Power System Technology
ISSN:1000-3673

Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

Evaluation of Social and Environmental Driving Factors in Water and Food Nexus with Emphasis on Reuse of Water in the Production of Food Products

Mahsa Arab[1], Mehdi khakzand[2], Fatemeh Mehdizadeh Saradj[3]

[1]Phd Student, Architecture, School of Architecture and Environmental Design, Iran University of Science and Technology, mahaas94@gmail.com

[2*]Associate Professor, Department of Architecture (Landscape), School of Architecture and Environmental Design, Iran University of Science and Technology, mkhakzand@just.ac.ir

[3]Professor, Department of Conservation of historic buildings and sites, School of Architecture and Environmental Design, Iran University of Science and Technology, mehdizadeh@just.ac.ir

Abstract:

Water resources and water pollution are both phenomena around the world and two of the biggest challenges that humanity is facing today, and non-conventional water sources aim to reduce the gap between them. The narrative of reusing water for production purposes. Food is sometimes thought of as one of reason versus emotion, which may not reflect the complexity of the issue at hand, including legitimate fear of risks, widespread regulations, and the internal reactions of farmers and the public. . Lack of water and deterioration of the quality of water resources require the adoption of modern water resources management policies. This management must be flexible to continuously cope with changes in the availability and demand for water resources. Such a comprehensive approach requires management of water supply and demand. Recycled water is becoming increasingly relevant. For the review of this article, a total of 17 analysis tools from quantitative, qualitative and mixed methods were used in the reviewed articles. Qualitative analysis method was used in 86 articles, while 67 articles used quantitative tools and 19 articles used mixed tools. Regarding internal classification analysis, the most popular qualitative tools were questionnaires and literature review (76.7%), while soil analysis and water monitoring were the most popular tools from a quantitative perspective (82.1%). The use of hybrid tools was less important and was the most popular cost-benefit analysis tool.

By analyzing the recent reviewed literature (2007-2023) from a holistic approach (geographical and social issues), this review examines the following: the main characteristics of the reviewed literature on this topic (geographic contexts, areas Research, key issues and tools Relevant drivers for effective adaptation of farmers' needs and public perceptions of water reuse, and

Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

current knowledge gaps and future challenges to be addressed by end-users, managers and authorities.
Keywords: water reuse, food production, social issues, water resource challenges.

Introduction:

Due to the progress of science and technology and the excessive increase in the world's population, the human need for water is increasing day by day. This vital substance is one of the most essential factors for the development of today's societies, and since water resources have been limited due to pollution caused by development and human activities, mankind has been forced to meet part of its water needs through sewage and sewage. or provide contaminated and used water. Wastewater treatment, while preserving the environment, makes use of wastewater and extraction and recycling of used water. lack of water, increase in population, lack of proper use of water resources, geographical and climatic conditions, low atmospheric discharge, inadequacy of discharge, dry and desert areas and water pollution by humans and high expenses in using new sources of water for consumption Among the main causes are the tendency towards treated wastewater. Until now, a significant amount of the country's water resources have not been used due to their low quality or environmental criteria have not been taken into account in their use. But it is believed that a part of these sources that have less quality problems or if they can be ignored in terms of environmental issues, should be included in the development and productivity programs of water resources. In developing countries, especially countries that are geographically located in arid or semi-arid areas, cheap and cost-effective systems must be used for the reuse of wastewater so that they can be trusted as a basic solution for creating new resources.

The increasing development of industry and population growth and the industrialization of the world society on the one hand and the spread of drought resulting from climate change on the other hand are the most important limiting variables of water resources in order to secure food production in developing countries located in arid and semi-arid regions. They are counted as. The countries of the Middle East and North Africa are considered the driest region in the world with one percent of fresh water resources. Considering the lack of fresh water resources in this region, the use of treated wastewater and the establishment of a relationship between water and food by these communities can be a realistic solution to reduce the lack of water resources, and until today, the most and most popular reuse of wastewater in It has been the matter of agricultural irrigation.

Currently, one of the main issues in Iran is the increase in water consumption, the stability of available water resources, along with drought, which will cause a water crisis in the coming years. The concern of water supply has become more acute in recent years due to the continuous occurrence of drought. Therefore, in order to reduce and prevent the water crisis, various solutions have been put on the agenda of planners and officials. Among these solutions are the

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

construction of dams and reservoirs, reservoirs, optimization of water use, and the use of treated wastewater. Due to the lack of water resources in many regions of the country and the increase in the volume of urban sewage, their reuse is inevitable. The effect of wastewater on agricultural products is of interest in terms of product quantity and product quality. The use of wastewater in agriculture has many advantages, which can reduce the pressure on water sources, reduce the cost of agricultural water, reduce the cost of agricultural fertilizer, increase agricultural products, provide low-consumption and high-consumption food elements for plant growth, reduce the pollution burden on the environment and access He named water sources with higher quality for drinking and health purposes. Among the other advantages of reusing wastewater, we can mention the solution of wastewater disposal problems, the possibility of recovering nutrients in wastewater, and recharging groundwater. The use of wastewater from urban sewage treatment plants in the agricultural sector may have environmental and health effects due to the remaining materials in it. For this purpose of work Wastewater collection in agriculture requires a special management that, while using it optimally, does not have environmental and health hazards in the soil, plants, and surface and underground water sources due to the presence of pathogenic microorganisms and chemicals.

Theoretical foundations and research background:

Water scarcity and water pollution are both phenomena all over the world and are one of the biggest challenges that humanity is facing today, and unconventional water sources aim to reduce the gap between them. Shidai et al., 2015). Worldwide water consumption continues to grow and it is estimated that by 2030, more than 160% of the world's total water volume will be needed to meet global water needs. Gosling and Arnell, 2016; Lavernick et al., 2017; Ajouni et al., 2018). The production of food and agricultural products is the most affected by the lack of water, because it accounts for 70% of the world's fresh water harvests and more than 90% of consumption. Norton-Brandau et al., 2013). Several alternative solutions can be implemented to reduce the gap between water demand and water supply for food use, such as control and reuse of runoff water. Al-Sikh and Mohammad, 2009 Desalination of brackish/sea water (Auni et al., 2013; Germandi and Minich, 2017), cloud fertilization (Chin et al., 2017) and wastewater reuse (Van Lier and Huibers, 2010). The UN's 2030 work for sustainable development is also pushing for the global adoption of desalination and reuse technologies as an essential tool for achieving the Sustainable Development Goals (SDGs) to ensure water availability , sustainable resource management and health for all (SDG 6), there must be integrated management of water resources. In addition, the percentage of untreated wastewater must be halved by 2030 and a significant global increase in the recycling and safe reuse of treated wastewater is required (Wenham et al., 2018).Water reuse is an inherent part of the natural water cycle, as discharge of effluent into water streams and its dilution in the circulating water stream traditionally allows be indirectly reused downstream for urban, agricultural and

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

industrial purposes (Ortega and Iglesias, 2009), depending on the type of treatment (primary to advanced) used to obtain it There is recycled water. Rahimi et al., 2018). By keeping the explanation simple without complex technical terms, primary treatment means a 30-40% reduction in organic load and pathogenic agents. Secondary treatment shows 59% and tertiary treatment approximately 99% organic load reduction without any significant pathogens after disinfection. The last two levels also include disinfection (Meng et al., 2016). According to Batsagarakis et al. (2013), as long as all safety precautions are taken, primary treatment can be used for controlled irrigation of forest lands and parks. Secondary treatment is suitable for trees such as olive trees, vineyards, etc. as long as it is not in contact with crops. Finally, tertiary treatment is suitable for all types of products consumed by humans. Furthermore, two main types of water reuse for irrigation of food crops can be recognized worldwide: direct and indirect agricultural irrigation. As a rule, direct reuse in food production is the reuse of recycled water directly afterwards.

treatment and with short-term storage for a wide range of irrigation purposes in commercial and individual farms (De Miguel et al., 2013; De Sanctis et al., 2017). In this case, the quality of irrigation water is determined by the quality of wastewater treatment plant (WWTP) effluent. et al., Gémar 2018). Therefore, it is easy to achieve the desired water quality by controlling the effluent quality. Seramkova et al., 2018). Indirect reuse of water in crop production occurs when treated wastewater is reused for various irrigation purposes mentioned above, but in long-term, medium-term or seasonal storage in water bodies. The following artificial or natural: surface reservoirs. underground tables; rivers, lakes and wetlands (Jeong et al., 2016).

Many regions of the world are exploring the reuse of alternative water sources in response to the emerging challenges of water scarcity. Lazarova and Bahri, 2008; Alisa and Ellsbury, 2017 Current and future water scarcity (Garcia Rubio and Guardiola, 2012; Mesa Jurado et al., 2012) and increasing pressure on global water resources (García-Cuerva et al., 2016; Tortajada and Ong, 2016). Since Half of the world's water bodies are seriously polluted, the treatment and reuse of wastewater improves environmental security by reducing the pollution of freshwater sources and providing more water for irrigation (Vithanage and Goonetilleke, 2017). The benefits of wastewater reuse are often cited in the literature (Worlicci et al., 2012; Beneduce et al., 2017). The most important advantage is that the source of new water supply is available for different purposes and water needs (Garcia and Pargament, 2015).

Additional benefits include 1) a reliable source of nutrients (especially nitrogen, phosphorus, and potassium) and organic matter, which helps maintain fertility. fertilization) and soil productivity (Miller, 2006; Parsonzo et al., 2010; Matiarasu et al., 2016) 2) Less energy use than other water use options (for example, imported water, desalinated water) (Adwumi et al., 2010) 3) to prevent the impact of new developments in water supply (for example, dams) (Ormerod and Scott, 2012 and 4) to reduce the amount of pollutants discharged into the

Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

environment (Mances et al. et al., 2010; Plumley et al., 2012). The authors like Alcón et al. (2010) to classify these benefits according to the market or non-market benefits of reusing wastewater in the production of food products. For example, market benefits arise from losses of food crops due to water scarcity and increased reliability of water supply, while non-market benefits relate to indirect reuse value associated with locally produced food and non-consumptive values associated with maintaining the status quo. Ecological river basin as well as social side effects of employment in agriculture. Accordingly, the inclusion of alternative water sources is increasingly part of a more integrated approach to managing the entire water cycle and a mechanism to support the circular economy and sustainable development goals. Smith et al., 2018).

The usual method, especially in suburban areas near large and medium-sized cities in the northwest (Zhang et al., 2018). In Australia, the use of recycled water is increasing and it currently accounts for 4% of the total consumption. Turner et al., 2016).

Wastewater reuse in Europe varies somewhat geographically. According to Satvo et al. (2013), in Northern Europe, wastewater is mainly used for environmental applications (15% of projects) and industry, which constitutes 33% of projects. However, in Southern Europe, recycled wastewater is mainly reused for irrigation of food crops (44% of wastewater projects) and urban or environmental purposes (73% of projects).

Applications of wastewater reuse, especially for irrigation of food crops, have been developed in many countries of the Mediterranean basin. Agrafioti and Diamadopoulos, 2012). In Israel, about 57% of its treated wastewater is reused and most of it is used in the production of food products. Reygaard et al., 2011) Cyprus has also developed a water reuse strategy (Panayiotou and Kathijotes, 2013) In Tunisia, about 52% of recycled water is reused. Klis et al., 2013, while in Spain, about 22% of collected wastewater is reused for agriculture. Navarro, 2018). A report by Hamilton et al. (2007) showed that about 20 megaha of land worldwide was irrigated with reclaimed wastewater a decade later. Through a GIS-based analysis, Tebo et al. (2017) estimated that about 6 megaha were controlled using treated wastewater and about 30 megaha were irrigated with diluted or untreated wastewater. This is approximately 10% of the world's irrigated surface area and 277 km, and more than 864 km of wastewater is supplied annually (Ait Mohab et al., 2018).

Although the technical aspects of wastewater reuse and management are often considered a priority. Jafarinejad, 2016, other concerns, such as aspects of regulation and perception, have not been evaluated or considered seriously enough and have often been ignored. . The aim of this article is to synthesize the current knowledge about the driving factors affecting water reuse in food production, taking into account the technical and social components of the last decade.

