo ao discutir especialmente a urbanização e a pobreza em relação aos recursos, mas muitas

[11] Campos, R. M. Ambienta Saúde Guarulhos. Destinatário: Alberto Urbinatti. [Guarulhos], 13 de abr. 2020. 1 mensagem eletrônica.
[12] Campos, R. M. Ambienta Saúde Guarulhos. Destinatário: Alberto Urbinatti. [Guarulhos], 13 de abr. 2020. 1 mensagem eletrônica.

vezes elas não superam olhares técnico-administrativos e perspectivas aplicadas do “Norte” global (DALLA FONTANA et al., 2020). Quando buscamos entender os “nexos de Sustentabilidade” a partir de políticas públicas de saúde, com características socioambientais, consideramos que essas agendas pré-existentes ou em formação no município podem agregar bastante à discussão, especialmente em contextos vulneráveis, como os que apresentaremos na próxima seção.

1.6. REGIÕES DE ESTUDO

As duas regiões de estudo fazem parte da Região Metropolitana de São Paulo (RMSP), que conta com mais de 21,5 milhões de habitantes em 39 municípios (EMPLASA, 2019a). A complexidade destes territórios se torna ainda mais evidente quando são olhados do ponto de vista da Macrometrópole Paulista (MMP), com cerca de trinta e três milhões de habitantes e 174 municípios (EMPLASA, 2019b). A MMP é uma nova perspectiva sobre estes territórios interdependentes, pois os paradigmas existentes em torno da governança e planejamento setorial e multisetorial têm sido cada vez mais ampliados a partir de fluxos de mercadorias, pessoas, especulação imobiliária, agronegócio, serviços ecossistêmicos, entre outros (LENCIONI, 2015; TORRES et al., 2019). A escolha de iniciar com este olhar macro é justamente pra entender que os territórios aqui estudados, ainda que situados em regiões periféricas dos municípios de São Paulo e Guarulhos, os dois mais populosos, são interconectados por diferentes fatores.

1.6.1 A REGIÃO DO JARDIM MAIA EM SÃO PAULO

O município de São Paulo é o maior do país em termos populacionais e a principal metrópole da América Latina, enfrentando inúmeros desafios do ponto de vista da sua urbanização acentuada, que chega a atingir 99,1% do seu território (BARROS, 2019). A crescente urbanização das periferias fez com que aproximadamente 30% de sua população (aproximadamente 3 milhões de pessoas) estejam vivendo em condições precárias de habitação, ocupando áreas quase sempre ilegais e informais e evidenciando uma concentração de áreas de risco nesses locais (NOBRE et al., 2010). Um deles está relacionado aos alagamentos,

decorrentes de chuvas cada vez mais problemáticas para o município e de regiões como a que estudamos aqui, o Jardim Maia e arredores[13].

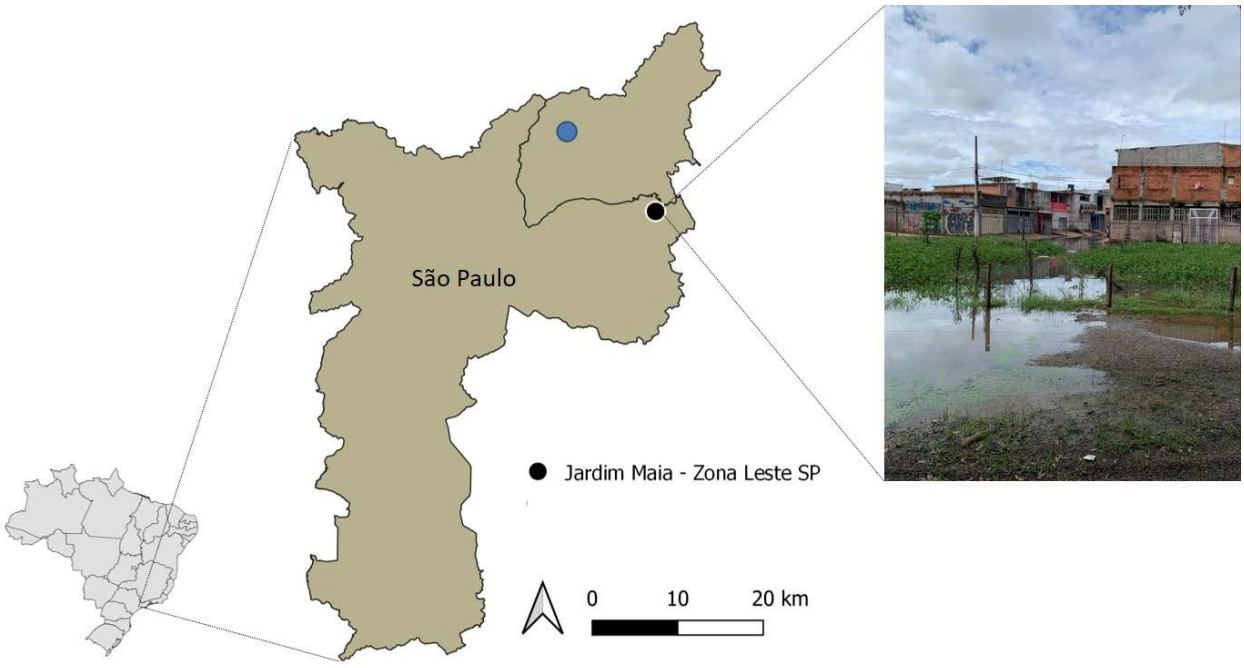
A região se situa no extremo Leste do município, próxima ao Rio Tietê. O Jardim Maia está entre os distritos de São Miguel Paulista e Itaim Paulista, próximo ao Jardim Helena. Somadas, segundo o último censo de 2010 (PREFEITURA DE SÃO PAULO, 2020a), as regiões contam com pelo menos 742.623 habitantes. A história da região está associada à antiga fazenda denominada como Biacica, região que anos depois receberia o nome de Itaim Paulista. Por volta de 1560, o local receberia uma pequena capela do padre Anchieta, uma das primeiras intervenções no local que hoje é São Miguel Paulista (PREFEITURA DE SÃO PAULO, 2020b). As primeiras ocupações remetem ao final do século XVIII, a partir da chegada da Ferrovia Estrada do Norte (antiga Central do Brasil) (PREFEITURA DE SÃO PAULO, 2019). A segunda onda de ocupações mais populares remete aos anos de 1940, intensificadas pelas atividades industriais da indústria Nitro Química Brasileira (MELO, 2004). Apesar de distante do centro da cidade de São Paulo, a região conta com estações da Companhia Paulista de Trens Metropolitanos (CPTM) que facilitam o transporte.

Na **Figura 8** pode ser observada a localização da região dentro do município de São Paulo.

[13] Ver: https://noticias.r7.com/sao-paulo/uma-semana-apos-chuvas-ruas-da-zona-leste-ainda-tem-agua-e-lama-18022020. Acesso em 09 de julho de 2020.

Figura 8: Região do Jardim Maia em São Paulo

Figura 8: Região do Jardim Maia em São Paulo



Fonte: elaboração própria.

1.6.2 O BAIRRO NOVO RECREIO EM GUARULHOS

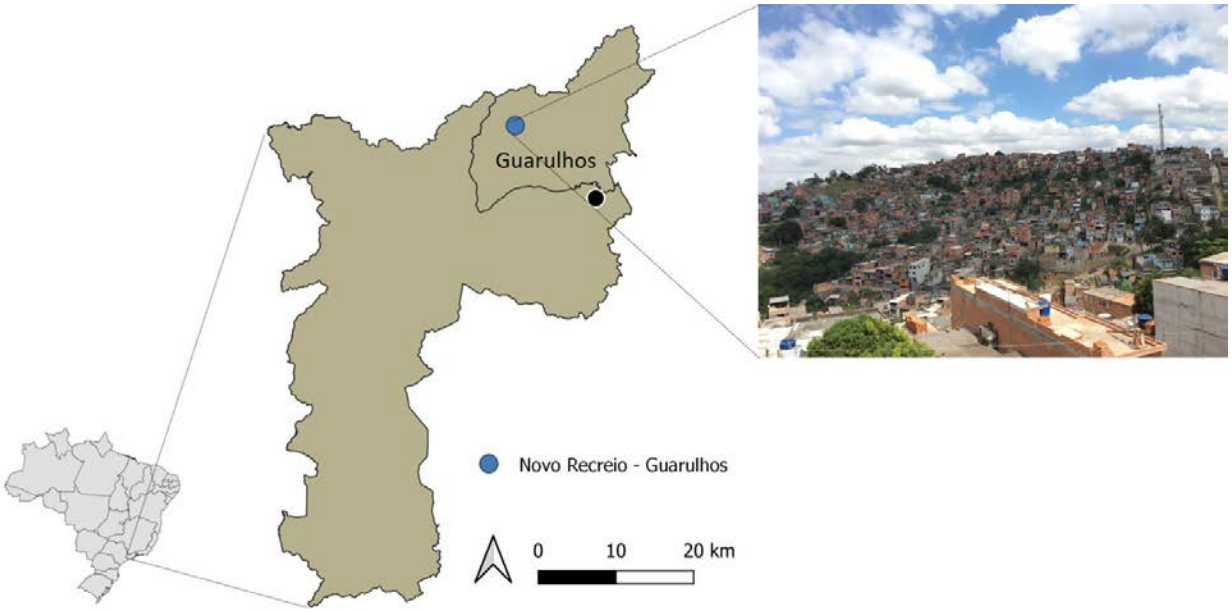
Guarulhos é o segundo maior município paulista em termos populacionais, com quase 1,4 milhões de habitantes segundo as estimativas do IBGE Cidades para 2019 (IBGE, 2019), em uma área de 319,19 km^2. Quatro rios cortam o território: Tietê, Cabuçu, Jaguari e Baquirivu-Guaçu. Este município é lembrado principalmente pelo aeroporto internacional que é o principal de toda a RMSP. Além disso, se situa entre algumas das principais rodovias do país. O potencial econômico e industrial se acelerou a partir dos anos de 1950 com a inauguração da Via Dutra, alterando a paisagem de uma região hortifrutigranjeira para industrial. Com isso, o aumento da população urbana em relativamente pouco tempo trouxe inúmeros desafios para os governos subsequentes do município. Alguns deles são as profundas desigualdades sociais e problemas ambientais como a ínfima infraestrutura sanitária e os sérios riscos associados à poluição e ao abastecimento de água para a população. Além dos riscos relacionados à água, as questões alimentar e energética também são desafios importantes para uma região metropolitana com poucas áreas produtoras de alimentos.

O Bairro do Novo Recreio está situado na porção noroeste do município de Guarulhos. A região é conhecida como Cabuçu, englobando o Parque Estadual da Serra da Cantareira,

Núcleo Cabuçu. Da mesma forma, a UBS Novo Recreio, onde foram criadas as bases para a pesquisa faz parte do Distrito Cabuçu nas regiões de saúde do município (PREFEITURA DE GUARULHOS, 2020). Nota-se que uma das vulnerabilidades do bairro é em relação ao abastecimento de água, que muitas vezes não está disponível para a população todos os dias. De maneira geral, a RMSP convive com o problema da crise hídrica há bastante tempo, tendo sido o ano de 2014 bastante crítico. A região têm consumido mais água do que produz, por exemplo, quando observamos os dados de 2015, o consumo para abastecimento público era na ordem de 68,2 m3/s e, entre esse, 31 m3/s vindos da bacia hidrográfica dos rios Piracicaba, Capivari e Jundiaí (FRACALANZA; FREIRE, 2015). A Companhia de Saneamento Básico do Estado de São Paulo (Sabesp) assumiu recente o abastecimento de água e a coleta de esgoto em Guarulhos, prometendo ampliar e melhorar os serviços[14].

Na **Figura 9** está ilustrada a região do Novo Recreio.

Figura 9: Região do bairro Novo Recreio



Fonte: elaboração própria.

[14] Ver: https://guarulhos.sabesp.com.br. Acesso em: 10 de julho de 2020.

2. OBJETIVOS

2.1. OBJETIVO GERAL

O objetivo geral deste projeto é compreender a abordagem do nexo de forma crítica, como um caminho teórico para pensar a sustentabilidade e auxiliar na identificação de práticas intersetoriais na governança da saúde, frente aos desafios ambientais em contextos urbanos periféricos da Região Metropolitana de São Paulo.

2.2. OBJETIVOS ESPECÍFICOS

- Revisar sistematicamente a literatura mundial sobre o conceito de governança do nexo;
- Analisar criticamente o debate sobre a governança do nexo e propor *insights* a partir de literaturas com escopos mais amplos, como os Estudos Sociais da Ciência e Tecnologia (ESCT) e os caminhos para a Sustentabilidade (CPS);
- Identificar políticas públicas do setor da saúde que considerem práticas intersetoriais e a questão da sustentabilidade nos municípios de São Paulo e Guarulhos;
- Analisar as principais narrativas dessas políticas públicas à luz dos contextos próprios de vulnerabilidade;

3. METODOLOGIA

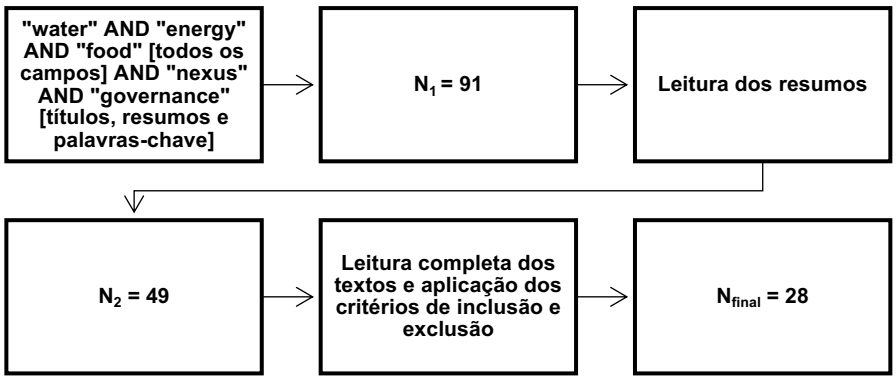
3.1. ARTIGO 1

Este artigo utiliza metodologias mistas, que propiciam análises quantitativas e qualitativas. O objetivo do artigo é apresentar uma busca sistematizada de artigos, a fim de revisar a ideia de "governança do nexo" na literatura mundial. As revisões sistemáticas de literatura (RSL) são uma forma de criar certo rigor e confiabilidade nas buscas por artigos, explicitando o processo (PETTICREW; ROBERTS, 2006). A busca e análise dos artigos foi subdividida em três partes. A primeira parte foi uma análise prévia usando as palavras-chave "water AND energy AND food" e "nexus". Os dados coletados são artigos do banco de dados das plataformas Scopus, Web of Science e Science Direct durante o período 2007-2018. Depois de excluir os artigos duplicados por meio do software OpenRefine, os resultados primários dessa busca foram 1455 artigos (N1=1455). Depois disso, foi aplicado o software *Gephi* para exploração visual de redes e medidas de centralidade computacional a esse grande grupo de dados. Esta é uma ferramenta analítica de rede que é usada para representar os "nós" (temas) e "arestas" (relacionamentos) em uma rede (BENITES-LAZARO; GIATTI; GIAROLLA, 2018a).

A análise de redes sociais (ARS) é uma ferramenta que facilita a comunicação entre um grupo de atores (indivíduos ou organizações) chamados como "nós" (SCOTT, 2011). De maneira geral, os "nós" são acoplados por alguns pontos em comum, tais como interesses, conhecimento, prestígio, entre outros, fazendo pontes entre olhares micro e macro sobre determinadas questões (CUNHA et al., 2016). A ARS opera em distintos níveis, e aqui utilizamos como ferramenta auxiliar para realizar a sistematização da literatura sobre a governança do nexo. Apesar de ser uma ferramenta bastante utilizada para análise de indivíduos e organizações, existem esforços recentes de entender o potencial dessa metodologia também para RSL (LEPPINK; PÉREZ-FUSTER, 2019; COWHITT; BUTLER; WILSON, 2020). Novas técnicas de análise de redes, como estas, são mais apropriadas para grandes conjuntos de dados, e se tornam mais robustas quando não apenas descritivas, mas interpretadas (SCOTT, 2011). O método permite aos pesquisadores reter as unidades tradicionais de registro, ao mesmo tempo em que amplia a perspectiva ao incluir informações sobre as relações entre estas unidades. Esta informação estrutural adicional permite aos pesquisadores abordar questões de pesquisa existentes usando novas ferramentas, abordando-as a partir de uma perspectiva teórica diferente (BENITES-LAZARO; GIATTI; GIAROLLA, 2018b).

A segunda parte diz respeito ao processo de delimitação dos artigos a partir de buscas em títulos, palavras-chave e resumos e em critérios de inclusão e exclusão definidos. Para essa parte foram adicionadas à busca inicial as palavras “nexus AND governance”. Como critério de inclusão, foram considerados artigos que discutem de forma conjunta os três elementos do nexo (água, energia e alimentos) e focam no tema da governança. Como critério de exclusão, não foram considerados aqueles: que tratam o nexo a partir de um ou dois dos recursos; que não utilizam o termo “governança”; e que usaram o termo governança como uma recomendação conclusiva. Além disso, foram excluídos livros ou capítulos de livros, *working papers*, artigos de conferências e relatórios. A **Figura 10** ilustra este processo de seleção.

Figura 10: Processo de seleção dos artigos



Fonte: elaboração própria.

Para confirmar o processo de busca, foi utilizado o software *T-Lab*. A partir da chamada “mineração de texto” e *machine learning*, realizando a busca de apenas artigos em inglês com as mesmas palavras-chave “water-energy-food nexus AND governance”, em títulos, resumos e palavras-chave no mesmo período (2007-2018). O mesmo grupo de artigos apareceu, e após a leitura completa desses textos, foram definidos 28 como número final a serem analisados. Foi definida uma matriz adjacente da rede (uma matriz onde cada elemento [*i, j*] é igual ao peso do arco do nó *i* ao nó *j*) também no software *T-Lab*. Isto incluiu: i) uma análise de rede com base no “ego” (*egonetwork analysis* - ENA), também através do *T-Lab*; ii) análise do discurso, também usando o *T-Lab*; e iii) ARS, usando o software *SocNetV* (Social Network Visualizer) para exploração visual das redes.

A análise de discurso consiste em um conjunto de técnicas para a pesquisa estruturada de textos com base no estudo da linguagem em uso e seus significados, variando desde a análise

das regularidades linguísticas até a qualidade normativa das discussões (BENITES-LAZARO; GIATTI; GIAROLLA, 2018b). Foi utilizado também um método misto para a análise de discurso, a fim de aproveitar tanto técnicas quantitativas quanto qualitativas. O método considera que tanto o número de repetições de palavras quantificadas pelo software *T-Lab* quanto os padrões léxicos exploratórios desempenham papéis importantes na análise textual. O objetivo foi encontrar relações entre os temas em torno da governança do nexo e extrair contextos elementares que permitiram uma análise qualitativa desses discursos presentes nos artigos.

3.2. ARTIGO 2

Para o segundo artigo, foi realizada uma revisão de literatura utilizando a plataforma Scopus, a partir das seguintes palavras-chave: "science AND policy OR science-policy OR science AND politics OR science-politics" AND "water AND energy AND food AND nexus" em títulos, resumos e palavras-chave. Não foi definido um período de tempo específico. Inicialmente, foram encontrados 50 artigos originais e revisões sobre o assunto (número que chamamos de Ni). A partir da leitura dos resumos, palavras-chave e aplicação dos critérios de inclusão e exclusão, chegamos a 19 artigos (Nf). Os critérios de inclusão referem-se aos artigos de pesquisa e revisão que abordam a relação entre ciência e política no debate do nexo de forma mais central. Foram excluídos livros, capítulos de livros, artigos de conferência e *working papers*, assim como aqueles que tratavam do assunto com pouca profundidade.

Analisamos a literatura encontrada para identificar temas comuns, e selecionamos narrativas também comuns entre estes artigos. Os temas foram definidos em um nível mais analítico e teórico a partir de uma leitura aprofundada dos artigos (GIBBS, 2007). Depois disso, discutimos as limitações desta literatura. Desenvolvemos então uma estrutura conceitual baseada na proposta de Jasanoff de "tecnologias de humildade" (2003b; 2007) para criar novas relações entre as questões de pesquisa, o conhecimento produzido e os aspectos teóricos em questão (MCGREGOR, 2018). Finalmente, indicamos alguns estudos para ilustrar os pilares propostos por Jasanoff.

Em essência, este trabalho é baseado em uma abordagem construtivista de uma "interface ciência-política-socidade" na literatura do nexo. A abordagem construtivista que nos baseamos é a da própria Jasanoff (1996), que se coloca como um caminho para a compreensão coletiva das controvérsias a serem investigadas e restabelecer a base para a autonomia científica

dentro de um escopo democrático. A leitura da obra de Jasanoff, assim como outros estudos da área de ciência e tecnologia, ocorreu durante o período de estágio no Science Policy Research Unit (SPRU), da Universidade de Sussex, sob orientação do Prof. Andy Stirling. O plano inicial de estudos foi pensado para abordar de forma mais aprofundada os aspectos do *nexus thinking* na governança dos recursos. As interações durante os meses de fevereiro a maio de 2019 foram cruciais para que as ideias iniciais de pesquisa ganhassem novas características.

3.3. ARTIGO 3

Este trabalho envolve estudo de caso e análise indutiva-dedutiva de narrativas. Buscou-se introduzir dimensões "holísticas" e "categóricas", assim como aspectos de "conteúdo" (LIEBLICH et al., 1998). As narrativas neste artigo envolvem histórias formadas a partir de quadros particulares de um determinado sistema. Elas são determinadas por atores, redes e instituições que definem um problema e promovem caminhos para suas soluções (LIEBLICH et al., 2010). Desta forma, ajudam a compreender certos tipos específicos de ações, estratégias e intervenções, algumas das quais são apoiadas por processos de governança que moldam caminhos de interações entre sistemas sociais, tecnológicos e ambientais (LEACH et al., 2010).

Em relação aos dados primários, vinte pessoas estiveram envolvidas mais diretamente em entrevistas e observação participante. Estas entrevistas foram realizadas tanto individualmente quanto em discussões de grupo. As discussões de grupo tiveram formatos mais abertos enquanto as discussões individuais foram semi-estruturadas. No que diz respeito à observação participante, ela pode ser considerada como um método de pesquisa em que o pesquisador busca se aproximar, ou tornar-se um membro do grupo observado, buscando compartilhar as experiências de vida e compreender hábitos e convenções sociais (NOVAES; GIL, 2009). Entre os envolvidos em entrevistas e atividades observadas diretamente em São Paulo estão 2 técnicos da Secretaria Municipal de Saúde, 1 assessor técnico da APS Santa Marcelina (parceira do PAVS em São Paulo), 4 funcionários da UBS Jardim Maia, 4 moradores e usuários dos serviços de saúde da região do Jardim Maia. Em Guarulhos, foram 2 técnicos da Secretaria Municipal de Saúde, 5 funcionários da UBS Novo Recreio e 2 moradores e usuários dos serviços de saúde do Novo Recreio.

Além disso, foram utilizados dados secundários, tais como informações governamentais disponíveis, estudos sobre o tema e material de mídia. A análise dos dados foi baseada em

métodos qualitativos, como descrito pelas cinco etapas seguintes (CRESWELL, 2014; BUTINA, 2015):

i) organização e preparação dos dados;
ii) obtenção de um sentido geral das informações;
iii) implementação de um processo de codificação usando o software Atlas.ti;
iv) divisão em categorias ou temas (inicialmente 35 códigos, e finalmente 6 categorias principais de narrativas);
v) interpretação dos dados através do framework conceitual "nexus of humility" como um caminho para a Sustentabilidade.

Os municípios de São Paulo e Guarulhos, localizados na RMSP, foram os estudos de caso para esta pesquisa. Em São Paulo, analisamos o PAVS com enfoque na UBS do Jardim Maia, localizada na zona Leste da cidade. Em Guarulhos, analisamos o PAS, com foco na UBS do Novo Recreio, que está localizada na zona Noroeste do município. Estas duas periferias urbanas são caracterizadas por vulnerabilidades sociais, políticas e econômicas. Os locais foram selecionados como casos de interesse neste trabalho por diferentes razões. A seleção de Guarulhos foi uma consequência direta do projeto ResNexus, do qual esta pesquisa é derivada. Um estudo anterior na mesma UBS (GIATTI et al., 2019) contribuiu significativamente para esta pesquisa de doutorado. A seleção de São Paulo é atribuída a uma entrevista com uma das coordenadoras do PAVS, que indicou a região do Jardim Maia por conta dos avanços das atividades do programa na UBS e as vulnerabilidades da região em relação à água, energia e alimentação.

É importante ressaltar que em 2017 o projeto de pesquisa foi aceito e aprovado pelo Comitê de Ética da FSP/USP por meio da Plataforma Brasil (CAAE 69041617.4.0000.542 – Parecer número: 3.733.306), com Emenda realizada em 2019 (CAAE 69041617.4.3001.0086 – Parecer número: 3.792.122). Portanto, as entrevistas e atividades que envolveram mais diretamente as pessoas foram previamente previstas e contaram com a entrega e assinatura de Termo de Consentimento Livre e Esclarecido (TCLE).

4. RESULTADOS E DISCUSSÃO

4.1. ARTIGO 1: THE CONCEPTUAL BASIS OF WATER-ENERGY-FOOD NEXUS GOVERNANCE: SYSTEMATIC LITERATURE REVIEW USING NETWORK AND DISCOURSE ANALYSIS

(Artigo publicado em open access no periódico internacional Journal of Integrative Environmental Sciences, em número especial sobre o nexo água-energia-alimentos)

Autores: Alberto Matenhauer Urbinatti[15]; Lira Luz Benites-Lazaro; Carolina Monteiro de Carvalho; Leandro Luiz Giatti[16].

[15] Corresponding author (albertourbinatti@usp.br).
[16] All authors are from the School of Public Health of the University of São Paulo.

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SPECIAL ISSUE: RETHINKING THE URBAN NEXUS

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The conceptual basis of water-energy-food nexus governance: systematic literature review using network and discourse analysis

Alberto Matenhauer Urbinatti, Lira Luz Benites-Lazaro, Carolina Monteiro de Carvalho and Leandro Luiz Giatti

School of Public Health, University of São Paulo, São Paulo, Brazil

ABSTRACT

In the last decade, the debate on the governance of water, energy, and food (WEF) has intensified, spurring the emergence of the term "nexus governance." In general, the reduction of trade-offs and construction of synergies between WEF have been placed on the scientific, political, and economic agenda. However, although increasingly used, it is difficult to find a clear meaning and definition of what the term represents. Based on a systematic literature review (SLR), using text-mining and machine learning algorithms, this article investigates what are the conceptual basis of the nexus governance debate, and attempts to clarify the main themes, networks, and gaps within this literature. The analysis is based on quantitative and qualitative methods, combining social network analysis (SNA) and discourse analysis (DA). The results highlighted that twenty-four governance-related concepts support this literature, breaking down into eight groups: water and basin governance; environmental and systems governance; risk and resource security governance; economic governance; global governance; urban governance; integrative and cooperative governance; and "epistemic" and transdisciplinary governance.

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KEYWORDS
Water-energy-food nexus; nexus governance; social network analysis; discourse analysis; systematic literature review

1. Introduction

In the last decade, many authors have tried to address the governance of water, energy, and food (WEF) holistically. The concept of WEF nexus has allocated this debate. In general, authors agree that the nexus is defined by the integration capacity of different sectors from generation to distribution in the search for more viable solutions for the planet. This is amid scenarios of inequalities, scarcity, misdistribution, and misuse of natural resources, and uncertainties associated with global changes (Hoff 2011; Dupar and Oates 2012; Reynolds and Cranston 2014; Allouche et al. 2015; Giatti et al. 2016; Lal 2016).

Important events in the last decade fostered the use of the concept, such as the Bonn 2011 Conference, Sixth Edition of Global Risks in 2011, World Water Forum 2012 in Marseilles, Rio+20 in 2012, and Stockholm Water Week in 2014 (Allouche et al. 2015). These conferences addressed integrated solutions in search of global environmental

CONTACT Alberto Matenhauer Urbinatti albertourbinatti@usp.br School of Public Health, University of São Paulo, São Paulo, Brazil

ABSTRACT

In the last decade, the debate on the governance of water, energy, and food (WEF) has intensified, spurring the emergence of the term “nexus governance.” In general, the reduction of trade-offs and construction of synergies between WEF have been placed on the scientific, political, and economic agenda. However, although increasingly used, it is difficult to find a clear meaning and definition of what the term represents. Based on a systematic literature review (SLR), using text-mining and machine learning algorithms, this article investigates what are the conceptual basis of the nexus governance debate, and attempts to clarify the main themes, networks, and gaps within this literature. The analysis is based on quantitative and qualitative methods, combining social network analysis (SNA) and discourse analysis (DA). The results highlighted that twenty-four governance-related concepts support this literature, breaking down into eight groups: water and basin governance; environmental and systems governance; risk and resource security governance; economic governance; global governance; urban governance; integrative and cooperative governance; and 'epistemic' and transdisciplinary governance.

KEYWORDS: water-energy-food nexus; nexus governance; social network analysis; discourse analysis; systematic literature review.

INTRODUCTION

In the last decade, many authors have tried to address the governance of water, energy, and food (WEF) holistically. The concept of WEF nexus has allocated this debate. In general, authors agree that the nexus is defined by the integration capacity of different sectors from generation to distribution in the search for more viable solutions for the planet. This is amid scenarios of inequalities, scarcity, misdistribution, and misuse of natural resources, and uncertainties associated with global changes (Hoff, 2011; Dupar and Oates, 2012; Reynolds and Cranston, 2014; Allouche et al., 2015; Giatti et al., 2016; Lal, 2016).

Important events in the last decade fostered the use of the concept, such as the Bonn 2011 Conference, Sixth Edition of Global Risks in 2011, World Water Forum 2012 in Marseilles, Rio+20 in 2012, and Stockholm Water Week in 2014 (Allouche et al., 2015). These conferences addressed integrated solutions in search of global environmental sustainability.

The relationships between WEF can be defined as follows. Water is needed to generate energy; energy is needed for the supply of water; energy is needed to produce food; food can be used to produce energy; water is needed to grow food; and food transports (virtual) water, usually using energy (Stringer et al., 2014). Thus, any problem in the management of one resource can directly affect the others (Hussey and Pittock, 2012).

Since both governance and WEF nexus have different meanings in the literature, it is a challenging task to understand them together. Nexus governance seems to appear as an umbrella concept for integrated decision-making and solutions for environmental issues. However, although this association is becoming increasingly common, it is not possible to say that it is an already well-defined concept.

A previous non-systematic review on nexus governance was carried out by the Stockholm Environment Institute (Weitz et al., 2017a), which pointed out the main gaps and proposals for the future regarding the governance debate on the WEF nexus. According to the authors, the literature on nexus governance is based on three perspectives: risk, economic rationality, and political economy. First, this is an important contribution, as it is the first effort to categorize seemingly unrelated studies published in recent years. Another working paper (in the Nexus Network Think Piece Series) by Stein et al. (2014) approaches the discussion on nexus governance by developing a foundation for a strategic action perspective. They recognize that nexus challenges are intrinsically linked to the perceptions, interests, and practices of actors, and construct an approach for the relational understanding of nexus governance. They also emphasize the need to address nexus challenges through existing governance arrangements.

Moving forward, in this work we are interested in capturing which are the governance concepts that constitute the literature about WEF nexus governance through a systematic literature review (SLR). It is, therefore, an attempt to understand whether nexus governance can be defined conceptually but also the way this is addressed in the literature. The innovative aspect of this research is to understand the conceptual foundations of nexus governance and decipher the differences found within quantitative and qualitative methods. This includes text-mining tools and machine learning algorithms, Social Network Analysis (SNA), and discourse analysis (DA). Three research questions guided this study:

- What governance concepts constitute nexus literature?
- What are their main themes and networks within the selected articles?
- Which are the research gaps in the nexus-governance discussion?

The paper is structured as follows: In Section 2 we describe the theoretical background of this research; Section 3 describes materials and methods used in this study; Section 4 presents the results of the study; in Section 5 we discuss the results; Section 6 refers to the research gaps; and finally in Section 7 we present the final remarks.

THEORETICAL BACKGROUND

The overlapping of decision-making possibilities is one of the main constraints for nexus governance, which faces the challenge of promoting interaction among pre-existing governance structures (Benson et al., 2015). One idea repeatedly addressed is the need to "break down the silos" (Cairns and Krzywoszynska, 2016). That is, there is progressive encouragement to expand research and policy decisions beyond specialized knowledge and traditional governance structures based on sectors. The possibility that WEF interactions go beyond the siloes can be supported by two concepts: *trade-offs* and *synergies*. Trade-offs analysis may reveal priorities in the governance process and inform locally defined norms of fairness in interventions. Institutional synergies can determine progress in ensuring balance and mitigation of possible rebound effects in environmental planning and management (Kurian et al., 2016). Besides, robust synergy can be defined by knowledge exchange among and across different sectors, enhancement of capacities by key players and the appropriation by agencies and departments of financing and technology (Gregory, 1997). Ultimately, the two concepts present similarities; "trade-offs" refers to a compromise that involves negotiation, while "synergies" means that inter-connection necessitates collective action (Kurian et al., 2016).

Based on this, institutional arrangements and governance structures in the nexus approach can be guided by 1) intersectionality, 2) interactionality and 3) hybridity (Kurian and Kardanian, 2015). These three components are much more uncertain possibilities than achieved characteristics. It would be necessary to change the intersection between material flows, financing and institutions; the vertical and horizontal interaction between economy, politics and society; and the analysis based on hybridity and transdisciplinarity (Kurian et al., 2016). To some extent, this approach interacts with many governance concepts, focusing on integrative governance across diverse sectors and actors.

Governance has increasingly become a fashionable term, gaining traction from the "Our Global Neighborhood" report in 1995 (Commission on Global Governance, 1995). It has also

been the subject of multiple disciplines and kinds of literature, all of which give the term governance different meanings (Kersbergen and Waarden, 2004). At least six different uses were selected, namely as the minimal state, corporate governance, new public management, "good governance," socio-cybernetic system, and self-organizing networks (Rhodes 1996; Pierre and Peters 2000). Despite their use in diverse disciplines, including development studies, economics, political science and international relations, law, planning, geography, business administration, public administration, sociology, and history. However, the concept could precisely connect different disciplines and thus stimulate comparisons between quite different phenomena (Kersbergen and Waarden, 2004). Essentially, governance was portrayed as socio-political and understood to have complex processes and interactions, constituting patterns of law (Bevir, 2011; Benites-Lazaro et al. 2018a). "It replaces a focus on the formal institutions of states and governments with recognition of the diverse activities that often blur the boundary of state and society" (Bevir, 2011, p.2).

Thus, following the work of Stoker (1998), governance can be understood as a set of institutions and actors beyond the boundaries of government. The term identifies different responsibilities for tackling social and economic issues, as well as power dependencies involved between institutions. In addition, governance can represent an autonomous self-governing network of actors, recognizing capacities beyond the control of the government but also seeing the latter as able to use new tools as a guide (Stoker, 1998).

MATERIALS AND METHODS

METHODS

In this study, we first performed social network analysis (SNA), a tool that facilitates communication between a group of actors (individuals or organizations) called nodes. Nodes are coupled by some common ground, such as interests, financial exchanges, friendships, dislikes, knowledge, prestige, etc. SNA operates on many levels, from family relationships and disease-spreading to the level of corporate strategies, social movements or even nations. This method is a way to re-incorporate context and bridge the gap between the micro and the macro, the cells constituting the animal, the individuals constituting groups, or the actors constituting a political system. This also allows researchers to retain the traditional units of recording, while

simultaneously broadening the perspective by including information about the relationships across these units. This additional structural information allows researchers to address existing research questions using new tools, approaching them from a different theoretical perspective (Benites-Lazaro et al., 2018b). Second, discourse analysis (DA), which consists of a set of techniques for the structured research of texts. It is "the study of language-in-use and is employed to engender a range of meanings varying from the analysis of linguistic regularities to the normative quality of discussions" (Benites-Lazaro et al., 2018b, p. 320). Similar to Benites-Lazaro et al, (2018b) in this study, we used a mixed-method for the DA, in order to take advantage of both qualitative and quantitative techniques. It assumes that, both, the number of word repetitions performed by software and the exploratory lexical patterns, play important roles in textual analysis. The analyses were deemed necessary to cope with the in-depth examination of twenty-eight articles. The aim was to find community and a relationship among themes, surrounding nexus governance and discovery patterns, and extract elementary contexts. Through this, a qualitative analysis could be conducted to identify the context of predominant discourses on nexus governance.

MATERIALS

The data collected are articles from the database of Scopus, Web of Science and Science Direct over the period 2007-2018 with the keyword "water-energy-food nexus" and "water-energy-food nexus AND governance." The results of the collection were 1455 articles (N_1=1455). The SLR was performed in two steps. First, we cleaned the duplicate articles. After this, we applied to this big data the open-source software *Gephi* for visual exploration of networks and compute centrality measures. This is a network analytic tool that is used to represent the nodes (themes) and edges (relationships) in a network to analyze the network data (Benites-Lazaro et al, 2018c). Second, the searches were deepened using *T-Lab* software, performing text-mining and machine learning to select only articles in English that focus on "water-energy-food nexus AND governance" in titles, abstracts and keywords in the same period (2007-2018). We did not consider papers that dealt with only one or two elements of the nexus, such as only "water" or "water-energy": the three elements would need to appear together. Moreover, books, book chapters, working papers, conference papers, and reports were excluded. The N_f is twenty-eight papers.

DATA ANALYSIS

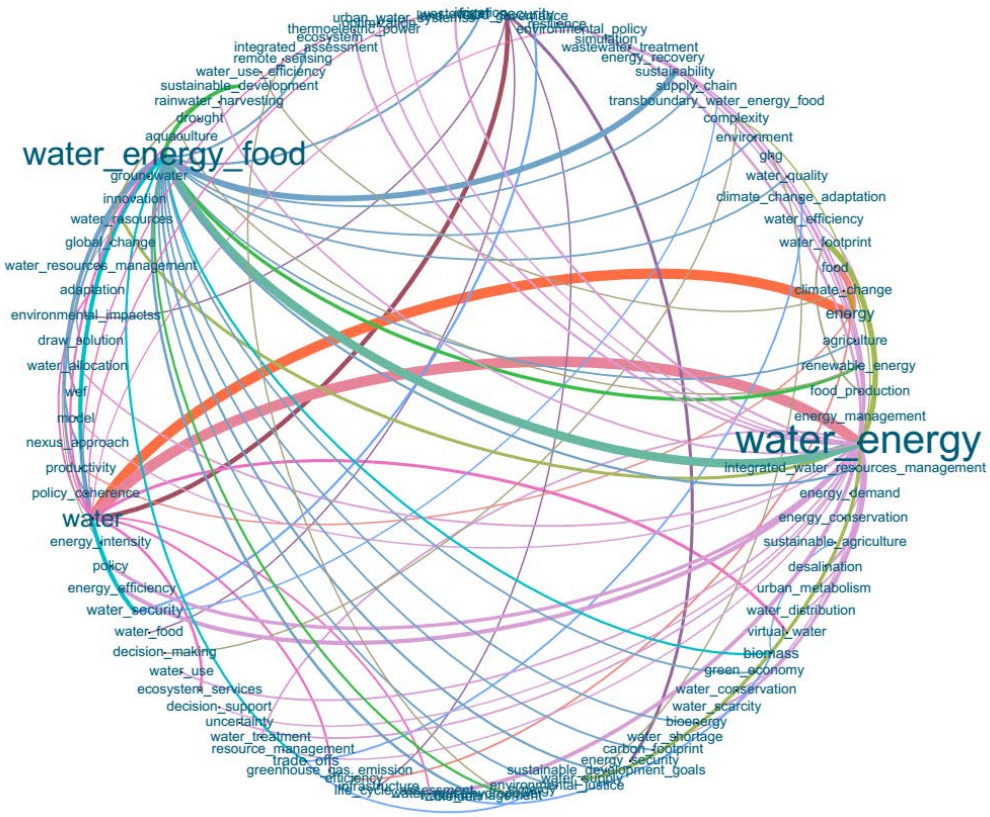
Quantitative and qualitative analysis were performed using the *T-Lab* software. This program uses a set of statistical, linguistic, and graphic tools to analyze texts (Lancia, 2012). In general, the steps of this software are the processing of documents creating a database, its transformation creating a target data, text mining discovering patterns and, finally, the interpretation that creates knowledge. One advantage is that it facilitates mixing qualitative and quantitative methods, performing a quantitative treatment of textual data, and enabling a qualitative analysis of the results to understand the discourse (Benites-Lazaro et al., 2018a). The adjacency matrix of the network (a matrix where each element [i, j] is equal to the weight of the arc from Node i to Node j was performed, using *T-Lab* software. This included: i) an ego network analysis (ENA), using *T-Lab* software; ii) discourse analysis (DA), also using *T-Lab* software; and iii) social network analysis (SNA), using the open-source software *SocNetV (Social Network Visualizer)* for visual exploration of the networks.

ENA enables a description of the relationship and role of the "ego" in its social network. The network is composed of one user centering the graph (the ego), all users linked to this ego (called “alters”), and all relations between the alters (Benites-Lazaro and Andrade, 2019). One objective of using this method was to identify the most important themes linked to governance, in the context of the WEF nexus. Hence, a network measure enabled comparing of the centralities of the ego “governance,” in our sample. The result is a mini-network, or immediate neighborhood surrounding an ego that can, perhaps, reveal something important about the theme or social world from the ego’s perspective (Benites-Lazaro and Andrade, 2019). The different metrics of the *SocNetV* are: a) Degree Centrality (DC), which quantifies how many ties a node has compared to other nodes in the network, indicating a measure of actor activity; b) Closeness Centrality (CC), which focuses on how close each node is to all other nodes in the network, that is, nodes with high CC are those who can reach many other nodes in a few steps; and c) Betweenness Centrality (BC) shows that each actor can be interpreted as a measure of potential control as it quantifies just how much that actor acts as an intermediary to others. An actor which lies between many others is assumed to have a higher likelihood of being able to control information flow in the network (Kalamaras, 2019).

RESULTS

SOCIAL NETWORK ANALYSIS (SNA)

Figure 1 shows the SNA applied in the 1455 articles (N_1) to identify the term "governance" within the research in the theme WEF nexus. "Governance" appear with 7 value of frequency. This value is not representative if compared with the topic "water-energy" that has 54 of frequency or topic such as "food security" with 18, and "climate change" with 16 of frequency. The frequency represents the count of the number of times the keyword appears by using the TF-IDF measure. This measure allows us to evaluate the weight of a term (lexical unit) within a document (context unit).



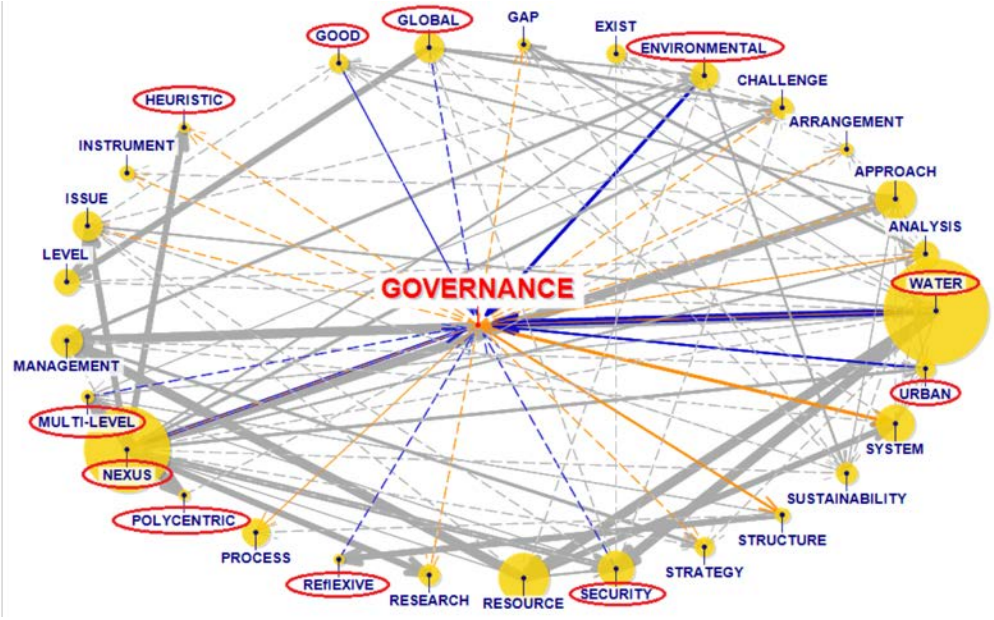
Source: The authors.

Figure 1. The network of subjects on water-energy-food nexus-related research

Keywords	Freq	Keywords	Freq	Keywords	Freq
water_energy	54	sustainable_development	11	climate_change_adaptation	6
water_energy_food	46	virtual_water	10	integrated_water_resources_management	6
water	36	policy	10	water_scarcity	6
energy	32	wastewater_treatment	9	bioenergy	6
sustainability	22	hydropower	9	trade_offs	6
water_footprint	19	ecosystem_services	9	wef	6
food_security	18	energy_efficiency	9	water_resources_management	6
food	17	irrigation	8	environment	5
climate_change	16	water_supply	8	biomass	5
water_resources	13	water_management	8	integrated_assessment	5
renewable_energy	12	**governance**	7	sustainable_development_goals	5
desalination	11	energy_security	7	biofuel	5
life_cycle_assessment	11	drought	7	uncertainty	5
water_security	11	resilience	6	water_use	5

Table 1. Values referring to Figure 1

Figure 2 shows the ego network analysis (ENA) for the word “governance” applied to the $N_{f,}$ highlighting topics with a high probability of predecessor connection such as “water” (0.08 or 8%) follow by the topic “nexus” with probability 5% of links, and topic “environmental” and “urban” with (4%) and (3%) of probability respectively. Topics as successors of governance or those words that appear after the word governance are “system” (4%), “structure” (3%), and “process” (3%). Also, it was possible to identify some of the concepts that most relate to the word governance. They are: "water", "nexus", "environmental", "good", "global", "urban", "polycentric", "multi-level", "reflexive", and "security". This analysis focuses only on the closest connections.



Source: The authors

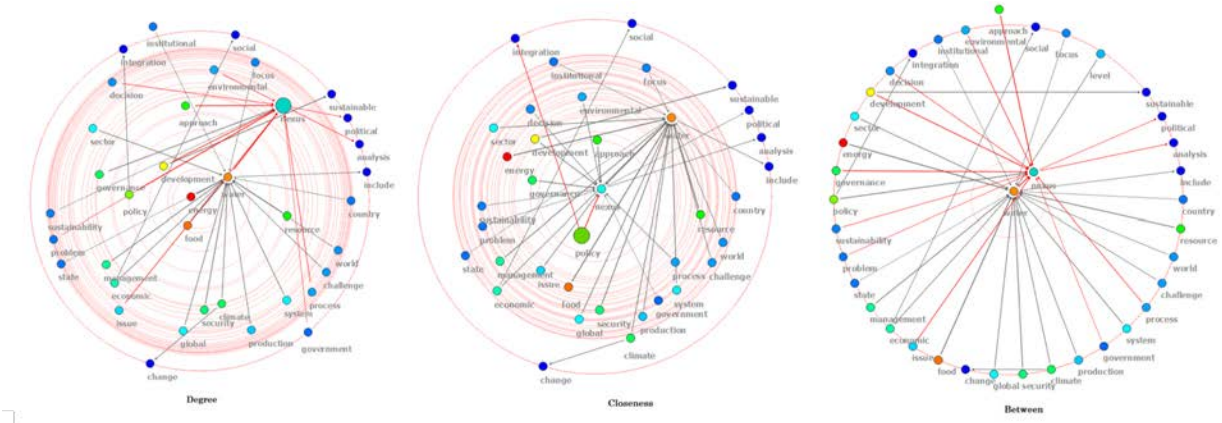
Figure 2. Ego network for the word "governance"

Prob	"Governance" predecessor	"Governance" successor	Prob
0.08	water	system	0.04
0.05	neuxs	structure	0.03
0.04	environmental	process	0.03
0.03	urban	water	0.02
0.02	good	analysis	0.02
0.02	security	approach	0.02
0.02	multi-level	gap	0.02
0.02	global	nexus	0.02
0.02	reflexive	research	0.02
0.01	level	arrangement	0.02
0.01	exist	strategy	0.01
0.01	management	challenge	0.01
0.01	policycentric	mechanism	0.01
0.01	resource	management	0.01
0.01	sustainability	policy	0.01
0.01	different	complex	0.01
0.01	integrate	understanting	0.01
0.01	policy	wef-nexus	0.01
0.01	system	global	0.01
0.01	adaptation	policy	0.01

Table 2. Values referring to Figure 2

While Figure 2 focuses on the network from a single word, Figure 3 shows more diverse groups of words. Figure 3 shows the network analysis employing centrality and connections between themes in the N_f. The three metrics (DC, CC and BC) indicate thirty-eight 'actors' with some degree of centrality. The words "water" and "nexus" are prominent, i.e., those with the highest degree of connection. The word with the highest DC value is "energy," indicating a large number of arches from it; the word with the highest CC value is "nexus;" and the word with the highest BC value is "water," evidencing that it is the main intermediary among the

other actors. From DC and CC it is possible to notice, besides those more frequent words like "nexus," "water," "energy," "food," "approach" and "governance," the most prominent words are "policy integration" and "sustainable development.” In addition, the centrality of the words "climate change" and "economic" in DC, and "environmental," "security" and "management" in CC are highlighted in the table below.