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

Research materials and methods:

In order to identify relevant literature, we used the following search terms to ensure a complex search string that focused on a combination of technical and social components related to reclaimed water reuse. The specific keywords used were as follows

Technical terms: recycling, recla, alternative, non-conventional water sources, reuse of water, wastewater, gray water, desalination, sea water, purification, environment.

Social terms: perception, attitudes, beliefs, acceptance, resistance, disgust, support, opposition, ice factor, agreement, influence, benefits, participation, public, farmers, irrigators, beneficiary

The field was applied to four different databases to ensure broad coverage:

ProQuest, Scopus, Web of Science and DOAJ in each database, the search process included the use of the OR operator for technical terms and the use of the AND operator for social terms. Both operators are fixed as part of the title of the article.

The articles returned by different databases were reviewed based on the entry criteria at three successive levels: title, abstract and full text. At each level, the compliance of the content analysis with any one or more criteria was examined.

Articles that are clearly focused on social attitudes, environmental issues and cases including cross-sectional analyzes of studies such as geography, agriculture, environmental sciences, economics and sociology have been prioritized. Relevant data for each study were recorded in one. Despite the importance of treated wastewater irrigation for farmers' livelihoods, information on the amount of wastewater produced, treated and used on a national scale is in many cases unavailable, limited or it's old. Qadir et al., 2016). However, some data can be extracted from recent publications. For example, in the United States, California and Florida use significant amounts of recycled water for food production. It is estimated that 46% of California's annual recycled water is reused for food production. In Florida, it is 44% (Brick et al., 2008). Most water reuse projects are located in arid and semi-arid regions, but wastewater reuse projects are increasingly implemented in humid regions due to rapid growth and urbanization. Perry and Praskiewicz, 2017). In Asia, where about 32% of wastewater produced is treated, Japan has adopted a comprehensive strategy for reuse of treated wastewater, where 7% of wastewater is reused in agriculture. Funamio et al., 2008). In fact, rather than providing water primarily for food production, Japan's recycled wastewater is focused on meeting urban water needs. Hara et al., 2016). Singapore relies on Malaysia for its fresh water supply, although it began to reuse water in the early 1970s. Lefebvre, 2018). In China, sewage irrigation began in 1957 and is now very common.

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

Table 1: Acceptance/exclusion criteria used in the search terms process. Source: Adapted from Flavivo et al. (2017).

Exclude	as follows	Indicator
Everything else	Reviewed	peer review
Everything else 7102 < Y	≤Y≥20172007	Year
Y., 2007<	Global, focused on English water stressed	geographical location
Everything else	countries/regions	Text language
Urban, industrial, environment,		Final consumption of
landscaping only	Irrigation, production of quality food	water
little (technical)	products,	Method
Only agricultural values,	mixed	Featured topics
chemical parameters, modeling	Perception, ice factor, risks, benefits, effects, regulations	

Table 2: Selected articles from database search analysis

92	186	–	208	392	638	774	Web of Sci.
26	102	77	216	334	426	597	Scopus
4	12	9	23	45	53	108	ProQuest
3	43	11	64	104	148	246	DOAJ
125	343	97	511	875	1265	1725	

Primary search Criterion 1: Articles and reviews Criterion 2: Selection of research categories Title analysis of repeated articles Abstract analysis Full text analysis of the database Spreadsheet (e.g. author, research area, article title, year of publication, journal name, region or case study) along with the main topics addressed by each article (e.g. keywords, tools, research questions and main results). Relevant data were summarized and linear regression was performed to reflect the nature of research in the literature (major disciplines, geographies, topics, tools, approaches) and to determine recent trends in research on the topic (key questions, challenges) during Course was used. The last decade lacks a minimal reference to social issues (ie articles focused on sewage infrastructure, technical innovation). When completing the final level of the review process, 217 articles were included for full-text analysis, of which 521 articles were selected for in-depth analysis of the main driving factors of reuse of recycled water in food production from the combination of technical and social components. became

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

research findings:

An initial database search of 1,752 documents, including duplicates (Table 2). For the purpose of this study, only records of periodicals (articles and advanced articles) were included in the systematic review. Therefore, books and book chapters, article articles, doctoral theses, research project reports, or industrial and government documents were excluded from the systematic review, although they were used for topic review that helped identify key terms. did After screening the reviewed articles, the number of suitable articles was reduced to 1256 articles (73.3% of the initial amount). From there, selecting the research category applied to each database enabled us to prioritize 875 articles (82.9% of Web of Sci. and Scopus articles). Reviewing the title analysis led to the exclusion of 463 articles for various reasons. A) The articles were not related to agricultural and irrigation systems (i.e. off-topic articles), B) Articles that were clearly focused on technical aspects (such as simulation-optimization models, chemical substances) . methods, health goals). In addition, a cross-matching of the title analysis results from each database was performed to remove duplicates. A total of 412 articles were transferred to the abstract analysis level. During the study of abstracts, 69 articles were excluded.

analyze :

Distribution of reviewed articles by year

There is a clear increase in the annual number of articles that cover the main technical and social drivers of reuse of recycled water in food production. Photo 1). Based on data analysis, 41.6% of all articles were published in the last three years, while 14.4% of all articles were published in one year (2010). The high productivity of reviewed articles published in 2010 can be explained by the several droughts that affected most European countries during 2005 and 2008, as most of the articles analyzed Mediterranean case studies. they did The value of the coefficient of determination (R2)) indicates a positive but not significant correlation between the years under study (2007-2017) and the annual number of articles related to the subject. Nevertheless, this percentage may be too high a proportion of changes to predict in a field such as social sciences.

Research areas and geographical context

Analyzing the profile of the researcher is the first attempt to know the type of research that will be conducted and the approach (technical and social or only social) that will be prioritized. The main areas of research have been identified from the affiliation of the first author (Figure 2). Note that in some articles, the authors do not have the same research area. If not, they will acquire new knowledge from other disciplines (e.g. environmental sciences combined with studies in human society, Wester et al., 2015, agricultural sciences in collaboration with biological and chemical sciences, Michailidis et al., 2015; or engineering and technology,

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

including management and planning issues, Miller-Roby et al., 2017). The analysis shows that the research fields of agricultural science and technology constitute 43.2% of the reviewed articles. The fields of social research (economics, management and planning, studies in human society and policymaking and political science) provide 34.4% of the articles in the database. Of the 125 articles reviewed, 55.2% are European case studies, while 11 articles (8.8%) do not specify any geographic context (e.g., Advanced Reviews, 2017, Jaramillo and Restrepo) or their research on Focused on A.

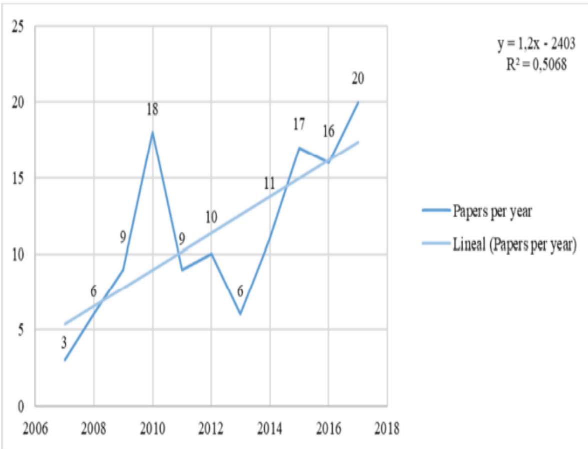

Figure 1: Distribution of reviewed articles per year

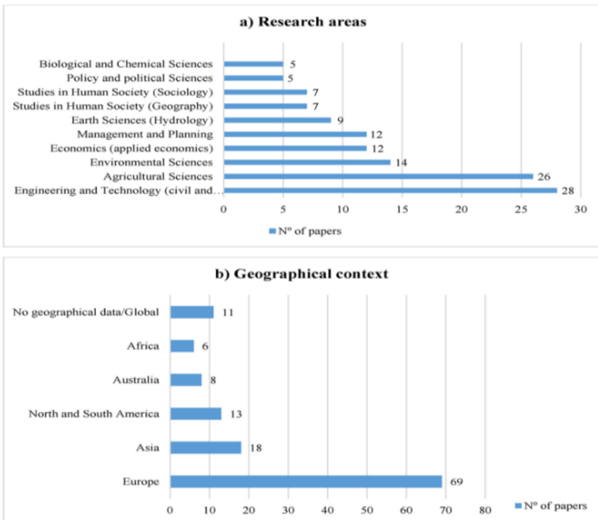

Figure 2. Research areas and geographical context of reviewed articles

on a global scale (e.g. frequently treated sewage fissures, Fatta-Kassinos et al., 2011). At the European level, research is clearly focused on Mediterranean countries such as Spain, Greece,

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

Italy, Great Britain and Portugal. Interest in these countries is not accidental. According to the report of the World Resources Institute and the Water Risk Atlas tool, these areas will face moderate to high physical risk quantity and high physical risk quality. In addition, the predicted change in water stress shows how climate change is expected to affect the water reuse ratio.

Keywords and research topics

A total of 32 keywords were identified in the reviewed articles in the period 2007-2017 (Figure 3). For this analysis, keywords related to geographical locations, agronomic parameters, or physiological and structural properties have been removed. Keywords can be classified into five categories: topic (irrigation, agriculture), norm (regulations, laws), risks (environmental effects, health risks, climate change), social (perception, ice factor, disgust, etc.), and concepts (recycled sewage, recycled water, desalinated water, etc.). Concepts category included 58.5% of keywords, followed by social category (16.2%), the most popular keywords were recycled water and irrigation/agriculture. Many publications include the benefits of non-conventional water sources in the introduction section (as a way to deal with risks). Although no specific keywords are included as references (e.g. Hernandez et al., 2010). In addition, although a significant number of articles analyze the relevance of the yuck factor, most of them have not included this issue in the list of keywords (Petosi et al., 2015; Shidaei et al., 2015).

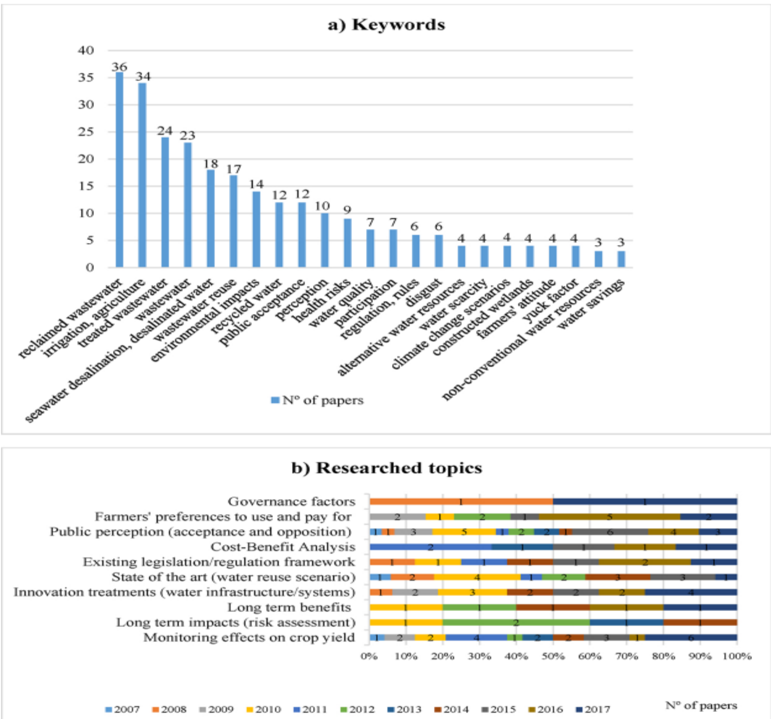

Figure 3 Key words and main research topics that have been investigated by recent studies (2007-2017)

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

Articles may simultaneously focus on more than one research topic (e.g. farmers' preferences and public perception, Starkel et al., 2015; Maila et al., 2017 or impact monitoring and cost-benefit analysis, Pedero et al., 2010; Melgarjo et al., 2016).