Source: The authors.

Figure 3. Degree Centrality, Closeness Centrality and Betweenness Centrality applied to N_f

Node	Label	DC	CC	BC
1	country	1.136130	5.144472	0.000000
2	resource	5.053780	10.038323	0.000000
3	world	1.423530	5.892662	0.000000
4	challenge	1.529410	6.136923	0.000000
5	process	1.574790	10.585003	0.000000
6	system	2.361340	7.636276	0.000000
7	government	1.000000	8.007078	0.000000
8	production	1.937820	6.953677	0.000000
9	climate	4.057150	6.623620	0.000000
10	security	3.813450	9.211764	0.000000
11	global	2.436970	7.744224	0.000000
12	change	0.000000	0.000000	0.000000
13	food	8.910920	11.399594	0.000000
14	issue	2.119330	12.364489	0.000000
15	economic	3.225210	5.970632	0.000000
16	management	3.541180	8.980117	0.000000
17	state	1.090760	5.013329	0.000000
18	problem	1.151260	8.776500	0.000000
19	sustainability	1.226890	9.134206	0.000000
20	policy	6.174790	13.129889	0.000000
21	governance	4.115970	16.180571	0.000000
22	energy	10.000000	11.624536	0.000000
23	sector	2.527730	7.868926	0.000000
24	development	7.475630	13.542240	0.000000
25	decision	1.393280	9.865136	0.000000
26	integration	0.000000	0.000000	0.000000
27	institutional	1.151260	5.187346	0.000000
28	environmental	1.695800	11.025700	0.000000
29	approach	5.189920	17.357212	0.000000
30	social	0.000000	0.000000	0.000000
31	focus	1.287390	5.554934	0.000000
32	level	1.831930	5.013021	0.000000
33	water	8.610090	13.862694	68.000000
34	nexus	2.680670	24.063813	58.000000

35	sustainable	0.000000	0.000000	0.000000
36	political	0.000000	0.000000	0.000000
37	analysis	0.000000	0.000000	0.000000
38	include	0.000000	0.000000	0.000000

Note: DC range: $0 \leq DC \leq \infty$ (node energy); BC range: $0 \leq BC \leq 1260$ (node water); CC range: $0 \leq CC \leq 0.0277778$ (node nexus).

Table 3. Values referring to Figure 3

SYSTEMATIZATION AND DISCOURSE ANALYSIS (DA) OF THE LITERATURE

The systematization was performed following the qualitative research from the elementary contexts provided by the *T-Lab* software, which allows identifying the context of predominant discourses on nexus governance and the categorization of different concepts that constitute the literature on nexus governance from the different scientific research. Table 1 summarizes the concepts used by the authors, the main focus of the articles, and correlation with nexus governance. This also helps to clarify the relationships resulting not only from DA but also from SNA.

CONCEPT	AUTHORS	FOCUS	CORRELATION WITH NEXUS GOVERNANCE
WATER GOVERNANCE (WG)	Gupta et al., 2013	Literature review on the state-of-the-art of water governance science	It does not go deeper into the concept; it only recognizes that single-sector water governance is not sufficient to regulate land, agriculture, and other issues. It needs to be a cross-sector process.
TRANSBOUNDARY BASIN GOVERNANCE (TBG)	Al-Said And Hefny, 2018	Analysis of regional cooperation in the Eastern Nile Basin	The WEF Nexus approach can be useful for highlighting key neglected issues on interlinked resources, at the basin and regional levels.
INTEGRATED WATER RESOURCE MANAGEMENT (IWRM)	Hagemann & Kirschke, 2017	How to strengthen nexus governance analysis from IWRM experiences	The importance of existing and useful governance strategies as conditions for governance transitions. Governance analysis should refer to different types of problems, contexts, and inter- and transdisciplinary research.
	Benson et al., 2015	Relation between IWRM and nexus	Both IWRM and nexus provide guidance on optical governance. Nexus aim at policy coherence and multi-level interaction, but the concept provides few normative principles on how governance should occur.
SOCIO-ECOLOGICAL SYSTEM (SES)	Giampietro, 2018	Perception and representation of the nexus at the interface between society and the natural environment	The concept of SES lends itself, particularly well, to the purpose of the abandonment of the current technocratic and top-down approach.
	Al-Said & Elagib, 2017	Literature review on WEF nexus	Nexus governance is the missing link in the nexus debate. It holds the promise of needed innovations and reconstructing policy and institutions to tackle issues of resource use and security.
	Villamayor-Tomas et al., 2015	Value-chain and institutional analysis of four irrigation-related cases studies	The conceptual bridge between value chains and institutional analysis would seem well-suited to the challenge of understanding nexus research, given the importance of resource flows and governance dynamics in these coupled systems.
ECOSYSTEM SERVICES (ES)	Pahl-Wostl et al., 2017	Analytical framework, using a network and ecosystem services to identify coordination failures and persistent sustainability problems, as well as leverage points for transformative change	The concept of Ecosystem Services (ES) may help to (a) operationalize the WEF nexus in terms of trade-offs and synergies, (b) develop a common language to negotiate risks, framed according to different logics in different security concepts (c) support the integration of fragmented institutional settings, and (d) encourage negotiation and cooperation among ES users. Thus, if combined with appropriate multi-level governance settings, the ES concept may become instrumental in supporting transformative change, overcoming sustainability deficits in the WEF nexus.

INTEGRATIVE ENVIRONMENTAL GOVERNANCE (IEG)	Weitz et al., 2017 Visseren-Hamakers, 2015	Literature review on the IEG literature	The IEG literature offers analytical insights that could help close gaps in the nexus literature, in relation to the conditions for cross-sector coordination and collaboration, dynamics beyond cross-sector interactions, and political and cognitive factors, such as determinants of change. Since 2010, the IEG literature has turned to the WEF nexus debate. These studies have focused on governance systems, at all levels, prioritizing policies and sectors.
ENVIRONMENTAL JUSTICE (EJ)	Middleton et al., 2015	Mapping of the rise of the WEF nexus as a research, policy, and project agenda, in mainland Southeast Asia.	Introducing the concept of EJ into the nexus, especially where narratives, trade-offs, and outcomes are contested, could make better use of how the nexus is framed, understood, and acted upon.
GLOBAL GOVERNANCE (GG)	Boas et al., 2016	It contributes to the institutionalization of a "nexus approach," in the global institutional setting of the Sustainable Development Goals.	Proposition for the new High-level Political Forum and Global Sustainable Development Report to adopt a nexus perspective. It also emphasizes the importance of designing partnerships that are focused on cross-national nexuses in sustainable development.
GLOBAL FINANCIAL NETWORKS (GFN)	Schimdt & Matthews, 2018	The role of global financial networks in articulating the nexus and connecting it to sustainability programs	The shift from 'state to system' of the nexus structures draws on the repertoire of financial techniques that delineate facts of the world descriptions of complex, adaptive systems—and makes accounts of the integrated dynamics linking economies, environments, and societies.
WORLD GOVERNANCE (WG)	Zisopoulo et al., 2018	It establishes the existence of the WEF Nexus approach, in a more concrete way, and includes proposals for holistic and increased internal structure and for a set of rules, recasting the current role into that of an actor with a Computable General Equilibrium platform.	Rethink the role of an actor with a new quantitative Economic Platform working in a new knowledge-based management system, by employing trade-offs, synergies, acts of influence, intermediation and governance which are suitable to the new state of world governance and its main players.
GOVERNANCE OF GLOBAL RISKS (GGR)	Amorim et al., 2018	Understanding how the global risks impact the nexus between water, energy, and food through a systemic analysis	Risk management can contribute to more effective governance. It also emphasizes the failure of national and regional, or global governance, as geopolitical risk to water, energy, and food.
INNOVATIVE GOVERNANCE OF SHARED RISKS (IGSR)	Gallagher et al., 2016	The policy and research agenda on the WEF nexus needs to consider dimensions of shared risks	The article proposes three points for sustainable development: externalities and shared risks across multiple scales; innovative government mechanisms for shared risks; and negotiating the balance between silos, politics, and power in addressing shared risks.
GOVERNANCE OF NEXUS SECURITY (GNS)	Beck & Walker, 2013	Insights from cross-system mapping to assess the role of city governance in achieving nexus security (or not) and the role of technological innovations in serving the same purpose	High quality governance entails granting access to the debate, for instance, how to manage the man-environment relationship — by each of the three actively engaged parties: individualists (I), hierarchists (H), or egalitarians (E). Each of the three will have a voice in the debate.
URBAN GOVERNANCE (UG)	Artioli et al., 2017	'Urbanize' the nexus agenda and consider the implications of policy integration for urban governance	It is important to take the nexus out of the global resources management debate and resituate it in broader political debates about government transformations in urban measures. Additionally, recognize the nexus as more of a driver policy change than a threat.
COOPERATIVE GOVERNANCE (CG)	Sperling & Raswami, 2017	Review of city case studies to inform a framework, for developing urban infrastructure design standards and policy instruments, in order to achieve energy efficiency and greenhouse gas mitigation through city carbon budgets and water use efficiency	The application of Ostrom's CG principles to city carbon and water budgets. Encouraging systems approaches at the nexus sectors may improve the management of successful "budget-based" approaches across sectors. It also suggests improvements in governance process to carbon and water budgets, such as the development of appropriate incentive, enforcement, and flexible mechanisms, among others.
GOOD GOVERNANCE (GG)	Lele et al., 2013	It uses examples from recent global developments (and from China and India) to place empirical analysis of governance issues at the top of global agenda	Contextualized solutions to challenges of WEF nexus security should be considered. Beyond that, develop an understanding of the roles, and linkages, between policies and institutions at various political and administrative levels. It requires the involvement of all stakeholders, and their collective impacts, on the short- and long-run outcomes.
POLICY INTEGRATION (PI)	Gain et al., 2015	Review of the emerging literature on the water-energy-food (WEF) nexus and, then, analyzes the nexus in the context of Bangladesh	PI is essential for implementing the WEF nexus approach. In this way, inter-ministerial collaboration is required among the Ministry of Water Resources, Ministry of Power, Energy and Mineral Resources, Ministry of Food, Ministry of Environment and Forest, and other relevant ministries and government bodies. Also, collaborative problem-solving processes are required through participation of the different level stakeholders.
			The implementation of the nexus requires an "inter-governance" unit that operates to bridge the gaps between different ministries, while

INTER-GOVERNANCE (IG)	Mohtar, 2016	It examines the governance of the nexus, understanding capacity building and models or tools available to support decision makers.	understanding and implementing the cross-cutting and integrative nature of the nexus.
ORGANISATIONAL GOVERNANCE (OG)	Harwood, 2018	It presents an approach that addresses the complexity that characterizes the WEF nexus in the context of the Mekong River Basin.	The approach of the Viable System Model presents a powerful means to address the complexity of the WEF nexus and, as such, should be used in an appropriate "mess" to demonstrate the reality of its potential. Organizational governance issues are effectively modeled using the VSM, revealing the multi-level perspective and drawing attention to the relevant governance mechanisms.
GOVERNANCE OF SOCIO-TECHNO-ECONOMIC-POLITICAL (STEP) NEXUS SOLUTION	Daher et al., 2018	It presents a framework for resource and stakeholder interactions and trade-offs, addressing governance and financing schemes for carrying forward the implementation of those scenarios	The STEP framework offers guidance through the different elements that need to be accounted for while assessing and promoting a nexus solution. Proposing feasible, implementable, sustainable solutions requires truly inclusive transdisciplinary conceptualization, quantification, and assessment of current and projected resource hotspots.
KNOWLEDGE CO-PRODUCTION (KCP)	Howarth & Monasterolo, 2016	Decision-making in response to shocks to the WEF nexus and barriers to the application of a transdisciplinary approach	Transdisciplinary approaches to knowledge production, such as participatory workshops, helps overcome gaps in the research-policy interface. Also, it is important to understand characteristics of the nexus to build resilience to shocks, thus, tackling risk.
REFLEXIVE GOVERNANCE (RG)	Halbe et al., 2015	Methodological framework to analyze sustainability innovations in the water-energy-food nexus and strategies for governing transition processes in Cyprus	The reflexive governance approach can induce a sustainability transition, and learning processes have to take place, simultaneously, at different levels. Participatory model-building, using the causal loops diagram (CLD), turned out to be a suitable method to systematically analyze stakeholder perceptions on issues in the WEF nexus.
GOVERNANCE HEURISTIC (GH)	Müller et al., 2015	This review article argues for systematic nexus thinking, based on the intrinsically linked systems of soil, water, and biodiversity.	The nexus thinking and landscape lens, in combination with virtual resource cycles, offers an opportunity to address trade-offs and utilize existing synergies to develop pathways towards integrated resource governance. It may serve as a GH to implement the post-2015 Development Agenda in a variety of national contexts. Hence, nexus thinking may serve as a GH for nation states to understand and, subsequently, operationalize the implementation of the post-2015 Development Agenda.
TRANSDISCIPLINARY APPROACHES (TA)	Kurian, 2017	It focuses on implications of the nexus approach for public policy formulation, implementation, and monitoring, and emphasizing the importance of transdisciplinary approaches.	An institutional framework that accounts for the role of the government in shaping individual behavior, with regard to management and use of environmental resources, needs to be delineated. It highlights the need to look at ecosystem and public services. Transdisciplinary approaches have the potential to better shape the translation of scientific results to respond to global challenges.

Source: The authors based on literature review.

Table 4. Concepts, focus and correlation with nexus governance

DISCUSSION

The mixed-methods used in this paper provided diverse possibilities to reflect on the associations found. SLR is an important tool when there is uncertainty about the evidence on a topic, with the main objective of clarifying some issue in a detailed and organized way (Petticrew and Roberts, 2006). The SNA can provide analyses and visualizations of multiple relational measures, such as centrality, to support research hypotheses. In the case of WEF nexus, the SNA has the potential to make visible complex interactions, for example, between financing, technology and leadership in conditions of scale and limits previously defined, showing if the character of the decisions about water, energy and food are coordinated or siloed (Kurian et al., 2018). In this paper, the SNA was used not for physical actors, but for protagonist

words within the text corpus of the twenty-eight selected articles. DA is an important complement to understanding interactions, seeking to identify the relationship between linguistic regularities such as meanings, purpose and negotiations through discourse (Suciu, 2019).

The first network analysis (Figure 1) showed that “governance” is not central in all articles collected primarily. This result illustrates that the concept of governance within WEF nexus research is underdeveloped. Figure 1 shows the predominance in researches of two sectors 'water-energy' or 'energy-water' and 'water-food.' Due to the water-centered nature and trend in many studies, some researchers have criticized that the current analyses of the link are insufficiently intersectoral, or even a new challenge to be consolidated towards integration (Benson et al., 2015). The focus on water alone undermines the original intention of developing an explicit intersectoral perspective and response options to replace the traditional sectors (Smajgl et al., 2016). In addition, isolated sector investments risk prioritizing the goals of one specific sector over others. Integrated analytical approaches that understand the complexity of WEF nexus can identify intersectoral trade-offs and internalize driving forces that might otherwise be overlooked in dual-sector approaches (Miralles-Wilhelm, 2016).

From both Figure 2 and the DA, it was also possible to identify the “water centrism” as the literature on the nexus suggests (Allan et al., 2013; Schimdt and Matthews, 2018). Even though the concept of water governance is not the main concept in most articles, the vast majority recognize this centrality. Those using more focused concepts are Gupta et al., 2013 (water governance), Al-Said & Hefny, 2018 (Transboundary Basin Governance - TBG) and Hagemann & Kirschke, 2017 and Benson et al., 2015 (Integrated Water Resources Management - IWRM). According to Gupta et al. (2013), the global water crisis cannot be solved through technocratic and depoliticized management or engineering processes; it needs a radical political challenge, from a global to the local level (glocal). Since TBG has historically been focused on state and water-related issues, the nexus approach extends the scope to important sectors such as agriculture and energy (Al-Said & Hefny, 2018).

This crucial connection between governance and water is precisely related to a legacy of the Integrated Water Resources Management (IWRM) approach. This concept encompasses many principles with a holistic and systemic view, and while it seems closely related to the nexus concept, it differs in certain aspects (Benson et al., 2015). Two points bridge this relation. First, IWRM was an attempt to create governance reform and integrate water with other policy objectives (Pahl-Wostl et al., 2011; Pahl-Wostl, 2017). Second, IWRM researchers and practitioners have generated important lessons that can help analyze and implement nexus

governance (Hagemann and Kirschke, 2017). Regarding the differences, the one that interests us most is related to governance approaches. Benson et al. (2012, 2015) show that nexus conceptualizations provide few normative principles on how governance should occur, while IWRM is often based on "good governance" principles, fostering transparency, and collaborative decision-making.

The World Bank introduced "good governance" in the 1990s as part of a controversial neoliberal agenda concerning the public sector, but it also brought important incentives to the ideas of representative and responsible government and absence of corruption (Bevir, 2013). However, this term may represent other different ideas, such as an objective solution of policy problems through decision-making, political dimensions of the extension to which decision-making processes are open and democratic, political assessment of the success of decisions, among others (Bevir, 2011).

Although more frequent in IWRM, the discussion on good governance has also recurred in selected papers. In the work of Lele et al. (2013), good governance assumes the merits concerning the enhancement of a personal and collective security sense within a community and its representativeness. Gupta et al. (2013) reinforce that even the fact that good governance has the potential to achieve multi-level coherence, there is tensions and trade-offs between effectiveness, participation and legitimacy. Pahl-Wostl et al., (2017) show the importance of engagement in supporting the design and the implementation of polycentric arrangements and the possibility of enabling good governance principles such as multi-level and coordinated systems of governance.

Also from Figure 2, the word "system" appeared as strictly related to "governance." It is not new to think that the nexus is an interconnected system between WEF. However, it can be deduced that if there is a unit in this literature, it can be tangible from the idea of a "system." It is also not novel to think about the world in a systemic and integrated way, even considering socio-political dimensions. For example, the Harappan civilization, which existed from 3300 to 1300 BC in the Indus Valley, proposed an "Ecological Consciousness." Other examples include "The discourse of the culture of nature" by the Assyrian king Assurbanipal in Mesopotamia (2700 BC) and "The Rig Veda" holistic approach by peoples from north-west India from 1500 to 1000 BC (Lal, 2016). In the last century, we find exponents such as the controversial General Systems Theory by Ludwig von Bertalanffy, who sought to approach holistically from a biological perspective alternatives to the methodological reductionism imposed by the Industrial Revolution (Hammond, 2003). In contemporary times, an example is a great effort made through Earth System Governance and the Sustainable Development Goals

to face climate change in an integrated way. Perhaps the great contribution of the WEF nexus is to bring to the debate different sectors of society, which are often on opposite sides of the debate, in an attempt to incorporate systems thinking into the policy-making process (Bazilian et al., 2011).

What is important here is that the idea of "systems thinking" defines some fundamental concepts in the nexus analyses. For instance, "water-energy-food system," "resource system," "ecosystem service," "socio-ecological system," "management system," "urban infrastructure system" and "viable system models." According to Pahl-Wostl (2017), nexus governance encompasses a broad understanding of governance in terms of political, social, economic, and administrative systems that determine the use of WEF and related service delivery. Harwood (2018) argued that a systems approach faces many challenges such as asking what should be recognized within the system in terms of its boundaries. It is, therefore, necessary to rethink conceptual boundaries to better fit this integration as a natural system to improve the decision-making process (Weitz et al., 2017b). The WEF nexus approach requires new models of analysis based on complex systems thinking (Giampietro, 2018) as well as facilitates the shift of techniques from state to system (Schmidt and Matthews, 2018). This shift takes place, for example, in the repertoire of financial techniques that consider the integrated dynamics linking economies, environments, and societies.

Figure 3 shows that in addition to the prominence of "water" and "nexus," it is possible to identify the centrality of the terms "policy integration" and "sustainable development." Environmental policy integration has been a widely debated concept since the publication of the Brundtland report, in 1987 (Weitz et al., 2017b; Boas et al., 2016). According to Gain et al. (2015), policy integration is essential for implementing the WEF nexus approach. This has been addressed in this literature mainly from the need to expand the levels of governance towards sustainable development. The term "multi-level" becomes important in this context, as shown in Figure 2. Harwood et al. (2018) clarify that governance should be viewed as multi-tiered, nested, and at multiple levels. In other words, cross-scale governance arrangements should be tied to nexus systems integration (Sperling and Raswami, 2017). In contrast, as Artioli et al. (2017) said, policy integration should not be considered to be inherently beneficial; it needs to consider the power relations that shape policy change. That is, it is crucial to understand the negotiation process of possible policy integrations, considering whether, and how, cross-sectoral policies can contribute to universal, equitable, and sustainable access to resources. Sustainable development is one of the debates present in the WEF nexus approach because the concept is closely related with the ecological modernization debate (Wiegleb and Bruns, 2018).

Nevertheless, the Sustainable Development Goals (SDGs) are important bases for the nexus debate (Boas et al., 2016; Pahl-Wostl, 2017; Amorim et al., 2018; Schmidt and Matthews, 2018; Daher et al., 2018).

The nexus literature often relates climate change as an element of the nexus as important as water, energy and food (Benson et al., 2015). Global climate change trends and competitive land-use patterns have dispelled the systemic ability to compensate for increased demand in an integrated manner that is both reliable and orderly (Zisopoulo et al., 2018). It can be said that the dimension of security and risk is closely associated with climate change (Amorim et al., 2018). Gallagher et al. (2016) remarked that risks could be better addressed if policy-makers increased the use of flexible governance mechanisms at multiple scales through the decentralization of authority. In this case, polycentric governance, which gained impetus in the 1960s, and integrative environmental governance can be appropriate concepts to provide it (Visseren-Hamakers, 2015). Weitz et al. (2017b) argued that nexus governance is to some extent a question of environmental governance.

Figure 3 also illustrates the importance of socio-economic perspectives. As Zisopoulo et al. (2018) indicate, socio-economic factors are associated with the structure of the particular economy and actors profile which leads to policy determination. Weitz et al. (2017b) argued that in nexus governance, a technical and administrative matter prevails, which often focuses on optimizing system performance. This is why the WEF nexus is commonly understood from a financial perspective. In general, financialization describes patterns of accumulation that accrue profit. However, Schimidt and Matthews (2018) believe that it is not a defense of capitalism, but a harbinger of how this shift from “state to system” draws based on financial techniques that delineate facts of the world. The possibilities of implementing the nexus are directly associated with saving resources, in other words, financial savings (Mohtar, 2016). This is a relevant feature of the WEF nexus because it brings to the debate important economic actors in the global scenario such as the World Bank and World Economic Forum. Notwithstanding, most authors understand that economic development should be associated with social development, especially of marginalized groups with restricted access to resources (Middleton et al., 2015). “Solutions for such complex, interconnected, and uncertain problems cannot be only technical; they cannot account only for physical resource constraints, or offer only socio-economic, technological, political, or financial interventions.” (Daher et al., 2018, p. 08).

Based on the different methods, it is concluded that eight themes are central to this literature: i) water centrism; ii) systems; iii) policy integration; iv) sustainable development v)

environmental governance; vi) social-economics and management; vii) resource security; and viii) climate change. Finally, as shown in Table 1, twenty-four concepts correlated with nexus governance were identified in the papers analyzed. They use different approaches to look at the same issue, which is the governance of water, energy and food together. In another synthesis effort, it can be said that the concepts related to governance are grouped into: *water and basin governance*; *environmental and systems governance*; *risk and resource security governance*; *economic governance*; *global governance*; *urban governance*; *integrative and cooperative governance*; and *'epistemic' and transdisciplinary governance*.

Source: The authors.

Figure 4. Thematic groups of concepts related to nexus governance

RESEARCH GAPS IN THIS LITERATURE

Three gaps were noted in this review. The first of these is the lack of theoretical approaches that define the concept of nexus governance more densely. According to Figure 1, few of the 1455 papers initially found develop the governance theme within the nexus literature. Most of those who develop merely recommended the necessity of nexus governance, and did not clarify how this should be implemented. In other words, governance has often appeared as a "recommendation". Only twenty-eight articles focused more closely on the topic. The most common strategy was to associate more established concepts of governance theory with the nexus debate. Nevertheless, twenty-four concepts were found as central. On the one hand, this

represents how nexus studies have diversified over recent years. This is convenient, as nexus-related methods may acknowledge ambiguities, complexities, uncertainties, and ignorance to alleviate pressure on appraisal (Stirling, 2015). On the other, it is an opportunity for future theoretical studies on nexus governance to strengthen the concept.

The second gap is related to participatory approaches and methods. Al-Said and Elagib (2017) point out the unclear dimension in the nexus literature regarding the participatory measures needed to achieve policy integration. Gain et al. (2015) propose that ministries should formulate policies in dialogue with stakeholders, experts, professionals, non-governmental organizations (NGOs), and the private sector through participatory approaches. Howarth and Monasterolo (2016) applied a participatory and bottom-up interdisciplinary approach, collecting and analyzing data from workshops in the UK with stakeholders in the field of business and finance, knowledge production, and policy-making, identifying barriers to the nexus. Halbe et al. (2015) indicate participatory model building using Causal Loop Diagrams (CLDs) as a suitable method for analyzing stakeholder perceptions on issues in the WEF nexus and related sustainability innovations. In this way, participatory approaches are promoted as a means to address integrated management problems and support the development of a systemic understanding among sectors and actors to search for innovative ways to cooperate and collaborate. The above examples show that these methods are being applied by some authors, however, in general, the science produced towards the WEF nexus is still little open to different knowledge, such as traditional knowledge.

The third gap follows this argument; it is the lack of critical approaches to the nexus debate itself. Similarly to Williams et al. (2019, p. 663), who questioned "[…] what is the political performativity of nexus thinking?," pointing out that there is little visibility for *nexus politics* and therefore a need for a more progressive concept of integration. In this review, it can be noted that some authors mention the power relations that exist in governance processes, but few of them discuss beyond the institutions and political actors, showing the very power of science being produced in this direction. Hagemann and Kirschke (2017) believe that to address nexus issues in governance, it is necessary to improve inter and transdisciplinary collaboration. Otherwise, one can note barriers due to the lack of involvement of the relevant social science disciplines such as political science, economics, and law in governance analyses. In addition, according to the authors, researchers do not use the results from different disciplines in their work. Transdisciplinary approaches are necessary to implement nexus governance since it encompasses decision-making through horizontal relations, that is, bottom-up approaches,

rather than vertical top-down ones (Stirling, 2015; Kurian and Kardanian, 2015; Howarth and Monasterolo, 2016; Artioli, 2017).

FINAL REMARKS

The innovative character of this research is to approach the governance of the nexus from different and complementary methodologies – SLR, SNA, and DA. In agreement with Stirling (2015), there are no ideal methods for nexus-related challenges, but a requirement for methodological pluralism. This choice helped in addressing the initial questions, as it brought to the nexus governance debate a more in-depth look at articles related to this topic.

Based on the first question (what governance concepts constitute nexus literature?), we have found twenty-four different concepts related to governance, elucidating a diversity of approaches. They were placed in Table 1 from approximations taken from the qualitative methodology. These concepts were mobilized to add to the governance of the nexus and to provide a base for reconsideration, in the future. The main themes of this literature can be categorized into eight groups: i) water centrism; ii) systems; iii) policy integration; iv) sustainable development v) environmental governance; vi) social-economics and management; vii) resource security; and viii) climate change. Similarly, the related concepts were also grouped into eight: water and basin governance; environmental and systems governance; risk and resource security governance; economic governance; global governance; urban governance; integrative and cooperative governance; and 'epistemic' and transdisciplinary governance. And we also found three gaps in this literature: 1) a lack of theoretical approaches that define the concept of nexus governance more densely, 2) the necessity to enhance focus on participatory approaches, and 3) a lack of critical analysis of the WEF nexus perspective.

This paper ends with tree final suggestions. First, it must be assumed that the concept of nexus governance cannot be universally applicable. This means that each context of analysis will have its own governance arrangements for water, energy and food. Second, it is necessary to recognize the diverse conceptual basis on which the concept has been approached. Exactly for this reason, it is a very open concept, based on different points of view and friendly to transdisciplinary approaches. Third, in our opinion, the WEF nexus approach is important in mitigating inequities, and thus, nexus governance must have strong inclusive characteristics to advocate the participation of several stakeholders including the most disadvantaged in the nexus. Here, participatory approaches can enhance the trans-disciplinary perspective for the

nexus, and research or evaluation should incorporate those often left outside formal processes of policy research (Stirling, 2015). Sometimes, more participation means more complexity; however, this complexity seems necessary in facing contemporary environmental problems. Some questions may be asked for future studies: Under what circumstances can we have more inclusive governance processes? What are the possibilities for marginalized actors in decision-making processes to decide which integrations matter? How can these actors become not only consumers but also agents of change?

Understanding the diversity of approaches and methods analyzed here can be an important lesson not only for the nexus debate but also for governance processes. Notwithstanding, given that the literature on nexus governance is focused on the issue of water, it is important to consider the need for more horizontal analysis on resources. This horizontality may also be important in understanding that no scale is more important than the other. The trans-scalar nature of the nexus is an essential characteristic in understanding that no scale becomes sufficient, putting different angles in perspective, and viable interactions will always be the object of political decisions. Particularly in relation to the concept of nexus governance, it should be noted that the debate has reshaped other concepts related to governance within the debate on water, energy and food. But there is still a long way to go to make this concept more robust. There is a need for articles that theoretically contribute to the concept of nexus governance in a more critical way. These may be alternatives to ensure that the concept does not remain restricted to scientific debate, but influences decision-making processes around the planet.

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4.2. ARTIGO 2: 'OPENING UP' THE GOVERNANCE OF WATER-ENERGY-FOOD NEXUS: TOWARDS A SCIENCE-POLICY-SOCIETY INTERFACE BASED ON HYBRIDITY AND HUMILITY

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Autores: Autores: Alberto Matenhauer Urbinatti[17]; Michele Dalla Fontana[18]; Andy Stirling[19]; Leandro Luiz Giatti[20]

[17] School of Public Health, University of São Paulo. Corresponding author (albertourbinatti@usp.br).
[18] School of Public Health, University of São Paulo.
[19] Professor of Science & Technology Policy at the Science and Policy Research Unit, University of Sussex
[20] Associate Professor at the School of Public Health, Department of Environmental Health, University of São Paulo

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Review

'Opening up' the governance of water-energy-food nexus: Towards a science-policy-society interface based on hybridity and humility

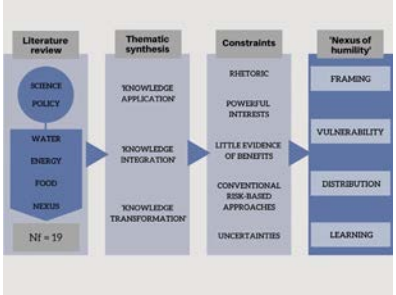
Alberto Matenhauer Urbinatti [a,*], Michele Dalla Fontana [b], Andy Stirling [c], Leandro Luiz Giatti [d]

[a] School of Public Health, University of São Paulo, 715, Dr. Arnaldo Av. - Cerqueira César, São Paulo, SP 01246-904, Brazil
[b] School of Public Health, University of São Paulo, 715, Dr. Arnaldo Av. - Cerqueira César, São Paulo 01246-904, SP, Brazil
[c] Science Policy Research Unit, University of Sussex, Sussex House, Falmer, Brighton, BN1 9RH, United Kingdom
[d] School of Public Health, Department of Environmental Health, University of São Paulo, 715, Dr. Arnaldo Av. - Cerqueira César, São Paulo 01246-904, SP, Brazil

HIGHLIGHTS

- A literature review was conducted on the science-policy interface of 'the nexus'.
- Knowledge is addressed in as 'application', 'integration', and 'transformation'.
- Pressures to 'close down' knowledge remain from the non-recognition of uncertainty.
- Insights to 'open up' are suggested from the 'technologies of humility'.
- Nexus of humility relies on framing, vulnerability, distribution, learning.

GRAPHICAL ABSTRACT



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ABSTRACT

The governance of the nexus between water, energy, and food (hereafter, 'the nexus') is permeated by complex interactions of knowledge at a science-policy-society interface. This paper starts from a literature review to find the main narratives that allow us to understand what is at stake in this interface. By thematically synthesising 19 select articles, we reached three layers of knowledge interaction: 'knowledge application', 'knowledge integration', and 'knowledge transformation'. To avoid misleading simplifications, we discussed the constraints on this debate and some pressures for what we consider as 'closing down' knowledge about the nexus. We then developed a conceptual framework based on the 'technologies of humility' proposed by Jasanoff (2003, 2007) to create opportunities to 'open up' the nexus approach. Finally, we illustrated the four pillars proposed by some studies to describe what we have termed 'nexus of humility': framing, vulnerability, distribution, and learning. These foci seek to enable a humbler appreciation on all sides of the persistent sources of uncertainty, divergence, and conditionality in sustainability governance. This framework also contributes towards necessary transformations of knowledge about nexus and its challenging implementation.

Contents

* Corresponding author.
E-mail addresses: albertourbinatti@usp.br (A.M. Urbinatti), mdallafontana@usp.br (M. Dalla Fontana), A.C.Stirling@sussex.ac.uk (A. Stirling), lgiatti@usp.br (L.L. Giatti).

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ABSTRACT

The governance of the nexus between water, energy, and food (hereafter, 'the nexus') is permeated by complex interactions of knowledge at a science-policy-society interface. This paper starts from a literature review to find the main narratives that allow us to understand what is at stake in this interface. By thematically synthesising 19 select articles, we reached three layers of knowledge interaction: 'knowledge application', 'knowledge integration', and 'knowledge transformation'. To avoid misleading simplifications, we discussed the constraints on this debate and some pressures for what we consider as 'closing down' knowledge about the nexus. We then developed a conceptual framework based on the 'technologies of humility' proposed by Jasanoff (2003; 2007) to create opportunities to 'open up' the nexus approach. Finally, we illustrated the four pillars proposed by some studies to describe what we have termed 'nexus of humility': framing, vulnerability, distribution, and learning. These foci seek to enable a humbler appreciation on all sides of the persistent sources of uncertainty, divergence, and conditionality in sustainability governance. This framework also contributes towards necessary transformations of knowledge about nexus and its challenging implementation.

KEYWORDS: Governance processes; water-energy-food nexus; nexus approach; science-policy interface; Science and Technology Studies; hybridity.

INTRODUCTION

The advent of growing academic and policy attention to a combined ‘water, energy, and food nexus’ (‘WEF nexus’ or ‘the nexus’) has been helpful in addressing the pressing needs for ‘joined up’ cross-sectoral actions (Allouche et al., 2015). Central to the ‘WEF nexus’ is the idea of deeply interconnected systems which are subject to radically growing pressures from expanding population and material consumption (Covarrubias, 2019). Moreover, intensifying climate disruption increases the uncertainties and conflicts in associated governance challenges. To operate in such systems while addressing the pressures, the nexus approach seeks to overcome the current lack of engagement between the systems of provisioning, that is, ‘breaking down the silos’ (Cairns and Krzywoszynska, 2016; Giatti et al., 2019). Such approaches attempt to articulate governance practices in different sectors, which have historically been governed quite separately (Bazilian et al., 2011; Hoff, 2011).

The scientific evidence on the nexus has increased steadily over the last decade (Wiegleb and Bruns, 2018), and the concept has been borrowed by different disciplines to serve a variety of objectives in different geographical contexts and through the adoption of the most diverse methodologies (Endo et al., 2020). However, other scholars point out that, although technical understanding of the nexus continues to improve, this has not resulted in effective and implementable policy (van Gevelt, 2020); how to transfer the concept from a theoretical framework into an integrated approach and policy is still under discussion (Del Borghi, 2020). Van Gevelt (2020) suggests moving beyond an apolitical and positivist conceptualisation of the nexus to bridge the science-policy divide.

This interface is highly complex, as there are two different institutional logics. The boundary between them is becoming increasingly blurred, and recursive rather than unidirectional relationships dominate (Eeten, 1999; Weingart, 1999). These interactions are still under-explored in nexus literature and concerns not only knowledge in politics, but also politics in knowledge within the power dynamics applied to the governance of the 'WEF nexus'.

To contribute to this debate, the questions that motivate this study are: What are the main themes and narratives that seek to bring nexus-oriented science and policy together? What are the constraints on this discussion? The objectives of this paper are: first, to advance the understanding of the conceptual and theoretical discussions of 'the nexus' in its interrelationship between the science and the political decision-making processes; second, to provide insights for the development of a broader analytical and conceptual framework that seeks to 'open up' the approach, as we will explain later.

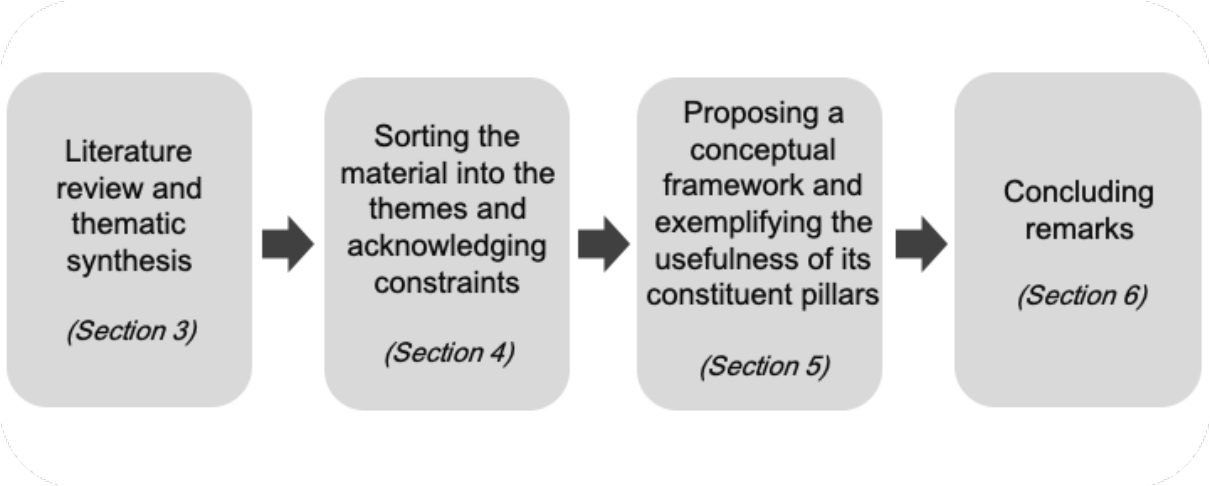
RESEARCH DEVELOPMENT

A literature review was conducted using the Scopus platform. The search was carried out using the keywords 'science AND policy OR science-policy OR science AND politics OR science-politics' AND 'water AND energy AND food AND nexus' in titles, abstracts, and keywords. There was no specific time period. Initially, 50 original articles and reviews on the subject were found (Ni). From perusing the abstracts, keywords, and application of the inclusion and exclusion criteria, we arrived at 19 articles (Nf). The inclusion criteria refer to those research and review articles that address the relationship between science and policy in the nexus debate in a more central way. Books, book chapters, conference papers, and working papers were excluded, as well as those that dealt with the subject in little depth.

We analysed the literature found to identify common themes, and selected common narratives between these articles. They were defined on a more analytical and theoretical level from an in-depth reading of the articles (Gibbs, 2007). After this, we discussed constraints of this literature. We then developed a conceptual framework based on Jasanoff's proposition of 'technologies of humility' (2003; 2007) to create new relationships between the research questions, the knowledge produced, and the theoretical aspects in question (McGregor, 2018). Finally, we indicated some studies to illustrate the pillars proposed by Jasanoff.

In essence, this paper is based on a constructivist approach of a 'science-policy interface' in the nexus literature. According to Jasanoff (1996), a constructivist approach is a path to the collective understanding of controversies, to address issues to be investigated, and to re-establish the basis for scientific autonomy within a democratic scope. The methodological flowchart can be seen in Figure 1.

Figure 1. Methodological flowchart

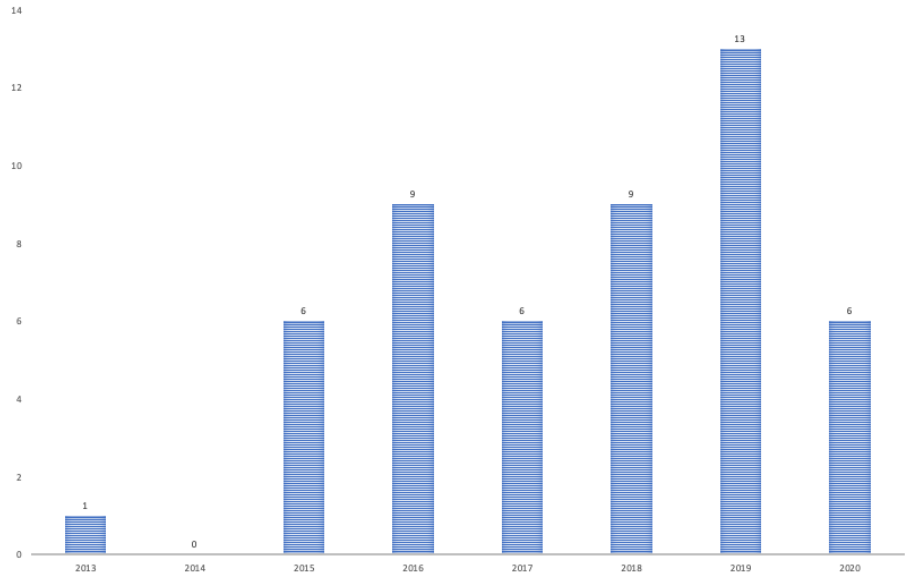


Source: The authors.

LITERATURE REVIEW AND SYNTHESIS

We consider Scopus as a pluralistic base that can meet our demand of trying to understand qualitatively the relation of nexus within the science-policy-society interface. Figure 2 shows the total initial number of publications (Ni) found on the Scopus platform. The year 2019 stands out from the others.

Figure 2. Total number (Ni) of publications per year



Source: The authors.

Table 1 shows the relevant articles selected for this discussion (Nf = 19) with their main narratives of interest.

Table 1. Literature review of science-policy interface in the nexus approach

Authors	Title	Key narratives
van Gevelt, 2020	The water–energy–food nexus: bridging the science–policy divide	*'[K]ey to bridging the science–policy divide is introducing a political dimension into our understanding of the WEF nexus' (p. 6).*
Foden et al., 2019	The water–energy–food nexus at home: New opportunities for policy interventions in household sustainability	*'[W]e consider how social practice and geographies of household sustainability research might be combined with the dictum of "nexus thinking" to re-imagine the framing of policy and intervention' (p. 406).*
Mercure et al., 2019	System complexity and policy integration challenges: The Brazilian Energy- Water-Food Nexus	*'A Nexus approach to science-informed policy-making must involve, primarily, an effort to integrate and condense existing knowledge in all of the domains concerned, to be delivered to decision-makers, in digestible form, across the various scales of governance in Brazil' (p. 241).*
Di Felice et al., 2019	An alternative to market-oriented energy models: Nexus patterns across hierarchical levels	*'[A]t the science-policy interface, the model may be used as a heuristic tool to inform decision-making, moving away from a paradigm of science speaking truth to power, and towards the co-production of knowledge among scientists, policymakers and other stakeholders' (p. 440).*
Bielicki et al., 2019	Stakeholder Perspectives on Sustainability in the Food-	*'[T]his work suggests that distinctions between the importance of one aspect (e.g., data) and another (e.g., policy) may be artificial,*

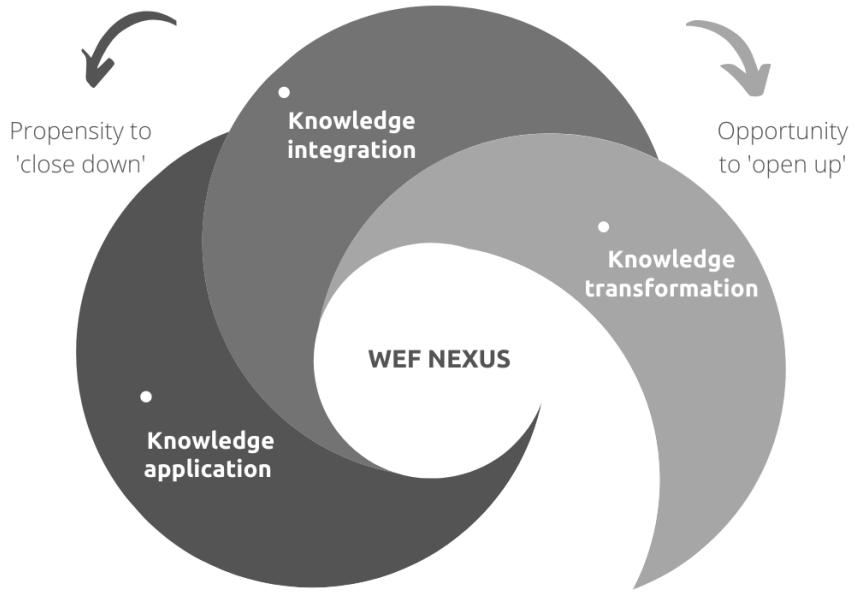
	Energy-Water Nexus	*and that proper attention must be given to the nuances of the issues, the policies, the people and their interests, and the physical, economic, or social systems that are involved' (p. 16).*
Yung et al., 2019	How Methods for Navigating Uncertainty Connect Science and Policy at the Water-Energy-Food Nexus	*'By keeping uncertainty transparent, political processes remain just that: deliberative, based on human judgments, and subject to democratic processes, rather than dictated by unproblematic "scientific facts" that ignore and conceal uncertainties' (p. 6).*
Brouwer et al., 2018	The Nexus Concept Integrating Energy and Resource Efficiency for Policy Assessments: A Comparative Approach from Three Cases	*'[T]he nexus concept provides integrated knowledge for cross-sectoral decision making and planning, with an explicit focus on biophysical, socioeconomic, and policy interactions across sectors (including trade-offs and synergies), leading to more efficient strategies for a resource efficient Europe' (p. 16).*
Karnib, 2018	Bridging Science and Policy in Water-Energy-Food Nexus: Using the Q-Nexus Model for Informing Policy Making	*'Using the Q-Nexus Model offers an example on how to bring inputs from science to inform policy-making to converge toward effective planning and development of WEF systems' (p. 4908).*
Blake et al. 2018	Soil erosion in East Africa: an interdisciplinary approach to realising pastoral land management change	*'[T]he implementation gap, i.e. between policy makers and practitioners, was bridged by engaging local stakeholders in the co-design of land management policies' (p. 3).*
Endo et al.., 2018	Describing and visualising a water-energy-food nexus system	*'[W]e re-created the WEF nexus system maps with a focus on human beings and society to visualise human–nature interactions in the WEF nexus system as a potential tool for a science–policy–society interface' (p. 15).*
Howarth and Monasterolo, 2017	Opportunities for knowledge co-production across the energy-food-water nexus: Making interdisciplinary approaches work for better climate decision making	*'[W]e reverse the siloed and linear narrative on climate decision making opening a window of opportunity for further design, development and implementation of measures through a bottom-up approach that allows nexus stakeholders to have their voice in the policy discussion, increasing nexus actors' commitment and thus contributing to policy effectiveness' (p. 109).*
Hagemann and Kirschke, 2017	Key Issues of Interdisciplinary NEXUS Governance Analyses: Lessons Learned from Research on Integrated Water Resources Management	*'[I]nter- and transdisciplinary collaboration should be strengthened in NEXUS governance research. This relates to single researchers as well as to the relevant implementation agencies, and scientific and donor organisations. Such intensified collaboration should aim at well-matched analyses of problems in particular' (p. 5).*
Wichelns, 2017	The water-energy-food nexus: Is the increasing attention warranted, from either a research or policy perspective?	*'The water-energy-food nexus is compelling to many observers, yet it is not clear that the nexus is sufficiently rigorous to guide scientific research or policy analysis. It is also not clear how one would determine which research and policy analysis represents a nexus approach, or if such a designation would be meaningful' (p. 121).*
Al-Saidi and Elagib, 2017	Towards understanding the integrative approach of the water, energy and food nexus	*'The idea behind the nexus is to look at the interdependent resource issues of water, energy and food using an integrated framework in scientific analysis and policymaking. Yet, there is no uniform way to do this. Two questions are thus open: First, how should the 'process of integration' look like, i.e. which links should be examined and at which stage of the management value chain? and, second, how should the 'state or view of integration' look like, i.e. in which institutions and by which actors?' (p. 1134).*
Cairns and Krzywoszynska, 2016	Anatomy of a buzzword: The emergence of 'the water-	*'We have questioned the integrative imaginary' underpinning much of the nexus discourse, and argue that attending to*

	energy-food nexus' in UK natural resource debates	*questions of power (of sectors, disciplines, forms of legitimate knowledge, stakeholders) is a crucial but often underplayed aspect of integration, and inadequately addressed by many actors in the nexus debates' (p. 169).*
Grenade et al., 2016	The nexus: reconsidering environmental security and adaptive capacity	*'The strength of nexus research lies in its reliance on an integrative approach to scholarship and policy development. However, nexus research's narrow focus on a few selected resources limits its potential to adequately engage the multiple systems needed to sustain human wellbeing in its complex interdependence with the environment' (p. 16).*
Mohtar and Lawford, 2016	Present and future of the water-energy-food nexus and the role of the community of practice	*'The WEF NCoP can help develop a global science-policy platform for sharing data, knowledge, and best practices' (p. 196).*
Keskinen et al., 2015	Water-Energy-Food Nexus in a Transboundary River Basin: The Case of Tonle Sap Lake, Mekong River Basin	*'At a more theoretical level, the study provides an opportunity to discuss the pros and cons of a nexus approach in terms of both research and science-policy-stakeholder interaction, also making use of the authors' previous research experience in the area' (p. 5426).*
Verhoeven, 2015	The nexus as a political commodity: agricultural development, water policy and elite rivalry in Egypt	*'Though the technocratic paradigm suggests that the nexus is what you make of it, this paper has underscored that it is vital to understand that there is no nexus (singular) but only multiple, socially constructed nexuses' (p. 371).*

Source: The authors, based on a literature review.