By analyzing the goals of the articles, we have been able to create 10 research areas. The top 5 researched topics are: 1) "public perceptions" (23.2%), 2) "monitoring the effects of water on product performance" (19.2%), 3) "state of the art" (13.6%), 4) "treatments innovative". " (12.8%), and 5) "Farmers' preferences for reuse and payment for" (10.4%). Social terms (state of the art, legal/legislative framework, cost-benefit analysis, public perception, farmers' preferences and governance factors) were created in 75 articles (60% of the total), while the technical terms (innovative treatment, long-term benefits and effects) and monitoring effects on product performance were included in 50 articles (40%) in only 2 of 11 years In the analyzed years (2014 and 2017), the number of articles related to social issues was less than 50% of the total production (for example, Tram et al., 2014; Beqapour et al., 2016). On the contrary, in 2008 and 2015, articles There were more that focused on social terms (Mesalaptosi et al., 2015).

The distribution of reviewed articles by year allows us to determine how each research topic has evolved over time. Regardless of the state of the art (since it involves the analysis of various research topics), in 2007 public perception (Mengaki et al., 2007) and regulatory effects (Kandela et al., 2007) focused the researcher's interests. In 2008, governance factors (Nancaro et al., 2008), legislation (Iglesias and Ortega, 2008) and innovative treatment (Illueca-Muñoz et al., 2008) joined the discussion of scientific production. One year later, more attention was paid to the perceptual issues of farmers. Russell and Lux, 2009) and people (Dolnikar and Shaffer, 2009) in 2010. In 2010, the long-term benefits (Leung, 2010) and impact (Munoz et al., 2010) of using recycled water were added to the primary research areas, one year later. Cost-benefit analysis was included in the analysis of non-conventional water resources. Molinos-Senant et al., 2011) and more attention to regulatory effects (Murugan-Coronado et al., 2011) in 2012, studies focused on farmers' preferences and public perception. Kemp et al., 2012) risk assessment (Cirelli et al., 2012) was carried out and a year later, new studies on cost-benefit analysis (Alcón et al., 2013) and regulatory effects (Pederro et al., 2013) were conducted. Innovative treatment (Ortega-Rieg et al., 2014) and regulatory effects (Contreras et al., 2014) Marceau et al., 2015; Saldias et al., 2016) Finally, there was renewed interest in innovative treatment (Licata et al., 2017) and regulatory effects (Romero-Trigueros et al., 2017) in 2017. It is worth noting that more interest in awareness of public perception of the use It is worth mentioning about non-conventional water sources instead of asking farmers to use and pay for the reuse of these purified water sources.

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

Analysis tools

In total, 17 analysis tools from quantitative, qualitative and combined methods have been used in the reviewed articles. Figure 4). The qualitative tools of this category include six types of analysis to promote stakeholder engagement (questionnaires, interviews, focus groups) and provide evidence and data collection strategies (literature review, SWOT analysis, along with creating a protocol) Is. The quantitative classification tools include four types of analyzes focused on field experiments: soil analysis, water monitoring, plant growth measurement, and chemical modeling. Finally, a mixed-category tool that includes seven types of analysis to compare parameters (test analysis, indicators), define systematic approaches (cost-benefit analysis, risk assessment, life cycle assessment) and promote stakeholder participation (decision-system support, agent-based model). 86 papers used a qualitative analysis method (Hines et al., 2011; Mahesh et al., 2015), while 67 papers used quantitative tools (Diaz et al., 2013; Maestre-Valero et al., 2016) and 19 papers from used a combination (Virgin et al., 2017). Note that articles may simultaneously use more than one analysis tool from quantitative, qualitative, and/or mixed methods (e.g., Freins et al., 2016). Regarding internal classification analysis, the most popular qualitative tools were questionnaire and literature review (76.7%), while soil analysis and water monitoring were the most popular tools from a quantitative point of view (82.1%). The use of hybrid tools was less important and the most popular tool was cost-benefit analysis.

It is time for a literature review to answer this question: What insights have been gained from different technical and social science approaches to understanding drivers and public responses to water reuse? We structure our answer to this question around three broad and interrelated strands of thought that have emerged from the literature of the past decade: risks, regulations, and the yuck factor.

Risks

The concepts of social structure risk are deeply rooted in the historical, social and cultural context, which are understood differently by individuals, societies and institutions. Dobbie and Brown, 2014). It is understandable that both from the point of view of the society (farmers and people) and from the point of view of the organization (water managers), major concerns about water reuse projects are caused by potential risks, both environmental and health. Grant et al., 2012).

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

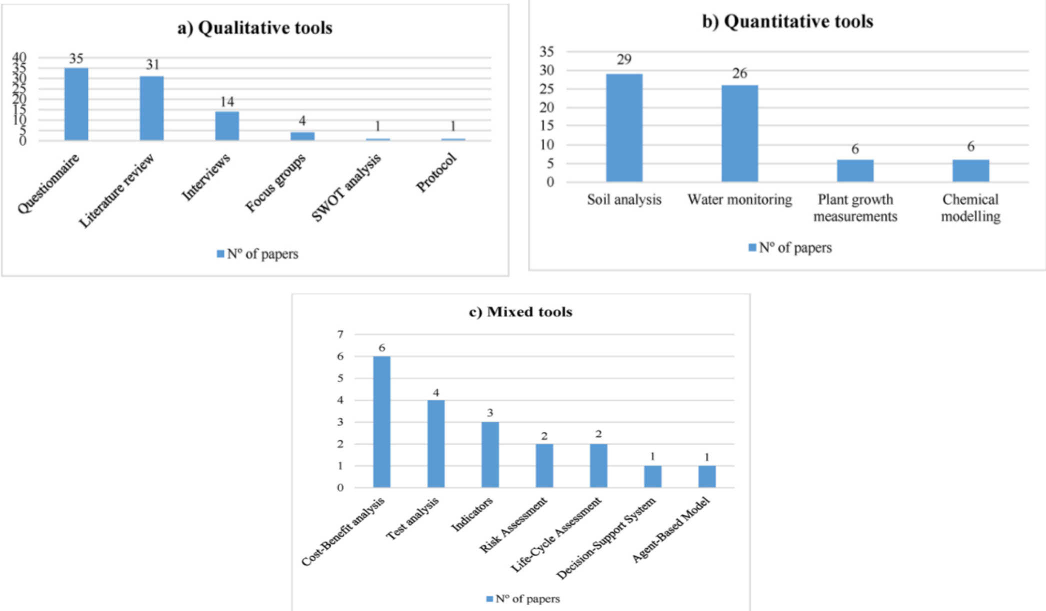

Figure 4. Analysis tools used in the reviewed articles

Environmental hazards

The presence of nutrients is one of the clearest effects recognized in the literature. Pederov et al., 2010). Although the nutrients in treated municipal wastewater provide fertilizer value for crop or landscape production, in certain cases they are more than the plant needs and can cause problems related to excessive vegetative growth, delayed or uneven maturity, or decrease in quality. Nutrients produced in significant amounts include nitrogen and phosphorus, sometimes potassium, zinc, boron, and sulfur. Diaz et al., 2013). Changes such as increasing pools of organic matter, salinity, and the accumulation of pollutants in the soil are other effects that are often reported. Contreras et al., 2014). Human and animal pathogens, phytopathogens and antibiotic-resistant bacteria and their genes are important biological pollutants that can be transported by sewage and/or enriched in soil. Bekra Castro et al., 2015). Wastewater also contains other pollutants such as metals, metalloids, drug residues, organic compounds, endocrine disrupting compounds and active residues of personal care products. Ghadeer et al., 2010).

In addition, regular reuse of wastewater can change minerals, macronutrients and micronutrients for plant growth, soil pH, soil buffer capacity and cation exchange capacity. Bano et al., 2011).

Some studies clearly focused on farmers' understanding of environmental risks. For example, Shidaei et al. (2016) investigated the factors of perceived health and environmental risks of reuse of wastewater in Iran and concluded that while farmers are concerned about the contribution of wastewater to soil fertility and its reliability as a They were aware of the water

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

source, they were worried about its negative impact on the environment. Another study by Mahesh et al. (2015) in an Indian micro-basin where the irrigation water is a mixture of canal water from the Musa River and groundwater, farmers felt that soil quality had changed over time due to the influence of effluent irrigation. , according to research studies by Biggs and Jiang (2009). Finally, although most studies are short-term, the main effect identified on perceived soil quality was the result of the duration of wastewater reuse. Chen et al., 2016).

Health risks

Citizens may perceive health risks or suspect that pathogens and chemicals are present in reclaimed water, and evidence suggests that perceptions of health risks increase when reclaimed water comes into contact with humans. Kandia et al., 2017). Perception about health risks describes people's mental judgment about health risks or behaviors and can be caused by factors such as tradition, family pressure, society norms, time pressure and discomfort. Karg and Drechsel, 2011).

Food safety is a major public concern that attracts the attention of researchers and stakeholders in general. Khan et al., 2009; Farahat et al., 2017). Contaminated food sources can lead to many serious health problems, such as depletion of essential nutrients in the body, which weakens the immune system. et al., 2012 Orisakwe). In addition, various studies have shown that there are high levels of enteric bacteria and viruses in treated wastewater. 2017, Okoh and Osuolale, which are usually resistant to common wastewater treatment and disinfection processes and can be released into the environment through sewage effluents. Simmonds et al., 2014). In fact, they exist in domestic sewage and due to the lack of proper removal in normal sewage and long persistence in the environment, they can be transferred to the environment. Mozni et al., 2016). According to a recent study conducted in India by Saldias et al. (2016), when asked directly, about 75% of respondents claimed to be aware of the health risks associated with wastewater reuse, while about 78% The farmers were told that if the water quality is better, they will grow other crops. (For example, vegetables for higher income). However, although farmers had years of experience in using sewage, in some cases they had very little knowledge of the health risks involved. This can be explained by the fact that farmers do not consume what they produce or because they do not receive feedback on the risks perceived by consumers. Kraita et al., 2008). The results also emphasize that the farmers' understanding of the health and environmental risks of the product is a complex set of factors, including previous knowledge, the distance from the farm to the sewage plant or canal (proximity) and the direction Market valuation is the most important factor to understand. Their desire or objection to using sewage (Shidai et al., 2015).

Detergents and disinfectants are resistant and can be spread in the environment through sewage effluents. Simmonds et al., 2014). In fact, they exist in domestic sewage and due to the lack of proper removal in normal sewage and long persistence in the environment, they can be transferred to the environment. Mozni et al., 2016).

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024
According to a recent study conducted in India by Saldias et al. (2016), when asked directly, about 75% of respondents claimed to be aware of the health risks associated with wastewater reuse, while about 78% The farmers were told that if the water quality is better, they will grow other crops. (For example, vegetables for higher income). However, although farmers had years of experience in using sewage, in some cases they had very little knowledge of the health risks involved. This can be explained by the fact that farmers do not consume what they produce or because they do not receive feedback on the risks perceived by consumers. Kraita et al., 2008). The results also emphasize that the farmers' understanding of the health and environmental risks of the product is a complex set of factors, including previous knowledge, the distance from the farm to the sewage plant or canal (proximity) and the direction Market valuation is the most important factor to understand. Their desire or objection to using sewage (Shidai et al., 2015).
Redam) and from the organizational point of view (water managers) major concerns about water reuse plans are caused by potential risks, both environmental and health. Grant et al., 2012).
United Nations (FAO) in 1987 (Haines et al., 2011). Recently, the United States Environmental Protection Agency and the United States Agency for International Development updated the 2010 "Guide to Wastewater Reuse" to include advances in wastewater treatment technologies, best practices for The participation of communities in the planning of projects and factors that support safe development. and sustainable water reuse (2017, Jaramillo and Restrepo). At the European level, Council Directive 60/2000/EC (Water Framework Directive) and Council Directive 271/91/EEC (Urban Wastewater Treatment Directive) created the basis of national frameworks. European Commission, 1991). The former implicitly recognizes reuse as a strategy to increase water availability, thereby contributing to the good status of water bodies, while the latter considers that "wastewater should be reused if necessary." Paranikianakis et al., 2015). The European Water Protection Plan (2012) identified water reuse as an important action that needs the attention of the European Union and a concerted effort is needed to instill confidence and increase acceptance of water reuse practices. This was even further pursued in the 2015 statement "Closing the loop - an EU action plan for a circular economy", which identified a set of activities to promote the reuse of treated wastewater. Recently, in May 2018, a proposal for a Regulation of the European Parliament and of the Council on Minimum Requirements for Water Reuse (COM) 2018(337) was presented because the reuse of treated wastewater generally has a lower environmental impact than the transfer of water. or, for example, desalination and creates a wide range of environmental, economic and social benefits. The wastewater reuse recommendations developed by these organizations and political frameworks are the background of many legal guidelines proposed in countries such as the United States, Portugal, Spain, Italy, Cyprus, France, Australia. , Israel, Jordan, Kuwait, Oman, Saudi Arabia and China (Angelakis and Gikas, 2014; Virgin et al., 2017). In some cases,

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

regulations at the regional level have been prioritized over the global framework. For example, the state of California was a pioneer in water reuse as it had regulations in place since 1918 (California State Board of Health). At the European level, the Spanish Royal Decree 2007/1620 was a significant step forward in the regulation of water reuse, as it clarifies both the responsibilities of public authorities and concession holders and end users, as well as permitted uses. And the quality criteria specify the minimum frequency. Sampling, criteria of analytical methods and compliance criteria (Iglesias et al., 2010; Molina and Melgarjo, 2016). Mole et al. (2012) and Faul et al. (2016) analyzed how many water reuse regulations in several EU countries were not developed in line with EU transversal principles such as the precautionary principle. In another case study, Shidaei et al. (2016) asked farmers what they knew about the rules and regulations of safe reuse of wastewater in food production, and only half of them answered positively.