Figure 3 shows three different layers of interaction between science and policy interpreted from the narratives in the selected articles. From the analytical thematic definition, we defined three layers of interaction: (1) 'knowledge application', (2) 'knowledge integration', and (3) 'knowledge transformation'. The first is a direct interaction of scientific knowledge with political decisions, in which one can find technocratic characteristics and propensities to 'close down' knowledge. The second is the assumption that there must be a dialogue between different sectors of science, policy, and society in general. The third is the proposal that, besides being integrated, knowledge needs to be transformed from a collective production to create opportunities to 'open up' knowledge about the nexus.

Figure 3. Different layers of science-policy interface on the nexus approach based on the narratives in the articles



Source: The authors.

DISCUSSION

LAYERS OF KNOWLEDGE INTERACTION AT THE SCIENCE-POLICY-SOCIETY INTERFACE

The challenges posed by interactions between science and policy can be seen in different layers in the literature on nexus. It can be said that the first layer of interaction is based on the application of knowledge about the nexus. This means that nexus-oriented science can be applied in political decision-making contexts.

Most papers bring a critical approach to this assumption. For example, Cairns and Krzywoszynska (2016) understood the nexus as being 'matters of concerns' instead of 'matters of fact'; Wichelns (2017) stated that the lack of a common definition makes the nexus problematic when applied empirically; and Verhoeven (2015) and van Gevelt (2020) criticised the 'technocratic paradigm'. If the technocratic question perceives science as being the main basis for political commitments (Millstone, 2007), we can find traces of this applicability of knowledge from a ready-made model, like the Q-Nexus Model (Karnib, 2018), as well as in the

recommendation made by Mercure et al. (2019) that knowledge about the nexus must be in a 'digestible' form to reach decision makers. Even if the nexus is framed in proposals such as the Regulatory Impact Assessment (RIA), there is no guarantee that better policies will occur because there will still exist a certain degree of positivism and limitations to cost-benefit analysis (Carroll, 2010). Nevertheless, a robust science does not imply effective policy implementation towards ‘the nexus’ (Kurian, 2017).

The second layer that is common in these studies is 'knowledge integration'. This is a crucial topic in WEF nexus discussions in general due to the new opportunities for interaction between different ‘sectors’ and ‘actors’ (Urbinatti et al., 2020). Brouwer et al. (2018), for example, proposes the integration of knowledge from existing models, such as the so-called E3ME, with System Dynamics Modelling approaches to allow the nexus concept to be implemented. Grenade et al. (2016) states that the strength of nexus lies in its reliance on an integrative approach to the development of researches and policies. Cairns and Krzywoszynska (2016) and Al-Saidi and Elagib (2017) criticise the integrative imaginary of nexus for not showing explicitly the political forces behind this integration.

The third layer is the 'knowledge transformation'. This is a reference to propositions that encompass society at the science-policy interface. That is, essentially participatory approaches are more willing to not only apply and integrate knowledge, but also transform it from various sources of knowledge. As Di Felice et al. (2019) stated, this is a way to go beyond 'speaking the truth to power'. It would therefore be a bottom-up co-production of knowledge, giving voice to the different actors involved (Howarth and Monasterolo, 2017). Transdisciplinary processes can also be associated with this layer (Hagemann and Kirschke, 2017).

ACKNOWLEDGING CONSTRAINTS AND PRESSURES TO 'CLOSE DOWN' KNOWLEDGE

This section addresses some constraints on this debate on nexus. First, there is a danger that claimed nexus application, integration or transformation will merely be rhetorical. Providing a broader platform for persistent interests whose inertia can only be overcome by direct political challenges is not powerful enough to achieve. Therefore, it is important to recognise that no amount of reference to coherence can count as a reformulation of historically entrenched interests or established governance structures. Application, integration, and transformation would involve surrendering the hard fought-privileges (Mohtar, 2016).

Second, more expansive knowledge production across different strategic fields risk increasing the danger that of domination of wider areas of science and policy by particular powerful interests. Power is not a singular discrete static ‘thing’, but a multidimensional set of processes and relations (Healey, 2003). There is, accordingly, no guarantee that any given sectoral concentration of power will remain confined to this setting and leave cross-sectoral governance free of domination. The dangers have long been understood in individual areas of regulation, which are routinely recognised to be subject to processes of capture by the interests they are supposed to be balancing. Therefore, diversity of sectoral decision-making arenas can help defend against particular industrial interests. As sectors are integrated, they can become more vulnerable to deeper and more comprehensive capture.

Third, even without these types of re-concentrations of power, there is still relatively little basis for assuming that any given 'nexus solutions' will prove beneficial in terms of wider public interests (Cairns and Krzywoszynska, 2016). Whether or not this is the case depends on other factors beyond integration. If the integration of science and policy formulation is associated with a reduction in the understandings and interests influencing the policy process, then particular integrated policies will be subjected to similar pressures that affect decision making in individual silos.

Overall, the dynamics of power-in-knowledge make the science-policy interface highly controversial. The political value of knowledge as a means to justify decisions and the particular authority of science in this regard (Collingridge, 1980; Genus & Stirling, 2018) makes production and interpretation of research for policy-making especially subject to dispute. These dynamics have been under-scrutinised as a result of the tendencies, which they themselves help foster, to treat the relationship between science and policy in simplistically normative and instrumental ways (Owens et al., 2006). In other words, pressures to 'close down' knowledge. Even cross-cutting coherence can drive new divisive forms of closure.

Political, economic, and disciplinary pressures for justification systematically force scientists and policymakers to emphasise the apparently more tractable conditions of ‘risk’. Nonetheless, conventional policy definitions of ‘risk’ (as probability-weighted magnitudes) intrinsically imply three other distinct conditions: uncertainty (a lack of confidence in probabilities), ambiguity (a lack of agreement on magnitudes) and ignorance – where ‘we don’t know what we don’t know’ (Wynne, 1992). This indicates the inherent status of ‘incertitude’ (Stirling, 2010; 2011). Under ‘incertitude’, the relevant bodies of knowledge are acknowledged to be so under-determining of decisions, that there can be no confidence in any particular single probability distribution across possible outcomes.

The consequences of externalised residual uncertainties, ambiguities, and ignorance are picked up by social actors lying outside the expert and sectoral interests, which inform and perform the calculations. The pictures of ‘the nexus’ thus produced in different layers of knowledge interaction are highly socially constructed, but in ways that the positivist idiom of ‘sound science’ for business models makes difficult to see. We discuss below how Science and Technology Studies (STS) — particularly from the concept of 'technologies of humility' — can contribute to a new conceptual framework.

PROPOSING A CONCEPTUAL FRAMEWORK

INSIGHTS FROM THE 'TECHNOLOGIES OF HUMILITY' TO 'OPEN UP' KNOWLEDGE

Science and Technology Studies (STS) have made significant contributions to broadening and enhancing more robust understandings of the science-policy-society interface. For instance, scientific knowledge production and the evolving dynamics of policymaking are recognised as aspects of the same process (Raman, 2014). This ‘hybrid’ quality of interactions between science and policy addresses the implications of complexity and uncertainty noted earlier. Complexity and hybridity are themselves the features of subjective processes of knowledge, as what is objectively known. Attempts either in the name of ‘science’ or ‘democracy’ to separate expertise and politics can erode the qualities of rigour and accountability in the resulting politics (Jasanoff, 1994). Unless these attempts are recognised more as compounding the problem than offering ‘solutions’, notions of the ‘WEF nexus’ must be understood as political-scientific hybrids.

Unlike Latour's (1993) observation that the purification of nature and society is the central movement of modernity, Jasanoff suggests that this movement lies in the continuous production and reproduction of epistemic, material, and normative hybrids that constitute worlds (Willems, 2014). In this broad context, Jasanoff's (2003) objectives in proposing the idea of ‘technologies of humility’ are to emphasise the possibility of unanticipated consequences, make explicit the normative character hidden behind scientific techniques, and recognise from the beginning the need for a plurality of points of view and collective learning. The following quote illustrates these objectives. ‘How should policy-makers deal with these

layers of ignorance? The short answer is with humility, about both the limits of scientific knowledge and about when to stop turning to science to solve problems' (Jasanoff, 2007, 33).

The general idea of humility is complementary to the existing emphasis on 'sound science' as a basis for policymaking on the 'WEF nexus'. It urges parallel responsibilities to reflect on the processes of politics inside science, avoid artificial closure of uncertainties, consider ethical issues, understand people's vulnerabilities, expand attention to diverse contending alternatives, examine the promised benefits and risks, actively promote social learning processes, and balance against the shaping effects on the interests of the scientific community, governments, industry, and society (Jasanoff, 2007). Towards these ends, Jasanoff (2003, 2007) proposes four pillars for realising 'technologies of humility': framing, vulnerability, distribution, and learning. The next section reflects on how these pillars can correlate with 'nexus governance'.

'NEXUS OF HUMILITY': PRACTICAL IMPLICATIONS OF MULTIPLE HYBRIDITIES

Here, we discuss the complexity of the governance of 'the nexus' through what we call the 'nexus of humility' framework. This framework seeks to recognise the many crucial dimensions of hybridity in contemporary ideas of the nexus. These dimensions reside in the complex ways via which an individual focus on water, food, or energy will tend to frame the world differently. Within each of these domains, a further host of divergent perspectives does the same. Thus, a consequence of recognising the radical nature of this hybridity is that possible modes, and forms of integration and coherence must be recognised as radically plural. To accept these general imperatives does not imply that there can ever be a single definitive 'best integrated' or 'most coherent' picture. It is this irreducible multiplicity that makes humility such an important quality in knowledge 'application', 'integration', and 'transformation'.

The importance of hybridity emerges in a deeper form out of this dilemma. The WEF nexus is at the same time hybrid in its objective and subjective focus. There are important benefits from the more holistic 'objective' discipline of apprehending interacting water, food, and energy systems together. Rather than allowing the accrual of benefits from fuelling the assumptions about the resulting robustness of more holistic views, what this enjoins is a further form of humility — all the trickier for being associated with a more ostensibly comprehensive picture.

Equal participation of different stakeholders is imperative not because it yields a singular objective and authoritative understanding. Rather it enables a greater, humbler appreciation on all sides of the persistent sources of uncertainty, divergence, and conditionality. Jasanoff's work states that 'technologies of humility' are needed to make this embedded knowledge more clear, transparent, accountable, responsive, and reflexive of the most vulnerable social interests.

FRAMING

Regarding framing, Jasanoff (2003, 2007) shows the importance of analysis that considers the full extent of the problem. For example, if a problem is addressed too tightly or superficially, there are inevitable consequences for the decision-making process. Therefore, it is necessary to establish a wider— preferably democratic— debate, values, and interests that shape the framework through which understandings of the WEF nexus are produced.

To attend to framing is not merely about clarifying the scale or space characterising a given 'nexus problem'. There exists no ideal scale at which a given problem can be addressed. Thus, there is no scale at which the challenges of framing do not yield alternative, equally valid understandings. As Gupta et al. (2013, p. 573) show in their use of the concept of 'glocal' processes, highlighting 'potential conflicts and synergies between formal and informal systems, between hierarchical and local systems, and between economic power and social values', this cross-scalar nature is a further aspect of the hybridity of the nexus concept. Rather than upholding pre-set categories of domains for joining different types of expertise, recognition of the importance of framing introduces a challenge to nurture more extensive, equal, and diverse discussions among all relevant social actors – whatever notional categories they might be assigned to. This especially includes the least powerful communities who are most likely to be excluded.

Again, such challenges of divergent framing are routinely identified in choices over the interconnections between the resources such as water-energy in the Middle East and North Africa (Siddiqi and Anadon, 2011), land-water-food in the case of biofuels (Benites Lázaro et al., 2020; Rulli et al., 2016), or the land use-climate change-energy nexus (Dale et al., 2011). Plural framings are also central to the study of 'nexus' policies that encourage sustainable food chains (Covarrubias and Boas, 2019), urban agriculture (Siegner et al., 2018), and organic waste management (Lin et al., 2018). In all these areas, the results obtained equally by analysis are

conditional on the politics of alternative frames. Therefore, practical implications of the multiple hybridities noted here can be developed.

VULNERABILITY

Vulnerability is a cue to understand the historical, cultural, and experiential dimensions of a policy context. If vulnerabilities are not to open up to ill-informed mistakes, they cannot simply be ignored by 'sound science'. In particular, reducing population groups to statistical representations can be dangerous and insufficient. There can be no understanding of risks or security as those play out in the real world, without considering the diversity and differences between people.

For instance, in the urban periphery of a metropolitan region like São Paulo, Brazil, it is common to find people in extremely vulnerable conditions in relation to the consumption of fresh and healthy food. Then, the nexus analysed through social practices can interact with local and spatial possibilities, cultural backgrounds, and populational health status (risk of growing obesity) to reduce the consumption of beef, substitution by ultra-processed food, and respective trade-offs concerning the nexus (Giatti et al., 2019). Rasul and Sharma (2016) give another example by presenting the potential conditions for proposing a 'nexus policy' in the Hindu Kush Himalayan region where people suffer severely from the lack of access to resources. In these regions, the eradication of poverty and the reduction of vulnerability must be given priority in nexus policies.

DISTRIBUTION

By invoking distribution, Jasanoff (Jasanoff, 2003, 2007) emphasises that it is not enough simply to calculate an economically 'optimal' aggregate outcome. The economic theorems that assume that the market process will provide for requisite 'trickle down' are no substitutes for concrete attention to the actual dynamics that play out in the real world. Without transparent accountable attention to distributional challenges as a core focus for WEF nexus policy, powerful processes of decision justification will lead powerful interests to impose wishful thinking about distribution.

In terms of the distribution of ‘nexus innovations’, Dalla Fontana and Boas (2019) indicate that Amsterdam’s nexus decisions are based on the technological innovation by utility companies responsible for water and energy. However, the study shows that new technologies do not radically transform the supply system through the redistribution of nexus innovations. Rather, they consolidate the status quo and maintain the strong position of these companies that operate centralised infrastructure networks.

According to Hoolohan et al. (2019), the potential of technological innovations throughout the WEF nexus depends on the recognition of the unintended consequences of policy mechanisms to support technological adaptation, as well as a restructuring of incentives for the achievement of multi-sectoral benefits. They conclude that for wider technological innovation in energy production processes via anaerobic digestion in the UK, knowledge development and dissemination practices for technological adaptation become fundamental. It is also essential to recognise the political and economic aspects behind the spaces where knowledge development takes place.

LEARNING

Finally, when Jasanoff (Jasanoff, 2003, 2007) refers to the challenge of learning, it is not enough to advocate that knowledge be accessible, transparent, accountable, and actively shared. Social learning is an array of complex processes, running equally from society at large towards researchers and policymakers (about the values and framings that should be highlighted in the production of science) as well as from experts to the society (about the detailed contents of the research that emerges). Rather than suppressing the uncertainties, ambiguities, and ignorance, effective social learning is only possible through openly exploring the resulting dilemmas with self-aware civic deliberation.

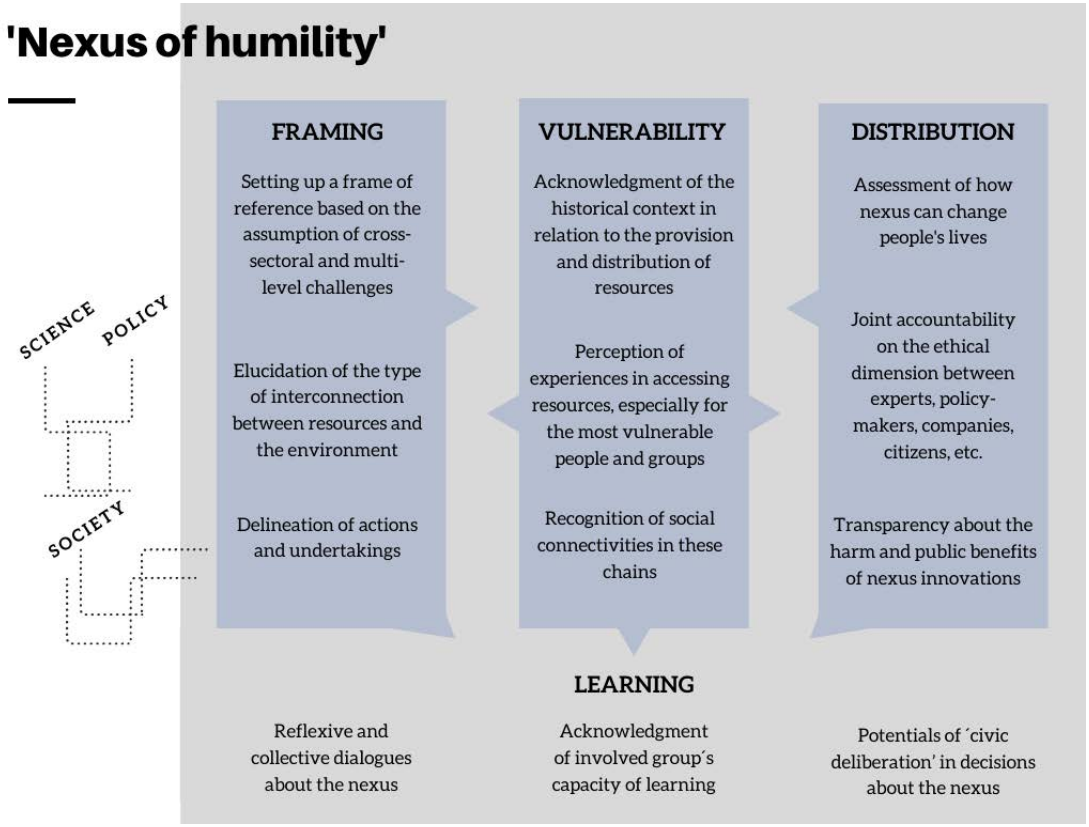
This leads to the emphasis on collective dialogue in the 'nexus of humility' for learning. The opportunity for self-reflection by the actors involved, in their own contexts, is necessary to assess alternatives in relation to the nexus (Giatti, 2019). It is not easy to include different actors overcoming steep gradients of power and privilege during a process of engagement, before and afterwards. Otherwise, there can persist a ‘nexus of exclusion’ (Giatti et al. 2019). In other words, people from vulnerable communities, who typically deal with scarcities on a daily basis, will remain ‘cognitively excluded’ from decisions (Santos, 2007).

For example, Kraftl et al. (2019) point out the importance of understanding the nexus in the daily experiences of young people in Brazil as a form of learning. The resulting narratives of this study are connected with a strong sense of community and social injustice. The nexus approach needs to become an educational, conceptual, and political tool to highlight the interdependence of the resources, people, and spaces where they are constituted.

As another example, Howarth and Monasterolo (2017) analyse different workshops held in the UK, based on a participatory and interdisciplinary approach aimed at knowledge creation. The results show the barriers noted by the participants for encouraging transdiciplinarity, such as difficulties in communication and collaboration that can lead to confrontations about the language used, as well as sets of skills and expertise. With imperatives operating in multiple directions, learning capacities can become robust only if they are constituted in many processes and not in a one-way science communication nor even a ‘two way’ dialogue between ‘science and society’. Underpinning the possibility of this type of learning is the establishment of the conditions of civic deliberation in which citizens themselves are recognised as the most salient knowledge holders and producers. Without this essential humility in public reasoning about the ‘WEF nexus’, equal framing of problems and responses will remain highly vulnerable to shaping by incumbent interests in a 'sound science’ (Miller, 2008).

In Figure 4, the points that are relevant to the science-policy-society interface in ‘nexus governance’, from each pillar proposed by Jasanoff, are suggested.

Figure 4. 'Nexus of humility' framework as a basis for the science-policy-society interface



Source: The authors, based on Jasanoff (2003, 2007).

CONCLUDING REMARKS

There is a strong need to rethink governance structures, knowledge production capacity, and decision-making procedures, as well as cultural implications of the transformations that are necessary and possible in 'nexus' governance. A crucial problem lies in the fact that the challenge of the 'WEF nexus' is even greater than is suggested in the widely acknowledged criticisms. Unless deeper challenges are substantively addressed, the emerging movement around the WEF nexus risks — most of the time based on technocratic assumptions — being reduced to rhetoric, and thus becoming part of the problem rather than the solution. This reductionism may support the maintenance of the power of dominant groups and their imposition of knowledge, as well as contribute to convenient ways of denying or hiding uncertainties.

This paper explores some of these deeper challenges by recognising, from the revised literature, the different layers of knowledge narratives at the science-policy-society interface on the nexus: 'knowledge application', 'knowledge integration', and 'knowledge transformation'. In order to be robust in ways that do justice to the scale of problems in sustainability governance, the problems and solutions need to be explored in ‘plural and conditional’ terms, as more equal forms of deliberation between diverse social actors as well as different scientific disciplines.
We have concluded that a more robust knowledge of the nexus crosses all three layers from a humble appreciation of a 'status of incertitude' as well as redefines framing, vulnerabilities, distribution, and learning. First, what has emerged and been explored in each respect is a systematic set of principles to help guide and test governance actions that involve a collective — and mutually interrogating — process of exploring alternative framings of problems and solutions. Second, there is a dominant concern with the circumstances of the most marginal groups that require particular attention to their vulnerabilities. Third, more focus is needed on distribution than scale. Fourth, there is the overarching responsibility to prioritise more plural and democratic forms of social learning.

The ‘WEF nexus’ is not only a problem to be viewed but a method of viewing problems. It is not only about ‘speaking truth to power’ but recognising how ‘the power shapes the truth’ — with political dimensions being apparent even inside the ostensibly independent science. Therefore, the ‘WEF nexus’ must be understood in terms of its own origins, in a drive for more simple, tractable, and compliant policy fixes. As a result, knowledge about ‘the nexus’ cannot be expressed as singular prescriptive recommendations.

Taken together, these cumulative challenges raise serious questions about an existing tendency in some quarters, to a state of hubris, on the part of policymakers and expert communities concerned with the ‘WEF nexus’ — overclaiming the validity of particular perspectives and over asserting the entitlement of specific interests. To help achieve a more balanced political gradient, this paper has collected a series of practical principles and guidelines that resonate with the emerging work analysing the governance dilemmas. Because this contrasts with the prevailing tendency to hubris around the WEF nexus, the resulting prescriptions are termed as a ‘nexus of humility’.

In the spirit of this quality of humility, this analysis cannot claim any transcendentally definitive status. As with all such interventions, the analysis needs to be treated, conditionally, in relation to its starting point. Future works that deepen this consideration are necessary. However, where there is recognition that the production of knowledge for the ‘WEF nexus’ needs to become more resistant to the 'close down' pressures of concentrated power, incumbent

interests, and disciplinary hierarchies, then what is developed here can be applied under a number of conditions. It is through practical actions that the important body of practice around ‘the nexus’ stands most chance of 'opening up' different layers of knowledge doing justice to the motivations of practitioners and the scale of the problems they seek to address.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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4.3. ARTIGO 3: 'NEXUS' NARRATIVES IN URBAN VULNERABLE CONTEXTS: PATHWAYS TO SUSTAINABILITY VIA MUNICIPAL HEALTH PROGRAMMES

(Artigo submetido à análise da banca)

Autores: Alberto Matenhauer Urbinatti[21]; Simone Omori Honda; Carolina Monteiro de Carvalho; Leandro Giatti[22]

ABSTRACT

The water–energy–food nexus approach ('WEF nexus') has been widely used as a framework in the context of urban Sustainability in recent years. However, some elements of the approach are quite normative, leading to a technical view of resources and technocratic implementations of approaches to decisions. To avoid these constraints, this paper is based on the framework of 'nexus of humility' in order to more openly appreciate the interactions between water, energy, and food, and to consider the social construction aspects of the nexus itself. The approach of Pathways to Sustainability is combined with this framework to analyse two government programmes associated with the Family Health Programme in the two cities of São Paulo and Guarulhos in Brazil, namely the Green and Healthy Environments Programme and the Environmental Health Programme, respectively. We conducted interviews with 20 people linked to these policies and analysed narratives inductively and deductively. The results indicated six groups of narratives: *Environmental and social determinants of health*, *health prevention and promotion*, *intersectoriality*, *politics and economy*, *territory*, *learning and participation*. Moreover, we concluded that narratives related to the WEF nexus, even if they are not explicitly part of the government guidelines, are present within the existing axes of action. Public health is an important support pillar for development of synergies related to Sustainability in urban areas. Finally, we sought to contribute to the literature by showing how this new framework can 'open up' avenues for Sustainability within the contexts of high urban vulnerability and social inequality.

KEYWORDS: Sustainability governance; Water–energy–food nexus; Health policies; Urban vulnerability; Brazil.

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[21] Corresponding author (albertourbinatti@usp.br).
[22] All authors are from the School of Public Health of the University of São Paulo.