The yuck factor

The standard explanation for public resistance to water reuse projects is the "yuck factor," or feelings of dread and disgust associated with drinking or buying food products produced with wastewater. The yuck factor is also defined as a "psychological disgust", "disgust" or "deep discomfort". Marx et al., 2008). It is associated with "affect initiative", which believes that people's willingness to accept a certain risk is determined by an emotional response (affect), which precedes the cognitive evaluation of information. Fife-Shaw et al., 2008). Contrary to these explanations, which focus on psychological aversion, authors like Ormerod and Scott (2012) argue that the yuck factor is based on social and cultural perceptions of risk. According to this, the opinion affects the intention to accept, and the intention affects the behavior - ethics.
Regulations and regulations
Risks based on water and soil quality standards for irrigation water reuse is a relatively broad topic that includes extensive guidelines and regulations that vary in their specificity for specific end uses of water. Most articles on wastewater reuse regulations are based on the World Health Organization (WHO) document "Effluent Reuse: Wastewater Treatment Methods and Health Protection Measures" (1973) with the aim of protecting public health and promoting rational reuse. of wastewater and disposal in agriculture (Mara and Kramer, 2008). Another paper established guidelines for wastewater quality for agricultural reuse published by the Food and Drug Administration.

Implementation of Water Reuse Schemes A growing body of social research seeks to understand why farmers (and, more interestingly, the general public) support or reject the reuse of reclaimed water. and what challenges should be addressed to ensure mutual understanding between farmers. Demands and public perception

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

Farmers' freedom of action

Farmers are ultimately the final consumers of recycled water and their decision to irrigate or not to irrigate with alternative water can disrupt any water reuse project.

In addition, a special panel of experts sharing their experiences of the irrigation process will provide suggestions that could influence future reuse projects in the surrounding area. Maila et al., 2016). Majid et al. (2010) referring to how farmers express two opposing views on the quality of wastewater: disgust in the family and social sphere, which is valuable in the economic sphere and food production. Although many farmers recognized the fertility value of sewage, they did not have enough insight into it and applied fertilizers at rates based on the mind's eye. The main factors identified as important to understand are the quality of the water delivered to the farm (Ortega-Rieg et al., 2014), the capacity of farmers to manage the risks of food crop production caused by irrigation with recycled water (Bakopoulou et al., 2010), community concerns in reuse for irrigation (Wester et al., 2015 (Carr et al., 2011). Mengaki et al. (2007) found that the vast majority of farmers support water reuse as a concept and with increasing degrees of contact With recycled water, the support for reuse is reduced.

Language is very important when asking about farmers' willingness to use wastewater. For example, while under treatment means that the described effluent has changed form from its previous (contaminated) state. Recycled indicates a return to an even earlier and purer source (Mengaki et al. (2009). At this point, it should be noted that in some articles, the technical usage and common use of specific terms such as recycled wastewater and The results of their study show how farmers who were willing to use treated wastewater for crop irrigation were described as "recycled water" instead of "treated wastewater." (2010) conducted in Thessaly region concluded that most farmers (58%) are willing to pay half of the price of fresh water for the recycled water used for crop irrigation A relatively high percentage of them (34%) do not pay for recycled water if they have fresh water for irrigation, while a very low percentage of farmers (8%) pay a little less for recycled water. Therefore, the authors conclude that farmers' income reduces the likelihood of paying half the price for recycled water when fresh and recycled water are available.

Since the cost of recycled water is an important factor in encouraging farmers to reuse recycled water and supporting the adoption of water reuse, most water reuse projects involve direct or indirect subsidies, i.e. suppliers tend to Offer recycled water at preferential prices. For example, in Spain, government departments can cover a maximum of about 70% of the operation costs related to the transfer of water from the WWTP to the irrigation of fields and about 10% of the total cost of installing the irrigation system used. Albana et al., 2010). However, according to the terms of the WFD, the actual cost of recycled water should be paid by the final consumer, but for example in regions such as Spain, this is not yet the case.

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

Public trust

A significant number of surveys have been conducted worldwide to understand how public perception, acceptance, and opposition interact with promoting organizational water reuse. Petosi et al., 2015). Several studies, clearly focused on public perception, have evaluated the acceptance levels of recycled/reclaimed wastewater for various purposes that vary in the extent of human contact. Regardless of the acceptance criterion used, the same pattern appears: the acceptance of water reuse decreases

increased human contact (Boyer et al., 2012). According to a recent comprehensive review by Fielding et al. (2018), 80% or more of the participants found it acceptable to use recycled water for public or home garden irrigation. However, the fact that each reviewed study used different methods to ask people (specific questions, different concepts) about whether they accept the use of wastewater for irrigation of food crops and landscape maintenance is not taken into account. It uses Kand, which varies from 40 to 50. % (Browning-Aiken et al., 2011; 2013, Alkan and Buyukkamaci) to 70-90% (Chen et al., 2015). There may be several reasons to explain the lowest percentage: 1) Many citizens can understand the health hazards or suspect them based on their appearance, color and smell. 2) The communities were suspicious that the programs were being carried out secretly and their concerns were being ignored. Beveridge et al., 2017) or 3) water reuse organizations failed to adequately promote the benefits of their operations. et al., 2008 Mujeriego).

Studies including Badour et al. (2009); Nancarrow et al. (2010); and Adewumi et al. (2014) show that public acceptance of product reuse is related to attitude, emotions, control over water source, subjective norms (influence of people around you), knowledge or information about the project, related risks, trust in the implementing authority, Satisfaction is physical quality, selection, specific use, source(s) of recycled water, cost and water scarcity. These factors have been investigated individually or in combination in different places where water reuse projects have been implemented or planned. For example, several modeling-based studies have argued that higher levels of trust are associated with lower risk perceptions, which in turn increase the likelihood of adoption. Ross et al., 2014). "Trust" is linked to the concept of "contagion", which comes from the feeling of "once in touch, always in touch". Rozin et al., 2015). This emotional reaction means that people cannot separate the end product of water reuse (clean water) from its polluted source (human waste). Another recent study argues that emotional reactions to "contagion" determine a "social representation" of water reuse (the way in which it is perceived in the public sphere) that significantly correlates with perceptions. Scientific and technical are different. Callaghan et al., 2012). The authors note that individuals may be aware of and influenced by the social representation of water reuse, even if they do not fully accept this representation themselves. According to this issue and according to Tram et al. (2014), water reuse experts recognize the positive role that recycled water may have in the water supply system and believe that risk aversion and management in the reuse of water Recycled water is

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

necessary due to upstream water quality problems, accidental leaks or incompatibility of uses. Water quality (Dupont, 2013).
Another common assumption collected by Stanks et al. (2006) is that water reuse projects fail because people are unable to understand expert information about risks and beliefs, therefore, if people are educated were given, they accepted the changes more easily. The media can provide part of this education (Goodwin et al., 2017). For example, Dolnikar et al. (2010) investigated the effect of information on the acceptance of recycled and desalinated water in a study of 1000 Australian subjects and found a positive relationship between the provision of information and public acceptance of alternative water sources. Horliman et al. (2009) noted that in Mawson Lakes, Australia, respondents had greater trust in water authorities when they were well informed about recycled water, and furthermore, respondents reported higher levels of satisfaction. They showed the use of recycled non-potable water. In another case study from the Jordan Valley, more than 70% of respondents expressed their desire to learn more about water treatment and reuse. Al-Mashakbah et al., 2013). Many of these studies show how public acceptance of reuse is more likely when environmental protection and improved water conservation have clear benefits. and when the awareness of water supply problems in the community is high (Dare and Mohtar, 2018). Both factors are closely related, and their inclusion is partly because these are the regions of the world where water reuse is most common.

that regularly experience water shortages - especially in the United States, the states of California, Texas, and Arizona. Australia; and Mediterranean countries (Horliman and Dolnikar, 2016). For example, Dolnikar et al. (2011) concluded that awareness of real water scarcity problems, as well as previous experience with water restrictions, increases the likelihood of respondents adopting water reuse.

Conclusion:

Ten years ago, Angelakis and Durham (2008) asked whether water reuse for agricultural purposes was one of the most misunderstood uses of water, just like the human water cycle. The success and failure of water reuse projects around the world (compared to the drivers of such projects) is shaped by the complex interrelationships between technical, economic and socio-political factors. Although the successful implementation of innovation and new technology - primarily focused on ensuring the quality of reused water - has been promoted in the past, this engineering practice has not always been accompanied by an understanding of the social environment in which the water reuse project must be implemented. Is. Gu et al., 2015). Furthermore, it should be recognized that many well-established reuse schemes were implemented before broad public participation became a necessity in water sector planning and management, and hence they They benefited from it. Based on this, priority was given to

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024
achieving a new water source, while environmental and health risks and regulatory issues were excluded from the social discussion. Duong and Saffors, 2015). However, for farmers and the public, risks and regulations are key issues in whether or not water reuse is accepted. A recent study by et al. (2015) Antwi-Agyei shows how farmers underestimate or overestimate risks depending on how the study is presented. Farmers tended to overestimate the risks to the extent that they needed help when there was any possibility of benefit to them, for example, by asking for new investment in innovative water quality equipment or by asking for a reduction in the cost of water reuse. highlight However, because farmers knew that this practice was not socially acceptable, they took risks when talking to the government, the media, health officials, or people who they thought could threaten their business. They take less. Both extremes are supported by the findings of Covelo and Johnson (1987), which means that risks are "exaggerated or minimized based on the social, cultural and moral acceptability of the underlying activities" and from this Based on this general theory that risk perception is formed socially.

Risk perception is clearly related to regulation, an example of which is the conflict between advocates of strict water quality standards to fully protect public health and advocates of a pragmatic position that recognizes existing wastewater reuse practices. and promotes the use of non-potable water. less restrictive water quality standards (Kozwak et al., 2017). Both concepts agree that if water quality problems are to be overcome, it is necessary to upgrade tertiary treatment plants that consider the needs of farmers and public perception. Deniz et al., 2010). Moreover, this technological investment should be included in the regulatory framework in line with the international effort to reduce the discrepancies between the current standards on water quality and the potential uses of water, which is much requested - especially at the Union level. Europe, to be included. Accordingly, regulations should be open to public consultation to ensure good governance principles, and they should be tailored to the context, health risks and cost-effectiveness of each individual country. Ricart et al., 2018). This last point is particularly relevant with regard to the potential of water reuse, as more compelling legal and financial incentives may draw attention to technical investment or more social debates. For example, within the framework of the European Union, the five member states with the highest reuse potential (Italy, Germany, France, Portugal, and Greece) can reach the same water reuse rate as Spain by 2025 (European Commission, 2016). Also, in Israel, it is estimated that until 2040, treated wastewater will become the main source of irrigation water. Providing 70% of the country's total irrigation water consumption with Coppolo et al., 2010).

From the literature reviewed, it has long been recognized that the main challenges to more effective water management are mainly socio-institutional rather than technical, with institutional fragmentation, limited long-term strategic planning, lack of project visibility and insufficient community participation.