INTRODUCTION

Recent decades have witnessed profound changes in the form, structure, and organisation of cities as spatial and decentralised expansion has redefined metropolitan spaces as complex systems comprising social, economic, environmental, and political issues (KLINK, 2009; LEICHENKO; SOLECKI, 2013). It is estimated that approximately one-third of the global urban population, mainly in developing countries, lives in conditions similar to those in slums, which are characterised by low income households and deficiencies in access to basic health services (CAMPBELL-LENDRUM; CORVALAN, 2007). Large urban systems, such as metropolitan regions, have seen an increase in socio–environmental vulnerability (JACOBI, 2013). Over the coming decades, urban vulnerability associated with global environmental changes will demand intense refocusing on health aspects, including reducing rates of diseases such as malaria and dengue, while improving access to health services.

Urban resilience is one of the most discussed solutions regarding climate change in cities (MEEROW et al., 2016). It is also recognised as a crucial attribute in the search for Sustainability, given its link to dynamic socio-ecological systems, durability, stability, and robustness (DAWSON et al., 2010). However, it is rather difficult to confer practical viability to these attributes (THAPA et al., 2013). We follow the suggestion of Leach et al. (2007a) to differentiate 'sustainability' ('*the general capability to maintain any unspecified feature of system structure or function over indefinite periods of time'*, p. 18) from 'Sustainability' ('*the capability of maintaining specified values of human well-being, social equity and environmental quality over indefinite periods of time*', p. 18). This perspective on Sustainability seems interesting to host the debate on the nexus.

Resilience can be developed from knowledge of the problems, hazards, risks, and vulnerability itself (MARANDOLA JR.; HOGAN, 2009). Accordingly, the World Bank (2011) considers resilience as a crucial strategy in governance processes applied to the most vulnerable groups in large cities, such as children, the elderly, the disabled, and population minorities. Meerow et al. (2016) define resilience as the ability of an urban system to maintain or quickly return to the desired functions in the face of a disorder, to adapt to change and to transform systems that limit current or future adaptive capacity. However, if the 'desired functions' are permeated by environmental and climate injustices in the basic infrastructure of life of certain populations, the intended purpose would be consequently defeated.

The so-called social determinants of health, when associated with environmental issues, constitute two important agendas that should be incorporated by all countries, in a cross-sectoral

manner, between health and the other sectors of environmental governance (WHO, 2008; SOBRAL; FREITAS, 2010). According to Akerman et al. (2016), social determinants seek to understand the health-disease process from the way society is organized and, more than that, the way and conditions in which social life is constructed. The balance between health and disease is determined by a reputation for factors of social, economic, cultural, environmental and biological origin (CARRAPATO et al., 2017). Through the lens of the environmental and social determinants of health, strategic political actions are the promotion of healthy spaces, the empowerment of citizens, the development of skills, knowledge and attitudes that support health (SILVA et al., 2014).

It is here that the Pathways to Sustainability (PTS) approach can contribute to the debate (DEMERITT et al., 2011; LEACH et al., 2007, 2010). This approach considers governance through a broad view of the different layers of vulnerabilities, socio-cultural values, resilience aspects, and inequities in a given context. Furthermore, it recognises the importance of developing adaptive, reflexive, and transformative governance. The PTS also seems to offer an interesting background to reflect on the narratives of the 'water–energy–food (WEF) nexus'. In general terms, the nexus approach seeks to invest in sustainable ecosystem services, creating more with less, and accelerating access of low-income populations to basic water, energy, and food services (BAZILIAN et al., 2011; HOFF, 2011). It may thus be interesting to imagine alternative forms of governance towards Sustainability transformations.

In urban peripheral contexts in Brazil, the impossibility of consciously opting for sustainable consumption, including healthy eating and constant access to water and energy, makes it possible to identify the nexus of exclusion (GIATTI et al., 2019). Beyond the normative narratives present in the approach (ALLOUCHE et al., 2015), it is necessary to understand 'nexus' as a reflective opportunity vis-à-vis integrative urban practices and the politics of resources in scenarios of climate uncertainty. Furthermore, the resulting reflections focus on how knowledge is produced and distributed, and the thereby conditioned power dynamics in the process of social learning (MACMYNOWSKI, 2007). This includes thinking about sector diversity and the actors that can be involved in developing joint solutions on resource governance.

In this sense, the first objective of this paper is to analyse possible pathways to Sustainability using two public policies in the municipalities of the São Paulo Metropolitan Region as case studies: the Green and Healthy Environments Programme (GHEP) in São Paulo, and the Environment Health Programme (EHP) in Guarulhos. The second objective is to verify the contributions of these policies as narratives to the debate on the WEF nexus in the Brazilian

context. The hypothesis is that the intersectoral characteristics of Brazilian public health policies, by encompassing environmental issues, are opportune ways to promote nexus of Sustainability in urban peripheries. The paper is structured as follows: Section 2 presents the theoretical background of the research, Section 3 presents the methodology, Section 4 provides the results, Section 5 discusses the findings, and Section 6 concludes the paper.

CONCEPTUAL FRAMEWORK

'NEXUS OF HUMILITY' FRAMEWORK AS A PATHWAY TO SUSTAINABILITY

Recent years have testified to the rapidly growing prominence of the notion of a ‘WEF nexus’ across different areas of engineering and economics, and environmental and urban studies on global political and environmental changes. The concern over the global failure of existing infrastructure, in terms of inadequate and inequitable provision of water, energy, and food services to all those in need of them, is the main driver behind the thinking about nexuses (BAZILIAN et al., 2011). In short, ‘nexus’ approaches attempt to articulate governance practices in different sectors, which have historically been governed separately.

A turn towards more explicit economic arguments is a distinctive feature of governance discussions around the nexus compared (for instance) to the parallel (and notion-encompassing) debates over Sustainability. Globalised political and economic views of the WEF nexus lend weight to current controversies over the expediency of such framings to a ‘neoliberal economic agenda’ (LEESE; MEISCH, 2015). The involvement of important political and economic actors, such as the World Bank, the Organisation for Economic Cooperation and Development (OECD), and the United Nations, may raise hopes for trends towards more effective global governance. However, greater weight is implicitly given to concepts and bodies of evidence with narrow economic cost-effectiveness and resource efficiency structures from the technical–administrative viewpoints (WEITZ et al., 2017; WIEGLEB; BRUNS, 2018).

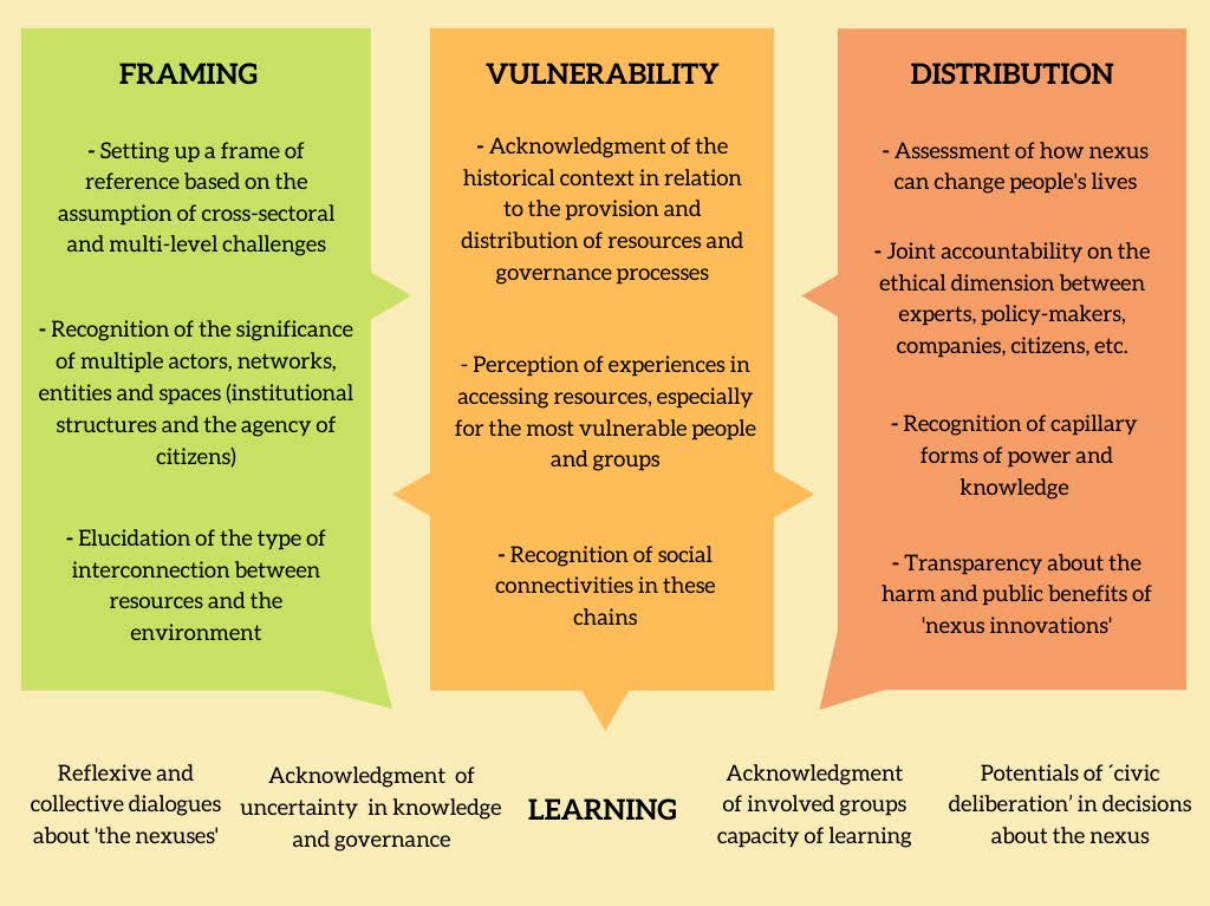
Along with wider global trends, the framing of the 2008 World Economic Forum around water security may also help explain the ‘securitisation’ imprint in nexus debates (PAHL-WOSTL, 2017; EMPINOTTI et al., 2020). Given the unduly narrow notions of risk and security, the nexus concept has been acknowledged for recognising problems associated with security at the macro level, but criticised for overlooking livelihoods and the environment

(SIMPSON; JEWITT, 2019). Such coarse-grained macro views can drive an apparently practical sense of urgency. However, while they can be enabling for incumbents, the resulting instrumentalised emergency rhetoric is often disabling for others (WIEGLEB; BRUNS, 2018). Even when framed in terms of security, the most acute injustices around water, energy, and food provisioning rarely arise from global scarcities. Rather, injustices arise to a greater extent from misallocations of resources, against which greater progress might be achieved with a more direct focus (MEHTA, 2007).

Unlike the more narrow normative approaches to nexuses, this study aims to develop narratives from a constructive point of view. The ‘nexus of humility’ framework has been suggested for this purpose (URBINATTI et al., 2020b) in an attempt to recognise the many hybrid dimensions in contemporary nexus ideas. These dimensions are constituted by the complexity generated by each type of individual and integrative framings between water, energy, and food. This conceptual construction is based on Jasanoff's concept of ‘technologies of humility’ (2003; 2007).

In general, the framework adapts four pillars suggested by Jasanoff to nexus-related issues, namely framing, vulnerability, distribution, and learning. The first concerns how we perceive the 'nexus', what should be integrated, how, and by whom, and whether the issue framed is responsive to society's needs (JASANOFF, 2015). The second suggests understanding the historical–cultural aspects of a given context, investigating whether the vulnerability factors can be mitigated. The third is more of a call for the distribution of the proposed action rather than compartmentalizing them into geographically-informed scales. This pillar also refers to the actions that can be taken if the consequences are unevenly distributed. The fourth, and perhaps most relevant, pillar concerns the learning process that nexus approaches may foster. In Jasanoff's words (2015, p. 1745), ‘What can be learned from the multiplicity of stories and explanations that diverse social groups offer for harms that have befallen them, and can the narratives of marginalised groups be given greater weight’? These pillars provide a broader look at both science and policy formulation. This does not mean that one must follow all the pillars to the letter in terms of practical implications, but that it is crucial to be aware that the nexus is much more a point of view than a replicable truth (URBINATTI et al., 2020b). Jasanoff (2003) says that ‘technologies of humility' are a way to make knowledge in science and policy more transparent, accountable, responsive, and reflective towards the most vulnerable social interests’.

Figure 1. Conceptual framework of the 'nexus of humility' as a pathway to Sustainability



Source: Adapted from Jasanoff (2003, 2007); Leach et al. (2007a, 2007b); and Urbinatti et al. (2020).

In order to address the conceptual aspects of ‘hybridity’ and ‘humility’ in governance processes holistically (i.e. politically and institutionally), we opted to include in the framework some aspects of governance suggested by the ‘pathways to Sustainability’ (PTS) approach (LEACH et al., 2007b). This gives rise to Sustainability, which is understood as the ability to maintain stability, durability, resilience, and robustness (LEACH et al., 2007a; LEACH et al., 2007b). However, it is necessary to understand what Sustainability means in a given context, and this task should be undertaken as part of governance (LEACH et al., 2007b).

Having said that, it is worth pointing out that bargaining on PTS is necessarily a political process. It therefore requires knowledge beyond the ability to conduct scientific analyses, namely knowledge of the diverse and deliberately inclusive kind. Overall, the awareness of power relations in the formulation of knowledge and in the decision-making process encourages humility in governance (LEACH et al., 2010). According to Leach et al. (2010, p. 63), five

questions guide the analysis of PTS: ‘Who are the actors and networks articulating the narrative? What is the specific framing of ‘the system’ and its dynamics – including the treatment of different notions of bounding and spatial and temporal scales, and the goals and values prioritised for system change? How is incomplete knowledge dealt with? To what extent does the narrative address the issue in terms of risk, uncertainty, ambiguity, or ignorance? Which dynamic properties of Sustainability are prioritised?’ Answering these questions, according to the authors, requires reflexive processes in order to make explicit that any assessment is partial and positioned depending on the social, economic, and political subjectivities of the analyst.

PTS does not define a specific mode of governance that is more worthy than others; rather, it understands the multiple aspects that compose governance. To this end, it recognises approaches to governance that have been widely studied in the literature, such as ‘state–society–corporate politics’ (RHODES, 1997; ELZEN et al., 2004; SMITH; STIRLING; BERKHOUT, 2005), ‘networked governance’ (SMITH, 2000; HAJER et al., 2003), ‘adaptive governance’ (FOLKE et al., 2005; CHAFFIN et al., 2014), ‘deliberative governance’ (FISCHER, 2003; FLYVBJERG, 2001), and ‘reflexive governance’ (VOSS et al., 2006; DRYZEK; PICKERING, 2017). Elements of ‘multi-level governance’ can be aggregated here, as it addresses flexible policymaking mechanisms from multi-directional, vertical and horizontal, encompassing authority and power (STEIN; TURKEWITSCH, 2008; DANIELL; KAY, 2017).

This paper seeks to use this theoretical reference suggested by PTS approach for the analysis of governance processes in the Brazilian context. More specifically, this analysis of two municipal programmes at different stages of their life cycles could provide interesting narratives regarding the ‘nexus’. Government programmes, as well as plans, are public policy unfolding when viewed in a more holistic way. This means that public policies unfold into plans, programmes, projects, databases or information and research systems after formulated (SOUZA, 2006).

We thus recognise the difficulties of adapting more general theories to specific contexts. In addition, we understand that there is a danger in applying global Northern theories in global Southern contexts; however, we believe that this approach meets the demands placed on this study. Therefore, we recognise that the study itself is a continuous exercise in reflection and adaptation.

This becomes evident, for example, when we highlight the setbacks in Brazilian policy analysis. First, Frey (2000) reflects on the supposed prominence of the institutional approach in relation to proceduralist approaches in societies with lower degrees of institutionalisation,

suggesting that the understanding of the exercise of power by political and economic elites may be more decisive in the Brazilian case. Second, the role of institutions in the formation of will and decision, and their respective consequences for the general political process, must be considered. Third, a policy analysis for delegative democracies such as Brazil should focus to an even greater extent on factors that condition public policy, such as polity (the institutional dimension) and politics (the political process), rather than considering policy (the contents of political decisions) in isolation. Within these broader aspects, particularly in relation to the temporal dimension of policies, the 'policy cycle' can be observed. According to Frey (2000) the different phases of the 'policy cycle' can be divided into: perception and problem definition, agenda-setting, programme elaboration and decision making, policy implementation, and finally policy evaluation and eventual action correction.

METHODOLOGY

This work involves case study research and inductive–deductive narrative inquiry. We do not delineate a specific mode of narrative analysis; instead, we seek to introduce 'holistic' and 'categorical' dimensions as well as 'content' aspects (LIEBLICH et al., 1998). Our version of 'narratives' in fact involves stories formed from particular frames of a given system. They are determined by actors, networks, and institutions that define a problem and promote pathways to their solutions (LEACH et al., 2010). The narratives therefore justify specific types of actions, strategies, and interventions, some of which are supported by governance processes that shape pathways of interactions among social, technological, and environmental systems.

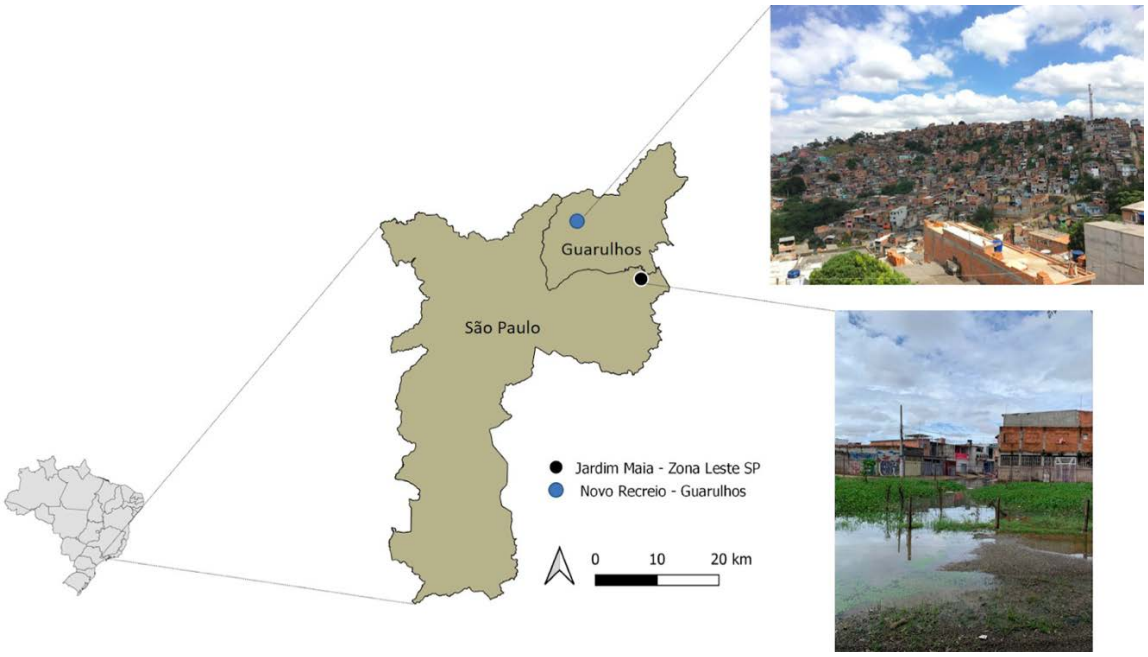
For primary data, 20 people were interviewed using open-ended and semi-structured formats. These interviews were conducted both individually and in group discussions, focusing on the SUS (Brazil's national Universal Health System). For example, group discussions had more open formats while the individual ones were semi-structured. Among those interviewed were municipal secretaries, City Hall technicians, coordinators of Basic Health Units (BHU), community health workers (CHW), environmental promotion workers (EPW), and health service users. Additionally, participants were observed at the study sites in order to formally record contextual information. Other studies on the subject as well as available governmental information were reviewed to gather secondary data. The data analysis was based on qualitative methods, as described by the following five steps (CRESWELL, 2014; BUTINA, 2015): i) organisation and preparation of the data, ii) obtaining a general sense of the information, (iii)

implementing a coding process using the Atlas.ti software, iv) division into categories or themes (initially 35 codes, and finally 6 main categories of narratives), and v) interpretation of the data through the lens of the 'nexus of humility framework' as the mode of governance under PTS.

The cities of São Paulo and Guarulhos, located in the Metropolitan Region of São Paulo, were the case studies for this research. In São Paulo, we analysed the GHEP with in-depth analysis of the BHU of Jardim Maia located in the east zone of the city. In Guarulhos, we analysed the Environment Health Programme (EHP) by focusing on the BHU of Novo Recreio, which is located in the northwest zone of the city. These two urban outskirts are characterised by social, political, and economic vulnerabilities. These locations were selected as the cases of interest in this work for different reasons. The selection of Guarulhos was a direct consequence of the project 'Resilience and Vulnerability at the Urban Nexus of Food, Water, Energy and the Environment (ResNexus)[23]', from which this research is derived. A previous study at the same BHU (GIATTI et al., 2019) contributed significantly to this research. The selection of São Paulo is attributable to an interview with the programme coordinator of the Jardim Maia BHU, the outcome of which pointed to its value in analysing how vulnerabilities in relation to water, energy, and food can arise. We approach the two case studies not as a direct comparison, but to understand similarities and differences. Figure 2 shows the two regions.

[23] Project funded by São Paulo Research Foundation (Fapesp). Grant number: 15/50132-6. Duration: March 01, 2016 - February 28, 2019.

Figure 2. Map of the study areas



Source: Authors' own elaboration.

THE GREEN AND HEALTHY ENVIRONMENTS PROGRAMME IN SÃO PAULO

The GHEP was inaugurated in 2005 in the Municipality of São Paulo in response to the demand for public policies that could holistically consider environmental issues, health promotion, and quality of life, especially with regard to the marginalized who live on the outskirts of the municipality. To this end, an alliance was signed between the Municipal Secretariat of Health, the Municipal Secretariat of Green and Environment, and the Municipal Secretariat of Assistance and Social Development in conjunction with the United Nations Programme for the Environment. The objectives were to train agents to focus on socio-environmental issues while acting in the interests of the population, generate spaces for co-management so as to allow the community to face environmental health risks in a prepared manner, and develop an agenda of integrated health and environment actions (PREFEITURA DE SÃO PAULO, 2010). In 2008, the Municipal Secretariat of Health incorporated the GHEP as a programme within Family Health Strategy, a leading SUS programme. The GHEP was linked to the Coordination of Primary Care in order to help it contribute to the implementation of integrated public policies in the municipality, and foster empowerment and community participation (PREFEITURA DE SÃO PAULO, 2011).

THE ENVIRONMENT AND HEALTH PROGRAMME IN GUARULHOS

The EHP was announced in 2017 with the objective of building participatory and collaborative processes for sustainable development through integrated agendas between the secretariats and sectors of the government of Guarulhos, particularly among the Municipal Secretariat of Health, Municipal Secretariat of Education, Municipal Secretariat of Environment, Municipal Secretariat of Public Services, Zero Waste Programme, health councils, and municipal councils, among others. Based on the Sustainable Development Goals, the programme focuses on interventions in territories and the empowerment of communities, helping to construct public policies aimed at creating a 'healthy' and 'sustainable' city. Although it was launched via an official event at the City Hall of Guarulhos, publications and reports about the programme are not available. The data used in this study were thus sourced directly from the Municipal Secretariat of Health, particularly the Department of Integrated Health Practices, CHW and health service users.