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024
Bischel et al., 2012). In particular, the perceived benefits of using recycled water may seem distant and abstract to the individual. Brewer et al., 2015). Benefits such as improved access to water for future generations may not be worth the short-term health risks. This means that people may be more willing to protect their current health at the expense of long-term water security, a problem naturally described as a social dilemma. Kemp et al., 2012).
Furthermore, water reuse can potentially be harmed by being associated with "recycling". Accordingly, while many recycled products have "higher moral value". This does not necessarily mean a higher economic value because these products are usually thought to be of lower quality than their non-recycled counterparts. This raises the hope that recycled water (and potentially also food crops irrigated with recycled water) And be cheaper. Meehan et al., 2013). This research supports the view that cultural meanings related to water and water use are an important source for many people's response to recycled water offers. Cognitive factors such as the law of contagion and the law of similarity may explain many of the cultural perceptions people may have about water reuse. The first shows that when water is in contact with contaminants, it can be psychologically very difficult for people to accept that it has been treated.
Second, the "appearance" of a substance's state or condition is psychologically related to the perception of reality. Collectively, these factors can create mental barriers to accept reuse water as a pure water source. So why do these laws affect certain water reuse projects and not others? The main reason is related to value differences. Although two projects may be technically similar, people may perceive different value depending on the problem the community needs to solve, the alternatives to solving the problem, and how to communicate this information to important audiences. Indirect reuse of drinking water is usually a new product or idea for communities. Its value should be convincing and described in simple and meaningful language. For example, when recycled wastewater is used directly for supply (eg irrigation purposes) it may be considered a private asset with a market value. However, if used for environmental purposes (such as enhancing water bodies), the reclaimed effluent is a public asset that has no market value, but its environmental value (in terms of the ecosystem services it provides) is difficult to quantify. to be Engel and Shaffer, 2013).

Public opposition to water recycling remains a barrier to its adoption. This general opposition can be explained by many reasons suggested by the reviewed literature. A study by Marks et al. (2008), based on baseline data on attitudes towards water recycling and its use in a representative Australian sample of major urban areas, reinforces the fact that public acceptance of water recycling does not It can only be achieved by reducing the objective level of risk (assessed by experts) associated with the required technologies. For example, studies focusing on the willingness of farmers to pay for the reuse of recycled water or the willingness of consumers to buy food produced with recycled water show that a large number of farmers

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

and consumers have a positive opinion - Although with different priorities: water supply, cost and quality for irrigation and health risks and contagion for citizens (Paranikianakis et al., 2015). However, a recent study conducted by Friens et al. (2016) focused on the opinions of farmers and consumers regarding water reuse products that were collected in interviews and focus group meetings in four European water reuse projects. was achieved, which showed how the farmers in the focus group did not believe that consumers would consider crops irrigated with reused water. As better or more lovely products. According to them, the reuse of recycled water for food production can only be successful if the quality of the water, as well as the final product, is guaranteed and certified, and if the change to recycled water is accompanied by a comprehensive communication plan. To increase public acceptance of recycled water. In addition, the citizens participating in the focus group meeting believe that a very important precondition for the final success of water recycling is the good performance of the assurance and certification system. Accordingly, some kind of identification should be promoted as a way of mutual understanding between producer and consumer. Furthermore, communication should focus not only on the solution (water reuse), but also on the underlying problem (water scarcity, water consumption, water pollution) by promoting more active public participation methods. Adapa et al., 2016).

A key strategy suggested by Bauman and Casperson (1974) and later by Dolnicaro Horliman (2009) is to focus on making water reuse programs into something that the public enjoys and approves of. do In the words of the authors, “place reclaimed water in an attractive environment and invite the public to look at it, smell it, picnic around it, fish in it, and swim in it.” (p. 670). For example, in Italy, in Milan there is a WWTP - the largest plant in the region, which treats approximately 150 million meters. 3/Sewage Year - Managers promote open days to show the factory activities to the public and farmers in order to support the adoption of corn, rice, grass and grain cultivation in a large agricultural area.

Recent findings have shown that, while awareness of the actual occurrence of de facto reuse is generally low, those who are aware that de facto reuse occurs in their supply area significantly (up to 10 times more) have a high level of reusability. Adoption for potable reuse scenarios (Raiso et al., 2016). This suggests that instead of awareness of the "need" of reuse as a solution to water supply issues, awareness of reuse as a "normal" part of the water resource landscape may be a significant driver of adoption. However, if recycled water is not integrated into the comprehensive water system, actual reuse will not be useful to improve the understanding of the benefits of alternative water sources. Just two examples: The city of Los Angeles currently discharges treated sewage into the ocean at a rate of about 1.5 millimeters. 3) d/ Wornes et al., 2011 and according to the Costa Brava Water Consortium (Catalonia, Spain), less than 10% of the total volume of WWTP (0.5 mm) 3 and 1) is included in the water system and 90% of it is rivers and lakes, also in periods of scarcity (Albana et al., 2010). In order to reverse this situation, new strategies to move from traditional WWTPs to innovative constructed wetlands

Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024
(CW) have been promoted in some areas as a cost-effective treatment that can treat a wide range of pollutants. remove them using a combination of physical, chemical and biological agents. processes (Ayaz et al., 2014; Vimazal and Berzinova, 2015; Machado et al., 2017). Sometimes, this process is favored by a marketing campaign. For example, the Government of Singapore (through the Public Service Board), in 2000, launched a wastewater recycling demonstration project in which part of the treated effluent from the Bedok Wastewater Treatment Plant was diverted to a water treatment plant called the NEWater Plant. became. Khan and Gerard, 2006). The use of language is not free: the aim of the promoters was to ensure that the project was well received by the public and that the "new" concept of the origin (waste) of water was secondary.

Implementation of innovative technologies and tools should be focused on this task. For example, by scaling up and long-term analysis of water, soil and crops or by overcoming risk management. Without knowing the risk and analyzing the relationship between risk and cost, it will be very difficult to promote behavior change towards safe and feasible water reuse methods. Furthermore, to reduce health risks, interventions and regulatory frameworks are likely to be successful if they are implemented in a participatory manner that involves the government, at-risk social groups, and other key stakeholders. Based on this, the reorientation of water governance towards integrated water management is needed. Furthermore, often in consultation with stakeholders, water reuse is excluded from integrated water management scenarios, often without considering the potential of water reuse as an alternative. The challenge for water reuse professionals here is to educate and reorient their institutions to adopt more conscious and sustainable practices by bridging the harsh but artificial divisions of water supply and wastewater.

Case studies drawn from the literature show how the best way to convince people about this important issue is to build and operate demonstration sites several years before full implementation and invite people to visit them to reduce fear. Is. As citizens become more familiar with the technology and have a general understanding of the benefits associated with increased water reuse, officials, planners, and managers may face less opposition to additional uses and through widespread implementation of cost-effective water reuse programs. Achieve more efficiency in water consumption. Direct site visits to sewage treatment plants and seeing the effluents of such facilities can have a significant effect on increasing public acceptance because studies have shown that although people accept experts' opinions about the quality of treated sewage, they mostly They rely on their personal perceptions of sewage. Effluent (often based on turbidity and suspended particles). The challenge is to identify public knowledge and perceptions and systematically address concerns through a framework of educational, policy and management strategies. To address this gap between technical and social drivers of water reuse, it is essential that engineers and social scientists work together. Engineers can provide

Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

the best, safest and least-consumption solutions to increase water resources. While social scientists can facilitate a better understanding of the reasons for public opposition to the reuse of water from alternative sources. Social scientists can also suggest ways that public policy makers can increase the acceptance of alternative water sources and find solutions that are most acceptable to society. Finally, managers can benefit from this social-technical approach to promote holistic water management between urban water reuse and food production.

The lack of water and the deterioration of the quality of water resources require the adoption of modern water resources management policies. This management should be flexible in order to continuously deal with changes in availability and demand for water resources. Such a comprehensive approach requires management of water supply and demand. Recycled water is becoming increasingly relevant to achieve the drivers of water reuse (risks, regulations and the yuck factor). A comprehensive approach between farmers and people is needed.

References:

[1] Adapa, S., Bhullar, N., Valle de Souza, S., 2016. A systematic review and agenda for using alternative water sources for consumer markets in Australia. J. Clean. Prod. 124, 14–20.

[2] Adewumi, J.R., Ilemobade, A.A., van Zyl, J.E., 2010. Treated wastewater reuse in South Africa: overview, potential and challenges. Resour. Conserv. Recycl. 55, 221–231.

[3] Adewumi, J.R., Ilemobade, A.A., van Zyl, J.E., 2014. Factors predicting the intention to accept treated wastewater reuse for non-potable uses amongst domestic and non-domestic respondents. J. S. Afr. Inst. Civ. Eng. 56 (1), 11–19.

[4] Agrafioti, E., Diamadopoulos, E., 2012. A strategic plan for reuse of treated municipal wastewater for crop irrigation on the Island of Crete. Agric. Water Manage. 105, 57–64.

[5] Ait-Mouheb, N., Bahri, A., Ben Thayer, B., Benyahia, B., Bourrié, G., Cherki, B., Condom, N., Declercq, R., Gunes, A., Héran, M., Kitir, N., Molle, B., Patureau, D., Pollice, A., Rapaport, A., Renault, P., Riahi, K., Romagny, B., Sari, T., Sinfort, C., Steyer, J.-P., Talozi, S., Topcuoglu, B., Turan, M., Wéry, N., Yıldırım, E., Harmand, J., 2018. The reuse of reclaimed water for irrigation around the Mediterranean Rim: a step towards a more virtuous cycle? Reg. Environ. Change 18, 693–705.

[6] Alcón, F., Pedrero, F., Martin-Ortega, J., Arcas, N., Alarcón, J.J., de Miguel, M.D., 2010. The non-market value of reclaimed wastewater for reuse in agriculture: a contingent valuation approach. Spanish J. Agric. Res. 8 (2), 187–196.

[7] Alcón, F., Martín-Ortega, J., Pedrero, F., Alarcón, J.J., de Miguel, M.D., 2013. Incorporating non-market benefits of reclaimed water into Cost-Benefit Analysis: a case study of irrigated mandarin crops in southern Spain. Water Resour. Manage. 27, 1809–1820.

Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024
[8] Aleisa, E., Al-Zubari, W., 2017. Wastewater reuse in the countries of the Gulf Cooperation Council (GCC): the lost opportunity. Environ. Monit. Assess. 189 (11), 553.
[9] Al-Mashaqbeh, O.A., Ghrar, A.M., Mgdad, S.B., 2012. Grey water reuse for agricultural purposes in the Jordan Valley: household survey results in Deir Alla. Water 4, 580–596.
[10] Al-Seekh, S.H., Mohammad, A.G., 2009. The effect of water harvesting techniques on runoff, sedimentation, and soil properties. Environ. Manage. 44, 37–45.
[11] Angelakis, A.N., Durham, B., 2008. Water recycling and reuse in EUREAU countries: trends and challenges. Desalination 218, 3–12.
[12] Angelakis, A.N., Gikas, P., 2014. Water reuse: overview of current practices and trends in the world with emphasis on EU states. Water Util. J. 8, 67–78.
[13] Ansari, S., Alavi, J., Ghafoori, M., 2018. A technical model for reclaimed water reuse in agricultural irrigation: a case study in Kordkuy, Iran. Environ. Earth Sci. 77, 90.
[14] Antwi-Agyei, P., Cairncross, S., Peasey, A., Price, V., Bruce, J., Baker, K., Moe, C., Ampofo, J., Armah, G., Ensink, J., 2015. A farm to fork risk assessment for the use of wastewater in agriculture in Accra, Ghana. PLoS One 10 (11), e0142346.
[15] Avni, N., Eben-Chaime, M., Oron, G., 2013. Optimizing desalinated sea water blending with other sources to meet magnesium requirements for potable and irrigation waters. Water Res. 47, 2164–2176.
[16] Ayaz, S.Ç., Aktas, Ö., Akça, L., Findik, N., 2015. Effluent quality and reuse potential of domestic wastewater treated in a pilot-scale hybrid constructed wetland system. J. Environ. Manage. 156, 115–120.
[17] Azhoni, A., Jude, S., Holman, I., 2018. Adapting to climate change by water management organisations: enablers and barriers. J. Hydrol. 559, 736–748.
[18] Baghapour, M.A., Reza, M., Djahed, B., 2017. A survey of attitudes and acceptance of wastewater reuse in Iran: Shiraz City as a case study. J. Water Reuse Desalin. 7 (4), 511–519.
[19] Bakopoulou, S., Polyzos, S., Kungolos, A., 2010. Investigation of farmers' willingness to pay for using recycled water for irrigation in Thessaly region, Greece. Desalination 250, 329–334.
[20] Bañón, S., Miralles, J., Ochoa, J., Franco, J.A., Sánchez-Blanco, M.J., 2011. Effects of diluted and undiluted treated wastewater on the growth, physiological aspects and visual quality of potted lantana and polygala plants. Sci Hortic-Amsterdam. 129, 869–876.
[21] Baumann, D., Kasperson, R., 1974. Public acceptance of renovated wastewater: myth and reality. Water Resour. Res. 10 (4), 667–674.
[22] Bdour, A.N., Hamdi, M.R., Tarawneh, Z., 2009. Perspectives on sustainable wastewater treatment technologies and reuse options in the urban areas of the Mediterranean region. Desalination 237 (1), 162–174.

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024
[23] Becerra-Castro, C., Lopes, A.R., Vaz-Moreira, I., Silva, E.F., Manaia, C.M., Nunes, O.C., 2015. Wastewater reuse in irrigation: A microbiological perspective on implications in soil fertility and human and environmental health. Environ. Int. 75, 117–135.
[24] Beneduce, L., Gatta, G., Bevilacqua, A., Libutti, A., Tarantino, E., Bellucci, M., Troiano, E., Spano, G., 2017. Impact of the reusing of food manufacturing wastewater for irrigation in a closed system on the microbiological quality of the food crops. Int. J. Food Micribiol. 260, 51–58.
[25] Beveridge, R., Moss, T., Naumann, M., 2017. Sociospatial understanding of water politics: tracing the multidimensionality of water reuse. Water Altern. 10 (1), 22–40.
[26] Biggs, T.W., Jiang, B., 2009. Soil salinity and exchangeable cations in a wastewater irrigated area, India. J. Environ. Qual. 38 (3), 887–896.
[27] Bischel, H.N., Simon, G.L., Frisby, T.M., Luthy, R.G., 2012. Management experiences and trends for water reuse implementation in Northern California. Environ. Sci. Technol. 46, 180–188.
[28] Boyer, T.H., Overdevest, C., Christiansen, L., Ishii, S.K.L., 2012. Expert stakeholder attitudes and support for alternative water sources in a groundwater depleted region. Sci. Total Environ. 437, 245–254.
[29] Brouwer, S., Maas, T., Smith, H., Frijns, J., 2015. Trust in Water Reuse: Review Report on International Experiences in Public Involvement and Stakeholder Collaboration. DEMOWARE Project D5.2. KWR Watercycle Research Institute, Nieuwegein, The Netherlands.
[30] Browning-Aiken, A., Ormerod, K.J., Scott, C.A., 2011. Testing the climate for non-potablewater reuse: Opportunities and challenges in water-scarce urban growth corridors. J. Environ. Pol. Plan. 13 (3), 253–275.
[31] Bryck, J., Prasad, R., Lindley, T., Davis, S., Carpenter, G., 2008. National Database of Water Reuse Facilities Summary Report. Water Reuse Foundation, Alexandria, Virginia (Accessed 12 June).
[32] Buyukkamaci, N., Alkan, H.S., 2013. Public acceptance potential for reuse applications in Turkey. Resour. Conserv. Recycl. 80, 32–35.
[33] Callaghan, P., Moloney, G., Blair, D., 2012. Contagion in the representational field of water recycling: informing new environment practice through social representation theory. J. Community Appl. Soc. Psychol. 22 (1), 20–37.
[34] Candela, L., Fabregat, S., Josa, A., Suriol, J., Vigués, N., Mas, J., 2007. Assessment of soil and groundwater impacts by treated urban wastewater reuse. A case study: application in a golf course (Girona, Spain). Sci. Total Environ. 374, 26–35.
[35] Carr, G., Potter, R.B., Nortcliff, S., 2011. Water reuse for irrigation in Jordan: perceptions of water quality among farmers. Agric. Water Manage. 98, 847–854.

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024
[36] Chen, W., Bai, Y., Zhang, W., Lyu, S., Jiao, W., 2015. Perceptions of different stakeholders on reclaimed water reuse: the case of Beijing, China. Sustainability 7, 9696–9710.
[37] Chen, Y., Vymazal, J., Brezinova, T., Kozeluh, M., Kule, L., Huang, J., Chen, Z., 2016. Occurrence, removal and environmental risk assessment of pharmaceuticals and personal care products in rural wastewater treatment wetlands. Sci. Total Environ. 566–567, 1660–1669.
[38] Chien, S.-S., Hong, D.-L., Lin, P.H., 2017. Ideological and volume politics behind cloud water resource governance – weather modification in China. Geoforum 85, 225–233.
[39] Cirelli, G.L., Consoli, S., Licciardello, F., Aiello, R., Giuffrida, F., Leonardi, C., 2012. Treated municipal wastewater reuse in vegetable production. Agric. Water Manage. 104, 163–170.
[40] Contreras, S., Pérez-Cutillas, P., Santoni, C.S., Romero-Trigueros, C., Pedrero, F., Alarcón, J.J., 2014. Effects of reclaimed waters on spectral properties and leaf traits of Citrus orchards. Water Environ. Res. 86 (11), 2242–2250.
[41] Covello, V.T., Johnson, B.B., 1987. The social and cultural construction of risk: issues, methods, and case studies. In: Johnson, B.B., Covello, V.T. (Eds.), The Social and Cultural Construction of Risk. D. Reidel Publishing Company, Dordrecht, pp. pp. 1–10.
[42] Dare, A., Mohtar, R.H., 2018. Farmer perceptions regarding irrigation with treated wastewater in the West Bank, Tunisia, and Qatar. Water Int. 43 (3), 460–471.
[43] De Miguel, A., Martínez-Hernández, V., Leal, M., González-Naranjo, V., de Bustamante, I., Lillo, J., Martín, I., Salas, J.J., Palacios-Díaz, M.P., 2013. Short-term effects of reclaimed water irrigation: jatropha curcas L. Cultivation. Ecol. Eng. 50, 44–51.
[44] De Sanctis, M., Del Moro, G., Chimienti, S., Ritelli, P., Levantesi, C., Di Iaconi, C., 2017. Removal of pollutants and pathogens by a simplified treatment scheme for municipal wastewater reuse in agriculture. Sci. Total Environ. 580, 17–25.
[45] Deniz, F., Sadhwani, J.J., Veza, J.M., 2010. New quality criteria in wastewater reuse. The case of Gran Canaria. Desalination 250, 716–722.
[46] Díaz, F.J., Tejedor, M., Jiménez, C., Grattan, S.R., Dorta-Santos, M., Hernández, J.M., 2013. The imprint of desalinated seawater on recycled wastewater: Consequences for irrigation in Lanzarote Island, Spain. Agric. Water Manage. 116, 62–72.
[47] Dobbie, M.F., Brown, R.R., 2014. A framework for understanding risk perception, explored from the perspective of the water practitioner. Risk Anal. 34 (2), 294–308.
[48] Dolnicar, S., Hurlimann, A., 2009. Drinking water from alternative water sources: differences in beliefs, social norms and factors of perceived behavioural control across eight Australian locations. Water Sci. Technol. 60 (6), 1433–1444.

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024
[49] Dolnicar, S., Schäfer, A.I., 2009. Desalinated versus recycled water: public perceptions and profiles of the accepters. J. Environ. Manage. 90, 888–900.
[50] Dolnicar, S., Hurlimann, A., Nghiem, L.D., 2010. The effect of information on public acceptance – the case of water from alternative sources. J. Environ. Manage. 91, 1288–1293.
[51] Dolnicar, S., Hurlimann, A., Grun, B., 2011. What affects public acceptance of recycled and desalinated water? Water Res. 45 (2), 933–943.
[52] Duong, K., Saphores, J.-D.M., 2015. Obstacles to wastewater reuse: an overview. Wiley Interdiscip. Rev. Water 2, 199–214.
[53] Dupont, D.P., 2013. Water use restrictions or wastewater recycling? A Canadian willingness to pay study for reclaimed wastewater. Water Resour. Econ. 1, 61–74.
[54] Elbana, M., Puig-Bargués, J., Pujol, J., Ramírez de Cartagena, F., 2010. Preliminary planning for reclaimed water reuse for agricultural irrigation in the province of Girona, Catalonia (Spain). Desalin. Water Treat. 22, 47–55
[55] Engel, S., Schaefer, M., 2013. Ecosystem services—a useful concept for addressing water challenges? Curr. Opin. Environ Sustain. 5 (6), 696–707.
[56] Farahat, E.A., Galal, T.M., Elawa, O.E., Hassan, L.M., 2017. Health risk assessment and growth characteristics of wheat and maize crops irrigated with contaminated wastewater. Environ. Monit. Assess. 189, 535.
[57] Fatta-Kassinos, D., Kalavrouziotis, I.K., Koukoulakis, P.H., Vasquez, M.I., 2011. The risks associated with wastewater reuse in xenobiotics in the agroecological environment. Sci. Total Environ. 409, 3555–3563.
[58] Fawell, J., Le Corre, K., Jeffrey, P., 2016. Common or independent? The debate over regulations and standards for water reuse in Europe. Int. J. Water Resour. D 32 (4), 559–572.
[59] Fielding, K.S., Dolnicar, S., Schultz, T., 2018. Public acceptance of recycled water. Int. J. Water Resour. D.
[60] Fife-Schaw, C., Barnett, J., Chenoweth, J., Morrison, G.M., Lunde, C., 2008. Consumer trust and confidence: some recent ideas in the literature. Water Sci. Tech. - W Sup. 8 (1), 43–48.
[61] Flávio, H.M., Ferreira, P., Formigo, N., Svendsen, J.C., 2017. Reconciling agriculture and stream restoration in Europe: A review relating to the EU Water Framework Directive. Sci. Total Environ. 596–597, 378–395.
[62] Frijns, J., Smith, H.M., Brouwer, S., Garnett, K., Elelman, R., Jeffrey, P., 2016. How governance regimes shape the implementation of water reuse schemes. Water 8, 605.
[63] Funamiu, N., Onitsuka, T., Hatori, S., 2008. Water reuse in Japan. In: Jiménez, B., Asano, T. (Eds.), Water Reuse: An International Survey of Current Practice, Issues and Needs. IWA, London, pp. 373–386.