RESULTS

The 35 codes defined through the thematic analysis were Green and Healthy Environments Programme (GHEP); References to GHEP [4]; Environment and Health Programme (EHP); Sustainable Development Goals [1]; sewage treatment [1]; SUS (Brazil's national Universal Health System); values and principles [2]; construction of indicators for the programmes [4]; water, energy, and food [1]; access to transport [5]; basic health care [2]; participation mechanisms [6]; expectation for participation [6]; risk area [5]; vulnerability [1]; selective waste collection [1]; recycling [1]; financial focus on health [4]; waste [1]; waste management in health services [1]; power relations [4]; distrust among the public and in participation [6]; distrust in government [6]; administrative focus [4]; barriers to action development [4]; flooding [5]; focus on development of the neighbourhood [5]; focus on diseases [2]; disease prevention [2]; access to water [1]; gardens and food [1]; intersectoriality [3]; knowledge production and educational aspects [6]; socio-environmental focus on health [1]; reference to territories [5]; and outputs and assessments [4]. The narratives were grouped by their proximal aspects. Following this, the codes were regrouped into the following six main narratives according to the themes relevant for this study:

[1] Environmental and social determinants of health,

[2] Health prevention and promotion,

[3] Intersectoriality,

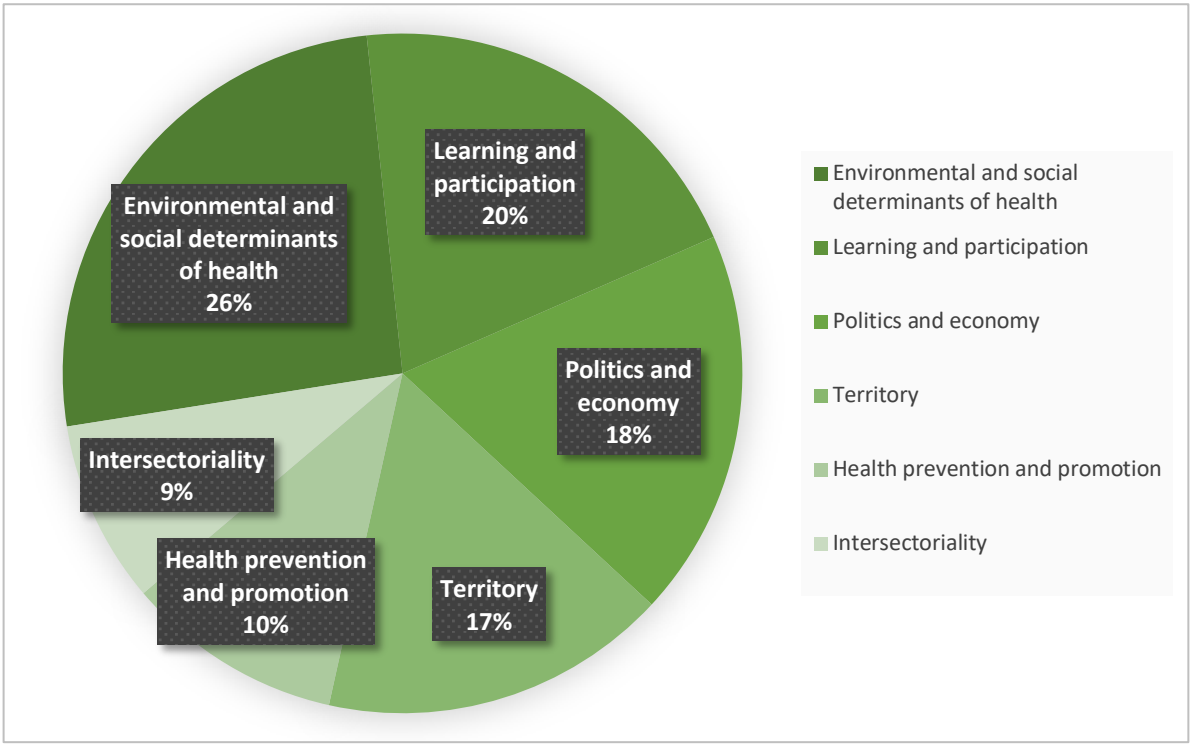
[4] Politics and economy,

[5] Territory, and

[6] Learning and participation.

Figure 3 shows the frequencies of these narratives in the transcribed documents.

Figure 3. Frequency of narratives



Source: Authors' own elaboration

The results show that 'environmental and social determinants of health' narratives were more prevalent in the discourses of the interviewed actors (26%), followed by 'learning and participation' narratives (20%), 'politics and economy' narratives (18%), 'territory' narratives (17%), 'health prevention and promotion'(10%), and 'intersectoriality' (9%). These narrative groups contributed to our understanding of the aspects related to water, energy, food, and the environment at the case study locations. In other words, these thematic narratives provided the

overview to organise the research according to the suggested framework. Table 1 shows the correlations presenting aspects of framing, vulnerability, distribution, and learning. In addition, aspects suggested by the PTS approach, such as political entities and spaces, structures and practices, power and knowledge, uncertainties, and history, politics and context, were covered.

Table 1. Nexus of humility and governance aspects under the framework of the pathways to Sustainability from the case studies

	SÃO PAULO (GHEP)	GUARULHOS (EHP)
FRAMING *Correlations with intersectoriality narratives and politics and economy narratives**	**- *(What)* water, energy, food, health and the environment in a peripheral context (Jardim Maia and region); *(How)* as thematic axes of a municipal health programme; *(By whom)* promoted by the Municipality of São Paulo and partners aimed at the local population** **- Entities:** Municipal Secretariat of Health, Municipal Secretariat of Green and Environment, Municipal Secretariat of Social Development, Health Family Association, Santa Marcelina Institution, Santa Catarina Association, Social Responsibility Institute of Albert Einstein Hospital, Monte Azul Association, Federal University of São Paulo, Paulista Society of Medicine Development **- Spaces:** Coverage throughout the municipality's health network, particularly in five Regional Health Coordination zones: north, west, central-west, south, and east **- Structures:** Programme within the Department of Basic Health Care; 963 items of healthcare equipment available with the municipality; FHP operates in at least 269 BHUs; 237 Environmental Promotion Workers **- Practices:** Programme developed between 2005 and 2008, during which 5,000 CHW with environmental themes capacitated; as of 2018, 205 projects in progress and 473,368 people involved during the year; GHEP at an advanced stage of policy evaluation and possible corrective action implementation	**- *(What)* water, energy, food, health and the environment in a peripheral context (Novo Recreio); *(How)* as thematic axes of a municipal health programme; *(By whom)* promoted by the Municipality of Guarulhos and partners aimed at the local population** **- Entities:** Municipal Secretariat of Health (departments, units, and services), Municipal Secretariat of Environment, Municipal Secretariat of Public Services, Municipal Secretariat of Education, SUS School, Municipal Councils, and Health Unit Management Councils. **- Potential partner entities:** University of Guarulhos, School of Public Health/USP, Faculty of Medicine/UNINOVE, NGO Ecoficina, NGO Ecosocial Água Azul, Cooperatives of Collectors, private initiatives **- Spaces:** Municipality divided into four health regions: Central, Cantareira, São João/Bonsucesso, and Pimentas/Cumbica; EHP not implemented in an expanded form as a programme, but intersects with other programmes (such as Integrative and Complementary Health Practices) popular in much of the city's territory (including Novo Recreio) **- Structures:** Department of Integral Health Care responsible for implementing health policies in territories, setting standards, and providing institutional support in a centralised manner; 69 BHUs in the city, 48 of which fit the Basic Health Care guidelines; BHU councils comprise community members, including Novo Recreio **- Practices:** Programme announced in 2017; capacitated many technicians and CHW; currently devising the mission and indicators; official flagging off scheduled for the year 2020; EHP in the transition phase between 'agenda setting' and programme and decision-making; seven working meetings held with groups involved in the programme; next stage will invite members involved in the GHEP in São Paulo to share experiences
VULNERABILITY	**- History of the region:** Region occupied for a long time; situated in an area that was	**- History of the region:** Peri-urban area that grew in an unplanned manner during the 1990s; belongs to Cabuçu, a region formerly containing farms that were

Correlations with environmental and social determinants of health narratives and heath prevention and promotion	formerly home to colonial farms; became urbanised with the arrival of a chemical industry in the 20th century. **- History of the programme:** GHEP inspired by the values and principles of the SUS created in 1988; GHEP related to the FHP; articulated in partnership with the United Nations Environment Programme. **- Environment**: Borders a municipality in the East; located in a region near the Tietê River **- Water:** Flooding occurs throughout the year **- Energy:** Illegally accessed by most residents; difficulties in accessing public transportation during flooding periods **- Food:** Lack of knowledge about healthy food	part of the municipality of São Paulo until the 1920s; Cabuçu well-known as the place of construction of the first concrete dam in the country (1908). **- History of the programme:** EHP also inspired by the values and principles of the SUS created in 1988; programme based on the Sustainable Development Goals; previously, four directories available for each of the four health regions mentioned above **- Environment:** Located in the northwest region, bordering the Atlantic Forest area and the Cantareira State Park **- Water:** Lack of access and supply **- Energy:** Illegally accessed by most residents; problems accessing public transport **- Food:** Lack of access to fresh and healthy food.
DISTRIBUTION *Correlations with territory narratives*	- Resident population in areas near the Tietê River are the most negatively affected - Problems solved with the assistance of the Jardim Maia BHU in conjunction the sub-City Hall through the Family Health Programme (FHP) and GHEP, together with the Santa Marcelina Hospital **- Power:** Central hierarchical structure, starting from the Department of Basic Health Care; capillary network in the territories; efforts for collective production of knowledge among technicians, coordinators, Environmental Promotion Workers, and the community; experience in territories important for the co-production of knowledge, and to encourage adaptive and reflexive learning processes	- The entire population reports difficulties entering and leaving the neighbourhood, especially on rainy days, when public transport also stops running - Important institutions with regard to solving resource-related issues are the Novo Recreio BHU (through the FHP), the Nazira Abbud Zanardi Municipal School, and the Mothers Club Association **- Power:** Power still fairly centralised in the Department of Integral Health Care; little progress so far for more urgent demands with the programme; process of capacitating CHW based on reflexive assumptions of knowledge production; principle of 'nobody makes anybody conscious' applicable but necessary to collectively build consciousness for sustainability; council meetings used for agenda-building in the territory
LEARNING *Correlations with learning and participation narratives*	- Constant use of sodium hypochlorite to purify drinking water and water used for household chores - Reuse of leftover food from street markets that take place twice a week - Development of food storage techniques during the flooding season (e.g. storing food at a height) - Donation and sharing of basic-needs grocery packages - Environmental Promotion Worker actively assists the BHU and is one of the main channels of communication with the community; household visits conducted; the Discussion Group 'Harvesting Fruits' is popular **- Uncertainties:** recognised and related, for example, to arboviruses and flooded areas; mapping system proposed by the municipality used as a technical approach to solve	- Local food production - Household water storage and rational use of water - Solid waste recycling - Alternatives to public lighting - Practices to overcome neighbourhood inequalities and underdevelopment regarding water and energy connections and sharing resources between households - Acting manager of the BHU Novo Recreio and one of the CHW involved in the capacity building process proposed by the EHP in 2017 **- Uncertainties:** Contingencies needed in the political process due to uncertainties in governance; arboviruses and vulnerabilities of territories also identified as uncertainties

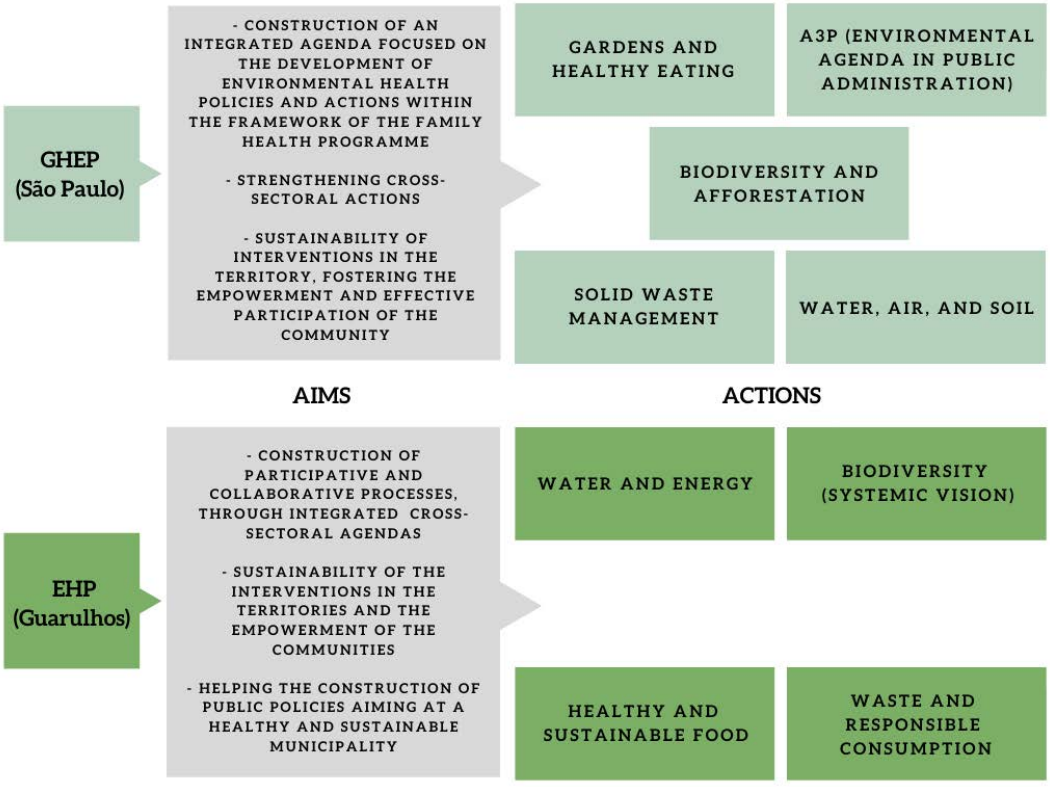
	vulnerabilities and enhance territory's potential	

* *The narratives may be correlated with other quadrants of the table; it is just a way to indicate the strongest connections.*

Source: The authors, based on both empirical data and Melo (2004), Carvalho (2010), and Giatti et al. (2019).

These are results of our analysis on the axes of governance based on the data collected for the two municipal programmes. Following, we highlighted narratives that include elements that reinforce the nexus point of view in the vulnerable contexts of the two municipalities. Figure 4 shows the different narrative axes of the two programmes we considered to be closely related to the nexus.

Figure 4. Axes closely linked to the nexus approach in the municipal programmes



Source: Author's own elaboration.

ANALYSIS OF THE NARRATIVES AND DISCUSSION

Devising the definitions of the scales in the nexus among water, energy, and food is complex, as it is difficult to ascertain the exact origin of each service supplying the local or regional level. Simultaneously, nexus governance is related to the global and local characteristics of each region of the planet. Thus, the responsibility of ensuring urban Sustainability is primarily that of the local actors. It is necessary to understand the context in which these actions take place, because given the vulnerability of the urban areas being studied here, the degree of impact of public policies can be heightened to a greater extent.

São Paulo is one of the main economic, financial, and political centres of Latin America. Since the 19th century, the city has played a leading role in the country's economy through its coffee production and intellectual and political activities, especially since the opening of the Law School in Largo São Francisco (URBINATTI; FERREIRA, 2019). The growing urbanisation of the peripheries in the last century was very rapid, and approximately 30% of its population (almost 3 million people) live in precarious conditions today, most of them occupying areas illegally (NOBRE et al., 2010). As per an article published by the newspaper Estadão in 2016, the Jardim Helena and Itaim Paulista neighbourhoods are among the areas with the 10 worst Human Development Indexes in São Paulo (0.751 and 0.762 respectively[24]). According to the Socioassistencial Atlas (PREFEITURA DE SÃO PAULO, 2015), 24,634 and 5,816 households in Itaim Paulista are classified as highly vulnerable and extremely vulnerable, respectively. The same source lists the region of São Miguel Paulista as having 13,509 highly vulnerable and 12,892 extremely vulnerable households. Being a small area within Jardim Helena and between Itaim Paulista and São Miguel Paulista, Jardim Maia does not appear in the list. In any case, these data characterise all these areas.

Guarulhos, located in the São Paulo Metropolitan Region, is the second-largest city in São Paulo state in terms of population. It is home to more than 1.3 million inhabitants according to IBGE Cidades (2016). Naturally, given its economic and industrial potential, this city has developed extensively since the 1950s, when Via Dutra was inaugurated, changing its landscape from that of a fruit- and vegetable-growing region to an industrial one. As a result, the increase in the urban population in a relatively short time has brought about numerous challenges for the subsequent municipal governments. Some examples include deep social

[24] The best is Moema (0.961). https://fotos.estadao.com.br/galerias/cidades,idh-os-20-melhores-e-os-20-piores-distritos-de-sao-paulo,24925?utm_medium=website&utm_source=archdaily.com.br. Accessed on 20th of April 2020.

inequalities and environmental problems, such as the small-scale sanitation infrastructure, and the serious risks associated with pollution and poor water supply to the population. The Novo Recreio neighbourhood is considered part of the Cabuçu region, and suffers from exactly these problems due to poor planning (CARVALHO, 2010).

Given this scenario, the social vulnerabilities became evident from the interviewees' speech excerpts[25]. For example, one of the CHW and resident of the Novo Recreio neighbourhood, identified here as E1, said the following:

E1: '*We thought – I speak for myself – we thought that with time it would settle down here, I would pay for my house, everything would stay beautiful! But that's not how it happened!'*

The narrative of underdevelopment was noted at many times in the conversations as a thread running through many of the problems related to quality of life, including access to resources, as shown in Table 3. An interview with another CHW (identified as E2), also a resident of the neighbourhood, exposes the environmental vulnerability.

E2: '*I'm glad you came now. If you'd come a week ago, you couldn't have come here. A landslide happened up there. That little stream over there flooded and destroyed the area. A tree fell, and we had to travel on foot'.*

In the case of São Paulo, we witnessed problems accessing the flooded area in the region of Vila Seabra during the course of this research itself. This area is under the care of the Jardim Maia BHU. It was not possible to enter the area. One of the residents of the region (E3) narrated how this problem, rather than the perceived lack of resources, affects them.

E3: '*We have enough energy for our use. Transport is another matter, however; we find it difficult to leave home (many of us have to face flood waters without any protection)! When floods occur, many families end up losing food if it is not stored properly and due to lack of planning. Some people face financial hardships and run out of food, and they can only count on neighbours to help!'*

[25] The transcribed passages presented here were translated to avoid altering the meanings of the interviewees' narratives. However, we recognize that there is a risk of this happening in any translation exercise.

The theme of flooding is recurrent in our interviews with the São Paulo residents. Another interviewee from the BHU (E4) said the following:

E4: *'[...]when the river floods, it brings back sewage with it, increasing the risk of diarrhoea and vomiting. If you pass through the area, you can smell the sewage'.*

Notably, a relationship of interdependence exists between the environmental issues, vulnerability, and health determinants of a territory, thereby generating a characteristic 'nexus perspective' for each region. It is in this sense that the narratives collected in this study allow us to understand the importance of the BHUs as the protagonists of the learning process in the theme of urban Sustainability. These narratives indicate resilient practices in communities. Thus, the two municipal programmes assume vital dimensions with regard to the institutional avenues relevant to PTS. In the case of São Paulo, as shown in Table 3, an interview with an important technician from the Municipal Secretariat of Health (E5) revealed that despite the hierarchy laid down in the guidelines and laws of the Secretariat, the territories create their own community-based networks of action.

E5: '*You want to know how everything down there [in the communities] is going? I don't know and I don't want to know! All I know is that they happen. Things take their course, their direction. There are professionals who manage this; now, it doesn't have to be from top to bottom. There's no such thing, there's no such thing! There are rules, there are guidelines, but the territory demands its own pathways'.*

The health policy underwent some of the most radical changes in the decentralising process during re-democratisation in 1988, as the government guaranteed the creation of a universal and decentralised public policy system, the SUS, with the responsibility of service provision being assigned to states and municipalities (FREY et al., 2017).

The narratives related to nexus can be identified in both policies, as seen in Figure 4. The majority of the projects implemented by the GHEP teams included community gardens. It is interesting to observe how many people, especially the elderly, consistently displayed the willingness to tend to the land and produce their own food. Community gardens that originate from public programmes, such as the GHEP, have a high chance of sustaining themselves. It is evident that such gardens are only possible due to the efforts of the group members and community participation; however, the involvement of public agencies and other partners, such

as through donations of seedlings, tools, or space and technical collaboration, increases the probability of long-term success. The GHEP relates to other programmes such as Traditional Medicine, Homeopathy and Integrative Health Practices, Health of the Indigenous Population, Integral Health Care for People Victims of Violence, Health of Children and Adolescents, Adult Health (for those with hypertension and diabetes), Health of the Elderly, Mental Health, Nutrition, and Family Health Support Centre, among others.

Consider for instance the community garden that was created at the Jardim Maia BHU in 2018 for learning purposes. It was located in the municipal school next door. It was eventually closed down due to lack of commitment. Currently, the main activities of the BHU are related to household visits encouraging responsible consumption practices, personal hygiene, disease prevention, and incentives for the correct disposal of batteries, cooking oil, and health waste among others. Every Tuesday, discussion groups called 'Harvesting Fruit' are held, which focus on topics related to water use and quality, food quality, and sustainable practices in the region. The BHU team led by the Environmental Promotion Worker participated in the 'Earth Hour' competition organised by the Santa Marcelina Association and inspired by the non-governmental organisation WWF in 2019. The elderly users' group at the BHU won third place, which cemented their interest in issues pertaining to climate change and Sustainability[26].

Household visits are also part of the regular practice in Guarulhos. However, no specific posts for EPW exist at the Novo Recreio BHU, and the CHW are responsible for this function. The aims of the EHP intersect with those of Integrative and Complementary Health Practices, and have resulted in many new gardens at the BHU for the population's use. The BHU at Novo Recreio did not house any gardens until after our group from the University of São Paulo conducted this research. Many community gardens were later created as the Novo Recreio BHU realised the therapeutic and health alternatives that could be availed by involving patients and residents as well as the local school, EPG Nazira Abbud Zanardi, which planned to use the garden as a pedagogical tool for its students and a therapeutic space for its employees. The community garden hosted by the school was also the site of a research project for a student pursuing a master's degree as well as the international ResNexus Project, which was supported by the EHP. Although the volume of the garden's produce was too small to benefit the entire neighbourhood, it worked as a didactic laboratory that provided space for meetings and food for thought regarding the development and importance of a garden in an urban environment.

[26] See http://www.aps.santamarcelina.org/iniciativas-ambientais-sao-premiadas-na-hora-do-planeta/. Accessed on 15th of May 2020.

Moreover, the success story of the community garden was disseminated via a collaborative book called ‘Vegetable Garden in the Community - Social Participation and Cultivation Techniques’ in 2019, based on the adaptation of the participatory instrument ‘community newspaper’, considering the ideas and suggestions of the group, so that they could share the learning and experiences they had.

As mentioned previously, the community garden not only served as an object of research for a student pursuing a master's degree, but it also validated popular knowledge, promoted community empowerment, and fostered local partnerships in the neighbourhood and with public agencies. In addition, the community garden represented, through the lens of the ResNexus Project, an example of synergy in the water, energy, and food sectors; referring to Hoff (2011), local food production reduces waste generation, since production circulates within the neighbourhood, eliminating the transportation required for conventional distribution and energy for storage, thereby reducing losses. However, certain conflicts were observed with regard to the continuity of the activities. According to one interviewee (E6), the garden prospered when the research group was involved, but once the research ended, the group failed to work collaboratively.

E6: ***‘So, what did we get out of it? While it was with you, the access was different, right? When it was just us from the community, the interest seemed to...it was different, we felt...’.***

In addition, some conflicting relationships arose in relation to change in the management of the BHU, as some were more predisposed to solving environmental issues, while others less so. These activities are related, either directly or indirectly, to broader governance processes. In order to understand governance nuances, we sought to relate aspects of ‘policy cycle’ previously mentioned. According to Frey (2000), to apply the category of ‘policy analysis’ – including ‘policy cycle’ – in the Brazilian context, it is necessary to consider the unstable dynamics of the country’s political institutions and processes. These dynamics are evident in the case of the EHP for instance, which was envisioned during the research and planning processes but did not develop exactly as announced by the government at the time. These aspects affected the survey data, as no official publications exist on the programme to date. Although we have not responded in detail to each of the policy analysis categories identified here, the data identify the aspects of each at the macro level.

Table 3 helps us to understand the similarities between the two policies as well as their crucial differences. An important similarity, on the one hand, is that the EHP is inspired by the

GHEP model. This can contribute to developing a metropolitan dynamic of sharing experiences on Sustainability in public health. On the other hand, some remarkable differences exist in relation to political–administrative practices and the prevalent institutional structures, revealing the 'policy cycle' stages distinctly. That is, roughly speaking, while the EHP would be at the programme design stage, seeking to implement the policy, the GHEP would be at a more advanced stage of policy evaluation, correcting eventual actions. These different temporal dimensions highlight that the network of partners involved in these programmes to date is also distinct: while the GHEP has networks formed regionally, nationally and internationally, the EHP has begun to establish partnerships.

In the case of the GHEP, despite the top-down hierarchical traits in the programme guidelines, the activities in the capillary territories have harnessed power relations, conflicts, and knowledge production. This contrasts with the predominance of narratives related to learning and participation. In the EHP, the activities have not yet formally expanded into the territories, given that they are quite concentrated under the aegis to the Municipal Secretariat of Health. The demands around health waste have become an urgent issue for the current government and have changed the course of the process. However, it must be recognised that many sustainable practices are already underway in the territories, including in the Novo Recreio, as CHW together with the BHU Council and community members have made significant strides in the search for improvements to the region.

Finally, it is important to point out that the six groups of narratives that we interpret from the defined codes corroborate with elements from the theoretical backgrounds of 'nexus of humility' approach. First, because the narratives of the respondents helped us to frame opportunities for discussion about a nexus in both municipalities while considering the vulnerabilities, the distribution of problems and the processes of resilience and learning could be related to the scopes of the two policies. Second, the scope of the PTS allows framing the narratives of a given system and its environment, their delimitations, and the structures and functions that can be considered as essential. Thus, framings and multiple narratives can co-exist while being implemented by different actors and co-produced with institutions based on power and knowledge. Governance itself shapes the prevailing framings and the manner in which they are negotiated, elevating the properties of a system on a temporal scale (LEACH et al., 2007a). This is how possible pathways to local Sustainability derived from governance processes emerge on the horizon.