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024
[64] Garcia, X., Pargament, D., 2015. Reusing wastewater to cope with water scarcity: economic, social and environmental considerations for decision-making. Resour. Conserv. Recycl. 101, 154–166.
[65] García-Cuerva, L., Berglund, E.Z., Binder, A.R., 2016. Public perceptions of water shortages, conservation behaviors, and support for water reuse in the U.S. Resour. Conserv. Recycl. 113, 106–115.
[66] García-Rubio, M.A., Guardiola, J., 2012. Desalination in Spain: a growing alternative for water supply. Int. J. Water Resour. D 28 (1), 171–186. Gémar, G., Gómez, T., Molinos-Senante, M., Caballero, R., Sala-Garrido, R., 2018. Assessing changes in eco-productivity of wastewater treatment plants: the role of costs, pollutant removal efficiency, and greenhouse gas emissions. Environ Impact Assess. 69, 24–31.
[67] Ghermandi, A., Minich, T., 2017. Analysis of farmers' attitude toward irrigation with desalinated brackish water in Israel's Arava Valley. Desalin. Water Treat. 76, 328–331.
[68] Goodwin, D., Raffin, M., Jeffrey, P., Smith, H.M., 2017. Evaluating media framing and public reactions in the context of a water reuse proposal. Int. J. Water Resour. D.
[69] Goonetilleke, A., Vithanage, M., 2017. Water resources management: innovation and challenges in a changing world. Water 9.
[70] Gosling, S.N., Arnell, N.W., 2016. A global assessment of the impact of climate change on water scarcity. Clim. Change 134, 371–385.
[71] Grant, S.B., Saphores, J., Feldman, D.L., Hamilton, A.J., Fletcher, T.D., Cook, P.L.M., Stewardson, M., Sanders, B.F., Levin, L.A., Ambrose, R.F., Deletic, A., Brown, R., Jiang, S.C., Rosso, D., Cooper, W.J., Marusic, I., 2012. Taking the "waste" out of "wastewater" for human water security and ecosystem sustainability. Science 337 (6095), 681–686.
[72] Gu, Q., Chen, Y., Pody, R., Cheng, R., Zheng, Z., Zhang, Z., 2015. Public perception and acceptability toward reclaimed water in Tianjin. Resour. Conserv. Recycl. 104, 291–299.
[73] Hamilton, A.J., Stagnitti, F., Xiong, X.Z., Kreidl, S.L., Benke, K.K., Maher, P., 2007. Wastewater irrigation: the state of play. Vadose Zone J. 6, 823–840.
[74] Hara, K., Kuroda, M., Yabar, H., Kimura, M., Uwasu, M., 2016. Historical development of wastewater and sewage sludge treatment technologies in Japan – an analysis of patent data from the past 50 years. Environ. Dev. 19, 59–69.
[75] Heinz, I., Salgot, M., Sagasta, D.M., 2011. Evaluating the costs and benefits of water reuse and exchange projects involving cities and farmers. Water Int. 36 (4), 455–466.
[76] Hernández, F., Molinos, M., Sala, R., 2010. Economic valuation of environmental benefits from wastewater treatment processes: an empirical approach for Spain. Sci. Total Environ. 408, 953–957. Hui, I., Cain, B., 2018. Overcoming psychological resistance toward using recycled water in California. Water Environ. J. 32 (1), 17–25

Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024
[77] Hurlimann, A., Dolnicar, S., 2016. Public acceptance and perceptions of alternative water sources: a comparative study in nine locations. Int. J. Water Resour. D. 32 (4), 650–673.
[78] Hurlimann, A., McKay, J., 2007. Urban Australians using recycled water for domestic non-potable use—an evaluation of the attributes price, saltiness, colour and odour using conjoint analysis. J. Environ. Manage. 83 (1), 93–104.
[79] Hurlimann, A., Dolnicar, S., Meyer, P., 2009. Understanding behaviour to inform water supply management in developed nations – a review of literature, conceptual model and research agenda. J. Environ. Manage. 91, 47–56.
[80] Iglesias, R., Ortega, E., 2008. Present and future of wastewater reuse in Spain. Desalination 218, 105–119.
[81] Iglesias, R., Ortega, E., Batanero, G., Quintas, L., 2010. Water reuse in Spain: data overview and costs estimation of suitable treatment trains. Desalination 263, 1–10.
[82] Illueca-Muñoz, J., Mendoza-Roca, J.A., Iborra-Clar, A., Bes-Piá, A., Fajardo-Montañana, V., Martínez-Francisco, F.J., Bernácer-Bonora, I., 2008. Study of different alternatives of tertiary treatments for wastewater reclamation to optimize the water quality for irrigation reuse. Desalination 222, 222–229.
[83] Jafarinejad, S., 2017. Cost estimation and economical evaluation of three configurations of activated sludge process for a wastewater treatment plant (WWTP) using simulation. Appl. Water Sci. 7, 2513–2521.
[84] Jaramillo, M.F., Restrepo, I., 2017. Wastewater reuse in agriculture: a review about its limitations and benefits. Sustainability 9, e1734.
[85] Jeong, H., Kim, H., Jang, T., 2016. Irrigation water quality standards for indirect wastewater reuse in agriculture: a contribution toward sustainable wastewater reuse in South Korea. Water 8, e169.
[86] Kandiah, V., Binder, A.R., Berglund, E.Z., 2017. An empirical agent-based model to simulate the adoption of water reuse using social amplification of risk framework. Risk Anal. 37 (10), 2005–2022.
[87] Karg, H., Drechsel, P., 2011. Motivating behaviour change to reduce pathogenic risk where unsafe water is used for irrigation. Water Int. 36 (4), 476–490.
[88] Kathijotes, N., Panayiotou, C., 2013. Wastewater reuse for irrigation and seawater intrusion: evaluation of salinity effects on soils in Cyprus. J. Water Reuse Desal. 3 (4), 392–401.
[89] Kellis, M., Kalavrouziotis, I.K., Gikas, P., 2013. Review of wastewater reuse in the Mediterranean countries, focusing on regulations and policies for municipal and industrial applications. Glob Nest J. 15, 333–350.
[90] Kemp, B., Randle, M.J., Hurlimann, A., Dolnicar, S., 2012. Community acceptance of recycled water - can we inoculate the public against scare campaigns? J. Publ. Affairs 12 (4), 337–346.

Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024
[91] Keraita, B., Drechsel, P., Konradsen, F., 2008. Perceptions of farmers on health risks and risk reduction measures in wastewater irrigated urban vegetable farming in Ghana. J. Risk Res. 11 (8), 1047–1061.
[92] Khan, S.J., Gerrard, L.E., 2006. Stakeholder communications for successful water reuse operations. Desalination 187, 191–202.
[93] Khan, S., Farooq, R., Shahbaz, S., Aziz Khan, M., Sadique, M., 2009. Health risk assessment of heavy metals for population via consumption of vegetables. World Appl. Sci. J. 6 (12), 1602–1606.
[94] Kosovac, A., Davidson, B., Malano, H., Cook, J., 2017. The varied nature of risk and considerations for the water industry: a review of the literature. Environ. Nat. Resour. Res. 7, 80–86.
[95] Lavrnic, S., Zapater-Pereyra, M., Mancini, M.L., 2017. Water scarcity and wastewater reuse standards in Southern Europe: focus on agriculture. Water Air Soil Pollut. 228, 251.
[96] Lazarova, V., Bahri, A., 2008. Water reuse practices for agriculture. In: Jiménez, B., Asano, T. (Eds.), Water Reuse. An International Survey of Current Practice, Issues and Needs. IWA Publishing, London, pp. 199–227.
[97] Lefebvre, O., 2018. Beyond NEWater: an insight into Singapore's water reuse prospects. Curr. Opin. Environ. Sci. Health 2, 26–31.
[98] Leong, C., 2010. Eliminating 'Yuck': a simple exposition of media and social change in water reuse policies. Int. J. Water Resour. D 26 (1), 111–124.
[99] Leverenz, H.L., Tchobanoglous, G., Asano, T., 2011. Direct potable reuse: a future imperative. J. Water Reuse Desalin. 1, 1–10.
[100] Licata, M., Tuttolomondo, T., Leto, C., LaBella, S., Virga, G., 2017. The use of constructed wetlands for the treatment and reuse of urban wastewater for the irrigation of two warm-season turfgrass species under Mediterranean climatic conditions. Water Sci. Technol. 76 (2), 459–470.
[101] Machado, A.I., Beretta, A., Fragoso, R., Duarte, E., 2017. Overview of the state of the art of constructed wetlands for decentralized wastewater management in Brazil. J. Environ. Manage. 187, 560–570.
[102] Maestre-Valero, J.F., Martín-Gorriz, B., Alarcón, J.J., Nicolas, E., Martínez-Álvarez, V., 2016. Economic feasibility of implementing regulated deficit irrigation with reclaimed water in a grapefruit orchard. Agric. Water Manage. 178, 119–125.
[103] Mahesh, J., Amerasinghe, P., Pavelic, P., 2015. An integrated approach to assess the dynamics of a peri-urban watershed influenced by wastewater irrigation. J. Hydrol. 523, 427–440.
[104] Mara, D., Kramer, A., 2008. The 2006 who guidelines for wastewater and greywater use in agriculture: a practical interpretation. In: Al Baz, I., Otterpohl, R., Wendland, C.

Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024
(Eds.), Efficient Management of Wastewater: Its Treatment and Reuse in WaterScarce Countries. Springer, Berlin, pp. 1–17.
[105] March, H., Hernández, M., Saurí, D., 2015. Perception of conventional and non-conventional water resources in areas under water stress: the case of Alicante, Spain. Rev. Geogr. Norte Gd. 60, 153–172.
[106] Marks, J.S., Martin, B., Zadoroznyj, M., 2008. How Australians order acceptance of recycled water. J. Sociol. 44 (1), 83–99.
[107] Matheyarasu, R., Seshadri, B., Bolan, N.S., Naidu, R., 2016. Abattoir wastewater irrigation increases the availability of nutrients and influences on plant growth and development. Water Air Soil Pollut. 8, 227–253.
[108] Mayilla, W., Magayane, F., Konradsen, F., Keraita, B., Ngowi, H., 2016. Awareness of measures for reducing health risk of using low-quality irrigation water in Morogoro, Tanzania. Expo Health. 8, 475–485.
[109] Mayilla, W., Keraita, B., Ngowi, H., Konradsen, F., Magayane, F., 2017. Perceptions of using low-quality irrigation water in vegetable production in Morogoro, Tanzania. Environ. Dev. Sustain. 19, 165–183.
[110] Meehan, K., Ormerod, K.J., Moore, S., 2013. Remaking waste as water: the governance of recycled effluent for potable water supply. Water Altern. 6 (1), 67–85.
[111] Melgarejo, J., Prats, D., Molina, A., Trapote, A., 2016. A case study of urban wastewater reclamation in Spain: comparison of water quality produced by using alternative processes and related costs. J. Water Reuse Desal. 6 (1), 72–81.
[112] Menegaki, A.N., Hanley, N., Tsagarakis, K.P., 2007. The social acceptability and valuation of recycled water in Crete: a study of consumers' and farmers' attitudes. Ecol. Econ. 62, 7–18.
[113] Menegaki, A.N., Mellon, R.C., Vrentzou, A., Koumakis, G., Tsagarakis, K.P., 2009. What's in a name: framing treated wastewater as recycled water increases willingness to use and willingness to pay. J. Econ. Psychol. 30, 285–292.
[114] Meneses, M., Pasqualino, C., Castells, F., 2010. Environmental assessment of urban wastewater reuse: treatment alternatives and applications. Chemosphere 81 (2), 266–272.
[115] Meng, F., Fu, G., Butler, D., 2016. Water quality permitting: from end-of-pipe to operational strategies. Water Res. 101, 114–126.
[116] Mesa-Jurado, M.A., Martin-Ortega, J., Ruto, E., Berbel, J., 2012. The economic value of guaranteed water supply for irrigation under scarcity conditions. Agric. Water Manage. 113, 10–18.
[117] Michailidis, A., Papadaki-Klavdianou, A., Apostolidou, I., Lorite, I.J., Pereira, F.A., Mirko, H., Buhagiar, J., Shilev, S., Michaelidis, E., Loizou, E., Chatzitheodoridis, F., Casielles, R., Lorenzo, A., 2015. Exploring treated wastewater issues related to

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024
agriculture in Europe, employing a quantitative SWOT analysis. Procedia Econ. Financ. 33, 367–375.
[118] Miller, G.W., 2006. Integrated concepts in water reuse: managing global water needs. Desalination 187, 65–75.
[119] Miller-Robbie, L., Ramaswami, A., Amerasinghe, P., 2017. Wastewater treatment and reuse in urban agriculture: exploring the food, energy, water, and health nexus in Hyderabad, India. Environ Res Lett. 12, 075005.
[120] Moazeni, M., Nikaeen, M., Hadi, M., Moghim, S., Mouhebat, L., Hatamzadeh, M., Hassanzadeh, A., 2017. Estimation of health risks caused by exposure to enteroviruses from agricultural application of wastewater effluents. Water Res. 125, 104–113.
[121] Mojid, M.A., Wyseure, G.C.L., Biswas, S.K., Hossain, A.B.M.Z., 2010. Farmers' perceptions and knowledge in using wastewater for irrigation at twelve peri-urban areas and two sugar mill areas in Bangladesh. Agric. Water Manage. 98, 79–86.
[122] Molina, A., Melgarejo, J., 2016. Water policy in Spain: seeking a balance between transfers, desalination and wastewater reuse. Int. J. Water Resour. D 32 (5), 781–798.
[123] Molinos-Senante, M., Hernandez-Sancho, F., Sala-Garrido, R., 2011. Cost-benefit analysis of water-reuse projects for environmental purposes: a case study for Spanish wastewater treatment plants. J. Environ. Manage. 92, 3091–3097
[124] Molle, B., Brelle, F., Bessy, J., Gatel, D., 2012. Which water quality for which uses? Overcoming over-zealous use of the precautionary principle to reclaim wastewater for appropriate irrigation uses. Irrig. Drain. 61, 87–94
[125] Morugán-Coronado, A., García-Orenes, F., Mataix-Solera, J., Arcenegui, V., MataixBeneyto, J., 2011. Short-term effects of treated wastewater irrigation on Mediterranean calcareous soil. Soil till. Res. 112, 18–26.
[126] Mujeriego, R., Compte, J., Cazurra, T., Gullón, M., 2008. The water reclamation and reuse project of El Prat de Llobregat, Barcelona, Spain. Water Sci. Technol. 57 (4), 567–574.
[127] Muñoz, I., Tomàs, N., Mas, J., García-Reyes, J.F., Molina-Díaz, A., Fernández-Alba, A.R., 2010. Potential chemical and microbiological risks on human health from urban wastewater reuse in agriculture. Case study of wastewater effluents in Spain. J. Environ. Sci. Health B 45 (4), 300–309.
[128] Nancarrow, B.E., Leviston, Z., Po, M., Porter, N.B., Tucker, D.I., 2008. What drives communities' decisions and behaviours in the reuse of wastewater. Water Sci. Technol. 57 (4), 485–491.
[129] Nancarrow, B.E., Porter, N.B., Leviston, Z., 2010. Predicting community acceptability of alternative urban water supply systems: a decision making model. Urban Water J. 7 (3), 197–210.

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024
[130] Navarro, T., 2018. Water reuse and desalination in Spain – challenges and opportunities. J. Water Reuse Desal.
[131] Norton-Brandao, D., Scherrenberg, S.M., van Lier, J.B., 2013. Reclamation of used urban waters for irrigation purposes – a review of treatment technologies. J. Environ. Manage. 122, 85–98.
[132] Orisakwe, O.E., Kanayochukwu, N.J., Nwadiuto, A.C., Onyekachi, D., Bede, O., 2012. Heavy metals health risk assessment for population via consumption of food crops and fruits in Owerri, South Eastern, Nigeria. Chem. Cent. J. 6, 77.
[133] Ormerod, K.J., Scott, C.A., 2012. Drinking wastewater: public trust in potable reuse. Sci. Technol. Hum. Val. 38 (3), 351–373.
[134] Ortega, E., Iglesias, R., 2009. Reuse of treated municipal wastewater effluents in Spain: regulations and most common technologies, including extensive treatments. Desalin. Water Treat. 4 (1-3), 148–160.
[135] Ortega-Reig, M., Palau-Salvador, G., Cascant, M.J., Benitez-Buelga, J., Badiella, D., Trawick, P., 2014. The integrated use of surface, ground and recycled waste water in adapting to drought in the traditional irrigation system of Valencia. Agric. Water Manage. 133, 55–64.
[136] Osuolale, O., Okoh, A., 2017. Human enteric bacteria and viruses in five wastewater treatment plants in the Eastern Cape, South Africa. J. Infect. Public Health 10, 541–547.
[137] Padilla-Rivera, A., Morgan-Sagastume, J.M., Noyola, A., Güereca, L.P., 2016. Addressing social aspects associated with wastewater treatment facilities. Environ Impact Assess. 57, 101–113.
[138] Paranychianakis, N.V., Salgot, M., Snyder, S.A., Angelakis, A.N., 2015. Water reuse in EU States: necessity for uniform criteria to mitigate human and environmental risks. Crit. Rev. Environ. Sci. Technol. 45 (13), 1409–1468.
[139] Parsons, L.R., Sheikh, B., Holden, R., York, D.W., 2010. Reclaimed water as an alternative water source for crop irrigation. Hortscience 45, 1626–1629.
[140] Pedrero, F., Kalavrouziotis, I., Alarcón, J.J., Koukoulakis, P., Asano, T., 2010. Use of treated municipal wastewater in irrigated agriculture—review of some practices in Spain and Greece. Agric. Water Manage. 97, 1233–1241.
[141] Pedrero, F., Alarcón, J.J., Nicolás, E., Mounzer, O., 2013. Influence of irrigation with saline reclaimed water on young grapefruits. Desalin. Water Treat. 51 (10-12), 2488–2496.
[142] Perry, D.M., Praskievicz, S.J., 2017. A new era of big infrastructure? (Re)developing water storage in the U.S. West in the context of climate change and environmental regulation. Water Altern. 10 (2), 437–454.

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024
[143] Petousi, I., Fountoulakis, M.S., Stentiford, E.I., Manios, T., 2015. Farmers' experience, concerns and perspectives in using reclaimed water for irrigation in a semi-arid region of Crete, Greece. Irrig. Drain. 64, 647–654.
[144] Plumlee, M.H., Gurr, C.J., Reinhard, M., 2012. Recycled water for stream flow augmentation benefits, challenges, and the presence of wastewater-derived organic compounds. Sci. Total Environ. 438, 541–548.
[145] Qadir, M., Sharma, B.R., Bruggeman, A., Choukr-Allah, R., Karajeh, F., 2007. Non-conventional water resources and opportunities for water augmentation to achieve food security in water scarce countries. Agric. Water Manage. 87, 2–22.
[146] Qadir, M., Wichelns, D., Rachid-Sally, L., McCornick, P.G., Drechsel, P., Bahri, A., Minhas, P.S., 2010. The challenges of wastewater irrigation in developing countries. Agric. Water Manage. 97 (4), 561–568.
[147] Rahimi, M.H., Kalantari, N., Sharifidoost, M., Kazemi, M., 2018. Quality assessment of treated wastewater to be reused in agriculture. Glob. J. Environ. Sci. Manage. 4 (2), 217–230.
[148] Ricart, S., Rico, A., Kirk, N., Bülow, F., Ribas-Palom, A., Pavón, D., 2018. How to improve water governance in multifunctional irrigation systems? Balancing stakeholder engagement in hydrosocial territories. Int. J. Water Resour. D.
[149] Rice, J., Wutich, A., White, D.D., Westerhoff, P., 2016. Comparing actual de facto wastewater reuse and its public acceptability: a three city case study. Sustain Cities Soc. 27, 467–474.
[150] Romero-Trigueros, C., Nortes, P.A., Alarcón, J.J., Hunink, J.E., Parra, M., Contreras, S., Droogers, P., Nicolás, E., 2017. Effects of saline reclaimed waters and deficit irrigation on Citrus physiology assessed by UAV remote sensing. Agric. Water Manage. 183, 60–69.
[151] Ross, V.L., Fielding, K.S., Louis, W.R., 2014. Social trust, risk perceptions and public acceptance of recycled water: testing a social-psychological model. J. Environ. Manage. 137, 61–68.
[152] Rozin, P., Haddad, B., Nemeroff, C., Slovic, P., 2015. Psychological aspects of the rejection of recycled water: contamination, purification and disgust. Judgm. Decis. Mak. 10 (1), 50–63.
[153] Russell, S., Lux, C., 2009. Getting over yuck: moving from psychological to cultural and sociotechnical analyses of responses to water recycling. Water Policy 11 (1), 21–35.
[154] Rygaard, M., Binning, P.J., Hans-Jørgen, A., 2011. Increasing urban water self-sufficiency: new era, new challenges. J. Environ. Manage. 92 (1), 185–194.
[155] Saldías, C., Speelman, S., van Huylenbroeck, G., Vink, N., 2016. Understanding farmers' preferences for wastewater reuse frameworks in agricultural irrigation: lessons from a choice experiment in the Western Cape, South Africa. Water SA 42 (1), 26–37.

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024
[156] Sato, T., Qadir, M., Yamamoto, S., Endo, T., Zahoor, A., 2013. Global, regional, and country level need for data on wastewater generation, treatment, and use. Agric. Water Manage. 130, 1–13.
[157] Sheidaei, F., Karami, E., Keshavarz, M., 2016. Farmers' attitude towards wastewater use in Fars Province, Iran. Water Policy 18, 355–367.
[158] Smith, H.M., Brouwer, S., Jeffrey, P., Frijns, J., 2018. Public responses to water reuse – understanding the evidence. J. Environ. Manage. 207, 43–50.
[159] Sramkova, M.V., Diaz-Sosa, V., Wanner, J., 2018. Experimental verification of tertiary treatment process in achieving effluent quality required by wastewater reuse standards. J. Water Process Eng. 22, 41–45.
[160] Starkl, M., Brunner, N., Amerasinghe, P., Mahesh, J., Kumar, D., Asolekar, S.R., Sonkamble, S., Ahmed, A., Wajihuddin, M., Pratyusha, A., Sarah, S., 2015. Stakeholder views, financing and policy implications for reuse of wastewater for irrigation: a case from Hyderabad, India. Water 7, 300–328.
[161] Stenekes, N., Colebatch, H.K., Waite, T.D., Ashbolt, N.J., 2006. Risk and governance in water recycling. Public acceptance revisited. Sci. Technol. Hum. Val. 31 (2), 107–134.
[162] Symonds, E., Verbyla, M., Lukasik, J., Kafle, R., Breitbart, M., Mihelcic, J., 2014. A case study of enteric virus removal and insights into the associated risk of water reuse for two wastewater treatment pond systems in Bolivia. Water Res. 65, 257–270.
[163] Thebo, A.L., Drechsel, P., Lambin, E.F., Nelson, K.L., 2017. A global, spatially explicit assessment of irrigated croplands influenced by urban wastewater flows. Environ. Res. Lett. 12, 074008.
[164] Tortajada, C., Ong, C.N., 2016. Reused water policies for potable use. Int. J. Water Resour. D 32 (4), 500–502.
[165] Tram, P., Ngo, H.H., Guo, W., Zhou, J.L., Nguyen, P.D., Listowski, A., Wang, X.C., 2014. A mini-review on the impacts of climate change on wastewater reclamation and reuse. Sci. Total Environ. 494–495, 9–17.
[166] Tsagarakis, K., Menegaki, A.N., Siarapi, K., Zacharopoulou, F., 2013. Safety alerts reduce willingness to visit parks irrigated with recycled water. J. Risk Res. 16 (2), 133–144.
[167] Turner, A., Mukheibir, P., Mitchell, C., Chong, J., Retamal, M., Murta, J., Carrard, N., Delaney, C., 2016. Recycled water – lessons from Australia on dealing with risk and uncertainty. Water Pract. Technol. 11 (1), 127–138.
[168] Van Lier, J.B., Huibers, F., 2010. From unplanned to planned agricultural reuse: making an asset out of wastewater. Irrig. Drain. Syst. 24 (1-2), 143–152.
[169] Vanham, D., Hoekstra, A.Y., Wada, Y., Bouraoui, F., de Roo, A., Mekonnen, M.M., van de Bund, W.J., Batelaan, O., Pavelic, P., Bastiaanssen, W.G.M., Kummu, M., Rockström, J., Liu, J., Bisselink, B., Ronco, P., Pistocchi, A., Bidoglio, G., 2018.

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024
Physical water scarcity metrics for monitoring progress towards SDG target 6.4: an evaluation of indicator 6.4.2 “Level of water stress”. Sci. Total Environ. 613-614, 218–232.
[170] Vergine, P., Salerno, C., Libutti, A., Beneduce, L., Gatta, G., Berardi, G., Pollice, A., 2017. Closing the water cycle in the agro-industrial sector by reusing treated wastewater for irrigation. J. Clean. Prod. 164, 587–596.
[171] Verlicchi, P.M., Al Aukidy, M., Galletti, A., Zambello, E., Zanni, G., Masotti, L., 2012. A project of reuse of reclaimed wastewater in the Po Valley, Italy: polishing sequence and cost benefit analysis. J. Hydrol. 432, 127–136
[172] Vymazal, J., Brezinova, T., 2015. The use of constructed wetlands for removal of pesticides from agricultural runoff and drainage: a review. Environ. Int. 75, 11–20.
[173] Wester, W., Timpano, K.R., Çek, D., Lieberman, D., Fieldstone, S.C., Broad, K., 2015. Psychological and social factors associated with wastewater reuse emotional discomfort. J. Environ. Psychol. 42, 16–23.
[174] Zhang, S., Yao, H., Lu, Y., Shan, D., Yu, X., 2018. Reclaimed water irrigation effect on agricultural soil and maize (Zea mays L.) in Northern China. Clean – Soil Air Water 46.