CONCLUDING REMARKS

By proposing this overview of two programmes from a framework we call ‘nexus of humility’ and combining it with the PTS governance approach, we sought to move closer to a more humble appreciation of the advances and barriers regarding Sustainability governance in urban contexts. This means that while these two programmes are not necessarily based on the nexus approach, we can recognise synergies and opportunities for ‘nexus thinking’ in municipal guidelines. In particular, we assumed that the discussion of ‘the nexus’ is highly relevant in relation to the connections between the democratic and reflexive components of the programmes. Public health is an important supporting pillar for the development of synergies related to Sustainability in urban areas. Moreover, the examples of the health programmes given here, which are grounded in the values of the SUS, provide opportunities to think about the nexus from the public health perspective and its importance in vulnerable communities.

PTS governance has proved to be an interesting analytical tool to identify narratives related to ‘the nexus’ in the two municipal programmes. First, it facilitated more than a normative analysis of Sustainability, allowing us to understand processes not always explicit in Brazilian urban governance. Second, we understood ‘the nexus’ as a holistic point of view within the following main six identified narratives. It is concluded that the main issues encompassed by the nexus approach, such as access to resources, quality of life, etc., can be correlated with the debate on environmental and social determinants of health. The predominance of these narratives indicates that nexus can become more robust if it includes this health focus. Moreover, although the programmes are based on participatory approaches, obvious traces of hierarchy and control were evident, which does not necessarily diminish the distribution of benefits; however, it does show that the actions of governments are limited. Despite the predominance of narratives related to learning and participation, the very structure of government has created constraints.

On the one hand, the results of our work open avenues for positive transformations outside these programmes within the territories in question. On the other hand, future scientific framings, including participatory approaches, must be implemented. Finally, pursuing Sustainability in large urban centres such as São Paulo and Guarulhos, which are characterised by huge social inequalities in relation to access to resources, will always be challenging. This study sought to contribute knowledge in this direction using assumptions that reflexively ‘open up’ concepts and theories that have been used in recent years. Moreover, our work suggested possible ways to rearrange them in Brazil’s unique context.

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5. CONSIDERAÇÕES FINAIS

Este estudo possibilitou compreender aspectos da sustentabilidade a partir da abordagem do nexo água-energia-alimentos em recortes diversos. Em relação a esta questão, reforça-se aqui que, apesar das principais abordagens que compõem os artigos da tese (nexo, CPS e ESCT) terem sido pensadas a partir do chamado "Norte" global, entende-se a necessidade de discuti-las desde aspectos contextuais que tendem a transformar, contrastar e até expandir os argumentos iniciais dos autores que aqui foram trabalhados. Deste modo, buscou-se contribuir com argumentos críticos para cada uma dessas abordagens, principalmente para a do nexo, a partir do "Sul" global.

Isto, evidentemente, não significa supervalorizar alternativas de um lado em detrimento do outro, mas entender que as prioridades para os enfoques são diversas e, muitas vezes, contrastantes. Em primeiro lugar, os rearranjos teóricos sugeridos ao longo desta tese são formas de valorizar ideias importantes que surgiram na Europa e nos EUA, mas também as confrontar com situações contextuais como as das periferias urbanas brasileiras. Em segundo lugar, a própria auto-organização das periferias, ora apoiadas pelas ações e instituições estatais, ora esquecidas por elas, abrem uma série de perspectivas para o entendimento da relação das pessoas com os recursos, o meio ambiente e a saúde. Estes saberes contribuem para entender quais "nexos" importam e o que, como e por quem deve ser "governado".

De acordo com o primeiro artigo, são muitas as formas como o conceito de governança do nexo vêm sendo tratado pela literatura. Os principais temas encontrados foram: o centralismo da água, abordagens sistêmicas, a integração de políticas, o desenvolvimento sustentável, a governança ambiental, a gestão socioeconômica, a segurança dos recursos e as mudanças climáticas. Da mesma forma, foram definidos grupos temáticos para as abordagens de governança utilizadas, que são: da água e das bacias hidrográficas; ambiental e sistêmica; dos riscos e da segurança dos recursos; com foco na economia; global; urbana; integrativa e cooperativa; e "epistêmica" e transdisciplinar. Esta diversidade temática presente na literatura nos permitiu concluir que o nexo não deve ser encarado como uma abordagem universalmente aplicável, ela depende dos seus contextos, gerando perspectivas "transescalares", isto é, demonstrando que nenhuma escala é necessariamente mais importante do que outra.

Este dado reforça a tese presente no segundo artigo de que os nexos são pontos de vista teóricos e práticos e, por isso, assumem enquadramentos flexíveis para discutir os recursos. O que buscamos ao longo do segundo e terceiro artigo foi sugerir que não basta pensar os recursos água, energia, alimentos e o meio ambiente sem compreender as pessoas nesses

enquadramentos. As histórias, as conexões interpessoais, as vulnerabilidades, a distribuição das ações intencionadas e os processos de aprendizagem ao longo do processo. Por isso, uma abordagem mais realista, rigorosa e responsável dos desafios do nexo se afasta de prescrições de definição singulares para enfrentar os problemas a partir de suas pluralidades. Ou seja, a ciência que vem sendo produzida se valendo da abordagem poderia englobar um conjunto de recomendações mais híbridas, plurais e condicionais, transparentes com os limites do enquadramento aos quais se propõem. Esta tese dá um passo nessa direção, criando oportunidades conceituais mais amplas para que novos estudos sejam realizados, especialmente através de mecanismos de pesquisa participativa que englobe de maneira mais transformadora os saberes das comunidades.

O que é necessário à luz destas preocupações, não é um ceticismo generalizado sobre as contribuições do nexo enquanto categoria conceitual, mas uma apreciação do papel da transparência, responsabilidade e participação na determinação das direções apropriadas para as transformações sociais. Uma visão responsável sobre as mudanças tecnológicas e sociais que diferentes nexos podem incentivar devem ser reconhecidas através não apenas do ritmo e da distribuição da inovação que importam, mas principalmente em relação às direções particulares e o grau de diversidade exibido nas infraestruturas resultantes. Os benefícios futuros de inovações que o nexo incentiva como, por exemplo, em torno da reciclagem, da coleta e tratamento de resíduos e incentivo a recursos renováveis, não estão somente na velocidade em que essas transformações ocorrem, mas sobretudo a partir de quais tecnologias foram escolhidas. Mais do que isso, vale questionar a maneira como essas inovações técnico-científicas para a Sustentabilidade ocorrerão, lideradas por quais grupos e a quem elas interessarão (PAUWELS, 2011). Para enfrentar estas questões de forma robusta - e também a reconhecer as persistentes incertezas, ambiguidades e ignorância associadas - é necessário não apenas uma inovação "eficiente", mas uma deliberação participativa contínua em termos democráticos.

Os dois estudos de caso aqui apresentados podem ser encarados como histórias que contribuem para pensar em inovações deste tipo a partir de políticas públicas já existentes ou em formação. Como explorado ao longo da tese, no Brasil e em tantos outros países emergentes, há enormes problemas relacionados ao acesso à água, energia, alimentos saudáveis e saneamento básico. Por isso, se a ciência produzida e o espectro amplo da governança dos recursos já são desafiadoras quando pensadas setorialmente, quando pensadas de forma intersetorial se tornam ainda mais complexas. Nesse sentido, nota-se que o próprio termo "nexo" é uma abstração que pode não condizer com as realidades estudadas. Em primeiro lugar,

o termo não aparece de forma explícita nos processos de governança ambiental nas cidades de São Paulo e Guarulhos. Entretanto, como mostrado, já existem similaridades importantes com as bases que constituem o conceito. Pode-se notar que as narrativas dos determinantes sociais e ambientais de saúde estão bastante conectadas com as bases constitutivas da abordagem do nexo em contextos periféricos. Em segundo lugar, o termo importa menos do que a realidade desses locais de estudo. Portanto, foram sugeridas aqui formas de entender o que chamamos de "nexos de Sustentabilidade" presentes nessas duas políticas públicas, em estágios diferentes, a fim de imaginar caminhos Sustentáveis em regiões vulneráveis dos dois municípios e também reconhecer barreiras existentes.

É justamente partindo de olhares sobre a Sustentabilidade em duas periferias urbanas da RMSP que se contribui para um olhar a partir do "Sul" global – ainda que este termo possa ter certo caráter vago. As urgências para condições de vida, no mínimo, aceitáveis transforma o próprio olhar sobre a Sustentabilidade. Se ela for pensada como a manutenção dos estágios atuais de vida dos ecossistemas, talvez seja insuficiente para dar conta do problema. A urgência não está em manter esses estágios, mas transformar a realidade e o conhecimento preservando os ecossistemas. Esta é uma tarefa que cabe não só para o os governos, mas precisa do engajamento também do setor privado e da colaboração entre os moradores. A especulação imobiliária na RMSP não tem contribuído nas últimas décadas nesse sentido, na medida em que é um dos vértices nessa grande rede da desigualdade e exclusão social dos grandes centros urbanos.

O próprio processo quase inexistente de uma "governança metropolitana" colaborativa, pode ser um contribuinte para as desigualdades regionais, pois quanto mais esta governança se pautar por argumentos de racionalidade técnica, mais as alternativas de autonomia local a partir da descentralização serão encobertas (FREY, 2012). No entanto, ao se observar dinâmicas como o lançamento do PAS em Guarulhos e sua inspiração no PAVS, que já ocorre há muito mais tempo no município de São Paulo, depreende-se um processo de troca de experiências de governança entre os municípios que pode ser bastante frutífera. Estes dois programas municipais, dessa forma, além de assumirem perspectivas intersetoriais dentro das duas estruturas de governo, contribuem para processos mais integrados no tocante à região metropolitana. Isto pode motivar ações que perpassem algumas barreiras encontradas no caso de Guarulhos, tais como as demandas urgentes que vêm ofuscando o desenvolvimento real do PAS e mudando o foco das atividades da SMSG, para que a política se torne efetiva nos próximos anos. E, para o caso de São Paulo, que continue a colaborar com possíveis práticas semelhantes em todo o território da Macrometrópole Paulista. Ao fim e ao cabo, muitas das

cidades são fronteiriças e a região como um todo tende a ganhar com práticas que busquem a Sustentabilidade alcançando um número maior de pessoas.

Pode-se concluir que as políticas públicas de saúde no Brasil, por suas características intersetoriais, podem ser bastante amigáveis à racionalidade proposta pela abordagem do nexo. Aqui reside uma das principais contribuições desta tese. Evidentemente, os "nexos de Sustentabilidade" poderiam ser pensados a partir de diferentes políticas públicas em São Paulo e Guarulhos, contudo, de acordo com as experiências e vivências durante os trabalhos de campo realizados nesta pesquisa, aquelas que melhor discutem Sustentabilidade na ponta do processo, ou seja, nos espaços e com as populações mais vulneráveis, estão no eixo da saúde pública. Ostensivamente, isto é reflexo dos valores e diretrizes do SUS, do Programa Saúde da Família e principalmente da atuação dos ACS e APA nos territórios dos municípios – que muitas vezes transcendem as atividades às quais são destinadas. São ações cotidianas de envolvimento e conscientização do pertencimento dos moradores a esses territórios que contribuem para ampliar compromissos, ou nexos, com a Sustentabilidade. Não obstante, são relações multi-níveis e intersetoriais entre o estado e a "sociedade" que fortalecem laços de confiança nos locais em convergência com a busca por melhores condições de vida. Esta consideração está dentro daquilo que definimos como "nexos de humildade".

Finalmente, este estudo proposto, ainda que sob considerações amplas e plurais sobre a abordagem do nexo, é um recorte perto do tamanho do problema ambiental e climático que precisará ser enfrentado nos próximos anos. Assim como as políticas analisadas são apenas parte das soluções. Futuros estudos serão necessários sobre os avanços dessas políticas e os reflexos nas populações das duas cidades. Também serão necessárias iniciativas mais amplas de diferentes participantes de processos de governança ambiental na RMSP. A participação social, enquanto envolvimento efetivo de diferentes saberes no fazer científico e na formulação de políticas será a chave para que transformações Sustentáveis apareçam no horizonte.

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APÊNDICES

APENDICE A – Termo de Consentimento Livre e Esclarecido (TCLE) aprovado pelo Comitê de Ética da FSP/ USP por meio da Plataforma Brasil

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Título do Projeto: RESILIÊNCIA E NEXO DE SUSTENTABILIDADE EM CONTEXTOS METROPOLITANOS: SINERGIAS INTERSETORIAIS A PARTIR DE POLÍTICAS PÚBLICAS

Pesquisador Responsável: Alberto Matenhauer Urbinatti

Você está sendo convidado a participar da seguinte pesquisa, como voluntário: **RESILIÊNCIA E NEXO DE SUSTENTABILIDADE EM CONTEXTOS METROPOLITANOS: SINERGIAS INTERSETORIAIS A PARTIR DE POLÍTICAS PÚBLICAS**. O motivo que nos leva a estudar a questão é a complexidade da governança no contexto metropolitano de São Paulo, buscando entender os problemas e as sinergias entre os temas de água, energia e alimentos e entre políticas públicas para a sustentabilidade. Os dados serão coletados através de dinâmicas de participação social, como entrevistas com abordagem essencialmente qualitativa.
Riscos e benefícios: Os riscos são considerados mínimos, a possibilidade de algum desconforto ao apresentar alguma situação cotidiana. Mas quanto a isso, há a possibilidade de renúncia de participação da pesquisa a qualquer momento. Os benefícios são a produção de conhecimento científico que poderá aumentar as chances de integração entre diferentes cidades de uma área metropolitana, criando possiblidades de sinergias entre políticas públicas e iniciativas da sociedade civil visando a sustentabilidade urbana.

GARANTIA DE ESCLARECIMENTO, LIBERDADE DE RECUSA E GARANTIA DE SIGILO: Você será esclarecido(a) sobre a pesquisa em qualquer aspecto que desejar. Você é livre para recusar-se a participar, retirar seu consentimento ou interromper a participação a qualquer momento. A sua participação é voluntária e a recusa em participar não irá acarretar qualquer penalidade ou perda de benefícios. O(s) pesquisador(es) irá(ão) tratar a sua identidade com padrões profissionais de sigilo.
Seu nome ou o material que indique a sua participação não será liberado sem a sua permissão. Você não será identificado(a) em nenhuma publicação que possa resultar deste estudo. Uma via deste consentimento informado será arquivada pelo pesquisador e outra será fornecida a você.

CUSTOS DA PARTICIPAÇÃO, RESSARCIMENTO E INDENIZAÇÃO POR EVENTUAIS DANOS: A participação no estudo não acarretará custos para você e não será disponibilizada nenhuma compensação financeira adicional.

Pesquisador Responsável: Alberto Matenhauer Urbinatti

DADOS DE IDENTIFICAÇÃO DO PARTICIPANTE OU LEGAL RESPONSÁVEL

Local e data:_____

Nome:_____

Assinatura:_____

Eu..... fui informado(a) dos objetivos da pesquisa acima de maneira clara e detalhada e esclareci minhas dúvidas. Sei que em qualquer momento poderei solicitar novas informações e motivar minha decisão se assim o desejar. O(s) pesquisador(es) certificaram-me de que todos os dados desta pesquisa serão confidenciais. Em caso de dúvidas poderei contatar o pesquisador no telefone (11) 98299-2336 ou o Comitê de Ética em Pesquisa da Faculdade de Saúde Pública da Universidade de São Paulo, sito à Av. Dr. Arnaldo, 715, Cerqueira César – CEP 01246-904, São Paulo, SP – Telefone: (11) 3061-7779 – e-mail: coep@fsp.usp.br

Declaro que concordo em participar desse estudo. Recebi uma via deste termo de consentimento livre e esclarecido e me foi dada a oportunidade de ler e esclarecer as minhas dúvidas.

....., ...de ..... de .....

Assinatura do sujeito de pesquisa ou responsável legal

Assinatura do pesquisador

Eu, Alberto Matenhauer Urbinatti, declaro que forneci todas as informações referentes ao projeto ao participante e/ou responsável.

APÊNDICE B – Primeira apresentação do Programa Ambienta Saúde para o grupo de pesquisa do Projeto ResNexus, em junho de 2017

Fonte: o autor.

APÊNDICE C – Lançamento público do Programa Ambienta Saúde em agosto de 2017

Fonte: o autor.

APÊNDICE D – Reunião motivada pelo PAS no Bairro Novo Recreio

Fonte: o autor.

APÊNDICE E – Primeiras reuniões da horta comunitária no Bairro Novo Recreio, 2017

Fonte: o autor.

APÊNDICE F – Primeiras hortaliças na horta comunitária Germinando o Futuro

Fonte: o autor.

APÊNDICE G – Placa da horta comunitária Germinando o Futuro no bairro Novo Recreio

Fonte: o autor.

APÊNDICE H – Atividade de campo do Projeto ResNexus no Bairro Novo Recreio, 2017.

Fonte: o autor.

APÊNDICE I – Bairro Novo Recreio Guarulhos

Fonte: o autor.

APÊNDICE J – Mostra PAVS Leste 2019

Fonte: o autor.

APÊNDICE L – UBS Jardim Maia, São Paulo

Fonte: o autor.

APÊNDICE M – Atividade de campo na UBS Jardim Maia, São Paulo, 2020

Fonte: o autor.

APÊNDICE N – Atividade do Grupo Colhendo Frutos, promovido pela UBS Jardim Maia com moradores da região, 2020

Fonte: o autor.

APÊNDICE O – Região de alagamento na Vila Seabra, próxima à UBS Jardim Maia

Fonte: o autor.

APÊNDICE P – Muro da EMEI Maria Quitéria, ao lado da UBS Jardim Maia

Fonte: o autor.

CURRÍCULO LATTES

Autor

Alberto Matenhauer Urbinatti

Endereço para acessar este CV: http://lattes.cnpq.br/5649330020908535
ID Lattes: **5649330020908535**
Última atualização do currículo em 07/07/2020

Doutorando em Saúde Pública na Faculdade de Saúde Pública da Universidade de São Paulo (FSP/USP). É bolsista da Fundação de Amparo à Pesquisa do Estado de São Paulo. Tem estudado governança e políticas públicas em cidades, com enfoque no nexo entre água, energia e alimentos. As pesquisas desenvolvidas atualmente estão associadas ao projeto "Governança ambiental da macrometrópole paulista face à variabilidade climática" (Processo 2015/03804-9) e ao "ResNexus" (Processo 2015/50132-6). Foi pesquisador visitante no Science Policy Research Unit (SPRU), da Universidade de Sussex, Inglaterra, como bolsista BEPE da Fapesp, sob orientação do Prof. Andy Stirling. É Mestre em Sociologia pelo IFCH/Unicamp com bolsa da Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP). Estudou riscos, impactos e políticas associados às mudanças climáticas em megacidades no Brasil e na China. Graduado em Ciências Sociais, com ênfase em Sociologia, também pela Universidade Estadual de Campinas (UNICAMP). **(Texto informado pelo autor)**

Identificação

Nome	Alberto Matenhauer Urbinatti
Nome em citações bibliográficas	URBINATTI, A. M.
Lattes iD	http://lattes.cnpq.br/5649330020908535

Endereço

Formação acadêmica/titulação

2016
Doutorado em andamento em Saúde Pública (Conceito CAPES 6).
Universidade de São Paulo, USP, Brasil.
com **período sanduíche** em University of Sussex (Orientador: Andrew Charles Stirling).
Título: Resiliência e nexo de sustentabilidade em contextos metropolitanos: sinergias intersetoriais a partir de políticas públicas,
Orientador: Leandro Luiz Giatti.
Bolsista do(a): Fundação de Amparo à Pesquisa do Estado de São Paulo, FAPESP, Brasil.
Palavras-chave: nexo; governança; políticas públicas; água; energia; alimentos.
Grande área: Ciências da Saúde
Grande Área: Ciências Humanas / Área: Ciência Política / Subárea: Estudos da ciência e tecnologia.
Grande Área: Ciências Humanas / Área: Ciência Política / Subárea: Ciência Política.

2014 - 2016
Mestrado em Sociologia (Conceito CAPES 6).
Universidade Estadual de Campinas, UNICAMP, Brasil.
Título: Respostas aos desafios das mudanças climáticas em níveis locais: os casos de São Paulo e Pequim,Ano de Obtenção: 2016.
Orientador: Leila da Costa Ferreira.
Bolsista do(a): Fundação de Amparo à Pesquisa do Estado de São Paulo, FAPESP, Brasil.
Palavras-chave: Risco; políticas climáticas; Mudanças climáticas; China; Brasil.

2009 - 2013
Graduação em Ciências Sociais.
Universidade Estadual de Campinas, UNICAMP, Brasil.
com **período sanduíche** em Universidade Técnica de Lisboa (Orientador: -).
Título: Mudanças ambientais globais e políticas públicas locais: riscos e alternativas.
Orientador: Leila da Costa Ferreira.
Bolsista do(a): Fundação de Amparo à Pesquisa do Estado de São Paulo, FAPESP, Brasil.

Formação Complementar

2015 - 2015
Mandarim básico. (Carga horária: 75h).
Beijing Jiaotong University, BJTU, China.

2012 - 2013

Orientador

Leandro Luiz Giatti

Bolsista de Produtividade em Pesquisa do CNPq - Nível 2

Endereço para acessar este CV: http://lattes.cnpq.br/7596494543629391
ID Lattes: **7596494543629391**
Última atualização do currículo em 27/04/2020

Professor Associado no Departamento de Saúde Ambiental da Faculdade de Saúde Pública da Universidade de São Paulo. Possui graduação em Ciências Biológicas pela Universidade Sao Judas Tadeu (1996), mestrado e doutorado em Saúde Pública pela Faculdade de Saúde Pública da Universidade de São Paulo, área de concentração Saúde Ambiental (2000 e 2004). Pesquisador CNPq nível 2, bolsa de produtividade em pesquisa. Orientador permanente no Programa de Pós-Graduação em Saúde Pública/FSP-USP. Orientador permanente e membro da comissão de coordenação do Programa de Pós-Graduação Mestrado Profissional em Ambiente, Saúde e Sustentabilidade/FSP-USP. Editor adjunto da revista Ambiente & Sociedade. Atua na coordenação de sub-projeto de pesquisa junto ao INCLINE - INterdisciplinary CLimate INvEstigation Center. Membro da Comissão de Cultura e Extensão da Faculdade de Saúde Pública - USP. Pesquisador colaborador no grupo de pesquisa Meio Ambiente e Sociedade do Instituto de Estudos Avançados/IEA-USP e no Centro de Estudos de Governança Socioambiental - IEE/USP. Foi pesquisador visitante no Instituto Leônidas e Maria Deane - Fiocruz/Amazônia entre 2005 e 2009. Tem experiência na área de Saúde Coletiva, com ênfase em Saúde Ambiental, atuando principalmente nos seguintes temas: indicadores de sustentabilidade ambiental e de saúde, saneamento, ciência pós-normal, pesquisa-ação, nexos de sustentabilidade, promoção da saúde e governança socioambiental e em saúde. **(Texto informado pelo autor)**

Identificação

Nome	Leandro Luiz Giatti
Nome em citações bibliográficas	GIATTI, L. L.;GIATTI, LEANDRO;GIATTI, LEANDRO LUIZ;GIATTI, L.L.;GIATTI, L.
Lattes iD	http://lattes.cnpq.br/7596494543629391
Orcid iD	? https://orcid.org/0000-0003-1154-6503

Endereço

Endereço Profissional	Faculdade de Saúde Pública - USP, Departamento de Saúde Ambiental. Av. Dr. Arnaldo, 715 Cerqueira Cesar 01246904 - São Paulo, SP - Brasil Telefone: (11) 30617978 Ramal: 7978 Fax: (11) 30617732 URL da Homepage: www.fsp.usp.br

Formação acadêmica/titulação

2000 - 2004	Doutorado em Saúde Pública Departamento de Saúde Ambiental. Universidade de São Paulo, USP, Brasil. Título: Ecoturismo e Impactos Ambientais na região de Iporanga - Vale do Ribeira / SP, Ano de obtenção: 2004. Orientador: Aristides Almeida Rocha. Palavras-chave: Saúde Pública; impactos ambientais; ecoturismo; limnologia sanitária; unidade de conservação; saneamento. Grande área: Ciências da Saúde Setores de atividade: Captação, Tratamento e Distribuição de Água, Limpeza Urbana, Esgoto e Atividades Conexas; Produtos e Serviços Voltados Para A Defesa e Proteção do Meio Ambiente, Incluindo O Desenvolvimento Sustentado; Cuidado À Saúde das Populações Humanas.
1999 - 2000	Mestrado em Saúde Pública Departamento de Saúde Ambiental. Universidade de São Paulo, USP, Brasil. Título: Reservatório Paiva Castro - Mairiporã - SP: Avaliação da qualidade de água sobre alguns parâmetros físicos químicos e biológicos (1987/1998),Ano de Obtenção: 2000.